MEMORANDUM FOR: DISTRIBUTION
MAJCOMs/FOAs/DRUs

FROM: HQ USAF/SE
1400 Air Force Pentagon
Washington, DC 20330-1400

SUBJECT: Revision of SECAF Construction Approval, Air Force Waiver and Exemption Risk Acceptance Authority

By Order of the Secretary of the Air Force, this Air Force Guidance Memorandum (AFGM) immediately implements changes to AFMAN 91-201, Explosives Safety Standards. Compliance with this memorandum is mandatory. To the extent its directions are inconsistent with other publications, the information herein prevails in accordance with AFI 33-360, Publications and Forms Management.

The attachment to this memorandum contains guidance revising the current SECAF construction approval, explosives waiver and exemption risk acceptance authority, and updates the waiver and exemption decision nomographs.

This memorandum becomes void after one-year has elapsed from the date of this memorandum, or upon publication of an Interim Change or rewrite of the affected publication, whichever is earlier.

JOHN T. RAUCH
Major General, USAF
Chief of Safety

Attachment
Guidance Change
The changes below to AFMAN 91-201, dated 21 March 2017, are effective immediately.

*1.8.2. SECAF, or designated representative, must approve all planned construction for locations not meeting QD standards. Exception: construction activities performed in support of contingency operations at contingency locations that do not exceed the established MILCON low-cost threshold. This exception is not applicable to enduring locations as defined by DoDI 3000.12, Management of U.S. Global Defense Posture.

*1.11.1. This paragraph applies to all waivers and exemptions requiring SECAF or SAF/IE approval. To expedite processing of HSSs with waivers or exemptions through Air Staff and Secretariat offices, a standardized format is essential. Units or MAJCOMs seeking HAF-level approval for waivers and exemptions will submit all required information electronically. Provide all HSS information required in Chapter 14, even though it may not all be included in the package forwarded to HAF-level. See Attachment 9 for additional guidance. Assemble HAF-level request packages using the following format (AFSEC/SEW may modify the tab format to accommodate SECAF approval and/or SAF/IE risk acceptance memorandum(s)):

*1.12.2. Approval Levels for operations within the United States (i.e., the fifty states, the District of Columbia, and U.S. Territories). Consequence-based approval levels for CONUS locations range from the SAF/IE down to Numbered Air Force (NAF) Commander level. The following are the required approval levels for each risk assessment level as specified in Figure 1.1.

*1.12.3. Approval levels for operations outside the United States (i.e., the fifty states, the District of Columbia, and U.S. Territories). Consequence-based approval levels for these locations will follow the Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 4360.01B, Explosives Safety and Munitions Risk Management for Joint Operations Planning, Training, and Execution, and Geographic Combatant Commander’s supplemental guidance, see Chapter 13 of this manual for additional guidance. If the Geographic Combatant Commander delegates risk decision authority to the MAJCOM Commander, the command may use the CONUS medium and low risk approval levels specified in paragraphs 1.12.2.3 and 1.12.2.4.

*1.12.3.1. DELETED. Extremely High and High, MAJCOM/CC or CV.

*1.12.3.2. DELETED. Medium, NAF/CC or CV. Where NAFs do not exist, MAJCOMs will identify an alternate intermediate command level between wing and MAJCOM; if there is no intermediate command level, MAJCOM approval is required in place of NAF.

*1.12.3.3. DELETED. Low, NAF/CC or CV. The NAF/CC or CV may delegate this level of risk acceptance to the Wing Commander. In the event a NAF does not exist, MAJCOM may delegate this level of risk acceptance.

*1.12.4. Elevation Authority. USAF/SE may elevate any QD exception for these locations to the Air Force Chief of Staff for informational purposes.

*1.12.5. During the initial stages of operations at contingency operating locations, follow Geographic Combatant Commander supplemental guidance to CJCSI 4360.01B to address DoD military munitions-related risk and consequence management.
*Figure 1.1. Waiver and Exemption Decision Nomograph.*

Title: ________________________________________ Exception Type: ________________
Title: ____________________________ Exception Type: ______________

*13.2.2.1. DoD installations within the US.

*Figure 1.2. DELETED. Waiver and Exemption Decision Nomograph-Wartime/Contingency Operations.
EXPLOSIVES SAFETY WAIVER/EXEMPTION REVIEW ELEMENTS
(Units seeking HAF-level approval should seek local legal review to ensure the request meets current domestic and international legal requirements.)

1. **Tab 1: MAJCOM/CC or CV Memorandum.** Is the memorandum included and formatted per Attachment 2 to AFMAN 91-201 (to include the required legal review and, if applicable, proof of host nation notification)? (Enclosure (1) of this attachment summarizes international legal considerations.)

2. **Tab 2: Maps.** Are the maps for the ESP included? (See paragraph 14.24., AFMAN 91-201.)

3. **Tab 3: AF Form 943 / Explosive Safety Siting Submittal Form** (See AFMAN 91-201 Figure 14.3, as an example.)
   a. Do the forms clearly show siting pairs without exceptions?
   b. Do the forms clearly show exceptions requiring HAF-level approval?
   c. Do the forms clearly show exceptions that have received approval at a subordinate level?

4. **Tab 4: Identification of the Specific Standard Not Met**
   a. Is the specific reference from AFMAN 91-201 requiring the waiver/exemption identified and cited?
   b. Is sufficient information included to explain the **nature** of the exemption? (See Enclosure (2) of this attachment.)
   c. Are highlighted excerpts from AFMAN 91-201 used to explain the type of required separation and distance required or how distance is calculated?

5. **Tab 5: Justification.** Is there a detailed narrative explanation of the “**strategic or compelling reason(s)**” for requesting the HAF-level waiver or exemption? (See Enclosure (2) of this attachment.)
   a. Are there specific references to aircraft sortie rates or other pertinent data included to justify the type, quantity, and placement of explosives at the PES?
      • Type:__________________Quantity:__________________Placement:__________________
   b. Is the position of the excepted PES fully justified?
   c. Is additional relevant information provided to substantiate the request? (See enclosure 2 of this attachment for samples.)
   d. Are **feasible** corrective actions identified? (See Enclosure (2) of this attachment.)
   e. Is justification included explaining why no feasible corrective action can be implemented (e.g., cost, mission impact, time available)?

6. **Tab 6: Risk Assessment.** Is a risk assessment provided IAW Chapter 4 of AFMAN 91-201?
   a. Is a separate waiver or exemption decision nomograph provided for each excepted PES to ES pair requiring HAF-level approval?

7. **Corrective Actions**
   a. Are all explosives mishap mitigation actions taken or planned discussed?
      • Were alternative building techniques considered? Why or why not?
      • Was barricading considered? Why or why not?
      • Was glass protection considered? Why or why not?
      • Was tiered siting considered? Why or why not?
      • Is construction planned? Why or why not?
   b. Is a cost estimate and schedule for completion provided for each corrective action being pursued?
   c. If no corrective actions are feasible to ultimately correct the waiver or exemption, is this stated and justified?
8. **Options.**
   a. Were all **reasonable** options fully considered, even though rejected by the unit or MAJCOM? (See Enclosure (2) of this attachment.)
   b. Were details provided as why each of the other options was not chosen?
   c. Were funding limitations, real estate limitations, or other constraints discussed?
EXPLOSIVES SAFETY WAIVER/EXEMPTION REVIEW ELEMENTS
INTERNATIONAL LEGAL CONSIDERATIONS

Ask: Is this a location outside of the United States (i.e., the fifty states, the District of Columbia, and U.S. Territories)?

If the answer is yes:

1. International agreements related to the U.S. presence or activities must be examined to identify if there are any relevant provisions to explosive safety waivers or exemptions in order to ensure obligations of the United States and foreign partners are met. The legal review should list and address any applicable agreements.

2. The legal review should identify any relevant notification or approval requirements, which may be found in basing agreements, status of forces agreements (SOFAs), or other agreements.

   • The legal review should identify whether it is notification or approval that is required by any international agreements.

   • The legal review should indicate what notice or approval was obtained by the relevant commander or the delegated authority, how that notice or approval was conveyed, and address how this met all applicable requirements under the applicable agreements(s) or was made in accordance with AFMAN 91-201, paragraph 1.3.4.

   • If the international agreements with the host nation are silent on notification or approval of explosive safety waivers and exemptions, notification is to be made in accordance with AFMAN 91-201, paragraph 1.3.4.

   • The legal opinion/memo should address any other relevant obligations to the Host Nation.

   • Source: AFMAN 91-201, Paragraphs 1.2.1.4. and 1.3.4.
EXPLOSIVES SAFETY WAIVER/EXEMPTION REVIEW ELEMENTS
PRACTICAL GUIDANCE

- **Strategic or Compelling Reason:** A strategic or compelling reason is any reason which necessitates the exemption so that the proper Air Force authority must accept the added risk to personnel or property. Ease of operation or convenience are not reasons for requesting an exception.
  - A strategic reason is a reason which relates to a national security, national defense, or military strategy. Joint doctrine defines strategy as a prudent idea or set of ideas for employing the instruments of national power in a synchronized and integrated fashion to achieve theater or multinational objectives. Issuance of an explosive safety waiver or exemption may be necessary to achieve a particular military strategic objective.
  - A compelling reason is any other reason which would convince proper Air Force authority that something must be done.

- **Feasible:** A corrective action is feasible if it is capable of being accomplished using available resources within the time required.

- **Nature of the exemption:** The basic, inherent, or essential features which characterize a particular explosives safety waiver or exemption, including the type of separation (i.e., inhabited building distance, intraline, and public traffic route distance) and the separation safety distance required per DoD and/or Air Force manuals.

- **Reasonable:** In the context of an explosives safety waiver or exemption, an option is reasonable if it is neither extreme nor excessive in light of the risk.
EXPLOSIVES SAFETY STANDARDS

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

ACCESSIBILITY: Publications and forms are available on the e-Publishing website at www.e-Publishing.af.mil for downloading or ordering.

RELEASABILITY: There are no releaseability restrictions on this publication.

OPR: AFSEC/SEW

Certified by: AFSEC/CD
(Mr. James Rubeor)

Supersedes: AFMAN 91-201, 12 January 2011

Pages: 474

This Manual implements Air Force Policy Directive (AFPD) 91-2, Safety Programs, and DoD 6055.09-M, Volumes 1–8, DoD Ammunition and Explosives Safety Standards. It establishes a central source for explosive safety criteria. It identifies hazards and states safety precautions and rules when working with explosives. It applies to all Air Force, Air National Guard (ANG), Air Force Reserve Command (AFRC), and contractor personnel and facilities involved in explosive operations. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force. This AFI may be supplemented at any level, but all supplements that directly implement this publication must be routed to SAF/AAII Policy Branch for coordination prior to certification and approval. Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, Recommendation for Change of Publication; route AF Forms 847 from the field through the appropriate functional chain of command. The authorities to waive wing/unit level requirements in this publication are identified with a Tier (“T-0, T-1, T-2, T-3”) number following the compliance statement. See AFI 33-360, Publications and Forms Management, Table 1.1 for a description of the authorities associated with the Tier numbers. Send MAJCOM supplements to AFSEC/SEW, 9700 G Avenue SE, Kirtland AFB NM 87117-5670. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with (IAW) Air Force Manual (AFMAN) 33-363, Management of Records, and disposed of IAW the Air Force Records Disposition Schedule (RDS) in the Air Force Records Information Management System (AFRIMS).
SUMMARY OF CHANGES

This revision reflects changes in guidance and procedures dealing with Air Force explosives safety standards. Major changes include incorporation of GM1; expansion of blast effects on personnel; updates weather watch/warning procedures; expansion of protective design construction requirements; and the deletion of Chapter 9, Protection of Electro-Explosive Devices From Hazards of Electromagnetic Radiation to Ordnance (HERO) and its replacement with a chapter on Munitions Potentially Presenting and Explosive Hazard. The HERO information previously presented in Chapter 9 is available in AFI 91-208, Hazards of Electromagnetic Radiation to Ordnance (HERO) Certification and Management. It also includes guidance for overpressure barricade design; clarification of chocking requirements for explosives-loaded vehicles (e.g., munitions materials handling equipment (MMHE) and materials handling equipment (MHE)); updates to electromagnetic radiation (EMR) formulas for pulsed systems; clarifies withdrawal procedures for ammunition and explosives (AE) not involved in a fire; updates compatibility requirements for licensed location; adopts new rounding rules used for quantity distance (QD) calculations; updates QD criterion for various facility types and situations; and, corrects and updates notes used in QD tables. Furthermore, it removes written Commander acceptance requirements for parking aircraft at less than survivability; reduces coordination host/tenant requirements for explosives site plans (ESP) (may also be referred to as a QD safety submission (QDSS)) without exceptions; removes references and procedures for Risk Based Siting; includes additional chapters for Real Property, Waste Military Munitions, Material Potentially Presenting an Explosive Hazard (MPPEH); Unexploded Ordnance (UXO); includes review elements for both munitions response explosives safety submissions (MRESS) and munitions response explosives site plan (MRESP) packages; and incorporates use of a revised Automated Explosives Safety Siting Program for use in developing ESPs. Additionally, this Manual introduces new phraseology for an MRESS, formerly an explosives safety submission (ESS); a munitions response chemical safety submission (MRCSS), formerly a chemical safety submission (CSS); and an MRESP, formerly an explosives site plan (ESP) when referring to munitions response activities under the Military Munitions Response Program (MMRP).

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Chapter 1
INTRODUCTION AND EXCEPTION PROGRAM

Section 1A—Explosives Safety General Instructions

1.1. Purpose

1.1.1. The purpose of this Manual is to implement AFPD 91-2, Safety Programs, and DoD 6055.09-M and establish an Air Force Weapons Safety program to:

1.1.2. 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 must always be provided when practicable.

1.1.3. 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 (CAs)). This maxim is known as the cardinal principle of explosives safety.

1.1.4. Observe explosives safety practices during all operations that include the use of live explosives.

1.1.5. Comply with DoD and Air Force explosives safety and environmental standards.

1.2. Scope.

1.2.1. The provisions of this Manual apply:

1.2.1.1. Whenever any explosives, propellant, or similar Hazard Class 1 energetic materials or other ammunition items in Classes 2 through 9 are present on Air Force-owned or leased facilities (except as allowed in paragraph 1.2.1.3.), or are in the custody and control of Air Force civilian or military personnel (see paragraph 3.5.1.2.).

1.2.1.2. Whenever United States (US)-titled AE are in the custody of Air Force civilian or military personnel, or Air Force contractors (except as allowed in paragraph 1.2.1.3.).

1.2.1.3. At Air Force-owned and contractor-operated facilities, as specified by contract, the Procuring Contract Officer (PCO) will ensure explosives safety requirements and procedures for compliance with current DoD and Air Force guidance must be clearly specified in the contract. (T-0). The contracting officer provides appropriate portions of DoD 4145.26-M, DoD Contractor’s Safety Manual for Ammunition and Explosives to the contractor. Weapons safety personnel from the organization responsible for the contract will advise the contractor on DoD and Air Force explosives safety standards specified in the contract. (T-0). In the event explosive safety requirements are not specified in a contract, apply the provisions of DoD 4145.26-M.

1.2.1.4. When DoD AE are located in overseas areas, comply with US AE safety standards to the extent consistent with appropriate international agreements and/or arrangements with the host country concerned. (T-0). Ensure host-nation officials receive appropriate notification of explosives-related activities. (T-1). When DoD AE are located in overseas areas, comply with US AE safety standards except when
compliance with more restrictive local standards is made mandatory by an appropriate international agreement. (T-1). When such ammunition is not in US custody, comply with US standards to the extent consistent with agreements or arrangements with the host country concerned. (T-1). If Air Force civilian or military personnel occupy leased bases within North Atlantic Treaty Organization (NATO) countries, also apply the safety distances in Allied Ammunition Storage and Transport Publication (AASSTP)-1, Manual of NATO Safety Principles for the Storage of Military Ammunition and Explosives, to exposures outside the base boundary and NATO criteria to host-nation exposed sites (ES) within the base. (T-0).

1.2.1.5. To Air Force personnel and facilities exposed by any other potential explosion site (PES), whether it is DoD, host-nation, or commercial AE, Commanders will ensure that US personnel and US-titled munitions are accorded the quantity-distance (QD) separation standards required by the Air Force and by DoD, even at foreign locations. (T-1). U.S. units will document their adherence to these standards by showing that US ESs are located at the required separation distances from host-nation PESs. US ESs will be licensed according to Chapter 14, and host-nation PESs identified in ESPs. (T-1). The identification of host-nation PESs does not constitute “siting” because the US does not authorize AE for host-nation facilities not under US control. If a violation of Air Force or DoD QD criteria to US targets is possible based on this analysis, obtain a waiver or exemption as outlined in Section 1B. (T-0) If correction of the problem is beyond US capabilities, notify the host-nation Commander by letter from the waiver or exemption approval level. (T-0) Attach to this letter enough information to convey the location, nature and extent of the potential explosives hazards. While other countries are not obligated to follow US rules, it may be helpful to explain to host-nations that US QD standards are enforced on US installations, and are based on testing, experience, and scientific analysis.

1.2.1.6. With the exception to Tier-0 (T-0) identified requirements that cannot be waived, Commanders will ensure all exceptions (i.e., deviations, event waivers, waivers, exemptions, and Secretary of the Air Force (SECAF) waivers and exemptions for new construction) to this Manual are accomplished IAW Section 1B. (T-1). All remaining waivers and deviations will be submitted IAW AFI 33-360. For the purposes of this instruction, the following definitions apply:

1.2.1.6.1. “Shall”, “must”, and “will” indicates a mandatory requirement that must be waived/ deviated from IAW AFI 33-360. “Will” is also used to express a declaration of purpose for a future event.

1.2.1.6.2. “Should” indicates a preferred, but not mandatory, method of accomplishment.

1.2.1.6.3. “May” indicates an acceptable or suggested means of accomplishment.

1.2.1.6.4. “Sign” indicates a requirement to obtain and maintain a signature by digital, electronic, or hard copy means.

1.2.1.7. To Air Force contract personnel (except as allowed in paragraph 1.2.1.3.) exposed to AE on Air Force installations. Such personnel may be afforded the same level of protection that would be similarly provided to Air Force civilian and military
personnel. The installation weapons safety office will notify the contracting officer, in writing, of explosives hazards to Air Force contract personnel. (T-1).

1.2.1.8. To the siting and construction of Air Force facilities (except as allowed in paragraph 1.2.2.)

Note: For purposes of this Manual, the term “MAJCOM” includes, Major Commands, Field Operating Agencies (FOA), Direct Reporting Units (DRU), and Air Component Commands (e.g., US Air Forces Central (USAFCENT).

1.2.2. Continue to use existing facilities not complying with these standards only when current hazards are not greater than those assumed for their original use, and only provided installations can clearly demonstrate that redesign or modification is not feasible, and that the quantity of explosives, propellants, or chemical agents cannot be reduced for reasons of operational necessity. (T-1).

1.2.2.1. To invoke this grandfathering clause for continued use of such facilities, have the following on file at the installation: (T-1).

1.2.2.1.1. Date of construction, original purpose and quantity of explosives approved.
1.2.2.1.2. Explosives safety criteria in effect at the time of construction.
1.2.2.1.3. An explanation why redesign or modification is not feasible.
1.2.2.1.4. An explanation why quantities cannot be reduced below existing levels.
1.2.2.1.5. An explanation why current explosives safety criteria cannot be applied to the facility.
1.2.2.1.6. A statement that risks are not greater than those assumed for the original siting.
1.2.2.1.7. Written approval from the installation Commander and the Major Command’s Chief of Safety (MAJCOM/SE) when initially invoking grandfather clause.

1.2.2.2. The installation Weapons Safety Manager (WSM) will review the information required in paragraph 1.2.2.1. at least every five years to see if mission changes allow the facility to be brought into compliance with current standards. (T-1). If compliance with current standards is not possible and the facility is still being used for its original purpose and IAW its original criteria, then continue to maintain the documentation that was generated at the onset. (T-1). The installation WSM will ensure documentation of the periodic review must be kept on file at the installation. (T-1).

1.2.2.3. Resiting such facilities requires compliance with these standards unless guidance of paragraph 1.2.2. is met or an exception is obtained IAW Section 1B. (T-1).

1.2.3. Evaluate non-DoD explosives siting submissions on DoD installations only to ensure compliance with DoD explosives safety standards to non-commercial (DoD and public) exposures (see paragraph 12.86.). (T-0).

Section 1B—Exception Program

1.3. General.
1.3.1. The AE safety standards herein are designed to manage the risks associated with AE by providing protection against serious injury, loss of life, and damage to property but are not intended to be so rigid as to prevent the Air Force from accomplishing its assigned missions. Consequently, when exceptions from these standards are made, proper authority within the Air Force must accept the added risk to personnel and property against the strategic or compelling operational reasons that necessitate such exceptions. Added risk to personnel and property must be analyzed and documented to include methods used to reduce the risk to a level acceptable to the Air Force approval authority.

1.3.2. Ease of operation or convenience is not an acceptable reason for requesting an exception.

1.3.3. This section implements Air Force Instruction (AFI) 90-802, *Risk Management*, by providing a mechanism for units to assess the level of risk involved with QD exceptions and by providing guidance on the appropriate approval level for each exception. Make this determination after a complete analysis of the mission, explosives requirements, and facilities.

1.3.4. Outside Continental United States (OCONUS) locations, Commanders will ensure host-nation military and civilian personnel are provided the same level of protection as U.S. personnel. Commanders will ensure host-nation Commanders are notified when QD exceptions to Air Force standards place host-nation personnel at additional risk beyond normal QD requirements. If required by Status of Forces Agreements (SOFA), basing, or other international agreements, host-nation approval must be obtained.

1.3.5. Exceptions need not be submitted when compensatory measures can be taken (e.g., temporarily reducing the authorized net explosive weight for quantity-distance (NEWQD) of a PES) that avoid an exception. Document as prescribed in paragraphs 14.22.8. and 14.23.12.

1.3.6. Exceptions need not be submitted for situations that, upon analysis by Headquarters Air Force Safety Center/Weapons Safety Division (AFSEC/SEW) and the DoD Explosives Safety Board (DDES), are determined to provide the required degree of safety through use of protective construction or other specialized safety features.

1.3.7. The host base weapons safety offices must maintain copies of current waivers, exemptions, deviations, and compensatory measures.

1.3.8. Commanders will ensure operations or activities involving exceptions are not allowed until the exceptions are approved by the required approval authority.

1.4. Deviations.

1.4.1. A deviation is a written authority permitting exceptions from mandatory non-QD requirements of this Manual for strategic or compelling operational reasons. Generally, Chapter 12 of this Manual contains QD requirements and all other Chapters contain non-QD requirements. AFSEC/SEW must formally approve deviations from paragraph 5.23.4.
“Side flash Protection for Nuclear Weapons” or AFI 91-208, *Hazards of Electromagnetic Radiation to Ordnance (HERO) Certification and Management*, for “Modern Mobile Emitters (MME)”.

1.4.1.1. Commanders will ensure deviation requests are documented as required in paragraph 1.4.3, below (T-1), with the following changes:

1.4.1.1.1. For deviations from paragraph 5.23.4., there is an additional requirement for a detailed description of compensatory measures which have been developed and are in place. The description must include the reduced value of side flash separation distance which will be observed. (T-1).

1.4.1.1.2. For deviations from paragraph 5.23.4., modify the requirement for a risk assessment (Chapter 4) to include only a review of the trade-offs between any expected additional risk from the decreased side flash separation distance and any expected increased safety due to the compensatory measures. (T-1). Develop on a case-by-case basis and in coordination with AFSEC/SEW, the requirements necessary to complete this assessment. (T-1).

1.4.1.1.3. For deviations from HERO requirements, modify the requirement for a risk assessment (Chapter 4) to include only a detailed technical evaluation of the electromagnetic hazards and Electrically Initiated Device (EID) sensitivities involved, and a description of the operational need for the deviation. (T-1).

1.4.1.1.4. For deviations from either paragraph, there is an additional requirement for a signed statement with the authority to accept any increased risk and acknowledge responsibility for any consequences resulting from performing operations under this deviation.

1.4.1.2. AFSEC/SEW will forward copies of all approved deviations to MAJCOM/SEW. (T-1).

1.4.1.3. MAJCOMs determine the criteria to identify, track and review base level deviations.

1.4.2. MAJCOMs will determine and document approval levels for all other deviations.

1.4.3. Document deviations using a memorandum format (T-1) and include the following information:

1.4.3.1. Requirement of this Manual (cite specific reference) that is being excepted.

1.4.3.2. Strategic or compelling operational reasons for requesting the deviation.

1.4.3.3. Risk assessment IAW Chapter 4.

1.4.3.4. Evaluation of feasible corrective actions and justification why none can currently be implemented (e.g., cost, mission impact).

1.4.3.5. Pursue proposed corrective action or actions to ultimately correct the deviation. Several corrective actions may be pursued at the same time. For each corrective action being pursued provide associated cost estimate and schedule for completion.

1.4.3.6. If no corrective actions are feasible to ultimately correct the deviation, so state and provide justification.
1.4.3.7. Expiration date, if appropriate.

1.4.4. Commanders responsible for the deviation will ensure deviations are reviewed every three years IAW paragraph 1.13. (T-1).

1.5. Event Waivers (Nonrecurring).

1.5.1. Event waivers provide written authority to temporarily deviate from requirements of this Manual when situations occur without sufficient time to comply with formal site planning procedures. Commanders will ensure formal DDES site plan approval is obtained within 365 days from the date of waiver approval, if required. (T-1).

1.5.2. Commanders will ensure event waivers are not used as a replacement for proper planning when formal explosives site planning approval can be obtained prior to the start of operations. (T-1).

1.5.3. The responsible Commander must approve the event waiver in writing prior to onset of operations, or as soon as possible thereafter, for the length of the operational requirement but not to exceed 365 days. (T-1). If the Air Force unit is a tenant on a non-Air Force installation, process according to governing directives.

1.5.4. The responsible Commander will ensure event waivers are documented using a memorandum format (T-1) and include, as applicable, the following information:

1.5.4.1. Type and NEWQD of munitions involved.

1.5.4.2. Type of ES. If people are present, give an estimate of the number of civilians and military.

1.5.4.3. Strategic or compelling operational reasons for approving the event waiver.

1.5.4.4. Distance required versus distance available and QD standard not met, if applicable.

1.5.4.5. Narrative explanation outlining the reason or reasons why the explosive standards could not be met and a discussion of reasonable alternatives considered and rejected.

1.5.4.6. Risk assessment IAW Chapter 4.

1.5.4.7. Waiver or exemption decision nomograph for each excepted PES to ES pair (see paragraph 1.12.).

Note: This is only used to describe the level of risk assumed, not the required approval level as described in paragraph 1.12.

1.5.4.8. Expected duration of the event waiver.

1.5.4.9. Point of Contact (POC) name, grade, phone, and e-mail.

1.5.5. Units will submit a copy of the approved event waiver to MAJCOM/SEW. (T-1). MAJCOM/SEW will then forward to AFSEC/SEW, which may be included as part of the formal explosives site planning submission process.
1.6. Waivers.

1.6.1. A waiver is a written authority permitting a temporary exception for existing construction, from a mandatory QD requirement of this Manual for strategic or compelling operational reasons. Generally, waivers are granted for a short period (5 years or less) pending cancellation or correction of the waived conditions. Waivers are not granted for periods exceeding 5 years.

1.6.2. Waiver approval level is based on the level of the assessed risk. The approval level is determined by application of the nomograph per paragraph 1.12.

1.6.3. Comply with the information requirements listed in paragraph 1.10. (See paragraph 1.11. for HAF-level waivers).

1.6.4. Forward waivers as part of the ESP package. MAJCOMs will validate and submit Hybrid Safety Submissions (HSS) to AFSEC/SEW for review and subsequent submission for final approval. AFSEC/SEW will return packages failing to meet the test of strategic or compelling operational need, or packages omitting information requirements listed in paragraph 1.10. or paragraph 1.11. for HAF-level waivers.

1.6.5. Commanders responsible for the waiver will ensure a waiver is reviewed biennially on the anniversary of their approval date. (T-1). See paragraph 1.13. for review process requirements.

1.7. Exemptions.

1.7.1. An exemption is a written authority permitting a long-term (more than 5 years) exception from a mandatory QD requirement of this Manual for strategic or compelling operational reasons.

1.7.2. Exemption approval level is based on the level of risk assumed by the specific hazard. The approval level is determined by application of the nomograph per paragraph 1.12.

1.7.3. Comply with the information requirements listed in paragraph 1.10. or paragraph 1.11. for HAF-level exemptions.

1.7.4. Forward exemptions as part of the ESP package. MAJCOMs will validate and submit exemption HSSs to AFSEC/SEW for review and subsequent submission for final approval. AFSEC/SEW will return packages failing to meet the test of strategic or compelling operational need, or packages omitting information requirements listed in paragraph 1.10. or paragraph 1.11. for HAF-level exemptions.

1.7.5. Commanders responsible for the exemption will ensure exemptions are reviewed every 5 years on the anniversary of the approval date. (T-1). Reviews may be accomplished early to spread out workloads. See paragraph 1.13. for review requirements.

1.8. SECAF New Construction Exemption.

1.8.1. SECAF waivers and exemptions are written authorities that permit an exception, for new PES or ES construction, from a mandatory QD requirement of this Manual for strategic or compelling operational reasons. This paragraph applies to SECAF waivers and exemptions for new construction at enduring locations.
1.8.2. SECAF must approve all planned construction at enduring locations or MILCON funded projects at non-enduring locations not meeting QD standards.

1.8.3. Comply with the information requirements listed in paragraph 1.11.

1.8.4. Forward SECAF waivers and exemptions as part of the ESP package. MAJCOMs will validate and submit SECAF new construction exemption HSSs to AFSEC/SEW for review and subsequent submission for final approval. AFSEC/SEW will return packages failing to meet the test of strategic or compelling operational need, or packages omitting information requirements listed in paragraph 1.11 (T-1).

1.8.5. See paragraph 1.13. for review process requirements.

1.8.6. Commanders will ensure temporary QD departures to workers performing construction are assessed and approved IAW paragraph 1.12. (T-1).

1.9. Exceptions for Non-DoD Explosives Activities on Air Force Installations.

1.9.1. Non-DoD explosives activities, that are non-compliant with the explosives safety standards in this Manual and do not hazard DoD activities or violate QD criteria to DoD activities, will not be processed as exceptions. (T-1).

1.9.2. Instead, ESP packages involving such non-compliant, non-DoD explosives activities will (T-1):

1.9.2.1. Clearly specify situations where non-compliance with explosives safety requirements exists.

1.9.2.2. Include a risk acknowledgement letter signed by the non-DoD user.

1.9.2.3. Include installation’s weapons safety office recommendation for ESP approval or disapproval with supporting rationale and installation Commander coordination.

1.9.3. Coordinate with the non-DoD user prior to higher headquarters submission of the ESP.

1.10. Waiver and Exemption Information Requirements.

1.10.1. Preparation of waivers and exemptions is a team effort involving installation safety, civil engineering, legal, and other agencies affected by the waiver or exemption. Involve all supporting and affected agencies to ensure thorough evaluation of the proposed waiver or exemption.

1.10.2. Identify waivers and exemptions for each individual PES to ES relationship not meeting the QD requirements of this Manual.

1.10.3. For each excepted PES to ES pair, submit the following information in the ESP package (T-1) (Attachment 3 contains a sample narrative of a QD exception request):

1.10.3.1. Waiver or exemption number.

1.10.3.2. Requirement from this Manual (cite specific reference) that is being excepted.

1.10.3.3. Strategic or compelling operational reasons for requesting the waiver or exemption.

1.10.3.4. Risk assessment IAW Chapter 4.
1.10.3.5. Waiver or exemption decision nomograph (see paragraph 1.12.).

1.10.3.6. Evaluation of feasible corrective actions and justification why none can currently be implemented (e.g., cost, mission impact).

1.10.3.7. Proposed corrective action or actions to ultimately correct the waiver or exemption. Several corrective actions, any one of which may correct the waiver or exemption, may be pursued at the same time. For each corrective action being pursued provide associated cost estimate and schedule for completion. Installation safety staff will keep copies of supporting documentation for corrective actions being pursued. (T-1).

1.10.3.8. If no corrective actions are feasible to ultimately correct the waiver or exemption, so state and provide justification.

1.10.3.9. Expiration date, if appropriate.

1.10.4. See paragraph 14.22.6. for identifying waivers and exemptions on the AF Form 943, Explosives Site Plan, or Explosives Safety Siting (ESS) Submittal Form.

1.10.5. If the waiver or exemption decision nomograph (paragraph 1.12.) requires Assistant Secretary of the Air Force, SAF/Installations, Environment and Logistics (SAF/IE) approval, comply with the information requirements in paragraph 1.11.

1.11. HAF-Level Waiver and Exemption Information Requirements.

1.11.1. This paragraph applies to all waivers and exemptions requiring SECAF or SAF/IE approval. To expedite processing of HSSs with waivers or exemptions through Air Staff and Secretariat offices, a standardized format is essential. Units or MAJCOMs seeking HAF-level approval for waivers and exemptions will submit all required information electronically. Provide all HSS information required in Chapter 14, even though it may not all be included in the package forwarded to HAF-level. Assemble HAF-level request packages using the following format (AFSEC/SEW may modify the tab format to accommodate SECAF approval and/or SAF/IE risk acceptance memorandum(s)):

1.11.2. Tab 1. MAJCOM/CC or CV Memorandum. Use the transmittal letter in Attachment 2 as a format for this memorandum.

1.11.3. Tab 2. Maps. Provide the map for the ESP according to paragraph 14.24.

1.11.4. Tab 3. AF Form 943 or Explosive Safety Siting Submittal Form. Clearly show siting pairs without exceptions, exceptions requiring HAF-level approval, and exceptions having received approval at subordinate levels of command (see paragraph 14.23. for specific guidance).

1.11.5. Tab 4. The Specific Standard Not Met. Identify and cite the specific reference in this Manual requiring the exemption or waiver. Provide sufficient information to explain the nature of the exemption or waiver. Use highlighted excerpts from this Manual to explain the type of separation required (e.g., inhabited building distance (IBD) or public traffic route distances (PTRD)) and the distance required or how the distance is calculated (e.g., QD distance criteria table, fragment distance criteria, etc.).

1.11.6. Tab 5. Justification. In narrative form, provide a detailed explanation of the “strategic or compelling operational” reason for requesting the HAF-level waiver or exemption. Use specific references to aircraft sortie rates or other pertinent data to justify the
type, quantity, and placement of explosives at the PES. Additionally, fully justify the position of the excepted ES. Provide any additional information, such as higher headquarters inspection findings or limiting factors (LIMFAC) to substantiate the request. Identify all feasible corrective actions and justify why none can currently be implemented (e.g., cost, mission impact).

1.11.7. **Tab 6.** Risk Assessment. Provide a risk assessment IAW Chapter 4. Provide a separate waiver or exemption decision nomograph for each excepted PES to ES pair requiring HAF-level approval (see paragraph 1.12.).

1.11.8. **Tab 7.** Corrective Actions. Discuss any and all actions taken or planned to mitigate the effects of an explosives mishap. Consider such things as building techniques, barricading, glass protection, tiered siting, or planned construction. Identify the proposed specific corrective action or actions to ultimately correct the waiver or exemption. Several corrective actions, any one of which may correct the waiver or exemption, may be pursued at the same time. For each corrective action being pursued provide associated cost estimate and schedule for completion. (Installation safety staff will keep copies of supporting documentation for corrective actions being pursued.) If no corrective actions are feasible to ultimately correct the waiver or exemption, so state and provide justification.

1.11.9. **Tab 8.** Options. Discuss fully all reasonable options considered by the unit but rejected in favor of the proposed action. Give details as to why each of the other options was not chosen. Discuss limitations to funding, real estate, or other constraints, as appropriate.

1.12. **Waiver and Exemption Decision Nomograph.**

1.12.1. The waiver and exemption decision nomograph is a tool to assess risk and determine the appropriate authority level for acceptance of risk at all locations for exceptions from mandatory QD requirements.

1.12.2. **Enduring Location Approval Levels for Peacetime/Armistice Operations.** Consequence-based approval levels for enduring locations during peacetime/armistice operations range from SAF/IE down to Numbered Air Force (NAF) Commander level. The following are the required approval levels for each risk assessment level as specified in Figure 1.1.

1.12.2.1. Extremely High, SAF/IE. MAJCOM/CC or CV may accept risk at this level for temporary QD departures to construction workers (see paragraph 1.8.6.).

1.12.2.2. High, MAJCOM/CC or CV.

1.12.2.3. Medium, NAF/CC or CV. Where NAFs do not exist, MAJCOMs will identify an alternate intermediate command level between wing and MAJCOM; if there is no intermediate command level, MAJCOM approval is required in place of NAF.

1.12.2.4. Low, NAF/CC or CV. The NAF/CC or CV may delegate this level of risk acceptance to the Wing Commander. In the event a NAF does not exist, MAJCOM may delegate this level of risk acceptance.

1.12.3. **Enduring Location Approval Levels for Wartime/Contingency Operations.** Consequence-based approval levels for enduring locations during wartime/contingency operations range from MAJCOM/CC or CV down to NAF command level. The following are the required approval levels for each risk assessment level as specified in Figure 1.2.
1.12.3.1. Extremely High and High, MAJCOM/CC or CV.

1.12.3.2. Medium, NAF/CC or CV. Where NAFs do not exist, MAJCOMs will identify an alternate intermediate command level between wing and MAJCOM; if there is no intermediate command level, MAJCOM approval is required in place of NAF.

1.12.3.3. Low, NAF/CC or CV. The NAF/CC or CV may delegate this level of risk acceptance to the Wing Commander. In the event a NAF does not exist, MAJCOM may delegate this level of risk acceptance.

1.12.4. Elevation Authority. USAF/SE may elevate any QD exception for enduring locations to the Air Force Chief of Staff for final approval or informational purposes.


Note: The GCC may authorize the application of CJCSI 4360.01A for enduring locations under their command.

1.12.6. The nomograph is a two-step process. First, conduct a risk assessment to categorize the level of risk. Then plot the criteria on the nomograph and determine the approval level.

1.12.6.1. Risk Assessment. Risk levels are calculated based on three criteria:

1.12.6.1.1. Likelihood. The likelihood of a mishap is the relative probability an explosives mishap may occur based on the type of explosives involved, the level of activity at the PES, and external threats to the location. Each excepted PES is categorized according to one of the five likelihood levels identified in Table 1.1. Contact AFSEC/SEW when Table 1.1 fails to describe explosive operations or locations adequately.

1.12.6.1.2. Exposure. Exposure is the amount of time personnel and resources at an ES are exposed to a PES. It is expressed as man-hours per year. Use Table 1.2. to categorize each excepted ES.

1.12.6.1.3. Severity. The possible severity of an explosives mishap is based on the worst-case type and amount of explosives present, the construction of both the PES and ES, and the distance between the PES and ES. Information in Chapter 2 is used to estimate the potential damage and injuries from a mishap explosion. Severity is categorized based on the effect on personnel, mission capability, and other resources according to Table 1.3.

1.12.6.2. Plotting the Nomograph. Each exception pair has three data points as defined in paragraph 1.12.5.1. Plot each data point on the applicable nomograph. Draw a straight line from the Likelihood point through the Exposure point to the Pivot Line. From this point on the Pivot Line, draw a straight line through the Severity point to the Risk Assessment Level line.

1.13. Periodic Reviews for Exceptions.

1.13.1. Commanders will ensure periodic reviews of exceptions are documented (T-1), and include the following:
1.13.1.1. Confirmation of the continued existence of the exception.
1.13.1.2. Verification of the accuracy of the previous data associated with the exception.
1.13.1.3. Validation of the strategic or compelling operational reasons for initial approval of the exception.
1.13.1.4. Validation that mitigating actions and stipulations are still in force.
1.13.1.5. Reassessment of proposed corrective actions. Identify any changes to proposed corrective actions and the reasons for those changes.
1.13.1.6. Current cost estimates for proposed corrective actions, if available.
1.13.1.7. Status of progress towards accomplishing corrective actions and eliminating the exception.
1.13.1.8. Estimated date and schedule for completion of corrective actions.

1.13.2. Submit copies of periodic review documentation through command channels to AFSEC/SEW. (T-1).

1.13.3. Use the periodic review documentation to advocate funding, and other support required, for corrective action implementation.

1.13.4. Approval Levels for Reviews.

1.13.4.1. Reviews of deviations from paragraph 5.23.4. “Side Flash Protection for Nuclear Weapons” or AFI 91-208 for “Modern Mobile Emitters (MME)” and any or all of its paragraphs, must be formally approved by AFSEC/SEW. (T-1).

1.13.4.2. MAJCOMs will determine and document approval levels for periodic review of all other deviations.

1.13.4.3. Commanders will ensure waivers or exemptions are reviewed at the original approval level. (T-1). However, if PES to ES data has changed, reapply the nomograph to determine the approval level.

1.13.4.4. When completion of the corrective actions associated with a waiver exceeds 5 years, the next higher approval level must reissue a new waiver (unless last approved by SAF/IE). (T-1).

1.13.5. Cancellation of Waivers and Exemptions. Units will notify MAJCOM’s who will in turn notify AFSEC/SEW of waivers and exemptions no longer needed according to procedures outlined in MAJCOM supplements. (T-1).
Figure 1.1. Waiver and Exemption Decision Nomograph—Peacetime/Armistice Operations.

Title: ____________________________ Exception Type: ________________
Figure 1.2. Waiver and Exemption Decision Nomograph-Wartime/Contingency Operations.
### Table 1.1. Likelihood of a Mishap

<table>
<thead>
<tr>
<th>Category</th>
<th>Storage</th>
<th>Maintenance Inspection, Assembly, Disassembly</th>
<th>Operations</th>
<th>Transportation</th>
<th>Destruction</th>
<th>Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Possible.</strong> Over a typical career, a mishap can be expected to occur on an intermittent basis within the USAF.</td>
<td>Dangerous unserviceable items awaiting destruction</td>
<td>Any operating location in an area subject to hostile actions such as rockets, missiles, air attacks, or terrorists.</td>
<td>Any explosives operations in an area subject to hostile actions such as rockets, missiles, air attacks, or terrorists.</td>
<td></td>
<td>Initial tests of new systems</td>
<td></td>
</tr>
<tr>
<td><strong>Seldom.</strong> Over a typical career, a mishap can be expected to occur randomly within the USAF.</td>
<td>Dangerously unserviceable items awaiting destruction</td>
<td>Hazardous environments with gases, fibers, etc.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unlikely.</strong> Over a typical career, a mishap can be expected to occur infrequently within the USAF.</td>
<td>Unserviceable (but not dangerous) items.</td>
<td>TDY operations during exercises, contingencies or alert.</td>
<td>Hot Cargo Missions of unserviceable or unpackaged material.</td>
<td>Burning, detonation, and static firing areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Improbable.</strong> Over a typical career, a mishap will rarely occur within the USAF.</td>
<td>Operating stocks in storage requiring handling more than once each month.</td>
<td>Home station during contingencies or exercises.</td>
<td>Home station activities during exercises, contingencies or alert.</td>
<td>Railheads requiring application of QD.</td>
<td></td>
<td>Testing operational systems.</td>
</tr>
<tr>
<td><strong>Practically Impossible.</strong> So rare, a mishap is not expected to occur during a typical career.</td>
<td>Unserviceable (but not dangerous) items in storage.</td>
<td>Pyrotechnics</td>
<td>TDY operations during peacetime.</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Functional tests not placing voltage across wiring circuits.</td>
<td></td>
<td>Flight line holding areas/ready service storage locations outside munitions storage areas</td>
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<tr>
<td></td>
<td>Outdoor operations during inclement weather.</td>
<td>Deployed ground-based missile meant to be employed in a non-mobile mission for offensive or defensive purposes.</td>
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<tr>
<td></td>
<td>Serviceable items in extended storage requiring handling less than once each month.</td>
<td>Paint and packing.</td>
<td>Home station flight line explosive activities during peacetime.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2. Exposure.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>LIMITS</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare</td>
<td>$\leq 48$ man-hours per year</td>
<td>Three people @ two workdays per year OR one person @ six workdays per year</td>
</tr>
<tr>
<td>Unusual</td>
<td>$\leq 288$ man-hours per year</td>
<td>Three people @ one workday per month OR 36 people @ one workday per year</td>
</tr>
<tr>
<td>Occasional</td>
<td>$\leq 1248$ man-hours per year</td>
<td>Three people @ one workday per week OR one person @ three workdays per week</td>
</tr>
<tr>
<td>Frequent</td>
<td>$\leq 10,440$ man-hours per year</td>
<td>10 people @ four hours per day OR 260 people @ five days per year</td>
</tr>
<tr>
<td>Continuous</td>
<td>$\geq 10,441$ man-hours per year</td>
<td>10 people @ eight hours per day OR 260 people @ 10 days per year</td>
</tr>
</tbody>
</table>

Table 1.3. Explosive Mishap Severity.

<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>CATASTROPHIC</th>
<th>CRITICAL</th>
<th>MARGINAL</th>
<th>NEGLIGIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>- Separation is $\leq$ IMD or equal to ILD &lt;br&gt; - Unstrengthened buildings will suffer severe structural damage approaching total destruction &lt;br&gt; - Mission curtailed &lt;br&gt; - Costs equal to or greater than $2,000,000 loss</td>
<td>- Separation is $\leq$ IMD or equal to ILD &lt;br&gt; - Unstrengthened buildings will suffer at least 50 percent damage and could approach total destruction &lt;br&gt; - Mission interrupted &lt;br&gt; - $500,000 but less than $2,000,000 loss</td>
<td>- Separation is $\leq$ ILD or equal to incremental PTR &lt;br&gt; - Unstrengthened building loss expected to equal at least 20 and as much as 50 percent &lt;br&gt; - Mission degraded &lt;br&gt; - $50,000 but less than $500,000 loss</td>
<td>- Separation is $\leq$ full PTR but $&lt; \text{IBD}$ separation &lt;br&gt; - Unstrengthened building loss expected to equal approximately 5 -10 percent of the replacement costs &lt;br&gt; - Mission unaffected &lt;br&gt; - Must be less than $50,000 loss</td>
</tr>
<tr>
<td>Personnel (Unrelated)</td>
<td>Personnel (Related)</td>
<td>loss</td>
<td></td>
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<td>----------------------</td>
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<tr>
<td>- Separation is IMD or less - ≤ K11; ≥ 8 psi overpressure - Personnel are likely to be seriously injured due to blast, fragments, debris, and translation (i.e., being struck against hard objects). - A 20 percent or better chance of eardrum rupture</td>
<td>- Separation is IMD or less - ≤ K11; ≥ 8 psi overpressure - A 2-15 percent chance of eardrum damage - Personnel may suffer serious injuries from fragments, debris, firebrands, or other objects. - A 20 percent or better chance of eardrum rupture</td>
<td>- At least full PTR but less than IBD - Occupants of exposed, unstrengthened structures may be injured by secondary blast effects, such as falling building debris - Personnel in the open are not expected to be killed or seriously injured by blast effects but, fragments and debris may cause some injuries.</td>
<td></td>
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<tr>
<td>- Separation is ILD or less - ≤ K18; ≥ 3.5 psi overpressure</td>
<td>- Separation is greater than ILD or equal to incremental PTR - Occupants of exposed, unstrengthened structures may be injured by blast effects, building debris and displacement or suffer temporary hearing loss.</td>
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<td>- Separation is IMD or less - ≤ K11; ≥ 8 psi overpressure</td>
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<tr>
<td>- Separation is IMD or less - ≤ K11; ≥ 8 psi overpressure</td>
<td>- Separation is less than ILD - ≤ K18; ≥ 3.5 psi overpressure - A 2-15 percent chance of eardrum damage - Personnel may suffer serious injuries from fragments, debris, firebrands, or other objects.</td>
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<tr>
<td>- Separation is ILD or less - ≤ K18; ≥ 3.5 psi overpressure</td>
<td>- Separation is greater than ILD or equal to incremental PTR - Occupants of exposed, unstrengthened structures may be injured by blast effects, building debris and displacement or suffer temporary hearing loss.</td>
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<td>- Separation is IMD or less - ≤ K11; ≥ 8 psi overpressure - A 2-15 percent chance of eardrum damage - Personnel may suffer serious injuries from fragments, debris, firebrands, or other objects. - A 20 percent or better chance of eardrum rupture</td>
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<td>- Separation is greater than ILD or equal to incremental PTR - Occupants of exposed, unstrengthened structures may be injured by blast effects, building debris and displacement or suffer temporary hearing loss.</td>
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<td></td>
<td>eardrum rupture</td>
<td>other objects.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>- Separation is barricaded ILD but $&lt;\text{ILD}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Unrelated)</td>
<td>- $K9$, $12\text{ psi}$; $&lt;K18$, $&gt;3.5\text{ psi}$</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Vehicles will be heavily damaged, probably to the extent of total loss or severely damaged with minor engine damage, and total glass breakage.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Costs equal to or greater than $$2,000,000$ loss</td>
<td>- Separation is $\geq\text{ILD}$</td>
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<tr>
<td></td>
<td>- Separation is $&gt;\text{ILD}$</td>
<td>&lt; incremental PTR</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- K9, 12 psi; $&lt;K18$, $&gt;3.5\text{ psi}$</td>
<td>- K18, 3.5 psi; $&lt;K24$, $&gt;2.3\text{ psi}$</td>
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<tr>
<td></td>
<td>- Vehicles will incur extensive, but not severe, body and glass damage consisting mainly of body panel dishing, and cracks in shatter resistant windows.</td>
<td>- Vehicles will suffer little damage, unless they are hit by a fragment or the blast causes a momentary loss of control.</td>
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<tr>
<td></td>
<td>- $$500,000$ but less than $$2,000,000$ loss</td>
<td>- Must be less than $$50,000$ loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aircraft</td>
<td>- Separation is $&gt;\text{incremental PTR}$ but $&lt;\text{full PTR}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- K24-K30; 2.3-1.7 psi</td>
<td>- Parked military and commercial aircraft will likely sustain minor damage due to blast, but must remain airworthy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Vehicles should suffer little damage, unless they are hit by a fragment or the blast causes a momentary loss of control.</td>
<td>- Mission unaffected</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Must be less than $$50,000$ loss</td>
<td>- Must be less than $$50,000$ loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARKED AIRCRAFT</td>
<td>- $&lt;K18$, $&gt;3.5\text{ psi}$ thru K11, 8 psi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Aircraft will be damaged heavily by blast and fragments; destruction by resulting fire is likely.</td>
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<tr>
<td></td>
<td>- Barricaded ILD; K9, 12 psi</td>
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<tr>
<td></td>
<td>- Aircraft will be damaged beyond economical repair both by blast and fragments.</td>
<td></td>
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<tr>
<td></td>
<td>- Barricaded AGM; K6, 27 psi</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- Aircraft will be</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARKED AIRCRAFT</td>
<td>- $&lt;K30$, $&gt;1.7\text{ psi}$ thru K24, 2.3 psi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Aircraft may suffer some damage to the fuselage from blast and possible fragment penetration, but must be operational with minor repair.</td>
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<tr>
<td></td>
<td>- Mission degraded</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>- $$50,000$ but less than $$500,000$ loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARKED AIRCRAFT</td>
<td>- $&gt;K30$, $\leq1.7\text{ psi}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Parked military and commercial aircraft will likely sustain minor damage due to blast, but must remain airworthy.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Mission unaffected</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Must be less than $$50,000$ loss</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| destroyed by blast, thermal, and debris effects.  
  - Mission curtailed  
  - Costs equal to or greater than $2,000,000 loss | to cause severe damage  
  - Mission interrupted  
  - $500,000 but less than $2,000,000 loss |
Chapter 2
REACTION EFFECTS

Section 2A—Principal Effects of Hazard Division (HD) 1.1 Events

2.1. Blast.

2.1.1. Blast Wave Phenomena. In an incident involving HD 1.1, or HD 1.1 with any other HD (an HD 1.1 event), the violent release of energy creates a sudden and intense pressure disturbance termed the “blast wave.” The blast wave is characterized by an almost instantaneous rise from ambient pressure to a peak incident pressure (P_i). This pressure increase, or “shock front,” travels radially outward from the detonation point, with a diminishing velocity that is always in excess of the speed of sound in that medium. Gas molecules making up the front move at lower velocities. This velocity, called the “particle velocity,” is associated with the “dynamic pressure,” or the pressure formed by the winds produced by the shock front.

2.1.1.1. As the shock front expands into increasingly larger volumes of the medium, the incident pressure decreases and, generally, the duration of the pressure-pulse increases.

2.1.1.2. If the shock wave impinges a rigid surface (e.g., a building) at an angle to the direction of the wave’s propagation, a reflected pressure is instantly developed on the surface and this pressure rises to a value that exceeds the incident pressure. This reflected pressure is a function of the incident wave’s pressure and the angle formed between the rigid surface and the plane of the shock front.

2.1.2. Partially Confined Explosions. When an explosion occurs within a structure, the peak pressure associated with the initial shock front will both be high and amplified by reflections within the structure. In addition, the accumulation of gases from the explosion exerts additional pressure and increases the load duration within the structure. This effect may damage or destroy the structure unless the structure is designed to either withstand or vent the gas and shock pressures. Structures that have one or more strengthened walls may be vented for relief of excessive gas by either frangible construction of the remaining walls or roof or through the use of openings. This type of construction permits the gas from an internal explosion to spill out of the structure. Once released from confinement, these pressures (referred to as “exterior” or “leakage” pressures) expand radially and may affect external structures or personnel.

2.1.3. QD K-factors. Throughout this Manual, NEWQD is used to calculate QD separations for blast protection by means of a formula using a “K-factor.” See paragraph 12.11. for explanation of this formula.

2.1.4. Expected Blast Pressures at Table 2.1. presents the peak incident pressures that would be expected at various K-factors from HD 1.1 events. Pressures may also be determined using the Incident Airblast Calculator and the Blast Effects Computer (BEC).

2.1.5. General Blast Effects On Structures.
2.1.5.1. Conventional Structures. Conventional structures are generally designed to withstand roof-snow loads of 0-50 pounds per square foot or wind loads up to 90 miles per hour (mph), or both. At 90 mph, the wind load equates to 0.14 pounds per square inch (psi). Given the pressures shown in Table 2.1, for the selected K-factors, it is evident that, even at IBD, conventional structures may not provide complete protection from blast. Generally, the weakest portions of any conventional structure are the windows. Table 2.2, provides the probability of breaking typical windows at various K-factors and associated incident pressures from HD 1.1 events.

2.1.5.2. Aboveground Structures (AGS). These are generally considered conventional structures and provide little protection from blast or fragmentation (see paragraph 2.5.).

2.1.5.3. Earth-Covered Magazine (ECM). An explosion at an ECM produces high reflected pressure and impulse. These can damage doors and headwalls of adjacent ECMs, propelling debris onto contents and communicating the explosion. When separated from each other by the minimum distances required by Table 12.1., ECMs provide AE with virtually complete protection against propagation (see Section 6C). However, AE in adjacent ECMs may be damaged and structural damage ranging from cracks in concrete, damage to ventilators and doors to complete structural failure may occur in the corresponding ECM.

Note: When ECMs containing HD 1.1 AE are sited so that if anyone is in the forward sector of another, separate the two by distances greater than the minimum permitted for side-to-side orientations. The greater distances are necessary to protect the door and headwall of a facing ECM from the adjacent explosion; to a lesser extent, they are necessary as protection from the directional effects of the source.

2.1.5.4. Underground Storage Facilities. Underground facilities sited per DoD 6055.09-M, Volume 5, provide a high degree of protection against propagation of an explosion between chambers, and between underground and aboveground structures. An HD 1.1 explosion in an underground storage facility causes very high pressures of prolonged duration. Blast waves and the accompanying gas flows travel throughout the underground facility at high velocity.

2.1.5.5. Barricaded Open-Storage Modules. Barricaded open-storage modules provide a high degree of protection against the propagation of an explosion (see Section 6D). However, if flammable materials are present in nearby cells, subsequent propagation by fire is possible. When an explosion occurs in adjacent modules separated by K1.1, AE will be thrown tens of yards and be covered with earth, thereby unavailable for use until extensive uncovering operations, and possibly maintenance, are completed. Items at K=2.5 separation distance from a donor explosion are expected to be readily accessible.

2.1.6. General Blast Effects on Personnel. Tables 2.3., 2.4. and 2.5. describe the expected effects of blast on personnel.

2.1.7. Computation of Blast Effects. Many of the blast effects described in this section were computed using the DDESB Blast Effects Computer (available at http://www.ddesb.pentagon.mil) and proven test methodologies as outlined in Department of Defense Explosives Safety Board (DDES) Technical Paper (TP) 16, Methodologies for Calculating Primary Fragment Characteristics, current revision. The DDESB Blast Effects
Computer can be used to estimate similar effects associated with various NEWQDs, facilities, and distances.

2.2. **Fragments.**

2.2.1. An important consideration in the analysis of the hazards associated with an explosion is the effect of any fragments produced. Although most common in HD 1.1 or HD 1.2 events, fragmentation may occur in any incident involving AE (see Section 2B). Depending on their origin, fragments are referred to as “primary” or “secondary” fragments.

2.2.2. Primary fragments result from the shattering of a container (e.g., shell casings, kettles, hoppers, and other containers used in the manufacture of explosives, rocket engine housings) in direct contact with the explosive. These fragments usually are small, initially travel at thousands of feet per second and may be lethal at long distances from an explosion.

2.2.3. Secondary fragments are debris from structures and other items in close proximity to the explosion. These fragments, which are somewhat larger in size than primary fragments and initially travel at hundreds of feet per second, do not normally travel as far as primary fragments.

2.2.4. The earth cover of an underground facility may rupture and create a significant debris hazard.

2.2.5. A hazardous fragment is one having an impact energy of 58 ft-lb or greater.

2.2.6. A hazardous fragment density is one hazardous fragment per 600 ft².

2.3. **Thermal Hazards.**

2.3.1. General. Generally, thermal hazards from an HD 1.1 event are less hazardous than blast and fragment hazards.

2.3.2. Personnel. It normally takes longer to incur injury from thermal effects than from either blast or fragmentation effects because both blast and fragmentation occur almost instantaneously. The time available to react to a thermal event increases survivability.

2.3.3. Structures, Material, and AE. The primary thermal effect on structures, material, and AE is their partial or total destruction by fire. The primary concern with a fire involving AE is that it may transition to a more severe reaction, such as a detonation.

2.4. **Groundshock and Cratering.**

2.4.1. In an airburst, there may be a downward propagation of groundshock. Cratering may be reduced or eliminated.

2.4.2. In a surface burst, ground shock is generated and cratering can be significant.

2.4.3. A buried or partially buried detonation produces the strongest ground shock; however, if the explosion is deep enough, no crater will be formed.

2.4.4. Underground Facilities. AE protection can be achieved by proper chamber spacing. An HD 1.1 explosion will produce ground shocks that may rupture the earth cover and eject debris (See DoD 6055.09-M).

2.5. **Expected Consequences.**

2.5.1. Barricaded Aboveground Magazine (AGM) Distance – K6 (27 psi). At this distance:
2.5.1.1. Unstrengthened buildings will be destroyed.

2.5.1.2. Personnel will be killed by blast, by being struck by debris, or by impact against hard surfaces.

2.5.1.3. Transport vehicles will be overturned and crushed by the blast.

2.5.1.4. Explosives-loaded vessels will be damaged severely, with propagation of explosion likely.

2.5.1.5. Aircraft will be destroyed by blast, thermal, and debris effects.

2.5.1.6. Barricades are an effective control measure for preventing simultaneous detonation of explosion by high velocity low angle fragments. However, they provide only limited protection against any propagation of explosives caused by a fire resulting from high angle firebrands.

2.5.2. Barricaded ILD – K9 (12 psi). At this distance:

2.5.2.1. Unstrengthened buildings will suffer severe structural damage approaching total destruction.

2.5.2.2. Personnel will be subject to severe injuries or death from direct blast, building collapse, or translation.

2.5.2.3. Aircraft will be damaged beyond economical repair both by blast and fragments. If aircraft are loaded with explosives, delayed explosions are likely to result from subsequent fires.

2.5.2.4. Transport vehicles will be damaged heavily, probably to the extent of total loss.

2.5.2.5. Improperly designed barricades or structures may increase the hazard from flying debris, or may collapse in such a manner as to increase the risk to personnel and equipment.

2.5.2.6. Barricading is a required control measure. Direct propagation of explosion between two explosive locations is unlikely when barricades are placed between them to intercept high velocity low angle fragments. Exposed structures containing high value, mission critical equipment or personnel may require hardening.

2.5.3. Unbarricaded Aboveground Magazine Distance – K11 (8 psi). At this distance:

2.5.3.1. Unstrengthened buildings will suffer damage approaching total destruction.

2.5.3.2. Personnel are likely to be injured seriously due to blast, fragments, debris, and translation.

2.5.3.3. There is a 15 percent risk of eardrum rupture.

2.5.3.4. Explosives-loaded vessels are likely to be damaged extensively and propagation of explosion may occur.

2.5.3.5. Aircraft will be damaged heavily by blast and fragments; destruction by resulting fire is likely.

2.5.3.6. Transport vehicles will sustain severe body damage, minor engine damage, and total glass breakage.
2.5.3.7. As a control, barricading will significantly reduce the risk of propagation of explosion and injury of personnel by high velocity low angle fragments.

2.5.4. Unbarricaded ILD – K18 (3.5 psi). At this distance:

2.5.4.1. Direct propagation of explosion is not expected.

2.5.4.2. Propagation of an explosion may occur at the ES, as either a direct result of a fire or as a result of equipment failure.

2.5.4.3. Damage to unstrengthened buildings may approximate 50 percent, or more, of the total replacement cost. Sensitive electronic equipment is expected to stop functioning.

2.5.4.4. There is a two percent chance of eardrum damage to personnel.

2.5.4.5. Personnel may suffer serious injuries from fragments, debris, firebrands, or other objects.

2.5.4.6. Fragments could damage the decks and superstructure of cargo ships and overpressure could buckle their doors and bulkheads on weather decks.

2.5.4.7. Aircraft can be expected to suffer considerable structural damage from blast. Fragments and debris are likely to cause severe damage to aircraft at K18 distances when small quantities of explosives are involved.

2.5.4.8. Transport vehicles will incur extensive, but not severe, body and glass damage consisting mainly of dishing of body panels and cracks in shatter-resistant window glass.

2.5.4.9. Suitably designed suppressive construction at PES or protective construction at ES may be practical controls for some situations. Such construction is encouraged when there is insufficient distance to provide the required protection.

2.5.5. PTRD (under 100,000 lbs High Explosives (HE)) – K24 (2.3 psi). At this distance:

2.5.5.1. Unstrengthened buildings can be expected to sustain damage approximately 20 percent of the replacement cost.

2.5.5.2. Occupants of exposed structures may suffer temporary hearing loss or injury from blast effects, building debris and displacement.

2.5.5.3. Although personnel in the open are not expected to be killed or seriously injured by blast effects, fragments and debris may cause some injuries. The extent of these injuries depends largely upon the PES structure and the amount and fragmentation characteristics of the AE involved.

2.5.5.4. Vehicles on the road may suffer little damage, unless they are hit by a fragment or the blast causes a momentary loss of control.

2.5.5.5. Aircraft may suffer some damage to the fuselage from blast and possible fragment penetration, but should be operational with minor repair.

2.5.5.6. Cargo-type ships should suffer minor damage to deck structure and exposed electronics from blast and possible fragment penetration, but such damage should be readily repairable.
2.5.5.7. Barricading is an effective control that can reduce the risk of injury or damage due to fragments for limited quantities of AE at a PES. When practical, suitably designed suppressive construction at the PES or protective construction at the ES may also provide some protection.

2.5.6. PTRD (over 250,000 lbs HE) – K30 (1.7 psi). At this distance:

2.5.6.1. Unstrengthened buildings can be expected to sustain damage that may approximate ten percent of their replacement cost.

2.5.6.2. Occupants of exposed, unstrengthened structures may be injured by secondary blast effects, such as falling building debris.

2.5.6.3. Pilots of aircraft that are landing or taking off may lose control and crash.

2.5.6.4. Parked military and commercial aircraft will likely sustain minor damage due to blast, but should remain airworthy.

2.5.6.5. Although personnel in the open are not expected to be killed or seriously injured by blast effects, fragments and debris may cause some injuries. The extent of these injuries will largely depend upon the PES structure, the NEWQD, and the fragmentation characteristics of the AE involved.

2.5.6.6. Barricading or the application of minimum fragmentation distance requirements are effective controls that may reduce the risk of injury or damage due to fragments for limited quantities of AE at a PES.

2.5.7. IBD – K40 to K50 (1.2 psi to 0.9 psi). At this distance:

2.5.7.1. Unstrengthened buildings can be expected to sustain damage that approximates 5- percent of their replacement cost.

2.5.7.2. Personnel in buildings are provided a high degree of protection from death or serious injury; however, glass breakage and building debris may still cause some injuries.

2.5.7.3. Personnel in the open are not expected to be injured seriously by blast effects. Fragments and debris may cause some injuries. The extent of injuries will depend upon the PES structure and the NEWQD and fragmentation characteristics of the AE involved.

2.5.7.4. Elimination of glass surfaces is the best control. If determined to be necessary, reducing the use of glass or the size of any glass surfaces and the use of blast resistant glass will provide some relief. For new construction, building design characteristics, to include consideration of how any required glass surfaces are oriented and use of blast resistant glass, can reduce glass breakage and structural damage.

Section 2B—Principal Effects of HD 1.2 Events

2.6. Blast.

2.6.1. HD 1.2, when not stored with HD 1.1 or HD 1.5, is not expected to mass detonate. In an incident involving HD 1.2, when stored by itself or with HD 1.3, HD 1.4, or HD 1.6 (a HD 1.2 event), AE can be expected to both explode sporadically and burn. Fire propagates through the mass of the AE over time. Some AE may neither explode nor burn. Blast effects
from the incident are limited to the immediate vicinity and are not considered to be a significant hazard.

2.6.2. A HD 1.2 event may occur over a prolonged period of time. Generally, the first reactions are relatively nonviolent and, typically, begin a few minutes after flames engulf the AE. Later reactions tend to be more violent. Reactions can continue for some time (hours), even after a fire is effectively out. Generally, smaller AE tends to react earlier in an incident than larger AE.

2.6.3. The results of an accidental explosion in an underground facility depend on the type and quantity of munitions, the type of explosion produced, and the layout of the facility. Hazards created outside the underground facility are not likely to be as severe as those produced by HD 1.1 or 1.3 material.

2.7. Fragments.

2.7.1. The primary hazard from a HD 1.2 event is fragmentation. Fragmentation may include primary fragments from AE casings or secondary fragments from containers and structures. At longer ranges, primary fragments are the major contributors to fragment hazards.

2.7.2. During a HD 1.2 event, fragmentation may extensively damage exposed facilities. However, less fragmentation damage can be expected from a given quantity of HD 1.2 than would be expected from the corresponding quantity of HD 1.1 because not all the HD 1.2 reacts.

2.8. Thermal Hazards.

2.8.1. An incident involving a quantity of HD 1.2 poses considerably less thermal risk to personnel than an incident involving corresponding quantities of either HD 1.1 or HD 1.3 because a HD 1.2 event’s progressive nature allows personnel to immediately evacuate the area.

2.8.2. A HD 1.2 event’s progressive nature provides an opportunity for a fire suppression system, if installed, to put out a fire in its early stages.

2.8.3. Ejected Items. In HD 1.2 events, a reaction may eject (lob) unreacted-AE or AE components from the event site. These ejected items may subsequently react.

2.8.4. Propelled Items. In HD 1.2 events, some AE or AE components may become propulsive and travel well beyond IBD.

2.8.5. Firebrands. In an incident involving only HD 1.2 or HD 1.2 with HD 1.4, firebrands are considered to be a hazard only in the immediate vicinity of the incident site.

2.9. Expected Consequences.

2.9.1. The expected consequences for HD 1.2 AE are similar to those for HD 1.1. The effects of HD 1.2 AE are NEWQD dependent.

2.9.2. The principal hazard to personnel in the open, to aircraft, and to occupied vehicles is fragments.
2.9.3. Airblast, fragment, and thermal hazards to buildings and parked aircraft or vehicles cannot be predicted reliably because the effects depend on the maximum credible event (MCE).

Section 2C—Principal Effects of HD 1.3 Events

2.10. Gas Pressures.

2.10.1. In an incident involving only HD 1.3 or HD 1.3 with HD 1.4 (a HD 1.3 event):

2.10.1.1. Where sufficient venting is provided, gas pressures generated by the event are not a significant concern. Examples of sites with sufficient venting include open storage and structures where internal pressures do not exceed one to two psi (non-confinement structure).

2.10.1.2. Where venting is insufficient, internal gas pressures may be substantial. In such situations, these pressures may blow out vent panels or frangible walls and, in some instances, cause partial or complete structural failure.

2.10.1.3. Where there is minimal venting and structural containment (extreme confinement), a detonation of a HD 1.3 item may occur with effects similar to those of an HD 1.1 explosion (e.g., HD 1.3 AE is considered as HD 1.1 (mass explosion) for QD purposes when stored in underground chambers).

2.11. Fragments.

2.11.1. In a HD 1.3 event, fragments are considerably less hazardous than those produced by HD 1.1 and HD 1.2 events.

2.11.2. Internal gas pressures may produce fragments from the bursting of containers or the rupture of containment facilities. In general, such fragments are large and of low velocity. For exceptions, see paragraph 2.13.3.

2.12. Thermal Hazards.

2.12.1. In a HD 1.3 event, heat flux presents the greatest hazard to personnel and assets. HD 1.3 substances include both fuel components and oxidizers. Burning HD 1.3 emits fuel-rich flammable gases, fine particles, or both. This unburned material may ignite when it comes in contact with air and cause a large fireball. This fireball expands radially from the ignition site and could wrap around obstacles, even those designed to provide line-of-sight protection from HD 1.1 events. Shields and walls can be designed to provide protection from thermal effects (see paragraph 4.19).

2.12.2. The nominal spherical fireball that would be expected from the rapid burning of HD 1.3 can be calculated by \( D_{\text{FIRE}} = 10 \times W_{\text{EFF}}^{1/3} \) where \( D_{\text{FIRE}} \) is the diameter of the fireball in feet and \( W_{\text{EFF}} \) is the quantity of HD 1.3 involved (lb), multiplied by a 20 percent safety factor (e.g., W of 100 lbs = \( W_{\text{EFF}} \) of 120 lbs).

2.12.3. In addition to the fireball itself, the thermal flux from the fireball can ignite fires out to intermagazine distance (IMD).

2.12.4. Propelled Items. In a HD 1.3 event, some AE or AE components may become propulsive and travel well beyond IBD.
2.12.5. Firebrands. In a HD 1.3 event, a severe fire-spread hazard may result from firebrands projected from the incident site. Firebrands can be expected to be thrown more than 50 feet from a HD 1.3 event. Firebrands can ignite fires well beyond the distance a fireball poses a threat.

2.13. Expected Consequences.

2.13.1. Exposed personnel may receive severe burns from fireballs or flash burning in a HD 1.3 event. The hazard distance is dependent on the quantity and burning rate of the HD 1.3 involved.

2.13.2. Buildings, vehicles, and aircraft may be ignited by radiant heat, sparks, or firebrands or may be damaged by heat (searing, buckling, etc.).

2.13.3. Personnel in nearby buildings, vehicles, or aircraft may be injured unless evacuated before heat conditions reach hazardous levels.

Section 2D—Principal Effects of HD 1.4 Events

2.14. Blast. There is no blast associated with an incident involving only HD 1.4 (a HD 1.4 event).

2.15. Fragments.

2.15.1. A HD 1.4 event will not produce fragments of appreciable energy (i.e., greater than 14.8 ft-lbs).

2.15.2. Fragments from HD 1.4S have energies less than or equal to 5.9 ft-lbs.

2.16. Thermal Hazards.

2.16.1. AE given this designation are considered to provide only a moderate fire hazard. A fireball or jet of flame may extend three feet beyond the location of the HD 1.4 event. A burning time of less than 330 seconds (5.5 minutes) for 220 lbs of the HD 1.4 AE is expected.

2.16.2. Firebrands. No fiery projections are expected beyond 50 feet.

2.16.3. Compatibility Group (CG) S Items. HD 1.4 AE assigned a CG S designation is the most benign of all AE (see paragraph 3.21.13). In a HD 1.4 event that only involves CG S; the expected blast, thermal, and projection effects will not significantly hinder firefighting or other emergency responses.

2.17. Expected Consequences. There may be minor consequences (projection, fire, smoke, heat, or loud noise) beyond the AE itself.

Section 2E—Principal Effects of HD 1.5 and HD 1.6 Events

2.18. HD 1.5 Effects. HD 1.5 effects are similar to those produced by HD 1.1, without the fragmentation effects.

2.19. HD 1.6 Effects. HD 1.6 effects are similar to those produced by HD 1.3.
Table 2.1. Expected Peak Incident Pressures From HD 1.1 Events.

<table>
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<tr>
<th>K-FACTOR (ft/lb^{1/3})</th>
<th>INCIDENT PRESSURE (psi)</th>
<th>K-FACTOR (ft/lb^{1/3})</th>
<th>INCIDENT PRESSURE (psi)</th>
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Table 2.2. Probability Of Window Breakage From Incident Pressure.

<table>
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<tr>
<th>K-FACTOR (ft/lb^{1/3})</th>
<th>INCIDENT PRESSURE (psi)</th>
<th>PROBABILITY OF BREAKAGE (percent) FOR WINDOWS FACING PES</th>
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</thead>
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<tr>
<td></td>
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<td>WINDOW 1</td>
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<td>40</td>
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<td>100</td>
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<td>328</td>
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</table>

Notes:
1. Window 1: 12” x 24” x 0.088” Float annealed (area = 2 ft²)
2. Window 2: 24” x 24” x 0.088” Float annealed (area = 4 ft²)
3. Window 3: 42” x 36” x 0.120” Float annealed (area = 10.5 ft²)
### Table 2.3. General Blast Effects On Personnel Eardrum Rupture.

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>Incident Pressure (psi)</th>
<th>K-FACTOR (ft/lb(^{1/3}))</th>
<th>Probability Minor(^1) (percent)</th>
<th>Moderate(^2) (percent)</th>
<th>Major(^3) (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eardrum Damage</td>
<td>3.0</td>
<td>20.0</td>
<td>3.2</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3.6</td>
<td>17.9</td>
<td>7.3</td>
<td>0.7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4.9</td>
<td>14.6</td>
<td>21.0</td>
<td>3.9</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>6.6</td>
<td>12.2</td>
<td>41.3</td>
<td>12.8</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>9.0</td>
<td>10.3</td>
<td>63.7</td>
<td>29.8</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>15.0</td>
<td>8.0</td>
<td>88.8</td>
<td>65.0</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>74.4</td>
<td>3.9</td>
<td>100</td>
<td>99.8</td>
<td>97.8</td>
</tr>
</tbody>
</table>

#### Notes:
1. Minor rupture includes minor slits and kinear disruption of the drum fibers producing a mesh-like effect.
2. Moderate rupture consists of large tears or multiple small holes or tears.
3. Major rupture is total disruption of the drum with large flaps of drum.

### Table 2.4. General Blast Effects On Personnel – Lung Damage.

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>Incident Pressure Pounds per square inch (psi)</th>
<th>Pulse Duration Millisecond (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold Lung Damage For a Standing Person</td>
<td>191.0</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>87.6</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>50.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>32.5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>19.3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>14.4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>12.1</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>10.9</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>10.5</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 2.5. General Blast Effects On Personnel – Lethality Due To Lung Rupture.

<table>
<thead>
<tr>
<th>EFFECT*</th>
<th>Probability (percent)</th>
<th>Weight (lbs)</th>
<th>Range (ft)</th>
<th>K-FACTOR (ft/lb^{1/3})</th>
<th>Incident Pressure (psi)</th>
<th>Pulse Duration (ms)</th>
<th>Positive Impulse (psi-ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lethality due to Lung Rupture</td>
<td>1</td>
<td>8,000</td>
<td>95.0</td>
<td>4.75</td>
<td>47.2</td>
<td>31.3</td>
<td>317.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27,000</td>
<td>155.0</td>
<td>5.19</td>
<td>38.5</td>
<td>47.4</td>
<td>437.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125,000</td>
<td>277.6</td>
<td>5.55</td>
<td>33.0</td>
<td>80.9</td>
<td>685.2</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>8,000</td>
<td>76.1</td>
<td>3.80</td>
<td>79.0</td>
<td>33.0</td>
<td>393.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27,000</td>
<td>128.4</td>
<td>4.28</td>
<td>60.1</td>
<td>47.8</td>
<td>526.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125,000</td>
<td>234.1</td>
<td>4.68</td>
<td>48.8</td>
<td>78.4</td>
<td>805.1</td>
</tr>
<tr>
<td></td>
<td>99</td>
<td>8,000</td>
<td>57.7</td>
<td>2.89</td>
<td>146.8</td>
<td>32.6</td>
<td>493.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27,000</td>
<td>103.8</td>
<td>3.46</td>
<td>97.9</td>
<td>50.8</td>
<td>643.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125,000</td>
<td>195.8</td>
<td>3.92</td>
<td>73.8</td>
<td>81.8</td>
<td>956.5</td>
</tr>
</tbody>
</table>

* Lethality due to lung rupture is caused by a combination of pressure and impulse. This combination will vary with the charge weight.
Chapter 3

HAZARD CLASSIFICATION

3.1. Purpose of Hazard Classification. The DoD Hazard Classification System is designed to reflect the type and degree of hazard associated with an AE item. It is used to determine the degree of protection (such as distance separation) needed for various exposed locations and people, and to determine which items can be safely stored together. Each AE item is assigned a hazard classification based on the form in which it is normally available as well as its common packaging, storage and transportation (commercial or military) configurations.

Section 3A—DoD Hazard Classification System

3.2. Responsibility for Hazard Classification. Air Force organizations that develop or are the first to adopt AE items for use are responsible for obtaining DoD hazard classifications using the procedures in Technical Order (TO) 11A-1-47, DoD Ammunition and Explosives Hazard Classification Procedures. It is the program office’s responsibility to ensure AE items are properly hazard classified before they enter Air Force installations.

3.3. Hazard Classification Authorities. The Air Force hazard classification authorities are assigned to HQ AFSEC/SEW, 96 TW/SES, and AFLCMC/EBHE. Army and Navy hazard classification authorities are listed in TO 11A-1-47.

3.4. Standards for Determining DoD Hazard Classification. Use the following resources to identify AE hazard characteristics for storage and transportation purposes:

3.4.1. TO 11A-1-47, as a basis for assigning hazard classifications to all AE for both storage and transportation applications.

3.4.2. The applicable Department of Transportation (DOT) hazardous materials regulations per Title 49, Code of Federal Regulations (CFR), Parts 171-177, Pipeline and Hazardous Materials Safety Administration, Department of Transportation.

3.4.3. The United Nations’ (UN) international system of classification developed for the transport of dangerous goods, ST/SG/AC.10/1/latest revision, Recommendations on the Transport of Dangerous Goods.

3.5. Description of DoD Hazard Classification System. The DoD hazard classification system consists of nine hazard classes and a not regulated category. The explosives hazard class, Class 1, is divided into six divisions based on the type of explosive hazard present. The hazard classification system also includes thirteen compatibility groups, five sensitivity groups, and a parenthetical number.

3.5.1. Hazard Classes.

3.5.1.1. Class 1. AE is assigned to the class that represents an item’s predominant hazard characteristic. Class 1 applies to AE in which the explosive hazard predominates. The six Class 1 divisions used to indicate the character and predominance of explosive hazards. This Manual uses the term “Hazard Division (HD)” to avoid repeatedly using the more cumbersome terminology “Subdivision X of Division Y of Class Z.”

Section
3D describes Class 1 divisions and subdivisions. See Chapter 2 for detailed reaction effects of Class 1 AE.

3.5.1.2. Classes 2 through 9. The DoD inventory includes AE items assigned to Class 2 (Gases), Class 3 (Flammable liquids), Class 4.1 (Flammable solids), Class 5.1 (Oxidizers), Class 6.1 (Toxic materials), Class 8 (Corrosive materials), and Class 9 (Miscellaneous hazardous materials). Although these items contain a small amount of explosives, the predominant hazard is not an explosive reaction. They are assigned to Classes 2 through 9 based on the predominant hazard. The DoD hazard classification system classifies articles that contain riot control substances, without explosives components, and bulk toxic materials as HD 6.1. Any item that contains explosives, but is not assigned to Class 1 due to its predominant hazard, is considered to have a net explosive weight of zero for QD determinations. Items that fall into this category do not contribute to the net explosive weight calculated for the storage site. Even though such items are assigned to another class, they will still have a DoD storage compatibility group designation, and may be combined in storage with compatible Class 1 items. When Classes 2 through 9 ammunition items are stored alone, they do not require siting or licensing, except as an exposed site.

3.5.1.3. Not-Regulated Category. This category applies when explosives and hazardous materials are present in an item, but not to the degree that criteria for assignment to one of the nine classes are met. Items that contain a hazardous material, but that have been designated Not-Regulated, do not require storage or handling as a hazardous material. The explosive weight of Not-Regulated items is not considered for QD purposes.

3.5.2. Compatibility Groups. Compatibility Groups (CG) are used for segregating AE on the basis of similarity of function, features, and accident effects potential. In developing the various compatibility groups, the following factors are considered: chemical and physical properties, design characteristics, inner and outer packaging configurations, hazard class and division, NEWQD, rate of deterioration, sensitivity to initiation, and effects of deflagration, explosion, or detonation. The compatibility groups are described in Section 3E.

3.5.3. Sensitivity Groups. Sensitivity Groups (SG) are used for determining allowable net explosive weights where revetments or substantial dividing walls (SDW) are used. The sensitivity groups are described in Section 3E.

3.5.4. Parenthetical Number. A parenthetical number is used to indicate the minimum separation distance (in hundreds of feet) for protection from debris, fragments, and firebrands when distance alone is relied on for such protection. This number is placed to the left of the hazard classification designators (e.g., (12)1.1, (08)1.2.3, or (02)1.3). It is assigned for all HD 1.2.3 items, and some HD 1.1 and 1.3 items.

3.6. Net Explosive Weight (NEW) and NEW for Quantity-Distance (NEWQD). NEW is the total quantity, expressed in pounds (kilograms), of explosives material or pyrotechnics in each item or round whereas NEWQD is the total quantity, expressed in pounds (kilograms), of HE equivalency in each item or round to be used when applying QD criteria or other standards.

3.6.1. The NEW listed in DoD Joint Hazard Classification System (JHCS) is the total weight of all explosive, propellant, and pyrotechnic material in a single article. The NEW is
identified because transportation regulations require documentation of the NEW on shipping papers for transportation.

3.6.2. The NEWQD is used for explosives siting, munitions storage, and operating locations. The NEWQD is equal to the NEW unless hazard classification testing has shown that a lower weight is appropriate for QD purposes. If the NEWQD is less than the NEW, the reason is usually that propellant or other substances do not contribute as much to the blast effect as the same amount of HE would. If NEWQD criteria are available for assets it should be used in the formula when calculating the amount of NEW on pads, in operating locations and storage locations.

3.7. Requirement for DoD Hazard Classification. Except as allowed in Section 3B, DoD hazard classifications are required as follows:

3.7.1. An interim hazard classification (IHC) must be assigned to explosives under development, test articles, components, and commercial products not having a final hazard classification (FHC) if they are transported or stored on DoD property. (T-1). DoD hazard classification authorities document the IHC in letters. These letters must be included in storage and shipment documentation until the classification is finalized. (T-1). The agency obtaining the IHC must renew it upon termination (as specified in the letter). (T-1). This applies if the item is still in the inventory or until an FHC is determined. IHCs assigned by Army and Navy classification authorities are acceptable to the Air Force.

3.7.2. An FHC must be assigned for explosives items that have become operationally fielded and items requiring commercial shipping OCONUS. (T-1). DoD FHCs are listed in the JHCS. Access to the JHCS can be made through the Defense Ammunition Center at https://www3.dac.army.mil/. Final DoD hazard classifications assigned by Army and Navy hazard classification authorities are acceptable to the Air Force.

Section 3B—Storage and Transportation Without DoD Hazard Classification

3.8. Storage and Transportation Without DoD Hazard Classification. Occasionally it may be necessary to store or transport explosive substances or articles that do not have a DoD-assigned FHC or IHC. Since such items are not listed in the JHCS, the unit having custody of these items must exercise care in maintaining appropriate approval and hazard classification documentation at the storage installation. (T-0). Such documentation may include Department of Energy (DOE) IHC, DOT EX-numbers, or locally-assigned storage hazard classifications established IAW procedures approved by AFSEC/SEW. Paragraphs 3.9, 3.10., 3.11., 3.12., and 3.13. describe the circumstances and the respective applicable conditions for storing or transporting AE without DoD hazard classification.

3.9. Explosives With DOE Hazard Classifications.

3.9.1. An item covered by a DOE IHC may be stored and offered for military or commercial transportation using that classification, subject to the requirements of paragraph 3.9.3. A copy of the applicable DOE IHC must be maintained at the installation where the items are stored, and must be carried with shipping papers on board each conveyance used to transport the items under that IHC. (T-0).

3.9.2. An item covered by a DOE FHC may be stored and offered for military or commercial transportation using that classification, subject to the requirements of paragraph 3.9.3. For
storage using DOE FHCs, installation records must reflect the DOT EX-number, Class, Division, Compatibility Group, and NEW for each item stored. \(T-0\).

3.9.3. Restrictions on the use of DOE hazard classifications:

3.9.3.1. Treat DOE assigned HD 1.2 as HD 1.2.1 and DOE assigned HD 1.5 as HD 1.1 unless an Air Force hazard classification authority determines a different hazard classification applies (see paragraph 3.3.).

3.9.3.2. Use the compatibility group assigned by DOE.

3.9.3.3. The NEWQD equals the NEW. For quantity-distance purposes, the NEWQD of articles hazard classified by DOE as HD 1.4S or as Not-Regulated equals zero. See paragraph 3.16.4. for MCE for HD 1.2.1.

3.9.3.4. Only store or transport items in the same or equivalent packaging they were hazard classified.

3.10. DoD-Owned Non-Stock-Listed Commercial Explosives. A unit may have a requirement to purchase a non-stock-listed commercial explosive product for evaluation or use. Although such items are not standard military inventory items, they are DoD-owned explosives once purchased. Commercial products are items that are not unique to military use and that are legally available for purchase and use by the general public or private businesses (e.g. commercial small arms ammunition, components and propellants; power tool cartridges; fire extinguisher cartridges; signal devices; pest control devices; theatrical special effects items; commercial demolition materials; and blasting agents). The following requirements apply to such explosives:

3.10.1. Hazard Classification. The unit may request a DoD IHC for a non-stock-listed commercial explosive item. Alternatively, store and offer the item for military or commercial transportation using the classification assigned for the product by DOT, subject to the requirements of paragraph 3.10.8. The classification assigned to commercial small arms cartridges by the manufacturer as prescribed in 49 CFR Part 173.56(h) may also be used for storage and transportation without a DoD hazard classification.

3.10.2. Requirements for Purchase.

3.10.2.1. Commanders must ensure the requirements below are accomplished prior to purchase of a non-stock-listed commercial explosive item for operational use. \(T-1\).

3.10.2.1.1. Safety certification as specified in AFI 91-205, Nonnuclear Munitions Safety Board.

3.10.2.1.2. Purchase approval from AFLCMC/EBHE. Submit requests for approval according to AFI 21-201, Munitions Management.

Note: Requirements for non-stock-listed commercial explosives for research and development (R&D) activities will comply with paragraph 3.10.2.1. and applicable MAJCOM supplements to this Manual. \(T-1\).

3.10.2.2. AFSEC/SEW approves emergency requirements to purchase non-stock-listed commercial explosives.
3.10.3. Adoption into the DoD Inventory. Commercial explosive items adopted as standard DoD inventory items, as evidenced by centralized item management by an Air Force Life Cycle Management Center (AFLCMC) or by another military service and assignment of a National Stock Number (NSN), must be covered by a DoD IHC or FHC (T-0).

3.10.4. Commercial Fireworks. Commercial fireworks may not be purchased by the Air Force under any circumstances.

3.10.5. A commercial product received as Black Powder for Small Arms, Class 4.1, Identification Number NA0027, is stored as Black Powder, HD 1.1D.

3.10.6. A commercial product received as Smokeless Powder for Small Arms, Class 4.1, Identification Number NA3178, is stored as Powder, Smokeless, and HD 1.3C.

3.10.7. A commercial product received as Cartridges, Small Arms, ORM-D, is stored as HD 1.4C unless a different hazard classification is issued by a DoD or DOE IHC authority and is on file at the installation.

3.10.8. DOT Hazard Classifications. For storage using DOT hazard classifications, installation files must have the DOT EX-number, Class, Division, Compatibility Group, and NEW, for each item stored. (T-1).

3.10.8.1. Treat DOE or DOT assigned HD 1.2 as HD 1.2.1, and DOE or DOT assigned HD 1.5 HD 1.1, unless an Air Force hazard classification authority determines a different hazard classification might apply (see paragraph 3.3.).

3.10.8.2. Use the compatibility group assigned by DOT.

3.10.8.3. The NEWQD equals the NEW and for quantity-distance purposes, the NEWQD of articles hazard classified by DOT as HD 1.4S or as Not-Regulated will equal zero. See paragraph 3.16.4. for MCE for HD 1.2.1.

3.10.8.4. Only transport and store items in the same or equivalent packaging they were hazard classified in.

3.11. Manufacturing, R&D Items. In manufacturing, R&D environments, explosives samples, substances, subassemblies, and items may be acquired, produced, and stored without DoD, DOT or DOE hazard classifications, provided they comply with paragraph 3.10.2.1. and applicable MAJCOM supplements.

3.11.1. Transport and store these items on-base IAW locally assigned hazard classifications provided a formal procedure for establishing and documenting the hazard classifications is approved by the MAJCOM/SEW and AFSEC/SEW.

3.11.2. Commanders must ensure these items are not offered for transportation from the installation or development location until the necessary DoD, DOT or DOE hazard classification is assigned. (T-1). Traversing a public roadway between gates or sites on the same installation is considered on-base transportation provided the transportation is in a DoD-owned vehicle operated by DoD personnel.

3.11.3. Commanders must ensure these items have Explosives Ordnance Disposal (EOD) procedures available prior to use. (T-1). The responsible test organization ensures local EOD activities receive a Source Data Package (SDP) prior to delivery of test assets. Develop the
SDP according to DID DI-SAFT-80931, *Explosives Ordnance Disposal Data* and TO 00-5-3, *Air Force Technical Order Lifecycle Management*.

3.12. Foreign Explosives. Foreign-owned military AE items brought onto Air Force installations to support Multinational military training, exercises, operations or cargo airlift operations may be stored IAW the hazard classifications assigned by the appropriate foreign competent authorities, provided:

3.12.1. MAJCOMs document procedures for obtaining AFSEC/SEW approval of these items.

3.12.2. The procedures required in paragraph 3.12.1. must:

3.12.2.1. Require MAJCOM/SEW to attain and forward to AFSEC/SEW shipping documents for each foreign munitions item requiring hazard classification.

3.12.2.2. Require the installation to maintain documentation of AFSEC/SEW review and approval of each item. (T-1).

3.12.2.3. Require the installation to maintain documentation of the foreign hazard classification of each item. (T-1).

3.12.3. Hazard classification documentation approved by the multinational forces’ competent authorities for their explosives and munitions is acceptable (in lieu of IHCs) for military air transportation between the foreign departure points and foreign destinations, regardless of whether an intermediate stopover in the US occurs. Such approval documentation is similarly acceptable for in-transit storage of multinational forces’ explosives and munitions on U.S. installations worldwide. At a minimum, multinational approval documentation includes: the assigned proper shipping name, United Nations identification number, hazard class/division and compatibility group, the quantity of articles per package, and must be written in English. A copy of the multinational hazard classification approval documentation accompanies military air shipments and are kept on file at installations where multinational forces’ explosives and munitions are temporarily stored during transit. Explosives and munitions classed HD 1.2 by multinational forces’ competent authorities are managed as HD 1.2.1 when sited on real property controlled by the US, or when possessed by US forces.

3.12.4. DoD IHCs assigned IAW T.O. 11A-1-47 accompanying airlift cargo may be used without AFSEC/SEW approval.

3.13. Non-DoD-Owned Explosives. Storage of non-DoD-owned explosives on Air Force installations is prohibited except for specific exceptions stated in AFI 32-9003, *Granting Temporary Use of Air Force Real Property* and 10 USC 2692 with 1998 Authorization Act changes, *Storage, treatment, and disposal of nondefense toxic and hazardous materials*. Some of these exceptions require approval from the SECAF or Deputy Assistant Secretary of Defense (Environment). Units will forward requests through their MAJCOMs. (T-1). Obtain coordination from MAJCOM A4, JA, SE and AFSEC/SEW prior to forwarding to Air Force Real Property Agency (AFRPA) for action. (T-1). Paragraph 3.13.1. identifies situations that do not require approval. When non-DoD-owned explosives are stored on an Air Force installation under one of the exceptions, DOE or DOT hazard classifications may be used subject to the
requirements in paragraph 3.13.2. Commanders must ensure commercial launch vehicles also comply with paragraph 3.13.3. (T-1).


3.13.1.1. Ammunition that is privately-owned by military members or their dependents can be stored on an Air Force installation, if the military member is assigned to that installation, or lives in billeting or a dormitory on that installation.

3.13.1.2. Non-DoD-owned explosives that may be or have been used in connection with an activity of the DoD, or in connection with a service to be performed on a DoD installation for the benefit of the DoD, can be stored or disposed of on an Air Force installation (see paragraph 12.86.).

3.13.1.3. Non-DoD-owned explosives may be temporarily stored or disposed of on an Air Force installation in order to provide emergency life-saving assistance to civil authorities (see paragraph 12.86.).

3.13.1.4. Non-DoD-owned explosives that constitute military resources intended to be used during peacetime civil emergencies IAW applicable DoD regulations may be stored on an Air Force installation (see paragraph 12.86.).

3.13.1.5. Explosives of other Federal agencies meeting the definition of “DoD Explosives Operations/Storage” may be stored on an Air Force installation when no alternative solutions are available provided all other storage requirements can be met.

3.13.2. DOE or DOT Hazard Classifications. For storage using a DOE IHC, a copy of the applicable DOE IHC must be maintained at the installation where the items are stored. (T-1). For storage using a DOE FHC, installation records must reflect the DOT EX-number, Class, Division, Compatibility Group, and NEW for each item stored. (T-1). For storage using DOT hazard classifications, installation files must have the DOT EX-number, Class, Division, Compatibility Group, and NEW, for each item stored. (T-1). The following additional requirements apply:

3.13.2.1. Items classed by DOE or DOT as HD 1.2 must be treated as HD 1.2.1 and HD 1.5 items must be treated as HD 1.1. If a different hazard classification might apply, contact an Air Force hazard classification authority (see paragraph 3.3.) to determine the correct classification.

3.13.2.2. Use the compatibility group assigned by DOE or DOT.

3.13.2.3. The NEWQD equals the NEW. For quantity-distance purposes, the NEWQD of articles hazard classified by DOE or DOT as HD 1.4S or as Not-Regulated equal zero. See paragraph 3.16.4. for MCE for HD 1.2.1.

3.13.2.4. Transport of store items only in the same or equivalent packaging in which they were hazard classified.

3.13.2.5. A commercial product received as Black Powder for Small Arms, Class 4.1, Identification Number NA0027, is stored as Black Powder, HD 1.1D.

3.13.2.6. A commercial product received as Smokeless Powder for Small Arms, Class 4.1, Identification Number NA3178, is stored as Powder, Smokeless, and HD 1.3C.
3.13.2.7. A commercial product received as Cartridges, Small Arms, ORM-D, is stored as HD 1.4C unless a different hazard classification is issued by a DoD or DOE IHC authority and is on file at the installation.

3.13.3. Commercial Launch Vehicles.

3.13.3.1. The responsible Commander contacts the responsible MAJCOM/SEW, who in turn contacts the AFSEC/SEW hazard classification authority for the assignment of an HD 1.3 hazard classification of a rocket motor. (T-1).

3.13.3.2. For commercial launch vehicles fueled by liquid propellants, the explosive equivalents of the fuel combinations (see Section 12N) may be used instead of the total weight of fuel in the vehicle for quantity-distance purposes. Lesser weights, based on launch vehicle failure analyses, may be used with the approval of AFSEC/SEW and DDESB. Likewise, a commercial solid rocket booster or booster section located at a DoD range launch facility may be stored using an NEWQD less than 100 percent of the propellant weight only with approval of AFSEC/SEW and DDESB.

Section 3C—Hazard Classification of Unpackaged Items

3.14. Hazard Classification of Unpackaged Items. When ammunition or explosive items are not in the form and packaging they are normally stored and shipped, different hazard classifications may apply due to changes in spacing, orientation, confinement, and other factors. Sometimes testing of unpackaged components may be required in order to demonstrate the validity of classifications used for siting unpackaged ammunition, or conservative assumptions must be made about the potential severity of an accidental explosion. Contact an Air Force hazard classification authority for assistance in determining the hazard classification of an unpackaged item (see paragraph 3.3.). (T-1).

3.14.1. The hazard classification for some unpackaged items may be given in paragraph 3.14.2. or in the item TO. Not-Regulated CG S items were classed based on how the unpackaged item reacts. Therefore the presence or absence of packaging does not change that designation.

3.14.2. The following are hazard classifications for certain unpackaged items:

3.14.2.1. Cartridges, 40 mm, High Explosive Dual-Purpose (HEDP), M433 stored in CNU 541/E Containers (modified MK 387 MOD 0 containers with CEMCOM buffer liners) are HD 1.2.2, with an NEWQD of 0.102 pounds per cartridge. This hazard classification is for storage only, not for transportation.

Note: CNU 541/E Containers are no longer available; however, this information is provided for existing containers.

3.14.2.2. Cartridges, 40 mm, General Purpose (GP), M406 stored in 18-round Ammunition Carrying Vests folded into M2A1 or M548 Ammunition Cans with plastic projectile covers installed are hazard classified as HD 1.2.2E, SG-3. This hazard classification is for storage only and requires each cartridge to be securely nested into a projectile cover made by cutting the 3-round plastic supports from approved bandoleer packs into single-round supports. This hazard classification is for storage only, not for
transportation. 40 mm HE/HEDP are HD 1.1 when out of approved packaging configuration.

3.14.2.3. 20 mm and 30 mm High Explosive Incendiary (HEI) cartridges, designated HD 1.2.2 when packaged, remain HD 1.2.2 when unpackaged.

3.14.2.4. Cartridges for small arms which have inert or tracer projectiles, are below .50 caliber, and are not in their standard packaging are classified as HD 1.4S when kept in closed metal ammunition boxes. They are considered HD 1.4C in other containers.

3.14.2.5. Cluster Bomb Unit (CBU)-87/89/97/103/104/105, T-1 is considered HD 1.2.2 out of shipping containers.

3.14.2.6. 2.75-in Infrared Illuminating Warheads (M278) and the 2.75-in White Phosphorus (WP) (M156) stored in a Launch Adapter Unit (LAU)-131 launcher or transportation modules (out of shipping containers) are classified as HD 1.2.1. This hazard classification does not apply to public transportation.

3.14.2.7. HD 1.3 Minuteman and HD 1.3 Peacekeeper missile stages with an HD 1.1 type (CL1/AODS) destruct system installed are considered HD 1.3.

3.14.2.8. Guided Bomb Unit (GBU)-39/B Small Diameter Bomb (SDB), GBU-39A/B SDB Focused Lethality Munition (FLM), and GBU-39B/B Laser SDB out of container are HD 1.1. In an all-up-round container (AURC) they are HD 1.2.3.

Section 3D—Class 1 Divisions and Subdivisions

3.15. HD 1.1 – Mass-Explosion.

3.15.1. Blast is the primary hazard in this division. HD 1.1 items may be expected to mass detonate when a small portion is initiated by any means. These explosions generally cause severe structural damage to adjacent objects. Propagation may occur so rapidly to unprotected explosives stored near the initially exploding stack that quantities must be considered as a single source for QD purposes. The combined shock wave, in this case, is the same as a single detonation of a charge equal to the total quantity of the stacks (see simultaneous detonation in Attachment 1).

3.15.2. Items in this division also generally present a fragmentation hazard, either from the case of the explosive device or from the packaging or facility where the explosives are stored.

3.15.3. HD 1.1 items include bulk HE, some propellants, mines, bombs, demolition charges, some missile warheads, some rockets, palletized projectiles loaded with bulk trinitrotoluene (TNT) or Comp B, mass-detonating CBU, and ammunition components having mass-detonating characteristics.


3.16.1. Items in this division will not mass detonate when configured for storage or transportation if a single item or package is initiated. When these items function, the results are burning and exploding progressively with no more than a few reacting at a time. The explosion will throw fragments, firebrands, and non-functioned items from the point of initiation. Blast effects are limited to the immediate vicinity and are not the primary hazard.
3.16.2. In an incident, the quantity distances specified for HD 1.2 items achieve the desired degree of protection against immediate hazards. Events involving HD 1.2 items that lob large amounts of unexploded rounds, components, and subassemblies, remain hazardous after impact. Such items are likely to be more hazardous than they were in their original state because fuze safety devices or other features may sustain heat and impact damage. Expect the sub-munitions, such as cluster bombs, of many types of munitions, to project distances as great as the relevant IBD. Furthermore, it is impractical to specify quantity distances which allow for the maximum possible flight ranges of propulsive items.

3.16.3. HD 1.2 items’ functioning effects vary with the size and weight of the item. These items are separated into three subdivisions (1.2.1, 1.2.2, 1.2.3) to account for the differences in magnitude of these effects and to set quantity-distance criteria.

3.16.4. HD 1.2.1. Generally, these items have an NEWQD greater than 1.60 pounds or exhibit fragmentation characteristics similar to or greater than (higher density, longer distance) M1 105 mm projectiles regardless of NEWQD. The MCE for a specific HD 1.2.1 item is the largest quantity of explosives expected to explode at one time when a stack of those specific items is involved in a fire. MCEs will be included in the JHCS for each HD 1.2.1 item. If the MCE is not available, use the default MCE determined by multiplying NEWQD in a single container by three.

3.16.5. HD 1.2.2. Generally, these items have an NEWQD less than or equal to 1.60 pounds or that at most exhibit fragmentation characteristics similar to high-explosive 40 mm ammunition regardless of NEWQD.

3.16.6. HD 1.2.3. These items do not exhibit any sympathetic detonation response in the stack test, or any reaction more severe than burning in the external fire test, bullet impact test, or slow cook-off test.

3.17. HD 1.3–Mass Fire, Minor Blast or Fragment. Items in this division burn vigorously and the fires are difficult to put out. Explosions are caused by pressure ruptures of containers, which may produce fragments (especially missile motors) but will not produce propagating shock waves or damaging blast overpressure beyond IMD. Burning container materials, propellant, firebrands, or other debris may be projected randomly, presenting a severe fire hazard. Depending on the amounts of burning explosive materials, their downwind toxic effects usually do not extend beyond IBD.

3.18. HD 1.4–Moderate Fire, No Significant Blast or Fragment. Items in this division present a fire hazard but no blast hazard. There is virtually no fragmentation or toxic hazard beyond the fire hazard clearance ordinarily specified for high-risk materials.

3.19. HD 1.5–Explosive Substance, Very Insensitive (With Mass Explosion Hazard). Substances in this division have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal transport or storage conditions.

3.20. HD 1.6–Explosive Article, Extremely Insensitive (No Mass Explosion Hazard). Items in this division contain only extremely insensitive detonating substances (EIDS), and demonstrate a negligible probability of accidental ignition or propagation. Fuzed HD 1.6 items must contain either an EIDS fuze or a non-explosive fuze (i.e., the fuze contains no explosives), otherwise the item is classified as HD 1.2.3.
Section 3E—Compatibility Groups and Sensitivity Groups


3.21.1. Group A. This group includes bulk initiating explosives that have the necessary sensitivity to heat, friction, or percussion to make them suitable for use as initiating elements in an explosive train (e.g. bulk lead azide, lead styphnate, mercury fulminate, tetracene, dry cyclonite (RDX), and dry pentaerythritol tetranitrate (PETN)).

3.21.2. Group B. This group includes detonators and similar initiating devices not containing two or more effective protective features. It also includes items containing initiating explosives designed to initiate or continue the functioning of an explosive train (e.g. detonators, blasting caps, small arms primers, and fuzes).

3.21.3. Group C. This group includes bulk propellants, propelling charges, and devices containing propellant with or without its own means of ignition (e.g. bulk single-, double-, or triple-base, and composite propellants, rocket motors (solid propellant), and propelled AE with inert projectiles).

3.21.4. Group D. This group includes bulk black powder and bulk HE. It also includes AE having no propelling charge, but does contain HE without its own means of initiation, that is there is no initiating device present or the device has two or more effective protective features (e.g. TNT, Composition B, and black powder; bulk wet RDX or PETN; bombs, projectiles, CBU's, depth charges, and torpedo warheads).

3.21.5. Group E. AE in this group contains HE without its own means of initiation but with, or containing, a solid propelling charge (e.g. artillery AE, rockets, and guided missiles).

3.21.6. Group F. AE in this group contains HE with its own means of initiation, that is the initiating device present has less than two effective protective features and may or may not have a solid propelling charge (e.g. grenades, sounding devices, and similar items with less than two effective protective features in their explosive trains).

3.21.7. Group G. This group includes illuminating, incendiary and smoke- (including hexachlorethane [HC]) or tear-producing AE. This excludes AE that are water-activated, contain WP or are flammable liquids or gels. Examples include flares, signals, and pyrotechnic substances.

3.21.8. Group H. In this group, AE contain WP or fillers spontaneously flammable when exposed to the atmosphere (e.g. WP and plasticized white phosphorus (PWP)).

3.21.9. Group J. In this group, AE contain flammable liquids or gels other than those that are spontaneously flammable when exposed to water or the atmosphere (e.g. liquid or gelfilled incendiary AE, fuelair explosive (FAE) devices, and flammable liquidfueled missiles and torpedoes.

3.21.10. Group K. In this group, AE contain toxic chemical agents or contain chemicals specifically designed for incapacitating effects more severe than lachrymation (tear-producing) (e.g. artillery or mortar AE (fuzed or unfuzed), grenades, rockets and bombs filled with a lethal or incapacitating chemical agents). (See Table 7.1, Note 4.)

3.21.11. Group L. This group contains AE not included in other CG, such as AE with characteristics that present a special risk that does not permit storage with other types of AE.
or with dissimilar AE of this group (e.g. water-activated devices, pyrophorics and phosphides and devices containing these substances, prepackaged hypergolic liquid-fueled rocket engines, triethyl aluminum (TEA), thickened TEA (TPA), and damaged or suspect AE of any group).

**Note:** Different types of AE in CG L presenting similar hazards may be stored together.

3.21.12. Group N. In this group, AE contain only EIDS (e.g., HD 1.6 AE).

3.21.13. Group S. AE in this group present no significant hazard. AE packaged or designed so that any hazardous effects from accidental functioning are limited to an extent that they do not significantly hinder firefighting are included in this group. Projections must not exceed eight Joules (e.g. explosive switches or valves, and small arms ammunition).

3.22. **Sensitivity Groups.** Where earth-filled steel bin revetments or SDWs are used for storage purposes, each HD 1.1 and HD 1.2 AE item is designated, based on its physical attributes, into one of five SG. Directed energy weapons are further identified by assigning the suffix “D” following the SG designation (e.g., SG2D). The SG assigned to an AE item is listed in the JHCS (see paragraph 6.27.3. for application and use of SG criteria with SDWs to prevent propagation to adjacent rooms or cubicles). Item-specific testing or analyses can be used to change an item’s SG. The five SGs, in relative order from least sensitive to most sensitive, are:

3.22.1. SG 1. Robust (see glossary in Attachment 1) military munitions.

3.22.2. SG 2. Non-robust (see glossary in Attachment 1) military munitions.

3.22.3. SG 3. Fragmenting military munitions.

3.22.4. SG 4. Cluster bombs or dispenser unit military munitions (see Attachment 1 glossary).

3.22.5. SG 5. Sympathetic detonation (SD)-sensitive military munitions.
Chapter 4

RISK ASSESSMENTS AND PROTECTION PRINCIPLES

Section 4A—Risk Assessments

4.1. Requirements for Risk Assessments.

4.1.1. Risk assessments are required for all new or modified explosives, explosives operations, equipment and facilities when not specifically covered in current Air Force guidance and/or approved publications. (T-1).

4.1.2. These risk assessments will be used to identify design and operations criteria (e.g., shielding, protective clothing). (T-1). See Chapter 2 for reaction effect information to support risk assessments. Use deliberate Risk Management (RM) when conducting a risk assessment and consider the following factors, as appropriate:

4.1.2.1. Initiation sensitivity.
4.1.2.2. Quantity of materials.
4.1.2.3. Heat output.
4.1.2.4. Rate of burn.
4.1.2.5. Potential ignition and initiation sources.
4.1.2.6. Protection capabilities of shields, types of clothing, and fire protection systems.
4.1.2.7. Personnel exposure.

4.2. Risk Assessments.

4.2.1. Explosives safety criteria in this Manual help Commanders make informed decisions on the proper mix of combat readiness and safety. This criteria specifies minimum acceptable standards for explosives safety. Compliance with these criteria still entails a significant risk to personnel, assets and facilities. RM may be used to further reduce, mitigate, or accept risks (see paragraph 4.3.).

4.2.2. Explosives risk assessments are a subset of the Commander’s overall RM program. An explosives risk assessment analyzes hazards associated with transporting, storing, disposing of, handling or firing AE materials. Explosives risk assessments may range from examining the relationship between a PES and an ES to determine what effect one has on the other in the event of an accidental explosion, to ascertaining the worst credible event ramifications of an explosives handling mishap. Although risk assessments are required when explosives standards cannot be met, they must also be routinely used in other instances as a Commander’s management tool (e.g., combat loaded aircraft parked on an open ramp, separated by K11, meet the required QD separation per this Manual). (T-1). However, Commanders must also be advised that in this situation the total destruction of adjacent aircraft is certain and that propagation is likely in the event of an explosion on one of the combat loaded aircraft. (T-1). The Commander must also be apprised of the probability of such an event happening. (T-1).
4.3. Risk Management (RM).

4.3.1. According to AFI 90-802, Risk Management, the following RM principles apply: (1) Accept no unnecessary risk, (2) Make risk decisions at the appropriate level, (3) Integrate RM into operations, activities and planning at all levels, (4) Apply the process cyclically and continuously.

4.3.2. Refer to AFPAM 90-803, Risk Management Guidelines and Tools, for methods on eliminating or reducing risk to support the five-step process of RM (see Figure 4.1.). The RM process may not be used to violate directives or other regulatory guidance; normal waiver or variance procedures must be followed in all cases. For exceptions to criteria in this Manual, refer to Section 1B.

4.4. System Safety. System safety is the application of engineering and management principles, criteria, and techniques to optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle. The system safety process is governed by Military Standard (MIL-STD)-882E, System Safety, and is intended to ensure hazards are identified early enough in the design phase of a program to either remove them through engineering design changes or to mitigate the associated risk to an acceptable level. Similar to the RM processes, the system safety processes require the remaining risk to be accepted by the appropriate authority.

4.5. Professional Assistance for Risk Assessments and System Safety Analyses. Units may experience situations when civil, structural, electrical, safety, etc. engineering support is necessary to perform a risk assessment or system safety analysis. There are numerous governmental and nongovernmental organizations (NGOs) available for professional assistance. Contact your MAJCOM/SEW for assistance.

Section 4B—Munitions Systems and Equipment

4.6. Safety Certification of Munitions Systems. All operational nonnuclear munitions systems used by the Air Force require safety certification as specified in AFI 91-205, Nonnuclear Munitions Safety Board. Risk assessments are accomplished, using the systems safety process for all new or modified operational munitions systems as a part of this safety certification process. The safety certification process ensures that residual risks are mitigated to an acceptable level via engineering or procedural controls. Engineering controls are incorporated into the design. Procedural controls are documented in item TOs, or other operating procedures and instructions.

4.7. Risk Assessments for Explosives Equipment. Risk assessments for new or modified explosives equipment are typically accomplished as part of the munitions safety certification process and resultant engineering controls are incorporated into the design (see paragraph 4.6.). Procedural controls are documented in the item TO or other operating procedures and instructions. For explosives equipment unique to the local environment, perform a risk assessment and document any required procedural controls in a locally written instruction (see Section 7B). (T-1).
Section 4C—Explosives Operations and Facilities

4.8. Risk Assessment for Explosives Operations. Risk assessments for new or modified explosives operations are typically accomplished as part of the safety certification of munitions systems and resultant engineering controls are incorporated into the munitions system, equipment, or facility design (see paragraph 4.6.). Procedural controls are documented in the item TO or other operating procedures and instructions. For explosives operations unique to the local environment, risk assessments are implemented through the ESP; document any operational limitations in a locally written instruction to ensure safety (see Section 7B).


4.9.1. Responsible agencies perform risk assessments when they establish a definitive drawing for proposed new explosives facilities. No further risk assessments need to be accomplished.

4.9.2. Design agents are responsible for the risk assessment of new or modified explosives facilities not having a definitive drawing. Design agents must accomplish the risk assessment as part of the design process. (T-1).

4.9.3. When protective construction is required for the new or modified explosives facility (or any exposed facility), Commanders will ensure the requirement for risk assessments, systems safety analyses, and engineering analyses as well as the requirements for protective construction design (see Section 6B) are accomplished IAW AFI 32-1023, Designing and Constructing Military Construction Projects. (T-1).

4.9.4. When protective construction is not required for the new or modified explosives facility (or any exposed facility), the ESP satisfies the risk assessment requirement.

4.9.5. Risk assessments for modifications to explosives facilities assess whether the modification will cause additional hazards or reduce the effectiveness of built-in safety features of the facility.

Section 4D—Glass Breakage Risk Assessments


4.10.1. In the event of an explosives mishap, glass can present a significant hazard to personnel in exposed facilities out to distances well beyond the IBD arc.

4.10.2. Glass breakage risk assessments determine the extent of this hazard, and identify potential mitigation techniques, to reduce the hazard to an acceptable level. If the hazard cannot be reduced to an acceptable level, the glass breakage risk assessment can be used to ensure the approving authority makes an informed risk acceptance decision.

4.11. Requirements for Performance of Glass Breakage Risk Assessments.

4.11.1. Glass breakage risk assessments, performed IAW paragraph 4.12., are required as follows:

4.11.1.1. For modification of an existing occupied facility within an IBD arc as described in paragraph 5.2.2. (T-1).
4.11.1.2. For modified operations in an existing occupied facility (when acting as an exposure) within an IBD arc. When the risk assessment reveals a hazard to personnel, use engineering mitigation actions, if feasible, to eliminate the hazard or reduce it to an acceptable level. Remaining risk must be accepted by the responsible Commander (see paragraph 4.13.). (T-1).

4.11.1.3. For existing occupied facilities (when acting as an exposure) within the proposed IBD arc of a new PES. If the risk assessment shows there is a hazard to personnel, use engineering mitigation actions, if feasible, to eliminate the hazard or reduce it to an acceptable level. Remaining risk must be accepted by the responsible Commander (see paragraph 4.13.). (T-1).

4.11.1.4. For existing occupied facilities (when acting as an exposure) within the IBD arc of an existing PES where modified operations increase the explosive hazard of the PES. If the risk assessment shows there is a hazard to personnel, use engineering mitigation actions, if feasible, to eliminate or reduce the hazard to an acceptable level. Remaining risk must be accepted by the responsible Commander (see paragraph 4.13.). (T-1).

4.11.1.5. For new occupied facilities located within the IBD arc of any existing PES.

4.11.2. Glass breakage risk assessments are recommended in the following situations:

4.11.2.1. As a baseline assessment for all existing occupied buildings within an existing IBD arc.

4.11.2.2. As a baseline assessment for all existing occupied buildings of a sensitive nature (e.g., schools, off-base buildings, on-base buildings with significant public access such as a commissary, buildings with large amounts of glass panels, etc.) inside or near IBD arcs.


4.12.1. The tool(s) selected for performing a glass breakage risk assessments are based on the intent of the analysis. If the intent is to demonstrate windows will not break due to design, placement, or treatment, then a detailed software based assessment is required. If however, the intent is to only demonstrate a hazard exists and injuries are possible, the information found in Chapter 2 of this Manual may be sufficient for obtaining information to support responsible Commanders risk acceptance.

4.12.2. Glass breakage risk assessments identify the risk to personnel from glass breakage and, if necessary, evaluate the effect of engineering mitigation actions to reduce the risk to an acceptable level. Protection level “Medium” as defined in United Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings, is considered acceptable levels of protection (see paragraph 4.13.).

4.12.3. Glass breakage risk assessments must:

4.12.3.1. Consider the presence and distance of personnel from glass panels.

4.12.3.2. Evaluate the worst case event likely to expose glass panels to blast hazards. (T-1). Glass panels that are exposed to multiple explosives facilities would necessitate evaluation only for the explosives facility that would place the maximum blast loading on
the glass panels. Blast loading from HD 1.2.1 AE is based on the MCE. Blast loading from HD 1.2.3 AE will be based on the NEWQD of the largest single round.

4.12.3.3. Show the anticipated blast loading (i.e., the facility producing the blast loading, the actual separation distance, what HD and NEWQD produces the blast loading, and what the glass panel parameters (type, size, pane thickness) are) (T-1).

4.12.3.4. Identify engineering actions taken to mitigate the hazards to personnel from glass breakage.


4.13.1. Minimize the number and size of glass panels. (T-1).

4.13.2. Orient the exposed facility to minimize blast loads on glass panels. (T-1).

4.13.3. Minimize or remove glass panels on the side of facilities facing the explosives facilities. (T-1).

4.13.4. Use tempered glass that breaks into small pieces with rounded edges. (T-1).

4.13.5. Use glazing, anti-shatter films, or net/blast curtains. (T-1). Where films are used, the base fire department notes this type construction on pre-fire plans to facilitate fire-fighting personnel entry in emergency situations.

Section 4E—Health Hazard and Environmental Assessments


4.14.1. Using organizations must ensure Bioenvironmental Engineering (BE) conducts a health hazard assessment of the work area and operation when dust or concentrations of vapors, fumes, or gases from explosives, equipment, or other chemicals in the work area are present. (T-1).

4.14.2. The squadron Commander must accept bioenvironmental assessment risks before operations may begin. (T-1).

4.15. Environmental Assessments. Using organizations must ensure each explosives operation is evaluated for compliance with environmental standards. (T-1). Include all hazardous wastes generated during all phases of the operation in the evaluation. Identify requirements for the control, storage, and disposition of hazardous wastes in written procedures.

Section 4F—Protection Principles

4.16. Protective Shielding and Remotely Controlled Operations. This paragraph does not apply to rod and gun club operations.

4.16.1. Equipment specialists will perform a risk assessment to determine if an operation requires protective shielding and must be remotely controlled for personnel protection. (T-1). Specify shielding and remote control requirements in the item TO. (T-1). As a minimum, personnel must use protective shielding when test procedures cannot ensure explosives are totally isolated and protected from potentially harmful environments such as electrical current or heat. (T-1). Operations such as continuity checks of electrically actuated
explosives devices, propellant cutting, explosives component assembly, modification, or disassembly and demilitarization may require shielding or be accomplished from a remote controlled location.

4.16.2. When a risk assessment indicates that there is an unacceptable risk from an accidental explosion or a flash fire, Commanders will ensure personnel are provided protection from blast, fragments and thermal effects, to include respiratory and circulatory hazards (T-1), as follows:

4.16.2.1. Personnel protection must limit incident blast overpressure to 2.3 psi, fragments to energies of less than 58 ft-lb, and thermal fluxes to 0.3 calories per square centimeter per second. (T-1).

4.16.2.2. K24 distance provides the required level of protection for blast and thermal effects only.

4.16.2.3. Shields that comply with MIL-STD-398A, Shields, Operational for Ammunition Operations, Criteria for Design and Tests for Acceptance, provide acceptable protection for blast, thermal and fragment effects.

4.16.3. The use of protective shielding or remotely controlled operations must be approved as part of the ESP. (T-1). (see paragraph 14.16.3.).

4.16.4. The TO managing agency must ensure safe design and testing of specific protective devices when required by a TO. Test for a 25 percent overload and obtain approval from the Nonnuclear Munitions Safety Board (NNMSB). (T-1).

4.16.5. When a using command establishes a requirement for protective devices, that command must ensure that these devices are of a safe design. Test for a 25 percent overload. (T-1).

Note: Shields that comply with MIL-STD-398A provide acceptable protection.

4.17. Intentional Ignition or Initiation of AE. At operations (e.g., function, proof, lot acceptance testing) where intentional ignition or initiation of AE is conducted (except EOD operational responses), the following requirements apply:

4.17.1. Operating personnel protection will meet the requirements of paragraph 4.16.2.1. (T-1).

4.17.1.1. Contain or defeat all fragments. (T-1).

4.17.1.2. Limit thermal flux to “Q” (calories/square centimeter/second) = 0.62t^{-0.7423} where “t” is the time in seconds that a person is exposed to the radiant heat. (T-1).

4.17.1.3. Comply with testing requirements of paragraph 4.16.4 or 4.16.5. (T-1).


4.17.2. The use of protective shielding must be approved as part of the ESP (see paragraph 14.16.3.). (T-1).
4.17.3. Areas used for intentional detonations meet the requirements of paragraphs 4.17.1. through 4.17.3. for protection of essential personnel provided the QD requirements of paragraph 12.72.4.1. are met.

4.17.4. EOD proficiency training ranges meet the requirements of paragraphs 4.17.1. through 4.17.3 for protection of essential personnel provided the QD requirements of paragraph 12.74. are met.

4.17.5. Static test firing of propellant-loaded items must meet the requirements of paragraph 4.16.2.1. for protection of operating personnel. (T-1).

4.18. Protective Measures. Personnel protection may be increased by:

4.18.1. Eliminating or establishing positive control of ignition and initiation stimuli.

4.18.2. Using sufficient distance or barricades to protect from blast or fragments.

4.18.3. Using SDWs or properly rated fire walls to protect from fragment or thermal hazards.

4.18.4. UFC 3-340-02, Structures to Resist the Effects of Accidental Explosions, contains design procedures to achieve personnel protection, protect facilities and equipment, and prevent propagation of explosions.

4.18.5. Using fire detection and extinguishing systems (e.g., infra-red actuated deluge system) in those areas where exposed, thermally energetic materials that have a high probability of ignition and a large thermal output are handled. Such systems must maximize the speed of detection, have adequate capacity to extinguish potential flash fires in their incipient state, and maximize the speed of the application of the extinguishing agent.

4.18.6. Using thermal shielding between the thermal source and personnel in AE operational areas, where it is essential for personnel to be present and the risk assessment indicates that an in-process thermal hazard exists. Any shielding used must comply with MIL-STD-398A. (T-0). When shielding is either not possible or inadequate, to include a failure to protect exposed personnel's respiratory and circulatory systems, augmentation with improved facility engineering design and personal protective clothing and equipment may be necessary.

4.18.7. Using thermal protective clothing that is capable of limiting bodily injury to first degree burns (0.3 calories per square centimeter per second) with personnel taking turning evasive action, when the maximum quantity of combustible material used in the operation is ignited.

4.18.8. Using protective clothing capable of providing respiratory protection from the inhalation of hot vapors or any toxicological effects, when the risk assessment indicates adverse effects would be encountered from the inhalation of combustion products.


4.19.1. If an immediately dangerous explosive situation is encountered, shut down all operations in the immediate vicinity, evacuate personnel to a safe location, and call EOD personnel to analyze and eliminate the hazard. (T-1). Do not resume operations until the hazard has been eliminated, removed, or otherwise determined to be safe by EOD personnel. (T-1).
4.19.2. Make pre-planned arrangements for emergency measures such as bomb threats, hung flares, ground burst simulators, etc. on installations without on-site EOD support. Coordinate these arrangements with MAJCOM Safety, EOD Functional Staff, Air Force Installation and Mission Support Center Detachment.

4.19.3. Locations used repeatedly for the emergency destruction of recovered military ordnance or hazardous explosive devices must have risk assessments pre-established and on file. (T-1).

4.19.4. Emergency destruction operations conducted at reduced QD ranges and non-standard destruction sites (e.g., EOD proficiency ranges or non-sited remote locations) may require the use of protective measures to limit fragmentation hazards. When the time and situation allows, emergency responders will use applicable technical data (e.g., Automated EOD Publication System (AEODPS), EOD Tactical Decision Aid, and DDESB Technical Paper 16) to apply protective measures. (T-1). Construction may increase acceptable time lines, and place essential personnel at increased risk, but through ORM, the benefit of protective measures could outweigh the cost of no construction at all.

Figure 4.1. 5-Step Risk Management Process.

Notes:
1. **Step 1**: Identify the Hazards: Step one of the RM process involves application of appropriate hazard identification techniques in order to identify hazards associated with the operation or
activity. Hazards can be defined as any real or potential condition that can cause mission degradation; injury, illness, death to personnel or damage to or loss of equipment/property.

2. **Step 2**: Assess the Hazards: The assessment step involves the application of quantitative and/or qualitative measures to determine the probability and severity of negative effects that may result from exposure to hazards/risks and directly affect mission or activity success. This process can be formalized or intuitive.

3. **Step 3**: Develop Controls & Make Decisions: Step three involves the development and selection of specific strategies and controls that reduce or eliminate risk. Effective mitigation measures reduce one of the three components (Probability, Severity or Exposure) of risk. Risk mitigation decisions must be made at the appropriate level for the identified risk. The higher the risk, the higher the decision-level needs to be to ensure that an appropriate analysis of overall costs to benefits has been carefully weighed. Keep in mind there is no “cookie-cutter” approach or specific standard for establishing levels of RM decision authority across the Air Force. However, it is critical that leadership/decision makers ensure that the levels of decision authority are aligned appropriately for mission requirements and experience levels of the personnel conducting operations/activities under their responsibility. It is possible for decision-levels to vary within a command for differing operations/activities if training requirements, mission sets or activities are divergent enough to warrant separate standards (i.e., AETC, Air Force Special Operations Command (AFSOC), etc.). Decision makers must ultimately choose the most mission supportive risk controls, consistent with RM principles that provide the best solution for the given hazards. Risk decisions must never be delegated to a lower level for convenience or when the situation dictates senior-level involvement; exceptions may be considered in time-critical situations where delays might endanger lives, resources or equipment.

4. **Step 4**: Implement Controls: Once control measures have been selected, an implementation strategy must be developed and carried out. The strategy must identify the: who, what, when, where and cost(s) associated with the control measure. For mission-related controls, accountability must be emphasized across all levels of leadership and personnel associated with the action so that there is clear understanding of the risks and responsibilities of Commanders and subordinates alike. There must always be accountability for acceptance of risk regardless of circumstances.

5. **Step 5**: Supervise & Evaluate: The RM process continues throughout the life cycle of the system, mission, or activity. Leaders and supervisors at every level must fulfill their respective roles to ensure controls are sustained over time. Once controls are in place, the process must be periodically reevaluated to ensure controls remain effective and mission supportive over time. AFI 90-802, *Risk Management*
Chapter 5

GENERAL EXPLOSIVES FACILITY DESIGN, CONSTRUCTION AND MAINTENANCE, AND EQUIPMENT DESIGN, MAINTENANCE AND INSPECTION

Section 5A—Introduction

5.1. Applicability.

5.1.1. Unless otherwise specified, the design requirements in this Chapter apply to all existing and new construction of explosives facilities, to include specific explosives facility designs covered in Chapter 6. Unless specifically excluded, the requirements in this Chapter apply to licensed explosives storage locations and to locations involving explosives operations not requiring explosives siting. This Chapter also provides requirements for the construction, maintenance, and repair of explosives facilities as well as equipment in these facilities.

5.1.2. This Chapter does not address extraordinarily hazardous situations (e.g., nitroglycerin manufacturing) that require special consideration and design features. In these situations, the MAJCOM develops specific design criteria.

5.1.3. Additional criteria specific to nuclear weapons storage, handling, and maintenance facilities apply as provided in AFMAN 91-118, Safety Design and Evaluation Criteria for Nuclear Weapon Systems.

Section 5B—Glass Panels

5.2. Glass Panels in Facilities Exposed to Explosives Hazards.

5.2.1. For construction of a new occupied facility within an IBD arc, do not use glass panels unless deemed operationally necessary. If the use of glass panels is deemed operationally necessary, comply with the following requirements, or process a deviation IAW paragraph 1.4.

5.2.1.1. Design the panels so that they do not break under the expected blast loading; the framing and sash of such panels must be of sufficient strength to retain the panel in the structure under the expected blast loading. Or, design the panels so that they withstand the same blast loading as the structure; the framing and sash of such panels must be of sufficient strength to retain the panel until the point of structural failure.

5.2.1.2. Provide engineering analyses and design details, as part of the ESP package, to demonstrate compliance with paragraph 5.2.1.1. The analyses must include the information addressed in paragraphs 4.13.2. and 4.13.3.

5.2.2. For modification of an existing occupied facility within an IBD arc, remove existing glass panels, if practical, as part of the scope of modification. Do not add glass panels unless deemed operationally necessary. If existing glass panels are not removed, perform a glass breakage risk assessment (see paragraph 4.13.). If the risk assessment shows there will be a hazard to personnel, use engineering mitigation actions to eliminate the hazard or process a deviation IAW paragraph 1.4 (see paragraph 4.14.). If the addition of glass panels is
deemed operationally necessary, comply with paragraphs 5.2.1.1. and 5.2.1.2. or process a deviation IAW paragraph 1.4.

5.2.3. Existing glass panels that are replaced due to damage (i.e., cracked or broken) must be replaced with equivalent strength or stronger glass panels.

5.2.4. Glass skylights will not be used in any facility within an IBD arc.

Section 5C—Hazardous Locations

5.3. Hazardous Locations. Comply with National Fire Protection Association (NFPA) 70, National Electrical Code (NEC), Article 500, Hazardous (Classified) Locations, requirements for the design and installation of electrical equipment and wiring for hazardous locations. Hazardous locations are those in which combustible dusts, flammable vapors, or gases are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

5.3.1. The presence of explosives does not necessarily make an area a hazardous location. To ensure proper identification of a hazardous location, it is necessary to have knowledge of the properties of the explosives involved, especially thermal stability and sensitivity to heat and spark. Use NEC definitions of Class I, Division 1 and Class II, Division 1, as modified below, for explosives applications.

5.3.1.1. Areas containing explosive dusts or explosives that may, through handling, produce dust capable of being dispersed in the atmosphere shall be regarded as Class II, Division 1.

5.3.1.2. Areas where explosive sublimation or condensation may occur are regarded as both Class I, Division 1 and Class II, Division 1.

5.3.2. Some definitive drawings for explosives facilities may identify the presence of a hazardous location or require the installation of certain basic electrical equipment to meet NEC requirements.

5.4. Electrical Equipment in Hazardous Locations.

5.4.1. Installation of electrical equipment in hazardous locations involving explosives will comply with NEC requirements for the appropriate hazardous location class, group and division. (T-1).

5.4.2. Equipment must be approved not only for the class of location, but also for the explosion properties of the specific gas, vapor, or dust that will be present. (T-1).

5.4.3. Intrinsically safe equipment must be certified by a reputable testing organization such as Underwriters Laboratories (UL). (T-1). Such equipment must be used IAW the recommended environmental and operational conditions specified in the certification. (T-1).

5.4.4. If the properties of an explosive are such that the NEC requirements for electrical equipment provide inadequate protection under prevailing conditions, use of any of the following approaches is acceptable:

5.4.4.1. Intrinsically safe equipment.

5.4.4.2. Purged or pressurized and suitably temperature-limited equipment.

5.4.4.3. Exclusion of electrical equipment from the hazardous atmosphere.
5.4.4.4. Isolation of equipment from the hazardous atmosphere by means of dust, vapor, or gas-free enclosures with surface temperatures positively maintained at safe levels.

5.4.5. Devices providing “cold light” through chemical action are acceptable for use in any hazardous location.

5.5. **Interior Surfaces in Class II Hazardous Locations.**

5.5.1. Interior surfaces should be smooth, free from cracks and crevices, and have joints taped or sealed.

5.5.2. If painted, interior surfaces should be covered with a hard gloss paint that is easily cleaned.

5.5.3. Horizontal ledges possibly holding dust will be avoided or beveled to prevent dust collection.

5.5.4. Cove bases at the junction of the walls and floor are recommended.

5.6. **Hardware in Hazardous Locations.** To reduce the risk of accidental ignition by spark, consider the operational conditions in any hazardous location before choosing and installing hardware. Certain hazards may be sufficient to warrant the use of materials that reduce the possibility of sparking.

5.7. **Static Electricity in Hazardous Locations.** To minimize the risk of ignition of a flammable or combustible atmosphere in a hazardous location due to static electricity, the requirements of Section 5E are met for all hazardous locations.

5.8. **Ventilation in Hazardous Locations.** Buildings with hazardous locations must comply with the following ventilation requirements:

5.8.1. Buildings where dust, fumes, or vapors (having explosive potential) are formed will be passively ventilated, usually at the source of the hazard. (T-1).

5.8.2. Design ventilation systems so that they have adequate measures for minimizing (eliminating) static discharge, including measures applied during the activation of Manual or automated ventilation systems. (T-1).

5.8.3. Equip exhaust fans where combustible dust or flammable vapors pass with nonferrous blades (or casting lined with nonferrous material) and approved motors. (T-1).

5.8.4. Electrically bond and properly ground the entire ventilation system. (T-1).

5.8.5. NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, may be used in the installation of such systems.

5.8.6. For buildings containing explosive dust, an air balance that gives a slight negative pressure within the building is required. (T-1).

Section 5D—Electric Supply Systems

5.9. Electric Supply Systems. This paragraph does not apply to licensed explosives storage locations and locations involving explosives operations not requiring explosives siting. For QD and fire protection separation requirements between explosives facilities and electric supply system components see paragraph 12.82. Install electric lines serving explosives facilities, including shielded cabling, power cabling, and communication lines underground in metal conduit from a point at least 50 feet away from the facility.

5.9.1. The line side of the main disconnecting switch or circuit breaker must have surge suppression IAW UFC 3-520-01, Interior Electrical Systems, and any Engineering Technical letters issued specifically for explosives areas. (T-1).

5.9.2. Surge protection must be included for all incoming conductors. (T-1). The surge protection must include suppression at the entrance to the facility from each wire to ground. (T-1). All other metallic utility lines and pipes must be electrically connected to the structural steel of the building prior to entering the facility. (T-1).

5.10. Backup Power. An alternate source of power is required for explosives operations where the lack of a continuous power supply may cause a fire or explosion, as determined by risk assessment (see Chapter 4).

Section 5E—Static Grounding and Bonding

5.11. Areas Requiring Static Grounding and Bonding Systems. See Section 7D for static grounding and bonding requirements during specific operations. Static grounding and bonding systems are required for:

5.11.1. Hazardous locations (see Section 5C).

5.11.2. Areas where EIDs are exposed.

5.11.3. Areas where exposed explosives are handled.

5.11.4. Areas where explosive components incorporating an electrical initiating system are undergoing maintenance; assembly to, or disassembly from, an all-up-round (AUR) configuration; or electrical connection or disconnection.

5.11.5. Areas where electrically initiated munitions and explosive devices are undergoing maintenance and electrical test operations and the responsible engineering function has determined grounding is necessary. This will usually be documented in the specific item TO or similar product (i.e. test data package).

5.11.6. Areas where explosives are loaded or unloaded on aircraft (unless exempted per paragraph 7.13.1. or 7.13.2.).

5.12. Static Grounding and Bonding Requirements.

5.12.1. The method generally used to eliminate or reduce the hazard from static electricity is to provide an electrically continuous path to ground via ground wire, cable, or strap.

5.12.1.1. These grounds should be one continuous ground wire, cable or strap. Short ground wires, cables, or straps should not be connected together to make a longer one.
5.12.1.2. Each ground wire, cable, strap must be connected to the item and facility ground individually. Avoid connecting multiple ground wires, cables, or straps to another ground wire, cable or strap connecting mechanism (alligator clip, clamp, etc.).

5.12.2. Static grounding bars or other grounding devices may be appropriate for some operations (see paragraph 7.12.1.). Such grounding bars or devices will be located at the entrance to or within the area where work will be performed.

5.12.3. Wire used as a permanent static ground conductor must be large enough to withstand mechanical damage and must not be less than American Wire Gauge (AWG) No. 6 (or No. 8 for existing bonds), or a braided cable of equal resistance. Wires used as static grounds for portable or movable equipment, or for temporary static bonding cables, will be large enough to carry the expected current load as specified in the item technical data, but will not be smaller than AWG No. 12 (3/32-inch cable).

5.12.4. Static grounds will be bonded to the facility's grounding system. Static grounds will not be made to telephone grounds; electrical conduit systems; gas, steam, hot water, or air lines; sprinkler systems; or air terminals of lightning protection systems (LPS) (connection to the “down wire” of the system at ground level is authorized).

5.12.5. When all of the objects are conductive, they can be grounded by electrically connecting all parts to a common ground conductor.

5.12.6. Partial grounding, or using conductors that are too weak or have too much resistance, may increase the static hazard by providing opportunities for discharge through an uncontrolled path to ground.

5.12.7. Electrical continuity may be broken by oil on bearings, paint, or rust at any contact point. To get a continuous circuit, grounding straps must be used to bridge such locations.

5.12.8. Equipment in contact with conductive floors or tabletops will not be considered grounded.

5.12.9. For explosive facilities, shielded cabling, power cabling, and communication lines must run underground in metal conduit for at least 50 feet prior to entering the structure. (T-1). All other metallic utility lines and pipes, including steam, water, and air conditioning lines must be bonded to the LPS just before they enter the building. (T-1).

5.12.10. Do not place electrically energized objects or tools on grounded surfaces where explosives operations are conducted. If electrically energized objects or tools (heat sealers, heat guns, etc.) are required for the operation, place these objects on a non-conductive surface to prevent continuity between the electrically energized object or tool and the grounded surface.

5.13. **Permanent Static Grounding Systems.**

5.13.1. A resistance of 25 Ohms or less is required from item connection to facility ground. In hazardous locations, resistance to ground of 10,000 Ohms or less for equipment static bonding straps is adequate to bleed off the static charges; continuity across bonds must be less than one Ohm.

5.13.2. IAW AFI 32-1065, *Grounding Systems*, give all permanent static grounding systems a continuity test at the time of initial installation and at any time a lack of continuity is
suspected due to damage or corrosion. (T-1). A resistance reading of 25 Ohms or less must be obtained. (T-1). Documentation of initial and recurring testing is required. (T-1). Consider equipment (except a belt-driven machine) as a unit in testing of resistance to ground.

5.13.3. Hazardous locations:

5.13.3.1. Ground all conductive parts of equipment IAW the NEC.

5.13.3.2. Where the installation permits viewing, make a visual inspection of all static bonds and grounds for breaks and corroded connections before starting operations on each day the equipment is to be used. Test any suspected connections and bring them up to required standards before starting operations.

5.13.4. In non-hazardous locations, visually inspect static bonding and grounding straps for breaks and corroded connections quarterly IAW AFI 32-1065. Test suspect connections for continuity, bring up to required standards, and re-test before starting operations.

5.14. Temporary Static Grounding or Bonding Cables.

5.14.1. Perform a continuity test on temporary static grounding or bonding cables at the time of their initial placement into service.

5.14.2. Prior to each subsequent use, inspect the cable for any evidence of corrosion or damage.

5.14.2.1. Replace the clamp if jaws are deformed, spring is weak, or other defect is noted that would prevent a good connection.

5.14.2.2. Replace the cable if more than one third of the cable strands are broken. Deteriorated or damaged plastic coating does not affect electrical capability of cables.

5.14.2.3. Perform a continuity test if a lack of continuity is suspected due to damage or corrosion or after any components have been replaced.

5.14.3. A resistance of 10 Ohms or less is required from inside one of the clamp jaws to inside the other clamp jaw.

5.14.4. Documentation of continuity testing on temporary static grounding or bonding cables is not required.

5.15. Static Grounding or Bonding Reels.

5.15.1. Give all installed static discharge reels a continuity test at the time of their initial installation.

5.15.2. Prior to each subsequent use, visually inspect the static discharge reel for security of mounting and evidence of any corrosion or damage. Perform a continuity test if a lack of continuity is suspected due to damage or corrosion or after any components have been replaced or repaired.

5.15.3. A resistance reading of 10 Ohms or less is required from inside the clamp jaw to the frame the reel is mounted.

5.15.4. Accomplish the test by extending the entire length of the cable.
5.15.5. Documentation of continuity testing on temporary static grounding or bonding reels (or cables) is not required.

5.16. **Belt**ing. If static electricity is a hazard, use non-static-producing belting having a resistance to ground not exceeding 600,000 Ohms. This includes belt-driven compressors, conveyor belts, and so forth. In measuring the total resistance to ground for belt-driven machinery, do not count the resistance of the belting.

Section 5F—Conductive Floors

5.17. **Areas Requiring Conductive Floors.** Conductive floors may be required in hazardous locations and where certain exposed explosives and materials are sensitive (easily detonated or ignited) to the uncontrolled discharge of static electricity, and the requirements of Section 5E are deemed inadequate to protect from the hazards of static electricity. Dust-air mixtures of ammonium perchlorate, tetrytol, and dust of solid propellants are subject to static discharge and conductive flooring must be considered where they are present.

5.18. **Requirements for Conductive Floors.**

   5.18.1. Conductive floors will be non-sparking.
   
   5.18.2. Conductive floors will be smooth, free from cracks, and of a type that will not develop surface separations, wrinkle, or buckle under operational loads.
   
   5.18.3. Where washing is required, conductive floors will be able to withstand repeated applications of hot water and cleaners.
   
   5.18.4. Where conductive floors are required, table tops where exposed explosives or dusts are encountered must be conductive, or covered with a conductive material, meeting the same requirements as the conductive floor.
   
   5.18.5. In small areas, conductive mats or runners can be suitable in lieu of conductive floors. Personnel (except electricians performing system checks), in places where conductive floors or coverings are required and installed, will wear conductive footwear (shoes or grounding straps).
   
   5.18.6. Where conductive floors are required, the resistance between the ground and the wearer will not exceed 1,000,000 Ohms; that is, the total resistance of conductive footwear on a person, plus the resistance of floor to ground. Additionally, resistance between the floor and ground connections must not be less that 25,000 ohms.

5.19. **Testing and Maintenance of Conductive Floors.**

   5.19.1. Test conductive floors when installed to ensure that design specifications are met, and at intervals thereafter as prescribed in AFI 32-1065. Do not use test instruments until all exposed explosives and explosives dusts, gases and vapors that are subject to possible ignition or initiation have been removed from the area.
   
   5.19.2. Do not paint over conductive floors.

5.20. **Testing and Maintenance of Conductive Footwear.**

   5.20.1. Test conductive footwear before each shift.
   
   5.20.2. Conductive footwear requires care to ensure retention of its conductive properties.
5.20.2.1. Store conductive footwear in lockers close to the room where it will be worn and don conductive footwear at this same location.

5.20.2.2. Take precautions to prevent the accumulation of even a thin layer of dust or wax which can insulate conductive footwear from the floor.

5.20.2.3. Supervisors will ensure that conductive footwear is not altered so as to negate their safety features.

5.20.2.4. Use only conductive materials in the repair of conductive footwear. Clean conductive footwear thoroughly before repair.

Section 5G—Installed Systems and Equipment Grounds

5.21. Installed Systems and Equipment Grounds. Pay special attention to the installation and maintenance of electrical grounding where explosives are involved in accordance with the following:

5.21.1. Bond all grounding mediums together.

5.21.2. If the structure is equipped with an LPS, interconnect all grounds, including static grounds, as outlined in AFI 32-1065.

5.21.3. Test grounding when installed to ensure that design specifications are met and at intervals thereafter as prescribed in AFI 32-1065. Document all tests and inspections on appropriate forms or automated products.

5.21.3.1. Before making any electrical continuity and resistance tests or electrical repairs, remove all exposed explosives, EIDs, and explosives dust, gases and vapors that are subject to initiation under the specific circumstances.

5.21.3.2. If there is an operating generator or energized transformer at the location, connect a shunt grounding strap before opening an installed grounding connection for repair or replacement.

Section 5H—Lightning Protection Systems

5.22. Facilities Requiring LPS. Properly maintained LPS are required for all explosives facilities (to include open locations), except as noted in paragraph 5.25. The DoD has selected the LPS criteria of NFPA 780, Standard for the Installation of Lightning Protection Systems, for AE facilities. If LPS test methods or designs are used, other than prescribed in this section, they must offer equivalent protection to those prescribed in this section and be approved via the ESP. DoDM 3150.02, DoD Nuclear Weapon System Safety Program Manual, and AFI 91-100 series Weapons System Safety Rules provide LPS program guidance for nuclear weapons facilities and operations.

5.23. LPS Design. LPS design and installation must, at a minimum, meet the requirements of AFI 32-1065, Grounding Systems and NFPA 780. The LPS must feature air terminals, down conductors, sideflash protection, surge suppression of data lines and bonding of all other conductive penetrations into the protected area, and earth electrode systems. Structural elements of the building may serve as air terminals, down conductors, or the earth electrode. Design the LPS to intercept lightning at 100 feet or less striking distance arc IAW NFPA 780. The Base
Civil Engineer ensures any changes to LPS design and installation, grounding, or surge suppression is reflected in as-built electrical drawings. (T-1).

**Note:** The pitched roof requirements of NFPA 780 may not be used in lieu of this requirement.

5.23.1. Air Terminals. An air terminal is a component of an LPS that is able to safely intercept lightning strikes. Air terminals may include overhead wires or grids, vertical spikes, or a building’s grounded structural elements. Air terminals must be capable of safely conducting the current from a lighting strike.

5.23.2. Down Conductors. Down conductors (flat or round) provide low impedance paths from the air terminals described above to the earth electrode (ground) system. Structural elements having a high current capacity and low impedance to ground need not be augmented with wires. Where wires are used as down conductors, they must meet the requirements listed in NFPA 780.

5.23.3. General Sideflash Protection. Protection from side flash is obtained either by bonding metallic objects to the down conductors or the earth electrode system, IAW NFPA 780, except as modified herein, or it is obtained by maintaining a separation distance between metallic objects and these LPS components.

5.23.3.1. Bond fences and railroad tracks located within six feet of a structure’s LPS to the structure’s LPS.

5.23.3.2. The reinforcing bars in adjacent structural elements must be joined in a manner to provide electrical bonding between the elements. This is an absolute requirement for facilities that are used to store AE. Techniques commonly used and approved in the construction industry to join reinforcing steel are acceptable for this purpose. The steel arch of an ECM must be similarly joined to the rebar in the floor.

5.23.4. Sideflash Protection for Nuclear Weapons. The Nuclear Weapon System Safety Group (NWSSG) adopted a standard sideflash separation distance value of seven-feet as a conservative baseline for nuclear safety critical operations. In the absence of any specific additional guidance due to location or weapon configuration, the 7-foot value must be the sideflash separation distance required (see paragraph 5.23.4.2. and Table 5.1.). When weapons are in an operational configuration where no lightning sideflash separation distance is required, all other separation distance requirements not specifically related to lightning (i.e., for access, ventilation, inventory, etc.) are still applicable.

5.23.4.1. The sideflash protection requirements for all nuclear weapons, depending on their operational configuration, are listed in Table 5.1. The term “major maintenance” refers to the weapon configuration resulting from the disassembly or the performance of any maintenance operations, as currently approved, which could result in exposure of the weapon’s internal components to electrical energy. Major maintenance does not include Permissive Action Link (PAL) procedures.

5.23.4.2. Location Considerations for Sideflash Separation Distance.

5.23.4.2.1. If operations are being performed inside a hardened aircraft shelter (HAS) or a protective aircraft shelter (PAS) and these operations include weapon configurations that require a separation distance (see Table 5.1.), then:

5.23.4.2.1.1. When using an LPS modified Weapons Maintenance Truck
(WMT)/Secure Transportable Maintenance System (STMS), no minimum sideflash separation distance is required between the WMT/STMS and the HAS/PAS provided all additional safety requirements are adhered to IAW TO 11N-50-1007, Transportation Maintenance System Operator/User Manual A/S32U-42 and A/S32U-43 and TO 11N-50-1010-1, Secure Transportable Maintenance System, Operator/User Manual A/M32U-22, including any separation distance requirements between the weapon and the inside walls of the WMT/STMS. (See paragraph 5.23.4.3. for proper application of separation distance).

5.23.4.2.1.2. When no WMT/STMS is being used, a minimum sideflash separation distance of seven-feet is required between the weapon and the HAS/PAS. See paragraph 5.23.4.3. for proper application of separation distance.

5.23.4.2.2. If operations are being performed at any location other than in a HAS or a PAS and these operations include weapon configurations that require a separation distance, then a minimum sideflash separation distance of seven-feet is required between the weapon and facility (see paragraph 5.23.4.3. and Table 5.1. for proper application of separation distance).

5.23.4.2.3. The standard separation distance of seven-feet may be reduced by determining the specific sideflash separation value for a particular facility.

5.23.4.2.3.1. Sideflash separation distance reduction is based on Faraday shield impedance characterization testing and the adequate bonding and appropriate installation of surge suppression using a methodology approved by AFSEC/SEW prior to implementation.

5.23.4.2.3.2. Documentation of the bonding and surge suppression configuration, including the associated separation distance calculations, in an attachment to the ESP, must accompany the characterization test results for formal review and approval by AFSEC/SEW before an exception to the 7-foot standard separation distance is granted. (T-1). Changes to the bonding and surge suppression configuration must be submitted to AFSEC/SEW for approval prior to implementation. (T-1).

5.23.4.2.3.3. Faraday shield characterization and implementation methodologies must include specific maintenance and inspection procedures and comply with the following requirements (see AFI 32-1065, Grounding Systems):

5.23.4.2.3.3.1. Visually inspect bonds and surge suppressors as a minimum every six months to validate the installation and serviceability. (T-1). Additionally, perform a visual inspection of all surge suppression devices when a lightning strike occurs to the facility. (T-1).

5.23.4.2.3.3.2. Take electrical resistance measurements of bonds, as a minimum, once every two years. (T-1). Such measurements are also required when the facility is subjected to an earthquake, tornado, flood, or other such acts of nature that could have affected the integrity of the bonds; and any time modification, maintenance or repair to the structure, penetration or any LPS
component requires the bond or connection to be broken. The bond resistance must be less than one Ohm. Larger readings require tightening or reattaching of the bonds.

5.23.4.2.3.3. Take transfer impedance measurements, as determined by Faraday shielding characterization testing, as a minimum, once every 10 years. (T-1).

5.23.4.2.3.3.4. Maintain a record of all resistance or transfer impedance measurements at all required points and of visual inspections for at least six inspection and testing cycles IAW AFI 32-1065. (T-1).

5.23.4.2.3.4. The measures taken to implement a Faraday shield approach for reducing the required lightning sideflash separation distance in a particular facility do not impact, adversely affect or relieve the requirements to maintain a conventional LPS as described in Section 5H and the current version of AFI 32-1065.

5.23.4.3. The required safe separation distance (SSD) is properly applied to an item (weapon, WMT/STMS, etc.) to be protected from lightning sideflash by maintaining a minimum free space separation of the specified distance between the item and the facility’s walls, ceiling, or any other structural member capable of conducting electrical energy (e.g., steel columns, rebar-reinforced interior walls, columns or beams).

5.23.4.3.1. Objects in the floor such as concrete rebar, floor grounds, and structural members of the Weapons Storage Vault (WSV), when the vault is in a full down position, do not require the application of the sideflash separation distance.

5.23.4.3.2. If an ungrounded metallic conductor is located within the SSD of the item being protected, then the shortest free space distance measured between the metallic conductor and any structural member capable of conducting electrical energy must be at least equal to the full separation distance (seven-foot default) minus the shortest free space distance measured between the metallic conductor and the item being protected.

5.23.4.3.3. Transient or temporary infringement of the sideflash separation distance requirement (e.g., the movement of personnel through the facility or the requirement to use an overhead crane in the course of approved maintenance procedures) can be permitted. Avoid these actions whenever possible or their duration will be minimized while still allowing required maintenance operations to be safely completed. These violations are not justified by issues of convenience or for the sole purpose of ease of operations.

5.23.4.4. Deviations from paragraph 5.23.4. must be approved by AFSEC/SEW (see paragraph 1.4.1.). (T-1).

5.23.5. Surge Protection for Incoming Conductors. Include LPS surge protection for all incoming conductors. The surge protection must include suppression at the entrance to the building from each wire to ground. (T-1). Bury shielded cabling, power cabling, and communication lines underground in metal conduit for a minimum of 50 feet before entering
the structure. (T-1). All other metallic utility lines and pipes must be electrically connected to the LPS or the structural steel of the building just before they enter the building. (T-1).

5.23.6. Earth Electrode System. Earth electrode systems dissipate the current from a lightning strike to ground. Earth electrode systems may be concrete encased electrodes, ground loop conductors, radials, grounding rods, ground plates, a conductor immersed in nearby salt water, chemical grounds that are installed for the purpose of providing electrical contact with the earth, or combinations of these.

5.23.7. Underground Storage Facility. An underground storage site requires protection against lightning only for exposed or partially exposed parts. Consider LPS requirements on a site specific basis.

5.24. LPS Inspection, Maintenance, Testing, and Training. Ensure that LPS meets, at a minimum, the requirements of AFI 32-1065. Perform maintenance to ensure the integrity of the LPS conforms to AFI 32-1065.


5.24.2. Electrical tests. Electrically test LPSs when placing a new facility into service and after any facility modification that may have affected the system. (T-1). Perform electrical tests IAW AFI 32-1065. (T-1).

5.24.2.1. A maximum resistance value of one Ohm is permitted across all bonds when conducting bonding (resistance) tests.

5.24.2.2. The maximum resistance to earth must not exceed 25 ohms when conducting earth ground resistance tests unless a ground loop conductor is installed. The resistance to ground of a ground loop system is acceptable even if greater than 25 ohms.

5.24.2.3. Use test instruments that are in good working order and calibrated IAW manufacturers’ recommendations.

5.24.3. Records and Data. Keep records and test measurement data of resistance to earth tests and bonding on file for the last six inspection cycles. (T-1). Review these records for trend analysis as prescribed in AFI 32-1065. (T-1).

5.24.4. Training. Personnel who design, maintain, repair, modify, and test LPS and grounding systems must be thoroughly familiar with test equipment operation; lightning protection, grounding, and bonding theory and practices; referenced codes and standards; and specific requirements and procedures within AFI 32-1065. (T-1).

5.24.5. Maintenance. Perform maintenance to ensure that the integrity of the LPS conforms to the criteria contained in AFI 32-1065. (T-1).

5.25. LPS Exceptions. Properly maintained LPS are required for explosives facilities, with the following exceptions:

5.25.1. Air terminal systems are not required on a HAS, a PAS, a metal aircraft shelter, or an earth covered magazine, provided:

5.25.1.1. All reinforcing steel in the walls and floors are properly bonded and grounded.

5.25.1.2. Metal ventilators at least 0.188 (3/16) inches thick are grounded.
5.25.1.3. Metal ventilators less than 0.188 (3/16) inches thick are protected by an air terminal.

5.25.1.4. Down conductor, sideflash protection, surge suppression, and earth electrode system requirements of paragraph 5.23. are met.

5.25.2. A LPS is not required for licensed explosives storage locations and for locations involving explosives operations not requiring explosives siting.

Note: This exemption is made because of the explosives; other contents of the building may require a LPS.

5.25.3. An “integral” LPS is not required for an all-metal building that has been shown to meet the additional criteria of a “metallic cage” system, as both are defined in NFPA 780. This exception must be approved by AFSEC/SEW prior to operational use of the building in this configuration (see paragraph 1.4.). (T-1).

5.25.4. The following locations do not require a LPS provided that the responsible Commander accepts the loss of resources and structure and any potential collateral damage to other nearby exposures. Commanders will ensure risk acceptance is documented by letter (i.e., signed by the Commander stating he/she understands and accepts the potential loss of resources and structures at the location without LPS and any potential collateral damage to other nearby exposures) and submitted with the ESP. (T-1).

5.25.4.1. Explosives locations served by a local lightning warning system to permit the controlled termination of operations at the issuance of a lightning watch and immediate personnel protection actions at the issuance of a lightning warning as prescribed in Section 7H.

5.25.4.2. Facilities containing only AE that cannot be initiated by lightning, as determined by AFSEC/SEW and approved by DDESB, and where no fire hazard exists.

5.25.4.3. Facilities where personnel are not expected to sustain injury and at the same time, the resulting economic loss of the structure, its contents and/or surrounding facilities is minimal.

5.25.4.4. Facilities used for temporary (non-recurring) storage of munitions.

5.25.4.5. Structures, facilities, or mobile equipment housing explosives or explosives operations not regularly situated at a fixed location.

5.25.4.6. Structures and facilities limited to the storage or handling of small arms ammunition where the value of the ammunition is $10,000 or less.

5.25.4.7. LPS may be omitted on EOD intentional detonation and proficiency training ranges, and holding areas sited within the range boundary. A Commander’s risk acceptance memorandum is not required. Apply the requirements set forth in paragraph 5.25.4.1.

5.25.5. LPS may also be omitted on flightline PESs if the system interferes with flightline criteria contained in UFC 3-260-01, Airfield and Heliport Planning and Design. A Commander’s risk acceptance is not required. See Section 7H for procedures in the event of electrical storms.
5.25.6. Large catenary systems that cannot conform to the bonding distances calculated from the equations provided in AFI 32-1065 must be considered under the provision in paragraph 5.22. Provide engineering analyses to ensure variances provide equivalent protection prior to submission to the DDES for approval.

5.25.7. ECMs that constitute a metallic cage, as defined in NFPA 780, and that do not contain any energized or unbounded metallic penetrations, do not require earth resistance testing.

Section 5I—General Design Considerations for Explosives Facilities

5.26. Blowout-type Construction. Roofs and walls of explosives facilities will be as light in weight (weak) as practicable. Design facility features (e.g., roofs, walls, blow-out panels) to allow venting of an internal explosion with the minimum number of large fragments. Avoid installing hardware (including pipes and ducts) on light blowout-type walls, roofs or panels; if unavoidable, select materials or items that will not yield heavy fragments in an explosion. Consider the use of frangible panels in the design of HD 1.3 facilities where high overpressures from a detonation or a confined deflagration are expected (see HNDED-CS-93-7, Hazard Division 1.3 Passive Structural Systems Design Guide). This paragraph does not apply to licensed explosives storage locations.

5.27. Non-combustible Construction. Construct exterior walls and roof coverings of explosives building out of non-combustible materials. Use non-combustible material for interior surfaces of explosives buildings (see UFC 3-600-01, Fire Protection Engineering for Facilities). If it is necessary to use combustion-supporting materials in the interior of an explosives building, treat or cover all exposed surfaces with fire-retardant material. This paragraph does not apply to licensed explosives storage locations, and locations involving explosives operations not requiring explosives siting.

5.28. Underground Explosives Storage Facilities. All wiring and electrical equipment in underground storage facilities will, in addition to any other requirements of this Chapter, be of moisture and corrosion resistant materials and construction unless a site specific analysis indicates that such construction is not necessary. Commanders will ensure underground facilities have emergency lighting systems to provide minimum illumination in the event of a power failure. (T-1).

5.29. Outdoor Explosives Storage Sites. This paragraph does not apply to licensed explosives storage locations and locations involving explosives operations not requiring explosives siting.

5.29.1. Outdoor explosives storage sites will have a minimal slope, be well drained, and free from unnecessary combustible materials.

5.29.2. Adequate dunnage is needed, especially between the stack and an unimproved surface to ensure stack stability. Build and place the dunnage, supporting timbers or platform where explosives are stored to prevent falling, sagging, or shifting of the explosives. See specific item TOs.

5.29.3. Provide nonflammable or fire-resistant, waterproofed, overhead covers for packaged explosive items unless the item is contained in packing designed and approved for unprotected outside storage. There must be at least 18 inches between the top of the stack
and the cover. (T-1). If airspace is kept between the cover and the stacks, the sides of covered stacks may be protected by nonflammable or fire-resistant, waterproof covers.

5.30. **Stairways.** Stairways will conform to Air Force Occupational Safety and Health (AFOSH) standards, AFI 91-203, *Air Force Consolidated Occupational Safety Instruction*, and NFPA 101, *Life Safety Code* requirements. (T-1). Open-sided stairways in an explosives building (or in one where a dangerous fire hazard exists) must have handrails at least 42 inches high. (T-1). They must have mid-railings to preclude falls when vision might be impaired by smoke, injury or when panic might result. (T-1). Avoid open risers.


5.32. **Platforms, Runways, and Railings.** Platforms, runways, and railings must conform to AFI 91-203 requirements. (T-1).

5.32.1. Platforms and runways less than 30 feet long require one stairway or fixed ladder. Those over 30 feet long or more than 250 square feet in area require two stairways or ladders. (T-1).

5.32.2. Platforms, floor openings, runways, tanks, or open vats comply with AFI 91-203.

5.32.3. Permanent railings must be made of metal except in those process buildings where metal railings would increase the hazard. (T-1).

5.33. **Passageways.** If weather-protected passageways (ramps) are needed between buildings or magazines, they must have suitable fire stops between the buildings.

5.34. **Walkways.** Walkways at the entrances to or between adjacent operating buildings containing explosives will be hard surfaced or boardwalks. (T-1). Keep these walkways free from foreign material. Provide foot brushes, door mats, or scrapers at the entrance of each building, except magazines. Give special attention to passageways, walkways, and stairs subjected to the effects of inclement weather.

5.35. **Roads.** This paragraph does not apply to licensed explosives storage locations, and locations involving explosives operations not requiring explosives siting, unless they are located within an explosives storage area.

5.35.1. Provide good all-weather roads to, and within, the explosives area.

5.35.2. Arrange road systems serving groups of magazines or explosives buildings without dead ends so that motor vehicles carrying explosives cannot be isolated. To prevent dead ending, interconnecting roads for magazine service roads need only be passable trails adequate to accommodate the typical vehicles used at the installation.

5.35.3. Roads serving a single magazine or explosives processing building (including its service facilities) may dead end at the magazine or building. Design the road system to eliminate the need for passing through an intermediate explosives area when traveling between one operating area and another, within the same explosives storage area.

5.36. **Gates.** There is no mandatory safety requirement for more than one personnel gate in the fence around an explosives area. Weapons Safety, Security and Civil Engineering usually determine how many gates are needed after considering all elements of the situation. Give consideration to providing alternate personnel gates for a single event emergency. This
paragraph does not apply to licensed explosives storage locations, and locations involving explosives operations not requiring explosives siting. Consider alternate ways of evacuating an explosives area based on where explosives events may occur.

5.37. Drainage. Provide adequate drainage for access and internal roads and all explosives locations. Provide magazines with condensation drainage from the storage facility interiors. This paragraph does not apply to licensed explosives storage locations, and locations involving explosives operations not requiring explosives siting.

5.38. Drains and Sumps. The following requirements apply to facilities handling liquid explosives or liquids containing explosive waste:

5.38.1. When lines are required for draining liquid explosives or liquids containing explosive waste, they will be free of pockets and low spots. (T-1). The drain line will be sloped at least one quarter inch per foot so that explosives will not settle in the drain line. (T-1). The drain system will include a sump or basin so explosives can be removed. (T-1).

5.38.2. Bolted sump tanks or other types of construction that allow the explosives to settle in obscure or hidden spaces are prohibited. Avoid any deposition of explosives from sump effluent due to drying, temperature changes, or interaction with other industrial contamination. Use sweeping and other dry-collecting measures to keep explosives which are appreciably soluble in water out of the drainage system.

5.38.3. Design sumps so that suspended and solid explosive material that may settle cannot be carried in the wash waters beyond the sumps. Construct sumps so the overflow does not disturb any floating solids. The design will allow enough settling time, based on the settling rate of the material and the usual rate of flow. It will allow the collected explosives to be removed easily and allow those floating on the water to be retained until they can be skimmed from the water surface.

5.38.4. In all new construction, drains between the source of explosives and the sump will be troughs with rounded bottoms. (T-1). The drains will have removable, non-sparking, ventilated covers for ease of inspection for accumulated explosives. (T-1). Waste liquids will not be run into closed drains and sewers.

5.38.5. Inspect drains periodically and take steps to prevent the buildup of explosive deposits. Do not connect drains and sewers containing explosive waste to the normal sewage systems. All residues from hazardous material clean-up operations are considered hazardous waste and must be disposed IAW AFI 32-7086, Hazardous Materials Management and AFPD 32-30, Explosives Ordnance Disposal. (T-1).

5.39. Tunnels. Tunnels must be drained, ventilated, well lighted, and have at least two exits. (T-1). Water and steam service lines in tunnels will be lagged with suitable insulation. Tunnels between buildings that contain explosives will be built to resist the shock wave and blast of an explosion (see DoD 6055.09-M for design guidance). (T-1). Only authorized personnel will enter the tunnels. (T-1).

5.40. Laundries. Laundries for washing uniforms and rags that are contaminated with explosives must comply with the following requirements:

5.40.1. The laundry will include a safe place to store uniforms and rags that are contaminated with explosives before washing. (T-1). Sumps will also be provided to remove
explosives from waste water. (T-1). There must be facilities available to test whether the contaminant (particularly any insoluble toxic substance) has been removed. Contact Environmental Management for assistance.

5.40.2. Inform commercial businesses laundering such articles of the nature of the explosives contamination and possible dangerous chemical reactions.

5.41. Steam for Explosives Processing or Facility Heating. This paragraph does not apply to licensed explosives storage locations, and locations involving explosives operations not requiring explosives siting.

5.41.1. Steam used to heat buildings that contain explosives must not exceed 228°F. (T-1). Process steam may exceed this if necessary but will not exceed 250°F. (Process steam is steam that is in direct contact with explosives or in the case of equipment failure, would exhaust directly into contact with explosives or explosive fumes.) However, for TNT specifically, the maximum temperature allowed for processing is 240°F.

5.41.2. Steam or hot water pipe surfaces in contact with wood, paper, or other combustible materials must never be hotter than 160°F. (T-1). If the hot water pipes and the steam lines are hotter than this, they must be covered and painted with an impervious material or otherwise protected against direct or prolonged contact with these items. (T-1).

5.41.3. Where a reducing valve is used, install a relief valve on the low pressure piping. The production of superheated steam caused by the throttling action of reducing valves will be prevented by positive means, preferably by using a “water leg” or water column to control steam pressure of 5 psi or less.

5.41.4. Where close control of steam temperature is needed, install indicating and recording pressure or temperature gauges. Periodically test such devices and record the test results.

5.41.5. Where circulating hot water is used for heating, the installation and operating conditions will conform to AFI 32-1068, Heating Systems And Unfired Pressure Vessels.

5.41.6. In explosives handling or storage locations where resistance to ground is high, ground steam or hot water lines where they enter buildings.

5.41.7. A hot work permit is required to use any equipment exceeding 228°F in a building containing explosives. (T-1).

5.42. Magazine Ventilation and Vermin-Resistance.

5.42.1. Provide magazines with appropriate means of air circulation or dehumidification, when required by civil engineering, logistics, or health directives.

Note: Do not install ventilators in 3-bar or 7-bar rated earth-covered magazine designs unless allowed by the DDESB approved definitive design drawing to ensure the ECM’s strength rating is not affected.

5.42.2. Magazine vents (when installed or repaired) must prevent the entry of sparks and burning embers, or have fusible links to close the vents when an outside fire threatens the magazine. Where fusible links are installed, leave unpainted, and ensure they are serviceable, properly installed, and rated for a maximum temperature of 155°F to 165°F (68.3°C to 73.8°C) NSN 4210-00-033-6032 or suitable substitute. Existing magazine vents that do not prevent the entry of sparks and burning embers may continue to be used until
repaired or replaced; however, it is strongly recommended that these vents be evaluated by civil engineering (base fire marshal or designate) for their ability to prevent the entry of sparks and burning embers.

5.42.3. Provide magazines with vermin resistance, when required by civil engineering, logistics, or health directives.

Section 5J—Emergency Exits for Explosives Buildings


5.43.1. Exterior fire escapes from a building with two or more stories must be of non-combustible material and are separated from the interior of the building by fire-resistant walls.

5.43.2. Arrange fire escape stairs so they are exposed to the smallest number of window and door openings. Protect all openings as required by the NFPA 101.

5.43.3. Fire walls are designed to limit the spread of fire to only one zone of a facility. They are normally extended through the roof of the building to prevent a fire on one side of the fire wall from immediately spreading to the remainder of the facility. Construct proposed fire walls as prescribed in UFC 3-600-01, Fire Protection Engineering for Facilities. Protect any openings through the fire wall as described in the NFPA 80, Standard for Fire Doors and Other Opening Protectives, and NFPA 221, Standard for Fire Walls and Fire Barrier Walls.

5.44. Building Exits.

5.44.1. One properly located exit is suitable for small operating rooms or cubicles having substantial dividing walls on three sides.

5.44.2. In larger buildings or rooms, at least two exits remote from each other (regardless of dimensions), will be provided for each operating room or building containing explosives. (T-1).

5.44.3. If more than eight persons are occupying a room containing explosives, have more than one exit or one exit for each multiple of five persons (or fraction thereof). Coordinate with the installation’s Ground Safety (SEG) and Fire Marshall for the number of exits required based on occupancy.

5.44.4. Exits must be at least 32 inches wide by 80 inches high. (T-1). However, in determining the total number of exits required, available space (in multiples of 32 inches of width) may be considered additional exit units. Space exits equally about the perimeter of the building. Refer to NFPA 101, paragraph 7.2.1.2.3.2., for exceptions to the 32 inch width.

5.44.5. Exits must be IAW requirements outlined in NFPA 101. (T-1). Exits must lead directly outside. (T-1). Plan each exit to avoid obstructing the escape of personnel. Do not place explosives, equipment, and operating materials between personnel and exits.

5.45. Exit Doors.

5.45.1. ECM doors are not authorized for new construction projects used as operating locations or for existing ECMs converted to use as operating locations. Existing operating
locations using ECM doors may be grandfathered if the ESP has been formerly approved by the DDESB or AFSEC/SEW.

5.45.2. Exit doors in operating buildings will open outward. (T-1).

5.45.3. During operating hours, exit doors may be fastened with dead-bolt panic hardware that cannot be operated from the outside.

5.45.4. Exit doors must never be less than 32 inches (refer to NFPA 101, paragraph 7.2.1.2.4. for exceptions to the 32 inch width) by 80 inches high. (T-1).

5.45.5. Do not obstruct exit doors or departure routes.

5.45.6. Exit doors must be panel or flush surface type construction except for existing storage magazines already approved by AFSEC/SEW or DDESB. (T-1).

5.45.7. Vision panels in each door are desirable. The using agency may omit them for security. Vision panels must be in the upper half of the door, not exceed 100 square inches, glazed with acrylic plastic or equivalent material and be of shatter resistant, non-combustible material or slow-burning material of a type that is practically smokeless. (T-1). The requirements of Section 5B do not apply to vision panels in exit doors.

5.46. Safety Chutes. Provide safety chutes as exits from multistory hazardous locations where rapid egress is vital and cannot be otherwise provided.

5.46.1. Make supporting members for safety chutes of non-combustible materials and anchored to structural members designed to provide resistance to the effects of an explosion or fire.

5.46.2. Provide these chutes for work levels above the ground floor and placed on opposite sides of the operation (so that people will not be trapped by a fire between them and a single chute).

5.46.3. Exits to safety chutes will open on a platform at least three feet square, equipped with guardrails. (T-1). The chutes will begin at the outside edge of the platform.

5.46.4. Landings from safety chutes must be located where escape routes will be free from tripping hazards, low guy lines, drains, ditches, or other obstructions. (T-1).

5.46.5. A manual or automatic tripping device must be installed at or near the entrance to chutes to give an alarm in the operating building and nearby structures. (T-1). This tripping device may also actuate deluge valves and water curtains in the building or room affected.

5.46.6. Recommended safety chute dimensions and construction requirements include a 40-50 degree angle with the horizontal; a 24 inch depth, and a 12 inch radius at the bottom. The lower end of the chute will not be over 24 inches above the ground and will have enough of a horizontal run to prevent an injury to the employee because of the rate of fall (induced speed) during the exit.

5.46.6.1. Chutes 40 feet long require six feet of horizontal run.

5.46.6.2. The juncture of sections will be well-rounded and must overlap in the direction of travel.
Section 5K—Explosive Dust Collection Systems

5.47. Vacuum Collection. Vacuum (aspirator) systems with a wet-type collector that moistens explosive dust close to the point of origin and keeps it wet until the dust is removed for disposal are preferred. However, some dusts, (e.g., Explosive D) must be collected in a dry-type system.

5.47.1. Arrange vacuum systems so each type of explosive is collected separately or so dissimilar hazards (e.g., black powder with lead azide) are not mixed.

5.47.2. Provision must be made for the proper liberation of gases that may be formed in a vacuum system.

5.47.3. Vacuum systems used to collect more sensitive explosives (such as black powder, lead azide, mercury fulminate, tracer, igniter, incendiary compositions, and pyrotechnic materials) must be used only for operations with fuzes, detonators, small arms ammunition, and black powder igniters. (T-1). Wet-type collectors are required, with a compatible wetting agent close to the point of intake. (T-1).

5.48. Location of Dry-Type Collection Chambers.

5.48.1. Stationary dry-type collection chambers must be located outside of operating buildings, in the open or in a separate building used exclusively for collection chamber. (T-1).

5.48.1.1. A protective barrier [e.g., operational shield, barricade, SDW] is required between the operating building and the outside location or separate building where the vacuum collection chamber is placed. (T-1).

5.48.1.2. If the chamber contains 25 pounds of explosives or less, locate the protective barrier at least eight feet from the operating building.

5.48.1.3. If the chamber contains more than 25 pounds of explosives, the protective barrier will be separated from the operating building by a minimum of ILD based on the quantity of explosives in the chamber. (T-1).

5.48.1.4. When it is not practicable to locate dry-type vacuum collection chambers outside the operating building, a separate room within the building may be set aside for the purpose. This room must not contain other operations and never be used as a communicating corridor or passageway between other operating locations within the building when explosives are being collected. (T-1). If more than one collection chamber is placed in the room, subdivide the room into cubicles separated by SDWs. Not more than one collection chamber will be in a single cubicle.

5.48.2. Do not place portable dry-type vacuum collectors in a bay or cubicle where explosives are present. If they do not contain more than five pounds of explosives, they may be placed outside the building or in a separate cubicle with SDWs. If they contain more than five pounds, the requirements for stationary collectors apply.

5.49. Location of Wet-Type Collection Chambers. If stationary and portable wet-type collection chambers do not contain more than five pounds of explosives, they may be placed in operating bays or cubicles. If placed in separate cubicles, the limits for each one may be 15 pounds. If they contain more than 15 pounds, the location requirements for dry-type collectors will apply.
5.50. **Design and Operation of Collection Systems.**

5.50.1. Electrically ground the entire system and test the grounds semiannually.

5.50.2. Design the system so that metal parts do not pinch explosives or explosive dusts.

5.50.3. Pipes or tubes through which dust travels must have flanged, welded, or rubber connections. Threaded connections are not allowed.

5.50.4. Design the system to reduce accumulation of explosive dust in parts other than the collection chamber.

5.50.5. Use long radius turns (centerline radius at least four times the diameter of the duct) in the duct work.

5.50.6. Keep the number of points of application of vacuum to a minimum.

5.50.7. Each room requiring vacuum collection must have a separate exhaust line to the primary collection chamber. (T-1). Service no more than two bays by a common leader to the primary collection chamber.

5.50.8. The vacuum line must be as short as possible from points of application of vacuum to the wet collectors.

5.50.9. Keep the number of wet primary collectors serviced by a single secondary collector at a minimum. Connect no more than two dry primary collectors to a single secondary collector (wet or dry-type).

5.50.10. If an operation does not create an airborne concentration of dust, a manually operated suction hose to remove explosive dust is preferred.

5.50.11. Do not connect manually operated hoses to explosive dust-producing machines. A permanent attachment increases the risk of propagation through the collection system should a detonation occur at the dust-producing machine.

5.50.12. In dry vacuum collection systems, install two collection chambers in series, ahead of the pump or exhaust.

5.50.13. Wet collectors must provide for immersion of explosives to break up air bubbles, to release airborne particles, and to remove airborne moisture before it leaves the collector. (T-1). This keeps moistened particles of explosives from entering the small piping between the collector and the exhaust or pump.

5.50.14. Remove explosive dust from the collection chamber at least once each shift to eliminate unnecessary and hazardous concentrations of explosives. (T-1). Clean the entire system weekly (T-1), dismantling the parts if necessary.

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**Section 5L—Water Supply and Fire Suppression Systems for Explosives Facilities**

5.51. **Water Supply for Explosives Manufacturing Areas and Loading Plants.** Install an outside, underground, looped system of mains. The water distribution system will meet the requirements of UFC 3-600-01 and the NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*. (T-1). Mains will be valved properly and will not extend under explosives locations.
5.52. Automatic Sprinkler Systems.

5.52.1. Certain buildings in explosives manufacturing, surveillance, and inspection or ammunition workshop areas (e.g., the receiving building in a load line) may require automatic sprinkler systems. Determine the proper system by engineering studies of the hazards involved. Also, equip each system with an audible warning device to alert personnel. Connect sprinkler systems in each building into the central alarm location and install sprinkler systems as prescribed in UFC 3-600-01. (T-1).

5.52.2. When explosives facilities are placarded for “Apply No Water”, automatic sprinkler systems will only be disabled after a risk assessment has been accomplished/approved by the local fire chief. If the risk assessment indicates the continued use of the automatic system is appropriate (e.g., to keep a potential fire from reaching the explosives items), the presence of the “Apply No Water” and an operable automatic sprinkler system does not constitute a violation of this standard. In all cases, the audible warning device must remain operable. (T-1).

5.53. Deluge Systems. Machinery or operations in which there is a process fire hazard will have an auto deluge system as required by an engineering study.

5.53.1. Use quick-acting sensors such as ultraviolet detectors. In addition, provide hand-operated, quick-acting deluge control equipment.

5.53.2. Actuate control devices by rate of rise, fixed temperature, or their combination, as appropriate. If the system contains electrical components, place the controls in enclosures approved by the NEC.

5.53.3. Charge deluge systems with steam, water, or chemicals. This depends on the expected character of the fire to be controlled, as determined by engineering studies of the hazards and NFPA 13, Standard for the Installation of Sprinkler Systems, and NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.

5.53.4. If there are two or more deluge systems in the same fire area, supply mains and the arrangements and size of the system riser will provide each system with the required quantities of water per head.

5.53.5. A device will be installed on the supply side of the system so that it will actuate an audible warning device in affected operating areas when the pressure fails.

5.53.6. Stop operations protected by a deluge system immediately if the system fails and do not resume until adequate protection is provided.

Section 5M—Monitoring of Design and Construction of Explosives Facilities

5.54. Monitoring of Design of Explosives Facilities. Weapons Safety and Civil Engineering must jointly ensure the design requirements of this Chapter, and Chapters 4 and 6, are properly incorporated into design specifications (to include the statement of work when design and construction effort is being contracted) and as-built drawings for new explosives facilities. (T-1). Additionally, those requirements that apply to nuclear weapon storage, maintenance, and handling facilities as defined in AFMAN 91-118, Safety Design and Evaluation Criteria for Nuclear Weapon Systems, must also be addressed in construction planning of new facilities for these purposes. (T-1).
5.55. Monitoring of Construction of Explosives Facilities. In regards to the actual construction of explosives facilities, Weapons Safety and Civil Engineering must jointly:

5.55.1. Ensure compliance with the final approved construction drawings with regard to design requirements driven by explosives safety considerations. (T-1).

5.55.2. Ensure any changes that affect explosives safety considerations are reflected on the as-built drawings and the ESP updated if necessary. (T-1).

5.55.3. Ensure that the actual construction location of sited explosives facilities complies with the approved ESP. (T-1).

5.55.4. Ensure temporary construction workers are provided protection from explosives in nearby facilities per paragraph 12.17.11. (T-1).

5.55.5. Ensure explosives in nearby facilities are protected from temporary construction operations. (T-1). Give consideration to fire hazards and radio frequency (RF) hazards.

Section 5N—Maintenance and Repair of Explosives Facilities and Equipment

5.56. Removal of Explosives. Supervisory and weapons safety personnel will determine, based on a risk assessment, whether explosives must be removed prior to performing maintenance and repair of explosives facilities, or maintenance and repair of equipment in explosives facilities (see Chapter 4). (T-1).

5.56.1. Only perform maintenance and repair in the interior of an ECM that contains bulk explosives if the explosives are physically protected and a risk assessment shows that hazards to the explosives can be adequately controlled (see Chapter 4). (T-1).

5.56.2. Because electricians are not allowed to work on live electrical equipment while wearing conductive shoes, remove all explosives from areas with conductive floors before proceeding with the electrical work. (T-1).

5.57. Requirements for Maintenance and Repair With Explosives Present.

5.57.1. Brief maintenance personnel on the hazards involved and precautions needed to perform the work safely, and actions to take in the event of an accident. (T-1). This includes self-help projects.

5.57.2. If hazards warrant, trained weapons safety personnel must monitor repair activities for safety. The monitor will halt repair activities when, in their opinion, hazards are being created. (T-1). The senior supervisor of the facility will resolve the problem before resuming operations. (T-1).

5.57.3. Keep floor clean and free of extraneous materials and equipment in immediate area.

5.57.4. Hot Work.

5.57.4.1. Do not use flame or heat-producing equipment inside the facility unless facility contents are protected from the flame, sparks and heat by physical separation or shielding. (T-1).

5.57.4.2. Keep flame or heat-producing equipment used outside the facility as far as practicable from all explosives (to include explosives in nearby facilities). When needed, use baffles and screens to confine sparks and flames.
5.57.4.3. Meet requirements of AFI 91-203.

5.57.4.4. Notify the fire department before work begins. (T-1).

5.57.5. Maintenance personnel must wear conductive footwear in areas with conductive floors. (T-1).

5.57.6. Ensure RF hazards presented by maintenance and repair operations are evaluated and controlled IAW AFI 91-208.

5.58. Maintenance of Explosives Facilities.

5.58.1. Annually check the depth of the earth cover on ECMs to ensure it is at least two feet. (T-1). MAJCOMs may require more frequent inspections based on environmental conditions. ECMs with a suitable material finish (e.g., geotextiles, gunite, asphalt) do not require a depth check as long as there are no signs of the earth cover washing out from underneath the suitable material. If the earth cover erodes to less than two feet, repair as soon as practical (not to exceed 90 days) or classify as an above-ground magazine.

Note: Barricaded above-ground magazine criteria may be used if the remaining earth cover meets the barricade criteria of Section 6E.

5.58.2. Periodically check ventilators to ensure they function properly. Ventilators may be closed where blowing snow or humid air would increase condensation. They may also be closed to protect supplies from blowing sand. Set up controls to make sure heat does not build up within the storage space.

5.58.3. Periodically check fusible links to ensure they are unpainted, serviceable, properly installed, and temperature-rated per paragraph 5.42.2.

5.59. Maintenance and Repair in Hazardous Locations. Before beginning maintenance and repair in a hazardous location, a weapons safety representative will ensure the area is inspected for the presence of explosives residue. Maintenance personnel must provide for the removal of all hazardous materials, to include removal of all explosive residue material from equipment, crevices beneath floors, within walls and pipes, and under fittings where explosives may have collected and thoroughly wash down the area.

5.60. Maintenance and Repair of Hazardous Location Equipment and Electrical Installations. Extraordinary care will be taken in the maintenance and repair of equipment and electrical installations in hazardous locations.

5.60.1. Equipment and electrical installations must be periodically inspected and maintained by qualified personnel, with a written record kept of the inspections and maintenance. (T-1). Where inspection frequency is not prescribed in a TO, technical manual (TM), or other directive, the inspection period will be decided by the local fire chief on the basis of the existing situation. (T-1).

5.60.2. Before repairs are allowed on any equipment or electrical installation that has been exposed to explosive residue contamination, clean the equipment and tag it. (T-1). The operating supervisor must sign the tag, certifying that all explosives have been removed. (T-1). If it has been impossible to clean some part, note this on the tag, together with clear instructions to maintenance personnel on how to handle it safely.
5.61. **Maintenance and Repair of Electrical Equipment.** Only qualified persons are authorized to maintain and repair electrical equipment. Where the equipment may have been exposed to explosives contamination, the explosives will be removed or neutralized before repairs are started.

5.62. **Post-Maintenance and Repair of Explosives Facilities and Equipment.**

5.62.1. Inspect the facility after completion of the work to ensure it is safe for resumption of explosives storage or operations.

5.62.2. Examine and test newly repaired equipment to ensure its safe operating condition before resuming use of the equipment.

**Table 5.1. Lightning Sideflash Policy for Nuclear Weapon Configurations.**

<table>
<thead>
<tr>
<th>Weapon</th>
<th>Configuration</th>
<th>Sideflash Policy Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>W80, W84, W78, W87</td>
<td>All TO 11N-WXX-1 Configurations¹</td>
<td>No separation distance required</td>
</tr>
<tr>
<td>B83</td>
<td>Less than a fully-assembled forward assembly²</td>
<td>Apply separation distance IAW paragraph 5.23.4.</td>
</tr>
<tr>
<td>B61</td>
<td>Major Maintenance³</td>
<td>Apply separation distance IAW paragraph 5.23.4.</td>
</tr>
</tbody>
</table>

**Notes:**

1. Maintenance Actions accomplished IAW Special Procedures, Alts or Mods must be reviewed and approved IAW AFI 91-103. Sideflash policy requirements must be determined on a case-by-case basis and properly documented via Special Procedures, Alts or Mods.
2. See 11N-B83-1A, *Assembly, Test, Maintenance, and Storage Procedures with Illustrated Parts Breakdown; B83-0/-1 (Supplement).*
3. Major Maintenance is any activity where major sub-assemblies are separated.
Chapter 6

PROTECTIVE CONSTRUCTION AND SPECIFIC EXPLOSIVES FACILITY DESIGNS

Section 6A—Introduction


6.1.1. This Chapter contains standards for construction of earth-covered magazines (ECM), barricaded open storage modules, barricades, revetments, substantial dividing walls, firewalls, and multicube or segregated magazines.

6.1.2. Facilities constructed per this Chapter:

6.1.2.1. Are permitted to use reduced separation distance criteria as shown in Chapter 12.

6.1.2.2. Must meet all the other design criteria of Chapter 5.


6.3. Special Structures. The DDESB has approved reduced NEWQD and reduced QD for AGM and containers listed in DDESB TP 15, Approved Protective Construction. Use and siting of these AGM and containers must meet all conditions or restrictions specified in the design and approval documentation as described in the referenced document.


Section 6B—Protective Construction

6.5. Purpose of Protective Construction. Construction features and location are important safety considerations when planning facilities. Potential explosions’ effects may be altered significantly by construction features that limit the amount of explosives involved, attenuate blast overpressure or thermal radiation, and reduce the quantity and range of hazardous fragments and debris. The major objectives in facility planning are:

6.5.1. Protection against explosive propagation between adjacent bays or buildings and personnel protection against death or serious injury from incidents in adjacent bays or buildings. Consider the construction of separate buildings to limit explosive propagation, rather than the use of either protective construction or separation of explosives within a single building when safety would be greatly enhanced or cost would be significantly reduced.

6.5.2. Protection of assets, when warranted.

Note: Proper location of ES in relation to PES helps minimize unacceptable damage and injuries in the event of an incident.
6.6. **Requirements for Use of Protective Construction.** Hardening an ES or constructing a PES to suppress explosion effects and provide an appropriate degree of protection may allow a reduction of the separation distances required by QD tables.

6.6.1. Accomplish design of explosion resistant facilities by an organization or individual experienced in the field of structural dynamics using design procedures accepted by professionals in the field. UFC 3-340-02 (formally known as TM-5-1300), is an appropriate source of effects data and design methods.

6.6.2. Existing, Approved Protective Construction Designs. DDESB TP 15 documents previously approved protective construction designs. An ESP using approved protective construction designs must:

6.6.2.1. Reference the DDESB approval memorandum. (T-1).

6.6.2.2. Identify the design or drawing numbers used, if available. (T-1).

6.6.2.3. Specify that the protective construction will be used in the same manner as that stated in the referenced in the DDESB approval memorandum. (T-1).

6.6.2.4. State that the structural design has not been altered in any manner that impacts the design’s integrity or its ability to provide the required level of protection. (T-1).

6.6.2.5. State that the site specific adaptations of the design have been reviewed and are appropriate for the site conditions. (T-1).

6.6.3. Modifications to Previously Approved Protective Construction Designs. For a protective construction design previously approved by the DDESB, where a structural aspect of the protective design has been modified by a structural engineer with experience in designing blast resistant structures, the submitting MAJCOM must provide:

6.6.3.1. A complete description of the structural modifications made, the reasons for the modifications, and any explosives safety impact resulting from the modifications.

6.6.3.2. The basis of design and the explosives safety protection being afforded by the modified design.

6.6.3.3. The following protective construction design and MAJCOM review data:

6.6.3.3.1. For preliminary DDESB approval, concept structural design drawings that are at least 35 percent complete. For final DDESB approval, the structural design drawings must be at least 60 percent complete, with all protective construction design modifications sufficiently developed for validation.

6.6.3.3.2. Design calculations for all critical structural elements.

6.6.3.3.3. All applicable electrical, grounding, and LPS details.

6.6.3.3.4. Supporting blast analysis, experimental data reports, blast design calculations, and other technical information. Blast analysis and design calculations must satisfy UFC 3-340-02 requirements.

6.6.3.3.5. A memorandum from the submitting MAJCOM Civil Engineer or AFIMSC Detachment Commander verifying that the protective construction design modifications comply with DoD 6055.09-M and UFC 3-340-02 requirements. Base
this verification upon a quality control review (unless a more detailed independent technical review is warranted based upon either the lack of experience by the designer or the use of a new, unvalidated blast analysis or design approach) by a competent DoD blast design agency such as the Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EEWC) or the US Army Engineering and Support Center, Huntsville (USAESCH). Because both of these organizations operate on a cost reimbursable basis, projects must arrange payment for these organization’s services.

6.6.3.3.6. AFSEC/SEWC will provide appropriate contact information upon request.

6.6.4. New Protective Construction Designs. For a new protective construction design, the submitting MAJCOM must provide:

6.6.4.1. The criteria being met; a complete description of both the design’s capabilities and the basis for the design, and the level of explosives safety protection level it affords.

6.6.4.2. The following protective construction design and MAJCOM review data:

6.6.4.2.1. For preliminary DDESB approval, concept structural design drawings that are at least 35 percent complete. For final DDESB approval, the structural design drawings must be at least 60 percent complete, with all protective construction design modifications sufficiently developed for validation.

6.6.4.2.2. Design calculations for all critical structural elements.

6.6.4.2.3. All applicable electrical, grounding, and LPS details.

6.6.4.2.4. Supporting blast analysis, experimental data reports, blast design calculations, and other technical information. Blast analysis and design calculations must satisfy UFC 3-340-02 requirements.

6.6.4.2.5. A memorandum from the submitting MAJCOM Civil Engineer or AFIMSC Detachment Commander verifying that the protective construction design complies with DoD 6055.09-M and UFC 3-340-02 requirements. This verification will be based upon a quality control review (unless a more detailed independent technical review is warranted based upon either the lack of experience by the designer or the use of a new, unvalidated blast analysis or design approach) by a competent DoD blast design agency such as the Naval Facilities Engineering Services Center (NAVFAC EEWC) or the US Army Engineering and Support Center, Huntsville (USAESCH). AFSEC/SEWC will provide appropriate contact information upon request. Because both of these organizations operate on a cost reimbursable basis, projects must arrange payment for these organization’s services.

6.6.4.3. Once approved, a standard protective construction design can be site-adapted, provided the conditions and limitations of the DDESB approval are met. The DDESB will document new standard approved protective construction designs in DDESB TP 15.

Section 6C—Earth-Covered Magazines

6.7. Earth-Covered Magazines. An ECM's primary purpose is to protect AE. To qualify for the default IMD in Table 12.1., an ECM, acting as an ES, must not collapse. Although
substantial permanent deformation of the ECM may occur, provide sufficient space to prevent the deformed structure or its doors from striking the contents.

6.8. Earth-Covered Magazine NEWQD Limits. ECMs may be approved for storage of up to 500,000 lbs NEWQD of HD 1.1 IAW paragraph 12.6.1.

6.9. Earth-Covered Magazine Design Load Criteria. ECMs must be designed to withstand the following:

6.9.1. Conventional (e.g., live, dead, snow) loads for the barrel and rear wall of an arch-shaped ECM.

6.9.2. Conventional (e.g., live, dead, snow) and blast-induced loads for the roof, rear wall, and side walls of a flat-roofed ECM.

Note: Undefined ECMs must meet the criteria of paragraphs 6.9.1. through 6.9.3. only.

6.9.3. Expected blast loads, as applicable:

6.9.3.1. On the head wall and door of 3-Bar ES ECM is a triangular pulse with peak overpressure of 43.5 psi and impulse of 11.3W^{1/3} psi-ms.

6.9.3.2. On the head wall and door of 7-Bar ES ECM is a triangular pulse with peak overpressure of 101.5 psi and impulse of 13.9W^{1/3} psi-ms.

6.9.3.3. On the roof of a flat-roofed ES ECM is a triangular pulse with peak overpressure of 108 psi and impulse of 19W^{1/3} psi-ms.

6.10. Earth-Covered Magazine Earth Cover Criteria.

6.10.1. Earth cover will be reasonably cohesive and free from harmful (toxic) matter, trash, debris, and stones heavier than ten pounds or larger than six inches in diameter. Solid or wet clay or similar types of soil will not be used as earth cover because they are too cohesive. The larger of acceptable stones must be limited to the lower center of fills and must not be used for earth covered magazines. Compact and prepare the earthen material, as necessary, for structural integrity and erosion control.

6.10.2. If it is impossible to use a cohesive material (e.g., in sandy soil), or where vegetation growth is ineffective in preventing erosion, finish the earth cover over ECM with a suitable material (e.g., geotextiles, gunite, asphalt) that will not produce hazardous debris, but will ensure structural integrity. The important consideration for these materials is that they pulverize in the event of an accidental explosion. A mixture combined with straw, bark, or comparable material would be suitable. Wire mesh may be used in the finishing material. Aggregate may not be added to the finishing material. Consider means of validating earth cover depth as part of the design of the finishing material. Reference TM 5-630, Natural Resources and Land Management, for further information.

6.10.3. Select vegetation for ECM so that their weight or root system will not damage the structure.

6.10.4. The earth fill or earth cover between ECM may be either solid or sloped. Maintain a minimum of two feet of earth cover over the top of each ECM.
Note: If the specified thickness and slope of earth on the ECM is not maintained, site the ECM as an AGM. Barricaded AGM criteria may be used if the remaining earth cover meets the barricade criteria of Section 6E.

6.10.5. See paragraph 5.58.1. for maintenance of earth cover on ECMs.

6.11. Earth-Covered Magazine Drawings.

6.11.1. DDESB TP 15 provides listings of the various types of ECM that have been constructed over the years and identifies their structural strength designator (i.e., 7-Bar, 3-Bar, or Undefined). This reference also lists the 7-Bar and 3-Bar ECM designs that are currently approved for new construction.

6.11.2. If an ECM's drawing number or numbers are not listed in DDESB TP 15 treat it as an undefined ECM, until a structural analysis is performed to show that the ECM qualifies for another structural strength designation, or support documentation is provided to prove the ECM had been approved by the DDESB with a different structural strength designation.

6.11.3. For existing, arch-shaped undefined ECM, U. S. Army Corps of Engineers (USACE) Report HNDDE-0S-S-95-01, Guide For Evaluating Blast Resistance Of Nonstandard Magazines, may be used to determine if an Undefined ECM could qualify as a 7-Bar or a 3-Bar ECM.

6.11.4. DDESB approval is required prior to any change in an ECM's structural strength designator. (T-0).

6.11.5. Certain ECMs have been approved with reduced NEWQD and reduced QD and these are also listed in DDESB TP 15. Use of these ECMs requires that their use and siting meet all conditions and restrictions specified in the design and approval documentation, as described in the referenced document.

6.11.6. New construction of previously DDESB-approved 7-Bar and 3-Bar ECM must meet the minimum requirements of the current revisions of the approved drawings.

Section 6D—Barricaded Open Storage Modules

6.12. Barricaded Open Storage Modules. Modules allow the same amount of explosives to be stored using far less land space. However, in the event of an unplanned detonation in a cell, AE in an adjacent cell will be covered with earth and unavailable for use until extensive uncovering operations and possibly maintenance are completed. To reduce the MCE expected from an explosion in one cell, buffered storage arrangements may be used as described in paragraph 12.69.

6.13. Barricaded Open Storage Modules NEWQD and AE Type Limits.

6.13.1. The maximum NEWQD permitted to be stored within each cell is 250,000 lbs. Normal mixing rules apply (see paragraph 12.7.). HD 1.4 is not additive to the NEWQD.

6.13.2. Limit storage to AE that will not promptly propagate explosions or mass fire between modules, and that are not susceptible to firebrands and fireballs. These restrictions allow storage at K1.1 separation. IM distance for HD 1.2.x. and 1.4 for module to module separation is based on total NEWQD. MCE and Largest Single Round NEWQD (LSRN) are
not used to calculate IM distance between modules. Only the following AE are approved for modular storage:

6.13.2.1. HE bombs (fuzed or unfuzed, with or without fins), and similarly cased HD 1.1 AE when stored on nonflammable pallets.

6.13.2.2. The items listed below when contained in nonflammable shipping containers:
   6.13.2.2.1. 30 mm and smaller AE.
   6.13.2.2.2. CBU.
   6.13.2.2.3. Inert AE components.
   6.13.2.2.4. HD 1.4 AE.

6.13.3. Minimize module storage of AE items in flammable outer-packaging configurations. Cover AE items in flammable outer packaging configurations with fire retardant material. Do not store combustible dunnage or other flammable material in, or within, 100 feet of modules.

6.13.4. When fire retardant materials are used to cover AE items stored in modules, provide ventilation between the covers and the stored AE items to minimize the effects of solar heating upon the stored AE.

6.13.5. Limit AE stored in each module to one type of item, unless the MAJCOM/SEW authorizes mixed storage. Mixed storage of HE bombs and CBUs presents an extreme fragment hazard and must be avoided.


6.14.1. As depicted in Figure 6.1., a module is a barricaded area composed of a series of connected cells with hard surface (e.g., concrete, packed earth, engineered materials, etc.) storage pads separated from each other by barricades.

6.14.2. The only restriction on the arrangement of cells within a module and of groups of modules is that cell openings may not face each other, unless they are either barricaded or meet QD criteria for an unbarricaded AGM (see Table 12.1.).

6.14.3. Although a light metal shed or other lightweight fire retardant cover may be used for weather protection for individual cells, heavy structures (e.g., reinforced concrete, dense masonry units) or flammable material will not be used.

6.14.4. Table 6.1. provides the minimum pad sizes necessary to store the NEWQD indicated. The pad's size may need to be adjusted to accommodate specific AE. This adjustment impacts the required barricade height (see Table 6.1., Note 3).

6.14.5. Barricade requirements:

6.14.5.1. All barricades used in forming the module will meet the requirements in Section 6E. (T-1). The width or length of the stack of AE (controlled by the pad size of the cell) and the distances between the stack and the top of the barricade influences the minimum barricade height requirement. The heights listed in Table 6.1. are the minimum requirements for barricade locations. These minimum heights are based upon
both the storage pad sizes and the separations shown. When feasible, increase barricade heights (see paragraph 6.16.2.).

6.14.5.2. Locate the centerlines of barricades between cells of the module at a point halfway between adjacent AE storage pads. Locate back and end (outside) barricades at the same distance from the pads as those between the cells.

6.14.5.3. When selecting a site for a module, take maximum advantage of natural topographical barriers. When used, natural barriers provide the same level of protection as the barricade shown in Figure 6.1.

Section 6E—Barricades

6.15. Barricades

6.15.1. Properly constructed and sited barricades and undisturbed natural earth have explosives safety applications for protecting against low-angle fragments. Barricades provide no protection against high-angle fragments or lobbed AE; some of these high-angle fragments may travel to the outer limits of protection areas set up for PTR and IBD. If the barricade is destroyed in the process of providing protection, then secondary fragments from the destroyed barricade must also be considered as part of a hazards analysis.

6.15.2. To reduce hazards from high-velocity, low-angle fragments, place the barricade between the PES and the ES so that the fragments of concern impact the barricade before the ES. The barricade must both be thick enough so that it reduces fragment velocities to acceptable levels and high enough so that it intercepts the ballistic trajectories of the fragments of concern.

6.15.3. A barricade must interrupt all direct lines of sight between the ES and PES, and, in addition, meet the height and length requirements per paragraphs 6.16. and 6.17. respectively.

6.15.4. Barricades around the ES can be used to reduce minimum separations required by Table 12.1. or fragment distances from 1.2 munitions if tests or engineering analysis show the barrier will stop the low-angle, high-velocity fragments and the building will provide protection from the high-angle fragments that can be expected from the PES. The distance cannot be reduced below that required to provide adequate overpressure protection to the ES.

6.15.5. A secondary barricade at sites of mission-essential equipment and personnel (such as wing communications and trim pads) can provide some additional protection; however, high-angle, low-velocity fragments will still impact the exposed site.

6.15.6. Barricades meeting the requirements of paragraph 6.15.7. may be modified by substituting a retaining wall for the slope on one side. The slope and thickness of the retaining wall (preferably of concrete) must ensure a wide enough top to hold the earth firmly in place.

6.15.7. The slope of an earthen barricade must be two horizontal to one vertical, unless erosion controls are used. Earthen barricades with slopes no greater than one and one half horizontal to one vertical that were approved prior to 1976 may continue to be used. However, renovations to these facilities will meet the above criteria, when feasible.
6.16. Barricade Size and Orientation to Prevent Propagation Due to High-Velocity, Low-
Angle Fragments. Determine the location, height, and length of a barricade to prevent
propagation due to high-velocity, low-angle fragments as follows:

6.16.1. Location. The barricade may be placed anywhere between the PES and the ES;
however, placing it closer to either the PES or ES provides slightly greater asset protection.
For AE stacks of different height (elevation), the location determines the barricade’s required
height.

6.16.2. Height. To determine the required barricade height:

6.16.2.1. Establish a reference point at the top of the far edge of one of the two AE
stacks between which the barricade is to be constructed. When both stacks are of equal
height, the reference point may be established on either stack. If the tops of the two
stacks are not of equal height (elevation), the reference point must be on the top of the
lower stack.

Note: To preclude building excessively high barricades between AE stacks of different height
(elevation), locate the barricade as close as possible to the lower stack (see Figure 6.2.).

6.16.2.2. Draw a line from the reference point to the highest point of the other stack
(line-of-sight).

6.16.2.3. The barricade's height must be drawn so that the entire width of the barricade
crest is at least one foot [0.3 m] above the line-of-sight as established in paragraph
6.16.2.2.

Note: Measure the barricade height at the time of construction as prescribed in paragraph
6.16.2. If the specified thickness and height of the barricade is not maintained, reduce the AE
stack height as necessary or resite the AE stacks appropriately. Consideration should be given to
making the barricade higher than required for safety purposes in order to account for accuracy of
storage practices regarding AE stack heights, potential mission changes (requiring higher AE
stacks), and barricade settling/erosion/etc. that could seriously degrade AE storage capability.

6.16.3. Length. Determine the barricade's length per Figure 6.2.

6.17. Barricade Size and Orientation for Barricaded ILD Protection. Determine the
location, height, and length of a barricade as follows:

6.17.1. Location. Place the barricade anywhere between the PES and the ES. The location
determines the barricade's required height.

6.17.2. Height. To determine the required barricade height:

6.17.2.1. Establish a reference point at the top of the far edge of one of the two AE
stacks between the constructed barricades. When both stacks are of equal height, the
reference point may be established on either stack. If the tops of the two stacks are not of
equal height (elevation), place the reference point on the top of the lower stack.

Note: To preclude building excessively high barricades, locate the barricade as close as possible
to the stack where the reference point was established (see Figure 6.3.). When the exposed site
is not a PES, measure to the top of the ES. If the ES is an uninhabited PES (i.e., a service
magazine), measure to the top of the stack. If the ES is an inhabited PES (i.e., an operating
location), measure to the top of the ES.
6.17.2.2. Draw a line from the reference point to the highest point of the other stack.
6.17.2.3. Draw a second line from the reference point forming an angle of two degrees above the line.

6.17.3. Length. Determine the barricade’s length per Figure 6.3.

6.18. Barricade Size and Orientation for Protection Against Overpressure. General procedures to predict pressure mitigation versus barricade design and location have not been developed. However, based on direct-experimental work, the overpressure loading on a surface area shielded by a barricade is reduced by approximately 50 percent when the following conditions are met:

6.18.1. Overpressure barricades are only approved for use when placed at the front of 7-BAR ECMs as an ES and a fragment barricade is placed at the PES.
6.18.2. Location. The barricade’s standoff is within two barricade heights of the protected area.
6.18.3. Height. The top of the barricade is at least as high as the top of the protected area.
6.18.4. Length. The length of the barricade is at least two times the length of the protected area.

6.19. Barricade Construction Materials. Materials for earthen barricades will be reasonably cohesive and free from harmful (toxic) matter, trash, debris, and stones heavier than 10 pounds or larger than 6 inches in diameter. Limit the larger of acceptable stones to the lower center of fills. Compact and prepare earthen material, as necessary, for structural integrity and erosion control. Do not use solid or wet clay or similar types of soil in barricades because they are too cohesive. If it is impossible to use a cohesive material (e.g., in sandy soil) finish the barricade with a suitable material (e.g., geotextiles, gunite) that does not produce hazardous debris, but ensures structural integrity.


6.20.1. DDESB TP 15 lists DDESB-approved designs and construction materials for barricades. Use of these barricades satisfies barricading criteria.
6.20.2. Alternate barricade designs (e.g., earth filled steel bin) may be approved by the DDESB provided that testing or analysis demonstrates their effectiveness in stopping high velocity, low angle fragments.

6.21. Natural Barricades. Natural barricades (e.g., hills) meeting the requirements of this section are acceptable as barricades. Submit information in the ESP to demonstrate compliance with barricade design requirements, and include topographical maps of the terrain.

6.22. Inspection of Barricades. Inspect barricades at least annually to determine the degree of settling or erosion. MAJCOMs may require more frequent inspection based on environmental conditions. Barricades finished with a suitable material (e.g., geotextiles, gunite, asphalt) do not require a depth check as long as there are no signs of the earth fill washing out from underneath the suitable material. Add fill if a barricade has deteriorated and it no longer provides effective protection. Also inspect wood riveted barricades and replace rotten timbers or planking. Maintain barricades so as to prevent erosion or fire hazards. If the magazine’s earth cover erodes
to less than two foot repair as soon as practical (not to exceed 90 days) or classify as an aboveground unbarricaded magazine.

Section 6F—Earth-Filled, Steel Bin-Type Barricades for Outside Storage

6.23. Earth-Filled, Steel Bin-Type Barricades for Outside Storage.

6.23.1. These barricades, also known as revetments, are earth-filled steel bins used to separate AE awaiting scheduled processing (e.g., AE on a flightline associated with aircraft parking or loading operations; or the temporary positioning of AE awaiting transfer to preferred, long-term storage). These barricades, also used to separate explosive-loaded aircraft, are normally used to form a series of cells. They are designed to limit the MCE, for QD siting purposes, of AE properly positioned in separate cells by preventing propagation to adjacent cells.

6.23.2. When properly sited, these cells prevent propagation; however; all assets in the series of cells are at risk of loss. Although a revetment is effective in limiting the blast loading of an adjacent ES to that produced by the largest contents of a single cell, there is a significant probability that the contents of many of the cells may be damaged or destroyed by the initial and subsequent fire and explosion events. The extent of such losses increases with the amount of explosives present.

6.24. Revetment HD Limits. Revetments cells are approved for storage of any HD 1.1 and HD 1.2 AE assigned to SG 1 through 4 (as discussed in paragraph 3.22.). In addition, storage of HD 1.3, HD 1.4, or HD 1.6 items is approved.

6.25. Types of Revetments.

6.25.1. Type A revetments, which must be a minimum of seven feet thick, can be used to limit a MCE in a series of cells to the largest quantity in a single cell, provided the quantity in the single cell does not exceed 30,000 pounds NEWQD.

6.25.2. Type B revetments, which must be a minimum of 5.25 feet thick, can be similarly used to limit the MCE, provided no cell contains more than 5,000 pounds NEWQD.

6.26. Requirements for Revetments. For revetments to be used effectively, the following conditions must be met:

6.26.1. The criteria shown in Figure 6.2. (T-1).

6.26.2. AE will be positioned no closer than 10 feet from cell walls, no closer than three feet from the end of the wing walls, and no higher than two feet below the top of cell walls. (T-1).

6.26.3. AE will be distributed over the available area within the cell, rather than being concentrated in a small area. (T-1).

6.26.4. AE stored in a cell in quantities near the maximum NEWQD limit will not be configured into a single row of pallets, stacks, or trailers. (T-1).

6.26.5. The storage of AE in flammable outer-pack configurations will be minimized. (T-1).
Section 6G—Substantial Dividing Walls and Blast Doors

6.27. Substantial Dividing Walls. These walls are one way of separating explosives into smaller groups to minimize the effects of an explosion and allow a reduction in QD separation. To receive credit as a dividing wall, reinforced concrete walls must either meet Substantial Dividing Wall (SDW) criteria or be designed IAW the criteria in UFC 3-340-02. These walls may be used to comply with the compatibility group mixing rules given in Chapter 7 provided the required IMD between the substantial dividing walls are maintained as discussed below.

Note: Dividing walls filled with earth or sand, used to compartmentalize magazines must be at least five feet thick with earth or sand packed between retaining walls. Sand-bag type dividing walls will be at least five feet thick, except where approved for other uses as in TO 11N-20-7. See DDES TP 15, Approved Protective Construction, for all storage requirements.

6.27.1. Definition of an SDW. An SDW is a reinforced concrete wall having the following characteristics:

6.27.1.1. A minimum thickness of 12 inches.
6.27.1.2. A minimum steel reinforcing bar of ½-inch diameter (#4).
6.27.1.3. Steel reinforcing bars are spaced not more than 12 inches on center horizontally and vertically, on both faces of the wall, with bars on one face staggered with the bars on the opposite face.
6.27.1.4. Concrete cover over the steel reinforcing bars in approximately 2 inches thick.
6.27.1.5. Concrete has a minimum compressive strength of 2,500 pounds per square inch (psi).
6.27.1.6. SDW main steel is continuous into supports as follows:

6.27.1.6.1. If the SDW is used for prevention of propagation of burning reactions, it must, at a minimum, be adequately supported at the floor.
6.27.1.6.2. If the SDW is used for personnel protection, from either detonation or burning reactions, for remotely-controlled operations, it must, at a minimum, be adequately supported on at least two sides (e.g., the SDW is supported at the floor and with at least one adjacent SDW).

Note: Existing 12-inch reinforced concrete walls originally constructed for explosives operations, explosives storage, or remotely controlled explosives operations are considered adequate for meeting requirements listed in paragraphs 6.28.1.1. through 6.28.1.6.

6.27.2. When an SDW described above is incorporated into a room or cubicle, additional structural considerations must be addressed in order to limit internal pressure build-up within the room or cubicle and assure the capability of the SDW to provide propagation protection to munitions in adjacent rooms or cubicles. For this reason, the following additional criteria apply to a room or cubicle incorporating one or more SDW:

6.27.2.1. A minimum of two surfaces (wall or roof) of the room or cubicle must be open and frangible. A surface is considered frangible if its unit weight ≤ 10 lbs/ft². If a roof is treated as one of the frangible surfaces, then any potential additional dead load must be considered when calculating the roof’s unit weight. In areas where the design ground
snow load, \( p_g \), in ASCE 7, “Minimum Design Loads for Buildings and Other Structures” (latest version) or UFC 3-310-01, “Structural Load Data,” exceeds 20 lbs/ft\(^2\), the calculation of a roof’s unit weight must include consideration of potential snow load. To avoid undue conservatism, the snow load contribution to a roof’s unit weight may be taken as 42 percent of the average roof design snow load, calculated IAW ASCE 7.

6.27.2.2. A minimum scaled vent area \((A_v/V^{2/3})\) of 1.85 will be provided; where \( A_v \) = total area of flammable and open surfaces (ft\(^2\)) and \( V \) = volume of room (ft\(^3\)).

6.27.2.3. When used as a firewall for prevention of propagation of burning reactions, the SDW must be continuous from the floor to the roofline to mitigate thermal effects unless otherwise required by local fire codes to extend above the roof. When used to prevent propagation, the SDW must be at least two feet higher than the AE stacks on either side of the SDW.

6.27.2.4. Those rooms or cubicles containing only materials that are expected to exhibit burning reactions will have adequate venting area; that is, a flammable wall or roof.

6.27.3. Application and use of SDW for prevention of propagation of burning reactions. The following conditions apply to the use of SDW for the prevention of propagation of burning reactions. When these conditions are not met, individual NEWQD of each room or cubicles will be summed together and QD will be based on the summed NEWQD.

6.27.3.1. To prevent propagation in any acceptor room or cubicle separated by an SDW from adjacent donor rooms or cubicles, limit each adjacent donor room or cubicle containing material that will detonate to a maximum of 425 pounds NEWQD or to a loading density (NEWQD/room volume (ft\(^3\))) of < 0.20 pounds/ft\(^3\), whichever is attained first. Limit each adjacent donor room or cubicle containing HD 1.2.1 material to a maximum NEWQD of 5,000 pounds, and to an MCE of 425 pounds or a loading density of (MCE/room volume (ft\(^3\))) of < 0.20 pounds/ft\(^3\), whichever is attained first. Limit each adjacent donor room or cubicle containing HD 1.2.2 material to a maximum NEWQD of 5,000 pounds, and to the largest single item NEWQD/room volume (ft\(^3\)) of < 0.20 pounds/ft\(^3\), whichever is attained first. For HD 1.1 and HD 1.2.1 located in acceptor rooms or cubicles, limit storage to SG 1, 2, 3, and 4 AE only. Place HD 1.1 and HD 1.2 AE no closer than three feet from the nearest wall.

6.27.3.2. To prevent a propagation involving SG 5 in an acceptor room or cubicle separated by an SDW from adjacent donor rooms or cubicles, each adjacent donor room or cubicle containing material that will detonate is limited to a maximum of 20 pounds NEWQD, or to a loading density (NEWQD/room volume (ft\(^3\))) of < 0.01 pounds/ft\(^3\), whichever is attained first. Each adjacent donor room or cubicle containing HD 1.2.1 material is limited to a maximum NEWQD of 5,000 pounds, and to an MCE of 20 pounds or a loading density of (MCE/room volume (ft\(^3\))) of < 0.01 pounds/ft\(^3\), whichever is attained first. Each adjacent donor room or cubicle containing HD 1.2.2 material is limited to a maximum NEWQD of 5,000 pounds. Each adjacent donor room or cubicle containing HD 1.2.3 material is limited to a maximum NEWQD of 5,000 pounds, and to a largest single item NEWQD of 20 pounds or a loading density of (largest single item
NEWQD/room volume (ft$^3$) of $< 0.01$ pounds/ft$^3$, whichever is attained first. HD 1.1 and HD 1.2 AE will be placed no closer than three feet from the nearest wall.

6.27.3.3. To prevent propagation of a burning reaction (i.e., HD 1.3) between adjacent rooms or cubicles separated by an SDW, the NEWQD in each room or cubicle is limited to 5,000 pounds of packaged materials or 300 pounds for unpackaged materials. No standoff distance from the wall is required for HD 1.3.

6.27.3.4. When HD 1.2 and HD 1.3 are mixed together within a room or cubicle restrict their combined NEWQD to 5,000 pounds packaged or 300 pounds unpackaged. The MCE for HD 1.2.1 and the largest single item NEWQD for HD 1.2.3 must comply with the paragraphs above.

6.27.3.5. Mission essential quantities of HD 1.4 located in donor or acceptor rooms or cubicles do not affect the prevention of propagation of a burning reaction. No standoff distance from the wall is required for HD 1.4.

6.27.4. Application and use of SDW for personnel protection during remotely controlled AE operations. The following apply to the use of SDW for personnel protection during remotely controlled AE operations:

6.27.4.1. Separate personnel from operations involving materials that will detonate either by the shorter K24 separation distance when measured over or around an SDW or by the shortest distance that provides 2.3-psi level of protection to personnel. For HD 1.1, use the NEWQD; for HD 1.2.1, use the MCE; for HD 1.2.2, an NEWQD of 1.6 pounds must be used; and for HD 1.2.3, use the largest single item NEWQD.

6.27.4.2. Separate personnel from operations involving only material where a burning reaction is expected by the shorter K8 separation distance when measured over or around an SDW or by the shortest distance that limits the thermal flux to personnel to prevent the onset of second-degree burns (heat fluxes and exposure times experienced by personnel must be less than that given by the equation $t = 200q - 1.46$ where “$t$” is the time in seconds that a person is exposed and “$q$” is the received heat flux in kilowatts (KW) per m$^2$).

6.27.4.3. Protect personnel from fragments and debris having energies of 58 foot-pounds or greater (hazardous fragments). An SDW that is properly supported on two sides (such as a reinforced concrete floor and another SDW) provides such personnel protection from an MCE involving up to 300 pounds of AE expected to burn or up to 8 pounds of AE expected to detonate. The MCE for HD 1.1 is the NEWQD; for HD 1.2.1, use the MCE; and for HD 1.2.3, use the largest single item NEWQD.

Note: For HD 1.2.2, the MCE is less than 8 pounds, by definition.

6.27.5. If any of the SDW criteria discussed above cannot be met, then separately analyze the wall or room design and explosives scenario to determine if equivalent protection is provided by the available wall or room arrangement (e.g., a four wall cubicle, an alternate reinforced concrete wall design, a larger room, a greater standoff, or a smaller quantity of SG 5). The engineering analysis must address the specific conditions according to UFC 3-340-02 criteria to determine the proper wall construction or explosives weight and spacing limitations. DDES&B approval is required for any analysis performed.
6.27.6. ILD level of protection is not addressed by this section. The requirement remains K18 or ILD, as specified in the appropriate tables for the HD in question. Presently, there is no consideration that an SDW or any type of wall provides an equivalent ILD level of protection. However, if an SDW is determined to provide the required personnel protection from a remotely controlled operation, then by default, it can be assumed that K18 protection is also provided by that SDW. Refer to UFC 3-340-02 and MIL-STD 398A, *Shields, Operational for Ammunition Operations, Criteria for Design and Tests for Acceptance*, for personnel protection standards.

6.27.7. For nuclear weapons, the criteria in TO 11N-20-7, *Nuclear Safety Criteria*, when more restrictive, will be the limiting factor and override the above criteria.

6.27.8. The provisions of paragraph 4.19. apply.

**6.28. Blast Doors.** Blast Doors may be required for openings through SDWs. When required, design these doors to be at least equal in strength to the SDW. See UFC 3-340-02 for design factors for new structures. Take care to ensure these doors are not installed as a matter of convenience. Avoid blast doors when a continuous SDW would not unnecessarily interfere with operations.

**Section 6H—Multicube or Segregated Magazines**

6.29. **Multicube or Segregated Magazines.** See Section 6G for guidance. If the NEWQD limit is exceeded in any one cell, maintain compatibility throughout the facility and the total NEWQD of all cells is used to compute QD requirements. See paragraph 12.7. for rules when combining mass detonating with non-mass detonating explosives.

6.29.1. See paragraph 12.7. for determining MCE. When using the provisions in this paragraph, each cell may be considered a separate facility with equivalent IM distance between cells, for determining NEWQD in QD calculations.

6.29.2. A substantial dividing wall that is continuous from the floor to the roofline, unless otherwise required by local fire codes to extend above the roof, may be used to meet equivalent HD 1.3 IMD protection for 5,000 pounds of packaged (shipping or transportation configuration) or 300 pounds of unpackaged HD 1.3 materials.
Figure 6.1. Typical Eight-Cell Barricaded Open Storage Module.

NOTES:
1. Number of cells, cells' NEWQD, pad sizes (P), distances between cells (C) and modules (M), and minimum barricade heights can vary (see Table 6.1).
2. Refer to Section 6E—Barricades for barricade design criteria and for alternate barricade designs.
3. Determined by the installation.
Figure 6.2. Determination of Barricade Length and Height to Prevent Propagation Due to High-Velocity, Low-Angle Fragments.

Notes:
1. This illustration is for sloping terrain; however, a similar approach is used for level terrain.
2. Barricade must meet construction and siting criteria of Section 6E-Barricades.
Figure 6.3. Determination of Barricade Length and Height for Barricaded ILD Protection.

Notes:
1. This illustration is for sloping terrain; however, a similar approach is used for level terrain.
2. Barricade must meet construction and siting criteria of Section 6E.
Table 6.1. HD 1.1 IMD for Barricaded Open Storage Module.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>MINIMUM STORAGE PAD-TO-PAD SEPARATION DISTANCE (“C” IN FIGURE 6.1) (^1,2) (ft)</th>
<th>MAXIMUM PAD DIMENSION (“P” IN FIGURE 6.1) WIDTH OR DEPTH (ft)</th>
<th>MINIMUM HEIGHT ABOVE TOP OF STACK (^3) (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000</td>
<td>41</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>70,000</td>
<td>45</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>100,000</td>
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<td>2</td>
</tr>
<tr>
<td>150,000</td>
<td>58</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>200,000</td>
<td>64</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>200,000</td>
<td>64</td>
<td>40</td>
<td>2.5</td>
</tr>
<tr>
<td>250,000</td>
<td>69</td>
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<td>2.5</td>
</tr>
<tr>
<td>250,000</td>
<td>69</td>
<td>50</td>
<td>3</td>
</tr>
</tbody>
</table>

**Notes:**

1. \( D \) in ft, \( W \) in lbs; \( D = 1.1W^{1/3}; \ W = D^3/1.33 \)
2. AE will not be stored beyond the boundaries of the storage pad.
3. Barricade height based upon size of storage pad. When \( P \) exceeds 50 feet, then the barricade height will be increased 6 in for each 10 foot increase.
Chapter 7

EXPLOSIVES OPERATIONS AND STORAGE

Section 7A—Introduction

7.1. Introduction. This Chapter provides general information about explosives and safety requirements for operations involving explosives and explosives storage requirements, to include compatibility principles and mixed compatibility storage. The absence of specific guidance on a particular explosives operation does not imply that safeguards are not applicable.

Section 7B—Locally Written Instructions

7.2. Locally Written Instructions. Conduct all explosives operations IAW written instructions. Item TOs generally fulfill this requirement, but may not address all local conditions. Locally written instructions may be required to address the items in paragraph 7.3. Locally written instructions may take the form of crew briefings, safety briefings, local operating instructions, etc. The items in paragraph 7.3. may be addressed by one or more of these methods.

7.2.1. Locally written instructions will be:

7.2.1.1. Approved by the squadron Commander or equivalent. (T-1).

7.2.1.2. Coordinated with the weapons safety office and all other involved organizations. (T-1).

7.2.1.3. Available at the work site. (T-1).

7.2.1.4. Written in the language workers understand. (T-1).

7.2.1.5. Briefed to all workers prior to beginning an explosives operation. (T-1). Ensure workers understand the instructions prior to beginning the operation.

7.2.2. Locally written instructions are not required for EOD emergency operations in connection with render safe procedures (RSP) or disposal for level 1 EOD emergency response operations.

7.2.3. Locally written instructions are required for level 2 EOD emergency response operations when the time required to develop and gain approval of these procedures will not compromise safety or increase the risks posed to life, property, health, or the environment due to the unstable condition of the munition(s) under response. See AFI 32-3001, Explosive Ordnance Disposal (EOD) Program, for explosives or munitions emergency response.

7.2.4. Locally produced checklists and work cards concerning nuclear operations require approval according to TO 00-5-1, Air Force Technical Order System.

7.2.5. Develop and process locally produced operating instructions according to AFI 33-360, Publications and Forms Management.

7.3. Contents of Locally Written Instructions. Include the following information, as applicable, in locally written instructions. The MAJCOM will determine if additional items are required.
7.3.1. Personnel limits (see paragraph 7.5.). (T-1).

7.3.2. Explosives limits, including HD and CG of the explosives involved (see paragraph 7.6.). (T-1).

7.3.3. Exact locations where operations are done. (T-1).

7.3.4. Safety requirements, to include special requirements for personal protective clothing, blast and fragmentation hazards, and equipment. (T-1). Additionally, static grounding requirements per Section 7D of this Manual when handling or storing EIDs.

7.3.5. Step-by-step procedures for doing the task (refer to specific steps in the TO for applicable portions of the operation). (T-1).

7.3.6. Actions to be taken during an emergency. (T-1).

Section 7C—General Requirements for Operations Involving Explosives

Note: Before conducting intentional detonation operations involving live munitions (e.g., EOD operations or range clearance, not including the MMRP); evaluate the need for having emergency medical support onsite in the risk assessment.

7.4. Personnel Qualifications.

7.4.1. Train personnel who work with explosives IAW AFI 91-202, The US Air Force Mishap Prevention Program, and qualified in the tasks to be performed. (T-1).

7.4.2. Personnel must understand all safety standards, requirements, and precautions that apply to the operation. (T-1).

7.4.3. The supervisor must be knowledgeable of all hazards involved in the operation, convey emergency procedures to workers, casuals, and visitors, and maintain strict housekeeping standards (see paragraph 7.5.3.). The supervisor must also know what steps to take when abnormal conditions arise. (T-1).

7.5. Personnel Limits. Design explosives operations to ensure minimum exposure of personnel to explosives, in compliance with the cardinal principle (see paragraph 1.1.2.). Supervisors are responsible for enforcing personnel limits.

7.5.1. Buddy System. Good industrial safety practices may dictate use of the buddy system even though only one person may be required to perform the work. Use of the buddy system does not violate the cardinal principle.

7.5.2. EOD Procedures. Conduct EOD procedures IAW requirements of AFI 32-3001, Joint Service EOD 60-Series manuals, and EOD Tactical Decision Aid.

7.5.3. Casuals. Casuals are persons not normally part of an explosives operation but have duties that require their presence, such as quality assurance, safety or inspection personnel.

7.5.4. Visitors. Visitors are non-essential personnel with limited access. Stop operations when visitors are present.

7.5.5. Posting Personnel Limits. Clearly post personnel limits for the operations being conducted at each explosives operating location. Posted limits will distinguish between
supervisors, workers, and casuals. Locally written instructions containing personnel limits will suffice in lieu of posting.

7.5.5.1. Do not post personnel limits at aircraft parking locations, even if used for uploading or downloading explosives.

7.5.5.2. Do not post personnel limits at storage locations or licensed explosives storage locations.

7.6. Explosives Limits. Design explosives operations to ensure minimum exposure of personnel to explosives in compliance with the cardinal principle (see paragraph 1.1.2.). Only the explosives needed to ensure a safe and efficient work flow will be present in an operating location when operations are being conducted and be limited to a one day supply. Attempt to comply with compatibility group mixing requirements, if possible, to minimize the likelihood and severity of a mishap. Supervisors are responsible for enforcing explosives limits (see Section 7K).

7.6.1. Managing Explosives Limits. Use the NEWQD limits from approved explosive site plans when posting limits. Identify the HD and NEWQD explosive limits at all explosives locations, to include MCE for HD 1.2.1, NEWQD of the largest single round for HD 1.2.3, and (xx) for HD 1.2.3. Monitor limits using the following methods:

7.6.1.1. Managed in the Combat Ammunition System (CAS) or other Air Force approved databases when use to track NEWQD at the explosives storage or operating locations.

7.6.1.2. Identified on a properly displayed explosives facility license, AF IMT 2047, at a Licensed location (see Chapter 11).

7.6.1.3. Documented in a locally written instruction (see Section 7B).

7.6.1.4. Posted clearly at storage locations and operating locations.

7.6.2. Posting Operating Limits. For explosives operating locations, clearly post the HD and NEWQD limits (to include MCE for HD 1.2.1, NEWQD of the largest single round for HD 1.2.3, and (xx) for HD 1.2.3) for the operation being conducted, if less than the authorized explosives limits. These limits may be expressed in terms of the specific explosives items, such as “two Air Intercept Missile (AIM)-9 missiles.” Locally written instructions containing HD and NEWQD will suffice in lieu of posting (see Section 7B).

7.7. Housekeeping. The following are minimum precautions:


7.7.1.1. Do not commingle non-explosives waste materials (e.g., oily rags, combustible scrap, wood, paper, and flammable packing materials) with explosives residue.

7.7.1.2. Place non-explosives waste materials in approved, properly marked containers.

7.7.1.3. Place non-explosives waste material containers outside of explosives facilities, except for containers required at work locations during operations.

7.7.1.4. Empty non-explosives waste material containers at working locations as often as needed, but at least once each workday or shift.
7.7.1.5. Contact the base environmental management office for additional guidance for hazardous materials.

7.7.2. Explosives Residue.

7.7.2.1. Provide grounded, covered, self-closing containers for explosives residue and materials containing explosives residue (e.g., rags, clothing).

7.7.2.2. Cover explosives residue and waste materials containing explosives residue with water or oil, if this does not add to the hazard. Number 10 mineral oil is useful for covering pyrotechnic, tracer, flare, and similar mixtures. If using water, immediately immerse the items to reduce production of dangerous gases.

7.7.2.3. Remove explosives residue and materials containing explosives residue at frequent intervals and before leaving at the end of the duty day or shift. Place in the disposal area or an isolated temporary collection point.

7.7.2.4. When using isolated temporary collection points, set up time and quantity limits to ensure timely movement of collected material to the disposal area. Do not store collected material in the disposal area.

7.7.2.5. Dispose of explosives residue and materials containing explosives residue IAW environmental standards and locally written instructions approved by the base environmental management office (see Section 7B).

7.7.3. Cleaning Compounds.

7.7.3.1. Do not use cleaning compounds containing wax or oil on conductive floors or surfaces.

7.7.3.2. Do not use cleaning agents that include caustic alkalis in locations containing explosives residue (sensitive explosives compounds may be formed).

7.7.3.3. Remove explosives residue IAW the item TO.

7.7.3.4. Use non-abrasive cleaning compounds; such compounds are often combustible but not volatile. Closed cup flash point of cleaning compounds must not be less than 230° F.

7.8. Handling of Explosives. This paragraph applies to the handling of explosives and movement of explosives within the immediate vicinity of an explosives operation.

7.8.1. Only trained personnel under the supervision of an individual who understands the hazards and risks involved in the operation are to handle explosives.

7.8.2. Handle detonators, initiators, squibs, and other such electrically or mechanically initiated devices in protective containers during storage, transportation, and inspection. Use containers designed to prevent item-to-item contact. Mark to identify the contents.

7.8.3. Do not use bale hooks to handle explosives.

7.8.4. Do not use nails to secure covers or make repairs on explosives containers unless there is no hazard to the explosive item or danger of penetrating protective coverings. Exercise special care when using pneumatic- or cartridge-activated nail guns.
7.8.5. Do not tumble, drag, drop, throw, roll, or “walk” munitions. Containers designed with skids may be pushed or pulled for positioning.

7.8.6. Do not roll un-palletized conventional HE bombs or other explosives unless authorized by the item TO and lugs or other projections have been removed or if they are protected by dunnage rails.

7.8.7. Do not use conveyors, chutes, hand trucks, or forklifts in atmospheres and locations where they will create hazards.

7.8.8. Interlock and support sections of roller conveyors used to move explosives. Do not use boxes containing explosives or munitions to support conveyors.

7.8.9. Always consider vehicle and handling equipment type, type of load, and prevailing weather and surface conditions when determining if safe movement is feasible.

7.8.10. Restraining devices designed for use with vehicle and handling equipment will be used IAW applicable technical orders.

7.8.11. Do not move explosives rapidly across any non-conductive surface.

7.9. Portable Equipment. Ensure portable equipment meets the requirements listed in AFI 91-203 and the following requirements are adhered to:

7.9.1. UL-listed floodlight systems, mounted on heavy portable stands and placed outside the magazine door or the outdoor working area, may be used where required. Place or protect service cords so that they cannot be walked on or run over by equipment.

7.9.2. Flexible cords must be type SO hard service cord. Splices are not allowed. All flexible cords, receptacles, and attachment plugs must be equipped with three prongs so that the third prong (green wire) acts as ground. Place or protect each electrical cord so that it cannot be walked on or run over by equipment. Do not use flexible cords in place of fixed or installed electrical wiring. Immediately remove damaged flexible cords from service.

Section 7D—Static Grounding

7.10. Static Electricity. Static electricity is created when two different materials come in contact and then are separated again; this includes when the two materials are rubbed against each other. Separated charges accumulate on the two materials, creating a voltage potential that can be discharged when either of the materials is moved close to an uncharged or grounded object. This discharge can cause a mishap if it occurs through, or in the presence of, a hazardous substance susceptible to electrostatic initiation. For this reason, take precaution against performing unnecessary actions that lead to the buildup of static voltages, take action to avoid the prolonged storage of static voltages on personnel or equipment, and take action to discharge static voltages in a safe and controlled manner during operations involving explosives. See Section 5E for the static grounding and bonding system design and inspection requirements.

7.11. Requirement for Static Grounding. See paragraph 7.14. for static grounding techniques and paragraph 7.15. for methods to reduce the buildup of static electricity. Static grounding is required for:
7.11.1. Personnel, equipment, and explosives, when the responsible engineering function has
determined grounding is necessary for specific maintenance or electrical test operations;
grounding requirements will normally be included in the item TO.

7.11.2. Weapons systems in storage as required in the item TO.

7.11.3. Personnel and equipment in hazardous locations (see Section 5C).

7.11.4. Personnel handling EIDs (see Electrically Initiated Devices in Attachment 1). See
paragraph 7.12. for static grounding requirements for handling unpackaged EIDs.

Note: Always avoid directly touching an electrical primer.

7.11.5. Personnel handling exposed explosives (see exposed explosives in Attachment 1).

Note: Static grounding for demolition operations are conducted per applicable 60-series TOs.

7.11.6. Explosive components incorporating an electrical initiating system when undergoing
maintenance; assembly to, or disassembly from, an all-up-round (AUR) configuration; or
electrical connection or disconnection.

Note: Unless required by TO, static grounding is not required when replacing components of
AURs incorporating an electrical initiating system when the replacement operation does not
require electrical connection or disconnection.

7.11.7. Aircraft, when explosives are being loaded or unloaded, as required in paragraph
7.13.

7.12. Static Grounding for Handling Unpackaged EIDs. When EIDs are unpackaged and
handled follow item TO requirements for static grounding and comply with the following:

7.12.1. Personnel must periodically ground themselves. Post signs at entrances and in the
room reminding personnel that periodic grounding is required, except where compliance
would create any additional personnel safety hazard. Install one or more static grounding
bars or devices and require personnel to touch the grounding device before handling the EID
and at frequent intervals while working to discharge any static potential (see paragraph
5.12.2.).


7.12.3. Adhere to the precautions in paragraph 7.15.

7.12.4. Every person who handles exposed EIDs must be careful not to allow the EID’s
electrical contacts to touch any of the metal surfaces of aircraft and missile skin or structure.
Additionally, the handler must actively take precautions against allowing the buildup or
discharge of static electric energy through the EID’s electrical contacts.

7.13. Static Grounding for Aircraft During Explosives Loading and Unloading. Ground
combat and cargo aircraft during explosives loading or unloading operations, except as noted in
paragraphs 7.13.1. and 7.13.2. See TO 00-25-172, Ground Servicing of Aircraft and Static
Grounding/Bonding and applicable aircraft TO for grounding procedures. Personnel handling
the explosives will equalize their static electrical potential to that of the aircraft, vehicle or
handling equipment, before beginning operations and at frequent intervals thereafter to discharge
any static buildup. Ensure the aircraft being loaded or unloaded is not within the hazard zone of
any operating transmitters (see AFI 91-208).
7.13.1. Cargo aircraft do not require grounding during engine running onload/offload (ERO) operations.

7.13.2. Grounding of aircraft during explosives loading or unloading is recommended but not required where there are unusual parking problems in operating from bare or limited bases, nonmilitary airfields, host-nation airfields, etc. This exception does not relieve commands from responsibility for providing proper grounding in locations where operations continue or where parking facilities are required on a recurring basis. Where static grounding facilities are not available at a suitable parking location, use the best alternate method of reducing the hazard in the following order or precedence:

7.13.2.1. Keep static grounding to 10,000 Ohms or less by using grounding rods.

7.13.2.2. Equalize the static electrical potential between the aircraft and the vehicle or handling equipment used in loading or unloading by bonding them together with an approved static ground wire, cable, or strap (see paragraph 5.14.).

Note: It might not be feasible to bond the handling equipment to the aircraft if the handling equipment must move during the operation.

7.14. Static Grounding Techniques. In the absence of TO guidance, this paragraph provides techniques for accomplishing static grounding (see paragraphs 5.13. through 5.15. for further guidance).

7.14.1. Protective clothing is not a substitute for personnel static grounding. Accomplish static grounding of personnel by any of the following:

7.14.1.1. Through the use of wrist-straps connected to the facility ground.

7.14.1.2. By periodically touching a grounded surface (such as an airframe) or a grounding bar.

7.14.1.3. By wearing conductive footwear on conductive floors, mats or runners (see Section 5F), if the floor, mat, or runner is properly grounded.

7.14.2. Accomplish static grounding of equipment by any of the following:

7.14.2.1. Through the use of a static ground wire, cable, or strap between the item to be grounded and the facility ground (see paragraph 5.14.).

7.14.2.2. By using conductive tabletops, or conductive material coverings on the tabletop, if the conductive surface or material is properly grounded.

7.14.3. When making a grounding connection, attach the ground wire, cable, or strap to the item requiring grounding first, then connect the other end of the ground wire, cable, or strap to the approved facility grounding system. This ensures that if a spark occurs, it will occur at the connection to the facility grounding system instead of at the item.

7.14.3.1. If the existing static grounding or bonding reels were permanently attached to the facility ground when installed, a temporary grounding connection using an additional cable must be made first (when possible) following the procedure in paragraph 7.14.3. before connecting the item to the permanent system.

7.14.3.2. When static grounding or bonding reels are installed, either in new or existing facilities, do not permanently attach them to the facility grounding system.
7.14.4. When a different or new ground is needed for an item, always make the new ground connection first (in the same manner as described in paragraph 7.14.2.) before disconnecting the existing ground connection (make-before-break grounding). This ensures that the item is grounded at all times while transitioning from one ground connection to another.

7.15. Methods to Reduce the Hazards of Static Electricity. Personnel can minimize the possibility and severity of both the buildup and discharge of hazardous static electric potentials by observing the following guidance.

7.15.1. Whenever possible, personnel must avoid using rags or wearing outer garments made of materials having high static-generating characteristics (e.g., 100 percent polyester, nylon, rayon, silk, wool, etc.). Wool socks, glove inserts, and caps as well as undergarments of synthetic fabrics are less of a hazard than outer garments such as jackets or pants.

7.15.2. Whenever possible, personnel must use rags or wear outer garments made of cotton or a cotton-synthetic blend.

7.15.2.1. Clothing materials acceptable for flightline use (per Allowance Standard 016, Special Purpose Clothing and Personal Equipment) are acceptable for handling munitions; this includes Gortex even though it is 100 percent nylon.

7.15.2.2. When clothing is worn that has a high static-generating characteristic, such as Gortex or some flak vests, emphasize the techniques listed for controlling the discharge of any generated potentials.

7.15.3. Minimize exposure to conditions which aid the buildup of static electricity such as cold, dry climates or dry, windy climates.

7.15.4. Minimize activities which aid the buildup of static electricity such as physical motion or contact with moving non-conductive substances.

7.15.5. Control the discharge of any generated static electric potential by touching a static grounding bar or device (or by equalizing it to that of the system being handled) prior to touching the system and at frequent intervals during operations.

7.15.6. Minimize activities which can cause an uncontrolled discharge of static electric potential such as the quick or repeated removal of outer garments.

Section 7E—Testing, Procedures Verification, Disassembling and Modifying Explosives Items

7.16. Requirements for Test, Disassembly, and Modification of Explosives Items.

7.16.1. Modify, test, or disassemble explosives items only under the following circumstances:

7.16.1.1. When authorized by item TO.

7.16.1.2. When the MAJCOM and the weapons system’s program manager grant approval.

7.16.1.3. When EOD personnel perform RSP, technical intelligence gathering, or for special projects authorized per AFI 32-3001.
7.16.2. Allow only technically qualified personnel to test, disassemble, or modify explosives items.

7.16.3. Before starting operations, supervisors must ensure all requirements of Section 7B have been met.

7.16.4. Dry run all new procedures with inert or simulated explosives items when possible.

7.16.5. Handling new or test munitions (versus operational munitions) requires personnel certification. Use inert items when possible for certification.

7.16.6. Do not use suspended munitions (code condition J) unless specifically authorized by the munition’s program managers for:
   7.16.6.1. Dry runs.
   7.16.6.2. Personnel or test procedure certification, verification, or validation.
   7.16.6.3. Electrical testing of aircraft or other weapons systems.

7.16.7. Comply with paragraph 7.17. for electrical testing of explosives items.

7.16.8. Comply with paragraph 7.18. for weapons system testing involving live explosives.

7.16.9. Comply with paragraph 4.17. to determine the need for protective shielding and remotely controlled operations.

7.17. Electrical Testing of Explosives Items.

7.17.1. Follow instructions in specific weapon or weapons system TOs for testing individual explosives items or weapon systems containing explosives items. Where there is doubt about the safety or adequacy of any test procedure or instrumentation, submit a request for advice or assistance to the program manager responsible for the TO.

7.17.2. Ensure electrical test equipment introduced to a hazardous location meets the requirements of paragraph 5.4.

7.17.3. In developing specific weapon and weapons system TOs, the responsible engineering function must consider the following guidance:
   7.17.3.1. Electrical or electronic test equipment must use the weakest possible power source. If feasible, require the use of battery-powered equipment instead of a 110-volt source.
   7.17.3.2. The test power source must be incapable of initiating the explosive item being tested. Where greater power is used, provide positive safeguards to prevent delivery of enough power to initiate the item.
   7.17.3.3. Unless the test equipment is incapable of initiating the item being tested, operational shields must be provided, where needed, to protect personnel from injury (see paragraph 4.17.).
   7.17.3.4. Special attention must be given to the ventilation requirements of equipment containing vacuum tubes and the possibility of malfunction of equipment using resistors and other devices for limiting testing power.
7.17.3.5. The explosive item, test equipment, and leads must be protected from exposure to electromagnetic (induction and radiation fields) and electrostatic energy of more than an order of magnitude less than that required to initiate an explosion (see AFI 91-208).

7.18. Use of Live Explosives for Weapons System Testing. Do not use live explosives items for verification, validation, or electrical testing of aircraft or other weapons systems except as follows:

7.18.1. The conduct of research, development, test and evaluation (RDT&E) and operational test and evaluation (OT&E) flight testing or “Built-In Test” (BIT) checks or other low-current aircraft testing with live explosives installed, as long as doing so does not conflict with other applicable guidance such as TO 11A-1-33, Handling and Maintenance of Explosives-Loaded Aircraft.

7.18.2. If an inert item is available but a live item is scheduled to be used, provide MAJCOM/A4W/SEW/A3T with the test plan and a risk assessment that includes appropriate personnel protection for their approval (see Section 4F). (T-1).

7.18.3. If an inert item is not in the inventory and a live item is used, only qualified personnel with test squadron Commander approval will perform the test. Coordinate test plans with the weapons safety office. (T-1).

7.18.4. If an inert item is not in the inventory and a live item is used, operational command personnel can perform the test provided approval is obtained from, and the test plan and a risk assessment (including appropriate personnel protection) is approved by MAJCOM/A4W/SEW/A3T (see Section 4F). (T-1).

7.18.5. Live weapons are used for validation and verification testing in the development of EOD technical procedures IAW DoDD 5160.62, Single Manager Responsibility for Military Explosive Ordnance Disposal Technology and Training.

Section 7F—Requirements for Specific Situations

7.19. Places of Public Assembly. In-use small arms ammunition HD 1.4S may be carried into places of public assembly. Because of varying circumstances, MAJCOM will determine authorization to carry all other in-use AE (except HD 1.1) into places of public assembly and incorporated into the MAJCOM supplement to this Manual. HD 1.1 AE will not be taken into places of public assembly except when required by immediate security needs.

7.20. Static or Public Displays.

7.20.1. Refer to AFI 11-209, Aerial Event Policy And Procedures, AFI 10-1004, Conducting Air Force Open Houses, and TO 00-80G, Make Safe Procedures For Public Static Display, for procedures concerning display of aircraft.

7.20.2. Do not display, load, or install live explosives items on display aircraft. Do not render explosives items inert for this purpose unless authorized by the system’s program manager. Paragraphs 7.20.3. and 7.20.4. specify exceptions for aircraft on display.

7.20.3. Remove live or expended ammunition from aircraft gun systems or safe the gun systems mechanically and electrically before placing the aircraft on display.
7.20.4. Operational aircraft may be displayed without removing egress and aircrew flight equipment explosive components, including captive missiles with HD 1.4 items only, provided:

7.20.4.1. Proper TO safety precautions are followed.

7.20.4.2. Visiting personnel do not have access to explosives items or their actuating controls. Ensure constant surveillance of visiting personnel to prevent such access.

7.20.5. Remove ejection cartridges from external stores release systems and ensure safety pins and devices cannot be easily removed.

7.20.6. Munitions displays must be marked IAW TO 11A-1-53, Identification of Empty and Inert Loaded Ammunition Items and Components, and certified IAW TO 11A-1-60, Inspection of Reusable Munitions Containers and Scrap Material.

7.21. **Fireworks Displays and Airshow Events.** Commercial fireworks are extremely hazardous, even in the hands of trained experts. Safety personnel will ensure all safety requirements are provided to the base contracting office prior to the selection of the commercial firm that will be conducting the display. For additional guidance see AFI 10-1004, Conducting Air Force Open Houses.

7.21.1. Active-duty Air Force personnel (on- or off-duty) and on-duty Air Force civilian personnel will not take part in the transportation, storage, and setup or functioning of commercial fireworks for on-base fireworks displays.

7.21.2. Units must contract with properly licensed commercial firms to provide all necessary transportation, storage and security, setup, and functioning of fireworks for on-base displays. (T-1). Contractors must comply with safety guidelines in NFPA 1123, Code for Fireworks Display and AFI 91-202, paragraph 3.5., Contract Monitoring. (T-1).

7.21.3. All off-base opportunities to store commercially purchased explosives intended for use in USAF sponsored (on-base) air shows must be exhausted prior to considering use of the Munitions Storage Area (MSA) or other sited on-base facilities (see paragraphs 12.86. and 3.13.).

7.21.3.1. Only store commercial explosives having an approved SDS, DOT or other federally recognized certification identifying the items HD, NEW, and compatibility group (CG).

7.21.3.2. Commercial explosives must be packaged in the original shipping configuration.

7.21.3.3. Separate commercial and DoD explosives by a minimum of IMD.

7.21.3.4. Commercial explosives will be handled, stored, and transported by the commercial firm responsible for the explosives display. Munitions personnel will only escort contract personnel to/from the storage facility and open the facility for contractor access.

7.21.4. Commercially purchased explosives will not be handled or transported by DoD (civilian or military) personnel on or off-duty. Exception: EOD personnel providing emergency assistance/response may handle or transport commercial explosives (i.e., life-
saving attempts, preserving high value military resources, or operating under specific approval from MAJCOM).

7.21.5. Commercial firms responsible for the explosives display must be properly licensed and insured.

7.21.5.1. Commercial firms will comply with all established DoD safety regulations.

7.21.5.2. Commercial firms will take all unused and expended munitions items with them off-base at the completion of the display.

7.21.5.3. Commercial firms will ensure fire extinguishers and properly equipped vehicle for explosives transportation are provided.

7.21.6. Display site will meet the requirements of paragraphs 7.22., 12.73., and 12.74. and the following:

7.21.6.1. Will be freshly mowed or pre-burned within 48 hours of the display.

7.21.6.1.1. If the area is mowed, it is highly recommended the display area be saturated with water the night prior to the show.

7.21.6.1.2. Area will be inspected for rock and other debris which could contribute to a secondary fragment hazard. Items discovered will be removed from the site.

7.21.6.2. If USAF resources or equipment are to be used, the responsible installation Commander must accept the risk for the loss of the resources and any associated damages if this option is elected. (T-1). If USAF fuel resources are used, they will be delivered in portable (fuel bowser) delivery systems prior to the explosives being delivered to the site.

7.21.6.3. Crowd lines for air show displays will not be less than 1,250 feet from the intentional detonation site. (T-1).

7.21.7. Installation WSMs with the assistance of Munitions, EOD, Base Operations, Legal, and Fire Department personnel will complete a comprehensive explosives risk assessment for the scheduled explosives display event and forward to the MAJCOM/SEW for concurrence. (T-1). The assessment will include:

7.21.7.1. A scaled map of the display site with applicable safe zones depicted.

7.21.7.2. A list of all compensatory measures used in the Risk Assessment to meet required safety standards.

7.21.7.3. A list of explosives being used in the display (i.e., Nomenclature, HD and NEW, Quantity).

7.21.7.4. Scheduled sequence of events for the display cradle to grave (timeline and explanation of event).

7.21.7.5. Severe weather action/evacuation plan.

7.21.7.6. Misfire or dud procedures.

7.21.7.7. Responsible Commanders acceptance of risk.

7.21.8. Over flight of the explosives demonstration site will be restricted to no closer than 500’ Aboveground Level (AGL) by either DoD or commercial aircraft.
7.22. Live-Fire Demonstrations.

7.22.1. For DoD-conducted live-fire demonstrations, the MAJCOM may provide additional requirements in their supplement to this Manual to ensure safety of personnel. As a minimum, address the following:

- **7.22.1.1.** Essential personnel required for the live-fire demonstrations.
- **7.22.1.2.** Safety considerations (e.g., personnel withdrawal distances and acceptable exposures). Consider applying the requirements of paragraphs 12.71. and 12.72. for separation of non-essential personnel.
- **7.22.1.3.** Risk assessment requirements (see Chapter 4).
- **7.22.1.4.** Documentation, coordination, and approval requirements.

7.22.2. For contractor-conducted live-fire demonstrations, the MAJCOM may provide additional requirements in their supplement to this Manual to ensure safety of personnel. As a minimum, address the following:

- **7.22.2.1.** Address safety considerations (e.g., personnel withdrawal distances and acceptable exposures). As a minimum, apply the requirements of paragraphs 12.71. and 12.72. except as follows:
  - **7.22.2.1.1.** Ensure the demonstration explosives are not located in an active explosives clear zone.
  - **7.22.2.1.2.** Ensure the explosives clear zone of the demonstration explosives does not encompass Air Force facilities.
  - **7.22.2.1.3.** Apply “non-essential” separation criteria to all non-contractor personnel. Contractors will determine required separation and safety criteria for their own personnel.
- **7.22.2.2.** Risk assessment requirements (see Chapter 4).
- **7.22.2.3.** Documentation, coordination, and approval requirements.
- **7.22.2.4.** All off-base opportunities to store commercially purchased explosives intended for use in USAF sponsored (on-base) demonstrations must be exhausted prior to considering use of the MSA or other sited on-base facilities (see paragraphs 12.86. and 3.13.). Off-base storage for live fire demonstrations will be at the contractor’s expense.
  - **7.22.2.4.1.** Only store commercial explosives having an approved SDS, DOT or other federally recognized certification identifying the item’s HD and NEW, and a compatibility group (CG).
  - **7.22.2.4.2.** Store commercial explosives only in the original shipping and packaging configuration.
  - **7.22.2.4.3.** Separate commercial and DoD explosives a minimum of IMD.
  - **7.22.2.4.4.** Commercial explosives will be handled, stored, and transported by the commercial firm responsible for the explosives demonstration. Munitions personnel will only escort contract personnel to/from the storage facility and open the facility for contractor access.
7.22.2.5. Commercially purchased explosives will not be handled or transported by DoD (civilian or military) personnel on or off-duty. Exception: EOD personnel providing emergency assistance/response may handle or transport commercial explosives (i.e., life-saving attempts, preserving high value military resources, or operating under specific approval from MAJCOM).

7.22.2.6. Commercial firms responsible for the explosives demonstrations must be properly licensed and insured.

7.22.2.6.1. Commercial firms will comply with all established DoD safety regulations.

7.22.2.6.2. Commercial firms will take all unused and expended munitions items with them off-base at the completion of the demonstration.

7.22.2.6.3. Commercial firms will ensure fire extinguishers and properly equipped vehicle for explosives transportation are provided.

7.22.2.7. Demonstration site will meet the requirements of paragraphs 7.22., 12.73., and 12.74. and the following:

7.22.2.7.1. Will be freshly mowed or pre-burned within 48 hours of the demonstration.

7.22.2.7.1.1. Will be saturated with water the night prior to the event, if needed.

7.22.2.7.1.2. Will be inspected for rock and other debris which could contribute to a secondary fragment hazard. Items discovered will be removed from the site.

7.22.2.7.2. If USAF resources or equipment are to be used, the responsible installation Commander must accept the risk for the loss of the resources and any associated damages if this option is elected. (T-1). If USAF fuel resources are used, they will be delivered in portable (fuel bowser) delivery systems prior to the explosives being delivered to the site.

7.22.2.7.3. Viewing lines for demonstrations will not be less than 1,250 feet from the intentional detonation site. (T-1).

7.22.2.8. Over flight of the explosives demonstration site will be restricted to no closer than 500’ Aboveground Level (AGL) by either DoD or commercial aircraft.

7.23. Hunting.

7.23.1. Commanders will ensure hunting will not hazard explosives stored on open pads or in light structures. (T-1).

7.23.2. Hunting may be permitted in and around the MSA if PTR distance is maintained from all sited explosives facilities. This paragraph does not apply to Bird/Wildlife Aircraft Strike Hazard (BASH) and Entomology functions. The local Commander issues written permission and develops local operating instructions for hunting around MSAs on an installation. (T-1).

7.23.3. MAJCOMs may require additional procedures or restrictions due to unique circumstances or conditions.
7.24. **Training Involving Blank Ammunition (including Dye-Marking Cartridges).** Firing weapons (.50 caliber or less) using blank ammunition is permitted (including within an explosives storage area) but is subject to safety/operational requirements found in the specific weapons TO, AFMAN 31-129, *USAF Small Arms and Light Weapons Handling Procedures*, and the following requirements:

7.24.1. Develop written procedures containing the following provisions:

- **7.24.1.1.** Use of a designated disinterested official to certify only blanks are loaded.
- **7.24.1.2.** Provision of readily available fire extinguishers.
- **7.24.1.3.** Misfire procedures.
- **7.24.1.4.** Expended brass turn-in procedures.
- **7.24.1.5.** Notification of appropriate agencies (i.e., safety, munitions flight chief, fire department, hospital, and Security Forces).

7.24.2. Coordinate written procedures with the installation weapons safety office. Obtain approval from the explosives storage area Commander or flight chief when blanks are used within an explosives storage area.

7.24.3. Except for security forces conducting required training, all other training will be done at a minimum of PTR separation from sited explosives facilities.

7.25. **Exercises and Training Involving Simulators and Smoke Producing Munitions.** See paragraph 11.11. for licensed explosives storage requirements for simulators and smoke producing munitions used for training and exercises. The following requirements apply to the use of these devices during exercises and training:

7.25.1. Only Air Force stock-listed items are authorized for use by Air Force personnel. Other military services will use DoD approved items only, when using Air Force ranges or facilities. **DoD or other federal agency explosives operations and storage will be performed with DoD oversight and** conducted IAW this Manual. Planning for joint training and exercises ensures no exposure of Air Force personnel to non-Air Force stock-listed items. Exception: EOD personnel are the only Air Force personnel trained and equipped to respond to all DoD, NATO and other federal agency ordnance items.

7.25.2. Only trained personnel can prepare and activate these devices.

- **7.25.2.1.** This training must be provided by qualified personnel on an annual basis. *(T-1)*
- **7.25.2.2.** Qualified personnel who can provide training will be determined locally but may be from EOD, munitions, or weapons safety. These personnel must have classroom instruction, pass a written test, be qualified to handle, maintain and inspect the items for which they will provide training, and be retrained annually. *(T-1)*
- **7.25.2.3.** It is the responsibility of the user organization to request training and maintain training records.
- **7.25.2.4.** Higher headquarters evaluation teams using these devices must present proof of training to the installation weapons safety office. *(T-1)*
7.25.3. These devices present a fire hazard. Remove all combustible material from within a 10-foot radius of the initiation point. Consider winds and fire hazards such as dry grass or fire bans. Consider using a barrier (baffle or screen) to control the spread of heat during functioning.

7.25.4. Ground burst and hand grenade simulators also present a blast, debris or fragment hazard.

7.25.4.1. Comply with the following minimum distances unless greater separation distances are prescribed in the item TO for use of ground burst or hand grenade simulators:

7.25.4.1.1. Maintain a minimum separation of 125 feet from personnel and vehicles. Personnel who initiate these munitions may be closer than 125 feet, but they must be as close to 125 feet as possible and have their back to the munitions.

7.25.4.1.2. Maintain a minimum separation of 100 feet from facilities without a facing window.

7.25.4.1.3. Maintain a minimum separation of 200 feet from facilities with a facing window.

7.25.4.1.4. Maintain a minimum separation of 50 feet from hardened facilities, including hardened aircraft shelters.

7.25.4.1.5. Maintain a minimum separation of 200 feet from petroleum, oils and lubricants (POL) storage.

7.25.4.1.6. Maintain a minimum separation of 100 feet from aircraft in the open, or 200 feet if aircraft are explosives loaded.

7.25.4.1.7. Maintain a minimum separation of 200 feet from explosives operating locations, holding areas, open storage areas or butler-type storage facilities.

7.25.4.1.8. Maintain a minimum separation of 50 feet from above-ground magazines of block, brick, or concrete construction and from ECMs.

7.25.4.2. The required distances in paragraph 7.25.4.1. may be reduced by barriers or shields designed IAW UFC 3-340-02 or MIL-STD-398A, *Shields, Operational for Ammunition Operations, Criteria for Design and Tests for Acceptance*. Provide the design criteria to AFSEC/SEW for approval.

7.25.4.3. Monitor items for proper functioning, and notify EOD or other qualified personnel when an item malfunctions. The Incident Commander, with recommendation from EOD, will determine minimum withdrawal distances for malfunctioned items; these distances will never be less than the separation distances required by paragraph 7.25.4.1. (T-1).

7.25.5. Smoke-producing munitions can present a toxic hazard in high concentrations.

7.25.5.1. Comply with the item TO for separation and personal protective equipment (PPE) requirements. If no requirements are specified in the item TO, avoid the smoke or follow actions required in Table 10.3.
7.25.5.2. Contact Environmental Management and the Fire Department prior to use of these items.

7.25.6. Dispose of expended items IAW environmental standards and TO 11A-1-60, *General Instructions Inspection of Reusable Munitions Containers and Scrap Material Generated from Items Exposed to, or Containing Explosives*.

### 7.26. Training or Exercises Involving AE.

7.26.1. The Training or Exercise Team Chief, with the assistance of weapons safety, develops plans for conducting training and exercise events. The following are minimum requirements for these plans:

7.26.1.1. A risk assessment of explosives operations for the training or exercise (see *Chapter 4*).

7.26.1.2. A list of all explosives to be used in the training or exercise, to include NSN, HD, and explosives weights.

7.26.1.3. A detailed list of locations where explosives will be deployed for the training or exercise (see paragraph 7.19. for restrictions on taking explosives into places of public assembly).

7.26.1.4. A procedure for accountability and reconciliation of all items used in the training.

7.26.1.5. Required separation distances per paragraph 7.25.

7.26.1.6. Required PPE.

7.26.2. The responsible Commander will approve the plan in writing, ensuring personnel not normally associated with explosives operations and exercises are not exposed to explosives hazards. (T-1).

7.26.3. Additional requirements for EOD training at off-range locations are addressed in paragraph 12.75. of this Manual.

### 7.27. Military Working Dog Explosives.

Military Working Dog explosives training aids (including HD 1.1) may be transported and handled by qualified personnel in areas that provide realistic and effective training. See AFI 31-121, *Military Working Dog Program*.

7.27.1. Preclude exposure of personnel not related to the training through prudent scheduling and selection of training sites. Provide non-essential personnel separation per paragraph 12.77.4.

7.27.2. Post proper fire symbols and explosives operation signs at training sites (see *Chapter 10*).

7.27.3. Train using locally written instructions (see *Section 7B*). These instructions must include a documented post-training inventory of explosives samples ensuring no explosives are inadvertently left at the training site or discarded.

7.27.4. Inform the weapons safety office, Fire Department, and EOD (if applicable) before conducting operations.
7.28. **Repairing Containers.** Except as allowed in paragraph 7.32., do not repair containers of explosives in storage facilities containing other explosives.

7.29. **Remotely Controlled Operations.** Provide personnel protection per paragraph 4.17. and site per Chapter 12. Develop locally written instructions to ensure operations are terminated when operating or related personnel perform duties at distances or locations not providing the required protection (see Section 7B).

7.30. **Flightline Munitions Holding Areas.** Where practical and when it will not create an airfield obstruction or FOD hazard identify these areas by a physical boundary (such as rope and stanchions). Post signs to keep unauthorized personnel out of the area and to prohibit smoking within 50 feet. Post explosives limits and ensure authorizations are not exceeded. Provide fire extinguishers and post fire symbols. If providing permanent shelter for personnel, position missiles so the shelter is out of radial alignment with the warheads. Secure according to AFI 31-101 and DoD 5100.76-M, *Physical Security Of Sensitive Conventional Arms, Ammunition, And Explosives*, or return munitions to MSA for storage.

7.31. **Security Response Team Ammunition at the Missile Alert Facility (MAF).** Ammunition issued to security response team members performing duties at the MAF is considered “in use” and explosives siting and licensing requirements do not apply. The Security Control Center (SCC) is the only authorized location for maintaining 40 mm ammunition while in use inside the MAF. Applicable units will use Section 7B and this paragraph to develop locally written instructions that prescribe acceptable practices to ensure maximum protection of personnel when security response team ammunition is present at the MAF.

**Section 7G—Operations in Explosives Storage Spaces**

7.32. **Operations in Explosives Storage Spaces Containing Explosives.** AE containers will not be opened for the purpose of issuing items from storage locations. The following operations are authorized in explosives storage spaces:

7.32.1. Palletizing, removing and replacing shipping crates incidental to transportation.

7.32.2. Replacing unserviceable strapping on boxes.

7.32.3. Necessary functional testing or sampling specifically authorized by technical data for performance in a storage location (e.g., checking color-coded humidity indicators). Testing engineers will coordinate proposed testing and sampling authorizations with the NNMSB.

7.32.4. Opening bolted or latched special storage containers housing self-contained weapons or missiles for authorized testing, missile reprogramming, sampling or transfer to transport trailer or vehicle, and installing control surfaces and argon bottles on AIM-9 series missiles.

7.32.5. Minor repair, cleaning, painting or re-stenciling of AUR or containers. Solvents and paints used must not create a hazardous atmosphere within the storage space. Bioenvironmental or fire department services will evaluate the potential for hazardous atmospheres (see Chapter 5).

7.32.6. Removing bomb or CBU fuze well plugs for inspection if they can be easily unscrewed as prescribed in the TO. Remove plugs from the storage location for cleaning. If
the plug binds or there is evidence of exposed explosives, move bombs to an operating location before starting repairs. Clean threads and cavities with approved cleaning solvents.

7.32.7. Opening outer containers to remove inner packages. Complete any further processing of these items in an approved operating location.

7.32.8. Opening “lite” boxes for inventory purposes.

7.32.9. Opening containers of HD 1.4 explosives to allow inventory. Unpack, inspect, and repack in the storage location if building content is limited to HD 1.4 items.

7.32.10. Some repairs and minor modifications of large missile motors may be accomplished in missile storage facilities. A risk assessment, reviewed by weapons safety, must be accomplished showing the risk to move the motor is greater than the risk to perform the work in the storage location (see paragraph 4.3.).

7.32.11. Nuclear weapons maintenance in a WSV-configured HAS or PAS, consistent with applicable weapon system safety rules.

7.32.12. PAL operations, minor surface repair, cleaning, or stenciling of weapons and/or containers is authorized for nuclear weapons in any explosives storage space IAW applicable weapons system safety rules and technical orders.

7.32.13. Other operations as approved by AFSEC/SEW based on a risk assessment and mission requirements (see Chapter 4).

Section 7H—Procedures in the Event of Electrical Storms

7.33. Local Lightning Watch, Warning and Advisory Support. The servicing AF weather unit will provide lighting advisories, watches, and warning support to installations allowing units time to take precautionary measures (AFVA 15-137, Operational Weather Squadron Areas of Responsibility). Supervisory personnel will consult with the supporting weather unit and/or review the local weather support plan to ensure advisories, watches, and warnings provide coverage for their working areas and to become familiar with the base notification process. In addition, weather personnel will coordinate with all installation organizations to ensure weather requirements are being met, in accordance with AFMAN 15-129V2, Air and Space Weather Operations - Exploitation.

7.34. Procedures in the Event of Lightning for Conventional AE Only. The following guidelines apply when a lightning watch or warning is issued for the base:

7.34.1. A Lightning Watch will be in effect 30 minutes prior to thunderstorms being within a five nautical mile (nm) radius of the predetermined location. Initiate controlled termination procedures for all explosives operations at outdoor locations equipped with an LPS, at locations (outdoor and indoor) not equipped with an LPS, and facilities containing exposed explosives, explosive dust, or explosive vapor.

7.34.2. A Lightning Warning will be in effect whenever any lightning is occurring within a 5 nm radius of the predetermined location.

7.34.2.1. Immediately provide personnel protection equivalent to PTR distance from explosives facilities containing exposed explosives, explosive dust, or explosive vapor, regardless of whether the facility is equipped with an LPS; this includes providing
protection equivalent to PTR for all locations within the PTR arc. PTR distances will be based on airblast overpressure only (minimum fragment distances do not apply).

7.34.2.2. Explosives operations in facilities equipped with an LPS (including HAS/PAS) may continue (except where noted in paragraph 7.34.2.1.); however, assess the need and urgency for doing so. Cease operations involving EIDs that are uncapped, unplugged, or susceptible to electro-static discharge and vacate the maintenance bay where these operations are located. Evacuation of the non-maintenance administrative areas is not required.

7.34.2.3. Immediately provide personnel protection equivalent to PTR distance from explosives locations (indoor and outdoor, to include parked explosives-laden conveyances and flightline PES locations) not having an LPS; this includes providing protection equivalent to PTR for all locations within the PTR arc of a facility having an LPS. PTR distances will be based on airblast overpressure only (minimum fragment distances do not apply).

7.34.2.4. When intercontinental ballistic missile (ICBM) operations cannot be immediately evacuated, (e.g., due to protection level resources or a transporter-erector being in its upright position and the missile being raised or lowered) use technical orders to ensure the safety and security of personnel and weapons.

7.34.2.5. Cease all explosives operations at outdoor locations equipped with an LPS and not specifically mentioned in the paragraphs above.

7.34.2.6. Sites/explosives operations not requiring an ESP and licensed locations not requiring LPS are excluded from lightning evacuation as described in this paragraph. (See shelter criteria in AFI 91-203 for additional lightning response requirements).

7.34.3. See Section 5H for additional LPS information.


7.35.1. Locations supporting nuclear weapons operations will request forecast lighting advisories and observe lightning advisories for lighting within 10 nautical miles of their location from their servicing weather unit. Local procedures for these advisories are documented in Section 7H. In addition, DoDM 3150.02 prescribes response actions when 10 nautical mile lightning advisories are issued.

7.35.2. See Section 5H for additional LPS information.

Section 7I—Explosives Storage Requirements

7.36. Selection of Explosives Storage Method.

7.36.1. ECM storage is preferable for all types of explosives (see Section 6C). From an explosives safety and reliability standpoint, give priority to the use of ECMs for items requiring protection from the elements, long-term storage, or high security protection.

7.36.2. Indoor storage is preferable for all types of explosives and is mandatory for bulk HE, solid propellants and pyrotechnics, except as allowed by paragraph 7.41.2.2.
7.36.3. Outdoor storage is considered a temporary expedient. Use only when approved by 
the MAJCOM, or as allowed per Section 6D barricaded modules.

7.36.4. Where outdoor storage is approved, consider the use of barricaded open storage 
modules for high-density storage in a limited land area (see Section 6D).

7.36.5. Any magazine or warehouse-type building that gives protection from the weather and 
meets QD and security requirements is allowed for storing explosives HD 1.3 and 1.4 
materials.

7.36.6. Units may use other types of standard magazines built according to approved 
drawings. MAJCOMs may approve use of existing magazines of other descriptions 
(including contractors' facilities) if they provide the proper degree of protection and safety.

7.37. Explosives Storage in Operating Locations. Explosives may be stored in an operating 
location when operations are not being conducted, provided all other storage criteria are met.

7.38. Explosives Storage Facility Maintenance.

7.38.1. Practice good housekeeping in all locations.

7.38.2. Keep structures in good condition and suitable for the storage of munitions types and 
hazard divisions involved.

7.38.3. Certain items containing explosives have stringent temperature limitations (see 
applicable TO). Take precautions to ensure these limits are not exceeded.


7.39.2. Stacks of containers must be stable and arranged in magazines or other approved 
locations according to storage drawings or directives.

7.39.3. Provide ventilation when required by civil engineering, logistics and health 
directives.

7.39.4. Block storage is allowed if stack ventilation is maintained when required by civil 
engineering, logistics or health directives.

7.39.5. Maintain aisles so each stack may be inspected.

7.39.6. Inert and live AE or munitions components may be stored together, however, 
physically separate inert items from the live items they represent.

7.40. Marking of Explosives Stocks.

7.40.1. Keep boxes properly closed and clearly marked to show contents and quantity. 
Requirements of TO 11A-1-10, General Instructions--Munitions Serviceability Procedures 
and the item TO apply.

7.40.2. For dangerously unserviceable, unserviceable, or suspended lots, mark each package 
or stack to show its exact status. The markings must be clear to prevent inadvertent issue or 
loss of information.

7.40.3. Properly packed AE may not be stored with loose AE items, single inner packages 
(nonmetal), or explosives in unserviceable containers.
7.40.4. Properly packed AE may be stored with nonstandard boxes of AE IAW CG.

7.41. Munitions in Austere Areas.

7.41.1. The austere area provisions of paragraph 7.41.2. for explosives storage areas are authorized for use in:

7.41.1.1. All zones where hostilities exist.
7.41.1.2. Areas approved by Pacific Air Forces (PACAF), United States Air Forces in Europe-United States Air Forces Africa (USAFE-AFAFRICA) and United States Central Command Air Forces (AFCENT), where arrangement under paragraph 13.5. allows their application.
7.41.1.3. All bare or limited bases.
7.41.1.4. Other areas as may be approved by AFSEC/SEW.

7.41.2. Austere Area Provisions.

7.41.2.1. Minimum separations must prevent simultaneous detonation of explosives on opposite sides of an approved barricade and minimize the possibility of later, non-simultaneous propagating explosions. Use greater separations where possible.
7.41.2.2. Open storage is authorized for all HD of munitions and explosives. Give priority for cover to items requiring protection from the elements, considering the type of packing material involved.
7.41.2.3. Avoid single stacks of large quantities of mass-detonating explosives. Smaller stacks may limit losses due to accident or enemy action and often result in decreased land area requirement. Smaller stacks reduce the distance required between the explosives storage area and other exposures, such as flightline areas, inhabited buildings, or bulk POL storage.
7.41.2.4. When normal aboveground magazine separation is not feasible, use barricaded open storage modules (see Section 6D). Large quantities of explosives may be stored in this manner with relative safety.
7.41.2.5. If land is scarce and covered storage is necessary, consider the use of approved steel arch ECMs. These sectionalized, corrugated-arch structures allow storage of maximum amounts of mass-detonating explosives with minimum space between ECMs. They are available in any practical length in widths up to 30 feet. The commonly-used earth cover gives acceptable protection against propagation of an explosion from one ECM to another.
7.41.2.6. Site tri-service or joint-use storage facilities using DoD 6055.09-M.

7.42. Privately-owned Ammunition. Store privately-owned ammunition allowed on an Air Force installation as follows:

7.42.1. Base housing residents (i.e., military families living in government-provided family housing) can store their privately-owned ammunition in their quarters.
7.42.2. Billeting and dormitory residents cannot store their privately-owned ammunition in their quarters.
7.42.3. Store privately-owned ammunition in a licensed or sited explosives storage location (except as noted in paragraph 11.25.).

7.42.4. Do not store privately-owned ammunition in an MSA (see paragraph 3.13.1.1.).

7.43. Government Arms and Ammunition. MAJCOMs may authorize the storage of DoD firearms in explosives storage facilities within the MSA to meet operational commitments. Coordinate with MAJCOM/A4/SEW to authorize storage.

Section 7J—Storage and Compatibility Principles

7.44. Storage and Compatibility Principles.

7.44.1. AE may not be stored with dissimilar substances or articles (e.g., Class 3, Flammable and combustible liquid; Class 8, Corrosive material) that may present additional hazards to the AE unless they have been assessed to be compatible (see paragraph 7.44.5.).

7.44.2. AE may not be stored with unrelated non-AE items (e.g., powered lift trucks, dunnage, empty boxes, unused pallets, excess packing material).

7.44.3. AE may be stored with related noncombustible equipment as necessary to support approved contingency or war plans requiring ready use of such equipment.

7.44.4. Not-Regulated AE and AE assigned to Classes 2 through 9 may have a CG assigned. When so assigned, the AE may be stored with Class 1 AE IAW the CG.

7.44.5. AE in damaged packaging, in suspect condition, or with characteristics that increase risk in storage, are not compatible with other AE and will be stored separately as CG L.

7.44.6. Treat AE received without an assigned hazard classification as HD 1.1L and place in segregated storage. Contact AFSEC/SEW for assistance.

7.44.7. Segregate serviceable AE from unserviceable AE, including lots suspended from issue and use. Put them in a separate facility or segregate them physically within the same facility. If they remain in the same facility, clearly separate the unserviceable items using ropes, tape, painted lines or other highly visible means.

7.45. Found-on-Base AE. The following provisions apply to found-on-base AE:

7.45.1. Treat unidentified found-on-base AE of an unknown hazard division as HD 1.1L. If local munitions or EOD technicians can identify a found-on-base AE item sufficiently to determine that it is the same as a stock listed, hazard classified item, then it may be stored IAW that hazard classification.

7.45.2. Found-on-base AE will not be placed in a licensed facility, regardless of hazard classification. Ball cartridges, .50 cal and smaller, and all gauge of shotgun shells, may be treated as HD 1.4C; these same items may be treated as HD 1.4S if this hazard classification can be definitely established.

7.45.3. Recognize that unidentified AE may contain viable chemical or biological warfare agents, including recovered munitions from historic burial or off-shore disposal sites. If AE is suspected to contain chemical or biological warfare agents, activate local incident management system and wait for confirmation from the appropriate agency (Fire Department, Emergency Management, and Bioenvironmental Engineering). Contact the
MAJCOM Treaty Compliance Officer if the item is identified as a chemical or biological munitions item.

7.46. **Dangerously Unserviceable AE.** Treat dangerously unserviceable AE as CG L and store in an isolated location separated from other AE storage facilities by IMD. Dangerously unserviceable items are those having a substantially greater probability of inadvertent or unintentional activation than a normal item (e.g., UXO, discarded military munitions (DMM), and components thereof, even when rendered safe; or other unserviceable explosives or components that have undergone abnormal or unknown environments (i.e., aircraft crash, natural disaster, or other unknown conditions).

**Section 7K—Mixed Compatibility Group Storage**

7.47. **Mixed Compatibility Group Storage.** Separate storage of AE by HD and type provides the highest degree of safety. Because such storage is generally not feasible, mixed storage—subject to compliance with this Manual—is normally implemented when such storage facilitates safe operation and promotes overall storage efficiency. The CG assigned to AE indicates what can be stored with the AE without increasing significantly either an accident's probability or, for a given quantity, the magnitude of an accident's effects. AE of different CG may only be mixed in storage as indicated in Table 7.1., or as follows:

7.47.1. AE packaged and configured for rapid response (e.g., Rapid Deployment Force) may be mixed without complying with the compatibility and mixing requirements, as operationally required to achieve the optimum load needed by the intended receiving troops. Limit the MCE allowable at any of these storage sites to 8,818 lbs NEWQD. When computing QD requirements for such sites, Chapter 12 applies. However, exclude the following AE for NEWQD determination at such storage sites:

7.47.1.1. Propelling charges in HD 1.2 fixed, semi-fixed, mortar, and rocket AE.

7.47.1.2. The NEWQD of HD 1.3 items, except at sites that contain only HD 1.3 items. At such sites, HD 1.3 QD applies.

**Note:** In the application of this paragraph, to separate loading AE, the explosive weight of propelling charges is generally excluded when matched pairs of projectiles and propelling charges are at the site. However, if the quantity of propelling charges at the site exceeds the maximum usable for the quantity of projectiles at the site, sum the explosive weights of all propelling charges and projectiles at the site for NEWQD determination.
**Table 7.1. Storage Compatibility Mixing Chart.**

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**Notes:**

1. An “X” at an intersection indicates that the groups may be combined in storage. Otherwise, mixing is either prohibited or restricted per **Note 2** below.
2. A “Z” at an intersection indicates that when warranted by operational considerations or magazine non-availability, and when safety is not sacrificed, mixed storage of limited quantities (equal or less than 8,818 lbs total NEWQD) of some items from different groups is acceptable subject to approval from at least the MSA Commander. Approval must be in writing and must be kept on site.
3. Mixed storage of items within groups where no X or Z exists at that pair’s intersection, are authorized, except items in CG A, K and L, provided quantities are limited to 1,000 lbs total NEWQD or less and approved by a deviation (see **paragraph 1.4.**).
4. Examples of acceptable storage combinations are: a) HD 1.1A initiating explosives with HD 1.1B fuzes not containing two or more effective protective features and b) HD 1.3C bulk propellants or bagged propelling charges with HD 1.3G pyrotechnic substances.
5. Equal numbers of separately packaged components of hazard classified complete rounds of any single type of AE (i.e., missiles, general purpose bombs, etc.) may be stored together. They may also be stored with assembled rounds made up from these components. When so stored, compatibility is that of the complete round. That is, group H for WP rounds; group D, E, or F, as appropriate, for HE rounds. (The “equal number” provision is intended to limit the material stored to enough packaged components to make up the desired number of complete rounds. It is
not necessary to unpack extra components from normal packaging to make an “equal numbers” condition.

6. CG K requires not only separate storage from other groups, but also may require separate storage within the group. AFSEC/SEW will determine which items under CG K may be mixed with other items and which must be kept separate, when such a requirement develops. Request AFSEC/SEW determination through MAJCOM/SEW. Approval must be in writing and must be kept on site.

7. AE classed outside Class 1 may be assigned the same CG as Class 1 AE containing similar hazard features, but where the explosive hazard predominates. Non-Class 1 AE and Class 1 AE assigned the same CG may be stored together.

8. Ammunition designated “Practice” or “Target Practice” by NSN and nomenclature may be combined with the fully-loaded ammunition that it simulates (e.g., 2.75-inch target practice rockets with WP rockets).

9. For purposes of mixing, all AE must be packaged in its standard storage and shipping container. AE containers will not be opened for issuing items from storage locations. Outer containers may be opened in storage locations for inventorying and for magazines storing only HD 1.4 items, unpacking, inspecting, and repackaging the HD 1.4 ammunition (See paragraph 7.31.).

10. When using the “Z” mixing authorized by Note 2 above for articles of either CG B or CG F, each will be segregated in storage from articles of other CGs by means that prevent propagation (i.e., IMD) of CG B or CG F articles to articles of other CGs.

11. If dissimilar HD 1.6N AE are mixed together and have not been tested to ensure non-propagation, the mixed AE are individually considered to be HD 1.2.1 D or HD 1.2.2 D based on their NEWQD or overriding fragmentation characteristics for purposes of transportation and storage. When mixing CG N AE with CG B through CG G or with CG S, see Section 12C to determine the HD for the mixture.

12. Articles in group L must be segregated in a separate facility or meet the requirements of paragraph 6.29. - multicubes. Group L articles are not compatible with other articles in group L unless they are identical items.
Chapter 8

EXPLOSIVES TRANSPORTATION

Section 8A—Introduction

8.1. Introduction. This Chapter gives safety requirements for transporting explosives and for operating vehicles and MHE in explosives locations. In-use ammunition items that accompany security forces or other defense forces are not governed by transportation rules. Physically secure all onboard ammunition not loaded in a weapon or secured to an individual for immediate use during transport. QD criteria do not apply to munitions and explosives in the transportation mode. Take precautions to ensure minimum exposure of people and property during all phases of transportation. Limit the time munitions and explosives are in the transportation mode to the absolute minimum necessary to complete the task.

Section 8B—Explosives Transportation Standards

8.2. Federal Regulation. 49 CFR regulates commercial shipments of hazardous material, including explosives, by rail, motor vehicle, cargo aircraft and ship within the US (except maritime explosives). 49 CFR rules only apply on military installations when specifically prescribed. For transporting explosives and munitions on an Air Force installation use the criteria in this Manual. For transporting military explosives and munitions off an Air Force installation, but in an Air Force conveyance and operated by Air Force personnel, apply the rules in 49 CFR as prescribed in Air Force and Department of Defense (DoD) directives. See paragraph 8.3. for a list of applicable publications.


8.4. Local Laws Regulating Transportation of Explosives and Dangerous Articles. Each state and nearly all local and foreign governments have laws or ordinances regulating transportation of explosives and other dangerous articles within their jurisdiction. Obey local laws where state, local or host-nation governments have jurisdiction. Where there is exclusive federal jurisdiction, local laws may not apply. Where there is a conflict, contact your MAJCOM for clarification.

Section 8C—Hazard Classification for Explosives Transportation

8.5. Hazard Classification Requirements for Transportation. Explosives, to be acceptable for transportation by any mode, must have an assigned hazard classification (HD; storage
compatibility group; DOT class, markings, shipping name and label; and United Nations serial number), except as noted in paragraph 8.6. (T-0). Developmental items, test articles, components, and certain commercial items that contain explosives, but without a final classification must be assigned an IHC. (T-0). See Chapter 3 for hazard classification procedures. (T-0)

8.6. Commercial Explosives Hazard Classification Requirements for Transportation. Commercial explosive items purchased for official use must have a hazard classification assigned IAW TO 11A-1-47 before transportation and use, except as provided in this paragraph. (T-0). Store, transport, or offer for transportation, commercial explosives that have not been examined, hazard classified, and approved by DoD IAW 49 CFR Part 173.56 (b) (2) provided one of the following paragraphs is complied with:

8.6.1. The explosive has been designated, in writing, by the Associate Administrator for Hazardous Materials Safety (AAHMS), Research and Special Programs Administration, DOT, as “Not Regulated.”

8.6.2. The explosive has been approved for transportation, in writing, by the AAHMS in a Classification of Explosives, Competent Authority Approval, or in a Confirmation of Acceptability of a foreign Competent Authority Approval, and the hazard classification of the explosive is HD 1.4S.

8.7. Compatibility of Explosives During Transportation. 49 CFR Part 177.848 provides guidance for separating and segregating hazardous materials, including different explosives, in the various modes of commercial transportation. Explosives transported on a public highway by Air Force motor vehicles, operated by Air Force personnel, will be separated and segregated using the rules in 49 CFR, except as otherwise provided in this Manual or other applicable military directives. When an item containing explosives is assigned to other than Hazard Class 1 because of the predominant hazard, a compatibility group is still assigned (see paragraph 3.5.1.2.). For these items, compatibility for transportation, and temporary storage incident to transportation, must be based on rules for the assigned hazard class, not on the compatibility group. The compatibility group for these items applies only to long term storage. Cargo-configured items that may be shipped in the same Air Force aircraft are listed in AFMAN 24-204 and TO 11N-45-51 series. Procedures for submitting a compatibility waiver for air transportation of explosives is contained in AFMAN 24-204. The following exceptions to the above standards are permitted:

8.7.1. Development of new items for transportation by combining previously hazard classified components into an increased state of assembly to meet a valid military need. Use normal hazard classification procedures in TO 11A-1-47 to obtain the hazard classification approval for transportation applicable to the new configuration.

8.7.2. Movement of assembled or partially assembled explosive items between servicing explosives locations and aircraft loading points or other such locations on the same military installation, when the assembly has not been classed and approved as provided in TO 11A-1-47, but is necessary to meet valid operational requirements. If the operational requirement is expected to continue or can be anticipated, seek hazard classification approval.

8.7.3. Movement in a military vehicle of minimum quantities of explosive items necessary for demolition operations, to include proficiency training. Blasting caps, demolition
explosives and unserviceable (but not dangerously unserviceable) munitions may be transported by the same vehicle, provided MAJCOM approves the mixing of all applicable compatibility groups. See paragraph 8.22. for restrictions concerning the carrying of explosives inside passenger compartments.

8.7.4. Transport dangerously unserviceable munitions in a separate military vehicle. If transport in a separate military vehicle is not possible, segregate and sandbag from other explosives being transported. Transport dangerously unserviceable munitions according to paragraph 8.11.

8.7.5. Movement by a DoD-owned vehicle, operated by DoD personnel, of mixed loads consisting of components (not otherwise compatible for transportation), in the numbers and of the type’s necessary to assemble a number of complete rounds of a single type, when essential to meet operational requirements, and when separate (unmixed) movement is not feasible. See DTR 4500.9-R-Part II for procedures where such exceptions to compatibility rules are required.

8.7.6. Movement by a DoD-owned vehicle, operated by DoD personnel, or a mixed load of small quantities of items (not to exceed 1,000 pounds total NEWQD) from compatibility groups B through J, N, and S. The NEWQD of HD 1.4S items need not be included.

8.7.7. Movement by Security Forces of mixed loads of ammunition in performance of their duties.

8.8. Compatibility of Explosives During Temporary Storage. Table 7.1., 49 CFR, or AFSMAN 24-204 criteria may be used for temporary mixing of explosives while undergoing packing and unpacking operations or while in temporary storage awaiting shipment. Do not store other dangerous articles with these explosives. Shipping, receiving and storage facilities must comply with QD criteria of this Manual for the HD involved. (T-1).

Section 8D—Packaging for Explosives Transportation

8.9. Packaging. Packaging of explosives offered for shipment must comply with TO 11A-1-10, 49 CFR, Parts 173.1 – 173.477, or AFSMAN 24-204 specifications, as appropriate. (T-0). Follow these instructions:

8.9.1. Locally made packaging must meet the construction and marking requirements in 49 CFR, or must conform to a military Certification of Equivalency for the item being packed. (T-0).

8.9.2. Mark each package to identify contents. The DOT marking consist of the Proper Shipping Name; United Nations Identification Number; and the DOT EX-number, national stock number or other product code as specified in the hazard classification. See AFSMAN 24-204, TO 11N-45-51, or the Joint Hazard Classification System (JHCS), as appropriate. For Transportation Protective Service Material, mark IAW Defense Transportation Regulations and MIL-STD-129. (T-0).

8.9.3. If an item is not listed in above references, contact 406 SCM/GULAA, Hill AFB UT 84056-5609 for the required data.
8.9.4. Do not open or repair a package in a railcar, motor vehicle, or aircraft unless it is essential for inflight safety or to safely unload a damaged package. Avoid re-nailing boxes because of the potential to strike the explosives with the nail.

8.9.5. If a package is damaged or defective, remove it from the transporting vehicle at the earliest opportunity for repair.

8.10. Shipment of Damaged Explosives or Explosives that Failed To Function. If it is necessary to ship an explosive item that has been damaged, subjected to abnormal force or has failed to function, ask the responsible program manager for shipping, packing, marking and safety instructions. For damaged or failed-to-function AE, EOD must determine that it is safe to ship prior to munitions requesting shipping instructions from the program manager for the munition. (T-1).

8.11. Transporting Dangerously Unserviceable Explosive Items for Disposal. Package and mark dangerously unserviceable items and explosive residue such as partially burned signals as specified in the item TO or EOD technical publications. Consult EOD before transporting dangerously unserviceable items and explosive residue other than as approved by DOT. DoD personnel who are properly trained in procedures to be followed and specific hazards of the material may routinely transport dangerously unserviceable items and explosive residue. Inspect vehicles using DD Form 626, Motor Vehicle Inspection (Transporting Hazardous Material).

Section 8E—Explosives Movement Routes on Base

8.12. Explosives Movement Routes on Base. Designate the safest possible primary and alternate explosives movement routes to cover all phases of movement. Identify routes and any limitations on explosives quantities by hazard division on base maps. Avoid built-up areas and key, mission-oriented facilities and equipment to the maximum extent possible. Movements of munitions within an MSA, airfield or to and from licensed storage locations and transportation of explosives in support of the training of working dogs are not restricted to designated routes.

Section 8F—Incoming and In-transit Explosives Shipments

8.13. Incoming Explosives Shipments. Review guidance in the Transportation Facilities Guide maintained by Surface Deployment and Distribution Command (SDDC). Contact the base transportation officer for this guide. The base transportation officer is responsible for maintaining the base information current in the SDDC database. Clearly state in notification procedures the NEWQD (and MCE if applicable), by HD, that can be received at unloading facilities (e.g., railheads, ports, hot cargo pads, etc).

8.14. In-Transit Explosives Shipments/Secure Holding. When the SDDC or carrier requests temporary storage for in-transit shipments of explosives, DoD installations must accept arms ammunition and explosives (AA&E) shipments for safe haven or secure hold regardless of arrival time or final destination. (T-0). If safe haven or secure hold cannot be provided, the DoD activity will provide, in coordination with civil law enforcement authorities, assistance and escort to a suitable location. (T-1). Protection of shipment will be commensurate with the sensitivity of the AA&E. Under safe haven conditions or secure hold, explosive safety quantity distance requirements must be considered, but these requirements will not eliminate the responsibility to provide safe haven or secure hold to mitigate shipment vulnerability. See paragraph 1.5. for an
event waiver if a properly sited location is not used. Furthermore, DoD installations and activities will provide a secure holding or safe haven for A&E shipments during emergency (vehicle breakdowns, criminal/terrorist threat, etc.) and non-emergency conditions. (T-1). Coordinate with the base transportation officer to ensure the Transportation Facilities Guide correctly reflects the NEWQD (and MCE if applicable), by HD, that can be held at the Secure Explosives Holding Area. See Defense Transportation Regulation (DTR), Part II, Chapter 205Q, AFI 31-101, Integrated Defense, and AFI 10-2501, Air Force Emergency Management (EM) Program Planning and Operations, for information.

8.15. Inspection of Incoming Explosives Shipments. A representative of the Logistics Readiness Squadron (LRS) Commander will inspect all incoming motor vehicles carrying Hazard Class 1 explosives and other hazard class items that carry an explosives compatibility group, to include HD 1.4 shipments more than 1,001 lbs, at a designated inspection station before further routing on base. (T-1).

8.15.1. Inspection stations do not require explosives siting if they are limited to the activities described in paragraph 12.57. Apply QD criteria per Chapter 12 if the inspection station is also used as explosives storage or suspect vehicle holding area. Do not perform vehicle inspections at the station if it is in use as an explosives storage area or suspect vehicle holding area. The inspection station may be used as an interchange yard. Remove vehicles promptly after the inspection is completed.

8.15.2. Inspect Defense Transportation System (DTS) scheduled vehicles using DD Form 626. Inspect non-DTS scheduled vehicles using a locally generated form approved by the LRS Commander and the WSM or use the DD Form 626.

8.15.3. Once a vehicle has passed the initial inspection, a visual inspection of the external condition of the cargo may be done at any suitable location, including the unloading point.

8.15.4. Move any vehicle found or suspected to be in a hazardous condition to a suspect vehicle holding area, isolated from other locations, by the proper QD criteria per paragraph 12.62., unless it is more hazardous to move the vehicle.

8.16. Inspection of Outgoing Explosives Shipments. This paragraph does not apply to the departure of in-transit explosives shipments. Shipping activities will inspect all vehicles to be used for off-base shipments of explosives before and after loading for compliance with safety regulations. (T-1).

8.16.1. Complete DD Form 626 according to DTR 4500.9-R- Part II, Chapter 204, paragraph G.1. Inspect non-DTS scheduled vehicles using a locally generated form approved by the LRS Commander and the WSM.

8.16.2. Maintain a record of the vehicle number, the type of explosive cargo, and the number of each seal applied to the vehicle.

8.16.3. Drivers must be qualified to operate the vehicle and knowledgeable of the explosives being transported and associated hazards. (T-1). In addition, Air Force civilian drivers must have a Commercial Driver’s License, with a hazardous materials endorsement, to transport explosives off a military installation. (T-1). See AFI 24-301, Vehicle Operations.

8.16.4. Use DD Form 2890, DoD Multimodal Dangerous Goods Declaration to instruct drivers on the nature of their cargo, firefighting methods, and other specific precautions for
the particular shipment. Information on the preparation and use of DD Form 2890 is in DTR 4500.9-R-Part II, Chapter 204, paragraph G.2.

8.16.5. At overseas units, use bilingual instructions on the DD Form 626 where needed.

8.16.6. Use applicable technical data when special purpose vehicles are authorized to transport explosive loads.

8.16.7. Develop written procedures with the base Logistics Readiness Squadron to ensure procedures and requirements for military vehicles or drivers transporting explosives (assembled or partially assembled in a delivery mode) across or on public highways from one part of a base to another are compliant with the DTR 4500.9-R-Part II, Chapters 204 and 205. Examples may include the transportation of munitions from a preparation area across the highway to the main base flightline, or on the highway to a nearby auxiliary field. If this is a daily operation, there must be an agreement with local authorities on any local restrictions to be imposed. OCONUS locations must comply with host-nation requirements, including any notice requirements contained in host-nation law or applicable international agreements. If host-nation law or applicable international agreements are silent on notification, OCONUS locations (outside of operational areas) should consider notifying host-nation authorities of the movement of explosives regardless of any legal obligation to do so.

8.16.8. Externally inspect commercial carriers used to move explosives over public highways from one area to another area of an installation before entering the second area. Inspection is not required if the carrier was escorted or under surveillance en route.

8.17. Interchange Yards. Use this location for the exchange of tractor-trailers between the common carrier and the base activity involved. Interchange yards do not require explosives siting if they are limited to the activities described in paragraph 12.58. Apply QD if the interchange yard is also used as explosives storage or suspect vehicle holding area. Do not perform vehicle interchange operations at the yard if it is in use as an explosives storage area or suspect vehicle holding area. The interchange yard may be used as an inspection station. Remove vehicles promptly.

8.18. Holding Yards. Move explosives-loaded vehicles to a holding yard if they cannot be dispatched to unloading points promptly. See paragraph 12.59. for holding yard siting requirements. Holding yards may be used for interchange and inspection activities.

8.19. Classification Yards. Where the volume of vehicle traffic necessitates, establish a classification yard primarily for receiving, classifying, switching, and dispatching explosives-laden vehicles. Classification yards do not require explosives siting if they are limited to the activities described in paragraph 12.60. Apply QD criteria per Chapter 12 if the classification yard is also used as explosives storage or suspect vehicle holding area. Classification yards may also be used as interchange yards and vehicles will be removed promptly.

8.20. AE Transportation Mode Change Locations. Transportation mode change locations require explosives siting as per paragraph 12.59. (T-1).
Section 8G—Transportation and Movement of Explosives by Motor Vehicle and MHE

8.21. **General.** This section covers the transport and handling of explosives by DoD motor vehicle and MHE. The requirements of this section also apply to DoD rental vehicles when used to transport DoD explosives on military installations. Do not transport DoD explosives in Privately Owned Vehicles (POVs) under any circumstance.

8.21.1. Chock explosive loaded vehicles when parked and the driver is not behind the wheel. Chocking MHE or MMHE is not required if the explosives load is lowered and completely resting on the ground.

8.21.2. Chock other forms of explosives loaded MMHE and MHE (e.g., trailers, universal ammunition loading systems (UALS), etc.) when parked and/or left unattended.

8.22. **Transporting Explosives in Passenger Compartments.** Do not transport explosives in a passenger compartment of a vehicle, except as authorized below.

8.22.1. Minimum essential personnel and limited quantities of HD 1.4, 1.3, and 1.2.2 explosives, as approved by the local OI, may be transported together in cargo portion of vehicles (including Metro type vans used on the flightline) or in vehicles used as runway supervisory units.

8.22.2. Egress system assembled components may be transported in the cargo compartment of Metro-type vehicles.

8.22.3. For emergency responses in vehicles without separate cargo compartments (e.g., robot vans, Metro-type vehicles, High Mobility Multipurpose Wheeled Vehicle (HMMWV), EOD Base Support Emergency Response Vehicle (BSERV), Mine Resistant Ambush Protected (MRAP) family of vehicles); EOD units are authorized to transport minimum essential quantities of all HDs inside the vehicle. Ensure explosives are secured to prevent movement during transit. Separate incompatible explosives to the maximum extent possible.

8.22.4. Basic load munitions issued to emergency response personnel in the performance of their duties are exempt from these requirements. Basic loads can include HD 1.1 40 mm grenades, Light Anti-Armor Weapon (LAW) rockets, etc. However, comply with all requirements of this paragraph for transportation of re-supply stocks ensuring explosive resupply stocks are secured to prevent movement during transit.

8.22.5. When units responsible for demolition operations are issued vehicles without separate cargo compartments, such vehicles may be used to transport minimum quantities of explosives necessary to support demolition. Use trailers to the maximum extent possible.

8.23. **Transporting EIDs.** When transporting items containing EIDs, fully consider EMR hazards (see AFI 91-208). Vehicles with plastic bed liners may be used to transport EIDs that are in their original sealed outer package, box, or container. Metal ammo-type containers may be used to transport EIDs in vehicles with plastic bed liners if the containers provide the protection required by paragraph 7.8.2. and are bonded to the metal body of the vehicle.

8.24. **Transporting Aircraft Seats and Survival Kits.** Aircraft seats and survival kits with explosive devices installed must contain required safety pins and devices and be secured to prevent movement during transit. (T-1).
8.25. **Packaging.** Transport explosives in their approved storage and shipping packaging. If less than a single shipping package is transported, pack the explosives separately from other items in enclosed, clearly marked metal or wooden containers.

8.26. **Placarding.**


8.26.2. Commanders may omit placards on base where necessary to avoid attention of hostile forces. Instruct all personnel in proper emergency actions.

8.26.3. Where tow vehicle and trailer combinations are used on base, placard the tow vehicle on the front and the last trailer on the rear. Placard explosives loaded trailers in between on each side. Placards may be omitted for transporting HD 1.4 material on base provided the responsible Commander approves in writing.

8.26.4. Placard materials handling equipment only when used in the same manner as a transport vehicle or trailer.

8.26.5. Compatibility group letters may be omitted from the placard if the vehicle remains on the installation.

8.26.6. Placards are not required when transporting nuclear weapons or on any explosives loaded vehicle in a nuclear weapons storage area.


8.27. **Motor Vehicle Inspection.** Prior to use, inspect motor vehicles used to transport explosives to determine that:

8.27.1. Fire extinguishers are available, filled, and in good working order (see paragraph 10.23.).

8.27.2. Electric wiring is in good condition and properly attached.

8.27.3. Chassis, motor, pan, and underside of body is reasonably free of oil, grease, and fuel.

8.27.4. Fuel tank and feed lines are secure and not leaking.

8.27.5. Brakes, steering, lights, horn, and windshield wipers are functioning properly.

8.27.6. Tires are properly inflated and serviceable IAW TO 36-1-191.

8.28. **Load Protection and Stability.**

8.28.1. Cover exposed ferrous metal in the cargo compartment before transporting explosives that are not packaged in DOT specified containers or equivalent. (T-1).

8.28.2. Use only static resistant and noncombustible or flameproof tops or coverings.

8.28.3. Fasten safety chains between towing vehicles and trailers carrying explosives when lunette and pintle fastenings are used. Safety chains are not required when using specifically designed breakaway control safety features prescribed by the pertinent TO.
8.28.4. Ensure lifting devices on vehicles or handling equipment have a serviceable mechanism designed to prevent sudden dropping of the load in the event of power failure. (T-1).

8.28.5. Do not extend loads on the tines of a forklift more than one-third of the height of the top tier of containers above the backrest. (T-1).

8.28.6. Ensure forklifts use skids or pallets to move containers of explosives, except when containers are designed with fully enclosed stirrups (360 degrees) for forklift tines. (T-1).

8.28.7. Munitions may be carried on forklift tines when the weapon body is long enough to be firmly supported on both tines and strong enough to prevent damage.

8.28.8. Ensure munitions loads (AE and inert AE components) on all types of vehicles and handling equipment are stable and secure before movement. (T-1). Load stability is required for all movements, to include rewarehousing or other activities conducted between one or more storage magazines, storage pads or other operating location. For on base movements, munitions loads (AE and inert AE components) must be restrained, blocked, braced, tied down or otherwise secured to the vehicle to prevent movement and must not damage explosives or containers. (T-1). “Secure” means the load is protected by an effective restraining system. Restraining devices may include chains and binders, cargo nets and tie-down straps, sideboards and tailgates, etc.

8.28.9. Consider vehicle and handling equipment type, type of load, and the prevailing weather and road conditions when determining if safe transport is feasible. This guidance pertains to MSAs as well as applicable flightline operations.

8.29. Loading and Unloading.

8.29.1. Chock explosives loaded vehicles, MMHE (except MHU-196 and MHU-204 trailers) and MHE (trailers, UALS, etc.) during loading or unloading operations. (T-1).

8.29.2. To the maximum extent possible, position munitions cargo vehicles to permit loading and unloading from each side of the cargo bed. Access munitions from the side closest to the load unless access can only be obtained from one side.

8.29.3. Except as required in the event of an electrical storm (see Section 7H), do not leave explosives-laden vehicles unattended unless they are parked in a properly designated area, such as the weapons storage area, holding yard or flightline munitions holding area. (T-1).

8.29.4. Do not load or unload explosives from a motor vehicle while the engine is running (T-1), except under the following conditions:

8.29.4.1. Where the engine is required to provide power to vehicle mechanical handling equipment used in loading and unloading the vehicle.

8.29.4.2. Where necessary for emergency operations or timing for exercises simulating execution of emergency plans. In this case, small loads or packages of explosives delivered to aircraft, requiring only momentary unloading time, may be removed from a vehicle while the motor is running.

8.29.4.3. Engines of diesel-powered vehicles may continue to run during loading or unloading of explosives except when exposed explosives or hazardous locations are involved.
8.29.4.4. Adequate ventilation is provided to prevent unnecessary build-up of exhaust gases.

8.29.5. Do not leave vehicles at aircraft or storage locations longer than needed to complete explosives loading or unloading. If a delay occurs, move the vehicle from location.

8.29.6. Refuel trucks before loading explosives.

8.30. Vehicle Refueling.

8.30.1. Refuel non-explosives loaded vehicles and equipment at least 100 feet from structures or sites containing explosives.

8.30.2. When refueling explosives-loaded vehicles, maintain a bonded path between the tank being filled and the tank being emptied and ground the entire system. (T-1). Refer to Section 7D for further guidance on static grounding.

8.30.2.1. When refueling is completed, remove refueling vehicle from the storage area.

8.30.2.2. Use the smallest available size of refueling unit.

8.30.2.3. One person must be present during the entire operation.

8.30.2.4. During refueling, stop motors of vehicle being refueled and refueling truck (unless refueling truck motor drives the pump).

8.30.2.5. In event of a fuel spill, immediately notify the base fire department. Do not start motors of refueling truck or unit being refueled until area is rendered safe.

8.31. Battery-Powered MHE. Battery-powered MHE is preferred for handling explosives and used when possible.

8.31.1. Mount electrical cables to prevent catching on stationary objects or damage by cutting or abrasion. Protect cables to prevent short-circuiting as far as practicable.

8.31.2. Securely fasten batteries and give battery boxes ample ventilation, with ventilation openings that prevent access to the cell terminals from the outside.

8.31.3. Equip with a dead-man switch and a main service switch that can be operated from the driving position.

8.32. Gasoline or Diesel-Powered MHE.

8.32.1. Equip with a standard muffler and air cleaner.

8.32.2. Ensure gas caps are in place.

8.32.3. If necessary, install a deflector plate to prevent overflow from the fuel tank from reaching motor or exhaust pipe.

8.32.4. On gravity feed fuel systems or on pump systems that can be siphoned, install an emergency shutoff valve at fuel tank or in the feed line.

8.32.5. Protect fuel lines from rupture due to vibration.

8.32.6. Securely fasten electrical connections to prevent accidental disconnection that might result in sparks or fire.

8.32.7. Do not use equipment in areas classified as hazardous locations.
8.33. Liquefied Petroleum and Compressed Natural Gas Fueled Vehicles. Motor vehicles or other equipment used to transport explosives using Liquefied Petroleum (LP) or Compressed Natural Gas (CNG) for propulsion must have a fuel system which complies with the current edition of the National Fire Protection Agency, Standard 58, Section 8.2.6, regarding Engine Fuel Systems. (T-0).

8.34. Exposed Explosives Precautions. Do not use battery, gasoline or diesel-powered vehicles and materials handling equipment inside any structure or building containing exposed explosives. Use vehicles or equipment within the vicinity of structures containing exposed explosives providing:

8.34.1. Gasoline or diesel-powered units have exhaust system spark arrestors and, where applicable, carburetor flame arrestors (standard air cleaners).

8.34.2. Spark arrestors meet military specifications for the particular equipment and are installed so they will not become clogged in normal operation (AFI 91-203, and TO 38-1-23, Inspection and Installation of Exhaust Spark Arrestors and Exhaust Purifiers (Catalytic Mufflers) on Non-Aircraft Engines).

8.34.3. Vehicle operators inspect spark arrestors before each daily use and clean them if there is an excess of carbon particles.

8.35. Storage of Powered MHE. Store battery, gasoline, LP, CNG, or diesel-powered equipment in a magazine, storehouse or other suitable location that contains only non-explosives materials. Keep equipment at least 10 feet from combustible material. Keep aisles clear at all times and space to minimize spread of fire from one unit to another. Equipment essential for daily operations may be parked in fire-resistive buildings containing explosives. The following minimum requirements must be met: (T-1).

8.35.1. Use properly rated fire walls and closed doors to completely separate equipment from bays, rooms or cubicles containing explosives.

8.35.2. Ensure designed fire-resistant ratings for the enclosures containing explosives are not degraded.

8.35.3. Battery charging must comply with AFI 91-203, Chapter 31.

8.35.4. Weapons safety and fire protection personnel must review the local situation for any additional measures necessary to enhance safety.

8.36. Operating Powered MHE Inside Structures. Concentration of carbon monoxide in the operating area must not exceed the current occupational exposure limit. (T-1). Consult the local bioenvironmental engineer for a determination of exposure levels, applicable exposure standards, and recommended controls.


8.37.1. Only operator inspection and maintenance normally related to the operation of a vehicle will be done on explosives-laden vehicles. Such maintenance includes servicing with fuel, oil, air, lubrication and water, changing tires, fuses, hoses and drive belts, etc.

8.37.2. No maintenance will be done on an explosives-loaded vehicle or trailer that would increase the probability of fire or would require the use of heat-producing equipment.
8.37.3. No restrictions are imposed on tractor maintenance when the tractor is separated by at least 100 feet from an explosives-loaded trailer.

8.37.4. Do not elevate a vehicle to shift the load or place excessive strain on the tiedowns when tires are being changed.

8.37.5. Vehicles carrying nuclear weapons are subject to the maintenance restrictions in TO 11N-45-51 series.

Section 8H—Transportation of Explosives by Rail

8.38. General.

8.38.1. 49 CFR Part 174.1 – 174.750 and DOT safety regulations for safety devices, safeguards, design of equipment, etc., are mandatory for railway equipment transporting materials outside an installation. (T-0). In addition, follow these regulations within an installation.

8.38.2. Give special attention to rail clearances, buildings, loading docks, overhead lines, etc.

8.38.3. Locomotives. Carry portable fire extinguishers on all locomotives and other self-propelled rail vehicles IAW paragraph 10.23.2.

8.38.4. Track Layout. Loop railroad lines serving explosives areas to give at least two ways of exit.

8.38.5. Control vegetation along the railroad right-of-way on the base per paragraph 10.16.


8.39.1. By Engine. Secure load and cut in air brakes before movement. Do not uncouple cars while in motion or pulled apart by locomotive power.

8.39.2. By Car Mover. Station an individual at the hand brake during any manual movement of a car.

8.40. Spotting Railcars.

8.40.1. Set hand brakes and properly chock wheels when spotting single cars. When more than one car is spotted and the engine detached, set hand brakes on the downgrade end of the cut of cars. Do not rely on the automatic air brakes to hold spotted cars.

8.40.2. Locomotives will not stop in front of buildings and loading docks containing hazardous materials longer than needed to spot cars for loading or unloading.

8.40.3. Locate cars at a magazine or building so that personnel may evacuate the building or car rapidly if necessary.

8.41. Switching Railcars.

8.41.1. Take special care to avoid rough handling of cars.

8.41.2. Do not disconnect cars while in motion. Couple cars carefully to avoid unnecessary shocks. Do not disconnect other cars and allow them to strike cars containing explosives.
8.41.3. Place cars in yards or on sidings so they can be quickly removed from the danger of fire and handled as little as possible. Do not place cars under bridges or alongside passenger sheds or stations. Do not allow engines on a parallel track to stand opposite or near them.

8.41.4. Dropping, humping, kicking, or using the flying switch is prohibited.

8.42. **Marking Railcars with Blue Flags or Signals.** Place blue flags or signals at both ends of a car when personnel are working in, on, or under the cars, except as noted below. Do not move or couple cars marked in this manner. The supervisor or foreman in charge of the personnel loading or unloading the cars is responsible for placing and removing the blue flag or signal. Inform train crews in the use of blue flags or signals.

8.42.1. Flags are not required when flat cars are involved and the presence of a working party is clearly evident.

8.42.2. Flags or signals may be omitted from the end of a car located against or toward a dead end spur. This also applies to a loading ramp where no other rolling stock can approach from that direction.

8.43. **Loading Railcars.**

8.43.1. Inspect car thoroughly, inside and out, to determine its suitability to carry the type of explosives involved.

8.43.2. Broom clean the interior of the car before loading explosives.

8.43.3. Remove or cover protruding nails and bolt heads to prevent damage to packages.

8.43.4. Provide substantial gangways.

8.43.5. Remove any obstructions that may prevent free entry to the car.

8.43.6. Clear immediate area of leaves, dry grass, and other flammable materials.

8.43.7. Close the car and magazine doors during loading operations when engines or speeders are passing.

8.43.8. Do not leave cars partly loaded unless it is impossible to finish loading at one time. In this case, lock car doors.

8.43.9. If it becomes necessary to move a partially loaded car, brace the load.

8.43.10. During and after loading, properly brace and stay the shipment per paragraph 8.44.

8.43.11. After loading, seal the car per paragraph 8.49.

8.44. **Loading and Bracing.** When loading freight cars, consult Bureau of Explosives Pamphlets 6 and 6A and 49 CFR Part 174 for guidance unless specific instructions or car loading drawings are available for the items involved. These pamphlets govern the method of loading, staying, and bracing of carload and less-than-carload shipments of explosives. Refer to Bureau of Explosives Pamphlet 6C for guidance in securing truck bodies or trailers on flat cars. Also see this pamphlet for loading, blocking, and bracing of the cargo within, or on, such vehicles or containers. The carrier or cargo must not shift under an impact of eight miles per hour from either end. Obtain Bureau of Explosives pamphlets by writing: Bureau of Explosives, 50F St. NW, Washington DC 20336.
8.45. Placarding of Railcars.

8.45.1. Placard railcars transporting explosives according to paragraph 8.26.1.

8.45.2. Display placards when the first container of explosives is loaded in the railcar. Remove placards when the last container of explosives is removed from the railcar.

8.45.3. Four placards are required for each railcar. It is the responsibility of the shipper to furnish the needed placards.

8.45.4. Where necessary, to avoid attention of hostile forces, Commanders may omit placards when arrangements are made with the host-nation or governmental agency involved. Instruct all involved (including essential train crews) in proper emergency actions.

8.46. Railcar Requirements.

8.46.1. Cars used for the shipment of material requiring placarding under 49 CFR Part 172, must meet standards for the class of material being shipped as specified in 49 CFR Part 172. (T-0).

8.46.2. Inspect cars for HD 1.1 explosives before and after loading.

8.46.3. Accomplish, distribute, and affix car certificates according to 49 CFR Part 174.104 (f). (T-0).

8.47. Leaking Packages in Railcars.

8.47.1. Continually be alert to detect leaking packages or leaking tank cars.

8.47.2. Remove and repair leaking packages from cars. In the case of tank cars, transfer the contents.

8.47.3. Switch leaking tank cars containing compressed gases to a location distant from habitation and highways. The on-scene Commander must determine the appropriate distance and take action to transfer contents. (T-1).

8.47.4. Protect cars containing leaking packages or leaking tank cars to prevent ignition of liquid or vapors.

8.47.5. Hold to a minimum the movement of a leaking car until the unsafe condition is corrected.

8.47.6. If artificial light is necessary, use only approved explosion proof electric lights.

8.48. Tools for Loading and Unloading Railcars. Steel tools, used with reasonable care, may be used inside cars if explosives are not exposed. When explosives are exposed, take special care to prevent sparks.

8.49. Sealing Railcars.

8.49.1. Seal cars containing explosives with railway-type car seals stamped with an identifying number. The shipper keeps a record of car numbers and seals (see DTR 4500.9-R-Part II for additional car seal regulations).

8.49.2. When a car seal is changed on a car of explosives, record the following information:

8.49.2.1. Railroad.
8.49.2.2. Place.
8.49.2.3. Date.
8.49.2.4. Number or description of seal broken.
8.49.2.5. Number or description of seal used to reseal car.
8.49.2.6. Reason for opening car.
8.49.2.7. Condition of load.
8.49.2.8. Name and occupation of persons opening car. Document this record on waybills or other forms or memorandum that accompanies car to destination.

8.50. Processing Incoming Loaded Railcars.

8.50.1. A competent representative will inspect railcars containing explosives at a designated inspection station. Inspection stations do not require explosives siting if they are limited to the activities described in paragraph 12.57. Apply QD criteria per Chapter 12 if the inspection station is also used as explosives storage or suspect vehicle holding area. The inspection station may be used as an interchange yard. Remove railcars promptly.

8.50.2. Inspect the outside and underside of each car to detect damage (such as defective brakes, couplings, wheel flanges, or hot boxes) or unauthorized and suspicious articles.

8.50.3. If pits are not available, conduct inspections from ground level. Provide pits if sabotage is possible.

8.50.4. If rail traffic is heavy enough or in an emergency, a pit should help in inspecting and moving cars rapidly.

8.50.5. Isolate cars of explosives for prompt corrective actions when foreign and suspicious articles have been attached outside or underneath the car. Also isolate when there is a defect that could affect installation safety or car contents.

8.50.5.1. Move car, unless the problem prohibits, over the safest route to a location separated from other areas by proper IBD.

8.50.5.2. Correct the unsatisfactory conditions before the car and cargo are released from the designated suspect car site, unless a determination is made that they are safe to move.

8.50.6. Check individual car numbers and seal numbers against bills of lading. If the seal numbers on a car do not correspond to the numbers shown on the bill of lading, or a seal is not in place, treat as a suspect car. Remove it to the suspect car siting for additional inspection.

8.50.7. Visual inspection of the external condition of the cargo in cars that pass the initial inspection may be done at any suitable place, including the unloading point. Such cars may be considered reasonably safe. However, exercise care in breaking seals and opening doors because of the potential for shifted loads or leaking containers.

8.50.8. If warranted by the inspection results, promptly remove cars from the inspection station.
8.50.9. Externally inspect commercial carriers used to move explosives through a public access route, from one area to another area of the installation, before entering the second area. This is not needed if it is escorted or under surveillance enroute.

8.51. Rail Interchange Yards. Use this location for the exchange of railcars between the common carrier and the base activity involved. Interchange yards do not require explosives siting if they are limited to the activities described in paragraph 12.58. Apply QD criteria per Chapter 12 if the interchange yard is also used as explosives storage or suspect vehicle holding area. The interchange yard may be used as an inspection station. Remove railcars promptly.

8.52. Rail Holding Yards. If explosives-loaded railcars cannot be dispatched to unloading points promptly, move the railcars to a holding yard. See paragraph 12.59. for holding yard siting requirements. Holding yards may be used for interchange and inspection activities.

8.53. Rail Classification Yards. Where the volume of rail traffic necessitates, establish a classification yard primarily for receiving, classifying, switching, and dispatching explosives-laden railcars. Classification yards do not require explosives siting if they are limited to the activities described in paragraph 12.60. Apply QD criteria per Chapter 12 if the classification yard is also used as explosives storage or suspect vehicle holding area. The classification yard may be used as an interchange yard. Remove railcars promptly.

8.54. Trailers on Flat Cars or Piggyback Explosives Loading and Unloading. The following instructions govern use of explosives Trailers on Flat Cars (TOFC) railheads:

8.54.1. Control loading or unloading operations to reduce exposures to a minimum.

8.54.2. Quickly remove trailers from the railroad car and send at once to their destination or schedule for prompt loading on arrival at the site. If there is an unforeseen delay in loading or unloading, an explosives-loaded trailer may be kept at the site for a period not exceeding one working day.

8.54.3. Do not open piggyback shipping trailers and containers at the site except for emergency or suspected emergency situations, except as for Shipping and Storage Containers, Ballistic Missile (SSCBM). SSCBM received by TOFC may be opened at the site for inspection and road transport preparation per pertinent TOs.

8.54.4. Ensure adequate tie-down of trailers to railcars and blocking and bracing of explosives in the trailer. Cargo stability in transit is essential.

8.54.5. Apply safety rules in this Chapter on explosives-laden motor vehicles and their operation.

8.54.6. The provisions of Bureau of Explosives Pamphlet 6C apply to explosives piggyback operations. This pamphlet lists railcars and hitches approved for TOFC service.

8.54.7. Except for those just discussed, do not conduct operations on explosive items or explosives-laden containers, trailers, cars, etc., unless applicable QD criteria are met.

Section 8I—Transportation of Explosives by Air and Water

8.55. Transportation of Explosives by Air. Air transportation of explosives by commercial aircraft is regulated by the DOT regulations that are incorporated into 49 CFR Parts 171 to 177. Instructions about explosives-laden military aircraft (and certain DoD contract airlift operations)
are in AFJI 11-204, *Operational Procedures for Aircraft Carrying Hazardous Material*, AFMAN 24-204, *Preparing Hazardous Materials for Military Air Shipments*, applicable aircraft TOs, and other parts of this Manual. Transportation of impulse cartridges (HD 1.4 only) in aircraft travel pods or bomber aircraft equipment bays is permitted if these cartridges are packed correctly in the original DOT shipping containers. Govern this procedure by locally approved operating instructions IAW paragraph 7.2. More hazardous explosives (such as aircraft flares) are not authorized by this Manual for this type of carriage. See guidance in paragraph 8.2. for using NEWQD during transportation.

**8.56. Transportation of Explosives by Water.** Transportation of explosives and other hazardous materials by water in vessels engaged in commercial service is regulated by the United States Coast Guard (USCG). Shipments overseas must be made according to the regulations of the carrier, the USCG, or the Department of the Army. (T-0).
Chapter 9

MATERIAL POTENTIALLY PRESENTING AN EXPLOSIVE HAZARD (MPPEH)

Section 9A—Purpose and Applicability

9.1. Purpose and Applicability.

9.1.1. This Chapter implements the requirements necessary for the management of a MPPEH program as specified in DoDI 4140.62 and DoD 6055.09-M. The effective management of MPPEH, Material Documented as an Explosive Hazard (MDEH), and Material Documented as Safe (MDAS) will help prevent the unauthorized or unintentional transfer or release of an explosive hazard from AF control; the transfer or release of material documented hazardous to an unqualified receiver; or a shipment that violates hazardous material transportation regulations.

9.1.2. The requirements in this Chapter apply to all MPPEH, MDEH and MDAS that is under DoD control or the control of DoD contractors of a contractual requirement.

9.1.3. The requirements in this Chapter do not apply to:

9.1.3.1. Military munitions and munitions-related materials, including wholly inert components (e.g., fins, launch tubes, containers, and packaging material) that are to be used or reused for their intended purpose and are within an AF-established munitions management system.

9.1.3.2. Non-munitions-related material (e.g., horseshoes, rebar, other solid objects), and munitions debris that are solid metal fragments that do not realistically present an explosive hazard.

9.1.3.3. Other items that may present explosive hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions.

9.1.3.4. Persons outside the DoD other than defense contractors as provided in contracts.

9.1.3.5. Subsurface material.

Section 9B—Program Management

9.2. General.

9.2.1. As part of the MPPEH management and disposition process:

9.2.1.1. MDEH must not be commingled with MPPEH or MDAS or misidentified or improperly documented as MPPEH or MDAS once the explosive hazards it presents have been determined.

9.2.1.2. MDAS must not be commingled with MPPEH or MDEH or misidentified or improperly documented as MPPEH or MDEH once it has been determined to be safe.

9.2.2. Control and manage MPPEH and MDEH to prevent their unauthorized use, transfer, or release.

9.2.3. Ensure that only MDAS is released to the public.
9.3. Training.

9.3.1. Personnel who have responsibilities associated with MPPEH, MDEH and MDAS will meet the qualifications and requirements specified in DoDI 4140.62 and AFI 21-201, necessary to accomplish their assigned duties. (T-1).

9.3.2. The Commander or authorized official directly responsible for controlling the transfer or release of MPPEH, MDEH and MDAS will ensure personnel are assigned to a technically qualified position or designated, in writing, and confirm they are technically qualified to perform the duties assigned. (T-1).

9.3.3. Contractor personnel will be designated as technically qualified and approved as provided in contracts. (T-1).

9.4. Processing Points.

9.4.1. Site locations used for collected MPPEH processing operations (e.g., consolidation, inspection, sorting, storage, transfer, release) (MPPEH processing points) according to guidance specified in Chapter 14.

9.4.1.1. As an ES, at not less than ILD from surrounding PESs.

9.4.1.2. As a PES, when the MPPEH has not been documented as safe (i.e., MDAS) or when the material has been documented as an explosive hazard (i.e., MDEH).

9.4.2. ESP submission is not required for locations on operational ranges that are used temporarily during range clearance activities for intermediate management of collected MPPEH (MPPEH collection points) prior to transfer to a MPPEH processing point. Range managers must ensure that MPPEH collection points are located so that their ESQD arcs, based on the hazard classification and NEWQD assigned (see paragraph 9.4.3.) remain within the operational range’s impact area and associated safety buffer zone. (T-1).

9.4.3. Base the hazard classification and NEWQD upon characteristics of the type material involved, its packaging arrangement (if packaged), and the estimated or, if known, calculated amount of explosives potentially present.

9.5. Disposition Procedures.

9.5.1. The actual procedures used to control, secure, mark, inspect, certify, document, transfer, release, demilitarize or dispose of MPPEH, MDEH or MDAS will follow the requirements prescribed in AFI 21-201. (T-1).

9.5.2. Transportation. See Chapter 8 for further guidance concerning explosives transportation.
Chapter 10

FIREFIGHTING, EMERGENCY PLANNING AND FIRE PREVENTION

Section 10A—Hazard Identification for Firefighting and Emergency Planning

10.1. Scope and Applicability.

10.1.1. This section establishes standard firefighting hazard identification measures to ensure a minimum practicable risk in fighting fires involving AE. These identification measures are based on the classification of AE fires into four fire divisions according to their predominant hazard.

10.1.2. AE hazard symbols and supplemental symbols including chemical agent symbols are for firefighting situations (see paragraph 10.4.).

10.2. Fire Divisions. There are four fire divisions. Fire division 1 indicates the greatest hazard. The hazard decreases with ascending fire division numbers from one to four, and are related to HD as shown in Table 10.1. The hazard is based on the burning or explosives characteristics of the material. Fire symbols do not apply to liquid propellants, except for symbol 1, which is used to indicate a detonation hazard of Group IV propellant. Fire protection for insensitive HE (both bulk and filled items) is based on their equivalent storage classification.

10.3. Fire Division Symbols.

10.3.1. The four fire divisions are represented by four distinctive symbols so that firefighting personnel can recognize the hazards. A fire division number is shown on each symbol. For the purpose of identifying these symbols from long range, the symbols differ in shape as shown in Figure 10.1.

10.3.2. The shape and dimensions of the symbols are shown in Figure 10.1. This shape and color scheme is consistent with the requirements of the North Atlantic Treaty Organization (NATO), United Nations Organization (UNO), and International Maritime Organization (IMO).

10.4. Chemical Agent and Chemical Munition Hazard Symbols.

10.4.1. The storage of chemical agents and chemical munitions requires the use of chemical hazard symbols. Use these symbols in conjunction with fire symbols; where appropriate (see Figures 10.2. and 10.3.). Some of the common chemical agents used in AE, the CG of that AE, and the chemical hazard symbols required in storage are specified in Table 10.2.

10.4.2. The following sections describe these symbols, the hazards indicated by the symbols, and the recommended protective clothing and equipment to be used for fighting fires involving these chemical agents and chemical munitions. Where respiratory protection (self-contained breathing apparatus (SCBA) and protective masks) are used, personnel must implement a workplace respiratory protection program IAW AFI 48-137, Respiratory Protection Program. (T-1). Reference the item TO, or contact Bioenvironmental Engineering for protective clothing requirements for situations other than firefighting. The SCBA and other protective clothing and equipment prescribed in this paragraph must be used
if required for use by other applicable technical orders or other DoD or Air Force publications. (T-1). See AFI 10-2501 for further guidance.

10.4.2.1. Set 1 of Chemical Hazard Symbol 1 requires full protective clothing and indicates the presence of highly toxic chemical agents that may cause death or serious damage to body functions (see Figure 10.2. and Table 10.2.). Use the following full protective clothing (Level An encapsulating suit IAW TO 14P3-1-7, Toxicological Protective Apron, M-2):

10.4.2.1.1. Self-contained breathing apparatus (SCBA).
10.4.2.1.2. Impermeable suit, hood, boots, undergarments, coveralls, protective footwear, and gloves.

10.4.2.2. Set 2 of Chemical Hazard Symbol 1 requires full protective clothing and indicates the presence of harassing agents (riot control agents and smokes) (see Figure 10.2. and Table 10.2.). Use the following protective clothing:

10.4.2.2.1. Protective gas masks or SCBA.
10.4.2.2.2. Permeable coveralls.
10.4.2.2.3. Protective gloves.
10.4.2.2.4. Firefighting personnel equipped with normal heat-resistant clothing (e.g., firefighter protective ensemble) and gas mask or SCBA do not require the set 2 protective clothing.

10.4.2.3. Set 3 of Chemical Hazard Symbol 1 requires full protective clothing and indicates the presence of WP or other spontaneously combustible material. Use the following protective clothing:

10.4.2.3.1. Protective gas masks or SCBA.
10.4.2.3.2. Flame-resistant coveralls and gloves.
10.4.2.3.3. Firefighting personnel equipped with normal heat-resistant clothing (e.g., bunker suit) and gas mask or SCBA do not require the set 3 protective clothing (see Figure 10.2. and Table 10.2.).

10.4.2.4. Chemical Hazard Symbol 2 requires the wearing of breathing apparatus and indicates the presence of incendiary or readily flammable chemical agents that present an intense radiant heat hazard (see Figure 10.2. and Table 10.2.). Use protective masks to prevent inhalation of smoke from burning incendiary mixtures.

10.4.2.5. Chemical Hazard Symbol 3 warns against applying water and indicates a dangerous reaction will occur if water is used in an attempt to extinguish fire (see Figure 10.2. and Table 10.2.).

10.5. Obtaining Firefighting Symbol Decals. Decals for fire and chemical hazard symbols may be obtained through normal Air Force supply channels. National stock numbers (NSN) of standard and half-size decals are listed in Figures 10.1., 10.2., and 10.3. Make backing for fire symbol decals the shape of the decal and out of non-combustible material. If heat from the fire burns off the numbers, the fire department can act on the shape. AFVA 91-216, USAF Explosives Fire and Chemical Hazard Symbols, is available through publication channels.
Section 10B—Posting Firefighting Symbols

10.6. Purpose of Posting Firefighting Symbols. Firefighting symbols are used as a back-up precaution for alerting response personnel to explosives or chemicals present. Firefighting symbols posted on nuclear, chemical, or conventional weapon storage sites will comply with paragraph 10.7, unless otherwise directed by the Base Fire Chief (direction must be in writing). (T-1). These written directions notify personnel that local conditions (i.e., security considerations) may make it undesirable to identify munitions with fire symbols at the actual storage locations.

10.7. Posting Requirements for Firefighting Symbols.

10.7.1. Post the fire symbol and chemical symbol that applies to the most hazardous material present at nonnuclear explosives locations. (T-1).

10.7.2. When non-Class 1 hazardous items or materials are stored or used in a facility, without other items of class 1, identify the predominant hazard to guide emergency response personnel. In this case, placards are required IAW NFPA and Occupational Safety and Health Administration (OSHA) regulations. (T-0). Do not display NFPA and OSHA placards concurrently with Class 1 fire symbols.

10.7.3. Post firefighting symbols when AE or chemical agents are placed in a facility or location, and remove the symbols when the AE or chemical agents are removed. (T-1). The person in charge of the operation is responsible for posting or changing the symbols.

10.7.4. Notify the Emergency Communication Center (ECC) each time firefighting symbols are changed. (T-1).

10.7.5. Half-sized symbols may be used on doors or lockers inside buildings. Additionally, half-size symbols may also be used for individual bays on structures where full size symbols prohibit the proper functioning of the doors. Post full size symbols for the highest hazard and applicable sets to be visible from all approach roads. (T-1).

10.7.6. Licensed Explosives Storage Locations.

10.7.6.1. Post symbols on exterior and interior entrances to small rooms licensed for storing AE. (T-1).

10.7.6.2. Post symbols on lockers or containers licensed for storing AE. (T-1).

10.7.6.3. Posting symbols on the exterior of buildings containing licensed storage locations are optional, provided the Base Fire Chief approves in writing. When posted, ensure symbols are visible from all approach roads.

10.7.7. Non-Flightline Sited Explosives Locations.

10.7.7.1. Ensure symbols are visible from all approach roads.

10.7.7.2. When one symbol applies to all AE within a storage area or on a service road, it may be posted at the entry control point or row entrance.

10.7.7.3. Post individual symbols on each door of a multicube storage magazine. (T-1). Post the symbol for the highest hazard and applicable sets to be visible from all approach roads. (T-1).

10.7.8.1. Identify aircraft loaded with nonnuclear weapons with symbols posted at each aircraft or aircraft shelter.

10.7.8.2. One fire symbol may be posted at the entry point (point of entry for firefighting personnel) to an aircraft area.

10.7.8.3. Notify the ECC when each aircraft is loaded or unloaded. (T-1). Give aircraft parking location and type of explosives involved.

10.7.8.4. During mass loading of three or more aircraft, when a fire truck is present, notify the ECC as soon as the last loading is complete.

10.8. Exceptions to Posting Firefighting Symbols.

10.8.1. Locations with aircraft having only exempted devices according to paragraph 12.47. This exception does not apply to explosives cargo.

10.8.2. Missile sites with a single type of weapon system, such as ICBM sites.

10.8.3. Locations with 1,000 rounds or less of HD 1.4 small arms ammunition.

10.8.4. When, by agreement, host-nation symbols are used.

10.8.5. When the responsible Commander temporarily orders them removed for emergency security purposes.

10.8.6. Locations storing or maintaining nuclear weapons or both nuclear and nonnuclear weapons. Maintain a map or listing of munitions locations. Use line numbers or symbols from TO 11N-20-11, General Firefighting Guidance, for nuclear weapons. Provide this information to the Fire Department. Update as changes occur.

10.8.7. Aircraft loaded with nuclear weapons or with nonnuclear and nuclear weapons within the same designated area.

10.8.8. Aircraft in a designated explosives parking area if described in a local publication. Include the class/division, governing symbol, emergency procedures and the requirement to notify the Fire Department.

10.8.9. Locations storing only assembled aircrew flight equipment (e.g., parachutes, aircrew flight equipment kits, life rafts, life preservers, etc.) containing authorized explosives, when approved by the Base Fire Chief or authority having jurisdiction.

Section 10C—Firefighting Measures and Withdrawal Distances


10.9.1. Fires involving conventional munitions cannot be definitive to any one set of circumstances and environmental conditions. This precludes development of reliable standardized test criteria and reliable specific item firefighting and withdrawal times. The conclusion to be reached from available data is that a munitions reaction to fire is a function of case thickness and type of explosive filler which can be varied by environmental conditions. Since the circumstances of a fire cannot be predicted, specific item by item firefighting and withdrawal times cannot be determined with any degree of reliability.
10.9.2. Firefighters must have a thorough knowledge of the hazards associated with AE fires and expected AE reactions.\(\text{(T-1)}\). The firefighting forces and other essential personnel will be briefed before approaching the scene of the fire. \(\text{(T-1)}\). They will be informed of the known hazards and conditions existing at the fire scene prior to proceeding to the fire location. \(\text{(T-1)}\).

10.9.3. Fires involving AE will be fought according to the HD, fire division, the progression of the fire, and the procedures specified in this Manual. \(\text{(T-1)}\).

10.9.4. Report all fires starting in the vicinity of ammunition or explosives and fight immediately with all available means to prevent the spreading of fire and munitions involvement. \(\text{(T-1)}\). However, if fire engulfs explosives material or is supplying heat to it, or if the fire is so large that it cannot be extinguished with the equipment on hand, evacuate personnel involved and seek safety. \(\text{(T-1)}\). See Table 10.1. for additional information and when required, evacuate personnel per paragraph 10.10.

10.10. Fire Withdrawal Distances. Commanders are responsible for developing evacuation plans that include the applicable withdrawal distances as part of the installation’s emergency planning (see paragraph 10.13.). \(\text{(T-1)}\).

10.10.1. Non-essential personnel. These emergency withdrawal distances apply in emergency situations only and are not to be used for facility explosives siting.

10.10.1.1. The initial withdrawal distance for non-essential personnel will be at least IBD for the PES involved. If the fire involves AE, AE involvement is imminent, or the fire is or may become uncontrollable, then use the fire withdrawal distances listed in Table 10.3. The fire withdrawal distances depend on fire involvement and on whether or not the HD and quantity of explosives are known.

10.10.1.2. Structures or protected locations offering equivalent protection for the distances in Table 10.3 may be used in lieu of relocating personnel from the structure or location to the specified fire withdrawal distance. See Section 6B for additional information.

10.10.2. Essential personnel. Emergency authorities on-site will determine who qualify as, and the withdrawal distance for, essential personnel at accidents. \(\text{(T-1)}\).

10.10.3. Chemical Agents. AE containing both explosives and chemical agents requires special attention and precautions in firefighting (see Table 10.2.). Fires involving such AE will be fought IAW their fire division characteristics. Responding personnel must consider the additional hazards and precautions for the chemical agents involved. \(\text{(T-1)}\).

10.10.4. Underground Explosives Facilities. Entry to underground explosives facilities following a fire or explosion requires special precautions. Emergency personnel will monitor for the presence of toxic fumes or oxygen depleted atmospheres, and will evaluate structural damage during initial entry following an accident. \(\text{(T-1)}\). Commanders will develop written procedures that define actions in such emergency situations (see paragraph 10.13.). \(\text{(T-1)}\).

10.10.5. Nuclear Weapons. Nuclear weapons fire withdrawal distances are listed in TO 11N-20-11, General Fire Fighting Guidance.

10.11. Improvised Explosive Device (IED) Withdrawal Distances. Withdraw all non-essential personnel IAW AFMAN 10-2502, Air Force Incident Management System (AFIMS),
Standards and Procedures. (T-1). When determining more specific distances based upon suspicious/suspect devices use the Air Force “Recommended Improvised Explosive Device (IED) Minimum Evacuation Distance (MED)” chart provided in AFMAN 10-2503, Operations in a Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive (CBRNE) Environment.

Note: The use of any secondary agency MED chart for explosive devices is prohibited due to the inconsistency of the mathematical methods used to determine their evacuation distances, which in most cases, recommend much smaller safety footprints.

10.12. Withdrawal Distances for AE Not Involved in Fire (e.g., Dropped Munitions). Base the initial decision to evacuate non-essential personnel on the type of AE involved and its susceptibility to become more unstable, armed, or hazardous. Exercise good judgment, with regards to protecting personnel from the hazards of the AE or surrounding area. When evacuation is considered necessary, or is required by other technical guidance, clear the area to a distance of 300 feet (125 feet for simulators and smoke producing devices). (T-1). The incident Commander, with recommendation from EOD, may adjust withdrawal distances.

Section 10D—Emergency Planning

10.13. Emergency Planning. Commanders will develop an emergency management plan designed to provide safety, security, and environmental protection for accidents involving AE. Coordinate plans with the applicable federal, state, and local emergency response authorities (e.g., law enforcement, fire departments, hospitals, etc.) and any established Local Emergency Planning Committees (LEPC). (T-1).

10.13.1. In addition to requirements prescribed in AFI 10-2501, the plan will include the following: (T-1).

10.13.1.1. Specific sections and guidance that address withdrawal distances, emergency preparedness, contingency planning, and security. The developed EM plan will limit access to accident sites to trained and authorized personnel.

10.13.1.2. Procedures that minimize the possibility of an unpermitted or uncontrolled detonation, release, discharge, or migration of AE out of any storage unit when such release, discharge or migration may endanger human health or the environment.

10.13.1.3. Provisions for prompt notification (to include withdrawal distances) to emergency response and environmental agencies and the potentially affected public for an actual or potential detonation or uncontrolled release, discharge, or migration of AE that may endanger human health or the environment.

10.13.1.4. Provisions for complying with the Emergency Planning Community Right-To-Know Act (EPCRA) and Air Force implementing policies.

10.13.2. Each unit and installation fire protection agency with AE storage and operations must develop pre-fire plans as prescribed by AFI 32-2001, Fire Emergency Services Program. (T-1). Include all AE locations and operations, to include licensed explosives storage locations.

10.13.3. Each ECC will have an area map or computer-generated display showing all AE locations and operations and their firefighting symbols, to include licensed explosives storage
locations. (T-1). This map must also show adjacent facilities at risk from explosives. (T-1). Whenever possible, ensure all sites have a CE real property identification number.

10.14. Fire Drills. Drills are conducted to train firefighting forces and unit personnel, and to ensure all other personnel involved understand their duties. They are also conducted to evaluate fire alarm systems, firefighting equipment, and evacuation procedures.

10.14.1. Perform fire drills within the MSA at intervals not to exceed six months.

10.14.2. Coordinate fire drills with the Base Fire Chief if a Fire Department response is involved. (T-1). This does not preclude unannounced drills of a Fire Department’s response capabilities, provided coordination with the Base Fire Chief is accomplished at least 30 minutes before starting the drill.

10.14.3. Personnel responsible for conducting drills will ensure all involved are aware that the drill is an exercise, and not an actual fire. (T-1).

Section 10E—Fire Prevention

10.15. Heat-Producing Devices. In any explosives area, use devices that produce temperatures higher than 228o F (109o C) temporarily and only when essential. (T-1). Develop written safety procedures for these devices and include details on the location, purpose, and duration of use. (T-1). Coordinate the procedures through the base safety office and the Fire Department for approval. (T-1). Properly installed, approved furnaces and electrical space heaters are exempt. Heat-producing devices are not allowed where exposed explosives are present. Ensure personnel are qualified on the equipment prior to use.

10.16. Vegetation Control. The primary purpose of vegetation control is to limit the probability of combustible vegetation catching fire and to slow the spread of vegetation fires.

10.16.1. Except for firebreaks, maintain grounds in or near explosives storage areas or operating locations according to AFI 32-7064, Integrated Natural Resources. (T-1). Limit maintenance on these grounds to that which is necessary to prevent erosion or other waste of natural resources.

10.16.2. Balance the level of vegetation control with operational factors, such as cost to control, security, erosion prevention, BASH program requirements, and passive defense (camouflage).

10.16.3. Use varieties of vegetation that are resistant to burning where feasible.

10.16.4. Do not use herbicides or soil sterilants if complete removal of vegetation causes soil erosion.

10.16.5. Do not allow dead or cut vegetation to accumulate.

10.16.6. When animals are used for vegetation control on barricade surfaces and igloo earth cover, avoid overgrazing to prevent erosion.

10.17. Firebreaks. Where environmental and security factors allow, maintain 50-foot firebreaks around each PES except for ECMs. Maintain five feet around ECM ventilators. (T-1).

10.18. Controlled Burning. The installation Wildland Program Manager approves and provides oversight for controlled burning of vegetation.
10.18.1. Do not conduct controlled burning within 200 feet of any explosives location. (T-1).

10.18.2. Close windows, doors and ventilators of facilities containing explosives within 600 feet of burning operations. (T-1).

10.18.3. Accomplish all controlled burns according to approved, site specific burn plans. (T-1). See AFI 32-7064, *Integrated Natural Resources Management* for additional information.

10.18.4. The installation Wildland Program Manager determines firefighting personnel and equipment to be present during burning operations.

10.19. Flammable Liquids for Cleaning. (T-1). Do not use flammable liquids for cleaning purposes within an explosives area or near explosives, except as authorized by TO. Confine use to specific designated work areas. In-use stocks may not exceed a one-day supply. Store in approved safety containers or dispensers.

10.20. Paint and Other Flammable Materials. The following guidance applies when using paint and other flammable materials in AE locations.

10.20.1. Comply with AFI 91-203. (T-1). Store flammable materials in approved flammable storage cabinets, as required.

10.20.2. Small quantities of flammable materials, such as paints, lubricants and solvents, required to support explosives maintenance operations may be stored in explosives operating locations as required. This storage must not be the primary purpose of the area. Incidental storage of flammable materials not supporting explosives maintenance operations may be authorized within 50 feet of explosives operating locations. Consult fire department officials prior to establishing flammable storage areas in or near explosives operating locations.

10.20.3. Do not store materials that add fuel sources (such as wood, paper, and rags) with flammable materials.

10.20.4. Open containers of flammable materials only when in use.

10.20.5. For outdoor storage, place flammable materials in weatherproof containers.

10.20.6. Locate flammable storage locations at least 50 feet from explosives locations or isolate flammable storage by standard fire walls approved for the type and quantity of flammables being stored. (T-1).

10.20.7. Make available at least one fire extinguisher with a rating suitable for the type of material involved. (T-1). Determine fire extinguisher location by the Fire Emergency Services (FES) or civilian-equivalent fire unit, as appropriate per AFI 91-203, *Chapter 6*.

10.21. Operating Support Equipment. The following guidance applies when operating support equipment (not including vehicles powered by internal combustion engines in AE locations).


10.21.1.1. Locate equipment at least 25 feet from AE. (T-1). Equipment may be closer provided adequate ventilation and a fire-resistant dividing wall are provided.
10.21.1.2. Place aircraft ground support equipment as far away from AE as the length of
the power cord, the length of the hose or other equipment limitation will allow or as
directed by applicable TO.

10.21.2. Equipment designed into and installed as part of an operating or storage facility is
exempt from paragraph 10.21.1.

10.21.3. Operations in HASs are exempt from paragraph 10.21.1.

10.21.4. Do not refuel equipment within 100 feet of AE. (T-1).

10.22. Stacking Combustible Material. (T-1). The following guidance applies when stacking
combustible material in AE locations.

10.22.1. Stack containers, dunnage, lumber and so forth in an orderly manner.

10.22.2. Keep stacks stable and separated as far as practical from operations.

10.22.3. Limit stacks to 9,000 cubic feet.

10.22.4. Do not place bulk stacks of combustible materials closer than 100 feet from AE
locations.

10.22.5. If necessary, stack working quantities in the vicinity of AE. Remove all of the
material upon completion of the operation or at intervals that prevent hazardous
accumulation.

10.22.6. Provide suitable fire protection equipment.

10.22.7. When needed to prepare for combat operations, temporarily stack in or near the AE
storage site those empty containers, dunnage, and lumber that cannot be removed while the
work is in progress.

10.23. Fire Extinguishers. Unless otherwise directed by the Base Fire Chief, provide a
minimum of two fully charged fire extinguishers, suitable for the hazards involved, for
immediate use at any location where AE is being handled (T-1), except as noted.

10.23.1. See paragraph 11.7.8. for licensed explosives storage locations.

10.23.2. Provide each explosives-laden vehicle used for transport with at least two portable
2A:10BC rated extinguishers. (T-1). Mount fire extinguishers IAW AFI 24-301, Vehicle
Operations. (T-1). If explosives-laden vehicles are parked at a location designated for
explosive operations, additional fire extinguishers beyond those required in paragraph
10.23. are not required. If the vehicle leaves the explosives location, additional extinguishers
are required. Refer to AFI 24-301 and AFMAN 24-306 IP, Manual for the Wheeled Vehicle
Operator, for further guidance.

10.23.3. Ensure at least one fire extinguisher is available for each item of powered MHE
used to handle AE.

10.23.3.1. Individual fire extinguishers are not required for each piece of handling
equipment during explosive operations if the requirements of paragraph 10.23. are met.

10.23.3.2. If handling equipment is used to transport AE to a location where a second
fire extinguisher is not immediately available, two portable 2A:10BC rated extinguishers
are required for the handling equipment.
10.23.4. Provide flightline fire extinguishers for aircraft according to munitions loading manuals, AFI 91-203, and TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding*.

**10.24. Storing Water for Firefighting.** Adequate water to fight fires must be available. *(T-1).* Determine the capacity of the water supplies by the authority having jurisdiction (see paragraph 12.80.).

**10.25. Smoking.** AFI 91-203, *Chapter 24* prohibits smoking in aircraft maintenance facilities, flightline areas, and weapons storage and maintenance areas unless designated by the installation Fire Emergency Services (FES) Flight in coordination with the Maintenance Group Commander or equivalent, Airfield Manager and/or the functional manager. Additionally, for explosive locations, the following requirements apply:

**10.25.1.** Allow smoking in an explosives storage area or operating location only in specifically designated locations, where “designated tobacco areas” signs are posted.

**10.25.2.** A “No Smoking Except in Designated Areas” or “No Smoking” sign will be posted at each entrance to an explosives storage area. *(T-1).*

**10.25.3.** In an explosives storage area or operating location containing exposed explosives, include a notice that flame-producing devices must be turned over to the entry controller or placed in a container provided. *(T-1).*

**10.25.4. Requirements for Designated Smoking Locations.**

**10.25.4.1.** Do not place within 50 feet of any explosives locations (to include conveyances or MHE loaded with explosives items). *(T-1).*

**10.25.4.2.** Coordinate proposed location with weapons safety, CE and obtain installation fire chief or delegate approval. *(T-1).* Approval will address whether a fire extinguisher must be available. Display a certification of approval in each designated smoking location.

**10.25.4.3.** Provide suitable self-closing or self-contained properly marked receptacles for extinguishing smoking materials.

**10.25.4.4.** Provision of an electrical push-button type lighter that cuts off when pressure is released, or when the lighter tips over, is recommended.

**10.25.4.5.** Persons wearing clothing contaminated with flammables, explosives or other hazardous materials are not allowed in designated smoking areas.
Figure 10.1. Fire Division Symbols.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Large Symbol</th>
<th>Small Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>inches</td>
<td>metric (mm)</td>
</tr>
<tr>
<td>A</td>
<td>24</td>
<td>610</td>
</tr>
<tr>
<td>B</td>
<td>7</td>
<td>178</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>254</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>203</td>
</tr>
<tr>
<td>Letters (height)</td>
<td>10</td>
<td>254</td>
</tr>
<tr>
<td>Letters (thickness)</td>
<td>2</td>
<td>51</td>
</tr>
</tbody>
</table>

**Colors** (per Federal Standard 595B or GSA Catalog)
Background: Orange #12246
Letters: Black #17038
Figure 10.2. Chemical Hazard Symbols.

Symbol 1. Wear full protective clothing.
Background is blue, and figure and rim are as follows:
Red for Set 1 Protective Clothing: NSN 7690-01-081-9588
24-inch: NSN 7690-01-081-9587
12-inch: NSN 7690-01-081-9585
White for Set 2 Protective Clothing:
24-inch: NSN 7690-01-082-0291
12-inch: NSN 7690-01-082-0290

Symbol 2. Wear breathing apparatus.
Background is blue, figure and rim are white.
24-inch: NSN 7690-01-081-9589
12-inch: NSN 7690-01-082-6710

Symbol 3. Apply no water.
Background is white, circle and diagonal are red.
Figures are in mask.
24-inch: NSN 7690-01-082-2254
12-inch: NSN 7690-01-082-0292

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Large Symbol</th>
<th>Small Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>inches</td>
<td>metric (mm)</td>
</tr>
<tr>
<td>A</td>
<td>.24</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>.5</td>
<td>13</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>51</td>
</tr>
</tbody>
</table>

Colors (per Federal Standard 595B or GSA Catalog)
Red #11105
Blue #15102
Yellow #13538
White #17875
Black #17038
Figure 10.3. Supplemental Chemical Hazard Symbols.

G—Type Nerve Agents
24-inch: NSN 7690-01-082-5418
12-inch: NSN 7690-01-081-7481

VX Nerve Agents
24-inch: NSN 7690-01-081-7483
12-inch: NSN 7690-01-081-7482

H-Type Mustard Agents
24-inch: NSN 7690-01-082-6713
12-inch: NSN 7690-01-083-1663

Lewisite
24-inch: NSN 7690-01-082-6715
12-inch: NSN 7690-01-082-6714

Colors (per Federal Standard 595B or GSA Catalog)
Background: Yellow #13538
Letters: Black # 17038, as follows:

(a) 12 inches [305 mm] high and 2 inches [51 mm] thick on a 24-inch [610 mm] diameter circle.

(b) 6 inches [152 mm] high and 1-inch [25 mm] thick on a 12-inch [305 mm] diameter circle.
### Table 10.1. Fire Division Hazards and Actions.

<table>
<thead>
<tr>
<th>FIRE DIVISION</th>
<th>MATERIALS</th>
<th>HAZARD</th>
<th>ACTION/REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HD 1.1, HD 1.5, and Class IV liquid propellants</td>
<td>Mass explosion</td>
<td>1. Do not fight fire unless rescue attempt is planned.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. If there is suitable separation to symbol 1 materials and fire chief approves, firefighting forces may attempt to extinguish the fire.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. If personal safety is in doubt, take cover.</td>
</tr>
<tr>
<td>2</td>
<td>HD 1.2 and HD 1.6</td>
<td>Non-mass explosion, fragment producing</td>
<td>1. Give alarm; attempt to extinguish fire if in early stage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Firefighting forces should fight the fire. If not possible, prevent spread of fire.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Detonation of items could occur. Provide protection from fragments.</td>
</tr>
<tr>
<td>3</td>
<td>HD 1.3</td>
<td>Mass fire, minor blast or fragment</td>
<td>1. May be fought if explosives not directly involved.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. If WP munitions are involved, smoke is liberated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a. WP munitions may explode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Immerse Phosphorus in water or spray with water continuously.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. For fires involving hexachlorehane (HC) and incendiaries use dry sand or dry powder in early stage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. For fires involving pyrotechnics and magnesium incendiaries.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a. Protect adjacent facilities and equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Do not use carbon dioxide, Halon extinguishers or water on or near munitions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c. Allow magnesium to cool unless upon flammable material. In this case, use a 2-inch layer of dry sand or powder on the floor and rake the burning material onto this layer and re-smother.</td>
</tr>
<tr>
<td>4</td>
<td>HD 1.4</td>
<td>Moderate fire, no blast or fragment</td>
<td>1. Fight these fires.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Expect minor explosions and hot fragments.</td>
</tr>
</tbody>
</table>
Table 10.2. Compatibility Group and Chemical Hazard Symbols Required for Storage of Chemical Ammunition and Substances.

| Chemical Agents and Munitions | CG$^2$ | Full Protective Clothing | | | | Breathing Apparatus | Apply No Water |
|------------------------------|--------|--------------------------|--------|--------|------------------|-----------------|
| Toxic Agents$^1$            | K      | X                        |        |        |                  |                 |
| Tear Gas, O-Chlorobenzol    | G      | X                        |        |        |                  |                 |
| Smoke, Titanium Tetrachloride | G  | X                        |        |        |                  |                 |
| Smoke, Sulphur trioxide-chlorosulphonic acid solution | G     | X                        |        |        |                  |                 |
| Smoke, Aluminum-zinc oxide-hexachloroethane | G      |                           |        |        | X                | X               |
| White Phosphorous           | H      |                          |        |        | X                |                 |
| White Phosphorous plasticized | H    |                          |        |        | X                |                 |
| Thermite or Thermate        | G      | X                        |        |        | X                | X               |
| Pyrotechnic Material        | G      |                          |        |        | X                | X               |
| Calcium Phosphide           | L      |                          |        |        | X                | X               |
| Signaling Smokes            | G      |                          |        |        | X                |                 |
| Isobutyl methacrylate with oil | J    |                          |        |        |                  | X               |
| Napalm (NP)                 | J      |                          |        |        | X                | X               |
| Triethylaluminim            | L      |                          |        |        | X                | X               |

**Notes:**
1. Toxic Agents without explosives components that normally would be assigned to HD 6.1 may be stored as compatibility group K.
2. See Chapter 3 for information pertaining to CG.
Table 10.3. Fire Withdrawal Distances for Non-Essential Personnel.

<table>
<thead>
<tr>
<th>HD</th>
<th>UNKNOWN QUANTITY (feet)</th>
<th>KNOWN QUANTITY (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown, located in facility, truck, and or tractor trailer</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Unknown, located in railcar</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>$1.1^2$ and $1.5$</td>
<td>Same as unknown facility, truck, trailer, or railcar as appropriate</td>
<td></td>
</tr>
<tr>
<td>$1.2^2$ and $1.6$</td>
<td>2,500</td>
<td>2,500</td>
</tr>
<tr>
<td>1.3</td>
<td>600</td>
<td>Twice IBD with a 600 foot minimum (T12.12)</td>
</tr>
<tr>
<td>1.4</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>

Notes:
1. Emergency withdrawal distances do not consider potential flight range of propulsion units.
2. For HD 1.1 and HD 1.2 AE, if known, the maximum range fragments and debris will be thrown (including the interaction effects of stacks of items, but excluding lugs, strongbacks, and or nose and tail plates) may be used to replace the distances given.

For Transportation:
- $NEWQD \leq 500$ lb
  - $D = 2,500$ feet
- $NEWQD > 500$ lb
  - $D = 5,000$ feet for railcars
  - $D = 4,000$ feet for other modes

For Facilities:
- $NEWQD \leq 15,000$ lb
  - $D = 2,500$ feet
- $15,000$ lbs $< NEWQD \leq 55,285$ lbs
  - $D = 4,000$ feet
- $NEWQD > 55,285$ lbs
  - $D = 105W^{1/3}$
Chapter 11

LICENSED EXPLOSIVES STORAGE LOCATIONS

Section 11A—Purpose and Limitations for Licensed Explosives Storage Locations

11.1. Purpose of Licensed Explosives Storage Locations. Storage of small amounts of AE is sometimes required in facilities or locations that are not explosives sited IAW Chapter 14. Such storage may be permitted in a licensed explosives storage location IAW the requirements of this Chapter. Operations involving AE stored in explosives licensed locations and storage of AE not requiring licensing or explosives siting are also covered in this Chapter.

11.1.1. Licenses do not apply to explosives operations other than those listed in this Chapter.

11.1.2. Do not use licenses for convenience.

11.1.3. The host weapons safety office issues licenses.

11.1.4. Except as specified in this Chapter, QD requirements do not apply to licensed explosives storage locations.

11.1.5. Each explosives license requires locally written instructions.

11.2. General Limitations on AE in Licensed Explosives Storage Locations.

11.2.1. Limit quantities of AE to minimum quantities necessary to support specific, mission essential, and explosives operations or missions.

11.2.2. Do not license CG A, K, and L. Compatibility requirements specified elsewhere in this Manual do not apply.

11.2.3. Do not store HD 1.2.1 and HD 1.2.3 in a licensed explosives location, except as allowed per paragraph 11.15.

11.2.4. Do not store HD 1.1 in a licensed explosives location, except as allowed per paragraphs 11.15. and 11.23.

11.3. NEWQD Limitations on AE in Licensed Explosives Storage Locations. Do not exceed the following quantities of AE, expressed as NEWQD, on any one license.

11.3.1. Mission essential quantities of HD 1.4.

11.3.2. 100 lbs of HD 1.3.

11.3.3. 100 lbs of HD 1.2.2.

11.3.4. Turn in unserviceable explosive components or items to the base MSA as quickly as possible to preclude build-up of un serviceable NEWQD. (T-1). Count unserviceable NEWQD against the total NEWQD of the licensed facility.

Section 11B—Requirements for Licensed Explosives Storage Locations

11.4. General Requirements for Licensed Explosives Storage Locations.
11.4.1. The structure or room used for storage must be capable of being locked to prevent pilferage and unauthorized handling. (T-1). Contact Security Forces for resource protection requirements.

11.4.2. Post firefighting symbols IAW paragraph 10.7. (T-1).

11.4.3. Provide dunnage for ventilation when required by civil engineering, logistics or bioenvironmental directives. (T-1).

11.5. Separation Requirements for Licensed Explosives Storage Locations.

11.5.1. Explosives safety separation requirements do not apply to HD 1.4 AE stored in licensed explosives storage locations.

11.5.2. A minimum explosives safety separation of 25 feet is required from licensed explosives storage locations containing HD 1.3 AE to unrelated explosives operations, unrelated personnel, or other licensed explosives storage locations. (T-1). Where 25 feet cannot be obtained, a two-hour fire rated wall or two-hour fire rated cabinet is required. (T-1).

11.5.3. A minimum explosives safety separation of 100 feet is required from licensed explosives storage locations containing HD 1.2.2 AE to unrelated explosives operations, unrelated personnel, or other licensed explosives storage locations. (T-1). Where 100 feet cannot be maintained, a fragment barrier that provides protection equal to ¼-inch mild steel plate or one layer of sand bags (at least two sand bags higher than the stack of HD 1.2.2 stored) is required. (T-1). A substantial dividing wall (SDW) is an acceptable fragment barrier (see paragraph 6.27.).

11.5.4. Laboratory developed explosives to include R&D involving licensed HD 1.1, per paragraph 11.23., will apply a minimum explosives safety distance using Chapter 12 guidance for HD 1.1 commensurate with operation being performed (e.g., remote operations will use remote operation requirements for HD 1.1 and hands on operations will use explosive operation requirements for HD 1.1.). (T-1).

11.5.5. IAW the general explosives safety requirement to separate explosives storage and operations, provide the maximum separation possible between a licensed explosives storage location and the operation and personnel it supports. Comply with the requirements of paragraphs 11.5.2. and 11.5.3. to the maximum extent possible.

11.5.6. Parking Areas.

11.5.6.1. Locate POV, Government Owned Vehicle (GOV), and Aerospace Ground Equipment (AGE) parking areas a minimum of 100 feet from a licensed location. (T-1). This minimum distance of 100 feet may be reduced to 50 feet if the PES is of non-combustible construction, a barrier sufficient to prevent the vehicle or AGE from rolling within 50 feet of the PES is located between the parking spaces and the PES.

11.5.6.2. Temporary parking of GOVs or AGE, other than those being loaded or unloaded, will not be closer than 25 feet to any licensed location. (T-1). Temporary means the length of time for which the presence of the vehicle or AGE is essential to completion of a single task (e.g., a single work order number).
11.5.6.3. Local fire and safety officials may reduce these parking requirements for each
licensed location.

11.5.7. Fire protection distances for flammable and combustible materials found in other
sections of this Manual apply to licensed explosives locations.

Section 11C—Documentation for Licensed Explosives Storage Locations

11.6. AF Form 2047. Use AF Form 2047, Explosive Facility License (Figure 11.1.), to
document approval for licensed explosives storage locations. Display the AF Form 2047 at the
licensed explosives storage location.

11.7. Instructions for Completing AF Form 2047.

11.7.1. Item 1. Enter name of base.

11.7.2. Item 2. Enter name of requesting organization.

11.7.3. Item 3. Enter license number. The installation WSM assigns a number that consists
of the last two digits of the calendar year and a serial number, assigned in numerical
sequence (e.g., the first license issued in 2015 would be numbered 15-1; the second would
be 15-2).

11.7.4. Section I:

11.7.4.1. Item 4. Enter the assigned building number. For an unnumbered facility, insert
narrative description such as outdoor storage (in-transit).

11.7.4.2. Item 5. Enter description of the primary use of the facility (e.g., alert hangar,
small arms range, egress shop, security and administrative building, rod and gun club, life
support shop).

11.7.4.3. Item 6. Enter identifying number of applicable written operating instructions.

11.7.4.4. Item 7. If applicable, enter room number of the facility where explosives will
be stored.

11.7.4.5. Item 8. If applicable, describe the room’s purpose.

11.7.4.6. Item 9. Enter brief description of facility construction (e.g., concrete-masonry,
wood frame).

11.7.5. Section II. Enter the following information for each AE item (Section II is continued
on the back side of the form if more room is needed):

11.7.5.1. Column A. HD.

11.7.5.2. Column B. CG.

11.7.5.3. Column C. Enter stocklist nomenclature and national stock number (NSN), or
federal supply class and Department of Defense Identification Code (DODIC). When
actual NSN or DODIC is unknown (e.g., temporary Traffic Management Office or aerial
port shipment storage), authorized licensed storage will be based on listed NEW limits,
HD and compatibility IAW paragraphs 11.2. and 11.3.
11.7.5.4. Column D. Enter number of items authorized (both serviceable and unserviceable).

11.7.5.5. Column E. Enter total NEWQD based on number of items authorized. This column does not apply to HD 1.4 items.

11.7.5.6. Column F. Enter appropriate firefighting and chemical symbols.

11.7.6. Section III. The Commander of organization or the functional manager requesting the license will be the certifying official.

Section III—The Commander of organization or the functional manager requesting the license will be the certifying official.

11.7.7. Section IV. The individual who is assigned installation weapons safety responsibilities signs as the responsible official after:

11.7.7.1. Validating the quantity of AE to be kept.

11.7.7.2. Ensuring only the smallest quantity of AE needed to support mission requirements is authorized.

11.7.7.3. Physically inspecting the facility to ensure firefighting symbols are available for posting IAW paragraph 10.7.

11.7.7.4. Ensuring copies of applicable TO or other procedures are available at the facility.

11.7.7.5. Obtaining the coordination required in Section V.

11.7.7.6. Ensuring the installation Fire Protection Agency has completed the remarks section per paragraph 11.7.8.1.

11.7.8. Remarks.

11.7.8.1. The installation Fire Protection Agency will enter the specific type, quantity, and physical placement of fire extinguishers for the location, as well as any additional fire prevention practices.

11.7.8.2. If applicable, enter conditions of approval, expiration date (if other than indefinite), reasons pertaining to disapproval, comments of requesting organization, and TO or other procedural references.

11.7.9. Section V. Enter office symbols, dates, and names of coordinators.

11.7.9.1. Coordinate through responsible Munitions Accountable System Officer, the local Security Forces Resource Protection office and the installation Fire Protection Agency prior to being approved by the installation weapons safety (SEW) office.

11.7.9.1.1. Prior to coordination, the Security Forces Resource Protection office must physically inspect the facility to ensure the requirements of paragraph 11.4.1. have been met.

11.7.9.1.2. For licenses involving privately-owned ammunition outside the US and Guam, obtain the installation’s judge advocate coordination to ensure no host-nation laws are being violated.
11.8. Maintaining the AF Form 2047.

11.8.1. Update the AF Form 2047 each time the HD, NEWQD, CG, or quantity of AE items changes. (T-1).

11.8.2. When Munitions Operations (AFK) issues suitable substitutions for stock listed items, updating the AF Form 2047 is not required as long as the HD, NEWQD, CG, and quantity of AE items does not change. Place an asterisk (*) next to the stock number listed in column “C” of the AF Form 2047 that is posted at the location and enter in the “Remarks” block, “*Suitable substitute authorized.” When the FSC and DODIC, also known as the Department of Defense Ammunition Code (DODAC), is used the above asterisk is not required to identify a substitute.

11.8.3. Review the AF Form 2047 annually for continued requirement and applicability.

11.8.4. Cancel the AF Form 2047 when the requirement no longer exists.

Section 11D—Operations Involving AE Stored in Licensed Explosives Storage Locations


11.9.1. The unit or squadron Commander (or equivalent) approves locally written instructions as the authorization for operations involving AE stored in a licensed explosives storage location (see Section 7B). (T-1). These instructions must be available for the operation.

11.9.2. An ESP is not required for these operations as a PES.

11.9.3. Site these operations as an ES if located within the IBD of a PES.

11.9.4. Separation distances for these operations must meet the minimum distances specified in paragraph 11.5.

Section 11E—Requirements for Specific Licensed Explosives Storage Locations

11.10. Mobility Storage. Store AE designated for mobility within the base MSA until ready for shipment, unless the deploying unit has an extremely short timeline requirement that makes it impossible to store within the MSA. (T-1). License the storage of pre-positioned mobility AE only if a properly sited area is not available. The license is valid only for the duration of the mobility tasking. At host units without a designated MSA, explosive items designated for mobility may be stored in a consolidated licensed location providing adherence to all Chapter 11 provisions.

11.11. Training and Exercises. Licensing AE locations used solely for exercises, such as the ground burst simulators, smoke grenade storage, etc., is permitted. This license is valid only for the duration of the exercise.

11.12. Control Tower. If required, license the storage of necessary quantities of HD 1.3 pyrotechnics needed to conduct emergency operations at fixed and mobile control towers. Do not load pyrotechnic projectors and pistols unless the operational situation demands a state of immediate readiness. The same safety and security requirements that apply to firearms apply to projectors and pistols. Place in a proper rack, locker, box or compartment to prevent damage, unauthorized handling, theft or accidental discharge.
11.13. **Aircrew Flight Equipment (AFE).**

11.13.1. A license is not required for assembled parachutes, AFE kits, life rafts and life preservers containing authorized explosives when kept in personnel equipment rooms, life rafts, and aircrew flight equipment shops.

11.13.2. A license is required for those areas where AFE explosive components are stored.

11.13.3. An operating instruction, approved by the Commander, is required for all AFE shop operations involving explosive components (see Section 7B). (T-1).

11.14. **Riot Control Items.**

11.14.1. If required, store riot control and smoke grenades (except WP grenades) with small arms ammunition in arms rooms and other such locations. However, if the arms room is collocated with a facility where personnel are under physical restraint or confinement, the National Fire Codes, Standard 101, *Life Safety Code*, applies.

11.14.2. Do not store 40 mm grenades, pyrotechnics, tear gas or chemical irritants in the room regardless of the QD division or compatibility, unless the arms room has protective features which completely protect detainees from the effects of accidental explosives activation. (T-1).

11.14.2.1. Protective features include fragment barriers, blast doors, and exhaust fans.

11.14.2.2. Qualified engineers must evaluate capabilities of protective features. (T-1).

11.14.2.3. Limit the quantity to the smallest amount needed to support approved contingency plans.

11.15. **Egress Systems Maintenance Shops.** When necessary, units may license a limited quantity of in-use egress explosive components of any HD (including HD 1.1) in the egress shop after removal from aircraft undergoing maintenance. Do not exceed the total number of complete sets for the number of aircraft in maintenance. The following special provisions apply:

11.15.1. Store ejection seats, canopies, and explosives components not undergoing actual maintenance in a licensed storage location. (T-1).

11.15.2. Within the egress maintenance work area, the NEWQD limitations in paragraph 11.3. apply to the number of seats and spare components undergoing maintenance at any one time.

11.16. **Gun Systems and Maintenance Shops.** When possible, remove ammunition from guns and gun systems before they are brought into a weapons maintenance facility for repair. Gun systems using drums do not require removal of ammunition if the feed system is mechanically safed to prevent ammunition from feeding into the gun. QD requirements do not apply to gun system maintenance operations when explosives are limited to HD 1.4 and 100 pounds of HD 1.2.2 provided the using organizations ensure:

11.16.1. MAJCOMs will establish procedures for clearing jammed guns. Consider both active and contingency bases.

11.16.2. Do not bring guns or gun systems loaded with ammunition into the maintenance facility until needed to meet the work schedule and remove immediately after repair.
11.16.3. Precautions are established to prevent inadvertent firing.

11.16.4. Gun systems with live ammunition are grounded.

11.16.5. Gun system is pointed in the least hazardous direction.

11.16.6. Downloaded ammunition is removed from the building and returned to the base MSA as soon as possible.

11.16.7. Compliance with general explosives safety standards.

11.17. Incendiary Equipment and Document Destroyers. If necessary, store these items near the planned point of use to comply with emergency destruction plans. Establish quantities for each location by coordinating with base explosives safety and security representatives. The 100-pound HD 1.3 limit does not apply in this case. Limit quantity to the amount needed for emergency destruction plans. Training quantities are not authorized. Construct or protect storage rooms with noncombustible or fire-resistive material. If possible store in nearby small low-cost structures (sheds, conex, etc.). Ensure adequate ventilation is provided. Maintain 50-foot firebreaks or vegetation control zones and locate at least 75 feet from any other building. Store replacement stocks in the base explosives storage area. Only trained personnel are allowed to prepare and activate these devices.

11.18. Rod and Gun Clubs. License the explosives storage locations for clubs that hand-load ammunition on Air Force property. (T-1). For skeet and trap ranges adhere to criteria established by the National Skeet Shooting Association. See also paragraphs 11.19. and 11.20. Designate a qualified member to identify and enforce criteria.

11.19. Retail Stores. Where only retail sales are made, paragraph 11.25. applies. Do not complete a license unless the store sells primers and smokeless powder. More than 100 lbs of propellant and 25,000 primers, packed in their shipping containers, may be licensed if they are segregated in such a way that the MCE does not exceed 100 lbs of propellant and 25,000 primers, i.e., if IM separation is met. Do not place HD 1.3 propellant in other containers if it would result in extreme confinement in the event of ignition. (T-1). Use fire symbol 3 to designate the presence of both the propellant and primers. Keep the symbol posted during temporary periods when the propellant has been sold out, but primers are still in stock.

11.20. Hand Loading. Conduct hand-loading operations in a room or building used solely for this purpose. Do not store or reload ammunition in dormitories or bachelor officer quarters. Use retail store safety requirements as well as the following:

11.20.1. Develop and post an approved, locally written procedure. Refer to AFI 31-101, Integrated Defense, for security.

11.20.2. Grant loading privileges to only authorized personnel trained in the use of hand-loading equipment, safety provisions, and hazards involved. (T-1). Wear safety goggles or face shields during all loading operations. (T-1).

11.20.3. Strictly supervise members in training. Keeps a log showing names of certifying instructors and each person who has satisfactorily completed the training.

11.20.4. Do not permit smoking, matches or flame-producing devices in any loading or storage location.
11.20.5. Place a ground bar with a resistance of 25 Ohms or less at each entrance to the hand-loading room. (T-1).

11.20.6. Post a sign requiring each person to touch the ground bar before entering the room. (T-1).

11.20.7. Maintain and inspect the ground bar as outlined in Chapter 5.

11.20.8. Post explosives and personnel limits. (T-1). Allow no more than 10 lbs of propellants, 10,000 primers, and 5,000 assembled rounds in the hand loading room at one time. (T-1). These quantities are considered as part of the overall limits for the building.

11.20.9. Provide storage lockers for propellant and transfer to the loading point only quantities required to sustain a continuous operation. (T-1).

11.20.10. Remove only one packing tray at a time from primer storage. (T-1).

11.20.11. Repack unused components in their original containers and return them to the storage locker at the end of each loading operation. (T-1).

11.20.12. Lock unused lockers. (T-1).

11.20.13. Cover tables used for hand loading with a seamless, nonporous, non-sparking conductive material. (T-1).

11.20.14. Permanently attach and bond hand-loading equipment to a 25 Ohm or less grounded tabletop. (T-1).

11.20.15. Test the grounding system twice a year and when broken connectors are repaired. (T-1).


11.20.17. Visually inspect ground conductors before each day's operation. (T-1).

11.20.18. Keep floors and walls free of cracks that could accumulate explosive dust and foreign materials. (T-1). Observe good housekeeping practices at all times.

11.20.19. In case of a spill, stop all operations until the propellant is cleaned up. (T-1).

11.20.20. Put all salvaged propellant in a metal container that contains water and is marked "Scrap Explosives." (T-1).

11.20.21. Put all damaged components or complete rounds in separate, properly marked containers. (T-1).

11.20.22. Separate unserviceable items from serviceable stocks. (T-1).

11.20.23. Only qualified personnel must dispose of unserviceable propellants, damaged rounds or components, and empty explosives containers. TO 11A-1-42, General Instructions for Disposal of Conventional Munitions, AFI 21-201, and TO 11A-1-60, Inspection of Reusable Munitions Containers and Scrap Material are the authority and guidance for proper disposal.

11.20.24. Use only commercial-type loading tools, dies, scales, powder measures, and so forth for hand-loading operations. (T-1).
11.20.25. Place personnel protection shields between each piece of permanently-attached hand-loading equipment. (T-1). Shields must be large enough to protect adjacent personnel. Shields can be made of plywood, Plexiglas or similar materials.

11.20.26. Accomplish bullet molding outside the hand-loading room. (T-1).

11.21. **Force Support Squadron (FSS) Activities.** FSS activities such as aero clubs and boating activities are sometimes required to maintain and store commercial pyrotechnic signals. Control and store these items using the same criteria as the military item they resemble. Ensure personnel are properly trained. License the storage locations. (T-1). Technical data or manufacturer's data are sources for locally-written procedures.

11.22. **Minuteman Handling Team (MHT) Facility.** The transporter erector (TE) tractor or autocar with missile in tow may require temporary storage in the MHT facility. When using this procedure, comply with the following conditions: (T-1).

11.22.1. Storage is essential to meet operating requirements.

11.22.2. Vehicle is chocked and grounded.

11.22.3. Vehicle safety inspection is performed and no safety deficiencies exist.

11.23. **R&D Laboratories for Specific Experiments.** When necessary, units may license a limited quantity, not to exceed 200 grams in each licensed location, of HD 1.1 material for research use in laboratories. Licensing explosives used solely for a research project is allowed only for the length of the project. Commander-approved, locally-written procedures are required for the explosives operation (see Section 11D). (T-1).

11.24. **Base Defense Support Munitions for Dispersed Locations.** When required for defense against hostile forces, pre-position base defense explosives stocks in licensed temporary magazines. Store and protect licensed facilities and stocks as stated below:

11.24.1. If necessary, omit fire and hazard symbols to avoid attention of hostile forces. Post "No Smoking" signs and keep the fire department informed of each facility's location and type of explosives. (T-1).

11.24.2. Follow the instructions in paragraphs 11.4. and 11.5. if the facility is stocked with HD 1.2, 1.3, 1.4, and riot control items.

11.24.3. Submit ESPs for HD 1.1 items. (T-1).

**Section 11F—Items or Situations not Requiring a License**

11.25. **Items or Situations not Requiring a License.**

11.25.1. Licenses are not required for the storage of small arms ammunition (.50 caliber or less), commercial maritime distress signals and like items held by base exchanges and individuals in family housing.

11.25.2. Locations storing less than 1,000 rounds of HD 1.4 small arms ammunition or cartridges for EOD cartridge-actuated tools, up to 5,000 feet of shock tube, locations storing any quantity of thermal batteries, locations storing any quantity of cartridge-type explosives for powder-actuated hand tools meeting the requirements in AFI 91-203, and F/A-22 assembled pylons in storage (see paragraph 11.13.) do not require licenses.
11.25.3. The exception for quantities less than 1,000 rounds of HD 1.4 does not apply to the on-base storage of bird scare ammunition, privately owned ammunition belonging to dormitory and billeting residents, or approved commercial off-the-shelf explosives, except as noted in this Manual. Always store this ammunition in approved, licensed explosives storage locations, regardless of quantity. (T-1).
Figure 11.1. AF Form 2047-Explosives Facility License.

<table>
<thead>
<tr>
<th>CLASS/ DIVISION</th>
<th>COMPATIBILITY GROUP(S)</th>
<th>NOMENCLATURE</th>
<th>QNTY</th>
<th>EXPLOSIVE WEIGHT</th>
<th>FIRE SYMBOL</th>
</tr>
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<tbody>
<tr>
<td>1.4</td>
<td>G</td>
<td>Ctg, 40mm, Green Smoke, M579</td>
<td>1310-00-179-1159</td>
<td>25</td>
<td>N/A</td>
</tr>
<tr>
<td>1.4</td>
<td>*</td>
<td>Ctg, 12 Gage Shotgun</td>
<td>1305-00-147-5598</td>
<td>300</td>
<td>N/A</td>
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<tr>
<td>1.4</td>
<td></td>
<td>Ctg, .35 Cal Wedgewayter</td>
<td>1305-00-125-0549</td>
<td>3000</td>
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<tr>
<td>1.4</td>
<td></td>
<td>Ctg, 5.56mm Ball, M193 GR</td>
<td>1305-00-057-1876</td>
<td>5000</td>
<td>N/A</td>
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<tr>
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<td></td>
<td>Grenade, Hand, Riot M7/M7A1</td>
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<td>25</td>
<td>N/A</td>
</tr>
<tr>
<td>1.3</td>
<td></td>
<td>Grenade, Rifle Illum, M27</td>
<td>1330-00-028-5905</td>
<td>80</td>
<td>40 lbs</td>
</tr>
<tr>
<td>1.2.2</td>
<td></td>
<td>Ground Burst Simulator, M115A2</td>
<td>1370-00-752-8126</td>
<td>50</td>
<td>5.1 lbs</td>
</tr>
</tbody>
</table>

**III. CERTIFICATION**

I CERTIFY the above described facility is required in support of the mission of the above organization.

**DATE**
23 Apr 2014

**TYPE/ NAME, GRADE AND TITLE OF CERTIFYING OFFICIAL**
Jed I. Knight, Capt, USAF, Commander

**IV. ACTION OF RESPONSIBLE OFFICIAL**

24 Apr 2014

**TYPE/ NAME, GRADE AND TITLE OF APPROVING OFFICIAL**
Amanda B. Reckonwith, MSgt, USAF Wing Weapons Safety Mgr

**REMARKS**

Fire extinguisher requirements: Min of 2ea 2A10BC. One located near entrance to rm and the other on the west wall near locker but no closer than 5 ft Changes to fire/chemical symbols must be coordinated with the ECC. Vehicle parking (POV/GOV/AGE) is allowed in designated parking areas surrounding Bldg 2047 according to AFMAN 91-201, paragraph 11.5.5.

Chemical Symbol B: Full protective clothing set 2 (yellow man)
Chemical Symbol D: Breathing apparatus
Chemical Symbol E: Apply no water

**V. COORDINATION**

<table>
<thead>
<tr>
<th>TYPED NAME/ORG</th>
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<th>TYPED NAME/ORG</th>
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<td>00 SFS/RPO</td>
<td>Click to sign</td>
<td>00 MUNS/MASO</td>
<td>Click to sign</td>
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</tbody>
</table>
Chapter 12

QUANTITY-DISTANCE CRITERIA

Section 12A—Introduction

12.1. Introduction. The term “Quantity-Distance” (QD) refers to protection requirements from potential explosion sites (PES) to different kinds of exposed sites (ES). The QD standards were developed over many years and are based on explosives mishaps, tests and analyses. QD separations are based on an acceptable level of damage between a PES and an ES.

12.1.1. The damage or injury potential of explosions is normally determined by the separation distance between the PES and ES; the ability of the PES to suppress blast overpressure, primary and secondary fragments; and the ability of the ES to resist explosion effects. This Chapter:

12.1.1.1. Defines permissible exposures for both accidental and intentional detonations.
12.1.1.2. Sets minimum standards for separation distances between PES and ES by taking into account anticipated explosion effects, suppression, and resistance.
12.1.1.3. Establishes explosives safety siting criteria (QD relationships) for PES and ES, based on blast, fragment, firebrand, thermal, and ground shock effects. QD is determined by the effect requiring the greatest distance.

12.1.2. When an appropriate degree of protection can be provided either by hardening an ES or construction of a PES to suppress explosion effects, these factors may be taken into account and the distance required by the standard QD tables may be reduced. Submit construction designs with rationale or test results with the ESP. (T-1). See Chapter 6.

12.1.3. QD separation does not apply to AE in the transportation mode (see Chapter 8).

Section 12B—Quantity-Distance (QD) Principles

12.2. General. The bases for determining required separation distances (QD) are:

12.2.1. The construction and type of PES.
12.2.2. The HD types and NEWQD of AE present in the PES.
12.2.3. The construction and type of ES.
12.2.4. The distance separating the PES from the ES.
12.2.5. In some instances, the orientation of the PES and the ES.

12.3. Types of Separations.

12.3.1. Inhabited Building Distance (IBD). This is the minimum distance required to protect facilities and personnel not directly related to explosives storage and operations. At IBD some damage and personnel injury may still be expected (see Chapter 2 for reaction effects).
12.3.2. Public Traffic Route Distance (PTRD). This is the minimum distance required to protect public traffic routes (PTR) (see paragraph 12.16.3. for on-base roads) and other
designated exposures. At PTRD damage and personnel injury is expected (see Chapter 2 for reaction effects). For HD 1.1 and 1.2, PTRD is normally 60 percent of IBD. For HD 1.3 and 1.4, PTRD is the same as IBD. PTR are classified as high, medium, and low traffic density. Average the traffic density over a normal (non-holiday) week in terms of number of passengers during a 24-hour period.

**Note:** In applying criteria other than the default values given below (based on a car (and rail) speed of 50 mph and a ship speed of 10 mph), take into account, the following considerations 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. Use the default value of two passengers per car to estimate traffic density.

12.3.2.1. High Traffic Density. Routes having 10,000 or more car or rail passengers per day, or 2,000 or more ship passengers per day. IBD separation is required for high traffic density routes per paragraph 12.15.1.19.

12.3.2.2. Medium Traffic Density. Routes having at least 400 but less than 10,000 car or rail passengers per day, or at least 80 but less than 2,000 ship passengers per day. As a minimum, medium traffic density route criteria apply to any recreational activity that is extensive and occurs on a regular basis. PTRD separation is required for medium traffic density routes per paragraph 12.16.1.

12.3.2.3. Low Traffic Density. Routes having fewer than 400 car or rail passengers per day, or fewer than 80 ship passengers per day. PTRD separation (based on blast criteria only) is required for low traffic density routes per paragraph 12.16.2.

12.3.3. Intraline Distance (ILD). This is the minimum distance required to protect activities associated with explosives storage and operations. Applying ILD recognizes the operational need for some people to be in the proximity of explosives while at the same time preserving some mission capability in the event of an explosives accident. Unhardened facilities at this distance will be extensively damaged and occupants may be severely injured (see Chapter 2 for reaction effects). In addition to the minimal protection to related activities, ILD should prevent propagation between two explosives locations. At ILD, no propagation from the blast overpressure is expected, and the probability of propagation from low angle, high velocity fragments is significantly reduced. For HD 1.1 and 1.2, ILD is normally 36 percent of IBD.

12.3.4. Intermagazine Distance (IMD). This is the minimum distance between PESs to prevent one PES from simultaneously detonating an adjacent PES. Maintaining IMD is no guarantee that propagation from one PES to another will not occur, only that they will not simultaneously detonate. At this distance, severe structural damage approaching total destruction is expected for conventional structures, and severe personnel injury or death is expected (see Chapter 2 for reaction effects). Earth Covered Magazines (ECM) provide significant protection at IMD; maintaining IMD between ECMs will provide virtually complete protection of AE against the propagation effects of an explosion. However, AE in adjacent ECMs may be damaged (see paragraph 2.1.5.3.). When less than required IMD exists between any two or more PESs, add the quantities of explosives in these locations to form a single PES encompassing the area and NEWQDs of the PESs not meeting IMD. For this reason, do not waive any separation between explosives locations less than IMD.
Section 12C—Determining Net Explosive Weight for Quantity-Distance (NEWQD)

12.4. Determining NEWQD of AE Items. See paragraph 3.6, for guidance on determining the NEWQD of AE items. The explosive weight of Not-Regulated AE and AE assigned to Classes 2 through 9 is not considered for QD purposes (see paragraph 3.5).

12.5. Determining NEWQD of a PES. Generally, the combined NEWQD of all AE in a PES is used as the NEWQD of the PES for explosives siting. Determine NEWQD of a PES as follows:

12.5.1. If only one HD is present, combine the NEWQD of each AE item involved.

12.5.2. If multiple HDs are authorized, but only one HD is present at a time, determine the NEWQD separately for each HD (as described in paragraph 12.5.1.).

12.5.3. If more than one HD is present at the same time, determine the NEWQD per paragraph 12.7.

12.5.4. See Section 12N for determining NEWQD for energetic liquids.

12.5.5. Where explosives are located in a common facility or location and are further subdivided into cells or stacks by IMD or equivalent protection (such as for buffered storage or multicubicals), the cell or stack with the greatest NEWQD may be used for explosives siting if specifically allowed by this Manual or approved by AFSEC/SEW. Where IMD or equivalent protection is not provided, use the total NEWQD of all explosives.

12.5.6. For HD 1.2.1, use the MCE as outlined in paragraph 3.16.4. as the basis for determining applicable QD.

12.5.7. For HD 1.2.3, use the LSRN as outlined in paragraph 14.23.6. as the basis for determining applicable QD.

12.5.8. Base the NEWQD of a host-nation PES that may be hazarding Air Force facilities and personnel on the maximum NEWQD the host-nation indicates will ever be present at that PES location. If the NEWQD cannot be obtained from the host-nation, the responsible safety staff must estimate the type and quantity of explosives. Base estimates on knowledge of the host-nation's military mission and type of facility involved (such as ECM, aircraft shelter, or maintenance facility). As a general rule, use the maximum NEWQD that would be allowed in a similar Air Force facility per paragraph 12.6.

12.5.9. When an AE conveyance (e.g., railroad car or motor vehicle), containing AE is not separated from a PES in such a manner as to prevent mass detonation, then consider the conveyance and PES as a unit and add their NEWQDs. This does not apply to temporary staging for the purpose of loading/unloading.

12.5.10. The NEWQD of the HD requiring the greatest separation establishes the QD for the facility when it is used for multiple operations.

12.6. Maximum NEWQD. Regardless of actual separations, maximum NEWQD limitations for HD 1.1 and 1.2 are as follows:

12.6.1. ECMs (except as noted in paragraph 12.6.2.) and AGMs: 500,000 lbs.

12.6.2. 7-Bar Navy Box Type: 500,000 lbs except as noted in DDESFB TP 15.
12.6.3. Barricaded modules at K1.1: 250,000 lbs.

12.6.4. Hardened Aircraft Shelters (HAS): See paragraph 12.50.5.

12.6.5. Some facilities may have additional limits in order to use reduced QD criteria.

12.6.6. Maximum NEWQD limits do not apply to ships, piers and wharfs.

12.7. Determining NEWQD for Mixed HD.

12.7.1. General.

12.7.1.1. The presence of HD 1.4 does not affect the NEWQD of mixed HD. However, for QD determinations, consider HD 1.4 criteria.

12.7.1.2. When HD 1.1 is mixed with any other HD, treat the mixture as HD 1.1 except as noted in paragraph 12.7.2.

12.7.1.3. HD 1.5 is always treated as HD 1.1.

12.7.1.4. When dissimilar HD 1.6 are mixed and have not been tested to ensure non-propagation, then individually consider the mixed HD 1.6 AE to be HD 1.2.1 or HD 1.2.2, based on their individual NEWQD or over-riding fragmentation characteristics.

12.7.2. HD 1.1 with HD 1.2. From the following, use whatever generates the largest QD:

12.7.2.1. Sum the NEWQD for HD 1.1 and NEWQD for HD 1.2 and treat mixture as HD 1.1.

12.7.2.2. The NEWQD of the mixture is the NEWQD of the HD 1.2 sub-division requiring the largest QD.

12.7.3. HD 1.1 with HD 1.3. Sum the NEWQD for HD 1.1 and the NEWQD for HD 1.3 and treat the mixture as HD 1.1. AFSEC/SEW may grant exceptions to this guidance when analyses or test results demonstrate that the HD 1.1 (for liquid propellants) will not cause detonation of the HD 1.3.

12.7.4. HD 1.1 with HD 1.6. Sum the NEWQD for HD 1.1 and the NEWQD for HD 1.6 and treat the mixture as HD 1.1.

12.7.5. HD 1.2.1 with HD 1.2.2. The NEWQD for the mixture is the NEWQD of the sub-division requiring the largest QD.

12.7.6. HD 1.2.1 with HD 1.2.3. The NEWQD for the mixture is the NEWQD of the sub-division requiring the largest QD.

12.7.7. HD 1.2.2 with HD 1.2.3. The NEWQD for the mixture is the NEWQD of the sub-division requiring the largest QD.

12.7.8. HD 1.2.1 with HD 1.2.2 with HD 1.2.3. The NEWQD for the mixture is the NEWQD of the sub-division requiring the largest QD.

12.7.9. HD 1.2 with HD 1.3. The NEWQD for the mixture is the NEWQD of the HD requiring the largest QD.

12.7.10. HD 1.2 with HD 1.6. Treat the HD 1.6 as HD 1.2.3 and determine NEWQD IAW paragraphs 12.7.6. to 12.7.8., mixing rules for 1.2.3, as applicable.
12.7.11. HD 1.3 with HD 1.6. Sum the NEWQD for the HD 1.6 and the NEWQD for the HD 1.3 and treat the mixture as HD 1.3.

Section 12D—Determining Distances Between PESs and ESs

12.8. General. Separation distances are measured along straight lines. For large intervening topographical features such as hills, measure over or around the feature, whichever distance is shorter.

12.9. Measuring from a PES. Measure from a PES, to an ES, as follows:

12.9.1. The outside of the nearest exterior wall of the PES.

12.9.2. The outside of the nearest wall of the structure or room, within the PES, containing explosives.

12.9.3. The outside of the nearest wall of the compartment containing the greatest quantity distance hazard, when the PES is subdivided so that mass detonation between compartments will not occur.

12.9.4. The stack face of an open storage PES, such as modules and revetments.

12.9.5. The explosives carried externally on an aircraft parked either in the open or inside an approved lightweight shelter.

12.9.6. The explosives on an AE conveyance (e.g., railroad car or motor vehicle) located in the open, and separated from other PESs in such a manner as to prevent mass detonation.

12.9.7. The nearest edge of the PES conveyance (e.g., railroad car or motor vehicle) located in the open, and not separated from other PESs in such a manner as to prevent mass detonation.

12.9.8. The nearest external wall of the shelter or stall containing explosives or explosives-loaded aircraft, in a HAS.

12.9.9. The center of large missile silos and the outer edge of launchers or launch pad structures.

12.9.10. The edge of a facility pad if used to hold munitions.

12.9.11. The nearest edge of the aircraft cargo hold for internally loaded explosives.

12.10. Measuring to an ES. Measure to an ES, from a PES, as follows:

12.10.1. The nearest edge of a non-explosives location, building, or taxiway.

12.10.2. The outside of the nearest wall of the structure or room containing people, for an occupied ES.

12.10.3. The stack face of an open storage PES, acting as an ES.

12.10.4. The outside of the nearest wall of the structure or room containing explosives, for an ES requiring IMD.

12.10.5. The nearest edge of the tee or green or the centerline of the fairway, for a golf course.

12.10.6. The centerline of a runway.
12.10.7. The nearest edge of an open recreational area.
12.10.8. The nearest edge of the aircraft cargo hold for internally-loaded explosives.
12.10.9. The edge of the roadway or pavement, for an ES requiring PTRD.
12.10.10. The nearest point of an aircraft, if aircraft survivability is required.
12.10.11. The nearest AE (internal or external) on an aircraft, if only IMD or ILD protection is required.

Section 12E—Quantity-Distance (QD) Application

12.11. QD K-Factors. NEWQD is used to calculate QD separations for blast protection by means of the formula:

\[ D = K \times \text{NEWQD}^{1/3} \]

\( D \) = required distance (in feet)
\( K \) = protection factor depending on the degree of risk assumed or permitted
\( \text{NEWQD}^{1/3} \) = cube root of the NEWQD (in pounds)

12.11.1. Distance requirements are sometimes expressed by the value of \( K \), using the terminology K9, K11, K18 meaning K equals 9, K equals 11, K equals 18, etc. Tables 12.30 and 12.31 provide a listing of distances for various K-factors at various NEWQDs.

12.11.2. When performing QD calculations using formulae, resulting answers with a decimal value of 0.5 or more may be rounded up to the nearest whole number, and resulting answers with a decimal value of less than 0.5 may be rounded down to the nearest whole number (e.g., if calculating the required distance:

\[ D = K \times (\text{NEWQD})^{1/3} = 40(1500 \text{ lbs})^{1/3} = 457.89 \text{ feet} = 458 \text{ feet} \]
\[ D = K \times (\text{NEWQD})^{1/3} = 18(200 \text{ lbs})^{1/3} = 105.26 \text{ feet} = 105 \text{ feet} \]

Or, if calculating the allowable NEWQD:

\[ \text{NEWQD} = (D/K)^3 = (1150 \text{ feet}/40)^3 = 23,763.67 \text{ lbs} = 23,764 \text{ lbs} \]
\[ \text{NEWQD} = (D/K)^3 = (700 \text{ feet}/18)^3 = 58,813.44 \text{ lbs} = 58,813 \text{ lbs} \]


12.12.1. The quantity of explosives allowed in a PES is the most restrictive amount based on analyzing the nearest intermagazine (IM), intraline (IL), public traffic route (PTR), inhabited building (IB) or other exposed site (ES), subject to the NEWQD limitations in paragraph 12.6. Where there are two or more adjacent ESs, the quantity allowed at the PES is the smallest of the amounts permitted by considering each ES in turn.

12.12.2. The QD criteria for a PES-ES pair when both contain AE are determined by considering each location, in turn, as a PES and an ES. The separation distance required for the pair is the greater of the two separation distances. An exception is permitted for service magazines supporting an AE operation; base barricaded or unbarricaded (as appropriate) service magazine separation distances on the NEWQD and the HD of the AE in the magazine and not that in the explosives operating location it supports.

12.13. QD Determination.
12.13.1. When all AE in the PES is HD 1.1, determine the QD using Table 12.1. and Section 12H.

12.13.2. When all AE in the PES is HD 1.2, determine the QD using Table 12.2. and Section 12I.

12.13.3. When all AE in the PES is HD 1.3, determine the QD using Table 12.3. and Section 12J.

12.13.4. When all AE in the PES is HD 1.4, determine the QD using Table 12.3. and Section 12K.

12.13.5. When all AE in the PES is HD 1.5, treat as HD 1.1 for siting purposes and comply with paragraph 12.13.1.

12.13.6. When all AE in the PES is HD 1.6, determine the QD using Table 12.3. and Section 12L.

12.13.7. When all AE in the PES is HD 6.1, determine the QD using Section 12M.

12.13.8. When all AE in the PES are energetic liquids, determine the QD using Section 12N.

12.13.9. When siting more than one type of AE, determine separately the QD criteria as required for each type of AE per paragraphs 12.13.1. through 12.13.9. Base required QD separations on the most restrictive QD determined.

12.13.10. TO 11N-20-7, Nuclear Safety Criteria, provides active materials storage standards for nuclear weapons and when more restrictive, those requirements override QD criteria in this Manual. Upon receipt of a Joint Test Assembly, organizations will use parent War Reserve weapon explosives criteria for storage and transportation while the assembly remains in Air Force custody. (T-1).

12.13.11. If unable to verify QD criteria for a specific weapon system or a given situation, contact the appropriate MAJCOM for instructions. Such cases may include unusual circumstances, configurations, protection or hazards. Storage and handling of some ammunition items are MAJCOM unique and do not fit into any criteria contained in this Manual. In such cases, request guidance in writing through command channels to AFSEC/SEW, describing the specific situation, explaining the ammunition item and how it will be stored and handled. The AFSEC/SEW letter of approval may be incorporated into the MAJCOM supplement to this Manual.

Section 12F—Allowable Exposures

12.14. General. This section identifies allowable exposures to explosives. Further specific guidance may be found in the appropriate sections of this Manual. Contact your MAJCOM/SEW for assistance in determining required separation if guidance is not provided in this Manual.

12.15. Allowable IBD Exposures.

12.15.1. Buildings inhabited by people not related to munitions or explosives work. The following are examples of facilities not considered “related” to any PES:
12.15.1.1. Force Support Squadron (FSS) (formally MWR) facilities that contain structures.
12.15.1.2. Base civil engineering (CE) headquarters.
12.15.1.3. Industrial facilities, including central base supply and depot repair facilities.
12.15.1.4. Family housing, passenger terminals, and chapels.
12.15.1.5. Military billets, including permanent party dormitories, transient quarters, and other temporary billeting facilities, such as tent cities.
12.15.1.6. Commissaries, schools, and nurseries.
12.15.1.7. Wing and base headquarters, staff agencies (i.e., plans, manpower, safety, comptroller functions, etc.).
12.15.1.8. Hospitals and dispensaries.
12.15.1.9. Theaters.
12.15.1.10. Main exchanges, except for flightline annexes.
12.15.1.11. Base fire departments, except for flightline fire stations.
12.15.1.12. Law enforcement and Base Defense Operations Center (BDOC).
12.15.1.13. Hydrazine servicing facilities supporting multiple bases.
12.15.1.14. Recreation facilities (e.g., ball diamonds, golf courses and volleyball courts) that contain structures, such as concession stands or bleachers.

**Note:** PTR may be applied to the field, course or court but IBD is required to the subject structures.

12.15.1.15. Flightline passenger service functions (e.g., terminal buildings).
12.15.1.16. Main powerhouses that provide vital utilities to a major portion of an installation.
12.15.1.17. Essential warehouses, shops and other facilities that by reason of their vital strategic nature, or high intrinsic value of their contents, must not be placed at risk.
12.15.1.18. Functions that, if momentarily put out of action, would cause an immediate secondary hazard by reason of their failure to function.
12.15.1.19. PTRs with high traffic density as described in **paragraph 12.3.2.1**.
12.15.1.20. Auxiliary building when not directly related to the explosives mission and when accessed by personnel not directly related to the explosives mission. (See **paragraph 12.16.9**. if no structure is involved.) See **paragraph 12.67.3**.
12.15.1.21. Joint DoD or non-DoD use runway.
12.15.1.22. EOD facilities (offices, classrooms, shops) if they support multiple locations or organizations.
12.15.1.23. Main base support fire stations.
12.15.1.24. Ground control approach (GCA), radar approach control (RAPCON), and air traffic control (ATC) towers that support a joint use airfield, from all PESs.

12.15.1.25. GCA, RAPCON, and ATC towers that support a military use only airfield, from non-flightline PESs. Base the IBD on blast overpressure only; fragment distances are not applied.

12.15.1.26. Hazardous waste collection points not exclusively supporting an explosives area.

12.15.1.27. Unoccupied structures housing weather equipment not exclusively supporting an explosives area. Base the IBD on overpressure only; fragment distances are not applied.

12.15.1.28. Activities such as concerts, bazaars, and ceremonies (e.g., change of command, etc.) attended by people not related to munitions or explosives work.

12.15.1.29. Construction activities that are not related to existing explosives facilities or operations.

12.15.2. Installation boundary. If a proposed PES would create an IBD clear zone extending beyond the base boundary, the hazard becomes a legal issue. Identify existing exposures in the ESP request package and obtain DDESB approval. (T-1). An IBD arc may fall outside of the installation boundary, without causing an exception to QD requirements, provided one of the following methods of protecting the public and public property is complied with:

**Note:** Restrictive easements, Memorandums of Agreement (MOAs), and Memorandums of Understanding (MOUs) do not address existing exposures encumbered by the explosives clear zone of the PES.

12.15.2.1. Off-base land owned by a Federal, State, or Municipal agency in the Continental United States (CONUS) or its possessions or territories.

12.15.2.1.1. An existing restrictive easement MOA or MOU encompasses the off-base land encumbered by the explosives clear zone of the PES. Prior to establishing the PES, Safety (SE), CE, and JA representatives must review and ensure compliance with applicable in-place restrictive easement, MOA, or MOU rights. (T-1). The Commander will designate personnel to perform a quarterly review of the area to ensure compliance with the restrictive easement, MOA, or MOU. (T-1).

12.15.2.1.2. A new restrictive easement, MOA, or MOU is obtained from the land owner for the off-base land encumbered by the explosives clear zone prior to establishing or constructing the PES. Before funding construction, the installation Commander, Facility Board, and facility user must be briefed and accept the need to reduce or eliminate NEWQD in the user's facility to prevent an exception providing the desired restrictive easement is not obtained. (T-1). Request for preliminary ESP approval may be sought prior to obtaining the restrictive easement. Submit documentation substantiating coordination of the restrictive easement with the Air Force Real Property Agency (AFRPA) and recording with the USACE prior to submission and request for final ESP approval. (T-1). The Commander will designate personnel to perform a quarterly review of the area to ensure compliance with the restrictive easement. (T-1).
12.15.2.1.3. Off-base land owned by another DoD agency. In cases where an Air Force PES generates an explosives IBD clear zone encroaching onto property owned by another DoD service, the local Air Force organization responsible for submitting the ESP will obtain written acknowledgement from the exposed service component SE and CE equivalent offices for inclusion with the ESP submission package. It is up to the acknowledging agency to update their maps to reflect the Air Force explosives clear zone for their future planning purposes and to notify the Air Force unit of any planned exposures. The MAJCOM and AFSEC/SEW will coordinate with the applicable service component equivalent prior to requesting DDESB ESP approval. Recommend establishing an MOU or MOA with the other DoD agency.

12.15.2.1.4. Off-base land owned by other Federal Agencies. In cases where an Air Force PES generates an explosives IBD clear zone encroaching onto property owned by another federal agency, the local Air Force organization responsible for submitting the ESP will obtain written acknowledgement from the exposed agency SE and CE equivalent offices for inclusion with the ESP submission package. It is up to the acknowledging agency to update their maps to reflect the Air Force explosives clear zone for their future planning purposes and to notify the Air Force unit of any planned exposures. AFSEC/SEW will coordinate with the applicable agency equivalent prior to requesting DDESB ESP approval. Recommend establishing an MOU or MOA with the other Federal agency.

12.15.2.2. Off-base land owned by a private land owner requires a restrictive easement. All other requirements stated above in paragraphs 12.15.2.1.1. and 12.15.2.1.2. apply.

12.15.2.3. The off-base land encumbered by the explosives clear zone is open and manifestly unsuitable for habitation or public gatherings, is government land that is not open to the public, or access is restricted and controlled by other means. Only appropriate local government agencies for public safety, environment and health can declare land outside the base boundary unsuitable for habitation or public gatherings. Maintain documentation determining this land unsuitable for habitation or public gatherings with real property records. The Commander, Facility Board, and facility user must be briefed and accept the need to reduce or eliminate NEWQD in the PES creating the clear zone to prevent an exception providing a new encumbrance occurs. The Commander will designate personnel to perform quarterly reviews of the area to ensure it remains open, uninhabited, and unused and must periodically reconsider obtaining a restrictive easement, MOA, MOU or purchase of the land.

12.15.2.4. Establishing a clear zone beyond the installation boundary that does not involve a private land owner and where no new construction is involved. If the IBD clear zone extends past the installation boundary, an exception must accompany the QD safety submission unless the following compensatory measures can be accomplished:

12.15.2.4.1. A signed letter of agreement (LOA) between the installation Commander and airport manager stating that non-related personnel and activities are not exposed when the mission generating the clear zone is implemented. LOAs are not intended to insinuate the land owner accepts the risk, but rather to confirm exposures are eliminated when mission accomplishment dictates need.
12.15.2.4.2. LOAs must address termination terms of the LOA in writing with the appropriate parties. (T-1). Coordinate the LOA with CE and JA to validate all the terms of the agreement.


12.16.1. PTRs with medium traffic density as described in paragraph 12.3.2.2. Medium traffic density criteria apply, as a minimum, to recreational activity that is extensive and occurs on a regular basis.

12.16.2. PTRs with low traffic density as described in paragraph 12.3.2.3. The PTRD will be based on blast overpressure only; fragment distances will not be used. Normal PTRD required for HD 1.2.X.

12.16.3. On-Base Roads. On-base roads traveled by personnel not involved in munitions-related operations are now considered PTR. QD criteria are based on the traffic density (see paragraphs 12.3.2.1., 12.3.2.2., and 12.3.2.3.). In order to prevent the generation of a significant number of QD exemptions for existing roads, the procedures below are provided for assessing, documenting, and accepting the risks associated with application of QD criteria to on-base roads for PES/on-base road relationships existing prior to 1 October 2000. After 1 October 2000, any changes to a PES increasing its QD arc, construction of a new PES, construction of a new on-base road, or change in traffic density, requires the application of QD criteria to on-base roads traveled by personnel not involved in PES-related operations (see also paragraph A5.3.) If QD criteria cannot be met, obtain an exemption per Section 1B.

12.16.3.1. For those sited PES/on-base road relationships existing prior to 1 October 2000 accomplish the following risk assessment and documentation:

12.16.3.1.1. On a copy of the installation map, identify the following:

12.16.3.1.1.1. All PESs having QD arcs (PTRD or IBD based on traffic density) encompassing on-base roads traveled by personnel not involved in munitions-related operations.

12.16.3.1.1.2. The NEWQD of the above PESs.

12.16.3.1.1.3. The applicable QD arcs (PTR or IBD) of the above PESs based on the traffic density.

12.16.3.1.1.4. The segments of the applicable on-base roads passing through the above arcs.

12.16.3.1.2. Perform a risk assessment of the relationships shown above IAW Chapter 4. Some factors that might be considered include:

12.16.3.1.2.1. Operational necessity.

12.16.3.1.2.2. The operation being performed (e.g., static storage, maintenance, and production).

12.16.3.1.2.3. Operational activity cycles.

12.16.3.1.2.4. Alternate routes.
12.16.3.1.2.5. Traffic density.
12.16.3.1.2.6. Accident records.
12.16.3.1.2.7. Time interval of exposure.
12.16.3.1.2.8. Type and quantity of munitions in proximity to the area transited.
12.16.3.1.2.9. The closest distance from the area transited to the PES.
12.16.3.1.2.10. The need for installation-related personnel to transit the QD arc.
12.16.3.1.2.11. Consideration of methods to inform transients of potential risks (e.g., written acknowledgement of the risk by vendors or others with a recurring need to transit the QD arc, warning signs, flashing lights, physical barriers, etc.).

12.16.3.1.3. Document the Commander’s risk acceptance through a formal memorandum. (T-1). This memorandum must include the map showing the relationships accepting risk, a summary of the risk assessment, and a statement that the subject relationships existed as of 1 October 2000. Upon change of approving authority, ensure the new Commander is informed of the previous risk acceptance. (T-1).

12.16.3.2. Include the Commander’s risk acceptance and attached map in amendments to ESPs (for PESs existing prior to 1 October 2000) or reference if previously submitted with another ESP amendment. (T-1).

12.16.4. Open-air recreation facilities (e.g., ball diamonds, golf courses, and volleyball courts); not containing structures used for community relations purposes at military installations. As an exception, neither blast nor fragment criteria apply, when such facilities are located near AE support operations and are used only 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. This does not authorize the building of elaborate structures that substitute for properly sited recreational facilities or the collocation of unrelated military functions. Separate at ILD from other related PESs.

12.16.5. Open, military only or other combatant-type training, areas. If areas include fixed facilities, including small classrooms designed for occasional use coincident with the use of the training area, apply incremental IBD with a minimum of PTRD for fragmentation to the facility. 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 PESs.

12.16.6. Aircraft battle damage repair training areas.

12.16.7. Open-air aircraft passenger loading and unloading areas.

12.16.8. Parking lots for administrative areas. See paragraph 12.66.2.

12.16.9. Auxiliary 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 paragraph 12.67.2 and paragraph 12.15.1.20., if located within a structure.
12.16.10. Unmanned antenna/antenna farms when not directly related to the explosives mission. These are facilities that generate electromagnetic radiation which may or may not pose a threat to EIDs. A greater distance may be required to protect EIDs at the PES. See AFI 91-208 to determine SSDs. PTRD is based on blast overpressure only; fragment distances are not required.

12.16.11. Unoccupied weather equipment (antennas, ceilometers, etc.) not exclusively supporting an explosives area and when located in the open. The PTRD will be based on overpressure only; fragment distances will not be used.

12.16.12. Joint DoD-non-DoD use taxiway. A taxiway serving both DoD and commercial aircraft. A taxiway serving solely DoD, DoD chartered, or non-DoD aircraft on DoD authorized business is not joint use.

12.16.13. Provide operating personnel exposed to explosives research, development and test operations that are conducted by remote control procedures protection per paragraph 4.17., 4.18.1., and 4.18.2. Also provide non-related personnel IBD protection.

12.16.14. Land used for agricultural purposes. Apply PTRD without a minimum fragment distance for new PES locations or when a new ESP is required for an existing PES and the following conditions exist:

12.16.14.1. The exposure is frequent or higher, as described in Table 1.2. (e.g., when manual methods and numerous laborers are needed for certain types of crops or locations).

12.16.14.2. The exposure is determined to be occasional or lower (QD not required). See Table 1.2.

12.17. Allowable Unbarricaded ILD Exposures. For the following situations, the use of unbarricaded ILD may be used:

12.17.1. Explosives operating locations (e.g., surveillance, maintenance, inspection) directly related to the PES; the PES may be explosives storage or operating location. When necessary to conduct dissimilar concurrent operations, arrange operations to provide a minimum of ILD protection either by distance or equivalent protection, or must be operations not requiring QD separation. MAJCOM supplements to this Manual provide guidance on determining whether operations within a single facility require QD separation and factors to consider are:

12.17.1.1. Whether the same personnel are involved in both operations (e.g., AE workers are assigned to the same flight and move between operations as required).

12.17.1.2. Whether the same AE are involved in both operations (e.g., air-to-air missiles, chaff or flare).

12.17.1.3. Whether the operations are the same type (e.g., inspection, buildup).

12.17.1.4. Whether the AE involved in both operations presents similar hazards (e.g., same HD or CG).

12.17.2. Parallel operating lines, provided the AE involved in each operating line present similar hazards. Provide successive steps within a single explosives process or operation as
much protection as practical, but do not require QD separation. If the successive steps are housed in separate facilities provide ILD separation between facilities.

**Note:** The criticality or survivability of one or more of the operating lines may require that each line be given IBD-level protection.

12.17.3. Non-explosives facilities, excluding magazine-area loading docks that are used exclusively in support of a PES or explosives area. Such facilities include:

12.17.3.1. Gatehouses.

12.17.3.2. Field offices for branch or flight level supervision, Munitions Operations (AFK), munitions control, training, mobility, etc. See paragraph 12.20.3.4. for offices of personnel who perform hands-on work and their first level supervisors.

12.17.3.3. Dunnage preparation.

12.17.3.4. Small packing and shipping buildings.

12.17.3.5. Dog kennels.

12.17.3.6. Area security control (apply IBD to BDOC per paragraph 12.15.1.12.).

12.17.3.7. Motor pool dispatch points (for vehicles supporting storage area only).

12.17.3.8. Staffed power plants and staffed non-explosive hazardous material collection points.


12.17.3.10. Lunch rooms.

12.17.3.11. Break rooms and change houses supporting multiple PESs.

12.17.3.12. Inert operations involving components of an explosive weapon system; the operation must involve support of an explosive operation such as repairing bomb fins, or the operation simulates an explosive operation.

12.17.3.13. Auxiliary fire stations (apply IBD to main base support fire stations per paragraph 12.15.1.11.).


12.17.3.15. Manned facilities of a defensive or tactical missile battery.

12.17.3.16. GCA, RAPCON, and ATC towers that support a military use only airfield from flightline PESs.

12.17.3.17. Unmanned antenna/antenna farms. These are facilities that generate electromagnetic radiation which may or may not pose a threat to EIDs. A greater distance may be required to protect EIDs at the PES. See AFI 91-208 to determine SSD.

12.17.3.18. Unoccupied weather equipment facilities from the explosives area being supported.

12.17.3.19. Maintenance of military vehicles or equipment that is located OCONUS when the PES is a basic load or a ready storage area. In such cases:

12.17.3.19.1. The NEWQD at each PES is limited to 8,818 lbs or less.
12.17.3.19.2. The maintenance work is performed exclusively for the unit for where AE is stored.

12.17.4. 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. When such facilities serve an entire base complex, or when loss of the facility will cause an immediate loss of vital function, the minimum exposure level is IBD.

12.17.5. Minimum distance between separate groups of AE-loaded, combat-configured aircraft. For QD purposes, all combat forces at a single location are considered related. This may include Air Force, Army, Navy, Marines, and host-nation aircraft. One set of QD criteria applies to all combat forces at a single location (e.g., facilities or functions related to Air Force fighter aircraft are also related to Navy fighter aircraft). When the services disagree on the required QD, forward the problem through MAJCOM channels to AFSEC/SEW for action. (T-1). Use intervening barricades to eliminate propagation by primary fragment impact; thereby eliminating the need to total NEWQD.

Note: Loading AE aboard aircraft can be accomplished with each group of aircraft without additional protection.


12.17.7. Explosive Cargo Aircraft Related Activities. See paragraph 12.41.

12.17.8. Munitions or Weapons Storage Area Related Activities. See paragraph 12.42.

12.17.9. Parking areas for POVs supporting PESs. See paragraph 12.66.3.

12.17.10. Exposures that are provided blast suppression and structure hardening so that equivalent ILD protection for personnel and equipment is provided. Separate the following hardened facilities at reduced ILD (related facility) based upon their degree of hardening. Minimum separation distances for occupied facilities from HASs still apply. See paragraph 12.50.13.

Note: Provide definitive designs justifying a reduced K-factor.

12.17.10.1. Hardened Liquid Oxygen (LOX) Generation or Bulk Storage Facilities.

12.17.10.2. Hardened POL Truck Shelters (use IBD for parking areas for fuel service trucks unrelated to the PES).


12.17.10.6. Survivable Collective Protection System (SCPS) with a minimum of five feet earth cover-K3; with a minimum of three feet but less than five feet of earth cover-K5.

Note: SCPS built before 1 September 1988 at less than minimum separation distances for occupied facilities from HASs do not require a waiver or exemption. See paragraph 12.50.13.
12.17.11. Construction activities exposed by related PESs. This separation requirement applies to all construction activities related to PESs whether being accomplished by civilian, military, or host-nation personnel. Document a risk assessment, including the control measures taken and ensure all construction personnel are made aware of the explosives risks and evacuation procedures (e.g., emergency and lightning response) (see Chapter 4). Locally maintain the risk assessment documentation until operations have been completed and personnel have permanently vacated the work site. If this separation cannot be maintained, obtain a waiver per Section 1B.(T-1). Apply IBD IAW paragraph 12.15. to all construction activities not related to existing PESs.


12.18.1. Continue to use K9 to properly barricade facilities sited at K9 before 1 June 1980 until a revised siting of that facility is necessary, except as noted in paragraph 12.18.2. Comply with this Manual when resiting these facilities.

12.18.2. Use Barricaded ILD for the following facilities with barricades meeting the construction and location criteria of Section 6E, or from the side or rear of ECMs per paragraph 12.24.2.:  

12.18.2.1. Occupied facilities of a defensive or tactical missile battery where greater distances from the PES cannot be provided for technical or tactical reasons.

12.18.2.2. Field operations in magazine areas when performing minor maintenance, packaging or surveillance inspections (from adjacent magazines).

12.18.2.3. Successive steps of a single production, renovation, or maintenance operation housed in separate facilities.

12.18.2.4. A security alert force (apply IBD to central security control per paragraph 12.15.1.12.).

12.18.2.5. Break rooms and change houses that are part of an operating line, used exclusively by personnel operating the line, and are not integral to the PES.

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

12.18.2.7. Temporary holding areas for AE conveyances servicing production or maintenance facilities.

12.18.2.8. Service magazines supporting an explosives operating location.

12.18.3. Unoccupied auxiliary utility functions (e.g., transformer stations, water treatment and pollution abatement facilities) that serve an explosives area, but are not an integral function in the explosives area, and that would not create an immediate secondary hazard if lost. Such unmanned facilities need not be barricaded.

12.19. Allowable IMD Exposures. An allowable IMD exposure is container stuffing and unstuffing operations in magazine areas that provide routine support to multiple PESs.

12.20. Other Allowable Exposures.

12.20.1. Facilities that exclusively support an explosives area may be separated from the PESs in the explosives area as follows:
12.20.1.1. Unmanned hazardous material collection points may be located at fire protection distance (50 feet for non-combustible structures, 100 feet for combustible structures).

12.20.1.2. When essential for security purposes, site one-person guard towers at 50 feet. One person guard shelters require no QD.

12.20.1.3. Unmanned auxiliary power generation or conversion facilities (e.g., power plants, transformers, etc.) that exclusively supply power to an explosives area or security fence lighting may be located at fire protection distance (50 feet for non-combustible structures, 100 feet for combustible structures).

12.20.1.4. Small latrines may be located at fire protection distance (50 feet for non-combustible structures, 100 feet for combustible structures). This facility type is limited to toilets and sinks and do not contain showers, clothing lockers, or other conveniences.

12.20.2. The following facilities that exclusively support a single PES may be located at fire protection distance (50 feet for non-combustible structures, 100 feet for combustible structures) from the PES they support; provide separation to all other PESs:

12.20.2.1. Transformers.

12.20.2.2. Low pressure boilers. Some specially designed operating buildings have attached rooms for low-pressure boilers and other facilities. These buildings have safety features such as protective concrete separating walls (without openings) between boiler and working areas, light roof and frangible exterior walls for boiler enclosures. Such buildings, built according to Air Force definitive drawings, require no separation. This exception applies only where equipment installed or contained in attached rooms meets or exceeds original specifications and does not create additional hazards.

12.20.2.3. Paint storage buildings.

12.20.2.4. Auxiliary facilities such as heating plants, line offices, break areas, briefing rooms for daily work schedules or site safety matters, joiner shops, security posts, and similar functions.

12.20.3. The following facilities require no QD or fire protection distance separation:

12.20.3.1. One-person security structures for weapons-loaded aircraft; provide fire protection distance separation when possible.

12.20.3.2. Defensive fighting positions.

12.20.3.3. Break rooms, supply rooms, and change houses integral to a PES.

12.20.3.4. Offices, integral to a PES, of personnel who perform hands-on work in the PES (e.g., assemble, maintain, inspect, and test), and the NCOIC and first level supervisors (crew chiefs) of those who do hands-on work.

12.20.4. Abandoned facilities require no QD; however, fire protection distance separation applies: These facilities may or may not be scheduled for demolition.
Section 12G—Hazard Zones for ECMs and HASs

12.21. Hazard Zones for ECMs and HASs. QD criteria for ECMs and HASs are dependent upon the orientation of these PESs. The QD criteria in this Manual refer to “front,” “side,” and “rear” relationships for ECMs and HASs.

12.21.1. Use Figure 12.1. to determine whether an ES is exposed to the front, side or rear of an ECM.

12.21.1.1. The forward sector, or “front,” for 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.

12.21.1.2. 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.

12.21.1.3. All other orientations are considered “side” sectors.

12.21.2. Use Figure 12.2. to determine ECM to ECM orientation effects on IMD.

12.21.3. Use Figure 12.3. to determine whether an ES is exposed to the front, side or rear of a HAS.

Section 12H—HD 1.1 QD Criteria

12.22. HD 1.1 Hazardous Fragment Distances. Base the minimum distance for protection from hazardous fragments on primary and secondary fragments from the PES and the population or traffic density of the ES. The hazardous fragment distance (HFD) is defined as the distance at which the density of hazardous fragments becomes one per 600 ft².

Note: This distance is not the maximum fragment range.

12.22.1. The HFD may be determined by:

12.22.1.1. Default values, such as those shown in Table 12.4. for primary fragments or Tables 12.4. and 12.10. secondary fragments.

12.22.1.2. Some items have been evaluated for minimum HFD with results shown in Table 12.5.

12.22.1.3. Some 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). These items may or may not be listed in Table 12.5.

12.22.1.4. DDESB-approved analyses and approved tests may be used to determine minimum distances for both primary and secondary fragments. DDESB TP 13, Prediction of Building Debris for Quantity-Distance Siting is an example of a method to determine minimal distances for building debris, while DDESB TP 16, Methodologies for Calculating Primary Fragment Characteristics and DDESB TP 10, Change 3, Methodology For Chemical Hazard Predictions provide similar information for primary fragments.
12.22.2. Examples when minimum hazardous fragment and firebrand distances need not apply are:

12.22.2.1. 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, firefighters) that directly support these AE operations.

12.22.2.2. Related and support DoD-controlled functions where IMD and ILD would normally apply.

12.22.2.3. 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.

12.22.2.4. Between a PES and inert storage, whether in a facility or in the open.

12.22.2.5. Between facilities in an operating line; between operating lines; and between operating lines and storage locations.

12.22.3. Minimum hazardous fragment distances apply to:

12.22.3.1. An installation's boundary.

12.22.3.2. Administration and housing areas.

12.22.3.3. Recreation facilities (e.g., ball diamonds, golf courses and volleyball courts).

Note: See paragraph 12.22.2.1. for situations where minimum fragment distances do not apply to recreational facilities.

12.22.3.4. Flightline passenger service functions (e.g., terminal buildings).

12.22.3.5. Utilities that provide vital functions to a major portion of an installation.

12.22.3.6. Auxiliary storage and shops that by reason of their vital strategic nature, or high intrinsic value of their contents, must not be placed at risk.

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

12.22.3.8. POVs parked in administrative areas.

12.23. HD 1.1 IBD and PTRD. Table 12.1 provides a summary matrix of all the paired relationships for HD 1.1. For locations provided IBD or PTRD protection per paragraphs 12.15. and 12.16., the HD 1.1 IBD and PTRD are as follows:

12.23.1. HD 1.1 NEWQD \leq 450 lbs.

12.23.1.1. For HD 1.1 in a 7-Bar or a 3-Bar ECM, use ECM Front/Side/Rear IBD and PTRD as shown in Table 12.6.

12.23.1.2. For HD 1.1 in an Undefined ECM where the loading density (NEWQD (lbs)/internal volume (ft³)) is \leq 0.028 lbs/ft³, use ECM Front/Side/Rear IBD and PTRD as shown in Table 12.6.
12.23.1.3. For HD 1.1 in an Undefined ECM where the loading density is > 0.028 lbs/ft³, use ECM Side/Rear IBD and PTRD as shown in Table 12.6. For side/rear exposures, IBD is the greater of the ECM Side/Rear IBD as shown in Table 12.6, the HFD found in Table 12.4, the specific item HFD as shown in Table 12.5, or the parenthetical fragment distance, whichever is greater. When using Table 12.4, use the “Structure” column only if the ECM headwall meets the definition of aboveground structure heavy wall (AGS (H)) as defined in the legend of Table 12.2, or for non-fragment producing explosives. PTRD is 60 percent of the resulting IBD.

12.23.1.4. Where ECM, regardless of structural designation, have been designed, analyzed, or tested to have a reduced IBD and PTRD and have been approved by the DDÉSB, use the approved IBD and PTRD.

12.23.1.5. For HD 1.1 in a structure (excluding ECM) capable of stopping primary fragments, and contributing to the debris hazard, use the HFD listed in the “Structure” column of Table 12.4. PTRD is 60 percent of HFD. Structures that are capable of stopping primary fragments include all heavy wall (H) and heavy wall/roof (H/R) AGS, as defined in the Legend for Table 12.2. Doors and other openings where primary fragments could exit must be capable of stopping primary fragments from exiting the facility or will be barricaded IAW Section 6E to trap primary fragments that could exit the facility. All other structures (other than ECM) are considered incapable of stopping primary fragments.

12.23.1.6. Selected items have been evaluated for minimum HFD with results shown in Table 12.5. 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 may not be listed in Table 12.5. The HFD for these two categories apply only to items in the open. When in facilities, consider secondary debris as well as primary fragments. If in a facility incapable of stopping primary fragments, IBD is the greater of the HFD for Open locations as shown in Table 12.4, the specific item HFD as shown in Table 12.5, or the parenthetical fragment distance. For items not listed in Table 12.5, or assigned a parenthetical fragment distance, use the Open column of Table 12.4. PTRD is 60 percent of the resulting IBD.

12.23.1.7. For bare (non-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 12.4. PTRD is 60 percent of HFD.

12.23.1.8. For bare (non-fragment producing) explosives in the open, IBD is K40; PTRD is 60 percent of the resulting IBD.

12.23.1.9. For exposures not requiring fragment protection per paragraph 12.22.2, IBD is K40; PTRD is 60 percent of the resulting IBD.

12.23.2. HD 1.1 NEWQDs in the range 451 to 30,000 lbs.

12.23.2.1. The minimum HFD is 1250 feet. Consider facilities sited at 1,235 feet or 1,245 feet per past standards to be in compliance with the 1,250 feet minimum requirement.
12.23.2.2. For HD 1.1 in a 7-Bar or a 3-Bar ECM, use ECM Front/Side/Rear IBD and PTRD as shown in Table 12.6.

12.23.2.3. For HD 1.1 in an Undefined ECM where the loading density is \( \leq 0.028 \text{ lbs/ft}^3 \), use ECM Front/Side/Rear IBD and PTRD as shown in Table 12.6.

12.23.2.4. For HD 1.1 in an Undefined ECM with minimum internal dimensions of 26 feet wide and 60 feet long, use ECM Side/Rear IBD and PTRD as shown in Table 12.6, for side/rear exposures. For front exposures, IBD is the greater of the Other PES IBD as shown in Table 12.6, or the parenthetical fragment distance if it is greater than 1250 feet; PTRD is 60 percent of the resulting IBD.

12.23.2.5. For HD 1.1 in an Undefined ECM where the loading density is \( > 0.028 \text{ lbs/ft}^3 \) and internal dimensions are less than 26 feet wide and 60 feet long, use Other PES IBD and PTRD as shown in Table 12.6, for side and rear exposures. For front exposures, IBD is the greater of the Other PES IBD as shown in Table 12.6, or the parenthetical fragment distance if it is greater than 1250 feet; PTRD is 60 percent of the resulting IBD.

12.23.2.6. For HD 1.1 in a structure (excluding ECM), use the Other PES IBD and PTRD distances as shown in Table 12.6. However, if the item has a parenthetical fragment distance that is greater than 1250 feet, use the parenthetical fragment distance as the IBD; PTRD is 60 percent of the resulting IBD.

12.23.2.7. For HD 1.1 in the open, use the Other PES IBD and PTRD distances as shown in Table 12.6. However, if the item has a parenthetical fragment distance or a specific item HFD distance as shown in Table 12.5., this value may be used in place of the 1250 feet minimum HFD. IBD is the greater of K40, or the parenthetical fragment distance or specific item HFD as shown in Table 12.5.; PTRD is 60 percent of the resulting IBD.

12.23.2.8. For bare (non-fragment producing) explosives in the open, IBD is K40; PTRD is 60 percent of the resulting IBD.

12.23.2.9. For exposures not requiring fragment protection per paragraph 12.22.2., IBD is K40; PTRD is 60 percent of the resulting IBD.

12.23.3. HD 1.1 NEWQDs > 30,000 lbs.

12.23.3.1. For HD 1.1 in a 7-Bar or a 3-Bar ECM where internal dimensions are a minimum of 26 feet wide and 60 feet long, use ECM IBD and PTRD as shown in Table 12.6.

12.23.3.2. For HD 1.1 in a 7-Bar or a 3-Bar ECM where internal dimensions are less than 26 feet wide and 60 feet long, use Other PES IBD and PTRD as shown in Table 12.6, for front, side and rear exposures.

12.23.3.3. For HD 1.1 in an Undefined ECM where internal dimensions are a minimum of 26 feet wide and 60 feet long, use ECM Side/Rear IBD and PTRD as shown in Table 12.6, for side/rear exposures. For front exposures, IBD is the greater of the Other PES IBD as shown in Table 12.6., or the parenthetical fragment distance if it is greater than 1250 feet; PTRD is 60 percent of the resulting IBD.

12.23.3.4. For HD 1.1 in an Undefined ECM where internal dimensions are less than 26 feet wide and 60 feet long, use Other PES IBD and PTRD as shown in Table 12.6. for
side/rear exposures. For front exposures, IBD is the greater of the Other PES IBD as shown in Table 12.6., or the parenthetical fragment distance if it is greater than 1250 feet; PTRD is 60 percent of the resulting IBD.

12.23.3.5. For HD 1.1 in a structure (excluding ECM) or in the open, use the Other PES IBD and PTRD distances as shown in Table 12.6. However, if the item has a parenthetical fragment distance that is greater than 1,250 feet, use the parenthetical fragment distance as the IBD; PTRD is 60 percent of the resulting IBD.

12.23.3.6. For exposures not requiring fragment protection per paragraph 12.22.2., IBD is K40/50 as described in Table 12.6., Note 3. PTRD is 60 percent of the resulting IBD.

12.24. HD 1.1 ILD. Table 12.1. provides a summary matrix of all the paired relationships for HD 1.1.

12.24.1. Unbarricaded ILD from an 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 K18 unbarricaded ILD from an ECM, when accounting for this attenuation, is as shown in Table 12.7. for exposures permitted at unbarricaded ILD per paragraph 12.17.

Note: Airblast forms the basis for the equations given in the notes to Table 12.7. and per paragraph 12.17.10., some hardened structures may be sited at a reduced unbarricaded ILD.

12.24.2. Barricaded ILD from an ECM. The equivalent K9 barricaded ILD from an ECM is as shown in Table 12.7. for exposures permitted at barricaded ILD per paragraph 12.18. Use of barricaded ILD from the front of an ECM requires that a properly constructed, intervening barricade be located between the ES and the PES per Section 6E. If an ECM's earth cover meets all construction criteria of Section 6E, it qualifies as a barricade and use of barricaded ILD from the sides or rear of the ECM is permissible. Failure of the ECM's earth cover to meet the criteria of Section 6E requires use of unbarricaded ILD for siting purposes.

12.24.3. Unbarricaded ILD from Other than an ECM. The unbarricaded ILD from all PESs other than ECMs is as shown in Table 12.8. for exposures permitted at unbarricaded ILD per paragraph 12.17.

Note: Per paragraph 12.17.10., some hardened structures may be sited at a reduced unbarricaded ILD.

12.24.4. Barricaded ILD from Other than an ECM. The barricaded ILD from all PESs other than ECMs is as shown in Table 12.8. for exposures permitted at barricaded ILD per paragraph 12.18. Use of barricaded ILD requires that a properly constructed, intervening barricade be located between the ES and the PES per Section 6E.

12.25. HD 1.1 IMD. IMD from magazines is as shown in Table 12.1. The IM distances given for 100 lbs NEW in Tables 12.30. and 12.31. constitute the minimum magazine separations permitted.

12.25.1. Barricaded IMD from an ECM. Use of barricaded IMD from the front of an ECM requires that a properly constructed, intervening barricade be located between the ES and the PES per Section 6E. If an ECM's earth cover meets all construction criteria of Section 6E, it qualifies as a barricade and use of barricaded IMD from the sides or rear of the ECM is
permissible. Failure of the ECM's earth cover to meet the criteria of Section 6E requires application of unbarricaded IMD for siting purposes.

12.25.2. Barricaded IMD from an AGM. Use of barricaded IMD from an AGM 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 6E.

Section 12I—HD 1.2 QD Criteria

12.26. HD 1.2.1 and 1.2.2 QD Criteria.

12.26.1. Small quantities of HD 1.2.1 (≤ 450 pounds NEWQD), in certain packaging configurations, react in a manner more typical of an HD 1.1 event. When located in structures that stop primary fragments and generate a secondary debris hazard (e.g., certain ECM 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 ≤ MCE ≤ 450 lbs (meaning that there will only be a single HD 1.2.1 event and it will involve less than or equal to 450 lbs), treat the HD 1.2.1 as HD 1.1 and use paragraph 12.23.1.1. criteria.

12.26.2. The QD criteria for HD 1.2.1 items are based on the hazards from primary fragments and secondary debris. Structures that may contribute secondary debris include: frontal exposures from ECMs; cargo aircraft (with internally loaded AE); all aboveground structures, including heavy wall (H), heavy wall/roof (H/R), and light wall (L) as defined in Table 12.2.; and trucks, trailers, and railcars (with internally loaded AE). All structures are presumed to produce secondary debris unless data or analyses are provided, and approved by AFSEC/SEW, to show that the structural debris contribution is less than that shown in Table 12.10. Secondary debris evaluation is not required for externally-loaded AE on aircraft and stacks of AE on open trucks, trailers, or railcars.

12.26.3. The QD criteria for HD 1.2.2 items are based on the hazards from primary fragments.

12.26.4. Table 12.2. provides a summary matrix of all the paired relationships for HD 1.2.1 and 1.2.2.

12.26.4.1. HD 1.2.1 IBD in the open is given in Table 12.9. 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 12.9, for the appropriate Explosive Weight (number of items x NEWQD) or that given in Table 12.10. for the appropriate MCE.

Note: Hazardous debris distance (HDD) specified in Table 12.10. equates to IBD.

12.26.4.2. HD 1.2.2 IBD is given in Table 12.11.

12.26.4.3. PTRD given in Tables 12.9. through 12.11. 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 12.2.
12.26.4.4. ILD given in Tables 12.9, through 12.11, 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 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 12.2, for the applicable PES-ES combination.

12.26.4.5. IMD given in Table 12.2, are dependent upon the types of structures acting as both the PES and the ES.

12.27. HD 1.2.3 QD Criteria.

12.27.1. When siting HD 1.2.3, cap the NEWQD of the largest single round at ≤ 450 pounds, and cap the parenthetical fragment distance (xx) at 1300 feet. These caps are for simplicity in siting and may be exceeded with AFSEC/SEW approval.

12.27.2. Table 12.2, provides a summary matrix of all the paired relationships for HD 1.2.3.

12.27.2.1. The IBD for HD 1.2.3 is determined using Table 12.12, (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:

12.27.2.1.1. If the items are in a heavy structure that can interrupt primary fragments and can contribute secondary debris (including side/rear exposures from ECMs), the minimum IBD is the hazardous debris distance given in Table 12.10, for an MCE equal to the NEWQD of the largest single round. A heavy structure is defined as a structure with wall thickness ≥12 inches of reinforced concrete and a roof thickness >5.9 inches of reinforced concrete.

12.27.2.1.2. If the items are in the open or in a structure that can not interrupt primary fragments, the minimum IBD applied is the greatest parenthetical (xx) fragment distance assigned to the HD 1.2.3 item to be stored.

12.27.2.1.3. As an alternative to the criteria in paragraphs 12.27.2.1.1. and 12.27.2.1.2., 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:

12.27.2.1.3.1. If the largest single round NEWQD is > 1.6 lbs, consider the items as HD 1.2.1. Use the total NEWQD present, with an MCE equal to the NEWQD of the largest single round to determine the maximum QD.

12.27.2.1.3.2. If the largest single round NEWQD is ≤ than 1.6 lbs, consider the items as HD 1.2.2, based on the total NEWQD present.

12.27.2.2. PTR and IL for HD 1.2.3 are computed as 60 percent and 36 percent, respectively, of the determined IBD with a minimum distance equal to IMD given in Table 12.2.

Section 12J—HD 1.3 QD Criteria

12.28. HD 1.3 QD Criteria.
12.28.1. Table 12.3 provides a summary matrix of all the paired relationships for HD 1.3. Table 12.12 provides QD criteria for HD 1.3.

12.28.2. HD 1.3 includes items that burn vigorously with little or no possibility of extinguishment in storage situations.

12.28.3. Explosions are normally confined to pressure ruptures of containers and will not produce propagating shock waves or damaging blast overpressure beyond the magazine distance specified in Table 12.12.

12.28.4. A severe fire hazard may result from tossing about of burning container materials, propellant, or other flaming debris.

Section 12K—HD 1.4 QD Criteria

12.29. HD 1.4 QD Criteria.

12.29.1. Table 12.3 provides a summary matrix of all the paired relationships for HD 1.4. Table 12.13 provides QD criteria for HD 1.4. HD 1.4 AE presents a fire hazard with minimal blast, fragmentation, or toxic hazards.

12.29.2. In mixed storage, the NEWQD of HD 1.4 is not additive (see paragraph 12.7.1.1.). Determine QD criteria for each HD present, including HD 1.4, and use the largest value.

12.29.3. HD 1.4S AE may be stored (including associated handling) without regard to the QD criteria in Table 12.13 (see paragraph 2.23.).

Section 12L—HD 1.6 QD Criteria

12.30. HD 1.6 QD Criteria. Table 12.3 provides a summary matrix of all the paired relationships for HD 1.6. Table 12.14 provides QD criteria for HD 1.6. Base QD separations for HD 1.6 AE on the storage location and configuration. Only permit a maximum of 500,000 lbs NEWQD 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.

Section 12M—HD 6.1 Criteria

12.31. HD 6.1 Criteria.

12.31.1. 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 49 CFR Parts 171 to 177.

12.31.2. Hazard zones for toxic chemical agents are determined by the relative toxicity of the agents, the amount released to the atmosphere, the rate they are released (that is, evaporation, pressure, or explosive dispersal), terrain features, and meteorological conditions. Hazard zone calculations are based on MCE, using DDESB TP 10, Methodology for Chemical Hazard Prediction.

12.31.3. When siting AE containing toxic chemical agents, evaluate both the explosives and toxic chemical agent hazards with the greatest QD governing siting.
Section 12N—Energetic Liquids QD Criteria

12.32. Scope and Application.

12.32.1. This section applies to the storage of energetic liquids, listed in Table 12.15., in all types of containers, including rocket and missile tankage. Store and handle laboratory quantities as prescribed in Chapter 5 of AFI 91-203.

Note: The required QD are only based on the energetic liquids’ energetic reaction—that is, blast overpressure and container fragmentation. These QD requirements do not consider the toxicity or potential down-wind hazard. Therefore, QD may not be the only factor that needs to be considered when selecting a location for storage and operations of energetic liquids.

12.32.2. Exclusion. This section does not govern the storage or handling of energetic liquids for uses other than in space launch vehicles, rockets, missiles, associated static test apparatus, and AE.

12.33. Concept.

12.33.1. These QD standards were developed on the premise that construction materials are compatible with energetic liquids, facilities are of appropriate design, fire protection and drainage control techniques are employed, and other specialized controls (e.g., nitrogen padding, blanketing, and tank cooling) are used, when required.

12.33.2. When additional hazards associated with AE are involved, apply the safety distances prescribed in other sections of this standard.

12.33.3. These standards are based upon the estimated credible damage resulting from an incident, without considering probabilities or frequency of occurrence.

12.34. Determination of Energetic Liquids Quantity.

12.34.1. The total quantity of energetic liquids in a tank, drum, cylinder, or other container will be the net weight of the energetic liquids contained therein. Include the quantity of energetic liquids in the associated piping to the points that provide positive means for interrupting the flow through the pipe, or interrupting a reaction in the pipe in the event of an incident.

12.34.2. When the quantities of energetic liquids are given in gallons, the conversion factors given in Table 12.16. may be used to determine the quantity in pounds.

12.35. Measurement of Separation Distances.

12.35.1. Measure from the closest controlling hazard source (e.g., containers, buildings, segment, or positive cutoff point in piping).

12.35.2. Measure from the nearest container or controlling sub-division, when buildings containing a small number of cylinders or drums are present or when quantities of energetic liquids are subdivided effectively.


12.36.1. The main UN hazard classification designators for energetic liquids are indicated below.

12.36.1.1. Class 1: Explosives.
12.36.1.2. Class 2: Gases.
12.36.1.3. Class 3: Flammable liquids.
12.36.1.5. Class 5: Oxidizing substances and organic peroxides.
12.36.1.6. Class 6: Toxic and infectious substances.
12.36.1.7. Class 8: Corrosive substances.
12.36.1.8. Class 9: Miscellaneous dangerous substances and articles.

**Note:** The original liquid propellant Hazard Groups I - IV and CG A - F are no longer used.

12.36.2. Because two energetic liquids might each be compatible with certain explosive AE stores, but incompatible with each other, a two-part compatibility group designation is assigned to an energetic liquid. Another example is the storage of liquid gun propellant with explosive AE components.

**Note:** The design and logistics of modern weapons sometimes require that consideration be given to permitting storage or operations involving energetic liquids in a storage structure containing solid explosives (e.g., it may be necessary to store hydrocarbon-fueled cruise missiles having HE warheads with fueled configurations not containing explosive warheads.

12.36.2.1. The first element is the standard storage and transportation CG designation. The alpha designations are the same as the CG designations for UN Class 1 as given in Chapter 3. However, for storage and handling on DoD facilities, a CG may also be assigned to an energetic liquid in a Class other than Class 1. The absence of a CG indicates incompatibility with solid explosives.

12.36.2.2. The second element is a new Energetic Liquid Compatibility Group (ELCG) designation. The ELCG applies to mixed storage of energetic liquids or AE containing energetic liquids. The ELCG is specified in parentheses as the last element of the hazard classification. The ELCG designations and definitions are:

12.36.2.2.1. LA: Energetic liquids that are strong oxidizers, mainly of acidic character. These materials may cause or contribute to the combustion of other material, possibly resulting in serious flare fires or explosions. Includes, but is not limited to, nitrogen tetroxide and mixed oxides of nitrogen (MON), inhibited red fuming nitric acid (IRFNA), liquid oxygen (LO₂), hydrogen peroxide (H₂O₂), and gels, slurries, or emulsions of the above.

12.36.2.2.2. LB: Energetic liquids that are readily combustible when exposed to, or ignited in the presence of an oxidizing agent, but that are not strong reducing agents. Some may be hypergolic with group LA materials. Includes, but is not limited to, hydrocarbons such as kerosene’s and strained ring ramjet fuels; liquid hydrogen (LH₂); and gels, slurries, or emulsions of the above.

12.36.2.2.3. LC: Energetic liquids that are readily combustible when exposed to, or ignited in the presence of an oxidizing agent, and are also strong reducing agents. These are likely to be hypergolic with group LA substances. Includes, but is not limited to, hydrazine’s and other amines; and gels, slurries, or emulsions of the above.
12.36.2.4. LD: Energetic liquids that act mainly as combustible fuels, similar to groups LB and LC, when exposed to, or ignited in the presence of oxidizing agents but that may act as oxidizers in some combinations. They may be a monopropellant with the right catalyst, or may be pyrophoric and ignite upon release to the atmosphere (e.g., ethylene and propylene oxides, and boranes).

12.36.2.5. LE: Energetic liquids having characteristics that do not permit storage with any other energetic liquid. They may react adversely with either fuels (reducing agents) or oxidizers (e.g., nitromethane, nitrate ester based formulations such as Otto Fuel II, liquid monopropellants containing hydroxyl ammonium nitrate (HAN), halogen fluorides (ClF₃ and ClF₅) and fluorine, and gels, slurries, or emulsions of the above).

12.36.2.3. Mixing of energetic liquids.

12.36.2.3.1. Different energetic liquids in the same ELCG may be stored together.

12.36.2.3.2. ELCG-LE may not be mixed with other ELCG or dissimilar ELCG-LE.

12.36.2.3.3. Mixed storage is prohibited between energetic liquids of different ELCG designations with one exception. ELCG-LB and -LC must not be stored together, particularly when the majority of the material stored is ELCG-LB; however, mixed storage of ELCG-LB and -LC is permitted when operationally necessary.

12.36.2.4. As an example, for the 1.3C (LE) hazard classification for HAN-based liquid gun propellant XM-46:

12.36.2.4.1. "C": indicates the propellant can be stored in the same magazine with CG-C solid propellants. Because CG-C and CG-D can be mixed, CG-D HE projectiles could also be stored with the energetic liquid gun propellant.

12.36.2.4.2. "LE": indicates that hydrocarbon fuels (e.g., JP-10), an ELCG-LB, would not be permitted in this storage scenario, because its ELCG-LB indicates incompatibility with ELCG-LE.

12.36.3. Complete DoD hazard classification assignments for current energetic liquids are shown in Table 12.15.

Note: Conversions of energetic liquids from gallons to pounds is provided in Table 12.16.

12.36.4. Examine each new energetic liquid, or new non-bulk packaging configuration of an energetic liquid, developed or adopted for DoD use, and assign a hazard classification per Technical Bulletin 700-2, Naval Sea Systems Command Instruction 8020.8B, TO 11A-1-47, Defense Logistics Agency Regulations 8220.1, and DoD Ammunitions and Explosives Hazard Classification Procedures. The MAJCOM developing a liquid propellant (or first adopting for use any liquid propellant not listed here) must recommend the hazard classification and compatibility group designation. The responsible MAJCOM will forward substantiated proposals for such assignments as soon as systems application planning allows or warrants to AFSEC/SEW.

12.36.5. A different minimum distance may be assigned during the hazard classification process when the hazards of a particular new packaging configuration are not adequately addressed. This distance will be indicated parenthetically, in hundreds of feet, as the first
element of the hazard classification (e.g., if a new liquid oxidizer pressure vessel configuration is hazard classified as (04) 2.2 (LA), then a minimum distance of 400 feet would apply for IBD and PTRD, otherwise the prescribed liquid oxidizer QD criteria would apply).

12.36.6. Specific Hazardous Locations. The predominant hazard of the individual energetic liquids at specific hazardous locations can vary depending upon the location of the energetic liquid storage and the operations involved. These locations are listed below in the order of decreasing hazards.

12.36.6.1. Launch Pads. Operations at these facilities are very hazardous because of the proximity of fuel and oxidizer to each other, the frequency of launchings, lack of restraint of the vehicle after liftoff, and the possibility of fallback with resultant dynamic mixing on impact. To compute the explosive equivalent for the launch pad, use Table 12.17, with the combined energetic liquids weight in the launch vehicle tanks and any energetic liquids in piping that are subject to mixing, except as indicated in paragraph 12.36.8.

12.36.6.2. Static Test Stands. Operations at these facilities are less hazardous because test items are restrained and subject to better control than launch vehicles. As with launch pads, the proximity of fuel and oxidizer presents a significant hazard. To reduce this hazard, separate tankage and remotely locate it from the static test stand. Use explosive equivalents of Table 12.17, with the combined energetic liquids weight subject to mixing as determined by hazard analysis. The amount of energetic liquids held in run tanks can be excluded from consideration if the test stand meets all the following criteria, if applicable:


12.36.6.2.2. For cryogenic propellants, all tanks are constructed with double wall jacketing.

12.36.6.2.3. Run tankage is protected from fragments produced by an engine malfunction.

12.36.6.2.4. Both the fuel and oxidizer lines contain two (redundant), remotely operated valves to shut off flow in the event of a malfunction.

12.36.7. Ready Storage. This storage is relatively close to the launch and static test stands; normally it is not involved directly in feeding the engine as in the case with run tankage, an integral part of all launch and test stand operations. Use the explosive equivalents of Table 12.17, with the combined energetic liquids weight subject to mixing if the facility design does not guarantee against fuel and oxidizer mixing and against detonation propagation to, or initiation at, the ready storage facility when a mishap occurs at the test stand, on the ground at the launch pad, or at the ready storage areas. Otherwise, fire and fragment hazards will govern (See Tables 12.15, 12.18, 12.19, 12.20, and 12.21).

12.36.8. Cold-Flow Test Operations. Fire and fragment hazards govern (Tables 12.15, 12.18, 12.19, 12.20, and 12.21) if the design is such that the system is closed except for
approved venting, is completely airtight, fuel and oxidizer never are employed concurrently, and each has a completely separate isolated system and fitting types to preclude intermixing, and the energetic liquids are of required purity. Otherwise, use explosive equivalents with the combined energetic liquids weight (see Table 12.17).

12.36.9. Bulk Storage. This is the most remote storage with respect to launch and test operations. It consists of the area, tanks, and other containers therein, used to hold energetic liquids for supplying ready storage and, indirectly, run tankage where no ready storage is available. Fire and fragment hazards govern storage requirements except in special cases as indicated in Tables 12.15. and 12.17. (see Tables 12.15., 12.18., 12.19., 12.20., and 12.21.).

12.36.10. Rest Storage. This is temporary-type storage and most closely resembles bulk storage. It is a temporary parking location for barges, trailers, tank cars, and portable hold tanks used for topping operations when these units actually are not engaged in the operation; and for such vehicles when they are unable to empty their cargo promptly into the intended storage container. Fire and fragment hazards govern storage requirements except in special cases as indicated in Tables 12.15. and 12.17. (see Tables 12.15., 12.18., 12.19., 12.20., and 12.21.). The transporter becomes a part of that storage where it is connected during energetic liquids transfer.

12.36.11. Run Tankage (Operating Tankage). This consists of the tank and other containers and associated piping used to hold the energetic liquids for direct feeding into the engine or device during operation. The contents of properly separated "run tanks" (operating tankage) and piping are normally considered on the basis of the pertinent hazards for the materials involved, except for quantities of incompatible materials that are or can be in a position to become mixed. Use explosive equivalents for quantities of such materials subject to mixing unless satisfying provisions of paragraphs 12.36.6.2.1. through 12.36.6.2.4. (see Table 12.17.).

12.36.12. Pipelines. Maintain a 25-ft clear zone to inhabited buildings, as a minimum, on each side of pipelines used for energetic liquids (excluding flammable or combustible liquids that exhibit normal fire hazards such as RP-1, JP-10, and Otto Fuel II). Tables 12.15., 12.19., 12.20., and 12.21. apply, as appropriate.

12.37. QD Standards. Since many energetic liquids are not classified as UN Class 1 explosives, conventional QD storage criteria do not generally apply to these materials. At the same time, the (non-Class 1) UN transportation hazard classifications for many energetic liquids appear to be inappropriate or inadequate for application to storage safety (based on available accident and test data) (e.g., hydrazine has a UN hazard classification of 8 (corrosive), while it also is subject to dangerous fire and explosive behavior). Thus, the implementation of QD criteria for energetic liquids is based on an independent determination of the predominant hazard presented by the material in the storage environment. The following standards are applicable to energetic liquids used for propulsion or operation of missiles, rockets, and other related devices.

12.37.1. Tables 12.15., 12.18., 12.19., 12.20., and 12.21. provide minimum distance requirements for storage of bulk quantities, and in some cases, pressure vessels and other commercial packaging of energetic liquids. In general, the energetic liquid materials requiring the greatest distance determine the minimum separation to other energetic liquids. In addition, take positive measures to control the flow of energetic liquids in the event of a
leak or spill, in order to prevent possible fire propagation or accumulation of flammable liquids near other storage, and to prevent mixing of incompatible energetic liquids (except for specific hazardous locations as identified in paragraph 12.36.6. above). Explosives equivalence applies for some materials as indicated in Tables 12.15. and 12.17. Fragment hazards govern for some materials in certain packaging configurations. For the more conventional fuels and oxidizers, and also where minimum blast and fragment criteria are not required due to low confinement packaging, QD standards are adopted from OSHA and NFPA guidelines to account for normal fire protection principles.

12.37.2. For specific hazardous locations as defined in paragraph 12.36.6. above, explosives equivalency may apply. If so, consult Tables 12.15. and 12.17. with the combined energetic liquids weight subject to mixing and use distances found in Table 12.6. or 12.8. Enter weight of explosives equivalent in Table 12.6. or 12.8. AFSEC/SEW determines QD standards for other conditions and explosive equivalents for any combination not contained in Table 12.15. or 12.17.


12.38.1. Exercise caution in the storage and handling of contaminated energetic liquids. Such contamination may increase the degree of hazard associated with the energetic liquids.

12.38.2. Isolate energetic liquids known to be contaminated or in a suspect condition and provide separate storage from all other energetic liquids pending laboratory analysis for verification of contamination and disposition requirements, if any.

Section 12O—QD Criteria Specific Facilities and Systems


12.39.1. Airfield Criteria. Reference Unified Facilities Criteria 3-260-01, Airfield and Heliport Planning and Design and AFH 32-1084, Facility Requirements for minimum airfield criteria for parked explosives-loaded aircraft. If airfield criteria deviations are required, address the status of the deviations in the ESP transmittal letter. (T-1).

12.39.2. Forward Firing Munitions. Weapon systems such as guns, rockets, missiles, and flare dispensers pose an additional hazard (beyond their explosives hazard) because of their directional response and potential long range if inadvertently activated on the ground. QD requirements do not address this additional hazard. Comply with the following to minimize this additional hazard:

12.39.2.1. Position aircraft to present the minimum hazard to personnel and resources in the event of a mishap.

12.39.2.2. Do not unnecessarily stand or park vehicles in front of, or behind, these munitions when power is applied to the aircraft.


12.39.3. AE Prohibited Areas. Areas immediately beyond the ends of runways and along primary flight paths are subject to more aircraft accidents than other areas. For this reason, AE is prohibited from Accident Potential Zones (APZ) I and II and clear zones (CZ) of all
aircraft landing facilities as depicted and described in UFC 3-260-01, *Airfield and Heliport Planning and Design* and defined by the MAJCOM’s. Accomplish deviations to AE prohibited areas through risk acceptance documentation according to paragraph 1.4. ESP submittals must reference the approved airfield waiver as supporting justification for the deviation. (T-1).

12.39.4. Munitions Loading Operations. Conduct uploading and downloading of munitions at sited explosives-loaded aircraft parking areas (see paragraph 12.47.).

**12.40. Combat Aircraft Related Activities.**

12.40.1. All facilities and functions directly involved in maintaining, servicing, controlling, and flying combat aircraft are considered related to AE on the flightline supporting those combat aircraft and may be sited at ILD from such AE (subject to minimum separation distances from HASs as specified in paragraph 12.50.13. and to guidance given in paragraph 12.40.5.). The primary test to be applied in determining combat aircraft related facilities is that the function provides essential daily and direct support for the PES presenting the hazard. Examples of facilities and functions generally considered related to combat aircraft generation include:

12.40.1.1. Facilities that handle AE on the flightline, prepare and service armed aircraft, and those that house personnel who fly combat aircraft (e.g., alert crew shelters).

12.40.1.2. Direct flightline combat aircraft associated facilities, which may contain field offices, break rooms, unit training rooms, and equipment and supply rooms.


12.40.1.4. POL or LOX servicing facilities, including hot pit refueling areas.

12.40.1.5. Civil engineering functions solely dedicated to maintaining the runway and taxiways.

12.40.1.6. Forward supply points.

12.40.1.7. Intelligence, debriefing, and flightline security functions.

12.40.2. Because combat aircraft generation cannot progress without their combined efforts, combat aircraft support functions and facilities involving explosives may be considered related to each other, if they are considered related to the combat aircraft. Therefore, all explosives support functions and facilities deemed related to combat aircraft generation activities on the flightline may be located at ILD from one another (subject to minimum separation distances from HASs as specified in paragraph 12.50.13.).

12.40.3. Separate combat aircraft related facilities from any PES they are not related to by IBD, with no minimum fragment distance. If combat aircraft related facilities are located in a HAS, this separation from unrelated PESs may be reduced to K30 to the frontal cone and K9 or K18 to the sides or rear. Site some hardened facilities at lesser distances if equivalent protection is demonstrated by test or analysis and approved by AFSEC/SEW.

12.40.4. Separate other flightline facilities or activities not directly supporting combat aircraft generation by IBD, with no minimum fragment distance, from combat aircraft and their related explosives operations.
12.40.5. Typical MSA explosives operations located on the flightline (e.g., bomb build-up) may be considered related to combat aircraft, but are not necessarily related to other combat aircraft related facilities or flightline support functions (e.g., wheel and tire shop).

12.40.6. Flightline Dining Facilities. Provide IBD with a minimum fragment distance from all PES locations when access to the dining facility is available to personnel who do not directly support flightline activities. Provide IBD with no minimum fragment distance from an MSA PES location provided the dining facility is used exclusively by flightline personnel. Provide ILD from flightline PES locations when the dining facility is only used by personnel who directly support flightline activities.

12.41. Explosives Cargo Aircraft Related Activities.

12.41.1. Consider flightline personnel who solely support explosives cargo aircraft and all munitions maintenance activities related to explosives cargo and explosives cargo aircraft. These personnel may be separated at ILD from such AE.

12.41.2. Explosives cargo aircraft support functions and facilities involving explosives may be considered related to each other, if they are consider related to explosives cargo aircraft. Therefore, all explosives support functions and facilities deemed related to explosives cargo aircraft activities on the flightline may be located at ILD from one another.

12.41.3. Separate explosives cargo aircraft related facilities from any PES they are not related to by IBD, with no minimum fragment distance.

12.41.4. Separate other flightline facilities or activities not directly supporting explosives cargo aircraft operations and maintenance by IBD, with no minimum fragment distance, from explosives cargo aircraft.

12.41.5. Typical MSA explosives operations located on the flightline may be considered related to explosives cargo aircraft, but are not necessarily related to other explosives cargo aircraft related facilities or flightline support functions.

12.42. Munitions or Weapons Storage Area Related Activities.

12.42.1. Activities directly associated with munitions storage or munitions operations are considered related to MSA AE and may be separated at ILD from such AE.

12.42.2. Munitions support functions and facilities involving explosives may be considered related to each other (regardless of owning service, organization or country), if they are related to MSA AE.

12.42.3. Separate MSA-related facilities from any PES they are not related to by IBD, with no minimum fragment distance (e.g., the MSA office from a combat aircraft parking area (CAPA)). However, explosives operating locations may be protected by ILD from combat aircraft.

12.43. Concurrent Servicing Operations (CSO). CSO using live munitions will be conducted in sited CAPA locations. Identify inert CSO locations as ESs when they are located within a clear zone.

12.44. Hot-Pit Refueling Operations. All aircraft undergoing hot-pit refueling are considered to be in transportation mode and are exempt from QD criteria as a PES. Evaluate the hot-pit refueling area and associated aircraft as an ES; apply the greater separation treating the location
as a military use only taxiway or separation required for the POL. See paragraph 12.79. for QD requirements for the POL facilities associated with the hot-pit refueling area.

12.45. End-of-Runway (EOR) and Arm/de-Arm Pads and Crew Shelters. All aircraft undergoing EOR or arm/de-arm operations are considered to be in transportation mode and are exempt from QD criteria as a PES. As an ES, treat as a military use only taxiway. Site EOR and arm/de-arm crew shelters as military use only runways per Tables 12.1., 12.2., and 12.3. If these shelters are used as office areas for arm/de-arm crews, site these exposures at IBD, with no minimum fragment distance, from MSA, PESs, and ILD from flightline PESs.

12.46. Aircraft NEWQD. Exclude the following AE when determining the NEWQD of explosives loaded aircraft: AE installed on aircraft (e.g., egress system components, squibs, and detonators for jettisoning external stores, enginestarter cartridges, fire extinguisher cartridges, and destructors in electronic equipment), contained in survival and rescue kits (e.g., flares, signals, explosives components of emergency equipment), and other such items or materials necessary for safe flight operations.

12.47. Explosives Aircraft Exempt from Siting as a PES. Aircraft configured with the items listed below are exempt from QD site planning requirements when evaluated as a PES; site these locations as ESs. This does not include AE carried as cargo. Park in a designated aircraft parking area meeting airfield criteria and treat the aircraft as explosives-loaded in all other respects. The following munitions can be uploaded and downloaded at the designated aircraft parking area provided that the quantity of munitions being loaded or unloaded is limited to a single aircraft load. Munitions delivery trailers (i.e., UALS, BDU, flare & chaff mods, captive-carry missiles) are considered in the transportation mode (QD-exempt) provided the trailers do not remain at the designated aircraft parking area longer than the loading or unloading operation being conducted.

12.47.1. HD 1.2.2 gun ammunition, 30 mm or less.
12.47.2. HD 1.3 installed aircraft defensive flares. Externally loaded munitions such as LUU-1/2 flares and 2.75” training rockets require QD.
12.47.3. HD 1.4 munitions (e.g., chaff squibs, captive-carry training missiles, BDU-33s).
12.47.4. Installed explosives necessary for safe flight operations per paragraph 12.46. See glossary and TO 11A-1-33 for further information.

12.48. Other Aircraft Configurations.

12.48.1. For F-15 and F-16 aircraft in the open with AIM/Air-to-Ground (AGM) series missile configurations as shown in Figures 12.4. and 12.5. use Table 12.1. to determine the type of QD separation required for exposed sites and use Figures 12.4. and 12.5. to determine the actual QD separation distances. For aircraft in a structure, apply building debris criteria IAW paragraph 12.23.1.5. or 12.23.1.6. Exception: Aircraft in fabric or tubular shelters or light metal structures (e.g., butler building), apply the criteria above for aircraft in the open. Other aircraft configurations with mixed missile loads may be requested through MAJCOM/SEW.

Note: These distances are not reduced QD separations; they are only provided to simplify determination of required QD separations for standard aircraft configurations.
12.48.2. Internally loaded aircraft, e.g., F-35 and F-22, produce secondary debris; therefore, building debris criteria must be considered unless otherwise specified.

12.49. Reduced MCEs for F-15, F-16 and F-22 Aircraft with AIM Series Missiles. Testing and analysis have demonstrated an allowable reduction in MCE and QD for some F-15 and F-16 configurations. Use of these reductions is only allowed if no single trailer servicing the aircraft would present an MCE greater than the MCE used to generate the aircraft QD arcs. In most cases, this means that the trailer cannot be loaded with more than the MCE of missiles. Where test results permit, such as in the case of a single layer of AIM-120 missiles loaded in alternating directions on a single trailer, reduced trailer MCEs may be applied. In that specific case, the trailer MCE is a single AIM-120 missile. For F-15 and F-16 aircraft in the open with AIM series missile configurations as shown in Figures 12.6. and 12.7. use Table 12.1. to determine the type of QD separation required for exposed sites and use the following to determine actual QD separation distances: (T-1).

12.49.1. For F-15 aircraft in the open see Figure 12.6.

12.49.2. For F-16 aircraft in the open see Figure 12.7.

12.49.3. For F-22 aircraft in the open with AIM series missile configurations use Table 12.1. to determine the type of QD separation required for exposed sites and use the following to determine actual QD separations distances:

12.49.3.1. Configuration 1, four AIM-120s and two AIM-9s. NEWQD for MCE is 19.0 lbs. The HFD/IBD is 400 feet, PTR is 240 feet, ILD is 48 feet, and IMD is 10 feet. The AIM-9s will always be on stations 3/10 and the AIM-120s can be on stations 4/5 and 8/9 or 5/6 and 7/8.

12.49.3.2. Configuration 2, six AIM-120s and two AIM-9s. NEWQD for MCE is 19.0 lbs. The HFD/IBD is 400 feet, PTR is 240 feet, ILD is 48 feet, and IMD is 10 feet. The AIM-9s will always be on stations 3/10 and the AIM-120s on stations 4/5/6 and 7/8/9.

12.49.3.3. Configuration 3, two AIM-120s and two AIM 9s.

Note: AIM-120s must be AIM-120, Weapon Delivery Unit (WDU)-33/Bs and/or AIM-120, WDU-41/Bs. AIM-9s must be AIM-9L, WDU-17s, and/or AIM-9M, WDU-17s and/or AIM-9Xs.

12.49.4. For F-15, F-16 and F-22 aircraft in fabric or tubular shelters or light metal structures (e.g., butler building), apply the criteria above for aircraft in the open. (T-1).

12.49.5. For any other type of structure, building debris criteria must be considered IAW paragraph 12.23.1.5. or 12.23.1.6. (T-1).

12.50. Hardened Aircraft Shelters (HAS) and Associated AE Facilities.

12.50.1. All HAS, except Korean TAB VEE HAS fronts and Korean Flow-Through HAS fronts and rears, are structures capable of stopping primary fragments when doors are properly secured. HD 1.1 and HD 1.2.3 parenthetical (xx) fragment distances do not apply except out the front of a Korean TAB VEE and out the front or rear of a Korean Flow-Through HAS.

12.50.2. Separate HAS according to Table 12.23. to provide IMD (or equivalent) protection. (T-1). For First, Second, and Third Generation HAS, and Korean TAB VEE Modified (with
hardened front closure) HAS, these distances also provide a high degree of protection against
propagation of explosion when HAS doors are properly secured. However, the exposed
shelter may be damaged heavily and aircraft and AE within may be rendered unserviceable.
For Korean TAB VEE HAS front, and Korean Flow-Through HAS front or rear (due to
openings) at these distances there may be serious damage to aircraft and possible propagation
deletion due to fragments, debris, or fire.

12.50.3. HAS separated according to Table 12.24, (and with HAS doors properly secured)
are provided a higher degree of asset preservation (K30 or equivalent overpressure) than
those provided in Table 12.23. An explosion in one shelter or ready storage facility may
destroy it and its contents, but aircraft within adjacent shelters should be undamaged
provided the doors are closed. These aircraft may not be immediately accessible due to
debris.

12.50.4. Table 12.23. and Table 12.24. criteria are based on First, Second, and Third
Generation HAS doors remaining closed, except for:

12.50.4.1. Aircraft towing, fueling, servicing, run up, taxi and other maintenance
activities requiring temporary periods when HAS doors must be opened IAW AFI 21-
101, Aircraft and Equipment Maintenance Management.

12.50.4.2. During CSO or short periods when maintenance equipment or munitions are
being moved into or out of shelters. If doors are left open for extended periods, apply the
following criteria: (T-1).

12.50.4.2.1. For prevention of simultaneous detonation, apply default IMD to or from
an open front. No reduction from K11 is allowed between “open door” HAS front-to-
front exposures.

12.50.4.2.2. For aircraft survivability apply Table 12.22. to or from an open front.

12.50.5. First Generation and Korean TAB VEE HASs are limited to a maximum NEWQD
of 5,863 lbs. Second Generation, Third Generation, and Korean Flow-Through HASs are
limited to a maximum NEWQD of 11,000 lbs. Flow-Through HAS Pairs are limited to a
maximum NEWQD of 4,800 lbs in each HAS. HAS Pairs with rear walls or with front and
rear walls are limited to a maximum NEWQD of 2,390 lbs in each HAS. HAS Ready
Service ECMs/AGMs are limited to a maximum NEWQD of 22,000 lbs.

Note: W/WS3 HASs are limited to 10,000 lbs IAW AFI 91-112, Safety Rules for US/NATO
Strike Fighters.

12.50.6. Use separation distances of Table 12.25. for separation of unhardened ES from
Third Generation HASs, provided the NEWQD limitation of paragraph 12.50.5. (T-1).
Lesser distances may be permitted to hardened ES that provide equivalent protection, when
approved by DDESB.

12.50.7. Apply Table 12.25. for separation of unhardened ES from Second Generation and
Korean Flow-Through HASs as follows, provided the NEWQD limitations of paragraph
12.50.5. are met: (T-1).

12.50.7.1. To the front, sides, and rear of Second Generation HAS.
12.50.7.2. To the sides of a Korean Flow-Through HAS. For the front and rear, apply default QD criteria.

12.50.8. Apply Table 12.26, for separation of unhardened ES from First Generation and Korean TAB VEE HASs as follows, provided the NEWQD limitations of paragraph 12.50.5, are met: (T-1).

12.50.8.1. To the front, sides, and rear of First Generation HAS.

12.50.8.2. To the sides and rear of a Korean TAB VEE HAS. For the front, apply default QD criteria.

12.50.9. Apply Tables 12.25, or 12.26, for separation of unhardened ES from HAS Pairs, as appropriate, for the HAS Pair design involved. (T-1).

12.50.10. First Generation, Second Generation, Third Generation and Korean TAB VEE HASs sited for HD 1.2, HD 1.3, or HD 1.4 explosives, as shown below, do not generate a QD clear zone out the sides or rear. Korean Flow-Through HASs sited for HD 1.2, HD 1.3, or HD 1.4 explosives, as shown below, do not generate a QD clear zone out the sides. For HAS pairs, apply the requirements for the HAS pair design involved. (T-1). Default QD criteria apply out the front of all HASs, and out the front and rear of Korean Flow-Through HASs.

12.50.10.1. HD 1.2.1, with an MCE less than 110 lbs, and an NEWQD subject to the limitations in paragraph 12.50.5.

12.50.10.2. Mission essential quantities of HD 1.2.2.

12.50.10.3. HD 1.2.3, with a largest single round NEWQD less than 110 lbs and an NEWQD subject to the limitations in paragraph 12.50.5.

12.50.10.4. Mission essential quantities of HD 1.3.

12.50.10.5. Mission essential quantities of HD 1.4.

12.50.11. A HAS used solely as a maintenance facility would normally be classified as a related facility and would require ILD separation from a supported PES (except as permitted for a licensed facility or parking of explosives-loaded aircraft exempt from siting as a PES). As an ES, a First, Second, or Third Generation Maintenance HAS provides K30 equivalent protection at the reduced distances shown in Table 12.24, with doors properly secured. If Table 12.24. is not applied for aircraft survivability, then at a minimum, provide ILD equivalent protection (3.5 psi) to personnel within the maintenance HAS (T-1).

12.50.12. The front, side, or rear sectors of a HAS, as either a PES or an ES, are illustrated in Figure 12.3.

12.50.13. Locate occupied, unhardened facilities no closer to a HAS than those distances given in Tables 12.25, or 12.26. (T-1).

12.51. Weapons Storage Vaults in Hardened Aircraft Shelters. The nuclear weapon contents of a WSV will not contribute to an explosion in a HAS if certain separations are maintained. The explosives in the WSV need not be considered when computing the NEWQD of the HAS if the presence and location of conventional munitions in the HAS correctly conform to what is allowed by the applicable weapons system safety rules (WSSRs), AFI 91-112, Safety Rules for
US/NATO Strike Fighters. Table 12.23 provides minimum separation distances for HASs containing WSVs from all other HASs, with or without WSVs.

12.52. Revetments.

12.52.1. A connected series of such revetments meeting the requirements of Section 6F may be sited for the explosives weight of one revetment.

12.52.2. Site flightline revetment sets for combat aircraft parking and loading as a CAPA according to Tables 12.1., 12.2, and 12.3. (T-1). These revetment sets may be used for both aircraft parking and munitions holding. Aircraft in revetments are afforded equivalent IMD separation. Per Table 12.1., Note 14, two aircraft may be placed in a revetted cell at less than IMD without obtaining Commander approval; total the NEWQD of the two aircraft for determining QD separations to other exposures.

12.52.3. Site flightline revetment sets used for munitions as flightline munitions holding areas according to Tables 12.1., 12.2, and 12.3. (T-1).

12.52.4. Site revetment sets used solely for the storage of munitions as AGMs according to Tables 12.1., 12.2, and 12.3. (T-1).

12.53. Aircraft Battle Damage Repair Sites. The maximum NEWQD charge permitted is two ounces of HD 1.1. When using sandbags to cover charges and prevent fragment escape, a 300 foot clear zone is required. For un-sandbagged charges, a 500 foot clear zone is necessary.

12.54. Helicopter Landing Areas for AE Operations. Helicopter landing areas for loading and unloading AE within storage sites and quick reaction alert sites are considered AGM and may be sited at IMD based only upon the NEWQD carried by the helicopter. The following requirements apply to these helicopter landing areas:

12.54.1. Flight clearance criteria are met.

12.54.2. Landing and takeoff approaches will not be over any AE facilities.

12.54.3. Helicopter operations are to be limited to AE support of the facilities concerned.

12.54.4. Carrying of passengers is not permitted.

12.54.5. During helicopter takeoff, landing, or loading or unloading, AE operations will not be conducted at any PES located within IBD of the helicopter landing area. During landing or takeoff, PES doors will be closed.

12.54.6. Safety precautions normal to other modes of transportation are to be observed.

12.55. Mobile Missile Systems Used in a Static, Defensive Role. Mobile Missile Systems (e.g., Patriot, THAAD, NASAMS) may be deployed in a static (non-mobile) role for the protection of friendly forces and selected geopolitical assets from aerial and missile attack (e.g., main operating base (MOB), airfield, city).

12.55.1. Mobile missile systems in a static role (MMS (SR)) can generate potential hazards to surrounding AE, operations, personnel, and facilities from:

12.55.1.1. The explosion effects produced by an accidental explosion involving the AE associated with missile systems.

12.55.1.2. EMR being emitted by the system (see AFI 91-208).
12.55.1.3. Backblast generated during a launch of a missile, placing nearby facilities at risk of collapse or damage from backblast pressures; windows may break and generate hazardous glass fragments; personnel with backblast distance may be severely injured.

12.55.2. The following explosives safety requirements apply to MMS (SR) and associated support functions.

12.55.2.1. Deploy MMS (SR) IAW their specific, established implementation documentation (e.g., field manual, pamphlet, Standard Operating Procedures (SOP)), to include establishing prescribed exclusionary RF hazard and backblast zones, as applicable. Base safe separation requirements from MMS (SR) and support structures (e.g., support crew and security force structures) on this guidance.

12.55.2.2. Separate individual launcher stations and any re-loads from each other by IMD to minimize QD requirements, but if they are not, then sum the NEWQD for all launcher stations and re-loads together and used as the basis for determining required QD.

12.55.2.3. Site MMS (SR) as AGMs to other PESs in the explosives clear zone where they are deployed. (T-1). Provide IMD between MMS (SR)-related AE and surrounding AE storage. (T-1).

12.55.2.4. MMS(SR) may be treated as flightline Munitions Holding Areas to aircraft in the explosives clear zone where they are deployed. No separation is required to military use only runways and taxiways.

12.55.2.5. MMS(SR) deployed within the IBD of AE storage areas may be sited at ILD to manned functions considered related to area AE operations. Likewise, MMS (SR) deployed within the IBD of AE flightline operations may be sited at ILD to manned flightline support facilities.

12.55.2.6. Those manned functions solely providing support to MMS (SR) operations (e.g., motor pools) may be sited at ILD from the MMS (SR) and other PESs in the explosives clear zone where they are deployed.

12.55.2.7. Provide IBD/PTRD, as appropriate, to personnel not associated with AE operations. (T-1).

12.56. Tactical Missile Separations.

12.56.1. AIM-7 Missiles (Other than Weapon Adapter Unit (WAU)-17 Warhead).

12.56.1.1. When these conditions are met MCE is limited to a single AIM-7 warhead with an HD of (02)1.1.

12.56.1.1.1. Separate warheads of adjacent AIM-7 missiles by 5 inches or more. (T-1).

12.56.1.1.2. Separate AIM-7 warheads from all AIM-9 warheads by at least 22 inches, or ensure warheads are not radially aligned. (T-1).

12.56.1.2. See Table 12.5. for HFD for missiles at less than 5 inches from each other, if they are in the open or in a light structure which cannot stop primary fragments (see Table 12.2. Legend).
12.56.1.3. Containers. All missiles in an AURC will sympathetically detonate; therefore the MCE is all four warheads in the AURC. AIM-7 missiles that explode in an AURC will not propagate to warheads in adjacent containers, either vertically or horizontally. MCE is limited to four warheads.

12.56.1.4. In an ECM, the following configurations allow a reduced MCE:

12.56.1.4.1. Packed in an AURC, the MCE is four warheads.

12.56.1.4.2. For trailers, with or without other AIM-7 (not WAU-17) or AIM-9 missiles, the MCE is the total quantity of all warheads radially aligned and at less than 100 inches from each other.

12.56.2. AIM-7 Missiles (WAU-17 Warhead).

12.56.2.1. These warheads can sympathetically detonate other HD 1.1 explosives in radial alignment of the warhead. Use radial aligned separation distance of 100 inches or more to prevent propagation of one warhead to another. (T-1).

12.56.2.2. See Table 12.5. for HFD for missiles in radial alignment and at less than 100 inches from each other, if they are in the open or in a light structure which cannot stop primary fragments (see Table 12.2, A. through C.).

12.56.2.3. Containers. All missiles in an AURC will sympathetically detonate; therefore the MCE is all four warheads in the AURC (36 lbs x 4 or 144 lbs). Detonation of warheads in an AURC will not transfer to adjacent containers side-by-side, but containers within a single vertical stack must be alternated, nose-to-tail, to prevent propagation vertically. (T-1). MCE would then be four warheads.

12.56.2.4. In an ECM, the following configurations allow a reduced MCE:

12.56.2.4.1. For alternately stack containers (per paragraph 12.56.2.3.) and trailers not in radial alignment, the MCE is four warheads.

12.56.2.4.2. For alternately stacked containers (per paragraph 12.56.2.3.) and no more than three trailers in radial alignment, the MCE is twelve warheads.

12.56.2.5. For ECM storage other than that described in paragraph 12.56.2.4., and storage in all other heavy structures capable of stopping primary fragments, MCE is the total number of warheads in the structure unless a lesser MCE is approved by AFSEC/SEW (see Table 12.2., A. through C.).

12.56.3. AIM-9 Missiles.

12.56.3.1. A warhead detonation will not cause sympathetic detonation of adjacent AIM-9 missiles provided warheads are separated by 22 inches or more, or warheads are not radially aligned. If these conditions are met, MCE is limited to a single AIM-9 warhead.

12.56.3.2. See Table 12.5. for HFD in the open.

12.56.3.3. AIM-9 missiles that detonate in an AURC will not propagate to any adjacent container either vertically or horizontally. MCE is limited to four warheads.

12.56.4. AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM).

12.56.4.1. Out of container, these missiles are HD 1.1. In an AURC, they are HD 1.2.1.
12.56.4.2. MCE is limited to a single AIM-120 missile when the warheads of adjacent AIM-120 missiles are separated by 100 inches or more. See Table 12.5. for single missile HFD.

12.56.4.3. See Table 12.5. for HFD for missiles in radial alignment and at less than 100 inches from each other.

12.56.4.4. Containers. All missiles in an AURC will sympathetically detonate; therefore the MCE is all four warheads in the AURC. For AIM-120s with the WDU-33/B warhead, the AURC MCE is 68 lbs. For AIM-120s with the WDU-41B warhead, the AURC MCE is 76 lbs.

12.56.5. Single container MCEs may be used for mixed storage configurations of AIM-7, AIM-9 and AIM-120 missile containers provided the following conditions are met:

12.56.5.1. Each stack of containers contains the same type of missile and warhead.

12.56.5.2. Each stack is no more than three containers high.

12.56.5.3. For containers of AIM-7 missiles with the WAU-10 warhead: (1) orient the missiles in the same direction within the container, (2) there is no restriction on the orientation of the containers relative to one another within a stack, (3) there is no restriction on the orientation of containers between stacks, and (4) there is no required separation between stacks. (T-1). MCE of the stack(s) is 105 pounds (lbs) of HD 1.1 (based on the four warheads a single container).

12.56.5.4. For containers of AIM-7 missiles with the WAU-17 warhead: (1) orient the missiles in the same direction within the container, (2) the containers within a single stack must be alternated (nose-to-tail), (3) there is no restriction on the orientation of containers between stacks, and (4) there is no required separation between stacks. (T-1). MCE of the stack(s) is 144lbs of HD 1.1 (based on the four warheads in a single container).

12.56.5.5. For containers of AIM-9 missiles with the WDU-17 warhead: (1) there is no restriction on the orientation of the missiles relative to one another within a container, (2) there is no restriction on the orientation of the containers relative to one another within a stack, (3) there is no restriction on the orientation of containers between stacks, and (4) there is no required separation between stacks. MCE of the stack(s) is 36.4 lbs of HD 1.1 (based on the four warheads in a single container).

12.56.5.6. For containers of AIM-120 missiles with the WDU-33/B warhead: (1) orient the missiles in the same direction within the container, (2) there is no restriction on the orientation of the containers relative to one another within a stack, (3) there is no restriction on the orientation of containers between stacks, and (4) there is no required separation distance between stacks. (T-1). The stack(s) is HD 1.2.1 with an MCE of 68 lbs (based on the four missiles in a single container).

12.56.5.7. For containers of AIM-120 missiles with the WDU-41/B warhead: (1) orient the missiles in the same direction within the container, (2) there is no restriction on the orientation of the containers relative to one another within a stack, (3) there is no restriction on the orientation of containers between stacks, and (4) there is no required
separation distance between stacks. (T-1). The stack(s) is HD 1.2.1 with an MCE of 76 lbs (based on the four missiles in a single container).

12.56.5.8. Separate stacks of differing missile and warhead configurations from each other by a horizontal distance of 100 inches (e.g., stacks of AIM-7/WAU-10 containers will be separated by a horizontal distance of 100 inches from stacks of AIM-7/WAU-17 containers). (T-1).

12.56.5.9. When the above conditions are met, the storage of mixed AIM-7, AIM-9 and AIM-120 missile containers (with the specified warheads) may be sited using the most restrictive of the following:

12.56.5.9.1. Site the greatest MCE present as HD 1.1 (regardless of whether the greatest MCE is for HD 1.1 or HD 1.2.1).

12.56.5.9.2. Site the total HD 1.2.1 NEWQD present. (T-1).

12.56.6. AGM-65 Maverick Missiles. Explosives weights of individual AGM-65 missiles or loaded launchers need not be added together if adjacent missiles or launchers are separated by at least 130 inches and the nose of any AGM-65 missile does not point at any other missile.

12.56.7. AGM-88 High-Speed Anti-radiation Missile (HARM). For storage and transportation in an AURC, missiles are assigned HD 1.2.1, with an MCE <100 lbs. Out of container, missiles are assigned HD (04)1.1. A warhead detonation will not cause sympathetic detonation of adjacent warheads if they are separated by at least 6 inches, or if the warheads are not radially aligned.

12.56.8. Mixed Trailer Loads. Use criteria above and configurations as shown in TO 11-1-38, Positioning and Tie-Down Procedures – Nonnuclear Munitions, to determine MCE.


12.57.1. Inspection stations for trucks, trailers and railcars containing AE that are used exclusively for the activities below are not subject to QD criteria. However, these stations must be located as far as practical from other hazards (e.g., explosives, POL), populated areas, and flightlines, and the AE conveyance promptly removed. (T-1). Allowable activities are:

12.57.1.1. External visual inspection of the railcars or trucks containing AE.

12.57.1.2. Visual inspection of the external condition of the cargo packaging in vehicles that have passed the external inspection indicated in paragraph 12.57.1.1.

12.57.1.3. Interchange of trucks, trailers, or railcars containing AE between the common carrier and the DoD activity.

12.57.2. Apply applicable QD criteria if inspection stations are used for any other purpose (e.g., explosives storage, suspect vehicle holding area). (T-1).


12.58.1. Interchange yards for trucks, trailers, and railcars containing AE used exclusively for the activities below are not subject to QD criteria. However, locate these interchange
yards as far as practical from other hazards (e.g., explosives, POL), populated areas, and flightlines, and promptly remove the AE conveyance. (T-1). Allowable activities are:

12.58.1.1. External inspection of the trucks, trailers, or railcars containing AE.

12.58.1.2. Visual inspection of the external condition of the cargo packaging in vehicles that passed the external inspection indicated in paragraph 12.58.1.1.

12.58.1.3. Interchange of trucks, trailers or railcars containing AE between the common carrier and the DoD activity.

12.58.2. Apply applicable QD criteria if truck, trailer, or railcar interchanges are used for any other purpose (e.g., explosives storage, suspect vehicle holding area). (T-1).


12.59.1. Site vehicle and rail holding yards as AGM per Tables 12.1., 12.2. and 12.3. (T-1).

12.59.1.1. Where possible, separate explosives-loaded vehicles and railcars from each other by the applicable IMD. Distances to other exposures are then based on the vehicle and railcar with the largest NEWQD.

12.59.1.2. If IMD between vehicles and railcars cannot be met, park vehicles and railcars in groups, with IMD between each group. Base distances to other exposures on the total amount of explosives within the group of vehicles or railcars with the largest NEWQD.

12.59.1.3. Where paragraph 12.59.1.1. or 12.59.1.2. above is not possible, use the total NEWQD of all vehicles or railcars to determine separation distances.

12.59.2. In addition to the temporary parking of railcars, trucks, or trailers containing AE, holding yards may be used to interchange truck, trailers or railcars between the commercial carrier and the DoD activity, and to conduct visual inspections, but cannot be used simultaneously for these activities.

12.59.3. In developing large rail holding yards, consider the following layout guidance:

12.59.3.1. Design rail holding yards on a unit car or explosives weight group basis (e.g., 50,000, 100,000, or 250,000 net pounds of HD 1.1 explosives, regardless of the number of cars involved). Separate each explosives quantity car group from all other groups by IMD. (T-1).

12.59.3.2. Yards may be formed by two parallel ladder tracks connected by diagonal spurs or by a “Christmas tree” arrangement (a ladder track with diagonal dead-end spurs projecting from each side at alternate intervals). Other arrangements tailored to the operation are allowed. However, separate parallel tracks and spurs of all types by IMD for the quantities of AE involved. (T-1).

12.60. Classification Yards.

12.60.1. Where the volume of vehicle or rail traffic necessitates, establish a classification yard primarily for receiving, classifying, switching, and dispatching explosives-laden vehicles and railcars.

12.60.2. As an ES, site classification yards at IMD from all PESs. (T-1).
12.60.3. Classification yards do not require siting as a PES provided they are used exclusively for:

12.60.3.1. Receiving, dispatching, classifying, and switching of cars.
12.60.3.2. Interchanging of trucks, trailers, or railcars between the common carrier and the DoD activity.
12.60.3.3. Conducting external inspection of vehicles or railcars, or opening of free rolling doors of railcars for the purpose of removing documents and making a visual inspection of the cargo. Freeing or repairing a stuck or damaged door or doing any work inside a car is prohibited unless QD requirements can be met.

12.60.4. Specific QD separation applies if the classification yard is used for any other purpose (e.g., placing or removing dunnage or explosive items into or from vehicles or railcars).

12.61. AE Transportation Mode Change Locations. Site transportation mode change locations as operating locations per Tables 12.1., 12.2. and 12.3. (T-1).

12.62. Suspect Vehicle Holding Areas. Move explosives-loaded vehicles or railcars found or suspected to be in a hazardous condition to a suspect vehicle holding area, unless it is more hazardous to move the vehicle or railcar. Separate suspect vehicle holding areas (isolated) from other PES or ES by the applicable QD treating the holding area as an AGM.

12.63. Secure Holding Areas.

12.63.1. Secure holding areas are designated for the temporary parking of commercial carriers' motor vehicles transporting DoD-owned Arms, Ammunition, and Explosives (AAE), classified (SECRET or CONFIDENTIAL) materials, and Controlled Cryptographic Items (CCI). There are two types of secure holding areas and the criteria for each are provided below. Installations must site secure holding areas to meet known taskings. (T-1). The term Secure Holding Area is applicable to areas (CONUS, Hawaii, Alaska, and Puerto Rico) governed by MIL-STD-882E, Standard Practice for System Safety, and DTR 4500.9-R-Part II.

Note: The intent of secure holding areas is to provide a secure storage location for commercial carriers while in-transit, during emergencies or other circumstances that are beyond a carrier’s control.

12.63.1.1. Secure Explosives Holding Area. Site as a holding yard per paragraph 12.59. (T-1).

12.63.1.2. Secure Non-explosives Holding Area. No siting required if located outside all QD arcs. If located within a QD arc, site at PTRD from all PESs. (T-1). The holding of HD 1.4S materials, without regard to QD, is permitted at this location.

12.63.2. See paragraph 1.5. when there is no Secure Holding Area sited for the NEWQD or HD of the vehicle for unforeseen taskings.
12.64. Detached Loading Docks.

12.64.1. Site detached loading docks that service multiple facilities on the basis of use with regard to the facilities serviced, as shown below. (T-1) Site these loading docks as AGM with regard to all other facilities. (T-1).

12.64.2. When servicing magazines, separate such docks from the magazines by IMD, based only on the explosives limit of the loading dock. (T-1).

12.64.3. When servicing operating buildings, separate such docks from the operating building by ILD, based only on the explosives limit of the loading dock. (T-1).

12.64.4. Loading docks that support a single PES do not require QD separation from the supported PES.


12.65.1. Apply ILD from a service magazine to the operating location it supports. (T-1). No QD separation is required from the supported operating location back to the service magazine. See paragraph 12.12.2.

12.65.2. Site the service magazine as an AGM per Tables 12.1., 12.2. and 12.3. to all PESs that it does not support. (T-1).

12.65.3. Do not use railcars and vehicles as service magazines for explosives operating locations, unless such use is essential.


12.66.1. Reference DoD 5100.76-M, Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives, for parking POVs in an MSA.

12.66.2. Site parking areas not supporting the explosives mission (such as parking lots for administrative areas) as PTR exposures per Tables 12.1., 12.2. and 12.3. (T-1). A minimum 100 foot separation distance is required unless a greater minimum distance is specified in Tables 12.1., 12.2., or 12.3. (T-1).

Note: Motor pools normally require IBD because of office, workshops, and other inhabited buildings.

12.66.3. Site POV, GOV, and powered AGE parking areas supporting PESs a minimum of 100 feet from PESs to protect PESs from vehicle fires. (T-1). The minimum 100-foot separation may be reduced to 50 feet provided the PESs are of non-combustible construction and sufficient measures are in place between the parking spaces and PESs to prevent a parked vehicle or powered AGE from rolling to within 50 feet of PESs (e.g., sloping grade, curbs, vehicle barriers, drainage features). Access for emergency vehicles must be provided. (T-1). The provisions of this paragraph 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.)

12.66.4. Temporary parking of GOVs or AGE, other than those being loaded or unloaded, will not be closer than 25 feet to any PES. (T-1). Temporary means the length of time the presence of the vehicle is essential to completion of a single task (e.g., a single work order number).
12.66.5. Site parking areas used exclusively for non-munitions WRM vehicles at ILD from all PESs. *(T-1)*. A minimum 100-foot separation distance is required. Use PTRD or IBD, when possible, to prevent unacceptable damage to critical war support vehicles and equipment.

**12.67. Inert Storage.**

12.67.1. Unoccupied inert storage facilities that are directly related to the explosives mission, and unoccupied inert storage facilities not directly related but where control of and access to such inert storage is restricted only to personnel directly related to the explosives mission, may be located at fire protection distance from all related PESs (100 feet if the PES structure is combustible; 50 feet if the PES structure is non-combustible). Determine locations for such inert storage facilities only after consideration of personnel exposure, the importance of the materiel in relation to the explosives mission, the operational conditions, and the availability of space.

12.67.2. Site unoccupied inert storage not directly related to the explosives mission and when accessed by personnel not directly related to the explosives mission as a PTR exposure per *Tables 12.1.*, *12.2.* and *12.3.*, when located in the open (no structure involved). *(T-1).* Base the PTRD on blast overpressure only and do not use fragment distances. Locate such inert storage within an explosives clear zone only after consideration of personnel exposure, the importance of the materiel in relation to the mission, the operational conditions, and the availability of space. Minimum fire protection distances given in *paragraph 12.67.1.* apply.

12.67.3. Site unoccupied inert storage not directly related to the explosives mission and when accessed by personnel not directly related to the explosives mission as an inhabited building per *Tables 12.1.*, *12.2.* and *12.3.*, when located in a structure. *(T-1).* Base the IBD on blast overpressure only and do not use fragment distances. Minimum fire protection distances given in *paragraph 12.67.1.* apply.

12.67.4. Site occupied inert storage facilities (e.g., warehouses) supporting the explosives mission as related facilities per *Tables 12.1.*, *12.2.* and *12.3.* from the PESs they support. *(T-1).*

12.67.5. Site occupied inert storage facilities (e.g., warehouses) not supporting the explosives mission as inhabited buildings per *Tables 12.1.*, *12.2.* and *12.3.* *(T-1).*

12.67.6. Site related non-munitions WRM storage at ILD from all PESs. *(T-1).* Use PTRD or IBD, when possible, to prevent unacceptable damage to critical war support assets. See *paragraph 12.67.2.* and *12.67.3.* for non-related unoccupied non-munitions WRM storage.

**12.68. Protective Shielding and Remotely Controlled Operations.** For operations requiring protective shielding or remote control per *paragraph 4.17.*, see *paragraph 7.29.* for operating requirements and apply the following QD separations:

12.68.1. As an ES, treat as an operating location per *Tables 12.1.*, *12.2.* and *12.3.*

12.68.2. As a PES:

12.68.2.1. Provide equivalent PTRD protection for blast and thermal hazards; and equivalent IBD protection for fragment hazards, to related personnel. *(T-1).*

12.68.2.2. Provide IBD to all other non-related occupied ESs. *(T-1).*
12.68.2.3. Treat as an operating location per Tables 12.1., 12.2. and 12.3., for protection of unoccupied ESs; use of Table 12.1., Note 21 is not allowed. (T-1).

12.69. Buffered Storage.

12.69.1. Buffered Storage Concept. Under certain conditions, propagation can be prevented between stacks of tritonal-filled MK-82 and MK-84 bombs. NEWQD for QD purposes is the explosives weight of the largest stack plus explosives weight of intervening buffer material (excluding HD 1.4). Buffered storage can be used for ECMs, AGMs, or open stacks. The following limitations apply:

12.69.1.1. Limit stacks to 64 MK84 or 312 MK82 bombs and limit combined stacks to 60,500 lbs NEWQD. (T-1).

12.69.1.2. Acceptable buffer materials are: palletized 20 mm ammunition, palletized 30mm ammunition, or CBU-58s packaged two per metal container, stacked one pallet wide (one container CBU-58) and as high as the protected stack.

12.69.1.3. Position buffer materials between the two stacks of bombs to prevent line-of-sight exposure between stacks. (T-1).

12.69.1.4. Use steel nose and tail plugs in all bombs. Arrange bombs so the noses of the bombs in each stack are facing the buffer. (T-1).

12.69.1.5. Maintain a minimum of 38 feet between the nearest bombs of the separate stacks. (T-1). For bomb stacks of 24,000 lbs NEWQD or less, 20 feet is acceptable. Arrange the stacks within a structure so access is possible to verify the configuration.

12.69.1.6. Use only serviceable munitions in the bomb stacks or the buffer stacks.

12.69.1.7. Removed buffer material for periodic inspections does not affect sited capacities if returned within 24 hours.

12.69.1.8. Buffered storage is approved for storage in locations where US explosives safety standards are the only criteria applied. In locations where the host-nation has established safety criteria, these principles must be accepted by the host-nation before they may be applied. (T-1).

12.69.2. Units wanting to use different configurations or buffer materials must submit definitive drawings through the MAJCOM to AFSEC/SEW for approval. (T-1). These new buffers will consist of HD 1.2, 1.4, or inert materials that have an aerial density of 500 pounds per square foot. For bomb stacks less than 24,000 lbs NEWQD, an aerial density of 250 pounds per square foot is acceptable.

12.70. Angled Storage.

12.70.1. Angled Storage Concept. Tests have shown that fragments from an exploding MK-82/84 bomb that are capable of initiating a nearby bomb are limited to a zone extending perpendicular to the bomb. Therefore positioning of bombs outside the fragment zone of other bombs may significantly reduce the MCE.

12.70.2. Angled Storage in HASs.
12.70.2.1. Place single bombs and loaded triple ejector racks (TER), or bomb rack units (BRU) at a 15 degree angle along one shelter wall. (T-1). Angle bomb and rack away from the aircraft and point tails toward the wall. (T-1).

12.70.2.2. Maintain 4-foot separation distance from MK-84s to other weapons and 30-inch separation from MK-82s to other weapons. (T-1).

12.70.2.3. Do not align unfuzed cavities of bombs.

12.70.2.4. Install fuzes, boosters, steel nose and tail plugs or guidance packages.

12.70.2.5. Do not place bombs in an area on either side of another bomb bounded by two lines, 20 degrees forward and aft of lines perpendicular to the bomb centerline and starting at the nose and the tail of the bomb, respectively (see Figure 12.8.).

12.70.2.6. If above criteria is complied with, the MCE is the cumulative NEWQD of one TER or BRU, or for single angled bombs, it is the NEWQD of one bomb. When an explosives loaded aircraft is in the HAS, combine the weight of the explosives on the aircraft and the stored weapons if either the weapons on the aircraft or the stored weapons are in the fragment zone, described above, of the other weapons.

12.71. Locations Used for Intentional Burning of HD 1.1, HD 1.2, HD 1.3, or HD 1.4 AE or Static Firing of Motors. Criteria in this section are provided for intentional burns or static motor firing requiring siting per this Manual. The required QD in this section are only based on the AE’s energetic reaction (thermal, blast overpressure, and fragmentation). Treat items that have not been hazard classified IAW with TO 11A-1-47 as HD 1.1 for application of the criteria in this section. The criteria in this section do not consider toxicity, noise, or potential downwind hazards. Therefore, QD may not be the only factor considered when selecting a location for intentional burning or static motor firing. Check environmental compliance and Resource Conservation and Recovery Act (RCRA) requirements and permits for this operation. For overseas locations, check SOFA and applicable technical agreements for any applicable environmental protection requirements.


12.71.1.1. The QD criteria for siting of intentional burns or static motor firing apply from the moment of initiation through the duration of the burning operation. Prior to the actual burning or static motor firing event, operations may proceed using unintentional detonation QD.

12.71.1.2. The criteria in paragraph 12.71. are based on the potential for an unintended transition of a burning reaction to a reaction greater than burning (up to and including detonation of all the explosives present). The key to minimizing the potential for reactions greater than burning is to ensure the depth of explosives (or size of a clock or container of explosives) is limited such that it is insufficient to “confine” the reaction. Minimizing the total amount of explosives being burned at any given time will also minimize the potential damage in the event of a reaction greater than burning.

12.71.1.3. The criteria in paragraph 12.71. do not address the hazards associated with burning AE or static firing of motors inside a structure; the appropriate criteria for these situations must be addressed on a case-by-case basis to determine if the structural...
confinement may increase the potential for a reaction greater than burning, and to address the potential secondary debris hazards.

12.71.2. Protective Construction. Use DDESB-approved protective structures or measures to suppress thermal, blast, or fragment effects to reduce the required Minimum Separation Distance (MSD); see TP-15 for existing designs. (T-1). Use protective construction analyses to reduce the required MSD and submit these analyses with the ESP and demonstrate personnel protection as specified in Section 4F for essential personnel, or protection equivalent to the criteria in paragraph 12.71.6. for non-essential personnel. (T-1). Analyses intended to justify a reduced MSD must consider the actual composition, configuration, properties, characteristics, behaviors, etc., of the material to be burned, and the potential for and severity of reactions greater than burning.

12.71.3. NEW. The criteria in paragraph 12.71. are applied based on NEW versus NEWQD. Use the total NEW present for QD calculations, unless IMD (based on the HD) is met between burning locations. There is no requirement to adjust the NEW to address TNT equivalency. However, if TNT equivalency is addressed, it should be done per paragraphs 12.71.3.1. and 12.71.3.2.

12.71.3.1. Overpressure Calculations. If known, apply TNT equivalencies greater than one to the NEW. Do not use TNT equivalencies of less than one unless supported by data.

12.71.3.2. Fragment Distance Calculations. Make no adjustment for TNT equivalency when determining the HFD IAW paragraph 12.71.6. except when doing an item-specific calculation IAW DDESB TP-16.

12.71.4. Damaged AE. Damaged AE refers to damage that could significantly increase the likelihood of a reaction more severe than burning (i.e., an explosion or detonation) occurring (e.g., cracked propellant in a motor or a damaged motor case, might easily lead to a pressure rupture of the motor case at a minimum). If the condition of an item is unknown, assume it to be damaged. For burning of damaged HD 1.1, HD 1.2 or HD 1.3 AE, or the static firing of damaged HD 1.1 or 1.3 motors, apply the intentional detonation criteria of paragraph 12.72. unless an analysis is provided to show that the AE configuration cannot transition to a reaction greater than burning. (T-1).

12.71.5. Essential Personnel MSD.

12.71.5.1. Use K24 in the QD formula for the NEW to determine the MSD for personnel burning AE. (T-1). The K24 distance only provides protection for blast and thermal hazards per Section 4F. K24 may not provide protection, especially for small NEWs, from fragments or debris from an unintentional reaction, or even from other projections or firebrands generated by the intentional burning. Distances greater than K24 may be required based on the hazards associated with the specific burning operation.

12.71.5.2. For burning of AE in packaging that may produce debris, the non-essential personnel MSD is the unintentional detonation IBD using the NEW (i.e., larger of K24 in the QD formula for overpressure or the HFD using the “Structure” column of Table 12.4.).
12.71.5.3. For burning AE in casing that may produce primary fragments, the non-essential personnel MSD is the unintentional detonation IBD using the NEW (i.e., the larger of K24 in the QD formula for overpressure or the HFD per paragraph 12.23.

12.71.6. Non-Essential Personnel MSD and Non-Related Exposure MSD.

12.71.6.1. Burning of HD 1.1, HD 1.2, HD 1.3 or HD 1.4 AE.

12.71.6.1.1. For burning of bare (i.e., no fragment-producing casing or packaging) AE, the non-essential personnel MSD is K40 in the QD formula using the NEW with a minimum of 75 ft.

12.71.6.1.2. For burning of AE in packaging that may produce debris, the non-essential personnel MSD is the unintentional detonation IBD using the NEW (i.e., larger of K40 in the QD formula for overpressure or the HFD using the “Structure” column of Table 12.4.

12.71.6.1.3. For burning of AE casings that may produce primary fragments, the non-essential personnel MSD is the unintentional detonation IBD using the NEW (i.e., larger of K40 in the QD formula for overpressure or the HFD per paragraph 12.23.)

12.71.7. Static Firing of HD 1.1 or HD 1.3 Motors.

12.71.7.1. For static firing of HD 1.1 or 1.3 motors, the non-essential personnel/non-related exposure MSD is the unintentional detonation IBD (i.e., larger of K40 in the QD formula for overpressure, HFD per paragraph 12.23., or 300 foot minimum distance).

12.71.7.2. For static firing of HD 1.1 or 1.3 motors, the non-essential personnel/related exposure MSD is the larger of K24 in the QD formula for overpressure, HFD per paragraph 12.23., or 300 foot minimum distance.

12.71.7.3. The flame exposure area is 45 degrees on either side of the flame exit nozzle or port. The installation will ensure directional effects from static firing of motors are addressed (e.g., structural analysis of the restraint system/device). (T-1).

12.71.7.4. These distances can be reduced by using DDESB-approved protective structures or measures to suppress thermal, blast or fragment effects per paragraph 12.71.2.

12.71.8. Other Applicable QD.

12.71.8.1. The intentional burning or static motor firing areas/pads/stands will be sited at ILD from other PESs as an AE operating location. (T-1).

12.71.8.2. Locations Used for Intentional Burns or Static Motor Firing.

12.71.8.2.1. Prior to actual burning or static motor firing, site the location as an AE operating location. (T-1).

12.71.8.2.2. During burning or static motor firing, apply non-essential personnel MSD to personnel conducting unrelated AE operations.

12.72. Areas Used for Intentional Detonations. This paragraph does not apply to EOD training sites, off range locations, emergency operations, or range clearance operations where the
expected blast/fragmentation effects does not exceed existing range surface danger zones as defined in AFI 13-212, Range Planning and Operations (see paragraphs 12.74., 12.75.3., and 4.20., as applicable).

12.72.1. Check environmental compliance and Resource Conservation and Recovery Act (RCRA) requirements and permits for this operation. For overseas locations, check SOFA and applicable technical agreements for any applicable environmental protection requirements.

12.72.2. Shaped charge jets or slugs from directed energy munitions can travel significantly greater distances than case fragments; therefore, these munitions require specific analysis. For information on an item, contact the program manager for the munition.

12.72.3. Use the following criteria from the detonation area to all locations involving personnel that are not essential to the planned detonation, non-explosives facilities not related to the detonation, locations with exposed aircraft and open explosives storage locations. If the minimum separation distance requirements for previously approved DDESB sitings or those prescribed in this section cannot be met, provide personnel the protection specified in paragraph 4.17. Note: The calculation of NEWQD for EOD intentional detonations differs from that used for transportation and storage. For intentional detonations, NEWQD can never be less than the NEW; and, TNT equivalency must be factored-in for specific HE being used. Address the NEWQD and TNT equivalent determination for EOD intentional detonation per 60-Series Publications, AFTO 60A-1-1-4, Protection of Personnel and Property, and EOD Tactical Decision Aid.

12.72.3.1. For non-fragmenting AE, use K328 with a minimum distance of 200 feet. (T-1).

12.72.3.2. For fragmenting AE, use the larger of the two distances given in paragraphs 12.74.3.2.1. and 12.74.3.2.2. (T-1).

12.72.3.2.1. K328 with a minimum distance of 200 feet.

12.72.3.2.2. The distances given in Table 12.27. or Table 12.28. As calculated (using DDESB Technical Paper 16) or measured maximum fragment throw distance (including the interaction effects for stacks of items or single items, whichever applies) may also be used to replace these distances. Calculated case fragment maximum throw distances for selected munitions are listed in the Fragmentation Data Review Form located on the DDESB secure web page. This database is included in TP 16.

Note: Tables 12.27. and 12.28. as well as the Fragmentation Data Review Form in TP 16, are for individual items. These distances do not directly apply to stacks of munitions. Further, these throw distances do not consider fragments that are produced by sections of nose plugs, base plates, boattails, or lugs. These fragments are sometimes referred to as “rogue” fragments. In addition, shaped charge jets or slugs from directed energy munitions can travel significantly greater distances than case fragments; therefore, these munitions require specific analysis.

12.72.3.2.2.1. “Rogue” fragments produced by sections of nose plugs, base plates, or lugs, etc. can travel significantly greater distances (more than 10,000
feet) than those shown in Tables 12.27 and 12.28. Take care to properly orient the munition (e.g., lugs or strongbacks and nose or tail plate sections oriented away from personnel locations) or to minimize or eliminate the hazard of rogue fragments (e.g., sand bagging the munition prior to detonation, or removing components). For such bombs and projectiles with a caliber exceeding five inches, bury or cover the munition according to the Buried Explosion Module procedures outlined in DDESB TP 16. (T-1).

12.72.3.2.2.2. For detonation of multiple munitions, comply with the following unless an approved technical order alternative is authorized (EOD will use Joint Service 60 Series EOD manuals): (T-1).

12.72.3.2.2.2.1. Place the munitions in a single layer with their sides touching such that their axis is horizontal.

12.72.3.2.2.2.2. Place the munitions so that the nose of each munition is pointing in the same direction.

12.72.3.2.2.2.3. Orient the munitions so that lugs or strongbacks and nose or tail plate sections are facing away from areas to be protected.

12.72.3.2.2.2.4. Initiate the stack detonation so that all munitions detonate simultaneously.

12.72.3.2.2.2.5. Use the following when the procedures outlined in paragraphs 12.72.3.2.2.2.1. through 12.72.3.2.2.2.4. cannot be met: (T-1).

12.72.3.2.2.2.5.1. If the orientation of the potential rogue fragments can be controlled, then increase the separation distance required by the Fragmentation Data Review Form in TP 16 by 33 percent to account for the interaction effects and/or non-design mode initiation.

12.72.3.2.2.2.5.2. If the orientation of potential rogue fragments cannot be controlled, evaluate fragment ranges on a case-by-case basis.

12.72.3.2.2.2.5.3. If detonations involve stacks of mixed munitions, evaluate the distance for each munition separately using the procedures in paragraph 12.72.3.2.2. and select the largest distance.

12.72.4. Use the following criteria from the detonation area to all locations involving essential personnel, explosives storage facilities, and aboveground utilities: (T-1).

12.72.4.1. Use K105 and provide a personnel shelter that offers adequate overhead and frontal protection capable of defeating all potential fragments. If no personnel shelter is used, provide all essential and non-essential personnel protection IAW paragraph 12.72.3. Use AFTO 60A-1-1-4 to determine personnel protection for essential personnel involved in EOD operations.

12.72.4.2. If the essential personnel protection distance in paragraph 12.72.4.1. is not available, construct a personnel shelter that provides equivalent protection from the expected blast overpressure and fragment hazards for the types of munitions used. Obtain shelter design approval per paragraph 12.72.4.7.
12.72.4.3. On-site authorities, with advice from EOD, designate essential personnel and determine minimum distance for equipment and unoccupied non-explosives facilities related to the detonation.

12.72.4.4. From the detonation area to underground utilities, use K18 with a minimum distance of 100 feet.

12.72.4.5. Apply ILD separation from other PESs based on the PES’s NEWQD to control sites used for AE disposals, live-fire demonstrations and EOD non-emergency intentional detonations.

12.72.4.6. Holding Pads. Separate holding pads for additional shots using aboveground magazine criteria. Maintain ILD to the destruction point and to the personnel control site based on the NEWQD of the holding pad. In addition, maintain IMD between each holding pad.

12.72.4.7. Use shorter distances if equivalent protection is provided. Forward design and analysis information for equivalent protection to AFSEC/SEW for approval.

12.73. EOD Operational Responses. EOD operational responses require the application of public withdrawal distances to all non-essential personnel per paragraphs 10.11. and 10.12.

12.74. EOD Proficiency Training Ranges

12.74.1. Limit demolition explosives on EOD proficiency training ranges to a maximum of five lbs. (T-1). Use only non-fragmenting charges (e.g., Boot Banger, bare C-4, Conical Liquid Follow Through), shaped charges (e.g., Mk 7 series, Mk 2, flex linear), ordnance penetrators (e.g., Mk 23, Mk 24), explosive powered tools (e.g., Mk-2 dearmer, Percussion Actuated Non-electric Disruptor), and inert mild steel targets on training ranges. (T-1). Place a minimum of three sand bags in front of explosive penetrators to capture explosively formed penetrators and limit directional forces. (T-1).

12.74.2. Construct EOD proficiency training range destruction points to control ejection of debris by:

12.74.2.1. Constructing a barricade with two entrances surrounding the destruction point that is the equivalent of at least two side-to-side sandbags, is at least six feet high, and is constructed within 10 feet of the destruction point. (T-1).

12.74.2.2. Locating the barricade entrances at 180 degrees separation. Barricade these entrances, as described above, to effectively block all debris. (T-1).

12.74.3. Use the following criteria from the destruction point to all aboveground facilities (including PTRs, base boundaries, runways, taxiways, parking aprons and any PES except for associated holding pads as discussed in paragraph 12.74.8. below): (T-1).

12.74.3.1. If the destruction point is at least 500 feet from these facilities, limit demolition explosives to five lbs.

12.74.3.2. If the destruction point is less than 500 feet but 300 feet or more from these facilities, limit demolition explosives to 2.5 lbs.

12.74.3.3. If the destruction point is less than 300 feet but 200 feet or more from these facilities, limit demolition explosives to 1.25 lbs.
12.74.4. Only use explosively-operated tool kits and explosively-driven IED defeat charges on inert targets at EOD proficiency training ranges. (T-1). Targets may be “monitored” by non-fragmenting explosive charges that are within parameters of the established range. The tools, charges, and targets all require 100-foot separation distance from the destruction point to all aboveground facilities. Barricade the destruction point per paragraph 12.74.2. (T-1).

12.74.4.1. EOD tools (explosives devices) and inert training devices or targets are non-fragmentation producing devices. They may produce some debris, but should not be mistaken for fragmentation. Fragmentation is specifically designed into a weapon or device; whereas debris is not.

12.74.4.2. Vehicle-targets (for remote-opening techniques or otherwise checking for IEDs) on EOD proficiency ranges is standard practice. EOD teams are allowed to do this type of training on their proficiency ranges.

12.74.5. Only permit Explosively-Driven Water Tools (EDWT) operations at EOD proficiency training ranges provided the reduced QD given in the next paragraph remains within the established QD for that specific range. (T-1).

12.74.5.1. The approved list of EDWT includes Mineral Water Bottle (MWB), Hydra-Jet, Big Mike, Bottler, Boot Banger, Vantreppan, MLVD, Aqua Ram, and Exit Charge.

12.74.5.2. EDWT QD is determined using the equation \( QD = 328 \times NEW^{1/3} \), subject to a 100-foot minimum distance. When calculating the NEW, do not include the explosive weight of the main charge initiation chain (i.e., blasting caps, detonation cord, time fuze, shock tube, etc.). However, some EDWT use the detonation cord as the main water-propulsion charge, and in those cases, consider the NEW of that detonation cord in determining EDWT NEW and appropriate QD.

12.74.6. On-site authorities determine the minimum separation distance for essential personnel.

12.74.7. EOD proficiency training ranges used with other than bare charges or non-fragment producing items will meet the requirements of paragraph 12.72. (T-1). If using the training range for operations that will produce fragments above the level expected for normal EOD proficiency training (normally open shots), meet the requirements of paragraph 12.72. (T-1).

12.74.8. If the proficiency training range is located on an existing disposal range and meets the 500-foot separation distance from the detonation point to the perimeter of the disposal range IAW the requirements listed in AFI 32-3001, then barricades identified in paragraph 12.74.2. are not required.

12.74.9. Holding pads. Site holding pads for additional training shots using AGM criteria. (T-1). Maintain ILD to the destruction point and to the personnel control site. (T-1). In addition, maintain IMD between each holding pad. (T-1).

12.74.10. Locate control sites and detonation points at PTRD from all other PESs. (T-1).
12.75. EOD Training at Off-Range Locations and Outside Agency Collaboration Activities.

12.75.1. EOD personnel may use procedures with explosively propelled liquids, shots, gases, slugs, or heat against inert training munitions and soft targets at off-range locations on military installations in support of unit training, inspections, and evaluations.

12.75.2. EOD teams may use MK 1 Remote Wrenches, MK 2 .50 de-Armers, Field Fabricated de-Armers, Robotic Vehicles, Stand-off Disrupters, Stand-off De-Armers, Percussion Actuated Neutralizers (PAN), and Carbon 10 Disrupters for training.

12.75.3. Use EOD 60-series or applicable publications to calculate appropriate standoff distances for EOD training and operations at off-range locations. (T-1). Use only the explosives items listed below for off-range unit training, inspection and evaluation operations: (T-1).

12.75.3.1. Two .50 caliber impulse cartridges.
12.75.3.2. Two .50 caliber ball, M2 cartridges (projectile extracted).
12.75.3.3. Two electric or non-electric blasting caps.
12.75.3.4. Two 10 foot lengths of standard detonating cord (DODIC M456).
12.75.3.5. Thirteen feet of safety fuse.
12.75.3.6. Three M60 or M81 fuse lighters.
12.75.3.7. Three AN-M14 thermite grenades.
12.75.3.8. Shock Tube as required.
12.75.3.9. Igniters (Shock Tube Initiators, DODIC YY35) as required.
12.75.3.10. Five each, PAN Cartridges.

Note: Quantities listed here are the maximums authorized for each inspection or evaluation scenario.

12.75.4. Under the following conditions, EOD personnel may conduct off-range operations using the tools and explosives described in paragraphs 12.75.2. and 12.75.3.

12.75.4.1. Notify installation weapons safety office with the specific location, prior to the operation. (T-1).
12.75.4.2. Make proper notifications concerning anticipated noise. (T-1).
12.75.4.3. Do not locate the operation in an explosives prohibited zone. (T-1).
12.75.4.4. Evacuate non-essential personnel to the applicable withdrawal distances required for an actual situation. (T-1).
12.75.4.5. Place a minimum of three filled sand bags in front and behind tools that project slugs, fluids or shot to limit directional force unless fired from the robot. (T-1). Tools fired from robots only require three filled sand bags in front of the tool.
12.75.4.6. Use only slugs made of plaster that disintegrate on impact. (T-1).
12.75.4.7. Select an area free of all fire hazards and use only inert training ordnance or IED concealment devices as a target (see paragraph 12.74.4.).

12.75.4.8. When operating tool sets inside a building, take positive measures to prevent secondary or collateral damage. (T-1).

12.75.5. EOD Training off-range at off-base (law enforcement or international partner operated) locations with local, state and federal agencies or other international partners. Under the auspices of DoD Directives 3025.18, Defense Support to Civil Authorities and 1100.20, Support and Services for Eligible Organizations and Activities Outside the DoD, provide this guidance to facilitate open discussions and training for “Immediate Response” situations involving the mitigation of IED or military munitions. In these situations, the following minimum requirements apply:

12.75.5.1. EOD Leadership will complete a risk assessment of the lesson plans and training area to ensure all Air Force explosives safety standards have been addressed and/or mitigated. (T-1). As a minimum, coordinate these items with SEW, JA, and PA.

12.75.5.2. Obtain approval of an official participation request from the installation Commander or designated representative. (T-1). Include risk assessment, training objectives, time, place, Hazard Division of explosives used, method of initiation, and any other performance factors from the hosting local, state and federal agency or other international partners in the request.

12.75.5.3. The EOD Team Leader or designated representative will maintain EOD team integrity and ensure personnel safety at civil law enforcement operated locations. (T-1).

12.75.6. EOD Training On-Base with local, State and Federal agencies. Limit on-base training with local, state and federal agencies or other international partners to participation of EOD procedures.

12.75.6.1. The appropriate essential or non-essential personnel principles will be applied during explosive demonstrations. Conversely, training with civil law enforcement explosives are not authorized for detonation on base unless their munitions meet established DoD standards and the requirements of paragraph 7.26.

12.75.6.2. Obtain approval of an official participation request from the installation Commander or designated representative. (T-1). Include training objectives, time, place, Hazard Division, method of initiation, and any other performance factors.

12.76. Training in Explosives Entry Techniques. Explosives entry techniques are used in special missions where assault personnel require immediate access to the target. Siting is not required for training in explosives entry techniques at locations where the expected blast/fragmentation effects does not exceed existing range surface danger zones as defined in AFI 13-212. Site all explosives entry techniques training locations that are not managed per AFI 13-212. (T-1).

12.76.1. Essential personnel MSD. Use approved explosives entry techniques technical procedures to determine personnel protection for essential personnel involved in explosive entry technique training.

12.76.2. Non-essential Personnel MSD. The MSD for non-essential personnel is K328 with a minimum distance of 200 feet. The 200 foot minimum distance can be eliminated when a
protective barrier is provided that can contain, or absorb all fragments (this may include the training structure itself when breaching into the interior of the structure).

12.77. Military Working Dog (MWD) Explosives Search Training. Training of MWD involves searches to detect explosives that have been hidden in various public places. These training operations typically include handling explosives, cutting or dividing explosive training aids, removing explosives from shipping and storage containers, and repackaging explosives into other containers. For these reasons, training operations will: (T-1).

12.77.1. Be conducted by qualified personnel.
12.77.2. Be conducted in facilities that meet the requirements of this Manual.
12.77.3. Store explosives in facilities that meet the requirements of this Manual.
12.77.4. Provide non-essential personnel a K40 separation distance from the training site if more than 15 lbs NEWQD is being used for the exercise and a 100 foot separation distance from the training site if less than or equal to 15 lbs NEWQD is being used.

12.77.5. Minimize the number of samples and the quantity of explosives for each sample. On-site authorities will determine the total quantity of explosives permitted during an exercise considering:

12.77.5.1. The value and importance of the exposed facilities.
12.77.5.2. The exercise operating conditions.
12.77.5.3. The available separation distance for non-essential personnel.
12.77.6. Separate samples a sufficient distance apart to prevent an explosion from propagating from one sample to another.
12.77.7. Not use any initiating devices or initiating explosives.
12.77.8. Not place explosives near any heat or spark producing items (e.g., bare electrical wiring, radiators, electric heaters, heating vents, etc.).
12.77.9. Not place explosives in metal containers or other means of confinement that could produce fragments in the event of an accidental explosion.

12.78. Demilitarization Operations for Expended .50-Caliber and Smaller Cartridge Casings.

12.78.1. Treat a demilitarization operation for processing expended .50-caliber and smaller cartridge cases as a non-explosive operation provided: (T-1).

12.78.1.1. Cartridge casings to be processed are screened prior to processing.

Note: Screening is intended to ensure that only .50-caliber and smaller cartridges are processed, and to remove unused .50-caliber and smaller cartridges.

12.78.1.2. Demilitarization processing equipment is tested to be capable of containing overpressure, fragment, and thermal hazards associated with a worst-case reaction involving a single live round of the most energetic cartridge that could be processed in the equipment.
12.78.1.3. Demilitarization processing equipment is operated within the manufacturer's specifications and restricted only to the processing of expended .50-caliber and smaller cartridge casings.

12.78.1.4. Demilitarization processing equipment is inspected and maintained to ensure safe operation.

12.78.2. MAJCOMs will:

12.78.2.1. Approve the use of specific demilitarization processing equipment.

12.78.2.2. Establish and implement procedures for:
   12.78.2.2.1. Screening and segregating the material to be processed.
   12.78.2.2.2. Operating, inspecting, and maintaining the demilitarization processing equipment to ensure safe operation.
   12.78.2.2.3. Dispositioning of processed material.

12.78.3. Demilitarization processing operation locations meeting the requirements of paragraphs 12.78.1. and 12.78.2. do not require siting as a PES. As an ES, locate at ILD from all PESs, except from the PES where it is integral.

12.79. POL and Other Hazardous Materials.

12.79.1. Separate unprotected, aboveground bulk storage tanks (> 5,000 gallons) for hazardous materials (e.g., POL, liquid petroleum) from all PESs by IBD. (T-1). A dike system satisfying NFPA 430, Code for the Storage of Liquid and Solid Oxidizers is required. (T-1). Site aboveground storage tanks, that are provided protection against rupture or collapse from blast and fragment hazards, at lesser distances when supported by testing or analysis. (T-1).

12.79.2. Separate smaller unprotected, aboveground bulk storage tanks (< 5,000 gallons) from all PESs IAW paragraph 12.79.1. (T-1). When these criteria cannot be met, weigh the cost of distance or protective construction against the strategic value of the stored material, the ease of replacement in the event of an accident, and the potential environmental impact. Approve reduced distances if the responsible Commander accepts the possible loss of the tanks and any collateral damage that a fire might cause as a result of the tanks being punctured by fragments. (T-1).

12.79.3. Separate railroad tank car and transfer points or operations, tank trucks, POL transmission pipelines, and hydrants from all PESs by IBD. (T-1). Separate fuel truck transfer points or operations by PTRD, with no minimum fragment distance, if the trucks are limited to less than 48 hours at the location. (T-1).

12.79.4. Site unprotected, aboveground service tanks, to include fuel bladders, solely supporting AE storage or operating complexes that are supplied by a pipe system designed to resist blast and fragments at incremental IBD with a minimum distance of 400 feet from supported PESs provided: (T-1).
   12.79.4.1. Equip aboveground lines, if used, with automatic shut-off valves at the source.
   12.79.4.2. A dike system meeting the requirements of NFPA 430 is provided.
12.79.4.3. Responsible Commander accepts the possible loss of the tanks and any collateral damage that a fire might cause as a result of the tanks being punctured by fragments. (T-1).

12.79.5. A service tank (above or below ground) supporting a single PES or ES within an explosive clear zone does not require QD but will comply with NFPA 30. (T-1).

12.79.6. Small quantities of POL or other hazardous materials used for operational purposes require no specific separation distance for explosives safety; however, separate these materials as required by NFPA 30 or 50’, whichever is greater. (T-1). An example of this facility type would be small lockers used to store operational quantities of POL and other flammable materials in support of a single PES/ES. Implement operating procedures to limit adverse environmental impacts in the event of an accidental explosion. (T-1). This criteria does not apply to small daily use storage lockers located in operating environments.

12.79.7. Separate parking areas for fuel service trucks by ILD with a minimum of 100 feet from related PESs, and IBD from unrelated PESs. (T-1).

12.79.8. Site fixed refueling points at ILD with a 100-foot minimum from all related PESs (e.g., a remote, unmanned self-service station commonly located in a MSAs and flightline AGE shop). (T-1).

12.79.9. There must be at least 100 feet between explosives and any mobile petroleum dispensing unit operating in an explosives area, except where a shorter distance is needed during transfer operations to an underground tank located at less than 100 feet or where needed to refuel a mobile explosives transporter (such as the environmental control unit for the LGM-30) with the explosives load aboard.

12.79.10. Separate buried tanks and buried pipelines from all PESs containing HD 1.2, HD 1.3, HD 1.4, or HD 1.6 AE by at least 80 feet. (T-1). The required separation distance for HD 1.1 or HD 1.5 AE is K3 with a minimum distance of 80 feet. (T-1). Keep pumps and pump houses serving underground POL at least 50 feet from all PESs. (T-1). If the PES is designed to contain the effects of an explosion, then no QD is required.

12.79.11. Consider cut and cover POL tanks as underground if they have at least three feet of earth cover (five feet is recommended if the PES exposing the tank could generate large secondary debris fragments) are sited at K3. Unmanned cut and cover support facilities require ILD from all PES’s. (T-1).

12.79.12. Exempt the following from QD requirements:

- 12.79.12.1. Explosives loaded aircraft to POL hydrants set on the flightline flush with the pavement.
- 12.79.12.2. AE to in use material-handling equipment.
- 12.79.12.3. Licensed locations to POL facilities.


12.80.1. Separate unprotected aboveground storage tanks and towers, whose loss is unacceptable, from all PESs by IBD (see paragraph 10.24.). (T-1). Site aboveground storage tanks, that are provided protection against rupture or collapse from blast and fragment hazards, at lesser distances when supported by testing or analysis. (T-1).
12.80.2. QD criteria do not apply to storage tanks and associated components if loss is acceptable to the responsible Commander.

12.81. Underground Tanks or Pipelines for Water and Other Non-Hazardous Materials. Underground tanks or pipelines for non-hazardous materials whose loss is unacceptable, will meet the siting requirements of paragraph 12.79.10. (T-1). QD criteria do not apply if loss is acceptable to the responsible Commander.

12.82. Utilities and Services.

12.82.1. Utilities include steam, water, natural gas, POL lines, sewage, air lines, electrical lines, communication lines, and environmental facilities or equipment. The term “utility” does not apply to services provided to individual or grouped explosives facilities when that service is not also secondarily provided to other parts of the installation or community. The following requirements apply to utilities:

12.82.1.1. Do not locate aboveground electric distribution lines carrying less than 69 kilovolt (kV), the tower or poles supporting those lines, communication lines, and unmanned electrical substations closer to PESs than PTRD, with no minimum fragment distance. (T-1).

12.82.1.2. Do not locate aboveground electric transmission lines carrying 69 kV or more and the tower or poles supporting them closer to PESs than: (T-1).

12.82.1.2.1. IBD, with no minimum fragment distance, if the line in question is part of a grid system serving a large off-base area.

12.82.1.2.2. PTRD, with no minimum fragment distance, if loss of the line will not create serious social or economic hardships.

12.82.1.3. Separate aboveground electric transmission/distribution lines can be interrupted without loss of power (i.e., power is rerouted through existing lines or networks) from explosives sites IAW paragraph 12.82.2.

12.82.1.4. Do not locate utilities that provide vital functions to a major portion of an installation closer to PESs than IBD.

12.82.1.5. Do not locate power and utilities functions, including power plants, compressor stations, and electric power transformers that serve an entire base complex; or when loss of the facility will cause an immediate loss of vital function, closer to PESs than IBD. (T-1).

12.82.1.6. Site underground electrical and communications lines at K3 with no minimum distance required. (T-1). Other underground utilities will meet the siting requirements of paragraph 12.79.10. (T-1).

12.82.2. Do not locate overhead electric service lines (running past an explosives facility but not serving it) closer to a combustible explosives facility or to an open explosives facility than the length of the electric lines between the nearest service poles and the length of the nearest service pole. An exception is when an effective means (e.g., line spacers, weights, etc.) is provided to ensure that energized lines on breaking cannot come into contact with the facility or its appurtenances. No separation is required for non-combustible facilities.
12.82.3. Locate manned auxiliary services, including auxiliary power plants, compressor stations, and electric power transformers, at ILD from PESs they support. (T-1).

12.82.4. Locate unmanned auxiliary services (e.g., transformer stations, water treatment and pollution abatement facilities) that serve an explosives area, but are not an integral function in the explosives area, and that would not create an immediate secondary hazard if lost, at barricaded ILD from the PESs they support, even though such services need not be barricaded. (T-1).

12.82.5. Locate unmanned auxiliary service power generation or conversion facilities (e.g., power plants, transformers, etc.) that exclusively supply power to an explosives area or security fence lighting at fire protection distance (50 feet for non-combustible ES structures, 100 feet for combustible ES structures) from all PESs in the supported explosives area. (T-1).

12.82.6. Locate unmanned aboveground utility services (e.g., water treatment, pollution abatement facilities, water pump stations, sewage lift stations, etc.) that do not serve an explosives area or an entire base complex, and when loss will not cause an immediate loss of a vital function at IBD with no minimum fragment distance. (T-1).

12.82.7. See paragraph 5.9. for design requirements for electrical lines serving a PES.

12.82.8. Renewable Energy Projects. Do not locate equipment installed for the purpose of generating renewable energy, such as wind turbines and solar panel farms, closer to PESs than PTRD. (T-1). In addition, associated power lines must meet the requirements of paragraph 12.82.1. and associated inhabited structures and be no closer than IBD. (T-1).

12.82.8.1. Submitted ESPs must identify the energy customer and the equipment owner (e.g., USAF, commercial power company) and include a risk acknowledgement from the equipment owner for potential damage to equipment and power disruption in the event of an explosives accident. (T-1).

12.82.8.2. These requirements do not apply to individual solar generated power units for lighting, security systems and building energy reduction systems provided the electrical requirements contained in Chapter 5 are met and approved by civil engineering.

12.82.8.3. This equipment must have a full EMR assessment IAW AFI 91-208. (T-1).

12.83. LGM-30 (Minuteman). Use Table 12.27. to determine HE equivalency for the LGM-30 missile when calculating QD separations.

12.83.1. Calculate NEWQD for motor sets (Stages I, II, and III), assembled or unassembled, with HD 1.1 material, on HD 1.1 equivalency basis unless the HD 1.3 hazard is greater. (T-1).

12.83.2. When only HD 1.3 motors are present, use total NEWQD of the motors, and apply HD 1.3 QD criteria. (T-1). For LGM-30G motors use HD 1.3 QD criteria for shipping and storage purposes. (T-1). When a warhead is added to the assembled set, the 7,400-lb HE equivalency applies. Safety distances are based on 7,400 lbs HD 1.1 HE equivalency for all LGM-30 missile motor sets (models A through G) with or without a warhead installed. The IBD zone based on 7,400 lbs HD 1.1 is 1,200 feet measured from the center of the launch facility silo.
12.83.3. Separations for aircraft loading and unloading sites for solid propellant motors in shipping and storage containers. Storage, Shipping Container Ballistic Missile (SSCBM) and Payload Transporter Container: IBD is 1,200 feet (includes missile holding pads, facilities, aircraft or other equipment essential to the mission of the base); PTRD is 720 feet.

12.83.4. Aircraft Loading and Unloading Sites. When an aircraft loaded with these motors must be refueled, a fully staffed firefighting truck will be on standby at the aircraft during fueling operations. (T-1).

12.83.5. Railroad Loading and Unloading Sites. Criteria in paragraph 8.54, apply to railroad loading and unloading sites for Minuteman missile motors in the SSCBM and missile transporters shipped by the “piggyback” method.

12.83.6. Missile Alert Facility (MAF). Explosives-loaded vehicles (e.g., payload transporter, reentry vehicle guidance and control van, transporter erector) may be temporarily parked at the MAF, subject to the following controls:

12.83.6.1. The wing or installation Commander or his designated representative must approve each instance. (T-1).

12.83.6.2. Allow parking, if needed, for severe weather, equipment breakdown and repair, crew rest, darkness (where state law prohibits vehicle travel on highways after dark) or other emergency conditions.

12.83.6.3. No smoking outside missile alert facility support buildings.

12.83.6.4. Park only one explosives-loaded vehicle.

12.83.6.5. Publish a detailed operating instruction of safety precautions and controls.

12.83.6.6. Ensure required security is maintained.

12.84. LGM-118 (Peacekeeper). Use Table 12.30, to determine high explosives equivalency for the LGM-118 missile when calculating QD separations. (T-1).

12.84.1. Peacekeeper Separation. General explosives safety standards and QD criteria apply to the Peacekeeper except as follows: when stages 1, 2, and 3 are assembled at other than a silo launch facility (with or without stage 4 warheads being attached), the net explosives equivalency for the missile is 203,412 lbs (HD 1.1).

12.84.2. When the missile is in a silo launch facility or during missile installation or removal from the silo, the net explosives equivalency is 20,000 lbs (HD 1.1). Use this equivalency only for calculating IMD and ILD separations, and for use in risk assessments based on blast overpressure. Applicable distance for PTRD is 1,050 feet and for IBD is 1,750 feet.

12.85. Inter-DoD Component Support and Tactical Facilities.


12.85.1.1. Apply the separation distances in paragraph 12.85.2, between facilities of one DoD Component to those of another DoD Component regardless of the location of the boundaries. (T-1).

12.85.1.2. Other safety criteria (e.g., toxicity, noise, radiation, flight trajectory, etc.) may require greater distances. In these situations, the predominant hazard criteria apply.
12.85.2. The following minimum QD relationships apply: (T-1).

12.85.2.1. Separate AE storage facilities by IMD. (T-1).

12.85.2.2. Separate AE storage or operating locations of one DoD Component from AE operating locations of another DoD Component by IBD (See paragraph 12.85.2.3. for an exception to this criteria.). (T-1).

12.85.2.3. Separate explosive operations that present a similar degree of hazard or involve joint or support operations by ILD. (T-1).

12.85.2.4. Separate AE storage or operating locations of one DoD Component from AE tactical facilities of another DoD Component by IBD. (T-1). For joint or support operations, determine the separation distance as though both facilities belonged to a single DoD Component.

12.86. Criteria for non-DoD Explosives Activities on DoD Installations.

12.86.1. Conduct only non-DoD explosives activities on DoD property per Table 12.31. These non-DoD explosives activities must also comply with Bureau of Alcohol, Tobacco, and Firearms (BATF), Federal Aviation Administration (FAA), and other Federal, State, and local regulations. Definitions for the terminology used in Table 12.31. can be found in Attachment 1.

12.86.2. For these types of non-DoD explosives activities, DoD is only responsible for ensuring that IMD requirements, as outlined in ESP submissions, are met. DoD oversight of these non-DoD explosives activities is not intended.

12.86.3. Evaluate non-DoD, explosives activities based on IMD between multiple PESs to ensure non-propagation. (T-1). Where IMD is not met, add non-DoD explosives activity's sites to determine the applicable IMD or IBD to DoD sites.

12.86.4. In Table 12.31., “Check for IMD” means if IMD is not maintained between each PES, total all explosives quantities.

12.86.5. Determine IBD based on the requirements in this Manual.

12.86.6. Limit DoD site approval for non-DoD explosives activities to the area encumbered by the IBD arcs.

12.86.7. Review of building design, LPS, etc., is not necessary unless design features are used as justification to reduce the IBD arc.

12.87. Basic Load Ammunition Holding Area/Ammunition Holding Area Criteria (BLAHA/AHA).

12.87.1. BLAHA/AHA Introduction. To fulfill their missions, certain units must keep their basic load ammunition in armored vehicles, trucks, trailers, and structures or on pads. This involves an acceptance of greater risks to unit personnel, facilities, and equipment than permitted by other parts of this Manual. Storage compatibility requirements of Section 7J apply to BLAHA/AHA operations:

12.87.2. NEWQD computations must be IAW Section 12C. (T-1).
12.87.2.1. The maximum NEWQD at any BLAHA/AHA cell storing mixed compatibility must not exceed 8,818lbs. (T-1). A BLAHA/AHA may have multiple 8,818-lb cells, provided the cells are separated from each other by the applicable distances (D1, D2, and D3) given in Table 12.35 and Chapter 8.

12.87.2.2. When the NEWQD of a BLAHA/AHA cell exceeds 8,818lbs, the QD computations for the site must be IAW Chapter 12, the HD mixing rules must be IAW Section 12C, and the explosives compatibility storage criteria must be IAW Section 7J. (T-1).

12.87.3. QD Computations.

12.87.3.1. Use the total NEWQD of AE in each cell for computation of QD provided the required distances of Table 12.35 are met, to prevent prompt propagation between cells. (T-1). If the 8,818lbs NEWQD limit or required separation distances are not met, then the entire BLAHA/AHA must be considered one site and paragraph 12.87.2.2 applies.

12.87.3.2. Table 12.35 provides the QD requirements for BLAHA/AHAs.

12.87.3.3. Use Table 12.34 to determine the applicable QD for heavy, light, and non-armored vehicles, as described in paragraph 12.87.4 below. (T-1). ILD requirements are given in Note g of Table 12.35.

12.87.4. AE Loaded Vehicles. For the purposes of BLAHA criteria, treat combat vehicles as heavy armored, light armored, or non-armored.

12.87.4.1. Heavy Armored Vehicles (e.g., M1 Abrams Tank).

12.87.4.1.1. A heavy armored vehicle is expected to contain the fragments from an internal explosion involving the munitions stored within it, so QD is based on blast impulse only. Consider it well protected against the explosion effects from an external explosion.

12.87.4.1.2. For the reasons above, a heavy armored vehicle has no magazine distance and requires no separation from other heavy, light-armored, or non-armored vehicles. However, the hatches of a heavy armored vehicle are required to be closed, otherwise the vehicle must be treated as light armored.

12.87.4.1.3. All munitions must be contained within the on-board storage compartments, otherwise the heavy armored vehicle must be treated as non-armored as a PES. (T-1).

12.87.4.2. Light Armored Vehicles (e.g., M109 howitzer, FAASV. MJ13 mortar tracks, M2/M3 Bradley fighting vehicle, MRAP).

12.87.4.2.1. Do not expect a light armored vehicle to contain the explosion effects from an internal explosion involving the munitions stored within it, however, the munitions and vehicle will generate fragments. Expect the vehicle's structure/armor will either stop primary fragments or significantly reduce fragment velocities from an external munitions explosion. Therefore, base QD for a light armored vehicle on blast, fragments, and vehicle debris.

12.87.4.2.2. A light armored vehicle provides protection from an external blast and fragments/debris.
12.87.4.2.3. For the above reasons, treat a light armored vehicle as a barricaded ES and as an un-barricaded PES. (T-1).

12.87.4.2.4. Require the hatches and ramps to be closed, otherwise treat the vehicle as non-armored.

12.87.4.2.5. All munitions must be contained within the light armored vehicle (e.g., no external carry munitions) for it to be considered as a barricaded ES, otherwise treat the vehicle as non-armored. (T-1).

12.87.4.3. Non-armored vehicles (e.g., HUMMWV, trailer). Non-armored vehicles provide no protection from an internal/external explosion.


12.88.1. Scope and Application. QD's herein are for HD 1.1 AE. If only AE of other HDs are involved, apply the appropriate QD. This applies to:

12.88.1.1. Ship and barge units, hereafter referred to as ships.

12.88.1.2. Piers, wharfs, and associated facilities where AE may be handled or may be present in ships’ holds or conveyances.

12.88.1.3. Loading, off-loading, stowing, and shifting of AE from ships’ magazines.

12.88.2. Determining the Quantity of Explosives in a Ship.

12.88.2.1. Determine the NEWQD on board a ship per Section 12C. (T-1).

12.88.2.2. When ships are separated by $11W^{1/3}$ distances or greater, base the QD individually on the quantity of each ship. (T-1). Lesser separation distances require that the AE in all ships be totaled.

12.88.3. Measurement of Separation Distances.

12.88.3.1. Moored Ships.

12.88.3.1.1. Measurement of separation distances between ships or barges must be from the nearest point of one ship’s magazine (i.e., the PES) or the barge: (T-1).

12.88.3.1.1.1. For IMD, to the nearest point of another ship’s magazine or a barge.

12.88.3.1.1.2. For IBD and PTRD, to the nearest point of another ship or a barge.

12.88.3.1.2. Measurement of separation distances between ships or barges and shore ESs must be from the nearest point of a ship's magazine or the barge to the nearest point of the ES. (T-1).

12.88.3.2. Pier Operations. Measurement of separation distances from piers to surrounding facilities must be from the nearest point that AE is handled to the nearest point of an ES. (T-1). Consider movement of railcars or trucks passing through the clear space between ships at a pier or between piers an operational risk. It is generally impracticable to separate berths at a single pier by enough distance to prevent mass detonation of HD 1.1. To the extent operationally feasible, reduce the number of such exposures and total time required to the maximum extent practicable through scheduling.
12.88.3.3. Anchorages. Measurements from anchorages generally must be from the boundary of the area designated for the explosives anchorage. The explosives anchorage for a single ship is a circle, the radius being the distance from the mooring buoy or a ship’s anchor to the stern of the ship or of the AE lighters alongside when riding to the full scope of the chain. For an explosives anchorage, the separation distance to an ES depends upon whether any ships are separated properly (see paragraph 12.88.2.2.).

12.88.4. Siting Criteria and Application of QD.
12.88.4.1. Maritime Pre-positioning Ships (MPSs).

12.88.4.1.1. Apply reduced QD criteria to those MPSs that contain up to 1,300,000 lbs NEWQD of AE stored in standard International Standardization Organization (ISO) shipping containers. (T-I).

12.88.4.1.2. Determine IBD and PTRD for MPSs using K = 40.85 with a 3,700-foot minimum fragment distance for IBD and K = 24.01 with a 2,220-foot minimum fragment distance for PTRD for MPS loads where no more than 52 percent of the NEWQD is HD 1.1. (T-I). When the percentage of HD 1.1 is:

12.88.4.1.2.1. Between 52 and 65 percent, use the IBD and PTRD columns of Table 12.36.

12.88.4.1.2.2. Above 65 percent, use the Other PES columns of Table 12.6, with a 3,700 foot minimum fragment distance for IBD and a 2,220 foot minimum fragment distance for PTRD.

12.88.4.1.3. Determine the QD between applicable MPS piers/anchorages and non-explosives loading piers/anchorages using K = 32 with a 3,500 foot minimum fragment distance for MPS loads, where no more than 52 percent of the total NEWQD is HD 1.1. (An exception for non-explosive MPSs is provided in paragraph 12.88.4.8.1.). (T-I). When the percentage of HD 1.1 is:

12.88.4.1.3.1. Between 52 and 65 percent, use the ship-to-ship column in Table 12.36.

12.88.4.1.3.2. Above 65 percent, use K = 40 [15.87] with a minimum fragment distance of 3,500 feet.

12.88.4.2. Scuttling Site. A properly located scuttling site will, when feasible, be provided for positioning a ship for its flooding or sinking in the event it catches fire and must be moved to avert damage to other ships or piers. The location of a scuttling site depends on the greatest NEWQD that may be in a single ship to be scuttled at any one time (Figure 12.9. provides the applicable QD). Additional considerations for the scuttling site include:

12.88.4.2.1. Sufficient maneuvering room and depth to permit sinking the largest vessel that may be handled at the installation so that the holds will be flooded completely at low tide.

12.88.4.2.2. Providing the best available protection to other ships, piers, and shore installations in the event of a mass explosion.

12.88.4.3. Explosives Anchorages.
12.88.4.3.1. Separation of Explosives Anchorages from Main Ship Channels. Separate explosives anchorage from the main ship channel and from normally traversed routes of ships entering or leaving the harbor by the following distances (occasional watercraft passing through the arcs, while outside both the main ship channel and normally traversed routes of ships entering and leaving the harbor, are not subject to QD requirements): (T-1).

12.88.4.3.1.1. The PTRD from “Other PES” column of Table 12.6. (regardless of traffic density).

12.88.4.3.1.2. The turning circles and stopping distances of other ships passing the anchorage but not less than 3,000 feet.

12.88.4.3.2. Separation of Ships at Explosives Anchorages. When explosives anchorages are used for both loading and unloading ships and for mooring loaded ships, separate ships as follows: (T-1).

12.88.4.3.2.1. Separate loaded ships from each other by $18W^{1/3}$.

12.88.4.3.2.2. Separate loading and unloading ships from each other by $11W^{1/3}$ and, when possible, by $18W^{1/3}$.

12.88.4.3.2.3. Separate loaded ships from ships loading and unloading by $40W^{1/3}$.

12.88.4.3.3. Separation of Explosives Anchorages from Explosives Piers. Separate explosives anchorages from explosives piers by $40W^{1/3}$ except when the anchorage is used only for the loading or unloading of ships. In that case, $18W^{1/3}$ may be used.

12.88.4.4. Separation Distances of Ships at the Same Pier.

12.88.4.4.1. Berthing of two ships in tandem helps decrease the fragment hazard to the AE cargo of the second ship because of the additional protection afforded by the bow or stern.

12.88.4.4.2. When two ships cannot be separated by $11W^{1/3}$ and are loaded through all hatches at the same time, plan the spotting of railcars or trucks and the loading of hatches in both ships in a manner that puts the greatest possible distance both between the open hatches and the trucks and railcars serving the two ships. When possible, stagger the loading of the all ships.

12.88.4.5. Separation of Wharf Yard from the Pier. Separate a wharf yard from the pier it serves by $11W^{1/3}$ to prevent propagation. (T-1). If this separation distance cannot be met, then consider the wharf yard as part of the ship or barge and add to it for computation of the total amount of explosives for QD purposes.

12.88.4.6. Separation of Explosives Ships from Other Ships. Separate explosives ships being loaded or unloaded from non-explosives carrying ships and from loaded explosives ships that are not underway by $40W^{1/3}$ distances. (T-1). Use the PTRD from “Other PES” column of Table 12.6. for protection of ships that are underway.

12.88.4.7. Barge Piers and Anchorages.

12.88.4.7.1. Barge Piers. Site piers and wharfs, used exclusively for loading or unloading AE on barges or utility craft (i.e., barge piers), at IMD from all other PESs
(to include from another barge pier or a barge anchorage). (T-1). As a PES, site barge piers and anchorages IAW Figure 12.9.

12.88.4.7.2. Barge Anchorages. Site anchorages used only to moor AE-loaded barges and where AE loading or unloading is not permitted (i.e., barge anchorages) at IMD from all other PESs (to include from another barge anchorage or a barge pier). (T-1). As a PES, site barge anchorages IAW Figure 12.9. See paragraph 12.88.4.3. for criteria to apply to anchorages used for AE loading or unloading.

12.88.4.8. Separation of Pre-position Program Ships at Anchorages. The Military Sealift Command’s Pre-positioning Program (i.e., Combat Pre-positioning Force, Maritime Pre-positioning Force, Logistics Pre-positioning Ships) operates both explosives-loaded and non-explosives carrying ships that are then deployed to key locations around the world. These ships are pre-loaded with military equipment and supplies necessary to support military forces on a short-notice basis and thus support a common mission. The following criteria apply to Pre-positioning Program ships at anchorage:

- 12.88.4.8.1. Separate non-explosives carrying ships from explosives-loaded ships by a minimum of $18W^{1/3}$. (T-1).
- 12.88.4.8.2. Separate non-explosives carrying ships from non-pre-positioning program explosives-loaded ships by $40W^{1/3}$. (T-1).
- 12.88.4.8.3. Non-explosives carrying ships not associated with the Pre-positioning Program shall be separated from all explosives carrying ships by $40W^{1/3}$. (T-1).
- 12.88.4.8.4. Separate all non-explosives carrying ships from explosives ships being loaded or unloaded by $40W^{1/3}$. (T-1).

12.88.5. QD Tables.

- 12.88.5.1. Figure 12.9. illustrates required hazard factors.
- 12.88.5.2. Maintain Table 12.6. separation distances between explosives pier and wharf facilities and other ESs (e.g., administration and industrial areas, terminal boundaries, main ship channels, and PTR).
- 12.88.5.3. As an ES, separate ships from AE operating and storage facilities (including holding yards) by the “appropriate” IBD” column of Table 12.6. (T-1).
- 12.88.5.4. As a PES, separate ships from AE operating facilities by either the barricaded IMD (K6) or unbarricaded IMD (K11 [4.36]) as applicable. (T-1). An exception (see paragraph 12.19.) is permitted when the ES is a container stuffing and unstuffing operation that routinely supports AE ship loading and unloading operations. QD requirements of paragraph 12.88.5.3. must apply from such container stuffing and unstuffing operations (as a PES) to an AE ship (as an ES). (T-1).

12.88.6. General Cargo and Vehicles at AE Terminals.

- 12.88.6.1. Conduct concurrent movements of mission-related general cargo, vehicles, and AE through a terminal for the purpose of loading or unloading the same ship.
- 12.88.6.2. Conduct concurrent operations involving other ships at applicable QD separations (see Figure 12.9.).
12.88.6.3. Separation of inert materials and equipment in holding areas must be consistent with paragraph 12.67.

12.88.6.3.1. Limit personnel entering inert holding areas that are located within explosives safety QDs both in number and time of exposure.

12.88.6.3.2. Any labor intense activity must take place at IBD or PTRD, as applicable.

Section 12P—Space and Intercontinental Ballistic Missile Requirements

12.89. General Information. This section establishes explosives safety standards for storing, staging, maintaining, processing, assembling, handling, and testing large solid rocket motors (LSRM), motor segments and liquid propellants used in conjunction with space launch systems and Intercontinental Ballistic Missile (ICBM) test launches, and provides methods and criteria for mitigating the pre-launch risks associated with these operations.

12.89.1. These standards apply to Air Force locations that process, launch, and test launch vehicles or ballistic missiles containing more than 1,000 pounds of liquid propellants or more than 10,000 pounds of solid propellants. QD criteria for space and ICBM systems are found in paragraph 12.97.

12.89.2. Space launch vehicles and ICBM class missile systems use large quantities of energetic materials as fuel and oxidizer for their propulsion systems. Typically, these propulsion systems contain liquid or solid propellants in thousand to million pound quantities. These launch vehicles and missile systems can, under launch conditions, react much more violently than during conditions such as transportation, storage, and handling. Launch conditions include vehicles in a fully pressurized configuration (i.e., during countdowns and rehearsals, and testing on test stands). Pressurized vehicles can present a hazard to a wide area and, in some cases, miles of exposure. The combination of the potential for large explosions coupled with possible wide dispersion of the threat requires different methods of mitigating explosive hazards than normally used for non-dynamic hazards analysis, hazard classification, threat mitigation, and siting. These hazards and mitigating techniques will be contained in range or test requirement documents.

12.90. Support Facilities. These include those facilities used to store, stage, or process large rocket motors and motor segments. The same facility may be used for both staging and processing these motors. Take thermal and toxic properties as well as potential explosive effects IAW applicable directives such as UFC 3-340-02 into consideration prior to selecting or constructing operational maintenance and staging facilities for large rocket motors and motor segments.

12.90.1. Facility design and operational processing flow must keep the physical movement of these large rocket motors and motor segments to an absolute minimum. Limit the operations performed in these facilities to those associated with the primary function of the facility. Establish safety control areas as defined in paragraph 12.91., for all hazardous operations in these facilities.

12.90.2. There are two basic types of support facilities for large solid rocket motors (LSRM) and motor segments; a Motor Operations and Staging Facility, and a Motor Storage Facility.
12.90.2.1. Motor Operations and Staging Facility. This facility is primarily used to process and assemble LSRMs and motor segments for launch operations. It also has the capability for staging and maintaining motors and motor segments. Conduct operations involved with preparing LSRMs and motor segments using approved receipt-to-launch procedures or other approved technical data. Unlike many explosives operating buildings currently existing on military installations, the large motor facilities may have many direct support personnel simultaneously performing different tasks in support of the launch preparation. Limit these personnel to the minimum number necessary to accomplish the operation. Establish personnel limits in the operating procedures. Perform scheduled and unscheduled maintenance in this facility on motors and segments in the staging area. Limit maintenance of large rocket motors and motor segments in the staging area to periodic maintenance and inspections unless a hazard risk analysis indicates other operations may be safely performed. When unscheduled or unforeseen operations must be accomplished on solid motors in the staging area, the appropriate technical team will perform a risk assessment IAW AFPAM 90-803, Risk Management (RM) Guidelines and Tools. (T-1). Air Force explosives safety personnel will then evaluate and obtain approval of the risk assessment at the appropriate command level. (T-1).

12.90.2.2. Motor Storage Facility. This facility is primarily used for long term storage of motors and motor segments. Keep the movement of LSRMs and motor segments into and out of storage to an absolute minimum. Hazardous operations normally performed in these facilities involve lifting and positioning LSRMs and motor segments. Selected maintenance operations may be performed in these facilities provided they are limited to periodic maintenance inspections using approved procedures. Unscheduled operations, such as repairs or the correction of discrepancies found during periodic inspections, may be performed in these facilities if a risk assessment concludes it is less hazardous to perform the maintenance in the facility than to move the segment to another isolated facility. If government resources are at risk, the wing Commander or equivalent Commander approves the task before it begins. (T-1). If only commercial resources are at risk, risk assessment is the responsibility of the commercial operator. Use only Commander approved and safety reviewed/approved procedures when maintaining or repairing LSRMs and motor segments. (T-1).

12.90.3. MAJCOMs determine whether two operations involving LSRM’s are dissimilar with respect to the hazards presented and therefore require ILD separation. Factors to consider when making this determination are:

12.90.3.1. The explosive characteristics and quantities of explosives involved in each operation.

12.90.3.2. The end use of the LSRM’s undergoing preparation.

12.90.3.3. The makeup of the teams performing the operations (i.e., Will the same team perform the operations).

12.90.4. When contractor owned large rocket motors undergoing preparation are used for both DoD or commercial payloads of dissimilar programs and are within ILD, the responsible contract program offices and installation Commander must approve the risk analysis. Once approved, use the combined NEWQD of all rocket motors within the PES for
explosive siting. Adhere to quantity distance requirements between other ES and PES within IB of the operating location.

12.90.5. Separate LSRMs earmarked for DoD weapons or specific missions directed by presidential mandate in support of national defense (currently Minuteman III and Missile Defense Agency resources) from non-DoD assets by IBD. (T-1).

12.91. Safety Control Area. A safety control area is an area where personnel and equipment exposure is controlled in order to limit the risk from hazardous explosives operations. For LSRMs, the safety control area is an area centered where the ordnance task is taking place and has a radius of IBD based on the quantity of explosives which may become involved in a mishap. Certain engineering controls allow a reduction or modification in the size of the safety control area. Only one hazardous explosives operation may take place in a safety control area at a time. (T-1). Personnel required to be in the safety control area during an explosives operation are considered essential personnel; conversely, people who do not meet this definition are considered non-essential.

12.92. Simultaneous Operations. The large size of motor segments allows multiple operations to be easily conducted simultaneously on a single element, but the potential hazards that one task may present to another task must be carefully assessed before allowing more than one operation to proceed. Personnel performing processing or maintenance tasks on LSRM segments must be aware of other tasks that may be in progress on the same segment. Only perform a single operation within the same safety control area at a time. (T-1).

12.93. Barricades. Use barricades with fixed storage tanks to prevent high velocity fragments from a ground liquid fuel propellant vapor phase confined explosion striking a test vehicle on the test stand. (T-1). Design these barricades according to the criteria in paragraph 6.15.

12.94. Space Launch Complex. A space launch complex consists of a group of related facilities used for launching space vehicles. Facilities generally included are the launch pad(s), liquid propellant storage tanks, site instrumentation facilities, engineering personnel support buildings and Launch Center. Additional facilities include LSRM facilities and spacecraft processing facilities. A launch complex normally involves a variety of explosive hazards, the result of the presence of various quantities of liquid and solid propellants producing both mass fire and detonation explosive hazards. Perform system safety engineering hazard analyses of the complex to identify the various explosive hazards, their relationships, and the safety threat zones and launch area location. (T-1). Quantity Distance criteria is found in paragraph 12.97.

12.95. Space Test Facilities. Space test facilities normally consist of a wide array of test resources to support customers including flight hardware (ballistic, space, sounding rocket launch vehicles and satellites) and ground systems (field test, assembly and storage, launch, and on-orbit test facilities). A space test facility typically includes liquid propellant storage tanks or test site instrumentation, facility engineering personnel support buildings and a control center. The facilities normally involve a variety of liquid and solid propellants and can produce both mass fire and detonation explosive hazards. Perform system safety engineering hazard analyses of the facilities to identify the various hazards, their relationships, the safety threat zones, etc. (T-1).

Requirements, are used to identify and to assess potential hazards; and to determine and to implement controls to minimize the risks associated with operations involving LSRMs and motor segments.

12.96.1. The major hazards associated with space launch vehicles and missile prelaunch and propulsion test operations involve large quantities of propellants used in propulsion systems, destruct charges, and high pressure gas systems.

12.96.2. Perform hazard assessments to measure the potential for and consequences of mishaps resulting from the undesired release of energy or inhibiting the desired release of energy. Use these assessments to define the MCE.

12.96.3. Assess all launch vehicle operations to evaluate the hazards and to determine the mitigating activities necessary to achieve an acceptable level of risk, both for personnel and the launch or test site.

12.96.4. Determine the expected risk before beginning any potentially hazardous operation and get approval from the appropriate supervisory level before proceeding. Risk analyses must show that the potential benefits outweigh the cost in terms of overall risk before the operation is approved.

12.96.5. Credible Failure Modes. In order to determine the potential threat that a given launch vehicle and support system configuration poses during prelaunch or propulsive test operations, define credible failure modes. The specific failure mode that occurs will have a large influence on the explosive yield and the resultant blast overpressure, fragmentation, and thermal effects and thus on the severity of the accident environments, risk to personnel, and damage to facilities. General scenario categories include the following phases and operations:

12.96.5.1. Prelaunch and Test Operations.
12.96.5.2. Storage.
12.96.5.3. Handling.
12.96.5.4. Assembly.
12.96.5.5. Checkout (at the assembly building and at the launch or test complex).
12.96.5.6. Final Assembly.
12.96.5.7. Ordnance Installation.
12.96.5.8. Propellant Loading.
12.96.5.9. All-up Vehicle Checkout (prior to launch and static firing).

12.96.6. General Failure Modes. Handle the failure modes for liquid propellants and solid propellants separately because their geometric and chemical configurations are different. In the case of solid propellants, the fuel and oxidizer are already mixed homogeneously, therefore the failure scenarios do not have to account for mixing. Liquid propellants, on the other hand, are configured in separate storage or launch vehicle tanks, therefore the failure scenarios must account for the type, amount, and probability of mixing propellants.

12.96.7. Typical Prelaunch Failure Mode Scenarios:
12.96.7.1. Storage.

12.96.7.1.1. Liquid propellant scenarios primarily involve leaking or ruptured propellant tanks caused by loss of pressure control, insulation deficiencies, mechanical damage, and corrosion. Fuel and oxidizers are normally stored separately, so limit an MCE to a fire and tank pressure rupture or tank rupture and toxic vapor release.

12.96.7.1.2. Define solid propellant accident scenarios by the hazard classification grouping - 1.1 mass detonation, or 1.3 - mass fire. The most likely candidates to cause accidental ordnance initiation are introduction of stray electrical energy, fire, and dropping the segment with sufficient impact force to initiate the propellant or destruct charge if present.

12.96.7.2. Handling.

12.96.7.2.1. Handle liquid oxidizer and fuel separately using independent closed loop systems. Normally, differential pressure is used to transfer product from one holding tank to another or to load a launch vehicle. Typical accident events are limited to system leaks, vent and scrubber failures, or at worst, a tank rupture caused by over- or under-pressurization. Launch vehicle propellant loading scenarios are discussed in another section. Load liquid propellants serially to further reduce prelaunch mixing hazards. (T-1).

12.96.7.2.2. Handle solid propellant rocket motors by lifting with cranes or erectors at static test stands, the launch mount, in a processing facility, or by various transportation modes. Typically the MCE scenario involves vehicle rollover, or drop impacts during lifting or transportation. Drop impacts on hard surfaces can cause propellant ignition.

12.96.7.3. Booster Assembly.

12.96.7.3.1. Launch vehicle assembly processes normally do not involve liquid propellants.

12.96.7.3.2. Assembly operations for solid propellant rocket motors typically involve the same credible accident scenarios as those listed for handling.

12.96.7.4. Booster Checkout. Booster checkout normally does not impose additional hazards above and beyond those already listed except that the potential for inadvertent ignition of EIDs or inadvertent function of propellant system isolation valves is increased during certain electrical system checkouts. Pad or test stand checkout is normally accomplished after assembly and loading of solid propellant and hypergolic propellant stages. Multi-faceted threats exist with interaction between hypergolic and solid propellants that can result in pressure ruptures, toxic vapor hazard and propulsive flight.

12.96.7.5. Final Assembly. Normally, the launch booster, upper stages, and payload final assembly process is accomplished on the launch pad. Both solid propellants and hypergolic liquid propellants are present during the final assembly steps. A major threat involves the assembly and encapsulation of spacecraft and upper stages in facilities off the launch complex. These operations normally involve hypergolic propellants loaded in separate propellant tanks. Credible accident scenarios include puncture of one or more of
the propellant tanks during assembly or checkout, impact caused by lifting, failure resulting in a dropped system, or over- or under pressurization. Since these propellants are hypergolic; the potential exists for a fire if the fuel comes into contact with an oxidizer. Another major threat involves the toxicity of these propellants. Credible accident scenarios primarily involve handling, lifting, and mating stages with tank rupture accident scenarios the result of impacts caused by improper handling or dropping one or more stages. The results are the same as those listed above.

12.96.7.6. Ordnance Installation. Ordnance installation may take place in an off-the-pad assembly building or on the launch pad. During and after installation, credible accident scenarios primarily involve inadvertent ignition of EIDs. These devices must not be capable of detonating either the solid or liquid propellant. Inadvertent ignition of these devices can result in significant damage to the vehicle and severe injury or death to personnel. Unless unavoidable, do not load cryogenic liquid propellants on a launch vehicle until after ordnance is installed.

12.96.7.7. Propellant Loading. MCE accident scenarios during propellant loading involve over- or under-pressurization of the propellant tanks and major spills of fuel and oxidizer. These scenarios can result in a significant explosive yield.

12.96.7.8. All-Up Vehicle Checkout. This occurs prior to launch or static firing. During this phase of prelaunch operations the final liquid propellant topping off is completed and in some cases the liquid propellant and high pressure gas systems are brought to flight pressure. All systems are switched to internal power and final systems checks are performed. The MCE involves the fully loaded launch vehicle and payload. Explosive yield is based on static conditions for shock impact on solid propellants and non-dynamic mixing of liquid propellant either by the Confined by Missile (CBM) mode or the Confined by Ground Surface (CBGS) mode.

12.97. Space and Intercontinental Ballistic Missile Criteria.

12.97.1. Some launch pad facilities such as mobile service towers, umbilical mast towers, launch ducts, launch center, and launch mounts are identified by a building number on the base master plan. For the purpose of explosive site planning, consider them an “integral part of the facility” and do not require exposed site separation distances due to the common nature of their function. Likewise, facilities that provide direct support to these launch pads such as maintenance and build-up shops, pressurization systems, instrumentation terminal rooms, etc., are an integral part of the facility and do not require QD separation distances from the pads they support.

12.97.2. Technical support areas may be associated with these facilities. Locate all direct support personnel at no less than IL distance or equivalent protection from the PES and dispatch them to the PES as required.

12.97.3. Locate any parking lots (GOV or POV) exclusively serving the motor or motor storage, staging, or operations facility according to Chapter 12.

12.97.4. Locate launch complexes at Air Force launch ranges using two sets of criteria. Base the first set on QD criteria. They address pre-launch operations (including pressurized launch rehearsal) and static explosive threats. Define these for each facility in the ESP. (T-1). The TNT equivalencies to be used are included in Table 12.17. The second set of
criteria is used to locate a launch complex on the range address launch and space vehicle dynamic flight. Range safety guidance defines the criteria and flight safety analysis techniques required to determine the down range explosive threat resulting from a launch.

12.97.4.1. Separate new launch pads by at least an IL distance from each other. (T-1). The larger NEWQD of the two launch vehicles dictates the minimum separation between the two launch pads. For HD 1.1 launch vehicles, the minimum separation required is K - 18. For HD 1.3 launch vehicles, Table 12.12., ILD column. Hazardous operations in one facility may impact operations in another related facility. In order to protect personnel, consider IB quantity distance criteria between launch pads for new construction, as opposed to IL distances.

12.97.4.2. Determine launch complex locations in the range launch area based on flight safety analyses including risk analysis such as the Launch Area Risk Analysis (LARA) program and other flight safety techniques described in range safety guidance. The Range Safety Office responsible for a launch area will consider explosive siting and missile flight hazards when determining the location of a launch complex in relationship with other launch complexes and support facilities.

12.97.4.3. For QD purposes, measure from the explosives at the launch mount, for a launch complex and at the test stand, for a test complex.

12.97.5. Space Test Facilities. During explosives site planning for new motor or motor segment test operation facilities, provide a personnel direct support facility at least ILD from the PES. (T-1). It will be a dispatch point, break room, and change room for these personnel. Locate these direct support personnel facilities at closer than IL distances if protective measures are used to provide minimum required overpressure and fragment protection. Use the prevailing wind direction as a primary consideration when locating test stands in relationship to other facilities that will be inhabited during testing. Do not hazard Government assets with non-DoD LSRM test facilities on Air Force installations. (T-1). Use Table 12.31. to determine siting criteria for non-DoD explosives activities. (T-1).

Note: This separate location will permanently house direct support personnel for the PES.

12.97.6. Static Test Facilities. Site and construct static test facilities for maximum flexibility to meet frequently changing technological requirements. A typical static test facility will have several test stands that share common support facilities such as ready storage tanks, pressurization systems, test control rooms, maintenance support and build-up shops, and steam-generating vacuum systems. To the extent possible, separate test stands by ILD. In some cases test support requirements, such as vacuum testing, do not support QD separation if test objectives are to be achieved. To minimize the risk to adjacent test stands, use only one test stand at a time when QD requirements cannot be met. Remove or protect all equipment not being used to support current test operations, or obtain a waiver approved at the appropriate level. See Chapter 1 for waiver or exemption procedures.

12.97.7. Building and Use of Non-DoD Space Explosives Facilities on Air Force Installations and Non-DoD Use of Existing Government Facilities. Air Force guidance permits a non-DoD space user to lease land on an Air Force installation and construct explosives facilities to support non-DoD and Government space operations. Additionally, a non-DoD space user may be granted a license to use an existing Government explosives
facility. These facilities include but are not limited to explosives storage facilities, explosives operations facilities, missile launch pads, test facilities, and combinations thereof. Use Table 12.31 for QD criteria for siting non-DoD explosives activities.

12.97.8. DoD Explosives Hazard Classification. Apply DoD explosives hazard classifications to explosives stored or used on military installations and reflect them in all applicable facility ESPs. For commercial explosive items that have not been acquired and adopted for use by the Air Force, but will be stored and transported on an Air Force installation in conjunction with commercial launch programs, the following exceptions may be applied:

12.97.8.1. The items may be offered for transportation off the installation via commercial carriers using hazard classification approvals issued to the item manufacturers by the Department of Transportation (DOT).

12.97.8.2. An item may be stored, handled, and transported on the installation using the hazard classification approval issued by DOT if the local Commander reviews and concurs with that hazard classification, except for articles assigned to hazard class/division 1.2. These must be stored and handled as DoD hazard class/division 1.1. (T-1). Observe approval to store non-DoD commercial items as hazard class/division 1.2 from a DoD hazard classification authority listed in TO 11A-1-47. (T-1).

12.97.9. Expanding QD and Risk Assessment. Problems are encountered around launch pads and test stands where lack of real estate coupled with a high concentration of people, facilities, and equipment make compliance with QD standards impossible. Explosive content of a launch pad or test stand varies according to a well-defined operational concept and the maximum NEW is typically present only during a short period of time just before launch or test. This allows management to take actions to protect or remove resources and personnel as the NEW is increased.

12.97.10. Expanding QD. Expanding QD is a process available to Commanders similar to tiered siting allowing them to analyze and minimize risk to personnel, facilities, and operational capabilities. Expanding QD is a risk-based management tool that provides an organized way to evaluate risks and assess action that mitigates the impact of an explosive mishap during periods of increased activity. In an expanding QD system, a launch pad or test stand may have different NEWQDs during different stages of prelaunch or test missile buildup. To maximize protection under the expanding QD approach, the responsible Commander will develop and publish procedures to ensure non-essential equipment, supplies, and personnel are removed prior to increasing NEWQD limits. (T-1).

12.97.11. Procedures for Expanding QD RM. Determine launch pad or test stand NEWQD for various stages of launch vehicle buildup. For each stage, evaluate all ESs that are within the QD arc generated by the NEWQD. If QD criteria are not violated in the largest arc, submit an ESP for the maximum NEWQD. (T-1). If violations exist, the following actions are required:

12.97.11.1. Evacuate non-direct support personnel from an ES falling within the QD arc generated by the NEWQD. A waiver or exemption is required if the ES cannot be evacuated.
12.97.11.2. Publish procedures to minimize risk for stage with QD violations. Guidelines must specify: (T-1).

12.97.11.2.1. The organization responsible for implementing risk reduction actions.
12.97.11.2.2. Conditions where risk reduction actions are directed and when they take place.
12.97.11.2.3. On-scene inspection procedures to ensure RM actions are accomplished.
12.97.11.2.4. Facilities to be evacuated.
12.97.11.2.5. Critical equipment and supplies to be protected or evacuated.
12.97.11.2.6. Procedures to ensure the program is evaluated on a recurring basis.

12.97.11.3. On the ESP, clearly label the different QD arcs associated with the different NEWQD levels.

12.97.12. Launch Center Requirements.

12.97.12.1. Launch Center. In general, the Air Force is moving away from the use of hardened blockhouses located at launch complexes in favor of soft, remote launch control centers. Until all operations requiring on-site manning in the launch center during launch are moved to remote locations, ensure launch center personnel are protected to a reasonable degree of safety. In the event of detonation of a launch vehicle on the launch pad or shortly after lift-off, the launch center must be able to withstand a direct impact of the largest expected amount of explosive debris and also the over-pressure resulting from the initial explosion and from subsequent explosions of firebrands landing nearby.

12.97.12.2. Test Control Launch Center. Launch Centers for static test stands can either be unprotected facilities at K-24 for the maximum propellant load, or be hardened facilities capable of providing K-24 overpressure protection and fragment protection from the maximum propellant load.
Figure 12.1. Hazard Zones for Earth Covered Magazines (ECMs).

NOTES:

1. See paragraph 1224 for application of intraline distances from an ECM.
2. See paragraph 1224 and 1225 for application of barricaded IMD and ILD from an ECM.
3. See table 121 for application of intermagazine distances between ECM and Aboveground Magazines.

ECM Orientation Effects on Barricaded and Unbarricaded IMD and ILD.
Figure 12.2. ECM Orientation Effects on IMD.

Fig122A  ECM Orientation Effects on IMD: Side-to-Side Orientation  
(see paragraph 1225)

Fig122B  ECM Orientation Effects on IMD: Side-to-Side Orientation  
(see paragraph 1225)

NOTES:
Site A as a Side-to-Front (unbarricaded) ES
Site B as a Front (unbarricaded) to Side ES

Fig122C  ECM Orientation Effects on IMD  
(see paragraph 1225)
NOTE:
1. Site each magazine as a Front-to-Front ES:
   Site C as a Barricaded ES
   Site A and B as unbarricaded ESs

Fig 12.2D ECM Orientation Effects on IMD (see paragraph 12.25)

NOTES:
1. Site A as a Side-to-Front (unbarricaded) ES.
2. Site B as a Front (unbarricaded)–to–side ES.

Fig 12.2E ECM Orientation Effects on IMD: Canted ECM (see paragraph 12.25)

NOTES:
1. Site A as a Side-to-Front (unbarricaded) ES.
2. Site B as a Front (unbarricaded)–to–side ES.

Fig 12.2E ECM Orientation Effects on IMD: ECM of Significantly Different Lengths (see paragraph 12.25)
Figure 12.3. Hazard Zones for HASs.
Figure 12.4. F-15 Aircraft QD Separation Distances for Selected AIM/AGM Series Missile Configurations.

Notes:
1. Do not consider IM or IL criteria for the internal HD 1.2 gun ammunition and internal HD 1.3 flares with these loads.
2. AIM-120s shown are for the 16.9 pound warhead only.
3. AIM-120 models C4/C5 have 19 pound warheads and require new missile configuration requests IAW paragraph 12.48.
4. Disregard AIM-7 requirements; no longer in inventory.
Figure 12.5. F-16 Aircraft QD Separation Distances for Selected AIM/AGM Series Missile Configurations.

Notes:
1. Do not consider IM or IL criteria for the internal HD 1.2 gun ammunition and internal HD 1.3 flares with these loads.
2. AIM-120s shown are for the 16.9 pound warhead only.
3. AIM-120 models C4/C5 have 19 pound warheads and require new missile configuration requests IAW paragraph 12.48.
4. Disregard AIM-7 requirements; no longer in inventory.
Figure 12.6. Reduced MCEs and QDs for F-15 Aircraft in the Open.
Notes:
1. Use of this figure is only allowed if no single trailer servicing the aircraft would present an MCE greater than the MCE used to generate the aircraft QD arcs. In most cases, this means that the trailer cannot be loaded with more than the MCE of missiles. Where test results permit, such as in the case of a single layer of AIM-120 missiles loaded in alternating directions on a single trailer, apply reduced trailer MCEs. In that specific case, the trailer MCE is a single AIM-120 missile. Do not consider IM or IL criteria for the internal HD 1.2 gun ammunition and internal HD 1.3 flares with these loads.
2. Configuration numbers do not correspond to configuration numbers in Figure 12.7.
3. Unless otherwise specified, a) AIM-120s must be AIM-120, WDU-33/Bs and/or AIM-120, WDU-41/Bs, b) AIM-9s must be AIM-9L/M/X WDU-17s 7.9lb Warheads and/or AIM-9P, 10.5lb Warheads, c) disregard AIM-7 requirements; no longer in inventory.
4. Subsets of any configuration are acceptable as long as remaining missiles match type and location shown in the configuration.
5. Base IM for all configurations on the minimum aircraft separation requirement of 10 ft. If circumstances require locating aircraft at less than this distance, then lesser IM distances may be approved by AFSEC/SEW. Request approval through MAJCOM/SEW.
Figure 12.7. Reduced MCEs and QDs for F-16 Aircraft in the Open.
Notes:
1. Use of this figure is only allowed if no single trailer servicing the aircraft would present an MCE greater than the MCE used to generate the aircraft QD arcs. In most cases, this means that the trailer cannot be loaded with more than the MCE of missiles. Where test results permit, such as in the case of a single layer of AIM-120 missiles loaded in alternating directions on a single trailer, reduced trailer MCEs may be applied. In that specific case, the trailer MCE is a single AIM-120 missile. Do not consider IM or IL criteria for the internal HD 1.2 gun ammunition and internal HD 1.3 flares with these loads.
2. Configuration numbers do not correspond to configuration numbers in Figure 12.6.
3. Unless otherwise specified, a) AIM-120s must be AIM-120, WDU-33/Bs and/or AIM-120, WDU-41/Bs, b) AIM-9s must be AIM-9L/M/X WDU-17s 7.9lb Warheads, and/or AIM-9P, 10.5lb Warheads, c) disregard AIM-7 requirements; no longer in inventory.
4. Subsets of any configuration are acceptable as long as remaining missiles match type and location shown in the configuration.
5. Base IM for all configurations on the minimum aircraft separation requirement of 10 feet. If circumstances require locating aircraft at less than this distance, then lesser IM distances may be approved by AFSEC/SEW. Request approval through MAJCOM/SEW.

Figure 12.8. Fragment Zones for General Purpose Bombs.
Figure 12.9. Application of Separation Distances for Ship or Barge.

1 - K6
2 - K11
3 - K18
3A - K18 (See paragraph 12.90.4.8. for pre-positioning program ships.)
4 - K40
5 - Table 12.6. of this Manual IBD or PTRD (Other PES columns), as applicable.
6 - Table 12.6. of this Manual IBD, as applicable. (Ship or Barge)
Table 12.1. HD 1.1 QD Criteria.

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Notes:
1. Use this K-factor for NEWQD in PES up to 250,000 lbs.
2. Use this K-factor for NEWQD in PES greater than 250,000 lbs.
3. These barricades serve to mitigate both fragment and overpressure hazards. See Section 6E for their requirements.
4. ECMs must meet the design requirements in Section 6C. Paragraph 12.21. defines sectors (front/side/rear) of ECMs. Consider the front sector of an ECM unbarricaded unless barricaded per Section 6E to mitigate fragment hazards.
5. These barricades serve to mitigate fragment hazards. See Section 6D for their requirements.
6. AGMs are all types of above grade (non-earth-covered) magazines or storage pads. This includes open air munitions stocks, light structures (e.g., Butler buildings), and trucks/trailers/railcars loaded with explosives.
7. Although Barricaded Modules are considered AGMs, reduced QD (K1.1) may be applied between modules provided the requirements of Section 6D are met (to include limitations on the type of AE being stored in them, and prohibition on the use of heavy structures). If the requirements of Section 6D are not met, use AGM criteria.
10. See paragraph 12.24.3.
11. See paragraph 12.24.4.
12. See Section 12F - Allowable Exposures, Section 12H – HD1.1 QD Criteria, and Section 12O – QD criteria for specific facilities and systems.
13. Use Table 12.22. (K30 with a 111 foot minimum) to provide aircraft survivability from blast overpressure. Additionally, barricades are required if protection from low-angle, high-speed fragments is desired; side/rear of an ECM suffice as barricades for this purpose.
14. Minimum required distance is K11 or K6 if a barricade meeting the requirements of Section 6E is between the PES and ES. Combat aircraft may be separated at less than IMD provided: a) Their NEWQDs are combined to determine required QD to other exposures and b) Approval is obtained from at least the Vice Commander of the MAJCOM or Numbered Air Force (NAF) having operational control (OPCON) of the exposed aircraft (except for revetted cells containing two aircraft). If separation at less than IMD is required for support of a Unified Combatant Commander, the Vice Commander of the MAJCOM or NAF having OPCON of the aircraft will be the lowest approval level.
15. For QD purposes, an aircraft group is defined as two or more aircraft loaded with combat configured explosives that are parked at less than IMD. Although they do not reduce the required separation, intervening barricades are recommended. With NAF or MAJCOM approval, IMD may be used between groups for contingency operations, per Chapter 13.
16. This distance may be reduced to K11 or K6 if a barricade meeting the requirements of Section 6E is between the PES and ES. See Note 13 if survivability is desired.
17. Consider parked aeroclub aircraft as non-DoD aircraft for QD purposes; the presence of aeroclub aircraft does not make an airfield joint-use.
18. MAJCOMs may require greater separation for unique mission or high value aircraft.
19. See paragraph 12.23. for IBD and PTRD separation criteria.
20. These distances may be reduced with MAJCOM approval.
21. When required at locations outside the U.S. use K4.5. The use of this reduced separation depends on operational necessity, providing the Commander accepts the transient risk to military aircraft movements. Include the written risk acceptance as part of the ESP submission.
22. Use this row for locations in the open where passengers board and deplane.
23. Use this row if a structure is included where passengers assemble, such as a passenger terminal building.
24. Use this table for siting HD 1.5 (see paragraph 12.13.5.).
25. This distance provides aircraft survivability from blast overpressure. For IMD protection, this distance may be reduced to K9 or K6 if a barricade meeting the requirements of Section 6E is between the PES and ES.
26. This distance provides aircraft survivability from blast overpressure. For IMD protection, this distance may be reduced to K2.75.
27. This distance provides aircraft survivability from blast overpressure. For IMD protection, this distance may be reduced to K2.75.
28. This distance provides aircraft survivability from blast overpressure. For IMD protection, this distance may be reduced from K9, or K6 if a barricade meeting the requirements of Section 6E is between the PES and ES.
29. Base separations on shelter doors remaining closed, except for aircraft towing, fueling, servicing, run up, or taxi, and during concurrent servicing operations or short periods when maintenance equipment or munitions are being moved into or out of shelters. If doors are left open for extended periods, normal CAPA apply to and from the front. As a PES, parenthetical (xx) fragment distances do not apply except out the front of a Korean TAB VEE HAS and out the front/rear of a Korean Flow-Through HAS.
30. HASs must meet the category requirements in paragraph 12.50.1. Sectors (front/side/rear) of HASs are defined in paragraph 12.21. Consider the front sector of an HAS unbarricaded unless barricaded per Section 6E to mitigate fragment hazards. (See paragraph 12.50.)
31. This distance provides aircraft survivability. For IMD protection, this distance may be reduced to K11 or K6 if a barricade meeting the requirements of Section 6E is between the PES and ES.
32. Use Table 12.26.
33. Use Table 12.25.
34. Use Table 12.23. (IMD equivalent separation) for separation between HASs and between HASs and HAS Ready Service ECMs/AGMs. Use Table 12.24 (aircraft survivability) if survivability is desired
35. IBD out the side is K62; IBD out the rear is K40; IBD out the front is K50.
36. See paragraph 12.23.
37. See paragraph 12.24.
38. See paragraph 12.40.
39. See paragraph 12.41.
40. See paragraph 12.42.
Table 12.2. HD 1.2.1, 1.2.2, and 1.2.3 QD Criteria.

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Notes:
- E: Exposed Site (Es)
- T: Potential Site (Pt)
- S: Aboveground Magazine (A)
- FT: Flamethrower (F)
- FB: Field Bunker (B)
- L: Location (L)
- H or L: Hardened or Located (H or L)
- Column: Column of Analysis
- Column E: Column of Exposure
- Column FT: Column of Flamethrower
- Column FB: Column of Field Bunker
- Column L: Column of Location
- Column H or L: Column of Hardened or Located
LEGEND

(H) — Heavy Wall: • Barricade buildings with wall thickness ≥ 12 inches of reinforced concrete; • as an ES, door (to mitigate fragment hazards per Section 6B) if it faces a PES. ¶

(H/R) — Heavy Wall and Roof: • Barricade buildings with wall thickness ≥ 12 inches of reinforced concrete and a roof thickness ≥ 5.9 inches of reinforced concrete; • as an ES, door (to mitigate fragment hazards per Section 6B) if it faces a PES; side/rear exposures may or may not be barricaded. ¶

(L) — Light Wall: • Light structure, open stack, truck, trailer, railcar, and cargo aircraft. ¶

Notes:
1. See Section 12F - Allowable Exposures for additional exposures and Section 12O - QD criteria for specific facilities and systems.
2. When the NEWQD and the MCE of the packaged HD 1.2.1 items fall within the ranges specified in equation (NEWQD ≤ MCE ≤ 450 lbs), the HD 1.2.1 will be treated as HD 1.1 and the criteria of paragraph 12.23.1.1., as applicable, will be used (see paragraph 12.26.1.).
3. When siting HD 1.2.3, cap the NEWQD of the largest single round at ≤ 450 pounds, and cap the (xx) at 1300 feet. These caps are for simplicity in siting and may be exceeded with AFSEC/SEW approval.
4. ECMs must meet the design requirements in Section 6C. Sectors (front/side/rear) of ECMs are defined in paragraph 12.21. The front sector of an ECM is considered unbarricaded unless barricaded per Section 6E to mitigate fragment hazards.
5. These barricades serve to mitigate fragment hazards. See Section 6E for their requirements.
6. AGMs are all types of above grade (non earth-covered) magazines or storage pads. This includes open air munitions stocks, light structures (e.g., Butler buildings), and trucks/trailers/railcars loaded with explosives.
7. Required IMD separation is as follows: HD 1.2.1 MCE < 100 lbs: 200 feet; HD 1.2.1 MCE ≥ 100 lbs: 300 feet; HD 1.2.2: 100 feet; HD 1.2.3 to an ES containing only HD 1.2.3: 50 feet; HD 1.2.3 to an ES containing other than HD 1.2.3: K11 based on the NEWQD of the single round of the largest (greatest NEWQD) HD 1.2.3 item in the PES.
8. Although Barricaded Modules are considered AGMs, reduced QD may be applied between modules, provided the requirements of Section 6D are met (to include limitations on the type of AE being stored in them, and prohibition on the use of heavy structures). If the requirements of Section 6D are not met, use AGM criteria. Base IM distance for HD 1.2.x. for module to module separation on total NEWQD.
9. Do not use MCE and LSRN to calculate IM distance between modules per Note 8 above.
10. Required ILD separation is as follows:
   - HD 1.2.1, 1.2.2 and 1.2.3: 36 percent of the IBD, with a minimum distance equal to the IMD treating the ES as an AGM.
11. Apply PTRD separation per Note 21. If aircraft survivability is mandated by the MAJCOM, PTRD to the front of HAS with doors normally closed is acceptable for aircraft survivability or IBD separation per Note 17 for aircraft survivability for all other relationships.
12. Apply PTRD separation per Note 22. If aircraft survivability is mandated by the MAJCOM, PTRD to the front of HAS with doors normally closed is acceptable for aircraft survivability or IBD separation per Note 18 for aircraft survivability for all other relationships.
13. Apply IMD separation treating the ES as an AGM. If aircraft survivability is mandated by the MAJCOM, IBD separation per Note 17 is required for aircraft survivability.
15. Apply IMD separation treating the ES as an AGM. If aircraft survivability is mandated by 
the MAJCOM, IBD separation per Note 18 is required for aircraft survivability.
16. Apply IMD separation treating the ES as an AGM.
17. Required IBD separation is as follows: HD 1.2.1 MCE < 100 lbs: 200 feet; HD 1.2.1 MCE 
≥ 100 lbs: 300 feet; HD 1.2.2: 100 feet; HD 1.2.3: IBD per paragraph 12.27.2.1. 
18. Required IBD separation is as follows:
   HD 1.2.1 in a structure/truck/trailer/railcar/cargo aircraft: IBD is the larger of the IBD from 
   Table 12.9, or the HDD from Table 12.10. 
   HD 1.2.1 in the open/external a/c AE/stacks on open truck/trailer/railcar: IBD is the IBD from 
   Table 12.9
   HD 1.2.2: IBD is the IBD from Table 12.11.
   HD 1.2.3: IBD per paragraph 12.27.2.1.
19. Consider parked aero club aircraft as non-DoD aircraft for QD purposes; the presence of 
aero club aircraft does not make an airfield joint-use.
20. MAJCOMs may require greater separation for unique mission or high value aircraft.
21. Required PTRD separation is as follows: HD 1.2.1 MCE < 100 lbs: 200 feet; HD 1.2.1 
MCE ≥ 100 lbs: 300 feet; HD 1.2.2: 100 feet; HD 1.2.3: 60 percent of the IBD, with a 
minimum distance equal to the IMD treating the ES as an AGM (H or L)
22. Required PTRD separation is as follows: HD 1.2.1, 1.2.2 and 1.2.3: 60 percent of the IBD, 
with a minimum distance equal to the IMD treating the ES as an AGM (H or L).
23. When required at overseas locations only, use 125 feet. The use of this reduced separation 
depends on operational necessity, providing the Commander accepts the transient risk to military 
aircraft movements. If siting facilities, the MAJCOM/CC or CV must provide AFSEC/SEW a 
letter listing all installations where this separation distance will apply and state acceptance of 
transient risk to military aircraft movements.
24. Use this row for locations in the open where passengers board and deplane.
25. Use this row if a structure is included where passengers assemble, such as a passenger 
terminal building.
26. Treat as an Operating Location to determine required ILD separation.
27. No QD separation is required, unless the MAJCOM requires aircraft survivability (PTRD to 
the front of HAS with doors normally closed is acceptable for aircraft survivability; use IBD 
separation per Note 18 for aircraft survivability for all other relationships).
28. No QD separation is required.
29. MAJCOMs will determine required QD separation.
30. ECMs may be used to their physical capacity for HD 1.2 provided they meet separation 
requirements for a minimum of 100 lbs of HD 1.1, and provided separations to other exposures 
comply with applicable QD criteria.
31. Base separations on shelter doors remaining closed, except for aircraft towing, fueling, 
servicing, run up, or taxi, and during concurrent servicing operations or short periods when 
maintenance equipment or munitions are being moved into or out of shelters. If doors are left 
open for extended periods, normal CAPA apply from the front.
32. HASs must meet the category requirements in paragraph 12.50.1. Sectors (front/side/rear) 
of HASs are defined in paragraph 12.21. Consider the front sector of an HAS unbarricaded 
unless barricaded per Section 6E to mitigate fragment hazards (see paragraph 12.50.)
33. First, Second and Third Generation HASs, and Korean TAB VEE HASs, sited for HD 1.2.1 
MCE < 110 lbs, HD 1.2.2, or HD 1.2.3 LSRN<110 lbs do not generate a QD clear zone except
out the front. Korean Flow-Through HASs sited for HD 1.2.1 MCE < 110 lbs, HD 1.2.2, or HD 1.2.3 LSRN<110 lbs do not generate a QD clear zone except out the front and rear.

34. Fire protection distances still apply in Note 33 above.

35. Treat First, Second, and Third Generation HAS as AGM (H/R), Korean TAB VEE side/rear as an AGM (H/R) and front as an AGM (H or L), Korean Flow-Through side as an AGM (H/R) and front/rear as an AGM (H or L)

36. Required ILD separation is as follows: HD 1.2.1, 1.2.2 and 1.2.3: 36 percent of the IBD, with a minimum distance equal to the IMD treating First, Second, and Third Generation as an AGM (H/R), Korean TAB VEE side/rear as an AGM (H/R) and front as an AGM (H or L), Korean Flow-Through side as an AGM (H/R) and front/rear as an AGM (H or L)

37. MAJCOM may require aircraft survivability (PTRD to the front of HAS with doors normally closed is acceptable for aircraft survivability; use IBD separation per Note 18 for aircraft survivability for all other relationships).

38. Treat the PES as an AGM: for a front exposure from a First, Second or Third Generation HAS, use (H/R) criteria; for a front exposure from a Korean TAB VEE or Korean Flow-Through HAS, use (L) criteria. Treat the ES as an Operating Location: to a First, Second, and Third Generation use (H/R) criteria; to the side/rear of a Korean TAB VEE use (H/R) criteria and to the front use (H or L) criteria; to the side of a Korean Flow-Through use (H/R) criteria and to the front/rear use (H or L) criteria.

39. Base separations on shelter doors remaining closed, except for aircraft towing, fueling, servicing, run up, or taxi, and during concurrent servicing operations or short periods when maintenance equipment or munitions are being moved into or out of shelters. If doors are left open for extended periods, treat the front exposure as an Operating Location (H or L).

40. See paragraph 12.40.

41. See paragraph 12.41.

42. See paragraph 12.42.

43. Practical considerations such as firefighting and security dictate specific separation distance requirements.
### Table 12.3. HD 1.3, 1.4 and 1.6 QD Criteria.

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Notes:
1. See Section 12F - Allowable Exposures for additional exposures and Section 12O - QD criteria for specific facilities and systems.
2. ECMs must meet the design requirements in Section 6C. Sectors (front/side/rear) of ECMs are defined in paragraph 12.21. The front sector of an ECM is considered unbarricaded unless barricaded per Section 6E to mitigate fragment hazards.
3. AGMs are all types of above grade (non earth-covered) magazines or storage pads. This includes open air munitions stocks, light structures (e.g., Butler buildings), and trucks/trailers/railcars loaded with explosives.
4. The requirements of Section 6D are met (to include limitations on the type of AE stored in them and prohibition on the use of heavy structures). If the requirements of Section 6D are not met, use AGM criteria. HD 1.3 is not allowed in modules.
5. Consider parked aeroclub aircraft as non-DoD aircraft for QD purposes; the presence of aeroclub aircraft does not make an airfield joint-use.
6. MAJCOMs may require greater separation for unique mission or high value aircraft.
7. Use this row for locations in the open where passengers enplane and deplane.
8. Use this row if a structure is included where passengers assemble, such as a passenger terminal building.
9. ECMs may be used to their physical capacity for HD 1.3 and 1.4 provided they meet separation requirements for a minimum of 100 lbs of HD 1.1, and provided separations to other exposures comply with applicable QD criteria.
10. HD 1.4S may be stored (including associated handling) without regard to QD criteria (see paragraphs 12.29.3. and 2.23.).
11. Magazines storing only HD 1.4 may be located at IMD (per Table 12.13.) to all other explosives facilities (regardless of HD of NEWQD authorized in these facilities). Because the HD 1.4 may be destroyed as the result of a mishap involving the assets in these adjacent explosives facilities, the responsible Commander must accept the potential loss of the HD 1.4 stocks and the storage structure. Document the Commander’s risk acceptance by letter (i.e., signed by the Commander stating he/she understands and accepts the potential loss of the HD 1.4 stocks and the storage structure in the event of a mishap in an adjacent explosives facility) and submitted as part of the ESP. A new risk acceptance letter does not need to be generated when a new adjacent explosives facility is sited, as long as the original letter documented that other such structures might be added in future.
12. Required IMD separation is as follows: HD 1.3: See Table 12.12. IMD & ILD Column; HD 1.4: See Table 12.13. Applicable AGS IMD Column; HD 1.6: See Table 12.14. IMD & ILD Column.
13. Required IMD separation is as follows: HD 1.3: See Table 12.12. IMD & ILD Column; HD 1.4: See Table 12.13. Applicable AGS IMD Column; HD 1.6: See Table 12.14. IMD & ILD Column.
14. Required ILD separation is as follows: HD 1.3: See Table 12.12. IMD & ILD Column; HD 1.4: See Table 12.13. ILD Column; HD 1.6: See Table 12.14. IMD & ILD Column.
15. Required IBD or PTRD separation is as follows: HD 1.3: See Table 12.12. IBD & PTRD Column; HD 1.4: See Table 12.13. IBD & PTRD Column; HD 1.6: See Table 12.14. IBD & PTRD Column.
16. If required by the MAJCOM, for aircraft survivability, apply IBD/PTRD separation is as follows: HD 1.3: See Table 12.12. IBD & PTRD Column; HD 1.4: See Table 12.13. IBD & PTRD Column; HD 1.6: See Table 12.14. IBD & PTRD Column.
17. When required at overseas locations only, use 125 feet for HD 1.3. The use of this reduced separation depends on operational necessity, providing the Commander accepts the transient risk to military aircraft movements. If siting facilities, the MAJCOM/CC or CV must provide AFSEC/SEW a letter listing all installations where this separation distance will apply and state acceptance of transient risk to military aircraft movements.
18. IMD per Note 13 as a minimum unless the MAJCOM requires aircraft survivability (apply IBD/PTRD per Note 16 for aircraft survivability). See paragraph 12.47.
19. No QD separation is required.
20. MAJCOMs will determine required QD separation.
21. MAJCOM may require aircraft survivability (apply IBD/PTRD per Note 16 for aircraft survivability).

22. A HAS sited for HD 1.3 or 1.4 does not generate a QD clear zone except out the front.

23. HASs must meet the category requirements in paragraph 12.50.1. Sectors (front/side/rear) of HASs are defined in paragraph 12.21. The front sector of an HAS is considered unbarricaded unless barricaded per Section 6E to mitigate fragment hazards (see paragraph 12.50.)


25. See paragraph 12.41.

26. See paragraph 12.42.

27. For HD 1.3 and HD 1.4, no separation is required from the side or rear of an ECM.

Table 12.4. HD 1.1 Default Hazardous Fragment Distances (HFD) for IBD.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>HFD (feet) in the OPEN</th>
<th>HFD (feet) in a STRUCTURE</th>
<th>NEWQD</th>
<th>HFD (feet) in the OPEN</th>
<th>HFD (feet) in a STRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.5</td>
<td>236</td>
<td>200</td>
<td>30</td>
<td>561</td>
<td>200</td>
</tr>
<tr>
<td>0.7</td>
<td>263</td>
<td>200</td>
<td>31</td>
<td>563</td>
<td>200</td>
</tr>
<tr>
<td>1</td>
<td>291</td>
<td>200</td>
<td>50</td>
<td>601</td>
<td>388</td>
</tr>
<tr>
<td>2</td>
<td>346</td>
<td>200</td>
<td>70</td>
<td>628</td>
<td>519</td>
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<td>3</td>
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<td>200</td>
<td>100</td>
<td>658</td>
<td>658</td>
</tr>
<tr>
<td>5</td>
<td>419</td>
<td>200</td>
<td>150</td>
<td>815</td>
<td>815</td>
</tr>
<tr>
<td>7</td>
<td>445</td>
<td>200</td>
<td>200</td>
<td>927</td>
<td>927</td>
</tr>
<tr>
<td>10</td>
<td>474</td>
<td>200</td>
<td>300</td>
<td>1085</td>
<td>1085</td>
</tr>
<tr>
<td>15</td>
<td>506</td>
<td>200</td>
<td>450</td>
<td>1243</td>
<td>1243</td>
</tr>
<tr>
<td>20</td>
<td>529</td>
<td>200</td>
<td>&gt; 450</td>
<td>1250</td>
<td>1250</td>
</tr>
</tbody>
</table>

Notes:
1. Use this column for fragment producing munitions items in the open or in structures incapable of stopping primary fragments. NEWQD in lbs, HFD in feet, with a minimum HFD of 236 feet; ln is natural logarithm; exp [x] is e^x.

NEWQD < 100 lbs: \[ \text{HFD} = 291.3 + [79.2 \times \ln(\text{NEWQD})] \]
NEWQD \geq 100 lbs: \[ \text{HFD} = -1133.9 + [389 \times \ln(\text{NEWQD})] \]
HFD < 658 feet: \[ \text{NEWQD} = \exp\left(\frac{\text{HFD}}{79.2} - 3.678\right) \]
658 feet \leq \text{HFD} < 1250 feet: \[ \text{NEWQD} = \exp\left(\frac{\text{HFD}}{389} + 2.914\right) \]
2. NEWQD in lbs, HFD in feet, with a minimum distance of 200 feet; ln is natural logarithm; exp [x] is e^x.

NEWQD \leq 31 lbs: \[ \text{HFD} = 200 \text{ feet} \]
31 lbs < NEWQD \leq 450 lbs: \[ \text{HFD} = -1133.9 + [389 \times \ln(\text{NEWQD})] \]
HFD < 200 feet: \[ \text{NEWQD} = 0 \]
HFD = 200 feet: \[ \text{NEWQD} \leq 31 \]
200 feet < HFD \leq 1243 feet: \[ \text{NEWQD} = \exp\left(\frac{\text{HFD}}{389} + 2.914\right) \]
3. PTRD is 60 percent of HFD.
Table 12.5.  HFD for Open Stacks of Selected HD 1.1 AE.

<table>
<thead>
<tr>
<th>NOMENCLATURE6</th>
<th>NUMBER OF UNITS5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sparrow, AIM-7/WAU-17</td>
<td>280</td>
</tr>
<tr>
<td>Sidewinder, AIM-9</td>
<td>400</td>
</tr>
<tr>
<td>AMRAAM, AIM-120/WDU-33/B</td>
<td>280</td>
</tr>
<tr>
<td>AMRAAM, AIM-120/WDU-41/B</td>
<td>335</td>
</tr>
<tr>
<td>Chaparral, MIM-72H</td>
<td>400</td>
</tr>
<tr>
<td>Maverick, AGM 65 A/B/D</td>
<td>400</td>
</tr>
<tr>
<td>Maverick, AGM 65 E/F/G</td>
<td>670</td>
</tr>
<tr>
<td>ASROC</td>
<td>500</td>
</tr>
<tr>
<td>CBU-87 *</td>
<td>800</td>
</tr>
<tr>
<td>Improved Hawk</td>
<td>900</td>
</tr>
<tr>
<td>Penguin *</td>
<td>500</td>
</tr>
<tr>
<td>Projectile, 105mm7</td>
<td>340</td>
</tr>
<tr>
<td>Projectile, 155mm</td>
<td>415</td>
</tr>
<tr>
<td>Projectile, 57/54</td>
<td>300</td>
</tr>
<tr>
<td>Harpoon *</td>
<td>500</td>
</tr>
<tr>
<td>Tomahawk *</td>
<td>500</td>
</tr>
<tr>
<td>Bomb, 500-lb, MK 82</td>
<td>670</td>
</tr>
<tr>
<td>Bomb, 1000-lb, MK 83</td>
<td>815</td>
</tr>
<tr>
<td>Bomb, 2000-lb, MK 84</td>
<td>925</td>
</tr>
<tr>
<td>Bomb, BLU-109</td>
<td>880</td>
</tr>
<tr>
<td>Bomb, 750-lb, M117</td>
<td>690</td>
</tr>
<tr>
<td>Torpedo, MK 46</td>
<td>500</td>
</tr>
<tr>
<td>Torpedo, MK 48 8,9 (2.5-truck, or larger, unshielded)</td>
<td>630</td>
</tr>
<tr>
<td>Torpedo, MK 48 8,10 (Shielded, or other means of transport)</td>
<td>500</td>
</tr>
<tr>
<td>Tomahawk Loading on Guided Missile Submarines (SSGN)11</td>
<td>750</td>
</tr>
</tbody>
</table>

Notes:
1. Ten units or more until the point is reached where this distance is exceeded by the distance requirements of Table 12.6.
2. More than 10 units may be involved before 1250 feet is exceeded. Consult AFSEC/SEW for distances involving more than 10 units.
3. When handling more than one missile, transport or handle the missiles in a nose-to-tail configuration and in their launch capsule or shipping container; furthermore, they must be aligned and/or handled so that each group of two missiles is located outside of the warhead fragment beam spray region of the other two missiles.
4. Consult AFSEC/SEW for distances involving more than 8 units.
5. PTRD is 60 percent of the resulting IBD. ILD / IMD will be based on NEWQD.
6. Items identified by an asterisk “*” include fragments from shipping or storage containers. However, all of the HFD in this table may be applied to both packaged and unpackaged configurations.
7. 105 mm projectiles and 105mm complete rounds not in standard storage or shipping containers are HD 1.1.
8. All models, including Advanced Capability (ADCAP).
9. Use these distances when handling torpedo(es) from 2.5-ton trucks (or larger) where sandbag (or other equivalent) shielding (as described in Note (e) below) 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.

10. Use these distances when handling torpedo(es) from: a) 2.5-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, b) Other means of transportation such as flatbed trailers, boats, torpedo transporters, forklifts, or portable cranes. (Sandbag shield requirement is equivalent to a minimum thickness of two feet 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).

11. Limit handling to one launch tube at a time, with other tubes closed; risks associated with possible propagation from the Tomahawk being handled to all other AE in the SSGN as well as to AE in nearby combatant ships/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 Standard.) The reduced QD arc shall be drawn from the tube. (Pier-side staging areas must still be sited; however, the reduced QD in this table for Tomahawk missiles may be used provided the restrictions of Note 3 are applied.)
### Table 12.6. HD 1.1 IBD and PTRD.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>IBD (feet) FROM:</th>
<th>PTRD (feet) FROM:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ECM</td>
<td>ECM</td>
</tr>
<tr>
<td></td>
<td>FRONT ¹</td>
<td>SIDE ¹</td>
</tr>
<tr>
<td>1</td>
<td>500</td>
<td>250</td>
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<tr>
<td>1.5</td>
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<td>2</td>
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<td>700</td>
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<td>3,149</td>
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<tr>
<td>300,000</td>
<td>3,347</td>
<td>3,347</td>
</tr>
<tr>
<td>500,000</td>
<td>3,969</td>
<td>3,969</td>
</tr>
</tbody>
</table>

**Notes:**

1. For NEWQD < 45,000 lbs, the distance is controlled by fragments. When fragments are absent or if the HFD is less than the blast hazard range, then the following blast criteria may be used: (NEWQD in lbs, d in feet)
   - NEWQD ≤ 45,000 lbs:d = 35NEWQD¹/³
   - 45,000 lbs < NEWQD ≤ 100,000 lbs:d = 35NEWQD¹/³
100,000 lbs < NEWQD ≤ 250,000 lbs: \( d = 0.3955 \times \text{NEWQD}^{0.7227} \)

250,000 lbs < NEWQD: \( d = 50 \times \text{NEWQD}^{1/3} \)

\( d \leq 1,245 \text{ feet} \): \( \text{NEWQD} = \frac{d^3}{42,875} \)

1,245 feet < \( d \leq 1,625 \text{ feet} \): \( \text{NEWQD} = \frac{d^3}{42,875} \)

1,625 feet < \( d \leq 3,150 \text{ feet} \): \( \text{NEWQD} = 3.60935 \times d^{1.3837} \)

3,150 feet < \( d \): \( \text{NEWQD} = \frac{d^3}{125,000} \)

2. For NEWQD < 100,000 lbs, 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\(^2\) is less than the blast hazard range, then the following blast criteria may be used: (NEWQD in lbs, \( d \) in feet)

\( \text{NEWQD} \leq 100,000 \text{ lbs} \): \( d = 25 \times \text{NEWQD}^{1/3} \)

100,000 lbs < NEWQD ≤ 250,000 lbs: \( d = 0.004125 \times \text{NEWQD}^{1.0898} \)

250,000 lbs < NEWQD: \( d = 50 \times \text{NEWQD}^{1/3} \)

\( d \leq 1,160 \text{ feet} \): \( \text{NEWQD} = \frac{d^3}{15,625} \)

1,160 feet < \( d \leq 3,150 \text{ feet} \): \( \text{NEWQD} = 154.2006 \times d^{0.91760} \)

3,150 feet < \( d \): \( \text{NEWQD} = \frac{d^3}{125,000} \)

3. For NEWQD < 30,000 lbs, the distance is controlled by fragments and debris. Lesser distances may be permitted for certain situations (see paragraph 12.23.1.). (NEWQD in lbs, \( d \) in feet)

30,000 lbs < NEWQD < 100,000 lbs: \( d = 40 \times \text{NEWQD}^{1/3} \)

100,000 lbs < NEWQD ≤ 250,000 lbs: \( d = 2.42 \times \text{NEWQD}^{0.577} \)

250,000 lbs < NEWQD: \( d = 50 \times \text{NEWQD}^{1/3} \)

1,243 feet < \( d \leq 1,857 \text{ feet} \): \( \text{NEWQD} = \frac{d^3}{64,000} \)

1,857 feet < \( d \leq 3,150 \text{ feet} \): \( \text{NEWQD} = 0.2162 \times d^{1.7331} \)

3,150 feet < \( d \): \( \text{NEWQD} = \frac{d^3}{125,000} \)

4. Computed as 60 percent of applicable IBD.
Table 12.7. HD 1.1 ILD from an ECM.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>BARRICADED ILD (feet)</th>
<th>UNBARRICADED ILD (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FRONT&lt;sup&gt;1&lt;/sup&gt;</td>
<td>SIDE&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>50</td>
<td>37</td>
<td>26</td>
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<tr>
<td>70</td>
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<td>469</td>
</tr>
<tr>
<td>500,000</td>
<td>715</td>
<td>714</td>
</tr>
</tbody>
</table>

Notes:
1. NEWQD in lbs, d in feet
   NEWQD ≤ 300,000:  d = 10 x NEWQD<sup>1/3</sup>
   300,000 lbs < NEWQD ≤ 500,000 lbs:
   d = (13.659 - 1.6479 x 10<sup>-5</sup> x NEWQD + 1.4358 x 10<sup>-11</sup> x NEWQD<sup>2</sup>) x NEWQD<sup>1/3</sup>
   d ≤ 669 feet: NEWQD = d<sup>3</sup>/1000
   669 feet < d ≤ 715 feet:
   NEWQD = 1.50138 x 10<sup>8</sup> - 6.73914 x 10<sup>5</sup> x d + 1002.9 x d<sup>2</sup> - 0.4938 x d<sup>3</sup>
2. NEWQD in lbs, d in feet
   NEWQD ≤ 300,000 lbs:  d = 7 x NEWQD<sup>1/3</sup>
   300,000 lbs < NEWQD ≤ 400,000 lbs:
   d = (1.0848 + 1.986 x 10<sup>-5</sup> x NEWQD) x NEWQD<sup>1/3</sup>
   NEWQD > 400,000 lbs:  d = 9 x NEWQD<sup>1/3</sup>
   d ≤ 469 feet: NEWQD = d<sup>3</sup>/343
   469 feet < d ≤ 663 feet: NEWQD = 57,424 + 515.89 x d
   d > 663 feet: NEWQD = d<sup>3</sup>/729
3. NEWQD in lbs, d in feet
   NEWQD ≤ 300,000 lbs:  d = 6 x NEWQD<sup>1/3</sup>
300,000 lbs < NEWQD ≤ 400,000 lbs:
\[ d = (-3.059 + 3.0228 \times 10^{-5} \times \text{NEWQD}) \times \text{NEWQD}^{1/3} \]
NEWQD > 400,000 lbs:
\[ d = 9 \times \text{NEWQD}^{1/3} \]
\[ d \leq 402 \text{ feet: NEWQD} = d^{3}/216 \]
\[ 402 \text{ feet} < d \leq 665 \text{ feet: NEWQD} = 148,160 + 379.7 \times d \]
\[ d > 665 \text{ feet: NEWQD} = d^{3}/729 \]

4. NEWQD in lbs, d in feet
NEWQD ≤ 500,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
\[ d \leq 1429 \text{ feet: NEWQD} = d^{3}/5,832 \]

5. NEWQD in lbs, d in feet
NEWQD ≤ 300,000 lbs:
\[ d = 16 \times \text{NEWQD}^{1/3} \]
NEWQD > 400,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
\[ d < 402 \text{ feet: NEWQD} = d^{3}/216 \]
\[ 402 \text{ feet} < d \leq 665 \text{ feet: NEWQD} = 148,160 + 379.7 \times d \]
\[ d > 665 \text{ feet: NEWQD} = d^{3}/729 \]

6. NEWQD in lbs, d in feet
NEWQD ≤ 100,000 lbs:
\[ d = 12 \times \text{NEWQD}^{1/3} \]
NEWQD > 400,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
\[ d \leq 1071 \text{ feet: NEWQD} = d^{3}/4,096 \]
\[ 1071 \text{ feet} < d \leq 1328 \text{ feet: NEWQD} = -118,180 + 390.35 \times d \]
\[ d > 1328 \text{ feet: NEWQD} = d^{3}/5,832 \]

NEWQD < 500,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
NEWQD > 400,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
\[ d < 402 \text{ feet: NEWQD} = d^{3}/216 \]
\[ 402 \text{ feet} < d \leq 665 \text{ feet: NEWQD} = 148,160 + 379.7 \times d \]
\[ d > 665 \text{ feet: NEWQD} = d^{3}/729 \]

NEWQD < 300,000 lbs:
\[ d = 16 \times \text{NEWQD}^{1/3} \]
NEWQD > 400,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
\[ d < 402 \text{ feet: NEWQD} = d^{3}/216 \]
\[ 402 \text{ feet} < d \leq 665 \text{ feet: NEWQD} = 148,160 + 379.7 \times d \]
\[ d > 665 \text{ feet: NEWQD} = d^{3}/729 \]

NEWQD < 300,000 lbs:
\[ d = 16 \times \text{NEWQD}^{1/3} \]
NEWQD > 400,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
\[ d < 402 \text{ feet: NEWQD} = d^{3}/216 \]
\[ 402 \text{ feet} < d \leq 665 \text{ feet: NEWQD} = 148,160 + 379.7 \times d \]
\[ d > 665 \text{ feet: NEWQD} = d^{3}/729 \]

NEWQD < 300,000 lbs:
\[ d = 16 \times \text{NEWQD}^{1/3} \]
NEWQD > 400,000 lbs:
\[ d = 18 \times \text{NEWQD}^{1/3} \]
\[ d < 402 \text{ feet: NEWQD} = d^{3}/216 \]
\[ 402 \text{ feet} < d \leq 665 \text{ feet: NEWQD} = 148,160 + 379.7 \times d \]
\[ d > 665 \text{ feet: NEWQD} = d^{3}/729 \]
## Table 12.8. HD 1.1 ILD other than ECM.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>BARRICADED ILD (feet)</th>
<th>UNBARRICADED ILD (feet)</th>
<th>NEWQD (lbs)</th>
<th>BARRICADED ILD (feet)</th>
<th>UNBARRICADED ILD (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>33</td>
<td>66</td>
<td>20,000</td>
<td>244</td>
<td>489</td>
</tr>
<tr>
<td>70</td>
<td>37</td>
<td>74</td>
<td>30,000</td>
<td>280</td>
<td>559</td>
</tr>
<tr>
<td>100</td>
<td>42</td>
<td>84</td>
<td>50,000</td>
<td>332</td>
<td>663</td>
</tr>
<tr>
<td>150</td>
<td>48</td>
<td>96</td>
<td>70,000</td>
<td>371</td>
<td>742</td>
</tr>
<tr>
<td>200</td>
<td>53</td>
<td>105</td>
<td>100,000</td>
<td>418</td>
<td>835</td>
</tr>
<tr>
<td>300</td>
<td>60</td>
<td>120</td>
<td>150,000</td>
<td>478</td>
<td>956</td>
</tr>
<tr>
<td>500</td>
<td>71</td>
<td>143</td>
<td>200,000</td>
<td>526</td>
<td>1,053</td>
</tr>
<tr>
<td>700</td>
<td>80</td>
<td>160</td>
<td>300,000</td>
<td>602</td>
<td>1,205</td>
</tr>
<tr>
<td>1,000</td>
<td>90</td>
<td>180</td>
<td>500,000</td>
<td>714</td>
<td>1,429</td>
</tr>
<tr>
<td>1,500</td>
<td>103</td>
<td>206</td>
<td>700,000</td>
<td>799</td>
<td>1,598</td>
</tr>
<tr>
<td>2,000</td>
<td>113</td>
<td>227</td>
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<td>900</td>
<td>1,800</td>
</tr>
<tr>
<td>3,000</td>
<td>130</td>
<td>260</td>
<td>1,500,000</td>
<td>1,030</td>
<td>2,060</td>
</tr>
<tr>
<td>5,000</td>
<td>154</td>
<td>308</td>
<td>2,000,000</td>
<td>1,134</td>
<td>2,268</td>
</tr>
<tr>
<td>7,000</td>
<td>172</td>
<td>344</td>
<td>3,000,000</td>
<td>1,298</td>
<td>2,596</td>
</tr>
<tr>
<td>10,000</td>
<td>194</td>
<td>388</td>
<td>5,000,000</td>
<td>1,539</td>
<td>3,078</td>
</tr>
<tr>
<td>15,000</td>
<td>222</td>
<td>444</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

1. d in feet, NEWQD in lbs
   
   NEWQD ≥ 50 lbs: \( d = 9 \times \text{NEWQD}^{1/3} \)
   
   \( d > 33 \text{ feet} \): \( \text{NEWQD} = d^{3/729} \)
   
   \( d < 33 \text{ feet} \): see Note 3
   
   NEWQD < 50 lbs: see Note 3

2. d in feet, NEWQD in lbs
   
   NEWQD ≥ 50 lbs: \( d = 18 \times \text{NEWQD}^{1/3} \)
   
   \( d > 66 \text{ feet} \): \( \text{NEWQD} = d^{3/5,832} \)
   
   \( d < 66 \text{ feet} \): see Note 3
   
   NEWQD < 50 lbs: see Note 3

3. For less than 50 lbs, 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. Continue using K18 without a minimum distance for specific situations having approved guidance such as Reduced MCEs for F-15/F-16 Aircraft and the 15 January 2003 SDW memo (UFC 3-340-02 may be used to prove complete confinement of blast, fragments, and debris).

4. Authorize quantities above 500,000 lbs NEWQD only for HD 1.1 energetic liquids.
Table 12.9. HD 1.2.1 QD in the Open.

<table>
<thead>
<tr>
<th>EXPLOSIVE WEIGHT 1 (lbs)</th>
<th>IBD 2 (feet)</th>
<th>PTRD 3 (feet)</th>
<th>ILD 4 (feet)</th>
<th>EXPLOSIVE WEIGHT 1 (lbs)</th>
<th>IBD 2 (feet)</th>
<th>PTRD 3 (feet)</th>
<th>ILD 4 (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>1,500</td>
<td>774</td>
<td>464</td>
<td>278</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>2,000</td>
<td>824</td>
<td>494</td>
<td>296</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>3,000</td>
<td>893</td>
<td>536</td>
<td>321</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>5,000</td>
<td>978</td>
<td>387</td>
<td>352</td>
</tr>
<tr>
<td>7</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>7,000</td>
<td>1,033</td>
<td>620</td>
<td>372</td>
</tr>
<tr>
<td>10</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>10,000</td>
<td>1,090</td>
<td>654</td>
<td>392</td>
</tr>
<tr>
<td>15</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>15,000</td>
<td>1,154</td>
<td>692</td>
<td>415</td>
</tr>
<tr>
<td>20</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>20,000</td>
<td>1,198</td>
<td>719</td>
<td>431</td>
</tr>
<tr>
<td>30</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>30,000</td>
<td>1,260</td>
<td>756</td>
<td>453</td>
</tr>
<tr>
<td>50</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>50,000</td>
<td>1,335</td>
<td>801</td>
<td>481</td>
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<tr>
<td>70</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>70,000</td>
<td>1,383</td>
<td>830</td>
<td>498</td>
</tr>
<tr>
<td>100</td>
<td>268</td>
<td>200</td>
<td>200</td>
<td>100,000</td>
<td>1,433</td>
<td>860</td>
<td>516</td>
</tr>
<tr>
<td>150</td>
<td>348</td>
<td>200</td>
<td>200</td>
<td>150,000</td>
<td>1,489</td>
<td>893</td>
<td>536</td>
</tr>
<tr>
<td>200</td>
<td>403</td>
<td>242</td>
<td>200</td>
<td>200,000</td>
<td>1,528</td>
<td>917</td>
<td>550</td>
</tr>
<tr>
<td>300</td>
<td>481</td>
<td>288</td>
<td>200</td>
<td>300,000</td>
<td>1,581</td>
<td>949</td>
<td>569</td>
</tr>
<tr>
<td>500</td>
<td>576</td>
<td>346</td>
<td>207</td>
<td>500,000</td>
<td>1,646</td>
<td>988</td>
<td>593</td>
</tr>
<tr>
<td>700</td>
<td>638</td>
<td>383</td>
<td>230</td>
<td>&gt; 500,000</td>
<td>Note 2</td>
<td>Note 3</td>
<td>Note 4</td>
</tr>
<tr>
<td>1,000</td>
<td>702</td>
<td>421</td>
<td>253</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Explosive Weight = Number of Items x NEWQD.
2. IBD in feet, NEWQD in lbs; ln is natural logarithm; exp (x) is e^x.
3. PTRD = 60 percent of IBD with a minimum distance equal to the IMD given in Table 12.2.
4. ILD = 36 percent of IBD with a minimum distance equal to the IMD given in Table 12.2.
Table 12.10. HDD for HD 1.2.1 Stored in Structures Which Can Contribute to the Debris Hazard.

<table>
<thead>
<tr>
<th>MCE ¹ (lbs)</th>
<th>HAZARDOUS DEBRIS DISTANCE ² (feet)</th>
<th>PTRD ³ (feet)</th>
<th>ILD ⁴ (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 31</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>50</td>
<td>388</td>
<td>233</td>
<td>200</td>
</tr>
<tr>
<td>70</td>
<td>519</td>
<td>311</td>
<td>200</td>
</tr>
<tr>
<td>100</td>
<td>658</td>
<td>395</td>
<td>237</td>
</tr>
<tr>
<td>110</td>
<td>695</td>
<td>417</td>
<td>251</td>
</tr>
<tr>
<td>150</td>
<td>815</td>
<td>489</td>
<td>293</td>
</tr>
<tr>
<td>200</td>
<td>927</td>
<td>556</td>
<td>334</td>
</tr>
<tr>
<td>300</td>
<td>1,085</td>
<td>651</td>
<td>391</td>
</tr>
<tr>
<td>400</td>
<td>1,197</td>
<td>718</td>
<td>431</td>
</tr>
<tr>
<td>450</td>
<td>1,243</td>
<td>746</td>
<td>447</td>
</tr>
<tr>
<td>&gt; 450</td>
<td>1,250</td>
<td>750</td>
<td>450</td>
</tr>
</tbody>
</table>

Notes:
1. Per paragraph 3.16.4., include HD 1.2.1 MCEs in the JHCS for each HD 1.2.1 item. If the MCE is not available, use the default MCE determined by multiplying NEWQD in a single container by three.
2. MCE in lbs, HDD in feet; ln is natural logarithm; exp [x] is e^x.
   31 lbs < MCE ≤ 450 lbs
   HDD = -1133.9 + [389 x ln (MCE)] with a minimum of 200 feet
   200 feet < HDD ≤ 1250 feet
   MCE = exp [(HDD/389) + 2.914]
3. PTRD = 60 percent of IBD with a minimum distance equal to the IMD given in Table 12.2. treating the ES as an AGM (H or L).
4. ILD = 36 percent of IBD with a minimum distance equal to the IMD given in Table 12.2. treating the ES as an AGM.
Table 12.11. HD 1.2.2 QD.

<table>
<thead>
<tr>
<th>EXPLOSIVE WEIGHT ¹ (lbs)</th>
<th>IBD ² (feet)</th>
<th>PTRD ³ (feet)</th>
<th>ILD ⁴ (feet)</th>
<th>EXPLOSIVE WEIGHT ¹ (lbs)</th>
<th>IBD ² (feet)</th>
<th>PTRD ³ (feet)</th>
<th>ILD ⁴ (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>1,000</td>
<td>238</td>
<td>143</td>
<td>100</td>
</tr>
<tr>
<td>1.5</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>1,500</td>
<td>262</td>
<td>157</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>2,000</td>
<td>279</td>
<td>168</td>
<td>101</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>3,000</td>
<td>306</td>
<td>183</td>
<td>110</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>5,000</td>
<td>341</td>
<td>205</td>
<td>123</td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>7,000</td>
<td>366</td>
<td>220</td>
<td>132</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>10,000</td>
<td>394</td>
<td>236</td>
<td>142</td>
</tr>
<tr>
<td>15</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<td>427</td>
<td>256</td>
<td>154</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>20,000</td>
<td>451</td>
<td>271</td>
<td>162</td>
</tr>
<tr>
<td>30</td>
<td>107</td>
<td>100</td>
<td>100</td>
<td>30,000</td>
<td>487</td>
<td>292</td>
<td>175</td>
</tr>
<tr>
<td>50</td>
<td>118</td>
<td>100</td>
<td>100</td>
<td>50,000</td>
<td>535</td>
<td>321</td>
<td>193</td>
</tr>
<tr>
<td>70</td>
<td>127</td>
<td>100</td>
<td>100</td>
<td>70,000</td>
<td>568</td>
<td>341</td>
<td>204</td>
</tr>
<tr>
<td>100</td>
<td>138</td>
<td>100</td>
<td>100</td>
<td>100,000</td>
<td>604</td>
<td>362</td>
<td>217</td>
</tr>
<tr>
<td>150</td>
<td>152</td>
<td>100</td>
<td>100</td>
<td>150,000</td>
<td>647</td>
<td>388</td>
<td>233</td>
</tr>
<tr>
<td>200</td>
<td>162</td>
<td>100</td>
<td>100</td>
<td>200,000</td>
<td>678</td>
<td>407</td>
<td>244</td>
</tr>
<tr>
<td>300</td>
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<td>100</td>
<td>100</td>
<td>300,000</td>
<td>723</td>
<td>434</td>
<td>260</td>
</tr>
<tr>
<td>500</td>
<td>202</td>
<td>121</td>
<td>100</td>
<td>&gt; 500,000</td>
<td>Note 2</td>
<td>Note 3</td>
<td>Note 4</td>
</tr>
</tbody>
</table>

Notes:
1. Explosive Weight = Number of Items x NEWQD.
2. IBD in feet, NEWQD in lbs; ln is natural logarithm; exp (x) is e^x.
3. 20 lbs < Explosive Weight
   IBD = 101.649 – [15.934 x (ln (Number of items x NEWQD))] + [5.173 x (ln (Number of items x NEWQD))^2] with a minimum of 100 feet
   Number of items x NEWQD = exp [1.5401 + (-17.278 + 0.1933 x IBD)^1/2]
4. PTRD = 60 percent of IBD with a minimum distance equal to the IMD given in Table 12.2. treating the ES as an AGM (H or L).
5. ILD = 36 percent of IBD with a minimum distance equal to the IMD given in Table 12.2. treating the ES as an AGM.
6. See Chapter 11 for storage and operations involving limited quantities of HD 1.2.2.
### Table 12.12. HD 1.3 QD.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>IBD &amp; PTRD $^{12}$ (feet)</th>
<th>IMD &amp; ILD $^{3,4}$ (feet)</th>
<th>NEWQD (lbs)</th>
<th>IBD &amp; PTRD $^{12}$ (feet)</th>
<th>IMD &amp; ILD $^{3,4}$ (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 1,000$</td>
<td>75</td>
<td>50</td>
<td>70,000</td>
<td>268</td>
<td>181</td>
</tr>
<tr>
<td>1,500</td>
<td>82</td>
<td>56</td>
<td>100,000</td>
<td>300</td>
<td>204</td>
</tr>
<tr>
<td>2,000</td>
<td>89</td>
<td>61</td>
<td>150,000</td>
<td>346</td>
<td>234</td>
</tr>
<tr>
<td>3,000</td>
<td>101</td>
<td>68</td>
<td>200,000</td>
<td>385</td>
<td>260</td>
</tr>
<tr>
<td>5,000</td>
<td>117</td>
<td>80</td>
<td>300,000</td>
<td>454</td>
<td>303</td>
</tr>
<tr>
<td>7,000</td>
<td>130</td>
<td>88</td>
<td>500,000</td>
<td>569</td>
<td>372</td>
</tr>
<tr>
<td>10,000</td>
<td>145</td>
<td>98</td>
<td>700,000</td>
<td>668</td>
<td>428</td>
</tr>
<tr>
<td>15,000</td>
<td>164</td>
<td>112</td>
<td>1,000,000</td>
<td>800</td>
<td>500</td>
</tr>
<tr>
<td>20,000</td>
<td>180</td>
<td>122</td>
<td>1,500,000</td>
<td>916</td>
<td>572</td>
</tr>
<tr>
<td>30,000</td>
<td>204</td>
<td>138</td>
<td>2,000,000</td>
<td>1,008</td>
<td>630</td>
</tr>
<tr>
<td>50,000</td>
<td>240</td>
<td>153</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Some HD 1.3 items have a parenthetical value (xx). For such items, the IBD/PTRD will be the greater of the parenthetical value, or the IBD/PTRD given in this table.
2. NEWQD in lbs, d in feet
   NEWQD $\leq 1,000$ lbs: $d_{IBD, PTRD} = 75$
   1,000 lbs $< NEWQD < 96,000$ lbs:
   $$d_{IBD, PTRD} = \exp \left[ 2.47 + 0.2368 \times (\ln (NEWQD)) + 0.00384 \times (\ln (NEWQD))^2 \right]$$
   with a minimum distance of 75 feet
   96,000 lbs $< NEWQD \leq 1,000,000$ lbs:
   $$d_{IBD, PTRD} = \exp \left[ 7.2297 - 0.5984 \times (\ln (NEWQD)) + 0.04046 \times (\ln (NEWQD))^2 \right]$$
   NEWQD $> 1,000,000$ lbs: $d_{IBD, PTRD} = 8 \times NEWQD^{1/3}$
   75 feet $< d_{IBD, PTRD} \leq 296$ feet:
   $$NEWQD = \exp \left[ -30.833 + (307.465 + 260.417 \times (\ln (d_{IBD, PTRD})))^{1/2} \right]$$
   with a minimum NEWQD of 1,000 lbs
   296 feet $< d_{IBD, PTRD} \leq 800$ feet:
   $$NEWQD = \exp \left[ 7.395 + (-124.002 + 24.716 \times (\ln (d_{IBD, PTRD})))^{1/2} \right]$$
   800 feet $< d_{IBD, PTRD}$: $NEWQD = d_{IBD, PTRD}^{3/125}$
3. NEWQD in lbs, d in feet
   NEWQD $\leq 1,000$ lbs: $d_{IMD, ILD} = 50$
   1,000 lbs $< NEWQD < 84,000$ lbs:
   $$d_{IMD, ILD} = \exp \left[ 2.0325 + 0.2488 \times (\ln (NEWQD)) + 0.00313 \times (\ln (NEWQD))^2 \right]$$
   with a minimum distance of 50 feet
   84,000 lbs $< NEWQD \leq 1,000,000$ lbs:
   $$d_{IMD, ILD} = \exp \left[ 4.338 - 0.1695 \times (\ln (NEWQD)) + 0.0221 \times (\ln (NEWQD))^2 \right]$$
   1,000,000 lbs $< NEWQD$: $d_{IMD, ILD} = 5 \times NEWQD^{1/3}$
   50 feet $\leq d_{IMD, ILD} \leq 192$ feet:
   $$NEWQD = \exp \left[ -39.744 + (930.257 + 319.49 \times (\ln (d_{IMD, ILD})))^{1/2} \right]$$
   with a minimum NEWQD of 1,000 lbs
   192 feet $< d_{IMD, ILD} \leq 500$ feet:
   $$NEWQD = \exp \left[ 3.834 + (-181.58 + 45.249 \times (\ln (d_{IMD, ILD})))^{1/2} \right]$$
   500 feet $< d_{IMD, ILD}$: $NEWQD = d_{IMD, ILD}^{3/125}$
4. Existing ECM, regardless of orientation, that meet the construction and barricading requirements and meet separation requirements one from another for a minimum of 100 lbs NEWQD of HD 1.1 (using the ECM-to-ECM QD criteria in Table 12.1.) may be used to their physical storage capacity for HD 1.3, provided all other QD relationships are sited per Table 12.12, for the HD 1.3 NEWQD.

5. For quantities less than 1,000 lbs, the required distances are those specified for 1,000 lbs. The use of lesser distances may be approved when supported by test data and/or analyses.

6. See Chapter 11 for storage and operations involving limited quantities of HD 1.3.

Table 12.13. HD 1.4 QD.

<table>
<thead>
<tr>
<th>NEWQD² (lbs)</th>
<th>IBD &amp; PTRD³ (feet)</th>
<th>ILD⁴,⁵ (feet)</th>
<th>AGS (L) IMD⁵,⁶ (feet)</th>
<th>AGS (H) &amp; (H/R) IMD⁵,⁷ (feet)</th>
<th>ECM IMD⁵,¹² (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 3000</td>
<td>75</td>
<td>50</td>
<td>50</td>
<td>0 to and from from the Sides &amp; Rear</td>
<td>See Note 11 for the Front</td>
</tr>
<tr>
<td>&gt; 3000⁹</td>
<td>100</td>
<td>100/50¹⁰</td>
<td>100/50¹⁰</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. 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. Separate such a structure from all other warehouses per the AGS (L) IMD column of this table.
2. See paragraph 12.7.1.1. 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.
3. IBD and PTRD are 50 feet from the sides and rear of an ECM. IBD and PTRD are 50 feet from an AGS (H), an AGS (H/R), and an ECM front that meets the definition of AGS (H) as defined in the legend for Table 12.2, doors and other openings shall be barricaded IAW Section 6E, or the IBD or PTRD column of this table applied from them.
4. ILD is zero feet from the sides and rear of an ECM. ILD is zero feet from an AGS (H), an AGS (H/R), and an ECM front that meets the definition of AGS (H) as defined in the legend for Table 12.2. Doors and other openings shall be barricaded IAW Section 6E, or the ILD column of this table applied from these doors and openings.
5. Magazines storing only HD 1.4 AE may be located at these IM or IL distances from all other magazines or operating locations 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 responsible Commander must accept the potential loss of the HD 1.4 stocks and the storage structure. Document the Commander’s risk acceptance by letter (i.e., signed by the Commander stating he/she understands and accepts the potential loss of the HD 1.4 stocks and the storage structure in the event of a mishap in an adjacent explosives facility) and submitted as part of the ESP. A new risk acceptance letter is not required when a
new adjacent explosives facility is sited, as long as the original letter documented that other such structures might be added in the future.

6. Applies to all AGS (L) as defined in the legend for Table 12.2.
7. Applies to all AGS (H) and AGS (H/R) as defined in the legend for Table 12.2. Doors and other openings shall be barricaded IAW Section 6E, or the AGS (L) IMD column of this table applied to and from these doors and openings.

8. HD 1.4S may be stored (including associated handling) without regard to QD criteria (see paragraphs 12.29.3. and 2.23.). Additionally, for reasons of operational necessity, limited quantities of HD 1.4 AE (e.g., small arms AE and riot control munitions) may be stored within facilities (e.g., hangars, arms rooms, and operating buildings) without regard to QD. See Chapter 11 for storage and operations involving limited quantities of HD 1.4.

9. There is no upper limit on the NEWQD specifically required for safety reasons.

10. Use the smaller distance when the ES is of non-combustible construction. Treat combat aircraft and explosives-loaded cargo aircraft as non-combustible structures.

11. Apply the appropriate AGS column of this table based on whether the ECM front meets the definition of AGS (L) or AGS (H), as defined in the legend for Table 12.2.

12. ECMs may be used to their physical capacity for HD 1.4 provided they meet separation requirements for a minimum of 100 lbs of HD 1.1, and provided separations to other exposures comply with applicable QD criteria.

Table 12.14. HD 1.6 QD.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>IBD &amp; PTRD 23 (feet)</th>
<th>IMD &amp; ILD 2,4 (feet)</th>
<th>NEWQD (lbs)</th>
<th>IBD &amp; PTRD 23 (feet)</th>
<th>IMD &amp; ILD 2,4 (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 100 5</td>
<td>37</td>
<td>23</td>
<td>10,000</td>
<td>172</td>
<td>108</td>
</tr>
<tr>
<td>150</td>
<td>43</td>
<td>27</td>
<td>15,000</td>
<td>197</td>
<td>123</td>
</tr>
<tr>
<td>200</td>
<td>47</td>
<td>29</td>
<td>20,000</td>
<td>217</td>
<td>136</td>
</tr>
<tr>
<td>300</td>
<td>54</td>
<td>33</td>
<td>30,000</td>
<td>249</td>
<td>155</td>
</tr>
<tr>
<td>500</td>
<td>63</td>
<td>40</td>
<td>50,000</td>
<td>295</td>
<td>184</td>
</tr>
<tr>
<td>700</td>
<td>71</td>
<td>44</td>
<td>70,000</td>
<td>330</td>
<td>206</td>
</tr>
<tr>
<td>1,000</td>
<td>80</td>
<td>50</td>
<td>100,000</td>
<td>371</td>
<td>232</td>
</tr>
<tr>
<td>1,500</td>
<td>92</td>
<td>57</td>
<td>150,000</td>
<td>425</td>
<td>266</td>
</tr>
<tr>
<td>2,000</td>
<td>101</td>
<td>63</td>
<td>200,000</td>
<td>468</td>
<td>292</td>
</tr>
<tr>
<td>3,000</td>
<td>115</td>
<td>72</td>
<td>300,000</td>
<td>536</td>
<td>335</td>
</tr>
<tr>
<td>5,000</td>
<td>137</td>
<td>85</td>
<td>500,000</td>
<td>635</td>
<td>397</td>
</tr>
<tr>
<td>7,000</td>
<td>153</td>
<td>96</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. When specifically approved by AFSEC/SEW, for HD 1.6 AE packed in non-flammable pallets or packing and stored in an ECM, the following QD apply, unless a lesser distance is permitted by this table for aboveground sites:
   \( D_{IBD, PTRD} = 100 \text{ feet} \)
   \( D_{ILD} = 50 \text{ feet} \)
D_{IMD} = no specific requirement
2. Single round distance for airblast applies as a minimum; D in feet, \text{NEWQD} in lbs.
\[ D_{IBD, PTRD} = 40W^{1/3} \] based on the \text{NEWQD} for a single round of AE
\[ D_{IMD, ILD} = 18W^{1/3} \] based on the \text{NEWQD} for a single round of AE
3. D in feet, \text{NEWQD} in lbs
\[ D_{IBD, PTRD} = 8W^{1/3} \]
\[ \text{NEWQD} = D_{IBD, PTRD}^3/512 \]
4. D in feet, \text{NEWQD} in lbs
\[ D_{IMD, ILD} = 5W^{1/3} \]
\[ \text{NEWQD} = D_{IMD, ILD}^3/125 \]
5. For quantities less than 100 lbs, the required distances are those specified for 100 lbs. The use of lesser distances may be approved when supported by test data and/or analyses. (These lesser distances can be applied to ECM storage).
Table 12.15. Hazard Classifications and Minimum QD for Energetic Liquids.

<table>
<thead>
<tr>
<th>ENERGETIC LIQUID</th>
<th>OSHA/NFPA FUEL(^1) OR OXIDIZER(^2) CLASS</th>
<th>DoD STORAGE HAZARD CLASS</th>
<th>MINIMUM QD(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen Peroxide, &gt; 60 percent</td>
<td>3 or 4(^4)</td>
<td>5.1 (LA)</td>
<td>800(^5) feet or Table 12.19</td>
</tr>
<tr>
<td>IRFNA</td>
<td>3</td>
<td>8 (LA)</td>
<td>Table 12.19</td>
</tr>
<tr>
<td>Nitrogen Tetroxide/MON</td>
<td>2</td>
<td>2.3 (LA)</td>
<td>Table 12.19</td>
</tr>
<tr>
<td>Liquid Oxygen</td>
<td>N/A</td>
<td>2.2 (LA)</td>
<td>Table 12.20</td>
</tr>
<tr>
<td>RP-1</td>
<td>II</td>
<td>3 (LB)</td>
<td>Table 12.18</td>
</tr>
<tr>
<td>JP-10</td>
<td>II</td>
<td>3J (LB)</td>
<td>Table 12.18</td>
</tr>
<tr>
<td>Liquid Hydrogen</td>
<td>N/A</td>
<td>2.1 (LB)</td>
<td>Table 12.21</td>
</tr>
<tr>
<td>Hydrazine, &gt; 64 percent</td>
<td>II</td>
<td>8 (LC)</td>
<td>800(^5) or 300(^6) feet or Note 7</td>
</tr>
<tr>
<td>Aerzine 50 (50 percent N(_2)H(_5)/50percent UDMH) (Unsymmetric dimethylhydrazine)</td>
<td>I B</td>
<td>6.1 (LC)</td>
<td>800(^5) or 300(^6) feet or Note 7</td>
</tr>
<tr>
<td>Methylhydrazine</td>
<td>I B</td>
<td>6.1 (LC)</td>
<td>800(^5) or 300(^6) feet or Note 7</td>
</tr>
<tr>
<td>UDMH</td>
<td>I B</td>
<td>6.1 (LC)</td>
<td>Table 12.18</td>
</tr>
<tr>
<td>Ethylene Oxide</td>
<td>I A</td>
<td>2.3 (LD)</td>
<td>HD 1.1 QD(^8) with TNT Equiv = 100percent, or 800(^5) or 300(^6) feet</td>
</tr>
<tr>
<td>Propylene Oxide</td>
<td>I A</td>
<td>3 (LD)</td>
<td>HD 1.1 QD(^8) with TNT Equiv = 100percent, or 800(^5) or 300(^6) feet</td>
</tr>
<tr>
<td>Nitromethane</td>
<td>I C</td>
<td>3 (LE)</td>
<td>HD 1.1 QD with TNT Equiv = 100percent(^6) or Table 12.18</td>
</tr>
<tr>
<td>Hydroxylammonium Nitrate (HAN)</td>
<td>2</td>
<td>8 (LE)</td>
<td>800(^5) feet or Table 12.19</td>
</tr>
<tr>
<td>XM-46 (HAN Monopropellant)</td>
<td>N/A</td>
<td>1.3C (LE)</td>
<td>800(^5) feet or use HD 1.3 QD</td>
</tr>
<tr>
<td>Otto Fuel II</td>
<td>III B</td>
<td>9 (LE)</td>
<td>HD 1.1 QD(^10) with TNT Equiv = 100percent, or 150(^11) feet or Table 12.18</td>
</tr>
<tr>
<td>Halogen Fluorides (ClF(_3)/ClF(_2))</td>
<td>4</td>
<td>2.3 (LE)</td>
<td>Table 12.19</td>
</tr>
<tr>
<td>Liquid Fluorine</td>
<td>4</td>
<td>2.3 (LE)</td>
<td>Table 12.19</td>
</tr>
<tr>
<td>Nitrogen Trifluoride</td>
<td>4</td>
<td>2.2 (LE)</td>
<td>Table 12.19</td>
</tr>
<tr>
<td>Nitrate esters (e.g., NG, TMETN, DEGDN, TEGDN, BITN)</td>
<td>N/A</td>
<td>1.1D (LE)</td>
<td>HD 1.1 QD with TNT Equiv = 100percent</td>
</tr>
</tbody>
</table>

Notes:
1. Flammable or combustible liquid classification index based on flash point and boiling point versus criteria as specified in Title 29, Code of Federal Regulations, Part 1910.109, Explosives and Blasting Agents, and NFPA 30 Flammable and Combustible Liquids Code. Primary descriptor is a Roman numeral, possibly with an additional letter.
2. NFPA oxidizer classification index as described in NFPA 430 Code for the Storage of Liquid and Solid Oxidizers. Descriptor is an ordinary number.
3. Positive measures for spill containment/control will be taken for isolated storage of energetic liquids IAW applicable OSHA and NFPA guidance (referenced in Tables 12.18. through 12.20.). For flammable energetic liquids and liquid oxidizers where only minimum blast or fragment distances are specified, applicable OSHA and/or NFPA guidance referenced in Tables 12.18. and 12.19. should also be used.
4. Hydrogen peroxide solutions of concentration greater than 91 percent are NFPA Class 4 oxidizers.
5. Should be used as a default value, unless otherwise hazard classified, when the material is packaged in small (non-bulk) shipping containers, portable ground support equipment, small aerospace flight vehicle propellant tanks or similar pressure vessels that provide heavy confinement (burst pressure greater than 100 psi).
6. Should be used as a default value, unless otherwise hazard classified, when the material is packaged in small (non-bulk) shipping containers (DOT 5C or equivalent), portable ground support equipment, small aerospace flight vehicle propellant tanks, or similar pressure vessels providing a lower level of confinement (burst pressure less than or equal to 100 psi and if adequate protection from fragments is not provided from terrain, effective barricades, nets, or other physical means (lightweight building construction is not adequate). If protection from fragments is provided, use the IBD/PTRD "Protected" column of Table 12.21.
7. For large ready, bulk, or rest storage tanks (as defined in paragraphs 12.36.7., 12.36.9., and 12.36.10.), use Table 12.21.
8. Where there is a reasonable risk of vapor cloud explosion of large quantities (e.g., in bulk tank storage).
9. Technical grade nitromethane in unit quantities of 55 gallons or less in DOT approved containers listed in 49CFR Part 173.202 may be stored as flammable liquids (See Table 12.18.) provided the following apply: a) Packages are stored only one tier high, b) Packages are protected from direct rays of sun, c) Maximum storage life of two years, unless storage life tests indicate product continues to meet purchase specification. Such tests are to be repeated at one-year intervals thereafter.
10. For underwater static test stands, when operated at hydrostatic pressure above 50 psig, or for propellant tanks or other vessels having burst pressures of greater than 100 psig without acceptable pressure relief devices (unless otherwise hazard classified). For underwater test stands, the TNT equivalence (MCE) should be included in the total energetic liquids weight in all pumps and plumbing, as well as the weight of energetic liquids held in tankage (under the test cell hydrostatic pressure) unless acceptable mitigation measures such as fuel line detonation arrestors and/or fuel tank isolation/barricading are used (as determined by hazard analysis).
11. Should be used as a default value, unless otherwise hazard classified, when the material is packaged in small vehicle propellant tanks, small (non-bulk) shipping containers, portable ground support equipment, or similar pressure vessels that provide relatively heavy confinement (burst pressure between 50 – 100 psig) without acceptable pressure relief devices.
Table 12.16. Factors to Use When Converting Energetic Liquid Densities.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DENSITY (lb/gal)</th>
<th>TEMPERATURE (degrees F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine pentafluoride</td>
<td>14.8</td>
<td>77</td>
</tr>
<tr>
<td>Chlorine trifluoride</td>
<td>15.1</td>
<td>77</td>
</tr>
<tr>
<td>Ethyl alcohol</td>
<td>6.6</td>
<td>68</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>7.4</td>
<td>51</td>
</tr>
<tr>
<td>Fluorine (liquid)</td>
<td>12.6</td>
<td>-306</td>
</tr>
<tr>
<td>HAN monopropellants</td>
<td>11.9</td>
<td>77</td>
</tr>
<tr>
<td>HAN solution (25 to 95 wt percent)</td>
<td>10.0 to 13.4</td>
<td>68</td>
</tr>
<tr>
<td>Hydrazine</td>
<td>8.4</td>
<td>68</td>
</tr>
<tr>
<td>Hydrogen peroxide (90 percent)</td>
<td>11.6</td>
<td>77</td>
</tr>
<tr>
<td>JP-10</td>
<td>7.8</td>
<td>60</td>
</tr>
<tr>
<td>Liquid hydrogen</td>
<td>0.59</td>
<td>-423</td>
</tr>
<tr>
<td>Liquid oxygen</td>
<td>9.5</td>
<td>-297</td>
</tr>
<tr>
<td>Monomethyl hydrazine</td>
<td>7.3</td>
<td>68</td>
</tr>
<tr>
<td>Nitrogen tetroxide</td>
<td>12.1</td>
<td>68</td>
</tr>
<tr>
<td>Nitrogen trifluoride</td>
<td>12.8</td>
<td>-200</td>
</tr>
<tr>
<td>Nitromethane</td>
<td>9.5</td>
<td>68</td>
</tr>
<tr>
<td>Otto Fuel II</td>
<td>10.3</td>
<td>77</td>
</tr>
<tr>
<td>Propylene oxide</td>
<td>7.2</td>
<td>32</td>
</tr>
<tr>
<td>IRFNA</td>
<td>12.9</td>
<td>77</td>
</tr>
<tr>
<td>RP-1</td>
<td>6.8</td>
<td>68</td>
</tr>
<tr>
<td>UDMH</td>
<td>6.6</td>
<td>68</td>
</tr>
<tr>
<td>UDMH/hydrazine</td>
<td>7.5</td>
<td>77</td>
</tr>
</tbody>
</table>

Note:
1. Conversion of quantities of energetic liquids from gallons to lbs: lbs of energetic liquids = gallons X density of energetic liquids (lbs/gal).

Table 12.17. Energetic Liquid Explosive Equivalents.

<table>
<thead>
<tr>
<th>ENERGETIC LIQUIDS</th>
<th>TNT EQUIVALENCE</th>
<th>RANGE LAUNCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO2/LH2</td>
<td>See Note 6</td>
<td>See Note 6</td>
</tr>
<tr>
<td>LO2/LH2 + LO2/RP-1</td>
<td>Sum of (see Note 6 for LO2/LH2) + (10 percent for LO2/RP-1)</td>
<td>Sum of (see Note 6 for LO2/LH2) + (20 percent for LO2/RP-1)</td>
</tr>
<tr>
<td>LO2/RP-1</td>
<td>10 percent</td>
<td>20 percent up to 500,000 lbs plus 10 percent over 500,000 lbs</td>
</tr>
<tr>
<td>IRFNA/UDMH</td>
<td>10 percent</td>
<td>10 percent</td>
</tr>
<tr>
<td>N2O4/UDMH + N2H4</td>
<td>5 percent</td>
<td>10 percent</td>
</tr>
<tr>
<td>N2O4 liquid oxidizer + PBAN solid fuel (Hybrid propellants)</td>
<td>15 percent</td>
<td>15 percent</td>
</tr>
<tr>
<td>Nitromethane (alone or in combination)</td>
<td>100 percent</td>
<td>100 percent</td>
</tr>
<tr>
<td>Otto Fuel II</td>
<td>100 percent</td>
<td>100 percent</td>
</tr>
<tr>
<td>Ethylene Oxide</td>
<td>100 percent</td>
<td>100 percent</td>
</tr>
</tbody>
</table>

Notes:
1. The percentage factors given in the table are to be used to determine equivalencies of energetic liquids mixtures at static test stands and range launch pads when such energetic liquids are located aboveground and are unconfined except for their tankage. Other configurations are considered on an individual basis to determine equivalencies.
2. Add the explosives equivalent weight calculated by the use of this table to any nonnuclear explosive weight aboard before distances can be determined from Tables 12.6 and 12.8.

3. These equivalencies apply also for the following substitutions: Alcohols or other hydrocarbons for RP-1, H₂O₂ for LO₂ (only when LO₂ is in combination with RP-1 or equivalent hydrocarbon fuel), MMH for N₂H₄, UDMH, or combinations of the two.

4. For quantities of energetic liquids up to but not over the equivalent of 100 lbs of AE, AFSEC/SEW will determine the distance on an individual basis. Protect all personnel and facilities, whether involved in the operation or not, by operating procedures, equipment design, shielding, barricading, or other suitable means.

5. Distances less than 1LD are not specified. Where a number of prepackaged energetic liquid units are stored together, separation distance to other storage facilities will be determined on an individual basis by AFSEC/SEW, taking into consideration normal hazard classification procedures.

6. For siting launch vehicles and static test stands, explosive equivalent weight is the larger of:
   (a) The weight equal to 8W²/3 where W is the weight of LO₂/LH₂; or (b) 14 percent of the LO₂/LH₂ weight. (For these calculations, use the total weight of LO₂/LH₂ present in the launch vehicle, or the total weight in test stand run tankage and piping where there is no positive means to prevent mixing in credible mishaps. When it can be reliably demonstrated that the MCE involves a lesser quantity of energetic liquids subject to involvement in a single reaction, the lesser quantity may be used in determining the explosive equivalent yield. When siting is based on a quantity less than the total energetic liquids present, document the MCE and associated explosive yield analysis in an approved ESP (see Chapter 14)).

7. These are hypergolic combinations.

8. Explosive equivalency of the hybrid rocket system N₂O₄ liquid oxidizer combined with PBAN (polybutadiene-acrylic acid-acronitrile) solid fuel was evaluated as 15 percent for an explosive donor accident scenario, 5 percent for a high velocity impact scenario, and less than 0.01 percent (negligible) for static mixing (tower drop) failures IAW NFPA 251, Standard Methods of Tests of Endurance of Building Construction and Materials.

9. See Note 10 of Table 12.15.

10. See Note 8 of Table 12.15.

Table 12.18. QD Criteria for OSHA/NFPA Class I – III Flammable and Combustible Energetic Liquids Storage in Detached Buildings or Tanks.

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>IBD/PTRD (feet)</th>
<th>ILD/ABOVEGROUND IMD (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlimited</td>
<td>50 ⁴,⁵</td>
<td>Note 6</td>
</tr>
</tbody>
</table>

Notes:
1. Other guidelines for diking, tank or container construction, tank venting, and facility construction apply (except for Class III B combustible liquids, e.g., Otto Fuel II). Refer to NFPA 30, Flammable and Combustible Liquids Code and NFPA 430, Code for the Storage of Liquid and Solid Oxidizers for further guidance on liquid storage and fire protection.

3. Guidelines on interior storage configuration (for container storage inside buildings) also apply with the following exceptions; (a) If the storage building is located at least 100 feet from any exposed building (under the direct jurisdiction of a fire protection organization) or property line; or (b) If the storage building is located at least 200 feet from any exposed building (not under the direct jurisdiction of a fire protection organization) or property line; or (c) for combustible liquids that will not exhibit sustained burning in bulk form, e.g., Otto Fuel II, as determined through ASTM D 92 Standard Test Method for Flash and Fire Points by Cleveland Open Cup or comparable testing. Refer to NFPA 30, Flammable and Combustible Liquids Code and NFPA 430, Code for the Storage of Liquid and Solid Oxidizers for further guidance on liquid storage and fire protection.

4. For container storage inside of a building, IBD/PTR distances may be less than 50 feet (to a minimum of 10 feet) if the storage building is constructed of fire resistive exterior walls having an NFPA Fire Resistance rating of two hours or more according to NFPA 251, Standard Methods of Tests of Endurance of Building Construction and Materials.

5. For large tank storage, QD may be 25 feet for tank capacities up to 100,000 gallons, and 37.5 feet for capacities between 100,001 and 500,000 gallons.

6. For flammable liquids container storage inside of a building, ILD/Aboveground IMD is 50 feet (except as in Note 4), or for adjacent incompatible oxidizer storage, distances specified for energetic liquid oxidizers (Table 12.19.) or oxygen (Table 12.20.). For flammable liquids storage in fixed or large portable tanks, ILD/Aboveground IMD is either (1) for compatible energetic liquids, equal to one sixth of the sum of the diameters of the two adjacent tanks, or distances specified in Note 5 for adjacent container storage inside of a building; or (2) for adjacent incompatible oxidizer storage, distances specified for energetic liquid oxidizers (Table 12.19.) or oxygen (Table 12.20.). ECM may be used to their physical capacity for storing flammable energetic liquids provided they comply with the construction and siting requirements of Chapter 6 and Chapter 12, respectively for Hazard Division 1.1. ECM must be sited for a minimum of 100 lbs of HD 1.1 items using Tables 12.7. and 12.1.
Table 12.19. QD Criteria for Energetic Liquid Oxidizer (excluding Liquid Oxygen) Storage in Detached Buildings or Tanks.

<table>
<thead>
<tr>
<th>NFPA OXIDIZER CLASS</th>
<th>QUANTITY (lbs)</th>
<th>IBD/PTRD/ILD/ABOVEGROUND IMD (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>up to 600,000</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>up to 400,000</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>≤ 50</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>700</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>1,000</td>
<td>147</td>
</tr>
<tr>
<td></td>
<td>1,500</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>3,000</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>5,000</td>
<td>328</td>
</tr>
<tr>
<td></td>
<td>7,000</td>
<td>404</td>
</tr>
<tr>
<td></td>
<td>10,000</td>
<td>510</td>
</tr>
<tr>
<td></td>
<td>15,000</td>
<td>592</td>
</tr>
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<td></td>
<td>20,000</td>
<td>651</td>
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<td></td>
<td>30,000</td>
<td>746</td>
</tr>
<tr>
<td></td>
<td>50,000</td>
<td>884</td>
</tr>
<tr>
<td></td>
<td>70,000</td>
<td>989</td>
</tr>
<tr>
<td></td>
<td>100,000</td>
<td>1,114</td>
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<tr>
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<td>1,275</td>
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<tr>
<td></td>
<td>200,000</td>
<td>1,404</td>
</tr>
<tr>
<td></td>
<td>300,000</td>
<td>1,607</td>
</tr>
<tr>
<td></td>
<td>500,000</td>
<td>1,905</td>
</tr>
</tbody>
</table>

Notes:
1. QD requirements do not apply to the storage of NFPA Class 2 and 3 oxidizers when all requirements of NFPA 430, Code for the Storage of Liquid and Solid Oxidizers, have been met.
2. Other requirements for interior storage configuration, building construction, diking, container materials, facility venting, etc. also apply. Refer to NFPA 430, Code for the Storage of Liquid and Solid Oxidizers for further guidance on oxidizer storage and fire protection.
3. Refer to NFPA 430, Code for the Storage of Liquid and Solid Oxidizers for definition and explanation of NFPA classification of oxidizers.
4. Multiple tanks containing NFPA Class 4 oxidizers may be located at distances less than those specified in the table; however, if the tanks are not separated from each other by 10 percent of the distance specified for the largest tank, then the total contents of all tanks are used to calculate distances to other exposures.
5. The equations given below may be used to determine distance/weights for other quantities:
   Quantity (W) in lbs, distance in feet
   \[ W \leq 10,000 \text{ lbs: Distance} = 149.3 \times W^{(-0.41+0.059 \times \ln(W))} \]
   \[ W > 10,000 \text{ lbs: Distance} = 24 \times W^{1/3} \]
   Distance > 75 feet:
   \[ W = \exp[-134.286 + 71.998 \times \ln(\text{Distance})] - 12.363 \times (\ln(\text{Distance}))^2 + 0.7229 \times (\ln(\text{Distance}))^3 + 0.0003 \times (\ln(\text{Distance}))^4 \]
6. NFPA 430 requires sprinkler protection be provided for storage of greater than 2,000 lbs of NFPA Class 4 oxidizers inside of a building (NFPA 430, Code for the Storage of Liquid and Solid Oxidizers).

Table 12.20. QD Criteria for Liquid Oxygen Storage in Detached Buildings or Tanks.

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>IBD/PTRD (feet)</th>
<th>ILD/ABOVEGROUND IMD (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlimited (^3)</td>
<td>100</td>
<td>100 (^4)</td>
</tr>
</tbody>
</table>

Notes:
1. Per NFPA 251, Standard Methods of Tests of Endurance of Building Construction and Materials, distances do not apply where a protective structure having an NFPA fire resistance rating of at least two hours interrupts the line of sight between the oxygen system and the exposure. Refer to 29 CFR Subpart H Part 1910 and NFPA 50, Standard for Bulk Oxygen Systems at Consumer Sites for further guidance.
3. QD is independent of oxygen quantity.
4. Minimum ILD/IMD distance between adjacent compatible energetic liquids storage is 50 feet.
Table 12.21. QD Criteria for Liquid Hydrogen and Bulk Quantities of Hydrazines.

<table>
<thead>
<tr>
<th>PROPELLANT WEIGHT (W) (lbs)</th>
<th>IBD/PRTRD</th>
<th>UNPROTECTED</th>
<th>PROTECTED</th>
<th>ILD/ABOVEGROUND IMD (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 100</td>
<td>600</td>
<td>80</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>600</td>
<td>90</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>600</td>
<td>100</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>600</td>
<td>113</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>600</td>
<td>130</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>700</td>
<td>600</td>
<td>141</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>1,000</td>
<td>600</td>
<td>153</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>1,500</td>
<td>600</td>
<td>166</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>2,000</td>
<td>600</td>
<td>176</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>3,000</td>
<td>600</td>
<td>191</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>5,000</td>
<td>600</td>
<td>211</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>7,000</td>
<td>600</td>
<td>224</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td>603</td>
<td>239</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>15,000</td>
<td>691</td>
<td>258</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>20,000</td>
<td>760</td>
<td>272</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>30,000</td>
<td>870</td>
<td>292</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>1,032</td>
<td>321</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>70,000</td>
<td>1,154</td>
<td>341</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>100,000</td>
<td>1,300</td>
<td>364</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>150,000</td>
<td>1,488</td>
<td>391</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>200,000</td>
<td>1,637</td>
<td>412</td>
<td>155</td>
<td></td>
</tr>
<tr>
<td>300,000</td>
<td>1,800</td>
<td>444</td>
<td>166</td>
<td></td>
</tr>
<tr>
<td>500,000</td>
<td>1,800</td>
<td>487</td>
<td>183</td>
<td></td>
</tr>
<tr>
<td>700,000</td>
<td>1,800</td>
<td>518</td>
<td>194</td>
<td></td>
</tr>
<tr>
<td>1,000,000</td>
<td>1,800</td>
<td>552</td>
<td>207</td>
<td></td>
</tr>
<tr>
<td>1,500,000</td>
<td>1,800</td>
<td>594</td>
<td>223</td>
<td></td>
</tr>
<tr>
<td>2,000,000</td>
<td>1,800</td>
<td>626</td>
<td>235</td>
<td></td>
</tr>
<tr>
<td>3,000,000</td>
<td>1,800</td>
<td>673</td>
<td>252</td>
<td></td>
</tr>
<tr>
<td>5,000,000</td>
<td>1,800</td>
<td>737</td>
<td>276</td>
<td></td>
</tr>
<tr>
<td>7,000,000</td>
<td>1,800</td>
<td>782</td>
<td>293</td>
<td></td>
</tr>
<tr>
<td>10,000,000</td>
<td>1,800</td>
<td>832</td>
<td>312</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Take positive measures to prevent mixing of hydrogen or hydrazine’s and adjacent oxidizers in the event of a leak or spill.
2. Distances are necessary to provide reasonable protection from fragments of tanks or equipment that is expected to be thrown in event of a vapor phase explosion.
3. W in lbs, Distance in feet
   W ≤ 10,000 lbs: Unprotected Distance = 600 feet
   10,000 < W ≤ 265,000 lbs: Unprotected Distance = 28 x W^{1/3}
   W > 265,000 lbs: Unprotected Distance = 1,800 feet
   603 feet ≤ Unprotected Distance < 1,798 feet: W = (Unprotected Distance/28)^3
4. The term “protected” means that protection from fragments is provided by terrain, effective barricades, nets, or other physical means.
5. Distances are based on the recommended IBD given in DTR 4500.9-R-Part II and extrapolation of the two cal/cm² data on the one percent water vapor curve.
W ≤ 100 lbs: Protected Distance = 80 feet
100 lbs < W:
Protected Distance = -154.1 + 72.89 x [ln (W)] – 6.675 x [ln (W)]^2 + 0.369 x [ln (W)]^3
80 feet ≤ Protected Distance:
W = exp [311.367 – 215.761 x (ln (protected distance)) + 55.1828 x (ln (protected distance))^2 – 6.1099 x (ln (protected distance))^3 + 0.25343 x (ln (protected distance))^4]
W: is in lbs, distance: is in feet

6. ILD/Aboveground IMD distances in this column apply for adjacent compatible (ELCG LB or LC) storage; for adjacent incompatible (other ELCG) storage, use IBD distances shown in previous columns. ECMs may be used to their physical capacity for storing hydrogen provided they comply with the construction and siting requirements of Chapters 6 and 12, respectively for HD 1.1. ECM must be sited for a minimum of 100 lbs of HD 1.1 items using Tables 12.7 and 12.1.

7. Distances are 37.5 percent of “protected” column.
8. Extrapolations above 1,000,000 lbs extend well outside data included in Title 14, Code of Federal Regulations, Part 77, Objects Affecting Navigable Airspace, current edition where the original QD tables were derived; however, they are supported by independent calculations and knowledge of like phenomena.

Table 12.22. HD 1.1 QD for Military Aircraft Parking Areas.

<table>
<thead>
<tr>
<th>NEWQD</th>
<th>Distance for Specific Targets Indicated in Table 12.11,1,3</th>
<th>NEWQD</th>
<th>Distance for Specific Targets Indicated in Table 12.11,1,3</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>111</td>
<td>7,000</td>
<td>574</td>
</tr>
<tr>
<td>70</td>
<td>124</td>
<td>10,000</td>
<td>646</td>
</tr>
<tr>
<td>100</td>
<td>139</td>
<td>15,000</td>
<td>740</td>
</tr>
<tr>
<td>150</td>
<td>159</td>
<td>20,000</td>
<td>814</td>
</tr>
<tr>
<td>200</td>
<td>175</td>
<td>30,000</td>
<td>932</td>
</tr>
<tr>
<td>300</td>
<td>201</td>
<td>50,000</td>
<td>1,105</td>
</tr>
<tr>
<td>500</td>
<td>238</td>
<td>70,000</td>
<td>1,236</td>
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<tr>
<td>700</td>
<td>266</td>
<td>100,000</td>
<td>1,392</td>
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<td>150,000</td>
<td>1,594</td>
</tr>
<tr>
<td>1,500</td>
<td>343</td>
<td>200,000</td>
<td>1,754</td>
</tr>
<tr>
<td>2,000</td>
<td>378</td>
<td>300,000</td>
<td>2,008</td>
</tr>
<tr>
<td>3,000</td>
<td>433</td>
<td>500,000</td>
<td>2,381</td>
</tr>
<tr>
<td>5,000</td>
<td>513</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. D in feet, NEWQD in lbs: D = 30W^{1/3} with a minimum distance of 111 feet; NEWQD = D^3/27,000 with a minimum NEWQD of 50 lbs.
2. D in feet, NEWQD in lbs: D = 30W^{1/3} with a minimum distance of 111 feet; NEWQD = D^3/27,000 with a minimum NEWQD of 50 lbs.
3. To protect against low-angle, high-speed fragments, provide barricades and do not reduce these distances.
Table 12.23. HAS Separation Criteria to Prevent Simultaneous Detonation.

<table>
<thead>
<tr>
<th>FROM:</th>
<th>1st Generation HAS</th>
<th>2nd or 3rd Generation HAS</th>
<th>Korean TAB VEE 5 HAS</th>
<th>Korean Flow-Through</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO:</td>
<td>S</td>
<td>R</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>1st Generation HAS</td>
<td>S K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>R K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>F K6</td>
<td>K4.5</td>
<td>K8</td>
<td>K6 K4.5</td>
</tr>
<tr>
<td>2nd or 3rd Generation HAS</td>
<td>S K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>R K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>F K4.5</td>
<td>K2.75</td>
<td>K8</td>
<td>K4.5 K2.75</td>
</tr>
<tr>
<td>Korean TAB VEE 5 HAS</td>
<td>S K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>R K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>F K6</td>
<td>K6</td>
<td>K11</td>
<td>K6 K6</td>
</tr>
<tr>
<td></td>
<td>F/R K6</td>
<td>K6</td>
<td>K11</td>
<td>K6 K6</td>
</tr>
<tr>
<td>HAS Ready Service ECM</td>
<td>S K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>R K2</td>
<td>K2</td>
<td>K2.75</td>
<td>K2 K2</td>
</tr>
<tr>
<td></td>
<td>FB K2.75</td>
<td>K2.75</td>
<td>K8</td>
<td>K2.75 K2.75</td>
</tr>
<tr>
<td></td>
<td>FU K6</td>
<td>K4.5</td>
<td>K8</td>
<td>K6 K4.5</td>
</tr>
<tr>
<td>HAS Ready Service AGM</td>
<td>B K2.75</td>
<td>K2.75</td>
<td>K6</td>
<td>K2.75 K2.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FROM:</th>
<th>HAS Ready Service ECM</th>
<th>HAS Ready Service AGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO:</td>
<td>S</td>
<td>R</td>
</tr>
<tr>
<td>1st Generation HAS</td>
<td>S K2</td>
<td>K2</td>
</tr>
<tr>
<td></td>
<td>R K2</td>
<td>K2</td>
</tr>
<tr>
<td></td>
<td>F K2.75</td>
<td>K2.75</td>
</tr>
<tr>
<td>2nd or 3rd Generation HAS</td>
<td>S K2</td>
<td>K2</td>
</tr>
<tr>
<td></td>
<td>R K2</td>
<td>K2</td>
</tr>
<tr>
<td></td>
<td>F K2</td>
<td>K2</td>
</tr>
<tr>
<td>Korean TAB VEE 5 HAS</td>
<td>S K2</td>
<td>K2</td>
</tr>
<tr>
<td></td>
<td>R K2</td>
<td>K2</td>
</tr>
<tr>
<td></td>
<td>F K6</td>
<td>K6</td>
</tr>
<tr>
<td>Korean Flow-Through HAS</td>
<td>S K2</td>
<td>K2</td>
</tr>
<tr>
<td></td>
<td>F/R K6</td>
<td>K6</td>
</tr>
<tr>
<td>HAS Ready Service ECM</td>
<td>S</td>
<td>R</td>
</tr>
</tbody>
</table>

Notes:
1. Separations are based on First, Second, and Third Generation HAS doors remaining closed, except for aircraft towing, fueling, servicing, run up, or taxi, and during concurrent servicing operations or short periods when maintenance equipment or munitions are being moved into or out of shelters. If doors are left open for extended periods, apply default IMD to or from an open front. A HAS arch or rear wall may be considered as a barricade for application of K6. No reduction from K11 is allowed between “open door” HAS front to front exposures.

2. First Generation and Korean TAB VEE HAS are limited to a maximum NEWQD of 5,863 lbs. Second Generation, Third Generation, and Korean Flow-Through HAS are limited to a maximum NEWQD of 11,000 lbs. HAS Ready Service ECMs/AGMs are limited to a maximum NEWQD of 22,000 lbs.

3. HAS Pairs: a) Flow-through HAS Pairs are limited to a maximum NEWQD of 4,800 lbs in each HAS. For this NEWQD, provide IM protection between each HAS in a HAS Pair. IM protection between a HAS Pair and adjacent HAS and HAS Ready Service ECM/AGM shall be IAW this table for the HAS designs involved. b) HAS Pairs with rear walls or with front and rear walls are limited to a maximum NEWQD of 2,390 lbs in each HAS. For this NEWQD, provide IM protection between each HAS in a HAS Pair. IM protection between a HAS Pair and adjacent HAS and HAS Ready Service ECM/AGM shall be IAW this table for the HAS designs involved.

4. Use $d = 1.25W^{1/3}$ if the ECM loading density is $\leq 1.25 \text{ lbs/ft}^3$.

5. A Korean TAB VEE HAS, modified to incorporate the hardened front closure of the First Generation TAB VEE or TAB VEE Modified HAS, may be treated as a First Generation HAS.

Table 12.24. HAS Separation Criteria for Asset Preservation.

<table>
<thead>
<tr>
<th>FROM:</th>
<th>1st Generation HAS</th>
<th>2nd or 3rd Generation HAS</th>
<th>Korean TAB VEE 4 HAS</th>
<th>Korean Flow-Through HAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO:</td>
<td>S R F</td>
<td>S R F</td>
<td>S R F</td>
<td>S F/R</td>
</tr>
<tr>
<td>1st Generation HAS</td>
<td>S K9 K6 K9</td>
<td>K9 K6 K9</td>
<td>K9 K6 K11</td>
<td>K9 K11</td>
</tr>
<tr>
<td></td>
<td>R K8 K5 K8</td>
<td>K8 K5 K8</td>
<td>K8 K5 K11</td>
<td>K8 K11</td>
</tr>
<tr>
<td></td>
<td>F K18 K18 K18</td>
<td>K18 K18 K18</td>
<td>K18 K18 K24</td>
<td>K18 K24</td>
</tr>
<tr>
<td>2nd or 3rd Generation HAS</td>
<td>S K9 K6 K9</td>
<td>K9 K6 K9</td>
<td>K9 K6 K11</td>
<td>K9 K11</td>
</tr>
<tr>
<td></td>
<td>R K8 K5 K8</td>
<td>K8 K5 K8</td>
<td>K8 K5 K11</td>
<td>K8 K11</td>
</tr>
<tr>
<td></td>
<td>F K11 K9 K18</td>
<td>K11 K9 K18</td>
<td>K11 K9 K18</td>
<td>K11 K18</td>
</tr>
<tr>
<td>Korean TAB VEE 4 HAS</td>
<td>S K30 K24 K24</td>
<td>K30 K24 K24</td>
<td>K30 K24 K30</td>
<td>K30 K30</td>
</tr>
<tr>
<td></td>
<td>R K30 K24 K24</td>
<td>K30 K24 K24</td>
<td>K30 K24 K30</td>
<td>K30 K30</td>
</tr>
<tr>
<td></td>
<td>F K30 K24 K24</td>
<td>K30 K24 K24</td>
<td>K30 K24 K30</td>
<td>K30 K30</td>
</tr>
<tr>
<td>1st Generation Maintenance HAS 4</td>
<td>S K9 K8 K9</td>
<td>K9 K8 K9</td>
<td>K9 K8 K11</td>
<td>K9 K11</td>
</tr>
<tr>
<td></td>
<td>R K8 K8 K8</td>
<td>K8 K8 K8</td>
<td>K8 K8 K11</td>
<td>K8 K11</td>
</tr>
<tr>
<td></td>
<td>F K18 K18 K18</td>
<td>K18 K18 K18</td>
<td>K18 K18 K24</td>
<td>K18 K24</td>
</tr>
<tr>
<td>2nd or 3rd Generation Maintenance HAS 5</td>
<td>S K9 K8 K9</td>
<td>K9 K8 K9</td>
<td>K9 K8 K11</td>
<td>K9 K11</td>
</tr>
<tr>
<td></td>
<td>R K8 K8 K8</td>
<td>K8 K8 K8</td>
<td>K8 K8 K11</td>
<td>K8 K11</td>
</tr>
<tr>
<td></td>
<td>F K11 K9 K18</td>
<td>K11 K9 K18</td>
<td>K11 K9 K18</td>
<td>K11 K18</td>
</tr>
</tbody>
</table>
Notes:

1. Separations are based on First, Second, and Third Generation HAS doors remaining closed, except for aircraft towing, fueling, servicing, run up, or taxi, and during concurrent servicing operations or short periods when maintenance equipment or munitions are being moved into or out of shelters. If doors are left open for extended periods, apply Table 12.22, to or from an open front.

2. First Generation and Korean TAB VEE HAS are limited to a maximum NEWQD of 5,863 lbs. Second Generation, Third Generation, and Korean Flow-Through HAS are limited to a maximum NEWQD of 11,000 lbs. HAS Ready Service ECM, used to support daily loading, are limited to a maximum NEWQD of 22,000 lbs and a loading density of not more than 1.25 lbs/ft³. And HAS Ready Service AGM are limited to a maximum NEWQD of 22,000 lbs.

3. HAS Pairs. Asset preservation is not provided between each HAS in a HAS Pair. Flow-Through HAS Pairs are limited to a maximum NEWQD of 4,800 lbs in each HAS. HAS Pairs with rear walls or with front and rear walls are limited to a maximum NEWQD of 2,390 lbs in each HAS. Asset preservation distances between a HAS Pair and adjacent HAS and HAS Ready Service ECM/AGM must be IAW this table for the HAS designs involved.

4. A Korean TAB VEE HAS, that has been modified to incorporate the hardened front closure of the First Generation TAB VEE or TAB VEE Modified HAS, may be treated as a First Generation HAS.

5. The distances reflect K30 equivalent protection (when doors are closed) for the aircraft. If this table is not applied for aircraft survivability, then ILD equivalent protection must be provided to personnel.
Table 12.25. QD from a Third Generation HAS PES to an Unhardened ES.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>FRONT</th>
<th>SIDE</th>
<th>REAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \leq 5 \text{ lbs} )</td>
<td>IBD, PTRD, ILD = 50 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
</tr>
<tr>
<td>( 5 &lt; \text{NEWQD} \leq 500 )</td>
<td>IBD, PTRD, ILD = 230 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
</tr>
<tr>
<td>( 500 &lt; \text{NEWQD} \leq 1,100 )</td>
<td>IBD, PTRD, ILD = 230 feet</td>
<td>IBD, PTRD, ILD = 394 feet</td>
<td>IBD, PTRD, ILD = 164 feet</td>
</tr>
<tr>
<td>( 1,100 &lt; \text{NEWQD} \leq 11,000 )</td>
<td>IBD = K50, PTRD = 50 percent, ILD = 35 percent, IBD, 300 feet min</td>
<td>IBD = K62, PTRD = 50 percent IBD, 394 feet min</td>
<td>IBD = K40, PTRD = 30 percent IBD, 300 feet min</td>
</tr>
</tbody>
</table>

Notes:
1. This table may be applied from the front, sides and rear of a Second Generation HAS, and from the sides of a Korean Flow-Through HAS. Apply default QD criteria from the front and rear of a Korean Flow-Through HAS.
2. Base separations on shelter doors remaining closed, except for aircraft towing, fueling, servicing, run up, or taxi, and during concurrent servicing operations or short periods when maintenance equipment or munitions are moved into or out of shelters. If doors are left open for extended periods, normal CAPA (per Tables 12.1., 12.2. and 12.3.) apply from the front.
3. Separate AE from the HAS walls by a distance sufficient to prevent breaching. For less than 1,100 lbs NEWQD a three foot separation from the wall is sufficient.
4. The QD criteria apply to IBD, PTRD and ILD exposures for quantities \( \leq 1,100 \text{ lbs NEWQD} \).
5. The 50 foot distance is not for QD purposes; it represents a minimum fire separation distance.
6. QD criterion applies to IBD, PTRD, and ILD exposures for quantities > 1,100 to 11,000 lbs NEWQD. Use 50 percent of the IBD criteria for PTRD exposures with a 300 foot minimum out the front and rear or a 394 foot minimum distance off the sides. Use 35 percent of the IBD criteria for ILD exposures with a 300 foot minimum distance out the front and rear or 394 foot minimum distance off the sides.
7. Minimum separation distances to unhardened ESs are based on the potential catastrophic risk to personnel from secondary HAS fragmentation in the event of an explosives mishap.
Table 12.26. QD from a First Generation HAS PES to an Unhardened ES.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>FRONT</th>
<th>SIDE</th>
<th>REAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2.63 lbs</td>
<td>IBD, PTRD, ILD = 50 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
</tr>
<tr>
<td>2.63 &lt; NEWQD ≤ 263.8 lbs</td>
<td>IBD, PTRD, ILD = 230 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
<td>IBD, PTRD, ILD = 50 feet</td>
</tr>
<tr>
<td>263.8 &lt; NEWQD ≤ 586.3 lbs</td>
<td>IBD, PTRD, ILD = 230 feet</td>
<td>IBD, PTRD, ILD = 394 feet</td>
<td>IBD, PTRD, ILD = 164 feet</td>
</tr>
<tr>
<td>586.3 &lt; NEWQD ≤ 5,863 lbs</td>
<td>IBD = K50 PTRD = 50% IBD, 300 feet min</td>
<td>IBD = K62 PTRD = 50% IBD, 394 feet min</td>
<td>IBD = K40 PTRD = 50% IBD, 300 feet min</td>
</tr>
<tr>
<td></td>
<td>ILD = 35% IBD, 300 feet min</td>
<td>ILD = 35% IBD, 394 feet min</td>
<td>ILD = 35% IBD, 300 feet min</td>
</tr>
</tbody>
</table>

Notes:
1. This table may be applied from the front, sides and rear of a First Generation HAS, and from the sides and rear of a Korean TAB VEE HAS. Apply default QD criteria from the front of a Korean TAB VEE HAS.
2. Separations are based on shelter doors remaining closed, except for aircraft towing, fueling, servicing, run up, or taxi, and during concurrent servicing operations or short periods when maintenance equipment or munitions are being moved into or out of shelters. If doors are left open for extended periods, normal CAPA (per Tables 12.1., 12.2. and 12.3.) apply from the front.
3. Separate AE from the HAS walls by a distance sufficient to prevent breaching. For less than 1,100 lbs NEWQD a three foot separation from the wall is sufficient.
4. These QD criteria apply to IBD, PTRD & ILD exposures for quantities ≤ 586.3 lbs NEWQD.
5. The 50 foot distance shown is not for QD purposes, but represents a minimum fire separation.
6. QD criteria applies to IBD, PTRD, and ILD exposures for quantities > 586.3 to 5,863 lbs NEWQD. Use 50 percent of the IBD criteria for PTRD exposures with a 300 foot minimum out the front and rear or a 394 foot minimum distance off the sides. Use 35 percent of the IBD criteria for ILD exposures with a 300 foot minimum distance out the front and rear or 394 foot minimum distance off the sides.
7. Minimum separation distances to unhardened ESs are based on the potential catastrophic risk to personnel from secondary HAS fragmentation in the event of an explosives mishap.
Table 12.27. Default Maximum Case Fragment Distances versus Diameter for Intentional Detonations.

<table>
<thead>
<tr>
<th>Diameter (in)</th>
<th>Maximum Fragment Distance$^1$</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Robust$^2$ (feet)</td>
<td>Extremely Heavy Case$^3$ (feet)</td>
<td>Non-Robust$^4$ (feet)</td>
</tr>
<tr>
<td>0.1</td>
<td>100</td>
<td>178</td>
<td>131</td>
</tr>
<tr>
<td>0.2</td>
<td>136</td>
<td>285</td>
<td>248</td>
</tr>
<tr>
<td>0.3</td>
<td>214</td>
<td>376</td>
<td>349</td>
</tr>
<tr>
<td>0.4</td>
<td>290</td>
<td>458</td>
<td>439</td>
</tr>
<tr>
<td>0.5</td>
<td>365</td>
<td>533</td>
<td>519</td>
</tr>
<tr>
<td>0.6</td>
<td>438</td>
<td>603</td>
<td>593</td>
</tr>
<tr>
<td>0.7</td>
<td>509</td>
<td>670</td>
<td>661</td>
</tr>
<tr>
<td>0.8</td>
<td>578</td>
<td>734</td>
<td>725</td>
</tr>
<tr>
<td>0.9</td>
<td>645</td>
<td>796</td>
<td>784</td>
</tr>
<tr>
<td>1.0</td>
<td>711</td>
<td>855</td>
<td>840</td>
</tr>
<tr>
<td>1.5</td>
<td>1,016</td>
<td>1,127</td>
<td>1,079</td>
</tr>
<tr>
<td>2.0</td>
<td>1,290</td>
<td>1,371</td>
<td>1,270</td>
</tr>
<tr>
<td>2.5</td>
<td>1,539</td>
<td>1,597</td>
<td>1,430</td>
</tr>
<tr>
<td>3.0</td>
<td>1,769</td>
<td>1,808</td>
<td>1,568</td>
</tr>
<tr>
<td>3.5</td>
<td>1,983</td>
<td>2,009</td>
<td>1,688</td>
</tr>
<tr>
<td>4.0</td>
<td>2,182</td>
<td>2,200</td>
<td>1,795</td>
</tr>
<tr>
<td>4.5</td>
<td>2,369</td>
<td>2,384</td>
<td>1,892</td>
</tr>
<tr>
<td>5.0</td>
<td>2,546</td>
<td>2,562</td>
<td>1,979</td>
</tr>
<tr>
<td>Diameter (in)</td>
<td>Maximum Fragment Distance¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Robust² (feet)</td>
<td>Extremely Heavy Case³ (feet)</td>
<td>Non-Robust⁴ (feet)</td>
</tr>
<tr>
<td>5.5</td>
<td>2,713</td>
<td>2,734</td>
<td>2,058</td>
</tr>
<tr>
<td>6.0</td>
<td>2,872</td>
<td>2,901</td>
<td>2,131</td>
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<tr>
<td>6.5</td>
<td>3,024</td>
<td>3,064</td>
<td>2,198</td>
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<td>7.0</td>
<td>3,169</td>
<td>3,223</td>
<td>2,261</td>
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<tr>
<td>7.5</td>
<td>3,307</td>
<td>3,378</td>
<td>2,319</td>
</tr>
<tr>
<td>8.0</td>
<td>3,440</td>
<td>3,530</td>
<td>2,373</td>
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<tr>
<td>8.5</td>
<td>3,568</td>
<td>3,679</td>
<td>2,424</td>
</tr>
<tr>
<td>9.0</td>
<td>3,691</td>
<td>3,825</td>
<td>2,472</td>
</tr>
<tr>
<td>9.5</td>
<td>3,810</td>
<td>3,969</td>
<td>2,517</td>
</tr>
<tr>
<td>10.0</td>
<td>3,924</td>
<td>4,110</td>
<td>2,559</td>
</tr>
<tr>
<td>10.5</td>
<td>4,035</td>
<td>4,249</td>
<td>2,599</td>
</tr>
<tr>
<td>11.0</td>
<td>4,142</td>
<td>4,386</td>
<td>2,637</td>
</tr>
<tr>
<td>11.5</td>
<td>4,246</td>
<td>4,521</td>
<td>2,674</td>
</tr>
<tr>
<td>12.0</td>
<td>4,347</td>
<td>4,654</td>
<td>2,708</td>
</tr>
<tr>
<td>12.5</td>
<td>4,444</td>
<td>4,786</td>
<td>2,741</td>
</tr>
<tr>
<td>13.0</td>
<td>4,539</td>
<td>4,916</td>
<td>2,772</td>
</tr>
<tr>
<td>13.5</td>
<td>4,631</td>
<td>5,044</td>
<td>2,802</td>
</tr>
<tr>
<td>14.0</td>
<td>4,721</td>
<td>5,170</td>
<td>2,830</td>
</tr>
</tbody>
</table>
Notes:

1. These calculated fragment throw distances are for individual munitions and do not apply to stacks. They also do not address “rogue” (non-case) fragments that are produced from sections of nose plugs, base plates, boattails, or lugs. Rogue fragments can travel to significantly greater distances (i.e., >10,000 feet) than those shown. Take care to properly orient the munition or take other measures to minimize rogue fragment hazards.

<table>
<thead>
<tr>
<th>Diameter (in)</th>
<th>Maximum Fragment Distance¹</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Robust² (feet)</td>
<td>Extremely Heavy Case³ (feet)</td>
<td>Non-Robust⁴ (feet)</td>
</tr>
<tr>
<td>14.5</td>
<td>4,808</td>
<td>5,296</td>
<td>2,857</td>
</tr>
<tr>
<td>15.0</td>
<td>4,893</td>
<td>5,419</td>
<td>2,883</td>
</tr>
<tr>
<td>16.0</td>
<td>5,057</td>
<td>5,663</td>
<td>2,933</td>
</tr>
<tr>
<td>18.0</td>
<td>5,362</td>
<td>6,137</td>
<td>3,020</td>
</tr>
<tr>
<td>20.0</td>
<td>5,640*</td>
<td>6,594*</td>
<td>3,095*</td>
</tr>
<tr>
<td>22.0</td>
<td>5,896*</td>
<td>7,037*</td>
<td>3,160*</td>
</tr>
<tr>
<td>24.0</td>
<td>6,133*</td>
<td>7,467*</td>
<td>3,217*</td>
</tr>
<tr>
<td>26.0</td>
<td>6,353*</td>
<td>7,886*</td>
<td>3,268*</td>
</tr>
<tr>
<td>28.0</td>
<td>6,558*</td>
<td>8,295*</td>
<td>3,312*</td>
</tr>
<tr>
<td>30.0</td>
<td>6,750*</td>
<td>8,695*</td>
<td>3,352*</td>
</tr>
<tr>
<td>35.0</td>
<td>7,182*</td>
<td>9,659*</td>
<td>3,435*</td>
</tr>
<tr>
<td>40.0</td>
<td>7,557*</td>
<td>10,580*</td>
<td>3,499*</td>
</tr>
<tr>
<td>45.0</td>
<td>7,887*</td>
<td>11,465*</td>
<td>3,549*</td>
</tr>
<tr>
<td>50.0</td>
<td>8,180*</td>
<td>12,319*</td>
<td>3,588*</td>
</tr>
<tr>
<td>55.0</td>
<td>8,443*</td>
<td>13,146*</td>
<td>3,619*</td>
</tr>
<tr>
<td>60.0</td>
<td>8,680*</td>
<td>13,950*</td>
<td>3,644*</td>
</tr>
</tbody>
</table>

* Extrapolated

Notes:
1. These calculated fragment throw distances are for individual munitions and do not apply to stacks. They also do not address “rogue” (non-case) fragments that are produced from sections of nose plugs, base plates, boattails, or lugs. Rogue fragments can travel to significantly greater distances (i.e., >10,000 feet) than those shown. Take care to properly orient the munition or take other measures to minimize rogue fragment hazards.
2. Determine maximum fragment distance (MFD) in feet and diameter (D) in inches for robust munitions as follows (ln is natural logarithm):
   \[ MFD = 711 \times D^{(0.91 - 0.073 \times \ln(D))} \]
   \[ D = \exp \left[ 6.233 - \left\{ 128.804 - 13.699 \times \ln(MFD) \right\}^{1/2} \right] \]
3. Determine MFD in feet and D in inches for extremely heavy case munitions as follows:
   \[ MFD = 854.8 \times D^{0.682} \]
   \[ D = (5.0243 \times 10^{-5}) \times MFD^{1.4663} \]
4. Determine MFD in feet and D in inches for non-robust munitions as follows:
   \[ MFD = 840 \times D^{(0.645 - 0.07 \times \ln(D))} \]
   \[ D = \exp \left[ 4.607 - \left\{ 117.417 - 14.286 \times \ln(MFD) \right\}^{1/2} \right] \]
5. Use of equations given in Notes (2), (3), and (4) to determine other D/MFD combinations is allowed.
6. See paragraph 12.72.3.2.2. for ranges associated with multiple munitions detonation.
Table 12.28. Default Maximum Case Fragment Distances versus Net Explosive Weight for Intentional Detonations.

<table>
<thead>
<tr>
<th>Net Explosive Weight (lbs)</th>
<th>Maximum Fragment Distance(^1)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Robust(^2) (feet)</td>
<td>Extremely Heavy Case(^3) (feet)</td>
</tr>
<tr>
<td>0.01</td>
<td>587</td>
<td>150</td>
</tr>
<tr>
<td>0.015</td>
<td>747</td>
<td>379</td>
</tr>
<tr>
<td>0.02</td>
<td>861</td>
<td>542</td>
</tr>
<tr>
<td>0.03</td>
<td>1,021</td>
<td>772</td>
</tr>
<tr>
<td>0.04</td>
<td>1,134</td>
<td>934</td>
</tr>
<tr>
<td>0.05</td>
<td>1,222</td>
<td>1,061</td>
</tr>
<tr>
<td>0.06</td>
<td>1,294</td>
<td>1,164</td>
</tr>
<tr>
<td>0.07</td>
<td>1,355</td>
<td>1,251</td>
</tr>
<tr>
<td>0.08</td>
<td>1,408</td>
<td>1,327</td>
</tr>
<tr>
<td>0.09</td>
<td>1,454</td>
<td>1,393</td>
</tr>
<tr>
<td>0.1</td>
<td>1,496</td>
<td>1,453</td>
</tr>
<tr>
<td>0.15</td>
<td>1,656</td>
<td>1,682</td>
</tr>
<tr>
<td>0.2</td>
<td>1,769</td>
<td>1,845</td>
</tr>
<tr>
<td>0.3</td>
<td>1,929</td>
<td>2,075</td>
</tr>
<tr>
<td>0.4</td>
<td>2,043</td>
<td>2,237</td>
</tr>
<tr>
<td>0.5</td>
<td>2,131</td>
<td>2,364</td>
</tr>
<tr>
<td>0.6</td>
<td>2,202</td>
<td>2,467</td>
</tr>
<tr>
<td>0.7</td>
<td>2,263</td>
<td>2,554</td>
</tr>
<tr>
<td>Net Explosive Weight (lbs)</td>
<td>Maximum Fragment Distance¹</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Robust²</td>
<td>Extremely Heavy Case³</td>
</tr>
<tr>
<td>0.8</td>
<td>2,316</td>
<td>2,630</td>
</tr>
<tr>
<td>0.9</td>
<td>2,362</td>
<td>2,696</td>
</tr>
<tr>
<td>1.0</td>
<td>2,404</td>
<td>2,756</td>
</tr>
<tr>
<td>1.5</td>
<td>2,564</td>
<td>2,985</td>
</tr>
<tr>
<td>2</td>
<td>2,677</td>
<td>3,148</td>
</tr>
<tr>
<td>3</td>
<td>2,837</td>
<td>3,378</td>
</tr>
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</tr>
<tr>
<td>9</td>
<td>3,271</td>
<td>3,999</td>
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<td>4,059</td>
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<tr>
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<td>3,472</td>
<td>4,288</td>
</tr>
<tr>
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<td>3,586</td>
<td>4,451</td>
</tr>
<tr>
<td>30</td>
<td>3,746</td>
<td>4,681</td>
</tr>
<tr>
<td>50</td>
<td>3,947</td>
<td>4,970</td>
</tr>
<tr>
<td>70</td>
<td>4,080</td>
<td>5,160</td>
</tr>
<tr>
<td>Net Explosive Weight (lbs)</td>
<td>Maximum Fragment Distance(^1)</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Robust(^2)</td>
<td>Extremely Heavy Case(^3)</td>
</tr>
<tr>
<td>100</td>
<td>4,221</td>
<td>5,362</td>
</tr>
<tr>
<td>150</td>
<td>4,381</td>
<td>5,592</td>
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<td>4,494</td>
<td>5,754</td>
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<td>4,654</td>
<td>5,984</td>
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<tr>
<td>500</td>
<td>4,856</td>
<td>6,273</td>
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<td>4,988</td>
<td>6,463</td>
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<tr>
<td>1,000</td>
<td>5,129</td>
<td>6,665</td>
</tr>
<tr>
<td>1,500</td>
<td>5,289*</td>
<td>6,895*</td>
</tr>
<tr>
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<td>5,403*</td>
<td>7,057*</td>
</tr>
<tr>
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<td>5,563*</td>
<td>7,287*</td>
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<td>5,764*</td>
<td>7,576*</td>
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<tr>
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<td>5,897*</td>
<td>7,766*</td>
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<tr>
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<td>6,037*</td>
<td>7,968*</td>
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<td>6,197*</td>
<td>8,198*</td>
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<tr>
<td>20,000</td>
<td>6,311*</td>
<td>8,360*</td>
</tr>
</tbody>
</table>

* Extrapolated

Notes:
1. These calculated fragment throw distances are for individual munitions and do not apply to stacks. They also do not address “rogue” (non-case) fragments that are produced from sections of nose plugs, base plates, boattails, or lugs. Rogue fragments can travel to significantly greater distances (i.e., >10,000 feet) than those shown. Take care to properly orient the munition or take other measures to minimize rogue fragment hazards.
2. Determine MFD in feet and W in pounds for robust munitions as follows:
MFD = 2404 + 394.5 * ln (W)  
W = exp [(MFD – 2404) /394.5]

3. Determine MFD in feet and W in pounds for extremely heavy case munitions as follows:  
MFD = 2756 + 565.9 * ln (W)  
W = exp [(MFD – 2756) / 565.9]

4. Determine MFD in feet and W in pounds for non-robust munitions as follows:  
MFD = 1561.3 + 191.8 * ln (W)  (100 foot minimum)  
W = exp [(MFD – 1561.3) / 191.8]

5. Use of equations given in Notes 2, 3, and 4 to determine other W/MFD combinations is allowed.

6. See paragraph 12.72.3.2.2. for ranges associated with detonation of multiple munitions.

<table>
<thead>
<tr>
<th>Stage</th>
<th>HD</th>
<th>NEWQD</th>
<th>TNT Factor</th>
<th>TNT Equivalency</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (F&amp;G)</td>
<td>1.3</td>
<td>45,800</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>I (F&amp;G)</td>
<td>1.3</td>
<td>45,800</td>
<td>.035</td>
<td>1600(1)</td>
</tr>
<tr>
<td>II (F&amp;G)</td>
<td>1.3</td>
<td>13,680</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>II (F&amp;G)</td>
<td>1.3</td>
<td>13,680</td>
<td>.152</td>
<td>2100(1)</td>
</tr>
<tr>
<td>III (F)</td>
<td>1.1</td>
<td>3671</td>
<td>1.01</td>
<td>3700(1)</td>
</tr>
<tr>
<td>III (G)</td>
<td>1.3</td>
<td>7281</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>III (G)</td>
<td>1.3</td>
<td>7281</td>
<td>.506</td>
<td>3700(1)</td>
</tr>
</tbody>
</table>

Note:
1. These equivalencies apply to LGM 30 Minuteman motors, whether assembled into a set or stored/handled separately, when an HD 1.1 initiator is present.
Table 12.30. Peacekeeper TNT Equivalencies.

<table>
<thead>
<tr>
<th>Stage</th>
<th>HD</th>
<th>NEWQD</th>
<th>TNT Factor</th>
<th>TNT Equivalency</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1.3</td>
<td>99,133</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>I</td>
<td>1.3</td>
<td>99,133</td>
<td>1.20</td>
<td>118960(1)</td>
</tr>
<tr>
<td>II</td>
<td>1.3</td>
<td>54,120</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>II</td>
<td>1.3</td>
<td>54,120</td>
<td>1.20</td>
<td>64,944(1)</td>
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<tr>
<td>III</td>
<td>1.1</td>
<td>15,606</td>
<td>1.25</td>
<td>19,508(1)</td>
</tr>
</tbody>
</table>

Notes:
1. These equivalencies apply to Peacekeeper motors, whether assembled into a set or stored/handled separately, when an HD 1.1 initiator is present.
2. Use HD 1.1 NEWQD versus TNT equivalency when stage III’s are stored only with other stage III’s.
Table 12.31. Criteria for Non-DoD Explosives Activities on DoD Installations.

<table>
<thead>
<tr>
<th></th>
<th>Non-DoD Storage</th>
<th>Non-DoD Operations</th>
<th>Shared Launch Facilities</th>
<th>DoD/Joint Storage</th>
<th>DoD Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>To</td>
<td>From</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-DoD Storage</td>
<td>Check for IMD</td>
<td>Check for IMD</td>
<td>IBD</td>
<td>IMD</td>
<td>IBD</td>
</tr>
<tr>
<td>DoD/Joint Storage</td>
<td>IMD</td>
<td>IBD</td>
<td>IBD</td>
<td>IMD</td>
<td>ILD</td>
</tr>
<tr>
<td>Non-DoD Operations</td>
<td>Check for IMD</td>
<td>Check for IMD</td>
<td>IBD</td>
<td>IBD</td>
<td>IBD</td>
</tr>
<tr>
<td>DoD Operations</td>
<td>IBD</td>
<td>IBD</td>
<td>IBD</td>
<td>ILD</td>
<td>ILD</td>
</tr>
<tr>
<td>Shared Launch Facilities</td>
<td>IBD</td>
<td>IBD</td>
<td>IBD</td>
<td>IBD Note 1</td>
<td>IBD</td>
</tr>
<tr>
<td>DoD Non-Explosives Facilities/Operations Non-Related</td>
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<td>IBD</td>
<td>IBD</td>
<td>IBD</td>
<td>IBD</td>
</tr>
</tbody>
</table>

Note:
1. ILD may be applied if both parties agree and document to accept the explosives hazard posed to each other.
Table 12.32. QD for HD 1.1 AE for K = 1.1, 1.25, 2, 2.75, 4.5, and 5.

<table>
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<tr>
<th>NEWQD (lbs)</th>
<th>Hazard Factor, K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.1 (ft/(\text{lb}^{1/3}))</td>
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<td>100</td>
<td>7.0</td>
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<tr>
<td>150</td>
<td>7.0</td>
</tr>
<tr>
<td>200</td>
<td>7.0</td>
</tr>
<tr>
<td>300</td>
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</tr>
<tr>
<td>700</td>
<td>9.8</td>
</tr>
<tr>
<td>1,000</td>
<td>11</td>
</tr>
<tr>
<td>1,500</td>
<td>13</td>
</tr>
<tr>
<td>2,000</td>
<td>14</td>
</tr>
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<tr>
<td>700,000</td>
<td>98</td>
</tr>
<tr>
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</table>
Table 12.33. QD for HD 1.1 AE for $K = 6, 8, 9, 11, 18, 40.$

<table>
<thead>
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<th>Hazard Factor, K</th>
</tr>
</thead>
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<td></td>
<td>$6$ (ft/lb$^{1/3}$)</td>
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Table 12.34. QD Requirements for Armored and Non-Armored Vehicles.

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<th>EXPOSURE</th>
<th>FROM POTENTIAL EXPLOSION SITE</th>
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<tbody>
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</tr>
<tr>
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</tr>
<tr>
<td>NON-ARMORED</td>
<td>IMD</td>
<td>N/R</td>
</tr>
<tr>
<td></td>
<td>PTRD</td>
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</tr>
<tr>
<td></td>
<td>IBD</td>
<td>D6 from Table 12.33</td>
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Note:
1. D1 distance may be applied if a barricade is provided between PES and ES. Refer to Table 12.35. Notes regarding the need for a barricade.
### Table 12.35. QD for BLAHA and BLSA.

<table>
<thead>
<tr>
<th>NEWQD (lbs)</th>
<th>D1 (feet)</th>
<th>D2 (feet)</th>
<th>D3 (feet)</th>
<th>D4 (feet)</th>
<th>D5 (feet)</th>
<th>D6 (feet)</th>
</tr>
</thead>
<tbody>
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<td>13</td>
<td>26</td>
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</tr>
<tr>
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<td>15</td>
<td>30</td>
<td>303</td>
<td>506</td>
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</tr>
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<td>532</td>
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<td>124</td>
<td>248</td>
<td>687</td>
<td>1,146</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

1. D1 is used for non-armored vehicle (PES) to non-armored vehicle (ES) when an adequate barricade per Section 6E is located between them, for light armored vehicle (PES) to non-armored vehicle (ES) when an adequate barricade per Section 6E is located between them, and for light armored or non-armored vehicle (PES) to light armored vehicle (ES) with no barricade required. Determine D1 and NEWQD for D1 (NEWQD in lbs, D in feet) as follows:

   \[ D1 = 2 \times \text{NEWQD}^{\frac{1}{3}} \]

   \[ \text{NEWQD} = \left( \frac{D1}{2} \right)^3 \text{ (8,818 lbs maximum)} \]

2. D2 is used for non-armored or light armored vehicles to the side or rear of an undefined ECM. Determine D2 and NEWQD for D2 (NEWQD in lbs, D in feet) as follows:
D2 = 6*NEWQD^{1/3}
NEWQD = (D2/6)^{3}(8,818 \text{ lbs maximum})

3. D3 is used for non-armored vehicles to non-armored vehicles without an adequate barricade, light armored vehicles to non-armored vehicles without an adequate barricade at the non-armored vehicles, and non-armored vehicles, light armored vehicles, to the front of undefined ECM when no barricade is present at the ES. Determine D3 and NEWQD for D3 (NEWQD in lbs, D in feet) as follows:
D3 = 12*NEWQD^{1/3}
NEWQD = (D3/12)^{3}(8,818 \text{ lbs maximum})

4. D4 is used for PTRD for BLAHA/AHA PES that cannot stop primary fragments but will generate debris (e.g., open or light weight structure, ISO container, non-armored or light armor vehicle). D4 is determined as follows:
D4 = 60 percent*D5

5. D5 is used for determining the IBD for BLAHA/AHA PES that cannot stop primary fragments but will generate debris (e.g., open or light weight structure, ISO container, non-armored or light armor vehicle) from non-armored and light armored vehicles. Determine D5 as follows:

NEWQD for D5 (NEWQD in lbs, D in feet):
NEWQD \leq 180 \text{ lbs} D5 = 886 \text{ feet.}
5,500 \text{ lbs} < NEWQD \leq 8,818 \text{ lbs} D5 = 12.2*NEWQD^{1/2}
D5 < 886 \text{ feet} Use equation from \textbf{Note D}, Table V3.E3.T2
886 \text{ feet} \leq D5 \leq 1,146 \text{ feet} NEWQD = (D5/12.2)^{2} (8,818 \text{ lbs maximum})

6. Use D6 for determining the IBD and PTRD from heavy armor vehicles when NEWQD exceeds 331 lb the IBD and PTRD specified in \textbf{Chapter 12} apply. Determine D6 and NEWQD for D6 (NEWQD in lbs, D in feet) as follows:
NEWQD \leq 110 \text{ lbs} D6 = 66 \text{ feet}
110 \text{ lbs} < NEWQD \leq 331 \text{ lbs} D6 = -4.49 + 0.487*(NEWQD^{1/3}) + 2.928*(NEWQD^{1/3})^{2}
D6 < 66 \text{ feet} NEWQD = 0
66 \text{ feet} \leq D6 \leq 138 \text{ feet} NEWQD = (0.0833 + [1.5421 + 0.3416*D6^{1/2}])^{3}
Table 12.36. Variation of MPS QD Factors with Loadout.

<table>
<thead>
<tr>
<th>Percentage of HD 1.1</th>
<th>IBD&lt;sup&gt;a&lt;/sup&gt; (ft/1b&lt;sup&gt;1/3&lt;/sup&gt;)</th>
<th>PTRD&lt;sup&gt;b&lt;/sup&gt; (ft/1b&lt;sup&gt;1/3&lt;/sup&gt;)</th>
<th>Ship-to-Ship&lt;sup&gt;c&lt;/sup&gt; (ft/1b&lt;sup&gt;1/3&lt;/sup&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 52</td>
<td>40.85</td>
<td>24.01</td>
<td>32.00</td>
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<td>53</td>
<td>40.97</td>
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<tr>
<td>65</td>
<td>42.42</td>
<td>24.93</td>
<td>33.23</td>
</tr>
</tbody>
</table>

<sup>a</sup> With a minimum fragment distance of 3,700 feet.

<sup>b</sup> With a minimum fragment distance of 2,220 feet.

<sup>c</sup> With a minimum fragment distance of 3,500 feet.
Chapter 13

EXPLOSIVES SAFETY AND MUNITIONS RISK MANAGEMENT FOR JOINT OPERATIONS PLANNING, TRAINING AND EXECUTION

13.1. Purpose. This Chapter complements DoD 6055.09-M, CJCSI 4360.01A, and provides explosives safety and munitions risk management (ESMRM) requirements for:

13.1.1. Non-enduring locations (e.g., contingency bases) established or tasked to support Joint or Multinational combat and contingency operations. Due to the hostile environment inherent to operations at Contingency Operating Bases (COB) and Combat Outposts (COP), the Geographical Combatant Commander (GCC) provides specific guidance on risk and consequence management from military munitions at these locations. Apply procedural requirements of CJCSI 4360.01A relating to ESMRM to COBs and COPs when the GCC determines it appropriate, given all operational and force protection considerations.

Note: The GCC may authorize the application of CJCSI 4360.01A for enduring locations under their command.

13.1.2. Aerial ports of embarkation/debarkation (APOE/APOD), seaports of embarkation/debarkation (SPOE/SPOD), and enroute infrastructure support facilities (DoD and non-DoD controlled) that are used to support GCC operational plans.

13.1.3. Combat and contingency training.


13.2. Applicability.

13.2.1. In addition to applicability of paragraph 13.1., this Chapter also applies to:

13.2.1.1. Subunified commands, joint task forces (JTF), and their subordinate component commands.

13.2.1.2. DoD Construction Agents (e.g., US Army Corps of Engineers (USACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC)), Contract Construction Agents (CCAs), and other designated DoD organizations (e.g., Defense Contract Management Agency (DCMA), troop labor (Air Force Prime BEEF, Naval Construction Battalions, J3 Engineers) involved in construction, construction management, or contract award/management of construction related activities of AE-related facilities or facilities within quantity distance (QD) arcs of AE facilities.

13.2.1.3. Combat training and contingency training, when specifically authorized by an Air Component Commander or GCC.

13.2.2. This Chapter does not apply to:

13.2.2.1. Enduring installations outside the US and DoD installations within the US (e.g., Main Operating Bases (MOB)). The Air Force will use this Manual for enduring locations.
Note: The GCC may authorize the application of CJCSI 4360.01A for enduring locations under their command.

13.2.2.2. Training ranges under the control of the Air Force and where all explosion effects are contained within established surface danger zones (SDZ).

13.2.2.3. Elements of a maneuvering force, engaged with the enemy or conducting movement to contact or movement to support operations, where risks and consequences must be addressed and managed by the appropriate Commander, IAW operational mission requirements.


13.3.1. As outlined in Figure 13.1. below and further expanded in CJCSI 4360.01A, GCC, Functional Combatant Commanders (See Joint Publication 1-0, Joint Personnel Support) and Air Component Commanders must:

13.3.1.1. Integrate ESMRM into joint planning and existing plans. (T-0).

13.3.1.2. Integrate ESMRM requirements into Multinational planning and existing plans. (T-0).

13.3.1.3. Validate IAW planning cycle’s Joint and Multinational plans during planning exercises. (T-0). When training exercises show the need to modify or update plans and supporting assumptions based on munitions-risks, update and modify plans to incorporate validated changes.

13.3.2. Assess S/APOD and S/APOE and en route infrastructure identified in the joint planning process as detailed in CJCSI 4360.01A. (T-0).

13.4. Joint and Multinational Training. During the planning phase and prior to conduct of this training, conduct and approve a risk analysis that thoroughly assesses the risk and consequences associated with the training as directed by CJCSI 4360.01A. (T-0).

13.5. Joint and Multinational ESMRM Execution.

13.5.1. The Base Operating Support Integrator (BOS-I) plays a critical role in the execution of explosives safety and ESMRM with regards to Joint and Multinational installation master planning and real estate and infrastructure management. The following major areas must be addressed by the BOS-I: (T-1).

13.5.1.1. Determination of explosives safety requirements to be used.

13.5.1.2. Land and infrastructure use management.

13.5.1.3. Explosives Safety Quantity Distance (ESQD) mapping.

13.5.1.4. Explosives site planning.

13.5.1.5. Conduct of ESMRM Consequence and Risk Identification (C&RI) Assessments when explosives safety requirements cannot be met and ensuring approval at the appropriate level.

13.5.1.6. Risk and consequence management, to include communication of risk decisions.
13.5.1.7. Planning for risks and potential consequences from the unintended functioning of munitions, to include coordination of force protection and explosives safety mitigation.

13.5.1.8. Construction management. All construction that increases hazards regardless of funding (e.g., Operations and Maintenance, Army (OMA), military construction (MILCON)) must have either an ESP or an approved deviation before construction begins. (T-1). All construction within or on the periphery of ESQD arcs must be closely managed and coordinated, as early as possible in the planning and design phase, to ensure compliance with explosives safety requirements.

13.5.2. Approved ESP or event waiver. All locations where military munitions are present or forecasted to be present must have an approved ESP or event waiver. (T-1). With respect to COBs and COPs, the GCC determines appropriate requirements (see paragraph 13.1.1.).

13.5.2.1. For locations meeting explosives safety requirements. The site approval process decision matrix is shown below in Figure 13.2. ESP packages will be prepared IAW Chapter 14. (T-1).

13.5.2.2. For locations which cannot be sited IAW Chapter 14, conduct an ESMRM C&RRI assessment and obtain deviation approval from the appropriate authority, as detailed in CJSCI 4360.01A. The deviation process decision matrix is shown below in Figure 13.3.

13.5.3. Consider the following location examples for ESP approval:

13.5.3.1. Storage locations (e.g., open location, pad, and structure).

13.5.3.2. Holding areas (e.g., basic load ammunition holding areas (BLAHA), ammunition holding area (AHA), field return holding, flightline holding areas, port and railhead holding areas, and marshaling areas, S/APOD and S/APOE and en route infrastructure).

13.5.3.3. Handling and operating locations (e.g., combat/cargo aircraft and remotely piloted aircraft (RPA) loading areas, ports, AE maintenance, repair, and renovation areas and sling-out areas, tenant operations).

13.5.3.4. Parking locations (even temporary) for vehicles carrying AE and located outside an established BLAHA/AHA.

13.5.3.5. Locations used for tactical assembly areas, AE field returns, amnesty returns, casualty AE collection (e.g., outside a hospital), etc.

13.5.3.6. AE-loaded combat and cargo aircraft parking areas.

13.5.3.7. Static missile systems.

13.5.3.8. Locations used for the treatment or disposal (e.g., open burn or open detonation) of munitions.

13.5.3.9. Inhabited ESs within ESQD arcs.

13.5.3.10. Future/planned construction pertaining to AE locations, regardless of what they are used for, to include planned exposed sites (ES) that will be constructed within ESQD arcs.
13.5.4. Approval process for MILCON that cannot meet explosives safety requirements is addressed in Section 1B of this Manual.


13.6.1. Limited quantities of hazard division (HD) 1.2.2, HD 1.3, or HD 1.4.

13.6.1.1. For reasons of operational necessity, and IAW Chapter 11 of this Manual, limited quantities of HD 1.2.2, HD 1.3, or HD 1.4 may be stored and used in operations without regard to QD and ESP approval.

13.6.1.2. The above is applicable to armored vehicles located outside a BLAHA/AHA.

13.6.2. QD Reduction Using Concertainer Barricades.

13.6.2.1. Ensure fill material for concertainer barricades is reasonably cohesive and free from harmful (toxic) matter, trash, debris, and stones heavier than ten pounds. Locate stones at the lower center of the barricade. The preferred hill material is a granular material, such as sandy soil.

13.6.2.2. Inspection of these type barricades will be conducted on a periodic basis to insure their integrity and stability. (T-1). Deteriorating or damaged sections will be replaced. (T-1).

13.6.2.3. DDESB has approved the use of a concertainer barricade design for prevention of prompt propagation between munitions storage cells, each containing up to 8,818 lbs net explosive weight (NEW) of AE with a reduced IMD of 28 feet versus the required default IMD (K6) criteria of 126 feet. The following apply to this approval: (T-1).

13.6.2.3.1. Each storage cell is restricted to a maximum of 8,818 lbs NEW of mixed HD 1.1 and HD 1.2 (sensitivity group 1 through 5), HD 1.3, and HD 1.4 AE. The MCE associated with any storage arrangement constructed per the Technical Paper 15 is one storage cell. When determining NEW for QD (NEWQD) for the cell, HD 1.4 may be excluded, as it will not contribute to the severity of an explosion were one to occur.

13.6.2.3.2. Use the "Open" column of Table 12.4, for determining appropriate QD for the NEWQD that is present, when in the open or in a structure that cannot stop primary fragments. If in a hardened structure that is capable of stopping primary fragments, use "Structure" column. Refer to Table 12.4, for additional details.

13.6.2.3.3. Maintain a minimum of 10 feet standoff from the munitions stack to the nearest concertainer barricade.

13.6.2.3.4. Section 6E—prescribes height and length requirements.

13.6.2.4. North Atlantic Treaty Organization (NATO) concertainer barricade criteria.

13.6.2.4.1. NATO AASTP-5, NATO Guidelines for the storage, Maintenance and Transport of Ammunition on Deployed Missions or Operations, provides criteria for AE storage of up to 8,818 lbs of AE in barricaded cells, with reduced QD. Those criteria provide QD for ES outside the camp/base. In addition, the criteria provide appropriate QD for the protection of personnel/ES inside the camp/base, from PES
fragments, debris, and blast, as well as ES building collapse, in consideration of PES and ES designs (i.e., open, light, semi-hardened, hardened).

13.6.2.4.2. Paragraph 13.8.3. addresses the use of NATO criteria by US Forces participating in NATO Multinational operations. NATO AASTP-5 criteria can also be used by US Forces outside of NATO Multinational operations, as allowed by the Air Force.

13.6.3. Fuel storage. Certain operations may require large amounts of on-site, operational fuel quantities. Limit operational fuel needs to the Mission Essential Quantity (MEQ) only. The installation Commander must approve the documented basis for arriving at the MEQ. (T-1). However, in almost all other cases, the following operational fuel limits and separation distances will meet the operational fuel needs and must be applied: (T-1).

13.6.3.1. Separate quantities up to 500 gallons from PES by at least 50 feet.
13.6.3.2. Separate quantities between 500 to 5,000 gallons from PES by at least 100 feet.
13.6.3.3. For bulk storage (i.e., greater than 5,000 gallons), apply paragraph 12.79.
13.6.3.4. For further protection from an accidental explosion at a PES and to provide fire protection to surrounding PES/ES, barricade fuel storage locations. If designed properly, the barricade also serves as a dike in the event of a fuel leak. Separate fueling trucks/tankers, when not being used, from PES by barricades.

13.6.4. Emergency Destruction. Follow guidance as set forth in paragraph 4.20. Conduct normal disposal operations IAW Section 12O.

13.6.5. Captured Enemy Ammunition (CEA).

13.6.5.1. Store CEA at a minimum of IMD, but preferably IBD, from all other AE stocks. CEA must not be co-located (i.e., same cell) with DoD AE. (T-1).
13.6.5.2. Manage CEA collected for exploitation IAW DoDDS-3325.01, Foreign Material Program, and DoD S-3325.04, Implementation of the Foreign Material Program. (T-0).

13.6.6. Mixing of DoD AE with Multinational AE. Do not assume that Multinational AE is hazard classified IAW the United Nations' international system of classification developed for the transport of dangerous goods, IAW ST/SG/AC.10/1/Revision 17, Recommendations on the Transport of Dangerous Goods, Model Regulations, Volumes I and II, which is the basis for US hazard classification, as outlined in Chapter 3. Also, do not assume that Multinational Nations conduct/manage AE surveillance or propellant stability test programs to ensure the safety of their AE items. For those reasons, unless it's specifically known that Multinational Nations have such programs and that they are actively managed/monitored, then do not store AE from those Nations with DoD AE. (T-1). The following apply to mixing of DoD AE with Multinational AE:

13.6.6.1. Multinational AE may be stored at the same site (e.g., building, pad) with DoD AE provided the owner(s) of the DoD AE accepts the risk and consequences of storing nonDoD ammunition with DoD ammunition and the involved nation(s)'AE:

13.6.6.1.1. Has been hazard classified in a manner equivalent to DoD explosives hazard classification procedures and as outlined in Chapter 3.
13.6.6.1.2. Is managed/monitored as part of both AE surveillance and propellant stability test programs.
13.6.6.1.3. Is packaged/stored in a manner that meets DoD standards.
13.6.6.2. Separate Multinational AE that does not meet all requirements of paragraph 13.6.6.1. from DoD AE by a minimum of IMD. (T-1).

13.6.7. Concurrent DoD and Multinational AE Operations. The following criteria govern such operations:

13.6.7.1. Separate concurrent DoD and Multinational AE operations (e.g., ammunition issues, returns, inspections) by a minimum of ILD. (T-1).
13.6.7.2. Non-concurrent DoD and Multinational AE operations may be performed on the same pad, site, or facility provided the AE of the first party is removed prior to the second party beginning AE operations.
13.6.7.3. Provide ILD level of protection to AE operations (DoD or Multinational) from AE storage sites (DoD or MN). (T-1).
13.6.7.4. Provide IMD level of protection to AE storage sites (DoD or Multinational) from AE operations (DoD or Multinational). (T-1).

13.7. DDESB TP-15. TP-15 consolidates into one document the protective construction approved by the DDESB. It describes past solutions that were developed to address specific problems being experienced by DoD Components, particularly to reducing the MCE and associated QD criteria. Appendix 2 was written specifically to incorporate all items that could benefit the operational theater in the areas of storage and operations.

13.8. Application of Explosives Safety Requirement Other than DoDM 6055.09-M and AFMAN 91-201. DoD policy and Joint Chief of Staff (JCS) guidance with respect to the application of other explosives safety criteria is as follows:

13.8.1. Comply with DoDM 6055.09-M and this Manual, and when outside the U.S., comply with host-nation, Multinational, or U.S. explosives safety standards, whichever are more stringent unless standards applicability is mandated in an International Agreement (IA). (T-1).
13.8.2. Joint Publication (JP) 3-16, Multinational Operations, advises Commanders of US forces operating as part of a Multinational (alliance or coalition) military command that they must follow Multinational doctrine and procedures ratified by the U.S. For doctrine and procedures not ratified by the U.S., Commanders must evaluate and follow the Multinational command's doctrine and procedures, where applicable and consistent with US law, regulations, and doctrine. (T-0).
13.8.3. NATO.

13.8.3.1. NATO explosives safety requirements are found in Allied Ammunition Storage and Transport Publication (AASTP)-1 and AASTP-5, both of which have been ratified by the U.S. for use by U.S. forces during NATO Multinational operations.
13.8.3.2. NATO requirements may be mandated for use in an IA or as part of a Multinational operation.
13.8.3.3. AFSEC/SEW and DDESB accepts an ESP based on the QD contained in AASTP-1, AASTP-5, and developed by US forces participating in NATO Multinational operations.


   13.8.3.4.1. The UN has developed explosives safety technical guidance referred to as the IATG. UN requirements may be mandated for use in an IA or as part of a UN Multinational operation.

   13.8.3.4.2. IATG QD requirements are similar to NATO QD requirements of Reference (n).

   13.8.3.4.3. DoD and Air Forces’ explosives safety programs fully meet the highest level of compliance (Level 3) described in the IATG.

Figure 13.1. Combatant Commander (CCDR) ESMRM Process Flow.
Figure 13.2. Explosives Site Planning (ESP) Process Decision Matrix-Locations that Can Meet Requirements.

- Decision made that a munitions-related process will be required at a location
- Can the munitions location meet requirements for a site approval?
- CJCSI 4360.01 ESMRM for Joint Operations Planning and Execution
- DoD 6055.09M DoD Ammunition And Explosives Safety Standards
- Yes
  - Develop and Submit Site Plan through service component
  - DDESB Review Acceptance or modification
- No
  - See Figure 13.3
Figure 13.3. Site Planning Process Decision Matrix-Locations that Cannot Meet Requirements.

1. Decision made that a munitions-related process will be required at a location.
2. Can the munitions location meet requirements for site approval?

   - Yes: See Figure 13.2
   - No: Develop and submit ESMRM C&RI assessment through Service Component, Subunified or JTF CDR appropriate.

   - GCC Review Acceptance or Modification
   - Provide copies to JCS & DDES per Ref c

Additional notes:
- DoD 6055.09M DoD Ammunition and Explosives Safety Standards
- CJSI 4360.01 ESMRM for Joint Operations Planning and Execution
Chapter 14

EXPLOSIVES SITE PLANNING

Section 14A—Introduction

14.1. **Purpose of Explosives Site Planning.** Explosives site planning is a process used to manage the risks associated with explosives activities to ensure the minimum risk to personnel, equipment, and assets, while meeting mission requirements.

14.1.1. Planning for the proper location and construction of PESs, and ESs exposed to PESs, is a key element of the explosives site planning process.

14.1.2. This process also ensures that risks above those normally accepted for explosives activities are identified and presented to the appropriate Commander for approval. The explosives site planning process is applicable to enduring and non-enduring locations (See Chapter 13).

14.2. **Responsibilities for Explosives Site Planning.** Safety, in coordination with civil engineering, fire, health, security, and environmental agencies, is responsible for performing explosives site planning.

Section 14B—Explosives Clear Zones

14.3. **Explosives Clear Zones.**

14.3.1. The explosives clear zone is the area surrounding a PES as determined by the required IB separation.

14.3.2. The IB separation is based on the sited, waivered, exempted, or actual explosives limits of the potential explosion site, whichever is greatest.

14.4. **Monitoring of Explosives Clear Zones.**

14.4.1. Safety and civil engineering will monitor and control construction and facility utilization inside explosives clear zones. (T-1).

14.4.2. Management of explosives safety clear zones is a cornerstone of the explosives site planning process.

14.5. **Mapping Requirements for Explosives Clear Zones.**

14.5.1. Explosives clear zones for all approved explosives site plans (ESP) s will be reflected on the installation Comprehensive Plan Maps IAW AFI 32-7062. (T-1).

14.5.2. Explosives clear zones must reflect the DDESB-approved NEW and IB distance. (T-1).

14.5.3. The WSM assists civil engineering in determining the explosives clear zones required on appropriate base maps.

14.5.4. Do not change explosives clear zones on base maps when they are expanded for a short-term situation (one year or less), such as an event waiver lasting less than a year.

14.6.1. Cancel the ESP used to establish an explosives clear zone when the use of an explosives location is no longer required. (T-1).

14.6.2. Submit the ESP cancelation memorandum to the MAJCOM safety office. (T-1). MAJCOM safety office forwards a copy of the ESP cancelation to AFSEC/SEW.

Section 14C—Explosives Site Plans (ESP)

14.7. ESPs. ESPs are a method to document the results of the explosives site planning process.

14.7.1. An ESP package consists of all the information necessary to assess compliance with explosives safety standards.

14.7.2. Once approved, the ESP identifies storage and operational limitations, and provides a tool for managing risks associated with the storage or operating location.

14.7.3. The term ESP is synonymous with Quantity Distance Safety Submission (QDSS) and Hybrid Safety Submission (HSS).

14.8. Funding for Projects Requiring an ESP.

14.8.1. Prior to approval of an ESP, expend only limited Air Force funds on the ESP project. ESP approval is covered in paragraph 14.15.

14.8.2. All funds spent prior to approval may be placed at risk if explosives safety standards are not followed properly. The investment could be lost if ESP approval is contingent on changes or new facility requirements that were not considered or adequately addressed during the ESP preparation and review process.

14.8.3. It is strongly suggested that at least preliminary ESP approval be obtained before awarding a contract for new construction of explosives facilities or non-explosives facilities within an explosives clear zone (see paragraph 14.13.).

14.9. Situations Requiring an ESP. Develop and submit ESPs for review and approval for the following situations: (T-1).

14.9.1. New construction of explosives facilities.

14.9.2. New construction of non-explosives facilities within an explosives clear zone.

14.9.3. Modification or change to the use of explosives facilities per paragraph 14.11.

14.9.4. Modification or change to the use of non-explosives facilities within an explosives clear zone per paragraph 14.11.

14.9.5. Recurring training and exercise explosives activities occurring in fixed locations, except as allowed in paragraph 14.10.9.

14.10. Situations Not Requiring an ESP. ESPs are not required for the following situations: (T-1).

14.10.1. Storage and associated HD 1.4S handling (see paragraph 12.29.3.).

14.10.2. Interchange yards limited to those operations described in paragraph 12.58.
14.10.3. Inspection stations where only the operations described in paragraph 12.57. are performed.

14.10.4. Parking aircraft loaded with specific munitions, while the aircraft is located in designated aircraft parking areas that meet airfield criteria (see paragraph 12.47.). This includes associated handling of these munitions, provided the quantity of munitions involved in the operation is limited to a single aircraft load.

14.10.5. Hung ordnance areas, arm or de-arm areas, and hot pit refueling areas not used as parking areas, unless they are located in an explosives clear zone (see paragraph 12.44. and 12.45.). In that case site areas as a non-explosives exposed site.

14.10.6. Licensed explosives storage locations, unless they are located in an explosives clear zone. In that case site locations as a non-explosives exposed site.

14.10.7. Explosives operations associated with licensed explosives storage locations.

14.10.8. Inert storage accessed by personnel related to the explosives mission.

14.10.9. Activation of simulators and smoke-producing devices in single or small quantities when used in conjunction with exercises and training (to include readiness inspections). See paragraph 7.25. for guidance.

14.10.10. Unmanned, non-explosives miscellaneous structures requiring only fire protection distance separation do not require an ESP, even if new construction is involved.

14.10.11. All non-enduring locations as defined by the Geographic Combatant Commander (GCC) that cannot be sited IAW this Manual will have an ESMRM C&RI assessment IAW CJCSI 4360.01A, Enclosure C (see Chapter 13).

14.11. Facility Modifications or Change in Use. Existing explosives facilities and exposed facilities within explosives clear zones may require modification or change in use to meet changing mission requirements. Evaluate such modifications and changes in use to determine if they affect the application of explosives safety requirements as approved in the original ESP.

14.11.1. Develop and submit a new ESP if the facility modification or change in use involves the following: (T-1).

14.11.1.1. A change in the classification of the facility for QD purposes (e.g., an explosive storage facility is changed to an operating location).

14.11.1.2. Changes in HD, NEWQD or NEW for intentional detonation sites.

14.11.1.3. Changes impacting the explosives clear zone (increase or reduction).

14.11.1.4. Increase in overall floor space, to include vertical additions.

14.11.1.5. Introduction of additional personnel performing a different function.

14.11.1.6. Compromise of the effectiveness of built-in safety features (e.g., opening is made in a SDW).

14.11.1.7. The installation of a new LPS (e.g., the complete replacement of an existing system or replacing an integral system with a mast or catenary system).

14.11.2. For other modifications or changes in use submit a memorandum describing the facility modification or change in use to the MAJCOM. (T-1). The MAJCOM will ensure
the facility modification or change in use does not affect the explosives safety criteria applied in the original ESP and submits the change to AFSEC/SEW to formally amend the ESP. (T-1).

14.11.3. Do not start construction on a project requiring an ESP until approval is granted by the DDESB. (T-1). For ESPs where no construction is involved, do not start explosives operations or non-explosives operations within explosives clear zones until the ESP is approved by the DDESB. (T-1).


14.12.1. The civil engineer or facility user notifies weapons safety as soon as a need is identified to build, modify, or change the use of any explosives facility or non-explosives facility located within an explosives clear zone. (T-1). Weapons safety determines the need for an ESP and solicits the information to prepare the request.

14.12.2. The civil engineer assists safety in development of the ESP by providing current maps or drawings and technical facility design assistance. Also, the civil engineer supplies facility design information such as construction, grounding, technical facility design assistance, and LPS information.

14.12.3. Site for maximum weights based on actual separation distances or capacity for storage locations; however, for other locations site for MEQ/operational limits. (T-1).

14.12.4. Coordinate the ESP with civil engineering and the user. Coordinate with fire, health, security, legal and environmental agencies, as appropriate.

14.12.5. Coordinate the ESP with bioenvironmental engineering if it involves biological and chemical fillers, liquid propellants, toxic gases, sonic hazard areas, any form of electromagnetic radiation, laser or other directed energy weapons (DEW) affecting health or the environment on-base (including radioactive sources and microwave generators and industrial x-ray). The MAJCOM will forward an information copy of the ESP to the Air Force Medical Support Agency (AFMSA/SG3PB), 1400 Key Blvd, Suite 400, Arlington VA 22209. (T-1).

14.12.6. When tenant facilities, including those of other services, are exposed, coordinate the ESP with the tenant unit. For ESPs that expose host-nation tenant facilities or areas, notify the host-nation Commander of the exposure and obtain host-nation approval, taking into account any notification or approval requirements in international agreements or SOFA. (T-1).

14.12.7. In cases where the explosives clear zone encroaches onto adjacent government agencies, such as another Air Force, or an Army, Navy or Marine installation, obtain written acknowledgement from the exposed service component for inclusion in the ESP. (T-1).

Note: It will be up to the acknowledging agency to update their maps to reflect the explosives clear zone for their future planning purposes.

14.12.8. Review and approve ESPs involving contractors through the Defense Plant Representative Office (DPRO), Administrative Contract Office (ACO) and the Designated Acquisition Official’s (DAO) safety office prior to Air Force processing. (T-1). Local level coordinates with responsible contracting officer.
14.13. ESP Contents. ESPs contain the information described in Section 14D. In some instances, a compressed timeline (such as that imposed by the design and build process) may require contract award or site preparation activities (e.g., facility demolition, grading or other site preparation) before all of the information required in Section 14D is available. In these instances, request preliminary ESP approval. Preliminary ESPs will include the information required in Section 14D, except for facility construction drawings and any required structural engineering analyses. (T-1). Specifically address the action required for approval (e.g. contract award, facility demolition). Submit a request for final ESP approval as soon as the construction drawings and any required structural engineering analyses are completed. (T-1).


14.14.1. The ESP originates at the installation level (See paragraph 14.26.). The primary means for originating an ESP is the automated Explosives Safety Siting ESP Program. MAJCOM/SEW reviews the ESP for accuracy and compliance with the standards in this Manual and applicable MAJCOM supplements. MAJCOMs then electronically submit the coordinated ESP to AFSEC/SEW (unless the ESP is approved by the MAJCOM per paragraph 14.15.). Include a MAJCOM endorsement stating approval along with any changes, modifications or specific precautionary measures considered necessary. After review by AFSEC/SEW, the ESP is endorsed and electronically submitted to the DDESB for approval. Reviewing agencies provide the ESP originator and previous review agency a copy of comments or changes made affecting the original intent of the ESP. (T-1). Any change affecting the content of the unit’s Automated Explosives Safety Siting Program database requires updates made at the unit. (T-1).

Note: For nuclear weapons capable facilities, AFSEC/SEW ensures the Air Force Nuclear Safety Design Certification Program has been completed prior to ESP submission to the DDESB (See AFI 91-103).

14.14.2. Air Force Host to Tenant Relationships. ESPs for tenant units are sent through host installation and tenant command channels. In cases where the host violates ESQD to a tenant facility, the host MAJCOM obtains coordination from the tenant MAJCOM before processing the ESP. Where no violation exists, provide an information copy of the ESP to the tenant MAJCOM when processing to AFSEC/SEW. If required by the tenant MAJCOM, the ESP must meet the requirements of the tenant MAJCOM supplement to this Manual. (T-1).

14.14.3. Inter-service Host to Tenant Relationships.

14.14.3.1. When an Air Force unit is tenant on an Army, Navy or Marine installation, request ESP approval through that service. (T-1). The ESP must meet the QD requirements of this Manual in addition to all host agency criteria. (T-1). Submit an information copy of the ESP request through the MAJCOM to AFSEC/SEW. (T-1).

14.14.3.2. Tenant Army, Navy or Marine units forward ESP requests through Air Force host installation channels. (T-1). Air Force host assists tenant units in preparing the ESP. In cases where the Air Force host violates ESQD to a tenant facility, the host MAJCOM obtains coordination from the tenant MAJCOM equivalent before processing the ESP. Where no violation exists, provide an information copy of the ESP to the tenant MAJCOM equivalent when processing to AFSEC/SEW. (T-1).
14.14.3.3. AFSEC/SEW will coordinate with the applicable service component before processing the ESP. (T-1). In cases where the Air Force host violates ESQD to a tenant facility, AFSEC/SEW obtains coordination from the applicable service component before processing the ESP. (T-1). Where no violation exists, an information copy of the ESP is sent to the applicable service component when processing for final approval.

14.14.4. AFSEC/SEW coordinates requests for ESP approval with the applicable service component if an Air Force explosives clear zone encroaches onto an adjacent Air Force, Army, Navy or Marine installation. (T-1).

14.14.5. MAJCOM/SEW may request expeditious AFSEC/SEW processing of an ESP. Requests for expeditious ESP processing will include the information required in paragraph 14.22.19. (T-1).


14.15. ESP Approval.

14.15.1. Except as authorized in paragraph 14.15.2., ESPs are approved by DDESB. ESPs with waivers or exemptions are submitted as HSSs to the DDESB for final approval IAW Section 1B. Do not start new construction until authorized by an approved ESP. (T-1). Do not commence explosives operations or events unless authorized by an approved deviation IAW paragraph 1.4. (T-1). Deviation documentation requirements prescribed in paragraph 1.4.3. are addressed in the ESP submission to the MAJCOM and AFSEC/SEW.

14.15.1.1. Once the ESP is reviewed by AFSEC/SEW, AFSEC/SEW submits the ESP to the DDESB or back to the MAJCOM if additional information is needed to gain DDESB approval.

14.15.1.2. If additional criteria is needed to complete the ESP package, provide it within 45 days of AFSEC/SEW initial review comments or provide notification to AFSEC/SEW from the MAJCOM with a status of delay and an estimated response date. (T-1).

14.15.1.3. If continued delays are encountered, AFSEC/SEW will return the ESP as disapproved with a detailed explanation of the reason for disapproval. (T-1). At this time, the deviation for operations to commence is invalidated. The entire ESP may be resubmitted under a new control number once all criteria are met and included in the ESP submission.

Note: If included in the ESP request, preliminary ESP approval may authorize some construction planning activities to begin per paragraph 14.13.

14.15.2. Approval levels for unique situations are as follows:

14.15.2.1. ESPs for training and exercise areas using flares, simulators, and smoke producing devices (HD 1.2.2, 1.3 and 1.4 only), and not within an established clear zone, are approved by the MAJCOM. This applies to recurring training locations and not to exercise support activities that move each time IAW exercise scenarios. Document required separation distances per paragraph 7.25. for exercise support activities that do not have a fixed location. (T-1).
14.15.2.2. MAJCOM/SEWs approve ESPs for installation of WSVs in HASs with previously approved ESPs by the MAJCOM/SEW.

14.15.2.3. The PCO for Air Force contracts involving explosives or ammunition approves ESPs for Contractor Owned Contractor Operated (COCO) facilities on non-government land. The contractor prepares and submits these ESPs. Do not forward these ESPs to either AFMC/SEW, AFSEC/SEW, or the DDESB. The Defense Contract Management Agency evaluates the ESP and provides approval or disapproval recommendations to the PCO.

14.15.2.4. The DDESB approves ESPs for Government Owned Contractor Operated (GOCO) facilities and COCO facilities on government land. Waivers and exemptions are approved by the responsible PCO and Air Force command level as prescribed in Chapter 1.

14.15.2.5. The DDESB approves ESPs for non-DoD explosives activities on Air Force installations per paragraph 14.17.

14.16. Maintenance of Approved ESPs. Approved ESPs (including the approval letter) are maintained by the installation safety office and using organization.

Section 14D—ESP Requirements

14.17. ESPs for Non-DoD Explosives Activities on Air Force Installations.

14.17.1. ESPs for non-DoD explosives activities on Air Force installations will include a risk assessment for all exposed government personnel, equipment, and assets (within or outside the explosives clear zone) and documented risk acceptance by the responsible Commander. (T-1). The responsible Commander must consider the possible impact to current and future DoD mission requirements in the event of a mishap. (T-1). Non-DoD user insurance coverage for government equipment and assets will not, by itself, be adequate justification for exposure to unacceptable risk.

14.17.2. ESPs for non-DoD explosives activities on Air Force installations will either be prepared IAW the requirements of this section, or will be “foot print” only ESPs. (T-1). Foot print ESPs contain only the information necessary to determine the explosives clear zone (i.e., do not include building design, LPS, etc., unless it is used to determine the explosives clear zone).

14.17.3. ESP approval alone does not authorize the conduct of non-DoD explosives activities on Air Force installations (see paragraph 12.86.).

14.17.4. See paragraph 12.86. for QD criteria for non-DoD explosives activities on Air Force installations, and paragraph 1.9. for guidance on exceptions to this Manual.

14.18. Siting a Non-Explosives Exposed Site. For new construction, modification, or change in use of non-explosives facilities within an explosives clear zone it is acceptable to submit an ESP for the non-explosives facilities. Comply with all applicable requirements of this section and include QD evaluations for all PESs within the evaluation zone. See paragraph 14.24.7., Table 14.1. and Figure 14.1.
14.19. **ESPs Involving Exceptions.** Include the information required per Section 1B for ESPs involving exceptions.

14.20. **Tiered ESPs.** Tiered ESPs are useful when the NEWQD of a PES varies because of operational requirements. It may also be useful when it is not practical on a daily basis to meet the required QD separation from a PES to all ESs for the largest possible NEWQD. Under the tiered ESP concept, the responsible Commander takes management actions (e.g., removal of personnel or equipment, re-designation of exposed sites) before introducing explosives or increasing the NEWQD of a PES. (T-1).

14.20.1. To prepare tiered ESPs, determine the NEWQD required for each type of activity at the PES and the QD separation required to each ES for each NEWQD. In instances where the required QD separation cannot be met at a given NEWQD, determine if management actions may be taken to meet the required QD separation. If the required QD separation cannot be met even with management actions, process a waiver or exemption IAW Section 1B.

14.20.2. Prepare a management plan to document management actions required for each tier of the ESP. Implement this management plan as a base operations plan, operating instruction, agreement, supplement or other appropriate publication. The management plan must specify: (T-1).

14.20.2.1. Description of each management action required.

14.20.2.2. Conditions where each management action is directed and when the action takes place.

14.20.2.3. The organization responsible for implementing each management action.

14.20.2.4. Requirement for periodic review of the management plan to ensure continued viability of the planned management actions.

14.20.3. Tiered ESPs will: (T-1).

14.20.3.1. Include an AF Form 943, Explosives Site Plan, or Explosives Safety Submittal Form for each tier, and assign a separate ESP action number to each tier.

14.20.3.2. Reference the document implementing the management plan required in paragraph 14.20.2. It is not necessary to include a copy of this document.

14.21. **Components of the ESP.** ESPs must include all the information needed for the reviewer to determine if the explosives safety requirements of this Manual are being met. (T-1). Although the exact contents of an ESP may vary depending on the activity sited, ESPs generally include a transmittal letter, an AF Form 943, or ESS Submittal Form, a site location map, and various attachments. For some ESPs, a transmittal letter containing pertinent information and a map may be all that is necessary. Other ESPs may require documentation such as detailed drawings, engineering analyses, risk assessments, Commanders’ risk acceptances, etc, in order to verify compliance with explosives safety requirements (See paragraph 14.26.).

14.22. **Transmittal Letter.**

14.22.1. The transmittal letter is important for getting an ESP successfully reviewed and approved. Generally, explain all aspects of the siting and attempt to answer any questions before raised. Consider that personnel reviewing the ESP may not be familiar with the base
or operation, including unique terminology, and do not know the mission or specific circumstances. If the AF Form 943 or ESS Submittal Form contains a modification to the generated ESP, explain the change in the transmittal letter. A sample transmittal letter is provided in Attachment 2.

14.22.2. Include the ESP action number in the subject line of the memorandum. ESP action numbers are developed as follows:

14.22.2.1. The requesting MAJCOM designation followed by the tenant MAJCOM designation, if appropriate (e.g., USAFE-AFAFRICA, or AFMC-ACC).

14.22.2.2. The installation where the PES is located (e.g., Hill, Ramstein, or Logan).

14.22.2.3. Calendar year designation (e.g., 14, or 15).

14.22.2.4. An (S) identifier followed by a sequence number (e.g., S26, or S39). Number each request sequentially for each calendar year (e.g., the first ESP for the calendar year would be S1). Canceled requests will not affect the number of subsequent requests (e.g., if USAFE-Ramstein-14-S10 were canceled, the next ESP submitted for Ramstein AB in 2014 would be S11.

14.22.2.5. If the ESP involves QD exceptions, include the statement, “WITH EXCEPTIONS” immediately following the ESP action number. Example: ACC-Barksdale-14-S33, WITH EXCEPTIONS. If the ESP involves only compensatory measures that avoid all QD exceptions, include the statement, “WITH COMPENSATORY MEASURES” immediately following the ESP action number. In addition, units will develop a means to assure continued implementation of compensatory measures per MAJCOM direction.

14.22.2.6. If the transmittal letter is for more than one ESP, include the ESP action number for each ESP (e.g., PACAF-Hickam-14-S5, S6, and S10, or AMC-Scott-15-S20 through S34).

14.22.3. Begin the letter by explaining the purpose of the submission (e.g., Request routine processing for subject site plan for final approval). If new construction is involved, include this statement in the subject line: “Involving new Construction.” This ensures reviewing and approval authorities correctly prioritize the submission request for review.

14.22.4. State the reason(s) for the request (e.g., “to construct a new maintenance and inspection facility,” or “to increase the NEWQD at an existing aboveground magazine”). Clearly identify whether new construction is requested; expeditious and new construction ESPs receive priority processing.

14.22.5. If the ESP replaces an existing ESP include a cancellation statement (e.g., “The modification to this facility cancels ESP AFMC-Hill-02-S7”).

14.22.6. State whether or not all explosives safety criteria are met. If there are waivers or exemptions, provide a unique exception identification tracking number for each waiver or exemption. This number is developed using the format as described in paragraphs 14.22.2.1. through 14.22.2.5., with the following modifications:
14.22.6.1. Use the identifier (W) for waivers or (E) for exemptions instead of (S) for the identification tracking number in Column 10 of the AF Form 943 or include in the Notes section on the ESS Submittal Form for the applicable exposure.

14.22.6.2. This unique identification number is based on the approval level, installation, and calendar year. Each installation uses its own numbering sequence (e.g., ACC-Hill-15-W01) as the first MAJCOM-level waiver identification number at Hill AFB for calendar year 2015. Use 388FW-Hill-15-W01 for the first wing-level waiver identification number.

14.22.6.3. Subsequent ESP submissions with QD exceptions within the same calendar year use the next available identification number at that installation for the type of exception required (e.g., the next MAJCOM-level waiver identification number at Hill AFB would be ACC-Hill-15-W02 while the first MAJCOM-level exemption would use ACC-Hill-15-E01). This method allows accurate tracking of exceptions based on the approval level, installation and calendar year.

14.22.6.4. Include superseded waiver or exemption identification numbers, if applicable.

14.22.7. If the ESP has any unique characteristics, explain what criteria are being applied and the basis for the application.

14.22.8. Describe compensatory measures if they are necessary to meet QD standards. The responsible Commander must sign ESPs containing compensatory measures. (T-1). Units will develop a means to assure continued implementation of compensatory measures per MAJCOM direction. (T-1).

14.22.9. For ESPs involving new construction, include the project identification and Programming, Design, and Construction (PDC) number.

14.22.10. Discuss any future plans that may impact this siting. State that the Base Facilities Board has reconciled this particular ESP with the base comprehensive plan. Provide meeting minutes, dated reference or written record of reconciliation.

14.22.11. Explain the format being used to record QD evaluation (e.g., “The attached AF Form 943 and map show all exposures and required separations”).

14.22.12. Provide a narrative description of the relevant explosives safety aspects of the facility design.

14.22.12.1. If the facility includes an LPS, state that it meets all design requirements of this Manual, NFPA 780, AFI 32-1065, and attach LPS drawings. For PESs, if the facility does not include an LPS, state what exception is being applied per paragraph 5.25, address any requirements relevant to that exception, and attach the Commander’s risk acceptance if required.

14.22.12.2. If protective construction features not previously approved by the DDESB are to be used (e.g., personnel shields, blast-resistant construction), include a structural engineering analysis and construction drawings (see paragraph 14.25.3.). Provide a summary of the results of the structural engineering analysis.

14.22.12.3. Describe how compliance with the glass panel design requirements of Section 5B is met. Attach a glass breakage risk assessment if required.

14.22.12.5. Describe unique safety aspects of the facility design such as the presence of hazardous locations, use of conductive floors, etc.

14.22.12.6. If the facility design is a standard design that the DDESB has previously reviewed and declared acceptable, construction drawings do not need to be submitted. Identify the drawing number and the source of previous DDESB approval (e.g., DDESB TP 15, Approved Protective Construction). HASs may be referred to by type (e.g., 3rd GEN, Korean TAB VEE). Contact MAJCOM/SEW if definitive drawing numbers are unknown. Describe any planned deviations from the standard design for purposes of local site adaptation (e.g., addition of gunite cover to an ECM to protect from erosion); do not make changes to standard designs that affect the explosives safety characteristics of the facility.

14.22.13. For tiered ESPs, identify the management plan implementation document.

14.22.14. Describe the evaluation zone used. State if the evaluation zone does not exceed the IB distance, or if there are no PESs in the evaluation zone.

14.22.15. State if a Commanders authorized risk acceptance option is being applied and the derivative paragraph/table/note option allowing the Commanders risk acceptance.

14.22.16. Identify and explain the purpose of all attachments.

14.22.17. Address compliance with ESP coordination requirements (e.g., notification or coordination with host-nation officials, discussions with tenant units, etc.).

14.22.18. Staff agency point of contact in the event clarification is necessary.

14.22.19. If expeditious processing is being requested, include the following:

14.22.19.1. On the subject line of the memorandum state: “Request for EXPEDITIOUS processing of Explosives Site Plan (ESP) for AFSPC-Vandenberg-14-S2.”

14.22.19.2. Explain the reasons why expeditious processing is necessary (e.g., compelling mission or construction impact). These reasons must show sufficient mission impact to warrant the expeditious processing, or the ESP will be reviewed according to the routine processing procedures.

14.22.19.3. Date when approval is needed and why it is needed by that date (e.g., “Approval is required by 15 June 2014 to support planned contract award for new construction”).

14.23. ESP Submittal Form. Use the ESP submittal form (AF Form 943 or ESS Submittal Form) to provide PES and ES information and to validate required QD separation. Prepare a separate Submittal Form for each PES (or ES in the case of an ES ESP) to be sited. See paragraph 14.27. for alternative Submittal Form formats. Instructions for completing AF Form 943 and the ESS Submittal Form are provided in Tables 14.2. and 14.3. respectively. Include the following information on the ESP Submittal Form:

14.23.1. ESP action number (see paragraph 14.22.2.).

14.23.2. Location of the PES or ES being sited. If the location is not a military installation, list civilian or commercial address.
14.23.3. For explosives locations, identify all ESs and PESs within the IB distance, and all PESs within the evaluation zone (EZ) if it is larger than the IB distance. For ESPs with an IB distance less than 100 ft, ensure exposures requiring a minimum separation distance (e.g., 100 ft for parking areas exclusively supporting the PES) are identified. For non-explosive locations, identify all PESs within the EZ. For some non-explosive locations, it may not be necessary to identify all PESs (e.g., unmanned miscellaneous structures requiring 50 foot separation from any PES can be sited by merely identifying the nearest PES).

14.23.4. The EZ is based on the QD type of the ES (e.g., Operating Location, CAPA), and the largest NEWQD PES on the installation. To determine the size of the EZ, when a K Factor is required use the largest HD 1.1 NEWQD authorized in a single PES on the installation or within the established clear zone (maximum of 500,000 pounds) (see Table 14.1.). For other HDs, use the minimum prescribed distances found in the appropriate QD tables. See Figure 14.1. for examples of EZs.

14.23.5. For all PESs and ESs, provide the following:

14.23.5.1. Assigned CE building number or other identifier (e.g., Bldg 123, or F123).

14.23.5.2. Applicable Table 12. (X) description (e.g., ECM, or Related Facility. Identify the presence of barricades if they affect the QD required).

14.23.5.3. Primary operation normally expected at the facility (e.g., shipping and receiving, maintenance and inspection, or bomb build-up). If facility type determines QD criteria applied, include definition of building such as Korean TAB VEE, 3rd Gen HAS, 26x60 igloo, 26x40 igloo, etc. Show definitive drawing numbers when available.

14.23.5.4. The organization whose assets or people will be in the facility. Include the MAJCOM, Wing, Squadron, and show unit designations by number and alpha designation (e.g., USAFE-52FW). Include the branch of service if other than the Air Force.

14.23.5.5. Optional for ESS Submittal Form. Total number of people (M for Military or DoD Civilian, C for Non-DoD Civilian, DC for Defense Contractors, and FN for Foreign Nationals) normally assigned to the location. Consider the number of persons present during exercises. Do not include casuals such as inspectors or quality control evaluators. Include a breakdown by room or bay, when appropriate. Do not show people assigned to explosives storage locations, AECPAs, or CAPAs.

14.23.6. For all PES, provide the NEWQD for all HDs (HD 1.2.3, 1.5 and 1.6 may be omitted unless quantities will be present). Include MCE for HD 1.2.1. Include LSRN and parenthetical fragment distance for HD 1.2.3. If no LSRN is specified, use the NEWQD of the single round. If no NEWQD is provided, contact AFSEC/SEW. For HD 1.4 show “Capacity” or “Op Limit.” If no explosives in a particular HD will be present, type “None.” For multiple room facilities, show values for each room where explosives will be present. Where IM is not provided between rooms or cubicles, show overall values for the facility. If explosives are unpackaged see Section 3C. The explosive authorization must always show the sited, waived, or exempted weights, whichever is greater.

14.23.7. It is important to ensure facilities or locations being sited, whether explosive or non-explosive, within the IBD and EZ comply with QD requirements. Accomplish this by
con ducting a paired relationship evaluation. Evaluate an explosives facility or location as both a PES and an ES. This is a two-way evaluation where the most restrictive distance between the pair is documented. A non-explosive ES is a one-way evaluation from surrounding PESs to the ES.

14.23.8. Identify the actual separation between each pair.

14.23.9. Using applicable Chapter 12 table and applicable Notes, identify the most restrictive (greatest) separation distance required between each pair for each HD, and the appropriate K-factor, minimum distance or rule used to determine this distance.

14.23.10. For each instance where the required separation is greater than the actual separation, provide the exception identification number (see paragraph 14.22.6.).

14.23.11. For ESPs with waivers or exemptions, include the following:

   14.23.11.1. Indicate the effect an MCE at the PES has on the unit mission, or other supported agencies (see Chapter 2).

   14.23.11.2. Describe any corrective actions, compensatory measures, and controls to achieve safety during operations if the ESP is approved. State whether corrective action can or cannot be done locally with available funds or other resources. If there is no planned construction or other corrective actions, explain why. Show planned or programmed (funded and unfunded) actions to eliminate exceptions. Such action might include recommendations to higher headquarters, assigning priorities, funding revisions to standard facilities, etc. If there are other local projects underway that involve funding, show the following: construction priority assigned, Military Construction Program (MCP) item number, and fiscal year for construction. Include any operational controls necessary.

   14.23.11.3. Give the reason for the request. Describe impact if requested action is not approved.

14.23.12. If exceptions are involved, or if compensatory measures are used to prevent an exception, include approvals from the appropriate agencies and the responsible Commander. For exceptions, the responsible Commander's signature shows that the request is needed for the mission and that the risks are acceptable for strategic or compelling operational reasons. For compensatory measures, the responsible Commander’s signature shows that the compensatory measures are acceptable and will be enforced.

14.24. Site Location Map. A sample site location map is provided in Figures 14.2. and 14.3.

14.24.1. Submit a map clearly showing all the PESs and ESs relevant to the ESP.

14.24.2. Use a 1”= 400’ (or similar metric) scale. To enhance clarity or show precise measurements, use a larger (1”=200’ or 100’) scaled map. To properly reflect certain distance and structure relationships within the area surrounding the project, use a smaller scaled map. Provide the scale on the map. Express all distances in feet, if feasible. An ESP generated map is acceptable.

14.24.3. Details such as the specific points of measurement, actual and required distance, and NEWQDs are encouraged.
14.24.4. When there is reasonable doubt about the accuracy of the mapped location, it is the responsibility of all participants in the explosives site planning process to define a locally acceptable method for determining the measurement accuracy required between the PES-ES locations.

14.24.5. If the base boundary is not shown on the map, certify the relationship of the explosives clear zone to the base boundary in the transmittal letter.

14.24.6. When siting a PES, show all exposed sites within IBD of the PES. When there is an evaluation zone larger than the IB clear zone of the PES being sited show the evaluation zone (with dashed line) and the PESs in it.

14.24.7. When siting an ES, show the evaluation zone (dashed line) and all PESs in the evaluation zone.

14.24.8. Use color coding to simplify and speed the review process. Identify the PESs in red and ESs in green. Highlight the clear zone lines in red.

14.24.9. Include ESP action number, title and scale.

14.24.10. Show topographic contours or features, such as natural barricades (i.e., dense forest or hills) if they are pertinent to the application of QD.

14.24.11. When siting multiple PESs, show the IBD clear zone for each PES. Show a blended clear zone if it provides additional clarity.


14.25.1. For facilities not being constructed IAW a previously DDESB-approved design (see paragraph 14.22.12.2.), construction drawings showing applicable safety and protective features are required. These drawings must show, as a minimum, the following information: (T-1).

14.25.1.1. Floor layout, roofs, windows, and general materials used.

14.25.1.2. Substantial dividing walls, vent walls, firewalls, operational shields and barricades.

14.25.1.3. Exits and fire protection system installations.

14.25.1.4. Types of floor finish, electrical systems and equipment, and ventilation systems and equipment.

14.25.1.5. Hazardous waste disposal systems.

14.25.1.6. LPS and static grounding systems. See paragraph 14.25.2. for detailed LPS drawing requirements.


14.25.1.8. Auxiliary support structures.

14.25.1.9. Drawings, specifications, rationale and base security manager approval of physical security designs when the design is different than standard construction methods used for explosive facilities.
14.25.1.10. Do not submit drawings (e.g., for landscapes or pavements) that are not relevant to QD or safety protective factors.

14.25.2. LPS drawings must include: (T-1).

14.25.2.1. Elements of the LPS, such as air terminals, masts, overhead wires, grounding electrode system and a description of the surge protection.

14.25.2.2. Top, front, side, and additional views as necessary depicting the dimensions (spacing and height) between design elements. Front and side elevations depicting air terminals and the 100-foot radius (200 feet diameter) rolling sphere zone of protection is suggested to facilitate the ESP review process.

14.25.3. For protective construction features not previously approved by the DDESB, provide construction drawings and a structural engineering analysis including:

14.25.3.1. Statement of the design objectives in terms of protection categories to be obtained (see DDESB TP 15, Approved Protective Construction).

14.25.3.2. The explosives quantities involved.

14.25.3.3. The design loads applied.

14.25.3.4. Any material properties and structural behavior assumptions made.

14.25.3.5. References and the sources of methods used.

14.25.3.6. Qualifications of the Preparer. Only engineers who are experienced in the field of structural dynamics and who use design procedures accepted by professionals, in that field, may design explosion resistant facilities.

14.26. Automated Explosives Safety Siting. Automated explosives safety siting programs are the preferred method of ESP development. To the greatest extent possible, use automated explosives safety siting for ESP development. In the event automated explosives safety siting program is not available for the location requiring an ESP submission, use manual means of ESP development but submit it electronically to the greatest extent possible.

14.27. Alternative Submittal Form Formats. In some instances, modifications to the AF Form 943, ESS Submittal Form, or a substitute format may be acceptable. Provide a description of the proposed alternative format, and justification for its use, to the MAJCOM for approval. MAJCOM/SE will coordinate with AFSEC/SEW prior to granting approval. (T-1). Any alternative format used must provide the information required in paragraph 14.23. (T-1).
Figure 14.1. Evaluation Zone Examples.

All these Evaluation Zones (EZ) are based on 500,000 lbs HC/D 1.1 (maximum capability of any PES).

Evaluate ALL exposures in the PES Inhabited Building Distance (IB) clear zones.

Evaluate only PES exposures in Evaluation Zones (EZ).

Magazine Location

Non-explosive Location

Combat A/C Parking Area
Figure 14.2. Sample Site Location Map.
Figure 14.3. Sample Automated Explosives Safety Siting (ESS) Program Drawing.
Table 14.1. Evaluation Zones for Exposed Sites.

<table>
<thead>
<tr>
<th>Exposed Site</th>
<th>Evaluation Zone (feet)</th>
<th>Evaluation Zone (K-Factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Covered Magazine</td>
<td>874</td>
<td>K-11</td>
</tr>
<tr>
<td>Aboveground Magazine</td>
<td>874</td>
<td>K-11</td>
</tr>
<tr>
<td>Barricaded Module</td>
<td>874</td>
<td>K-11</td>
</tr>
<tr>
<td>Operating Location</td>
<td>1429</td>
<td>K-18</td>
</tr>
<tr>
<td>Remote Operating Location</td>
<td>1429</td>
<td>K-18</td>
</tr>
<tr>
<td>Combat Aircraft Parking Area</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Aircraft Explosives Cargo Parking Area</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Flightline Munitions Holding Area</td>
<td>874</td>
<td>K-11</td>
</tr>
<tr>
<td>Hardened Aircraft Shelter</td>
<td>1429</td>
<td>K-18</td>
</tr>
<tr>
<td>Defensive Missile Battery</td>
<td>874</td>
<td>K-11</td>
</tr>
<tr>
<td>Airfield Military Use Only Runway</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Airfield Military Use Only Taxiway</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Airfield Joint, Military/Non Military Use Runway</td>
<td>3969(4)</td>
<td>K-50(4)</td>
</tr>
<tr>
<td>Airfield Joint, Military/Non Military Use Taxiway</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Non-Explosives Loaded Aircraft</td>
<td>3969</td>
<td>K-50</td>
</tr>
<tr>
<td>Passenger Load/Unload Area</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Facilities For Combat Aircraft Alert Forces</td>
<td>1429</td>
<td>K-18</td>
</tr>
<tr>
<td>Aboveground Utilities</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Underground Utilities</td>
<td>239</td>
<td>K-3</td>
</tr>
<tr>
<td>Aboveground Bulk POL Facilities</td>
<td>3969(4)</td>
<td>K-50(4)</td>
</tr>
<tr>
<td>Public Traffic Route</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Recreation Area/Facility</td>
<td>2382</td>
<td>K-30</td>
</tr>
<tr>
<td>Related Facility</td>
<td>1429(3)</td>
<td>K-18(3)</td>
</tr>
<tr>
<td>Inhabited Building Distance</td>
<td>3969(4)</td>
<td>K-50(4)</td>
</tr>
</tbody>
</table>

Notes:
1. Base evaluation zones shown on 500,000 pounds NEWQD at the applicable K factor for the paired relationship. Use smaller evaluation zones based on the largest amount of HD 1.1 authorized in a single PES on the installation or within the established clear zone. For other HDs, use the prescribed distances found in the appropriate QD tables.
2. Evaluation zones that are smaller than the IB clear zone of the PES being sited have no effect because all the facilities within that IB zone are already listed.
3. Related facilities being evaluated may not be related to the PES where the EZ was determined. In addition to the PESs in the evaluation zone, list those PESs that have an IB relationship to the ES.
4. Use evaluation zones for IB targets only to determine if an ESP is required. Only prepare an ESP for ESs requiring IB distance from all PESs if they are located within an explosives clear zone.
Table 14.2. Sample AF Form 943-Explosives Site Plan.

<table>
<thead>
<tr>
<th>FAC NO. 1</th>
<th>FACILITY/OPTION DESCRIPTION</th>
<th>OWNING MAJCOM/UNIT</th>
<th>NO. OF PEOPLE</th>
<th>SITED NEWQD</th>
<th>(xx) HC/D MCE/LSRN</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>415</td>
<td>Operating Location Explosives Operating Facility</td>
<td>ACC-311 MONS</td>
<td>37,000</td>
<td>11</td>
<td>1.2 to 149</td>
<td>7</td>
</tr>
<tr>
<td>506</td>
<td>Underground Utilities Water Main, Underground</td>
<td>ACC-312 CES</td>
<td>11</td>
<td>0</td>
<td>N/A</td>
<td>7</td>
</tr>
<tr>
<td>419</td>
<td>Relocated Facility SCRSM, with ≥ 2 ft of Earth</td>
<td>ACC-311 MONS</td>
<td>42M OC</td>
<td>1,200</td>
<td>1048</td>
<td>7</td>
</tr>
<tr>
<td>420</td>
<td>Operating Location Missile Maintenance Facility</td>
<td>ACC-312 MONS</td>
<td>10M OC</td>
<td>1,200</td>
<td>1048</td>
<td>7</td>
</tr>
<tr>
<td>422</td>
<td>Aboveground Magasse Mag. Aboveground, Structure</td>
<td>ACC-312 MONS</td>
<td>20,000</td>
<td>1</td>
<td>1214</td>
<td>7</td>
</tr>
<tr>
<td>423</td>
<td>Inert Storage, Structure STOR, SPARE INERT</td>
<td>ACC-312 MONS</td>
<td>13</td>
<td>0</td>
<td>1018</td>
<td>7</td>
</tr>
<tr>
<td>424</td>
<td>Aboveground Magazine Mag. Regenerated 1≤450 lbs Prim Frag Not Stopped</td>
<td>ACC-312 MONS</td>
<td>13</td>
<td>0</td>
<td>1018</td>
<td>7</td>
</tr>
</tbody>
</table>

Notes:
1. **Section I – General Information**
2. Action Number. Enter the ESP action number per paragraph 14.22.2.
   Base/Location. Enter the location of the PES or ES being sited. If other than a military base, list civilian or commercial address.
4. Date
5. **Section II – Site Data**
6. Column 1. Provide the assigned CE building number or other identifier (e.g., Bldg 123, or F123).
7. Column 2:
8. First line: Identify the facility being sited, using the applicable Table 12. (x) description (e.g., ECM, or Related Facility). Identify the presence of barricades if they affect the QD required.
9. Second line: Identify the primary operation normally expected at the facility (e.g., shipping and receiving, maintenance and inspection, or bomb build-up). If facility type determines QD criteria applied, include definition of building such as Korean TAB VEE, 3rd Gen HAS, 26x60 igloo, 26x40 igloo, etc. Show definitive drawing numbers when available.
10. Column 3. Identify the organization whose assets or people will be in the facility. Include the MAJCOM, Wing, Squadron, and show unit designations by number and alpha designation. Include the branch of service if other than the Air Force (e.g., 52FW).
11. Column 4. Identify the total number of people (M for Military or DoD Civilian, C for Non-DoD Civilian, DC for Defense Contractors, and FN for Foreign Nationals) normally assigned to the location. Consider the number of persons present during exercises. Do not include casuals such as inspectors or quality control evaluators. Include a breakdown by room or bay, when appropriate. Do not show people assigned to explosives storage locations, AECPPAs, or CAPAs.
12. Columns 5 through 6:
13. For a PES, provide the NEWQD for all HDs (HD 1.2.3, 1.5 and 1.6 may be omitted unless quantities will be present). Include MCE for HD 1.2.1 in Column 6. Include LSRN and parenthetical fragment distance for HD 1.2.3 in Column 6. For HD 1.4 show “Capacity” or “MEQ” in Column 5. If no explosives in a particular HD will be present, type “None” in Column 5. For multiple room facilities, show values for each room where explosives will be present. Where IM is not provided between rooms or cubicles show the overall value for the facility. If explosives are unpackaged see **Section 3C**. The explosive authorization must always show the sited, waived, or exempted weights, whichever is greater.
14. For an ES, type “None” in Column 5 for each HD.
15. **Section III – PES/ES Q-D Paired Relationships With Facility/Location Being Sited**
16. Columns 1 through 6:
17. Provide the same data as described for Columns 1 through 6 in **Section II**.
18. For PES ESPs, identify all ESs and PESs within the IB distance, and all PESs within the evaluation zone (EZ) if it is larger than the IB distance.
19. For ES ESPs, identify all PESs within the EZ. For some ES ESPs, it may not be necessary to identify all PESs (e.g., unmanned miscellaneous structures requiring 50 foot separation from any PES can be sited by merely identifying the nearest PES).
20. If exceptions are involved, provide the exception identification number per paragraph **14.22.6.** in Column 10, Remarks.
21. Column 7. Identify the actual separation between facilities listed in Column 2, **Sections II and III**.
22. Column 8. Identify the most restrictive (greatest) separation distance required between the facility listed in column 2, **Sections II and III**. If both facilities are PESs, perform a two-way
evaluation between the pair and document the most restrictive distance. For exposures requiring only 50’ minimum or no QD separation distance, use a one-line entry.

23. Column 9. Identify the applicable Chapter 12 Table column/line and applicable Notes to obtain the distance in Column 8. If there is a specific facility or situation that is not listed in the applicable Chapter 12 Table, use Section 12O.

Table 14.3. Sample Explosives Safety Site Plan Submittal Form.

Notes:
1. The following sections describe the information provided in a submittal form created using the Automated Explosives Safety Siting program. If siting without the use of an Automated Explosives Safety Siting program, refer to Table 14.2. and use the AF Form 943.
2. Section I – General Information:
3. Installation: Used to record the installation ID.
4. Location: Provides the location of the PES or ES being sited and must include the ESP ID number.
5. Date: Used to record the date the ESP was created.
6. QD Engine/Automated Explosives Safety Siting Program Version: Documents the QD engine/version number, as well as, the Automated Explosives Safety Siting Program build/version number used to create the ESP.
7. Section II – Data on Facility Being Sited.
8. Column 1: Provides the assigned CE building number or other identifier as well as the owning command and/or unit.
9. Column 2: Documents the assigned type code and facility description (e.g., EOL, Explosives Operating Facility).
10. Column 3: Identifies the largest required IBD. This value corresponds to the IBD zone on the submittal map.
11. Column 4: Identifies the largest required PTR.
12. Columns 5 through 10: Documents the HD NEWQDs, (xx), and MCEs for the facility being sited. If the facility being sited is a non-explosives ES, 0’ will be listed in all HD columns.
13. **Section III – PES/ES QD Paired Relationships with Facility Being Sited.**
14. If the ES is a non-explosives location, it will have a single line entry unless it falls within multiple sectors of a segmented clear zone. In this case, it will have a single line enter for each sector. If the ES is also a PES, and within the established IBD zone, it will have a two line entry; one as an ES and one as a PES (reverse). If the ES is a PES beyond IBD but within the EZ, it will have a single line entry (reverse).
15. Columns 1 and 2: Provides the same data described for Columns 1 and 2 in Section II above.
16. Column 3: Used to record the Actual Distance and Required Distance for the paired relationship. The required distance corresponds to the largest required distance found in columns 5 through 10.
17. Column 4: This column is used to describe the orientation of the ES from the PES being sited as well as the orientation of the ES to the PES (reverse) when the ES is also a PES. The Automated Explosives Safety Siting program-related code is also provided when applicable.
18. Columns 5 through 10:
19. For a non-explosives ES, a single line entry will be used unless the ES falls in multiple sectors of a segmented zone. In this case, a single line entry will be used for each sector. Each column will list the required distance, AFMAN reference, and exposure type (IM, ILD, PTRD, etc.). If exceptions are involved, the information for the HD causing the violation will be in red. Ensure “Submittal Notes” reference the exception number assigned to the violation.
20. For an ES that’s also a PES, use a multiple line entry. One for the ES as an ES from the PES being sited and one for the ES as a PES to the PES being sited. As a PES, columns will also document the NEWQD, MCE, and (xx) of the ES when applicable.
21. If the ES is also a PES beyond IBD but within the EZ, use a single line entry to show reverse siting requirements as a PES.
22. **Section IV – Exposures Not Requiring QD.**
23. Use this section to identify ESs not requiring QD. Typically, these facilities will have a type code of NAF (non-applicable facility). Include information in the Notes column explaining why QD does not apply.
Chapter 15
REAL PROPERTY KNOWN OR SUSPECTED TO CONTAIN MUNITIONS AND EXPLOSIVES OF CONCERN AND CHEMICAL AGENTS

Section 15A—Introduction

15.1. General. Use every means possible to protect the general public and the environment from exposure to AE hazards. This includes all explosive hazard areas, suspected or known to exist, on real property currently or formerly under USAF ownership or control.

15.1.1. This Chapter establishes explosives safety standards that, when applied, protects people and real property from explosive and Chemical Agent (CA) hazards associated with real property known or suspected to contain:

15.1.1.1. Munitions and explosives of concern (MEC).
15.1.1.2. CA in other than munitions configurations (e.g., DoD laboratory vials, CA identification sets, one-ton containers, CA-contaminated soil).

15.1.2. This Chapter establishes a process for determining site-specific actions that, when taken:

15.1.2.1. Ensure explosives safety is addressed throughout munitions responses to MEC.
15.1.2.2. Ensure Chemical Warfare Material (CWM) safety and, when applicable, explosives safety is addressed throughout CWM responses (i.e. a response to CA-filled munitions).
15.1.2.3. Result in DDESB approval of required safety submissions for munitions responses to MEC and for CWM responses (See Section 15E for required safety submission and their contents).
15.1.2.4. Document and report completion of MEC and CWM responses.

15.1.3. This Chapter does not apply to:

15.1.3.1. Operational ranges, with the exception of military munitions burial sites located on such ranges.
15.1.3.2. Explosives or munitions emergency responses.

Section 15B—Explosives Safety Standards for the Identification and Control of Areas Known or Suspected to Contain MEC or CA

15.2. Identification and Control. To ensure explosives and CA safety risk is identified and controlled on real property currently or formerly under the jurisdiction, custody, or control of the USAF, installations must: (T-1).

15.2.1. Identify all areas known or suspected to present explosive or CA hazards (Geographic Information Systems must be used):
15.2.1.1. In installation master plans for active installations (In some cases, these areas are also required to be identified in other documents).

15.2.1.2. In DoD’s military Munitions Response Site Inventory for those sites that are included in the Military Munitions Response Program (see Management Guidance for the Defense Environmental Restoration Program (DERP) and 10 U.S.C. 2710(a).

15.2.2. Maintain permanent records of those areas identified pursuant to paragraph 15.2.1. and ensure such records are readily available to current and futures users of the property. Retain records for areas such as operational ranges, former ranges, current or former munitions manufacturing facilities, current or former sites used for munitions demilitarization activities, and locations previously used for the burial of munitions. Records must: (T-1).

15.2.2.1. When practicable, include the nomenclature and the known or suspected location.

15.2.2.2. Summarize any clearance or response (removal or remediation) actions, or explosives or munitions emergency responses previously conducted within the area.

15.2.3. Prohibit unnecessary access and take appropriate action to deter unauthorized access to areas under DoD control that are known or suspected of containing potential explosive or CA hazards.

15.2.3.1. Such actions may include establishing access controls (e.g., fencing the area, establishing roving security patrols), which may be risk-based, or providing public notifications of any potential hazards (e.g., posting UXO-hazard warning signs, conducting UXO-safety education programs).

15.2.3.1.1. When used, signs must be kept legible and, when appropriate, in the predominant languages of the region, or as pictograms. (T-1).

15.2.3.1.2. When the DoD does not exercise jurisdiction, custody, or control over the area (e.g., Formerly Used Defense Sites (FUDS)), the responsible installation must, at a minimum, provide written notification of the potential explosive or CA hazards to the property owner and any known tenants. (T-1).

15.2.3.1.3. Maintain a record of this notification as a permanent record (see paragraph 15.2.2.).

15.2.3.2. Installations must, unless there is evidence to the contrary, assume the following areas present explosive hazards:

15.2.3.2.1. Impact areas on operational ranges. Exceptions are ranges known to have been exclusively used for training with only small arms ammunition.

15.2.3.2.2. Former ranges known or suspected to contain MEC.

15.2.3.2.3. Outdoor demolition areas, to include locations used for open burning (OB) or open detonation (OD).

15.2.3.2.4. Areas that are associated with military munitions production, demilitarization, renovation, or similar processes (e.g., operating buildings and any installed equipment) that generated explosives residues (e.g., dust, vapors, liquids)
and that might have become contaminated with such residues in concentrations sufficient to present explosive hazards, to include areas receiving processing wastewater (e.g., settling ponds, drainage swales).

15.2.3.3. Installations should, unless there is evidence to the contrary, assume the following areas present CA hazards:

15.2.3.3.1. Former CWM or CA burial sites.
15.2.3.3.2. Former CWM or CA disposal areas.
15.2.3.3.3. Former CWM impact areas.
15.2.3.3.4. Former training areas used for training with CWM or CA.
15.2.3.3.5. Former CWM or CA production and demilitarization facilities.

15.2.3.4. When access to areas known or suspected to present explosive or CA hazards is necessary, a risk assessment to evaluate the potential hazards associated with the proposed activity must be completed and methods to mitigate any potential exposures implemented before access is allowed. (T-1).

15.2.3.5. When access is necessary to real property not under DoD ownership, custody, or control, installations should obtain a right of entry for the property. (T-1).

15.2.4. Prohibit the disposal (e.g., burying, dumping) of military munitions on land or in water except when specifically authorized by the appropriate MAJCOM in coordination with AFSEC/SEW. (T-1). Such disposal actions must comply with applicable regulatory requirements. (T-0). This prohibition does not preclude:

15.2.4.1. The covering of munitions with earth to control fragments and noise during authorized destruction by detonation.
15.2.4.2. The use of in situ capping when implemented as an engineered remedy under an authorized response action.

Section 15C—Safety Aspects of Explosives and CA Response Actions

15.3. Response Actions.

15.3.1. Plans for munitions responses to MEC or CWM responses must: (T-0).

15.3.1.1. Ensure close coordination, as applicable, between DoD explosives and CA safety organizations, DoD environmental organizations, and appropriate regulatory agencies and stakeholders.
15.3.1.2. Specify those actions necessary to protect DoD personnel, installation-related personnel, and the public from exposure to explosive and CA hazards.
15.3.1.3. Provide the design for and explain the execution of a munitions and CWM response, when MEC and CA, respectively, have been determined to present an unacceptable risk.
15.3.1.4. Explain how the selected response actions will achieve a degree of protectiveness necessary for the current, determined, or reasonably anticipated future land use.
Provide the rationale for selection of technologies to be used to detect anomalies that can indicate the presence of MEC or CA, regardless of CA configuration.

Address how periodically (e.g., during 5-year reviews or consistent with long-term monitoring agreements) completed response actions will be reviewed to ensure the response remains effective. The need for such reviews is particularly important in areas where natural phenomena (e.g., frost heave, soil erosion, droughts, or tidal action) could expose MEC or CA, regardless of CA configuration, or where Land Use Controls (LUC) constitute a major element of the response. These reviews must consider:

1. The explosives safety aspects of munitions responses to MEC.
2. The CA safety and, when applicable, the explosives safety aspects of CWM responses.

Address how the personnel qualification provisions of DDESB TP 18 will be met.

Be approved by the DDESB for compliance with DoD explosives safety standards.

Provide for the submission of an After Action Report (AAR) to the DDESB upon completion of the response. AAR are not provided for DDESB approval, but are used to close out files maintained by the DDESB Staff.

Residual Explosive and CA Hazards.

Some areas that the military has used for munitions-related activities (e.g., live-fire training or testing, OB/OD) or for CA-related activities may not be appropriate, even after the performance of response activities, for certain uses (e.g., residential development). Such areas include former military range impact areas where the military has used munitions containing either HE or CA and sites used for either OB or OD. Such areas may, after a response, be better suited for uses that restrict or limit intrusive activities (e.g., wildlife refuges, surface recreational areas).

Some MEC or CA, regardless of CA configuration, might not be detected or removed during a response. Although residual risks can be managed (e.g., by use of agreed-upon LUC, to include safety education; recurring reviews; and construction support), residual hazards might still exist.

From an explosives and, when applicable, CA safety perspective, the degree to which MEC or CA removal is undertaken depends largely on the current, determined, or reasonably anticipated future land use. When MEC or CA, regardless of CA configuration, cannot be removed to the degree necessary to safely allow the current, determined, or reasonably anticipated future land use, the use must be changed or appropriately restricted to obtain DDESB approval of the relevant plan.

When DoD does not control the land and the imposition of LUC is not possible (e.g., on FUDS), the responsible installation must, at a minimum, provide the property owner, and any known tenants, written notification of the potential residual explosive or
CA hazards and the risks inherent in any use of property that is consistent with those hazards. (T-1).

15.3.3. Explosives Safety and CA Safety Aspects in the Selection and Design of Responses.

15.3.3.1. Explosives safety must be addressed in the selection and design of a munitions response to MEC. (T-1). CA safety, and when applicable, explosives safety must be addressed in the selection and design of a CWM response. (T-1). The protection afforded by a response must be consistent with the current, determined, or reasonably anticipated land use. (T-1). The design of the response that is included in the required submission must consider the site-specific information below. (T-1).

15.3.3.1.1. Historical Information. Historical information, documented in a written report, is gathered through a records search, to include the permanent records outlined in paragraph 5.2., and interviews. The following information is required:

15.3.3.1.1.1. The boundaries of the response area. For munitions responses, the Munitions Response Area (MRA) boundaries and, when appropriate, the boundaries of any Munitions Response Sites (MRS) (e.g., firing points, impact areas, and burial sites) within the MRA are required.

15.3.3.1.1.2. The type of MEC known or suspected to be present based on the types of munitions-related operations, training, or testing previously performed in the MRA or MRS.

15.3.3.1.1.3. The type and configuration of any CA known or suspected to be present.

15.3.3.1.2. Land Use. Land use is the current, determined, or reasonably anticipated future use of real property. Because portions of the response area (e.g., the MRA or MRS) might be used differently (e.g., public highway, wildlife refuge, sports field, industrial complex), different response actions (e.g., surface removal, subsurface removal, no removal, remedial response) may be appropriate within any given response area.

15.3.3.1.2.1. Where the land use is limited to surface activities, the munitions or CWM response may only involve removing surface MEC or surface CA. This removal may be technology-aided.

15.3.3.1.2.2. When the land use will involve or allow intrusive activities to occur, the response will normally require a subsurface removal, and may require follow-on construction support.

15.3.3.1.2.3. Where the current, determined, or reasonably anticipated land use is compatible with the explosive or CA hazards present or suspected, a response action to remove any explosive or CA hazards may not be necessary.

15.3.3.1.2.4. Where a response would adversely impact natural or cultural resources, a removal action may not be practical.

15.3.3.1.3. Results of Onsite Investigations. Use these results to validate and augment information discovered during the historical review and to determine the
specific boundaries of the response area (e.g., the boundary of an MRA or of any MRS within an MRA).

15.3.3.1.4. Analysis. Conduct a detailed analysis of available records, technical data, and the results of onsite investigations. This analysis must evaluate:

15.3.3.1.4.1. The types of MEC or CA, regardless of CA configuration, known to be present, to include its technical characteristics (e.g., filler, fuzing) and estimated distribution.

15.3.3.1.4.2. The potential explosive or CA hazards present.

15.3.3.1.4.3. Physical site characteristics (e.g., flora and fauna, endangered species, cultural items, geological, topographical, hydrological).

15.3.3.1.4.4. People potentially endangered.

15.3.3.1.4.5. Information from previous or current responses.

15.3.3.1.5. LUC. Evaluate the appropriateness and effectiveness of LUCs to manage any residual explosives safety or CA safety risks.

15.3.3.1.6. Technology. Evaluate the applicability, capabilities, and limitations of available technologies (e.g., detection, discrimination, removal).

15.3.3.1.7. Other relevant factors.

Section 15D—Special Considerations

15.4. Explosive Soil.

15.4.1. Because of some past munitions-related activities (e.g., settling ponds or explosives sumps at munitions production or demilitarization facilities), concentrations of explosives in soil (e.g., sand, sludge, clay) can exist such that the mixture itself presents an explosive hazard. Such mixtures are referred to as “explosive soil.”

15.4.1.1. The NEWQD of explosive soil is the weight of the mixture multiplied by the explosives concentration (e.g., 1,000 lbs [454 kg] of explosive soil that is 10 percent TNT has an NEWQD of 100 lbs [45.4 kg]).

15.4.1.2. The concentration necessary to present an explosive hazard depends on the distribution and type of explosives in the soil and the soil’s characteristics.

15.4.2. Primary (Initiating) Explosives.

15.4.2.1. Soil containing two percent or more by weight of any primary explosive or mixture of primary explosives presents an explosive hazard and must be treated as HD 1.1. (T-0).

15.4.2.2. Soil containing less than two percent by weight of any primary explosive does not present an explosive hazard.

15.4.3. Secondary Explosives.

15.4.3.1. Secondary explosives are much less sensitive than primary explosives.
15.4.3.2. Soil containing 10 percent or more of weight of either any secondary explosives or a mixture of secondary explosives presents an explosive hazard and must be treated as HD 1.1. (T-0).

15.4.3.3. Soil containing less than 10 percent by weight of any secondary explosive or a mixture of secondary explosives does not present an explosive hazard.

15.4.4. Nitroglycerin, Nitrocellulose, and Nitroguanidine.

15.4.4.1. Soil containing 10 percent or more by weight of nitroglycerine, nitrocellulose, or nitroguanidine presents an explosive hazard and must be treated as HD 1.1. (T-0).

15.4.4.2. Soil containing less than 10 percent by weight of nitroglycerin, nitrocellulose, or nitroguanidine does not present an explosive hazard. Care must be taken when applying this threshold rule to less-permeable soils, such as clay, that may cause nitroglycerin to pool, rather than be absorbed.

15.4.5. Other Energetic Materials Mixtures. The potential explosive hazard of such mixtures in soil may be unknown and may require testing. If the hazard is unknown, manage soil mixtures containing only propellants as secondary explosives, and all other soil mixtures containing energetics (e.g., liquid propellants) as primary explosives.

15.5. Real Property—Buildings and Installed Equipment.

15.5.1. Military munitions operating buildings (e.g., munitions production or demilitarization facilities) and any installed equipment may contain residual explosives that present an explosive hazard.

15.5.2. Of particular concern are building features (e.g., floors, roofs, walls, drains, internal and external piping, ventilation systems) where explosives residues could present explosive hazards and industrial equipment, particularly equipment with internal cavities from facilities used in munitions production or demilitarization operations (e.g., cast loading or milling, steam-out) that generated explosives residues (e.g., dust, vapors, liquids).

15.5.3. To the extent buildings or installed equipment is believed to present an explosive or CA hazard, installations, in coordination with MAJCOM and AFSEC/SEW, must submit to the DDESB for use of such buildings and installed equipment before use or transfer for purpose incompatible with the presence of the explosive hazard (see DoD 6055.09-M, Volume 7, for additional information). (T-1).

15.6. Construction Support.

15.6.1. Responsible installations must consider the level of construction support required, based on site-specific data, during activities below. (T-1).

15.6.1.1. Intrusive activities (e.g., building construction, laying utilities, or road improvements) on property known or suspected to contain MEC or CA, regardless of CA configuration, or on property where residual explosive or CA hazards may exist.

15.6.1.2. The removal or remediation of debris or media in areas where there is a probability of encountering MEC (e.g., former OB/OD grounds) or CA.

15.6.2. The responsible authority (e.g., installation Commander or designated representative) will determine whether such support is required and the level of effort of required support on
a case-by-case basis (see paragraph 15.10.7.). (T-1). Construction support is determined by the probability of encountering MEC or CA, regardless of CA configuration as follows:

15.6.2.1. Low Probability. “On-call” construction support is appropriate.

15.6.2.1.1. A “low” determination may only be assigned to those areas where a search of available historical records and onsite investigation data indicates that, given the military or munitions-related activities that occurred at the site, the likelihood of encountering MEC or CA, regardless of CA configuration, is low.

15.6.2.1.2. Munitions-related activities that may merit a “low” determination include, but are not limited to, the former use of the area for live-fire training exclusively with small arms ammunition; for maneuver training, to include maneuver training involving the use of smokes, pyrotechnics, and simulators; as firing points; for munitions inspection, handling, storage, or transfers, to include residue points and inert storage yards; for air defense; or as munitions operating facilities. The exceptions are facilities where the processes used might have resulted in the generation of concentrations of munitions constituents high enough to present an explosive hazard. Areas where previous responses have been completed may also qualify for “low” determinations.

15.6.2.1.3. Immediate reassessment by the responsibility authority of the level of construction support required is appropriate upon the discovery of MEC or CA, regardless of CA configuration.

15.6.2.2. Moderate to High Probability. Provide “Onsite” construction support to remove explosive or CA hazards in the construction footprint, per a DDESB-approved Munitions Response Explosives Safety Submission (MRESS) or Munitions Response Chemical Safety Submission (MRCSS), before intrusive construction or other intrusive activities occur.

Note: When the depth of intrusive activities exceeds the detection limits of the detection equipment used, remove soil in layers to allow detection and removal of MEC or CA, regardless of CA configuration, in the construction footprint.

15.6.2.2.1. A “moderate to high” determination may be assigned to those areas where a search of available historical records or onsite investigation data indicates that, given the military or munitions-related activities that occurred at the site, there is more than a low probability that MEC or CA are present.

15.6.2.2.2. Munitions-related activities that may merit a “moderate to high” determination include, but are not limited to, the former use of the area for live-fire training other than exclusively with small arms ammunition; as operational range impact areas; for OB or OD of munitions; as munitions operating facilities where processes used might have resulted in the generation of concentrations of munitions constituents high enough to present an explosive hazard; for munitions burial; or for any activities involving CA.

15.7. Anomaly Avoidance.

15.7.1. The use of anomaly avoidance techniques is appropriate on properties known or suspected to contain UXO or other munitions (e.g., DMM) that may have experienced...
abnormal environments to allow the below activities in such areas while avoiding surface explosive or CA hazards and, when necessary, subsurface anomalies. Use anomaly avoidance when:

15.7.1.1. Avoid surface MEC or CA, regardless of CA configuration, during any activities that require entry to the area (e.g., collections of environmental samples, the conduct of cultural resource studies).

15.7.1.2. Avoid subsurface anomalies during any intrusive work (e.g., drilling environmental monitory wells).

15.7.2. During anomaly avoidance:

15.7.2.1. Provide EOD escort support or within areas known or suspected to contain MEC, excluding CA, regardless of configuration, by UXO-qualified personnel as outlined in DDESB TP 18. (T-0).

15.7.2.2. Within areas known or suspected to contain CA, regardless of configuration, to include areas where such CA is commingled with other MEC, by UXO-qualified personnel trained in CWM responses. (T-0).

15.7.2.3. Explosives safety requires that discovered surface MEC or CA, regardless of CA configuration, be avoided and their location noted and reported to appropriate authorities. (T-0).

15.7.2.4. Detected subsurface anomalies must not be investigated, but must be marked, when appropriate, and avoided. (T-0).

15.8. Frost Heave.

15.8.1. This phenomenon occurs when three conditions are met; freezing temperatures are present in the soil column, the soil is frost susceptible, and there is sufficient moisture present in the soil to cause soil movement upon ice crystal formation. Evaluate these three factors to assess the likelihood of frost heave moving residual MEC or CA, regardless of CA configuration, upward through the soil column.

15.8.2. Where frost heave may have such an effect, explosives safety requires procedures be implemented to monitor the effectiveness of response actions for the affected area (Other naturally occurring phenomena, e.g., erosion, tidal changes, could necessitate similar monitoring).

15.9. Soil Containing CA.

15.9.1. The criteria below apply to soil known to be contaminated with one or more of the following CA: mustard, L, GD, GA/GB, O-cyclohexyl Methylphosphono-flouridate (GF) (common name is cylcosarin), or VX. This criteria applies only if a headspace measurement is at or above the Short Term Exposure Limits (STEL) or a laboratory extraction sample is at or above the Hazardous Waste Control Limit (HWCL) for solid materials: mustard, L, GD, GA/GB, GF, or VX. Certain CA-related operations, such as taking core samples at a suspect CWM or CA burial site, require laboratory extraction sampling (see paragraph 15.9.4.1.).

15.9.2. Soil where no evidence exists of CA contamination and does not require treatment or remediation.
15.9.3. An appendix to the site’s Site Safety and Health Plan that addresses the procedures (e.g., personnel protection, monitoring, sampling, packaging, and disposal) for the handling and disposition of CA-contaminated soil is required for environmental responses to soil known or suspected to be contaminated with CA.

15.9.4. Use air-sampling methods to detect CA during CWM responses. When encountering soil contaminated with CA and an air concentration is at or above the STEL, based on off-gas monitoring of the headspace of a container or of air in the immediate area of the operation, appropriate personal protective measures must be employed. (T-1). In addition, decontaminate the CA-contaminated soil to below the HWCL levels of paragraph 15.9.4.2. unless the CA-contaminated soil is shipped per DOT regulations and approvals and a receiving Treatment Storage Disposal Facility (TSDF) is qualified to process the CA-contaminated soil per Federal, State, interstate, and local laws and regulations. (T-0). If air monitoring is below the STEL, soil samples will be taken to determine if the soil exceeds the HWCL. (T-0).

15.9.4.1. The STELs for air sampling CA contamination are:

15.9.4.1.1. 0.003 milligrams per cubic meter (mg/m³) for mustard (H, HD, or HT) agent.
15.9.4.1.2. 0.003 mg/m³ for L.
15.9.4.1.3. 0.0002 mg/m³ for GD/GF.
15.9.4.1.4. 0.0001 mg/m³ for GA/GB.
15.9.4.1.5. 0.00001 mg/m³ for VX.

15.9.4.2. When encountering soil contaminated with CA at or above the HWCL levels listed in Table 15.1., as determined by laboratory extraction and analysis of soil samples, decontaminate the CA-contaminated soil to below the levels listed for HWCL, or to a level required by Federal, State, interstate, and local laws and regulations. (T-0).

**Table 15.1. Hazardous Waste Control Limits (HWCL).**

<table>
<thead>
<tr>
<th>Standard Name</th>
<th>Population</th>
<th>Exposure Scenario</th>
<th>Chemical Agent per Soil Mass (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Worker (Civilian/DoD)</td>
<td>Possible occasional exposure at hazardous waste treatment facility</td>
<td>GD/GF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
</tr>
<tr>
<td>HWCL</td>
<td></td>
<td></td>
<td>52</td>
</tr>
</tbody>
</table>

15.9.5. Once decontaminated to the appropriate level, package the CA-contaminated waste in a DOT-approved shipping container and ship to an approved, licensed treatment or disposal facility per Federal, State, and local laws and regulations. (T-0). Maintain records of disposition by the generator per Federal, State, interstate, and local laws and regulations, managed IAW AFMAN 33-363 and dispose IAW the Air Force Records Disposition Schedule. (T-1).

15.9.6. Dispose of soil that is found to be below the HWCL, but above the levels of paragraph 15.9.7., as hazardous waste per Federal, State, interstate, and local laws and
regulations or treaty an approved, licensed treatment or disposal facility to the levels of paragraph 15.9.7. (T-1).

15.9.7. Soil that is at or below the Health-Based Environmental Screening Levels (HBESL) for residential or industrial soil listed in Table 15.2., as appropriate, may be used or disposed of per Federal, State, interstate, and local laws and regulations (e.g., returned to the hole or disposed of as non-contaminated, non-hazardous material.

**Table 15.2. Health-Based Environmental Screening Levels (HBESL).**

<table>
<thead>
<tr>
<th>Standard Name</th>
<th>Population</th>
<th>Exposure Scenario</th>
<th>Chemical Agent per Soil Mass (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.22</td>
</tr>
<tr>
<td>HBESL-Industrial</td>
<td>General Adult Population</td>
<td>Frequent Exposures (250 days per year for 30 years)</td>
<td>5.2</td>
</tr>
</tbody>
</table>

**Section 15E—Required Explosives Safety Submissions (MRESS, MRCSS and Munitions Response Explosives or CWM Site Plans)**

15.10. **General.** Submit plans for leasing, transferring, or disposing of USAF real property (see AFI 32-9004) when AE are present, or are suspected to be present, through command safety channels to AFSEC/SEW, and in turn to AFCEC/CXD, for submission to the DDES for review and approval. (T-1).

15.10.1. Explosives and CA safety requires:

15.10.1.1. A DDES-approved site plan, MRESS, or MRCSS before the start of munitions response activities (e.g., field activities) that involve the placement of explosives on a site; the intentional physical contact with MEC or CA, regardless of CA configuration; or the conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain MEC or CA, regardless of CA configuration; (T-0).

15.10.1.2. An AFSEC/SEW review and approval pending DDES review and approval of the submission, provided the submission is at the DDES for review and approval and the submitting MAJCOM understands that DDES approval may impose different or additional munitions or CWM response requirements. (T-0).

15.10.2. A DDES-approved MRESS or MRCSS, or an explosives or CWM site plan, or a combination thereof, is required for:

15.10.2.1. MRS investigation or characterization (e.g., Engineering Evaluation/Cost Analysis (EE/CA) or Remedial Investigation/Feasibility Study (RI/FS)) that involves the intentional physical contact with MEC or CA, regardless of CA configuration (see paragraph 15.10.4.). (T-0).

15.10.2.2. A determination of “No DoD Action Indicated” (NDAI) or “No Further Action” (NOFA) (see paragraph 15.10.5.). (T-0).

15.10.2.3. Time Critical Removal Action (TCRA) (see paragraph 15.10.6.). (T-0).
15.10.2.4. Construction support (see paragraph 15.10.7.). (T-0).

15.10.2.5. Execution of the explosives safety or CA safety aspects of the selected response (see paragraphs 15.10.8. and 15.10.9.). (T-0).

15.10.3. A DDES B-approved MRESS or MRCSS, or a munitions response explosives site plan (ESP) or CWM site plan (CSP) is not required for:

15.10.3.1. Emergency munitions or explosives responses.

15.10.3.2. Preliminary assessments or site inspections (e.g., site visits in conjunction with an archival search) when intentional physical contact with MEC or CA, regardless of CA configuration, or the conduct of ground-disturbing or other intrusive activities are not intended (see paragraph 15.10.3.6.).

15.10.3.3. Clearance activities on operational ranges (addressing military munitions burial sites on operational ranges is not a clearance activity).

15.10.3.4. Munitions responses on former ranges used exclusively for training with small arms ammunition.

15.10.3.5. On-call construction support.

15.10.3.6. Anomaly avoidance activities.

15.10.4. A munitions response ESP or, when appropriate, CSP for an MRS investigation or characterization involving intentional physical contact with MEC or CA, regardless of CA configuration. (T-0).

15.10.4.1. Such site plans will address areas (e.g., magazines) used for the storage of commercial or military demolition explosives, MEC or CA, regardless of CA configuration; planned or established demolition or disposal areas; and the MRA, MRS, or response area boundaries (see paragraph 15.10.8.3.7.). (T-0).

15.10.4.2. Use MRS investigations and characterizations to collect the information needed to design the required munitions response and to prepare, as appropriate, an MRESS or MRCSS for the selected response. (T-0).

15.10.5. An NDAI or NOFA MRESS or MRCSS. When making an NDAI or NOFA decision for an MRA or MRS or for a response area, a munitions response ESP or CSP must, at a minimum, provide: (T-0).

15.10.5.1. The site identification (i.e., name, unique identifier).

15.10.5.2. The site location.

15.10.5.3. Justification for the decision.

15.10.6. A TCRA MRESS or MRCSS. To expedite the approval process, installations should submit a TCRA MRESS or MRCSS electronically through their chain of command to the DDES B. (T-1). A TCRA MRESS or MRCSS must, at a minimum, identify or provide: (T-0).

15.10.6.1. The site identification (e.g., name, unique identifier).

15.10.6.2. The TCRA’s location.
15.10.6.3. The TCRA’s purpose, in sufficient detail to explain the reason the TCRA was authorized.

15.10.6.4. The estimated initiation or completion date.

15.10.6.5. The munitions item with the greatest fragmentation distance (MGFD).

15.10.6.6. ESQD maps showing the minimum separation distances for (see paragraph 15.10.8.3.7.):

15.10.6.6.1. The removal area within an MRA, MRS or response area for:

15.10.6.6.1.1. Unintentional detonations (see paragraph 15.10.8.3.2.1.).

15.10.6.6.1.2. Intentional detonations (see paragraph 15.10.8.3.2.2.).

15.10.6.6.2. Areas or magazines for the storage of demolition explosives, MEC, or CA, regardless of CA configuration.

15.10.6.7. Implementation actions and controls (e.g., surface removal, evacuation, fences).

15.10.6.8. DDESB-approved engineering controls, if any.

15.10.6.9. A point of contact for additional information.

15.10.7. Construction Support MRESS or MRCSS. A safety submission is required for construction support where the probability of encountering MEC or CA, regardless of CA configuration, is considered moderately or highly probable. (T-0). Provide the information outlined in paragraphs 15.10.8. and 15.10.9., as appropriate. Tailor the information based on site-specific conditions.

15.10.8. Selected MRESS. The information below is required for a MRESS for the execution of the selected munitions response to address MEC. (T-0). When CA, regardless of configuration, is known or suspected to be present along with explosive hazards, or when it is explosively configured, a submission that provides both explosives safety (as outlined in this section) and CA safety information is required (see paragraph 15.10.9.).

15.10.8.1. Background. Provide, for informational purposes, a brief description of the reasons for the munitions response. Also, identify or provide:

15.10.8.1.1. The scope of munitions response activities.

15.10.8.1.2. Any significant differences in munitions response activities that will occur within the MRA or MRS.

Note: Identify significant differences in the current, determined, or reasonably anticipated future land use of different sections of the property, significant differences in the types or conditions of MEC expected to be encountered, and any sections of the MRA that does not require munitions response activities. (T-1).

15.10.8.2. Maps. Furnish the following maps and related information:

15.10.8.2.1. Regional Map. A map depicting the regional location of the MRA or MRS (e.g., a state or boundary illustration map with the MRA indicated on it).
15.10.8.2. MRA or MRS Maps. Include maps of the area or areas where a munitions response is planned. Indicate areas that:

15.10.8.2.1. Contain or are suspected of containing MEC.

15.10.8.2.2. Were suspected of containing MEC, but that research shows it no longer exists.

15.10.8.2.3. The MRESS does not address, areas addressed in a previous safety submission or areas that will be addressed in a future safety submission.

15.10.8.2.3. The current, determined, or reasonably anticipated future land use of property within the MRA or MRS that is known or suspected to contain MEC that the MRESS addresses.

15.10.8.2.4. The ownership and land use of adjacent properties, as appropriate.

15.10.8.2.5. Any other situation that may influence or require consideration during the response (e.g., flight corridors, traffic routes).

15.10.8.3. Explosives Safety Quantity Distance (ESQD).

15.10.8.3.1. Show planned locations for MEC response-related operations on ESQD maps.

Note: Preliminary site work, such as surveying, laying search lanes, and detecting anomalies do not require establishment of an ESQD arc.

15.10.8.3.2. Show ESQD arcs for both intentional and unintentional detonations on ESQD maps for each MRS. (T-0).

15.10.8.3.2.1. The Minimum Separation Distance (MSD) for unintentional detonations, which may be reduced by employing DDESB-approved engineering controls, for:

15.10.8.3.2.1.1. Nonessential personnel is the greatest distance of blast overpressure, as computed by using the formula: \[ D = 40W^{1/3} \] or the calculated HFD.

15.10.8.3.2.1.2. Team Separation distance (TSD) is based on blast overpressure, as computed by the formula: \[ D = 40W^{1/3} \].

15.10.8.3.2.2. The MSD for intentional detonations, which may be reduced by employing DDESB-approved engineering controls, is the greatest distance of (see Chapter 12):

15.10.8.3.2.2.1. Blast overpressure, as computed by using the formula: \[ D = 328W^{1/3} \].

15.10.8.3.2.2.2. The calculated Maximum Fragment Distance (MFD) (see Chapter 12).

15.10.8.3.3. MEC, Excluding CA-filled Munitions, Hazard Classification, and Storage.

15.10.8.3.3.1. Manage recovered MEC, other than recovered CWM (RCWM), as HD 1.1, unless assigned differently by an IHC authority, and assigned an
appropriate CG. (T-1). When storage at the MRA or MRS is necessary, recovered MEC must be stored separately from serviceable munitions and from any RCWM (see paragraph 15.10.9.6.). (T-1).

15.10.8.3.2. Afford nonessential personnel in structures protection equivalent to IBD from storage locations. (T-1). Afford nonessential personnel in the open protection equivalent to PTRD from storage locations (see Chapter 12). (T-1). There is no required ESQD protection for essential personnel from locations they are using for storage.

15.10.8.3.3. The IMD, based on the Net Explosive Weight Quantity Distance (NEWQD) of the munition with the greatest NEWQD that is reasonably expected to be encountered, applies from intrusive operations to storage sites to prevent propagation to a storage location in event of an accidental explosion during intrusive operations. For distances less than IMD, use DDESAB-approved engineering controls during intrusive operations. (T-1).

15.10.8.3.4. Planned or Established Demolition Areas. A planned or established demolition area is an area used repetitively to destroy munitions during a munitions response. Such areas may be an existing OD area or a new area planned for intentional detonation. Provide an ESQD arc around demolition areas. (T-1). Base the size of the ESQD arc on requirements of this Manual (see Chapter 12).

15.10.8.3.5. Mechanized MEC Processing Operations, Excluding CA-filled Munitions.

15.10.8.3.5.1. Classify these processing operations as either “high input” or “low input” based on a risk assessment that considers the degree of energy the process would impact any MEC potentially processed. (T-1).

15.10.8.3.5.1.1. High-input processing operations (e.g., shredders, crushers) intend to physically deform material including any MEC being processed, and certain excavations depending upon the risk assessment.

15.10.8.3.5.1.2. Low-input processing operations (e.g., on-site transport, dumping, raking, spreading, sifting, and magnetically separating) are not intended to intentionally deform material including MEC being processed, and certain excavations depending upon the risk assessment.

15.10.8.3.5.2. Personnel Separation Distances.

15.10.8.3.5.2.1. Nonessential Personnel.

15.10.8.3.5.2.1.1. During high-input processing operations, provide nonessential personnel protection for intentional detonations based on the MGFD (see paragraph 15.10.8.3.2.2.). (T-0).

15.10.8.3.5.2.1.2. During low-input processing operations provide nonessential personnel protection for accidental (unintentional) detonations (greater of HFD or K40). (T-0).

15.10.8.3.5.2.2. Essential Personnel. For both high- and low-input processing operations, essential personnel must: (T-0).
15.10.8.3.5.2.2.1. Be protected by shields or barricades designed to defeat hazardous fragments from the MGFD.

15.10.8.3.5.2.2. Be separated from the operation by K24 based on the munition with the greatest NEWQD that is reasonably expected to be encountered.

**Note:** DDESB-approved overpressure-mitigating engineering controls may be used to provide an equivalent level of protection (2.3 psi).

15.10.8.3.6. Intentional Burning of Buildings Contaminated with Explosives Residues that Present an Explosive Hazard. Separate all personnel by K328 overpressure distance based on the MCE for the building, but not less than 1,250 feet. (T-0).

15.10.8.3.7. ESQD Maps.

15.10.8.3.7.1. ESQD-maps must be to scale and legible per paragraph 14.24.2. (T-0).

15.10.8.3.7.2. When a map does not contain a scale, all distances must be labeled. (T-0).

15.10.8.3.7.3. The ESQD map must show the following: (T-0).

15.10.8.3.7.3.1. Each MRA or MRS.

15.10.8.3.7.3.2. The storage locations for demolition explosives and for recovered MEC.

15.10.8.3.7.3.3. Locations (planned or established) for the intentional detonations or burning of MEC, excluding CA-filled munitions. Such locations include areas where contained detonation technology will be used.

15.10.8.3.7.3.4. All ES and PES and their relationships.

15.10.8.3.7.3.5. All controlling ESQD arcs.

**Note:** Describe any protective measures (e.g., evacuation of inhabited buildings, blocking off public highways) that will be used to eliminate or minimize any exposures within the established exclusion zone. (T-0).

15.10.8.3.7.4. ESQD Arcs. ESQD arcs must be shown for: (T-0).

15.10.8.3.7.4.1. Munitions. Use the MGFD for ESQD purposes for any particular MRA or MRS. However, if a munition with a greater fragmentation distance is encountered during the conduct of a munitions response, adjust the ESQD arcs and amend the MRESS or munitions response ESP.

15.10.8.3.7.4.2. Explosive Soil. To determine the ESQD arc for explosive soil, calculate the MCE by multiplying the weight of the mix by the concentration of explosives (e.g., 1,000 lb of soil containing 15 percent TNT has an MCE of 150 lb). When concentrations vary within the site, use weighted averages or other valid mathematical techniques to determine the exclusion zone; however, the MRESS must support their use. The MSD for
nonesential personnel must be the greater of IBD for overpressure or the soil ejecta radius per DDESB-approved procedures.

15.10.8.3.7.4.3. Real Property (Buildings and Installed Equipment). For real property that is known or suspected to be contaminated with explosives residues that present an explosive hazard, and that is slated for cleanup or dismantlement, estimate the MCE on a case-by-case basis. The MRESS must include the rationale used for the estimation.

15.10.8.3.8. Soil Sampling Maps. When the property involves concentrations of explosives in the soil that are high enough to present an explosive hazard (see paragraph 15.4.):

15.10.8.3.8.1. Provide a map that indicates areas containing explosive soil. (T-0).
15.10.8.3.8.2. Address methods (e.g., blending, bio-remediation) used to reduce explosives concentrations to a non-reactive level. (T-0).
15.10.8.3.8.3. Address methods (e.g., wetting the soil before blending) used to reduce any explosive hazards. (T-0).

15.10.8.4. Types of MEC. Based on research or data generated from characterization of the MRA or MRs, provide the types of MEC expected to be encountered during munitions response activities. (T-0).

15.10.8.5. Start Date.

15.10.8.5.1. Provide the expected date that munitions response activities that involve the placement of explosives on a site, the intentional physical contact with MEC, or the conduct of ground-disturbing or intrusive activities in areas known or suspected to contain MEC are scheduled to start. (T-0).
15.10.8.5.2. Indicate the potential consequence, if any, if DDESB approval does not occur by the start date. Site preparation activities (e.g., surveying, gridding, or locating anomalies) may be conducted while awaiting DDESB approval of the MRESS.

15.10.8.6. MEC Migration. Describe naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal changes) that could cause the migration or exposure of MEC, and procedures for monitoring and managing such. (T-0).

15.10.8.7. Detection Equipment and Response Techniques. The intent of this section is to describe the capabilities of detection equipment relative to the degree of removal required to support the current, determined, or reasonably anticipated end use. (T-0).

15.10.8.7.1. Describe the techniques used to detect and remove MEC.
15.10.8.7.2. Identify the types of detection equipment to be used and the areas they will be employed.
15.10.8.7.3. Summarize methods used (e.g., test plots) to establish the expected detection capabilities of the equipment used. If anomaly discrimination will be used, explain what methods will be used to establish the expected accuracy of the discrimination.
15.10.8.7.4. When describing the detection methods:

15.10.8.7.4.1. Describe the rationale (e.g., best available technology based on geology, topography, munitions characteristics, resource requirements) used to select the detection methods and technologies to be used during the response. (T-0).

15.10.8.7.4.2. Address any limitations (e.g., equipment, terrain, soil type) and mitigating actions, if any. (T-0).

15.10.8.7.4.3. Describe quality assurance and quality control (QA/QC) standards and pass or fail criteria for QA/QC control audits. (T-0).

15.10.8.8. Disposition Techniques.

15.10.8.8.1. MEC, Excluding CA-Filled Munitions:

15.10.8.8.1.1. Briefly describe the MEC, excluding CA-filled munitions, disposition techniques (e.g., OB, OD, contained detonation, incineration) to be used. (T-0).

15.10.8.8.1.2. When recovered MEC, excluding CA-filled munitions, cannot be destroyed within the MRA or MRS, address how explosives safety requirements will be met during transportation and during offsite storage, treatment, or disposal. (T-0).

Note: Disposition actions must consider requirements applicable to waste military munitions. (T-0).

15.10.8.8.2. Material Potentially Presenting an Explosive Hazard (MPPEH). Describe the process to be used to manage MPPEH (see Chapter 9, MPPEH, DoDI 4140.62, Material Potentially Presenting an Explosive Hazard (MPPEH), and DoD 6055.09-M, Volume 7, Enclosure 6). (T-0).

15.10.8.9. Environmental, Ecological, Cultural and Other Considerations. Address any environmental, ecological (e.g., endangered species), cultural (e.g., archaeological, tribal spiritual or gathering sites) and other factors that impacted, from an explosives safety perspective, the selection of the munitions response. (T-0).

15.10.8.10. Technical Support. Summarize EOD, U.S. Army Forces Command/20th Support Command/22nd Chemical Battalion, or UXO-technician or UXO-qualified personnel support that may be required. Any Munitions Response ESS or Work Site Plan that references the use of local EOD to dispose of military munitions must be coordinated with the tasked Service installation EOD unit. (T-0).

Note: U.S. Army Forces Command/20th Support Command/22nd Chemical Battalion is manned with specially trained personnel that provide verification, sampling, detection, mitigation, RSP, decontamination, packaging, escort, and remediation of chemical, biological and industrial devices or hazardous materials.

15.10.8.11. Residual RM. Address:

15.10.8.11.1. LUCs. The MRESS must summarize any LUCs to be implemented and maintained on the property. (T-0).
15.10.8.11.2. Long-Term Management. The MRESS must address the management of any potential residual risks. (T-0).

15.10.8.12. Safety Education Program. Address methods to be used to educate the public on the risks associated with MEC and CA, regardless of CA configuration. (T-0).

15.10.8.13. Stakeholder Involvement. Briefly, summarize how stakeholder concerns affecting the explosives safety aspects of the selected munitions response were addressed. (T-0).

15.10.8.14. Contingencies. To reduce the need to submit amendments (see paragraph 15.11.1.), an MRESS may describe alternative actions that could be used to address contingencies (e.g., an MRESS may list alternative DDESБ-approved engineering controls that may be used under specified conditions).

15.10.8.15. Unexpected CA Discoveries. When CA, regardless of its configuration, is discovered during munitions responses to MEC, excluding CA-filled munitions, halt all onsite activities until the need for a CWM response is evaluated and a decision is approved by the Service-level explosives safety office. (T-0). If it is decided that a CWM response is necessary, do not begin response actions that involve the intentional physical contact with CA, regardless of configuration, or the conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain CA until DDESБ approves the required MRCSS or munitions response CSP. (T-0).

15.10.9. Selected MRCSS and Munitions Response CSPs.

15.10.9.1. General.

15.10.9.1.1. A response in an area (i.e., a munitions response in an MRA or MRS) that is known or suspected to contain CA, regardless of configuration, must include a CWM site plan for an Interim Holding Facility (IHF) and, when the use of onsite destruction technology is planned, for the site where those destruction activities will occur. (T-0). Generally, the information required in an MRCSS parallels that for an MRESS (see paragraph 15.10.8.); however, such information will be tailored to address CWM.

15.10.9.1.2. An MRCSS is not required for certain activities on a site with a history of CA-related activities when an installation or district Commander, or a command-designated representative, has approved a probability assessment finding for such activities stating that the probability of discovering CA is expected to be “seldom” or “unlikely.” However, the site safety and health plan must include contingency plans providing for the safe and expeditious evacuation of the site in the event CA is discovered. (T-0).

15.10.9.1.3. When CA, regardless of configuration, is discovered during these activities, halt all onsite activities until the need for a CWM response is evaluated and a decision is approved by the Service-level explosives safety office. (T-0).

15.10.9.1.4. If a CWM response is necessary, do not begin response actions that involve the intentional physical contact with CA, regardless of configuration, and/or the conduct of ground-disturbing or other intrusive activities in areas known or
suspected to contain CA until DDESB approves the required MRCSS or munitions response CSP. (T-0).

15.10.9.2. Explosives Hazards. When explosives hazards are known or suspected to exist along with CA hazards within a response area (e.g., the MRA or MRS), a submission addressing both explosives safety and CA safety (as outlined in this section) is required (see paragraph 15.10.8.). (T-0).

15.10.9.3. Background (see paragraph 15.10.8.1.).

15.10.9.4. Maps. The maps provided with a MRCSS must meet the requirements of paragraph 15.10.8.2. (T-0). In addition, show the one percent lethality distance and the IBD. (T-0).

15.10.9.5. Chemical Agent Hazards. When CA hazards are known or suspected to exist within a response area (e.g., the MRA or MRS), consider the CA downwind hazard when determining the MSD. Provide the following information in the MRCSS: (T-0).

15.10.9.5.1. A description of the CA MCE.

15.10.9.5.2. A description of how essential and nonessential personnel and the public will be protected should the CA MCE occur (see DoD 6055.09-M, Volume 6) for basic personnel protection requirements (e.g., hazard zones and protective equipment) for operations involving CWM. If an Engineering Control (EC), has not been DDESB-approved, is to be used to provide such protection, the MRCSS must include the technical data substantiating the new engineering control’s effectiveness. EC may be used for:

15.10.9.5.2.1. Protection from overpressure and fragments when explosively configured CWM are known or suspected.

15.10.9.5.2.2. Protection from CA effects (prevent vapor releases to the environment) during both response activities and when RCWM is stored in the IHF.

15.10.9.6. RCWM Hazard Classification and Storage.

15.10.9.6.1. Store RCWM, suspected or confirmed, regardless of its configuration, separately from serviceable munitions and from other MEC. (T-0). Additionally, store suspect RCWM separately from all other munitions and from RCWM. (T-0).

15.10.9.6.2. Manage suspect and known RCWM as HD 1.1 until stowed in an approved overpack container or until determined not to be RCWM or to be non-explosively configured RCWM (see paragraphs 15.10.8.3.3. and paragraph 15.10.9.6.4., as applicable). (T-0).

Note: For paragraphs 15.10.9.6.1. and 15.10.9.6.2. consider the CA downwind hazard with the greater of the two distances used for siting purposes.

15.10.9.6.3. Manage explosively-configured RCWM in an approved overpack container as HD 1.2.1. with an explosive MCE of one round or HD 1.2.2, based on its NEWQD. (T-0). Consider such storage HD 1.1 if advantageous for computing HFD using DDESB-approved procedures.
15.10.9.6.4. Manage non-explosively configured RCWM as HD 6.1. (T-0). Use the CA downwind hazard for siting purposes.

15.10.9.7. CWM Site Plan. A DDES-approved CWM Site Plan for an IHF is required when CA, regardless of configuration, is known or suspected to exist on a response area. (T-0). The IHF Site Plan, based on the worst-case CA configuration expected to be encountered, is included in the MRCSS. The IHF site plan must: (T-0).

15.10.9.7.1. Identify the public access exclusion distance (PAED).

15.10.9.7.2. Identify all associated ESQD arcs (see paragraph 15.10.8.3.).

15.10.9.7.3. Address the evacuation procedures for personnel within the PAED.

15.10.9.7.4. Address any security measures and access controls for the IHF.

15.10.9.7.5. Address any EC used to mitigate a CA release during IHF activities, such as:

15.10.9.7.5.1. Static storage within the IHF.

15.10.9.7.5.2. RCWM assessment activities (e.g., X-ray, portable isotopic neutron spectroscopy (PINS)).

15.10.9.7.5.3. Transportation preparation activities (e.g., transloading of multiple round containers (MRCs), MRC movement into or out of the IHF).

15.10.9.7.6. Address soil sampling maps (see paragraph 15.10.8.3.8.).

15.10.9.7.7. Address types of CA (see paragraph 15.10.8.4.).

15.10.9.7.8. Address start date (see paragraph 15.10.8.5.).

15.10.9.7.9. Detection Equipment and Response Techniques (see paragraph 15.10.8.7.).

15.10.9.7.10. Disposition Techniques.

15.10.9.7.10.1. CA, Regardless of Configuration.

15.10.9.7.10.1.1. Briefly, describe the disposition techniques (e.g., onsite destruction) to be used.

15.10.9.7.10.1.2. When RCWM cannot be destroyed on site, address how CA safety and, if applicable, explosives safety requirements, will be met during transportation and during offsite storage, treatment or disposal. (T-1). Disposition actions must consider guidance applicable to waste military munitions.

15.10.9.7.10.2. MPPEH. Describe the MPPEH management process to be used (see Chapter 9, MPPEH and DoD 6055.09-M, Volume 7, Enclosure 6).

15.10.9.7.11. Environmental, Ecological, Cultural, and Other Considerations (see paragraph 15.10.8.9.).

15.10.9.7.12. Technical Support (see paragraph 15.10.8.10.).

15.10.9.7.13. Residual RM (see paragraph 15.10.8.11.).
15.10.9.7.14. Safety Education Program (see paragraph 15.10.8.12.).

15.10.9.7.15. Contingencies (see paragraph 15.10.8.14.).

15.10.9.7.16. Unexpected MEC or Explosively Configured CWM Discoveries. When unexpected MEC or explosively configured CWM is discovered during a CWM response, halt all onsite activities that involve intentional physical contact with such MEC or explosively configured CWM, or the conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain such MEC or explosively configured CWM, until the newly identified explosive hazards are evaluated and the DDESB approves all required MRCSS amendments or explosive site plans. (T-0).

Section 15F—Amendments and Corrections

15.11. General. An amendment or correction to an approved MRESS or MRCSS does not require the resubmission of the complete MRESS or MRCSS package. However, the information submitted must be in sufficient detail to identify the specific MRESS or MRCSS being amended or corrected, the affected portions, and the precise amendments or corrections. (T-0).

15.11.1. Amendments. Amendments are only required when a change to an approved MRESS or MRCSS increases explosives safety or CA risks, identifies requirements for additional or increased explosive or CA hazard controls, or increases or decreases an ESQD arc.

15.11.1.1. An amendment requires DDESB approval before the affected response actions can continue. However, response actions need not be stopped pending such approval provided:

15.11.1.1.1. The amendment pertains to an area (e.g., MRA or MRS) where an MRESS or MRCSS has already been approved.

15.11.1.1.2. The MAJCOM, in coordination with AFSEC/SEW:

15.11.1.1.2.1. Institutes protective measures (e.g., increased ESQD, use of DDESB-approved EC) to address any explosive or CA hazards.

15.11.1.1.2.2. Accepts the possibility that the DDESB approval process may impose different or additional explosives safety or CA safety requirements.

15.11.1.2. If the amendment is for a new response area (e.g., a new MRS), then the DDESB must approve the amendment before intrusive activities begin in the new response area. (T-0).

15.11.1.3. To allow the response to continue with minimal interruption, process amendments by electronic means.

15.11.1.4. Changes that require an amendment include:

15.11.1.4.1. Constraints in funding, technology, access, and other site-specific conditions that impact the degree of removal addressed in the approved MRESS or MRCSS.
15.11.1.4.2. Any increase or decrease of the ESQD arcs.
15.11.1.4.3. A change in operations requiring explosives siting or re-siting of an IHF for CWM.
15.11.1.4.4. Changes in LUC or long-term management to address residual risks. Such changes would not require intrusive activities to stop while the amendment is being processed.

15.11.2. Corrections. Corrections address changes to an approved MRESS or MRCSS that do not increase explosives safety or CA risks or exposures. Corrections:
15.11.2.1. Do not require approval.
15.11.2.2. Are primarily administrative in nature and provided for information purposes.

Section 15G—After Action Reports (AAR)


15.12.1. An AAR for completed munitions or CWM responses is a required feature of all DDESB-approved MRESSs or MRCSSs. The ARR’s purpose is to document that the explosives and chemical safety aspects of the selected response have been completed per the approved ESS or MRCSS. In most cases, a “Statement of MEC Removal” or “Statement of Munitions Response MEC Removal Actions” fulfills the requirements in paragraph 15.12.2. The DDESB Staff acknowledges receipt of an AAR, and raises any issues that require resolution before land transfer or an alternative use can safely proceed.

15.12.2. The AAR:
15.12.2.1. Must be submitted through command channels to the DDESB. (T-1).
15.12.2.2. May be submitted electronically.
15.12.2.3. Remains part of the DDESB’s action file; however, installations will continue to be responsible for complying with all recordkeeping requirements.
15.12.2.4. Summarize the MEC or CA found, regardless of CA configuration.
15.12.2.5. Describes the relative effectiveness and any limitations of the technologies used during the munitions response or CWM response and the effects on residual risk relative to that originally projected.
15.12.2.6. Includes maps showing:
15.12.2.6.1. Areas where MEC or CA, regardless of CA configuration, was removed.
15.12.2.6.2. Areas within a response area (e.g., within an MRA or MRS) where response actions were not performed and the rationale for not addressing those areas.
15.12.2.6.3. The known or reasonably anticipated end use of each area.
15.12.2.7. Summarizes the LUCs implemented, if any, and the areas that apply.
15.12.2.8. Must address provisions for long-term management.
Section 15H—Transfer of Real Property outside DoD Control

15.13. General. AFI 32-9004, Disposal of Real Property, managed by the Air Force Civil Engineer Center (AFCEC), addresses contaminated real property. Coordinate activities associated with the disposal of contaminated real property with the installation civil engineer’s real estate division representative.

15.13.1. Whenever disposal is contemplated, conduct an Environmental Baseline Survey to identify any hazardous conditions associated with the subject property, including UXO and other hazardous materials.

15.13.2. Pursuant to DoD guidance on real property disposal, real property known to contain or suspected of containing explosive CA hazards may not be transferred out of DoD control (other than to the Coast Guard) until the Chairman, DDESB, has approved measures submitted by the transferring Component to ensure the recipient of the property is fully informed of both the actual and potential hazards relating to the presence or possible presence of explosives or CA, and restrictions or conditions placed on the use of the property to avoid harm to users due to the presence of explosives or CA.

15.13.3. Notices. A recipient of such DoD property must be provided details of any past explosives removal or remedial actions, including:

15.13.3.1. The degree of MEC or CA removal.
15.13.3.2. The process used to determine that degree of removal to be adequately protective.
15.13.3.3. Written notification that detection and removal methods are not 100 percent effective, and that residual hazards may remain in areas (e.g., MRS) that were subjected to response actions.

15.13.4. Restrictions and Conditions. Based on potential explosive and CA hazards present and the projected use of the property, impose the following types of use restrictions and conditions, as appropriate, on such DoD property:

15.13.4.1. A prohibition on excavation or drilling in any areas known or suspected to contain MEC or CA, regardless of CA configuration, without appropriate permits or assistance.
15.13.4.2. A prohibition on disturbing, removing, or destroying any found MEC or CA, regardless of CA configuration.
15.13.4.3. A requirement to immediately notify local law enforcement representatives of any discovery of MEC or CA, regardless of configuration.
15.13.4.4. A prohibition on the construction or installation of particular improvements including utilities, roadways, airstrips, navigable waterways, pipelines, and structures, both above and below ground.
15.13.4.5. A prohibition on specific alterations, extensions, or expansions to such improvements.
15.13.4.6. A prohibition on certain types of uses, such as child care centers, housing, or farming.
15.13.4.7. A restriction to a specific type of use or owner, such as a state National Guard range.

15.13.4.8. Inclusion of Air Force explosives and CA safety personnel and the Chairman, DDESB, in deliberations, decision making, and approvals pertaining to future munitions response activities to address MEC or CA, regardless of CA configuration.

15.13.4.9. Inclusion of the restrictions and conditions in the recorded land records for the jurisdiction, to the extent allowed by state law.
Chapter 16

SPECIAL STORAGE PROCEDURES FOR WASTE MILITARY MUNITIONS

Section 16A—Scope and Applicability


16.1.1. As referenced in DoD 6055.09-M, Volume 7, the Environmental Protection Agency (EPA) promulgated the Munitions Rule (MR), Title 40, Code of Federal Regulations, Subpart M Parts 260-299, Protection of the Environment to define when chemical and conventional military munitions become hazardous waste and to provide for the safe storage and transportation of such waste. The MR takes precedence over these standards and sets forth two approaches for the storage of waste military munitions:

16.1.1.1. A Conditional Exemption (CE) from certain RCRA requirements.

16.1.1.2. A new RCRA storage unit standard (i.e., Subpart EE, of Parts 264 and 265 of 40 CFR).

16.1.2. This Chapter establishes additional requirements for storage of waste military munitions.

Section 16B—General

16.2. General.

16.2.1. A military munition is a “waste” if it is a solid or hazardous waste under regulations implementing the RCRA, (42 U.S.C. Section 9601 et seq).

16.2.2. An unused military munition is a solid waste when any of the following occurs:

16.2.2.1. The munition is abandoned by disposal, burning, detonation (except during intended use), incineration, or treatment prior to disposal.

16.2.2.2. The munition is removed from storage in a military magazine or other storage area for the purpose of disposal of, burning, or incineration, or treatment prior to disposal.

16.2.2.3. The munition is deteriorated or damaged (i.e., the integrity of the munition is compromised by cracks, leaks, or other damage) to the point that it cannot be put into serviceable condition, and cannot reasonably be recycled or used for other purposes.

16.2.2.4. An authorized military official declared the munition a solid waste.

16.2.3. A used or fired military munition is a solid waste:

16.2.3.1. When transported off range or from the site of use, where the site of use is not a range, for the purposes of storage, reclamation, treatment, disposal, or treatment prior to disposal.

16.2.3.2. If recovered, collected, and then disposed of by burial, or landfilling either on or off a range.
16.2.4. For purposes of RCRA section 1004(27), a used or fired military munition is a solid waste, and, therefore, is potentially subject to RCRA corrective action authorities under section 3004(u) and (v), and section 3008 (h), or imminent and substantial endangerment authorities under section 7003, if the munition lands off-range and is not promptly rendered safe and/or retrieved.

16.2.4.1. Any imminent and substantial threats associated with any remaining material must be addressed. If remedial action is not feasible, the operator of the range must maintain a record of the event for as long as any threat remains. (T-1).

16.2.4.2. The record must include the type of munition and its location (to the extent the location is known). (T-1). For further clarification see 40 CFR Part 266.202 under Definition of Solid Waste.

Section 16C—Waivers and Exemptions

16.3. Waivers and Exemptions.

16.3.1. CE Storage. Waivers and exemptions from this standard are not authorized for AE storage facilities storing CE waste military munitions.

16.3.2. RCRA Storage. Waivers and exemptions from this Standard will only be available to units storing waste munitions under RCRA unit standards (e.g., of 40 CFR Subpart EE Part 264). The approval level for all waivers/exemptions is the Secretary of the Air Force. Approvals may be delegated no lower than the Assistant Secretary of the Air Force.

Section 16D—Storage Requirements

16.4. Requirements for Storage of Waste Military Munitions Under CE.

16.4.1. Installations storing waste military munitions under CE must comply with 40 CFR §266.205(a). (T-0).

Note: The MR-established CE does not apply to chemical agents or toxic chemical munitions.

16.4.2. Each installation must maintain records, for a minimum of three years from the last day the waste munitions were stored describing: (T-1).

16.4.2.1. The type of waste military munitions stored by standard nomenclature, Lot Number, Federal Supply Class (FSC), National Stock Number (NSN), Department of Defense Ammunition Code (DODAC), condition code, and quantity of each type waste military munitions stored. A separate record or line item is required for each type of munition in any mixed lot of munitions received for storage.

16.4.2.2. The date that each military munitions, by type, was identified as waste.

16.4.2.3. The last storage date for each, by type of waste military munitions.

16.4.2.4. The storage location or locations (e.g., building number or storage pad, and grid coordinates) used.

16.4.2.5. The disposition (e.g., destroyed, demilitarized, shipped) and date of action, by type of waste munitions.
16.4.2.6. When applicable, the sending and receiving sites for those waste military munitions received from or shipped to off-site sources.

16.4.3. Physically separate (e.g., on a separate pallet or shelf, etc.) waste military munitions from non-waste military munitions when both are stored in the same AE storage facility. (T-1).

16.4.4. Clearly mark the segregated waste military munitions to ensure proper identification. (T-1).

16.4.5. Store waste munitions under CE in AE storage facilities that comply (without waiver or exemption) with the provisions of this standard. Include each AE storage facility storing waste military munitions or explosives under CE in a DDESB-approved ESP that the installation keeps on file. Those portions of the ESP addressing AE storage facilities storing waste military munitions under CE must be available to appropriate Federal or State environmental regulatory authority upon request.

16.4.6. Installations must develop local operating instructions or plans that are designed to provide safety, security, and environmental protection. (T-1). Coordinate these plans with the appropriate Federal, State, and Local emergency response authorities (e.g., law enforcement, fire departments, hospitals, and etc.) and established planning committees.

Section 16E—Loss of CE

16.5. Loss of CE.

16.5.1. The unpermitted or uncontrolled detonation, release, discharge, or migration (e.g., loss or theft, or as a result of fire or explosion, etc.) of waste military munitions out of any storage unit that might endanger human health or the environment results in the immediate loss of CE for those waste military munitions. Incidents of this nature and the loss of CE require reporting per paragraph 16.7.

16.5.2. The appropriate Federal or State environmental regulatory authorities may withdraw CE based on review or inspection of the installation’s or responsible activity’s compliance with the requirements for storage of waste military munitions under CE. AFSEC/SEW may, at any time; restrict an activity from using CE. In addition, the DDESB or AFSEC/SEW, upon discovery of a condition that could warrant loss of CE, will report the condition to the Commander of the installation or responsible activity. (T-1).

16.5.3. If CE is lost, the waste military munitions are subject to other RCRA hazardous waste regulations. The installation or responsible activities must obtain any required RCRA permits because of the loss of CE. (T-1).

16.5.4. Installations and responsible activities may apply for reinstatement of CE per 40 CFR Part 266.205(c).

16.6. Other Storage Standards.

16.6.1. Many States regulate waste management activities, including the storage of waste military munitions. In the event such State regulations conflict with Air Force explosives safety standards, AFSEC/SEW will attempt to resolve the conflict.
16.6.2. For those issues that cannot be resolved, AFSEC/SEW will notify the DDESB of any irreconcilable conflict of State law, regulation, or directive with these or other DoD or Air Force explosives safety standards. The Chairman, DDESB, will review the law, regulation, or directive for any potential impact on explosives safety and will assist AFSEC/SEW, in coordination with the Deputy Under Secretary of Defense (Installations and Environment) (DUSD IE), in resolving such regulatory conflicts. Nothing in this paragraph affects the component’s right to seek review of the State law, regulation, or directive in a court of competent jurisdiction.

16.7. Un-Permitted and Uncontrolled Loss Reporting.

16.7.1. In addition to other applicable reporting requirements, installations and responsible activities will notify AFSEC/SEW (through MAJCOM), the appropriate Federal or State environmental regulatory authority IAW 40 CFR Part 266.205 (a) (1) (v), and established local committees as follows: (T-1).

16.7.1.1. Telephonically or electronically (by e-mail message or facsimile) within 24 hours from the time the installation or responsible activity becomes aware of any unpermitted or uncontrolled detonation, release, discharge, or migration of waste military munitions out of any storage unit (e.g., loss or theft, or as a result of fire or explosion, etc.) that endangers human health or the environment.

16.7.1.2. In writing, if the initial report was telephonic, within five days from the time the installation or responsible activity becomes aware of any unpermitted or uncontrolled detonation, release, discharge, or migration of waste military munitions out of any AE storage facility (e.g., loss or theft, or as a result of fire or explosion, etc.) that may endanger human health or the environment. Follow-up reports to AFSEC/SEW are only required when pertinent information, not previously reported, becomes known.

Section 16F—Closure of Facilities Storing Waste Munitions


16.8.1. When an AE storage facility storing waste military munitions under CE is permanently taken out of service for the storage of non-waste and waste military munitions, installations and responsible activities will ensure that such facilities are appropriately closed. (T-1).

16.8.2. Installations or responsible activities must notify the appropriate Federal or State environmental regulatory authority in writing at least 45 days before closure activities begin. (T-0). Initiation of these closure procedures must occur within 180 days after the date the decision is made to permanently stop using the facility for the storage of waste military munitions. (T-0).

16.8.3. Upon completion of closure activities, submit a “certification of closure,” signed by the installation or responsible activity Commander, or other equivalent level authority, and by an independent (i.e., an individual not assigned within the Commander’s or equivalent-level authority’s chain of command) registered professional engineer to the appropriate Federal or State environmental regulatory authority within 90 days of completing the closure activities, or by applicable law. (T-0).
16.8.4. The certificate of closure must state, at a minimum, that each of the explosives safety requirements in Chapter 15 have been met and that waste military munitions and residues are removed in such a manner as to protect the public and the environment consistent with the planned use of the storage facility and of the property. (T-0).

16.8.5. If closure certification cannot be rendered, the installation or responsible activity must contact the appropriate Federal and State environmental regulatory agency to determine the appropriate course of action. (T-0).

16.8.6. Discontinuance of Use for the Storage of Waste Munitions. When an AE storage facility storing waste military munitions under CE is permanently taken out of service for the storage of waste military munitions but is to continue in service for the storage of non-waste military munitions, installations and responsible activities will ensure that waste military munitions and residues are removed. (T-0).

16.8.7. Closure of Facilities Storing Waste Military Munitions Under RCRA. In addition to those explosives safety requirements in Chapter 15, closure procedures for those sites operating under existing RCRA permits follow those closure requirements stipulated in the respective permit.
Chapter 17
UNEXPLODED ORDNANCE (UXO)

Section 17A—Introduction

17.1. Overview. This Chapter establishes standards to protect personnel and property from explosive and chemical agent (CA) hazards associated with UXO or other military munitions, to include DMM, that have experienced abnormal environments. This Chapter’s standards do not apply during contingencies, combat operations, and military operations other than war; however, always consider these explosives safety principles in such circumstances and apply as the situation allows.

17.2. General.

17.2.1. UXO is considered the most dangerous category of military munitions. However, other military munitions, to include DMM, that are encountered outside the DoD’s munitions logistics management system, particularly those that have experienced an abnormal environment, must be considered equally dangerous and managed as UXO until assessed and determined otherwise by EOD personnel, EOD-qualified U.S. Army Forces Command/20th Support Command/22nd Chemical Battalion personnel and, when specifically authorized by the Air Force installation Commander, UXO-qualified personnel can make this determination for MPPEH programs, range residue programs, and MR activities (See Glossary for definition of an MR.) (T-2, DoDM 6055.09-M). UXO-Qualified Personnel may perform limited explosives operations to support specific range clearance objectives, limited to venting practice bombs or destroying spotting charges (T-1, DoDM 6055.09-M). Military munitions that have experienced abnormal environments include, but are not limited to, munitions remaining after attempted demilitarization by open burning (OB) or open detonation (OD); munitions involved in accidents or fires; munitions or components subjected to certain tests (e.g., fuze arming tests, jolt and jumble tests) that might cause arming. (U.S. Army Forces Command/20th Support Command/22nd Chemical Battalion are manned with specially trained personnel that provide verification, sampling, detection, mitigation, RSP, decontamination, packaging, escort, and remediation of chemical, biological and industrial devices or hazardous materials).

17.2.1.1. UXO will most likely be found in areas the DoD currently uses (e.g., operational ranges) or once used (e.g., former ranges) for military munitions training or testing. For a variety of reasons, UXO may also be encountered in other areas, to include where contingency, combat, or military operations other than war have occurred.

17.2.1.2. Munitions that may have experienced an abnormal environment might be encountered in areas where an accident or incident involving military munitions occurred, in areas that the DoD uses or once used for open detonation of excess, obsolete, or unserviceable military munitions, or in other areas.

17.2.2. Positive identification of any potential explosive or CA hazards and consideration of the potential consequences of an intentional or accidental detonation is required before disposition of any recovered munition. This is essential for munitions that might contain CA that pose a potential downwind CA hazard. Therefore, for both explosives and CA safety
reasons, manage munitions found outside the DoD’s established logistical munitions management systems (e.g., UXO, DMM) until assessed, identified, and evaluated as to their explosive or CA hazards by EOD qualified personnel. Also, manage munitions that contain an unknown liquid fill as chemical warfare material (CWM) until assessed, and the fill determined.

17.2.2.1. Only EOD personnel and, in some cases, U.S. Army Forces Command/20th Support Command/22nd Chemical Battalion personnel will respond to military or civilian authority requests for support to an explosives or munitions emergency.

17.2.2.2. For responses that either involve recovered CWM (RCWM) or munitions that contain an unknown liquid fill, U.S. Army Forces Command/20th Support Command/22nd Chemical Battalion personnel and, in cases where the munition’s physical characteristics allow positive identification, EOD personnel, are the only DoD personnel authorized to determine the most probable fill of such munitions. The determination as to whether certain munitions contain a CA fill is difficult, if not impossible, solely by visual inspection.

17.2.2.2.1. Many munitions have physical characteristics (e.g., shape, markings) that permit technically qualified personnel to rule out the potential for a CA fill (e.g., a U.S.-manufactured 4-inch Stokes mortar’s physical dimensions clearly indicate whether it contains a CA or explosive fill). However, the design or physical condition of some munitions may not allow their complete identification by visual inspection. This is especially true for used munitions and for munitions that have either experienced abnormal environments or been exposed to the elements (e.g., buried or submerged) for an extended period.

17.2.2.2.2. Munitions whose external design does not always allow positive visual identification of their filler include, but may not be limited to: 4.2 inch mortars (M1, M2, and the M2A1 models) and Livens projectiles (MKII (M1) and MKIIA1 models). U.S. Army Forces Command/20th Support Command/22nd Chemical Battalion personnel and, in some cases, EOD personnel, are the only DoD personnel authorized to determine the most probable fill of these munitions.

17.2.3. Discovery of military munitions (e.g., UXO) outside the DoD’s munitions logistics management system might, in some circumstances, indicate that a munitions response (see Chapter 15) or other protective measures are warranted. Installations must notify AFSEC/SEW, who will in-turn notify the Chairman, DDESB of: (T-1).

17.2.3.1. Repetitive explosives or munitions emergency responses to a discrete geographic area, where the circumstances surrounding the explosives or munitions emergency response are similar.

17.2.3.2. A single explosives or munitions emergency response that involves multiple military munitions (e.g., UXO, DMM, or RCWM) discovered at a discrete geographic area. Such discoveries might indicate that the area is a Formerly Used Defense Site (FUDS).

Section 17B—Disposition

17.3. Disposition of UXO and of Other Military Munitions Being Managed as UXO.
17.3.1. The DoD is responsible for protecting people, property, and the environment from potential explosive hazards (e.g., blast and fragmentation) or CA hazards (e.g., nerve agents, mustard gas) associated with DoD-owned UXO. The DoD is equally responsible for protecting personnel who respond to address such hazards.

17.3.2. USAF will work collaboratively with environmental regulators and safety officials toward resolving, in a mutually agreeable manner, any concerns with the planned disposition of UXO during a response action; however, the protection of people, to include DoD response personnel, from the hazards associated with the discovered munition and with its disposition is paramount.

17.3.3. There are no safe procedures for moving, rendering safe, or destroying UXO, but merely procedures considered less dangerous. Destruction-in-place (also referred to as blow-in-place (BIP)) is the least dangerous; therefore, it is the preferred method of UXO destruction.

17.3.4. DoD response actions to address UXO must comply with these standards and other applicable DoD policies and with applicable federal, state, interstate, and local laws and regulations, and any enforceable agreements. Installations must ensure that, if not already in place, protective measures (i.e., site security) are implemented as quickly as practicable following discovery of UXO or other munitions outside the DoD’s munitions logistics management system. (T-1). Should environmental regulators and safety officials have concerns regarding the sufficiency of the protective measures to be taken, raise these concerns to the AFSEC/SEW, who in-turn notifies the Chairman, DDESB for resolution. Maintain protective measures throughout any delay caused by:

17.3.4.1. Compliance with laws, regulations, and agreements.

17.3.4.2. The need to address concerns raised by environmental regulators and safety officials about:

17.3.4.2.1. Methods for managing any potential adverse impacts (e.g., harming endangered species, damaging cultural resources) of implementing a pending BIP operation.

17.3.4.2.2. The use of alternative (to BIP) disposition methods.

17.3.4.3. Other factors (e.g., weather).

17.3.5. Military munitions known to contain CA or contain or are suspected to contain an unknown liquid fill will not normally be destroyed by open detonation because they pose potential downwind CA hazards. The responsible DoD Component (normally the Department of the Army), no lower than the Deputy Assistant Secretary level, may approve individual exceptions. Approve such exceptions after discussions with appropriate elected representatives, environmental regulators, and safety officials from those communities that could potentially be impacted by the munition’s disposition (see paragraph 17.3.2.). DoD Components must make sure that protective measures to ensure explosives safety are maintained during any delay in disposition. (T-1).

17.3.6. Do not move UXO unless EOD qualified personnel determine that the risks associated with movement are acceptable. (During munitions responses, specifically authorized UXO-qualified personnel may make this determination that the UXO can be
moved. The definitions of MR is provided in the Glossary of this publication. Specifically, an MR does not include activities normally conducted by EOD on active and inactive ranges or energetic disposal procedures. The exception to this rule would be the use of UXO-Qualified personnel (non-active duty) for the MPPEH program and approved RDT&E programs per paragraph 7.18.). Although environmental regulators and safety officials recognize the expertise of AF personnel involved in UXO disposition decisions, they may challenge an Air Force field expert’s decision and seek to elevate their concerns to higher levels of authority for resolution (see paragraphs 17.3.2. and 17.3.4.).

17.3.6.1. If EOD qualified personnel determine that the risk associated with movement is unacceptable, or if the munition’s condition precludes a complete assessment beyond positive identification of any potential explosive hazard or determination that it does not present a CA hazard, then it must be BIP.

17.3.6.2. In some circumstances, EOD personnel may determine that careful movement of a UXO, for a limited distance and using prescribed EOD procedures, is both necessary and allowed by EOD procedures. In such circumstances, destruction by detonation will occur in the general vicinity of discovery.

17.3.7. Under some circumstances, when BIP does not pose an immediate, certain, and unacceptable risk to people, critical operations, facilities, or equipment, environmental regulators and safety officials may seek collaboration with the Air Force installation Commander to mutually agree to mitigation measures to reduce potential impacts of the pending BIP to public safety, the environment, and cultural resources (see paragraphs 17.3.2. and 17.3.4.).

17.3.8. When BIP poses an immediate, certain, and unacceptable risk to people, critical operations, facilities, or equipment, EOD personnel may determine that RSP must be attempted.

17.3.8.1. Because the application of RSP exposes EOD personnel to additional risks (greater than BIP), only attempt the application of RSP in limited circumstances.

17.3.8.2. Should EOD personnel employ RSP, apply protective measures to mitigate potential explosive effects and, when necessary, a possible CA release.

17.3.8.3. Only EOD personnel are authorized to conduct RSP.

17.3.8.4. EOD personnel must perform RSP per Joint Service EOD Technical Data. (T-1).

17.3.8.4.1. Raise conflicts between this Standard and the Joint Service EOD Technical Data through AFSEC/SEW to the Chairman, DDESB, and to the Joint EOD Program Board for resolution.

17.3.8.4.2. When the condition of UXO (e.g., crushed, bent, broken, etc.) precludes strict adherence to published procedures, onsite EOD personnel will determine and perform the procedure, established or innovative, that has the most probable degree of success to render the munitions safe while mitigating potential explosive or, when necessary, CA effects.

17.3.9. The onsite EOD supervisor, in the case of munitions responses, and the UXO safety officer ensures the detonation site is inspected after each detonation or any misfire. Do not
allow anyone within the Minimum Separation Distance (MSD) from the detonation site until the onsite EOD supervisor or UXO safety officer declares the area safe.

17.3.10. When EOD personnel or, in the case of munitions responses, authorized UXO personnel, positively identify UXO as to its explosive hazard and determine it safe to dispose of by other than BIP or immediate destruction by detonation, either in the general vicinity of discovery or at a designated location, then the Air Force installation Commander, with the advice of EOD personnel, may evaluate a variety of safe disposition alternatives and options for managing any potentially adverse impact of the selected disposition alternative (see paragraph 17.3.2.).

Section 17C—Special Considerations

17.4. General.

17.4.1. Disassembly and Inerting Operations.

17.4.1.1. Do not conduct disassembly and inerting operations without proper authorization.

17.4.1.2. Contact AFSEC/SEW for additional guidance on disassembly and inerting operations.

17.4.2. Construction Support.

17.4.2.1. Construction support may be required during intrusive activities (e.g., laying or repairing utilities, improving roads) on property known or suspected to contain UXO or DMM.

17.4.2.2. The responsible authority (e.g., installation Commander or designated representative) determines the level of construction support required on a case-by-case basis. Construction support is determined by the probability of encountering UXO or DMM.

17.4.2.2.1. Low Probability. EOD personnel or UXO-qualified personnel must be contacted to ensure they are available, advised about the project, and placed “on call” to assist if suspected UXO are encountered during construction. Discoveries of UXO or DMM on such sites require reassessment of the level of support required.

17.4.2.2.1.1. A “low” determination may only be assigned to those areas where a search of available historical records and onsite investigation data indicates that, given the military or munitions-related activities that occurred at the site, the likelihood that UXO or other MEC are present is low.

17.4.2.2.1.2. Munitions-related activities that may merit a “low” determination include, but are not limited to, the use of the area: for live-fire training exclusively with small arms ammunition; for maneuver training, to include maneuver training involving the use of smokes, pyrotechnics, and simulators; as firing points; for munitions inspection, handling, storage, or transfers, to include residue points and inert storage yards; for air defense; or as munitions operating facilities, the exceptions being facilities where the processes used might have resulted in the generation of concentrations of munitions constituents high enough to present an
explosive hazard. Areas where a previous response has been completed, pursuant to a DDESB-approved MRESS, for the stipulated reuse also qualify for “low” determinations.

17.4.2.2.2. Moderate to High Probability. EOD personnel must attempt to identify and remove any explosive or CA hazards in the construction footprint prior to any intrusive construction activities.

17.4.2.2.2.1. Assign a “moderate to high” determination to those areas where a search of available historical records or onsite investigation data indicates that, given the military or munitions-related activities that occurred at the site, there is more than a low probability that UXO or other MEC are present.

17.4.2.2.2.2. Munitions-related activities that may merit a “moderate to high” determination include, but are not limited to, the use of the area: for live-fire training other than exclusively with small arms ammunition (e.g., munitions containing HE projectiles); as operational range impact areas; for OB or OD of excess, obsolete, or unserviceable munitions; as munitions operating facilities where processes used might have resulted in the generation of concentrations of munitions constituents high enough to present an explosive hazard; for munitions burial; or for any activities involving possible disposition of CWM.

17.4.3. Anomaly Avoidance. Employ anomaly avoidance techniques on properties known or suspected to contain UXO or DMM to avoid surface UXO and, when necessary, subsurface anomalies.

17.4.3.1. When anomaly avoidance is used during training (e.g., maneuver training, live-fire training), testing, or operational range management activities conducted on such properties, the Commander responsible for such activities ensures: (T-1).

17.4.3.1.1. A risk assessment to evaluate the potential hazards associated with the proposed activities is completed and methods to mitigate any potential exposures are implemented.

17.4.3.1.2. Training in anomaly avoidance, explosives safety and, when appropriate, CA safety training is provided to all personnel involved in the training, testing, or operational range management activities that access property known or suspected to contain UXO or DMM.

17.4.3.2. When anomaly avoidance is used during other than training or testing activities, or during activities involving other than operational range management activities:

17.4.3.2.1. Avoid surface UXO during any activities that require entry to the area (e.g., conducting cultural resource studies).

17.4.3.2.2. Avoid surface UXO and subsurface anomalies during any intrusive work (e.g., drilling environmental monitoring wells).

17.4.3.2.3. Provide escort support by EOD personnel, or within areas known or suspected to contain UXO, excluding CA, regardless of configuration, by:

17.4.3.2.3.1. UXO-qualified personnel.

17.4.3.2.3.2. UXO Technician I personnel under the supervision of UXO
qualified personnel. The responsible Commander or authority may, based on a risk assessment and implementation of methods to mitigate any potential exposures, approve UXO Technician I personnel to perform escort duties without supervision.

17.4.3.2.3.3. UXO qualified personnel trained in CWM responses within areas known or suspected to contain CA, regardless of configuration, to include areas where such CA is commingled with other UXO.

17.4.3.2.4. During anomaly avoidance all UXO, surface and subsurface, must be avoided and their locations noted and reported to appropriate authorities. In addition, subsurface anomalies must not be investigated.

Section 17D—Access to UXO Areas

17.5. Access to Areas Known or Suspected to Contain UXO. To ensure explosives and CA safety risk is identified and controlled on real property currently or formerly under the jurisdiction, custody, or control of USAF, the Air Force installation Commander must: (T-1).

17.5.1. Prohibit unnecessary access (e.g., livestock grazing; recreational uses, such as hunting and hiking) and take appropriate action to deter unauthorized access to areas under Air Force control that are known or suspected to contain UXO or other munitions that have experienced abnormal environments.

17.5.1.1. Limit access to such areas, particularly operational range impact areas, to personnel who have an operational requirement to enter such areas (e.g., range maintenance, environmental monitoring, and security). Complete a risk assessment to evaluate the potential hazards associated with the proposed activity and implement methods to mitigate any potential exposures before allowing access.

17.5.1.2. Actions to prohibit or deter access may include: establishing access controls (e.g., fencing the area, establishing roving security patrols) and providing public notifications of any potential hazards (e.g., posting UXO hazard warning signs, conducting UXO safety education programs). Also, when used, signs must be legible and, when appropriate, multi-lingual or as pictograms. (T-1).

17.5.2. When the USAF does not control the area (e.g., FUDS), at a minimum, provide written notification to the property owner and, if known, any tenants of the potential explosive and CA hazards present. Maintain a record of this notification in permanent records.

17.5.3. Assume the following areas contain UXO or other munitions that have experienced abnormal environments:

17.5.3.1. Operational range impact areas, to include their associated safety zones (e.g., caution area, safety buffer zone). Exceptions include, but are not limited to, ranges used exclusively for training with small arms ammunition.

17.5.3.2. Ranges (sites) used for OB or OD of excess, obsolete, or unserviceable munitions.
17.5.3.3. Former impact areas and former OB or OD sites, unless documentation exists to show that they were adequately cleared during range closure or that an appropriate munitions response has been completed. In some cases, because these former impact areas or former OB or OD sites may have transferred from USAF control, the AF’s ability to restrict access may be limited or nonexistent. In such cases, the USAF must, at a minimum, ensure: (T-1).

17.5.3.3.1. The property owner is provided written notification of the potential explosives and CA hazards and the risks inherent in any use of property that is inconsistent with those hazards.

17.5.3.3.2. A public UXO safety education program is implemented, when appropriate.

17.5.4. On USAF property, prohibit construction in areas known or suspected to contain UXO or DMM without required: (T-1).

17.5.4.1. Construction or UXO avoidance support (see paragraphs 17.4.2. or 17.4.3.).

17.5.4.2. Approved MRESS, MRCSS, or site plan for munitions responses (see Chapter 15).

17.5.5. Provide, or in the case of owners or tenants of non-USAF controlled property, offer explosives safety and, when appropriate, CA safety training to all individuals authorized access to USAF property known or suspected to contain UXO.

17.5.6. Develop guidelines to determine when individuals, who for operational reasons (e.g., environmental monitoring), are authorized access to areas under USAF control that are known or suspected to contain UXO, must be escorted into the area IAW paragraphs 17.4.3.2.3. (T-1).

17.5.7. Establish UXO safety education programs to educate USAF personnel, their dependents, and private citizens that live near areas known or suspected to contain UXO about explosive hazards and, when appropriate, CA hazards associated with UXO, and with the risks associated with trespassing on operational ranges or with entering areas known or suspected to contain UXO.

17.5.8. Prior to changing the use of a property known or suspected to contain UXO or munitions that have experienced abnormal environments to a use that is incompatible with their presence:

17.5.8.1. For operational ranges, perform an appropriate range clearance, whether changing to a similar (e.g., converting an impact area to a hand grenade range) or dissimilar use (e.g., changing a range to a maneuver area).

17.5.8.2. For areas on USAF property, other than operational ranges, perform an appropriate munitions response.

17.5.8.3. For property not under USAF control, upon learning of a proposed change in use or pertinent munitions response action, offer to engage in munitions response activities only to the extent necessary to ensure planned response actions afford protectiveness from an explosives and CA safety perspective. The USAF engagement in such munitions response activities may be limited to explosives safety experts providing
basic guidance and advice during applicable deliberations, decision making, and approval activities unless additional DoD services are arranged through contractual or reimbursement mechanisms between USAF and other responsible parties.

Section 17E—Identification and Control

17.6. Identification and Control. To ensure explosives and CA safety risk is identified and controlled on real property currently or formerly under the jurisdiction, custody, or control of the USAF, Installation Commanders must create and maintain permanent records required by paragraph 15.2.2. (T-1). When an operational range is closed or an installation is deactivated, the Installation Commander must designate the office to transfer these records to ensure their permanent retention. (T-1).

17.7. Minimum Separation Distance (MSD) for UXO.

17.7.1. The MSD for intentional detonations, which may be reduced if supported by a hazard assessment or when using approved engineering controls listed in EOD publications (for explosives or munitions emergency responses) or other DDESB approved engineering controls (for munitions responses), is the greatest distance of:

17.7.1.1. Blast overpressure, as computed by using the formula: \( D = 328W^{1/3} \).
17.7.1.2. The calculated MFD.
17.7.1.3. The appropriate downwind hazard distance for CA (see Chapter 15).

17.7.2. The MSD for unintentional detonations, which may be reduced if supported by a hazard assessment or when approved engineering controls listed in EOD publications (for explosives or munitions emergency responses) or other DDESB approved engineering controls (for munitions responses), is the greatest distance of:

17.7.2.1. Blast overpressure, as computed by using the formula: \( D = 40W^{1/3} \).
17.7.2.2. The calculated MFD.
17.7.2.3. The appropriate downwind hazard distance for CA (see Chapter 15).

Note: Use lesser distances if supported by a hazard assessment; however, in no case will the distance be less than the HFD; the exception is when approved engineering controls are used.

17.7.2.4. Team Separation Distance (TSD). The greatest distance of:

17.7.2.4.1. Blast overpressure, as computed by using the formula: \( D = 40W^{1/3} \).
17.7.2.4.2. The appropriate downwind hazard distance for CA.

Section 17F—Other Considerations

17.8. General.

17.8.1. Transportation. All transportation must comply with the requirements of applicable federal, state, interstate, and local laws, and all implementing regulations relating to transportation of solid waste, hazardous substances, hazardous materials, and toxic substances. (T-1).
17.8.1.1. UXO. Before UXO that may pose an explosive or CA hazard may be transported or shipped over public transportation routes, EOD personnel must determine whether the UXO is safe for transport. (T-1). Document determinations that the UXO is safe for transport in the EOD incident report. A copy of the incident report must accompany the shipment. (T-1).

17.8.1.2. RCWM. Before RCWM may be transported or shipped, the Army Material Assessment Review Board assesses it as safe for transport and packaged in an over-pack container specifically designed and approved by the Army and by the DOT for the transport of RCWM (see paragraph 15.5.9.1.2.). In addition, the specific notifications and concurrences required in 50 U.S.C. § 1512 must be met. (T-1).

17.8.2. Firefighting Involving Areas Known or Suspected to Contain UXO or DMM (see Chapter 10).

17.8.2.1. Advanced planning is essential for firefighting operations involving areas that are known or suspected to contain UXO or DMM or CA hazards. Coordination of such plans between firefighters and explosives safety personnel or EOD personnel and, when appropriate, CA safety professionals, is essential.

17.8.2.2. Senior firefighting personnel must carefully assess whether to fight a fire involving areas that are known or suspected to contain explosive or CA hazards. (T-1). Factors to consider include, but are not limited, to: the types of munitions that might be present; the safety of firefighting personnel and of the public; the potential loss of critical assets; and the duration and intensity of the fire.

17.8.2.2.1. When the decision is made not to fight such fires, evacuate the area and remain so until it has cooled for at least 24 hours (see paragraph 10.10.).

17.8.2.2.2. When the decision is made to fight such fires, provide all firefighters involved in fighting the fire basic safety training for fighting fires involving military munitions.

17.8.3. Controlled Burns.

17.8.3.1. Permit burning of vegetation to facilitate safe UXO clearance or removal operations, provided proper safeguards are in place to protect all personnel from unintentional detonations. Carefully plan and execute these burns to manage explosives safety risks and environmental effects. During such burning operations, all personnel must be at MFD from the burning or burned area, based on the munition with the greatest fragment distance, and remain out of the area until it has cooled for at least 24 hours. (T-1).

17.8.3.2. Do not perform controlled burns on areas known or suspected to contain CWM. (T-1).

17.8.4. Technology.

17.8.4.1. Explosives safety is a paramount consideration when determining the most appropriate technologies to be used to detect, excavate, remove, and dispose of UXO and other munitions that present an explosive hazard.
17.8.4.2. Consider the use of remotely operated equipment (e.g., excavators, sifters, and shredders) or other standoff technologies (e.g., lasers) that may offer the safest approach for excavating and destroying UXO.

17.8.4.3. **Paragraph 15.5.8.3.5.** addresses mechanized UXO processing operations.

ANDREW M. MUELLER
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Attachment 1

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TO 11N-45-51, Transportation of Nuclear Materiel; General Shipping and Limited Life Component (LLC) Data, 22 March 2006

TO 11N-45-51A, Transportation of Nuclear Weapons Materiel; (Supplement) Shipping and Identification Data for Stockpile Major Assemblies (U), 10 December 2010

TO 11N-45-51B, Transportation of Nuclear Weapons Materiel; (Supplement) Loading and Unloading of Flatbed Truck or Tractor Trailer, Safeguards Transporter (SGT), Limited-Life Component (LLC) Truck, Military Air Shipment and Palletized Cargo, 4 March 2015


TO 14P3-1-7, Toxicological Protective Apron, M-2


Title 49, Code of Federal Regulations, Part 100-185, Pipeline and Hazardous Materials Safety Administration, Department of Transportation, Current Edition

United Facilities Criteria (UFC) 3-260-01, Airfield and Heliport Planning and Design, 17 November 2008

UFC 3-340-02 (formally known as TM-5-1300), Structures to Resist the Effects of Accidental Explosions, December 5, 2008

UFC 3-520-01, Interior Electrical System, 3 February 2010

UFC 3-600-01, Fire Protection Engineering for Facilities, 26 September 2006

UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings, 2 September 2012


**Prescribed Forms**

AF Form 943, *Explosives Site Plan*

AF Form 2047, *Explosives Facility License*

**Adopted Forms**

DD Form 626, *Motor Vehicle Inspection (Transporting Hazardous Material)*

DD Form 2890, *DoD Multimodal Dangerous Goods Declaration*

AF Form 847, *Recommendation for Change of Publication*

**Abbreviations and Acronyms**

AA&E—Arms, Ammunitions and Explosives
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AASTP</td>
<td>Allied Ammunition Storage and Transport Publication</td>
</tr>
<tr>
<td>ADUSD (FP)</td>
<td>Assistant Deputy Under Secretary of Defense (Force Protection)</td>
</tr>
<tr>
<td>ADCAP</td>
<td>Advanced Capability</td>
</tr>
<tr>
<td>AE</td>
<td>Ammunition and Explosives</td>
</tr>
<tr>
<td>AECPA</td>
<td>Aircraft Explosives Cargo Parking Area</td>
</tr>
<tr>
<td>AFCEC</td>
<td>Air Force Civil Engineer Center</td>
</tr>
<tr>
<td>AFE</td>
<td>Aircrew Flight Equipment</td>
</tr>
<tr>
<td>AFMAN</td>
<td>Air Force Manual</td>
</tr>
<tr>
<td>AFMC</td>
<td>Air Force Materiel Command</td>
</tr>
<tr>
<td>AFOSH</td>
<td>Air Force Occupational Safety and Health</td>
</tr>
<tr>
<td>AFRPA</td>
<td>Air Force Real Property Agency</td>
</tr>
<tr>
<td>AFRC</td>
<td>Air Force Reserve Command</td>
</tr>
<tr>
<td>AFSEC</td>
<td>Air Force Safety Center</td>
</tr>
<tr>
<td>AGE</td>
<td>Aerospace Ground Equipment</td>
</tr>
<tr>
<td>AGM</td>
<td>Aboveground Magazine, Air-to-Ground Missile</td>
</tr>
<tr>
<td>AGS</td>
<td>Aboveground Structure/Site</td>
</tr>
<tr>
<td>AGS (H)</td>
<td>AGS, heavy wall</td>
</tr>
<tr>
<td>AGS (H/R)</td>
<td>AGS, heavy wall and roof</td>
</tr>
<tr>
<td>AGS (L)</td>
<td>AGS, light</td>
</tr>
<tr>
<td>AHA</td>
<td>Ammunition Holding Area</td>
</tr>
<tr>
<td>AIM</td>
<td>Air Intercept Missile</td>
</tr>
<tr>
<td>AIT</td>
<td>Automatic Identification Technology</td>
</tr>
<tr>
<td>ALC</td>
<td>Air Logistics Center</td>
</tr>
<tr>
<td>ALCM</td>
<td>Air Launched Cruise Missile</td>
</tr>
<tr>
<td>AMRAAM</td>
<td>Advanced Medium-Range, Air-to-Air Missile</td>
</tr>
<tr>
<td>ANFO</td>
<td>Ammonium Nitrate/Fuel Oil</td>
</tr>
<tr>
<td>ANG</td>
<td>Air National Guard</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASHS</td>
<td>Assessment System for Hazard Surveys</td>
</tr>
<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
</tr>
<tr>
<td>ASU</td>
<td>Ammunition Storage Unit</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
</tbody>
</table>
AUR—All-Up-Round
AWG—American Wire Gauge
B—Barricaded
BASH—Bird/Wildlife Aircraft Strike Hazard
BATF—Bureau of Alcohol, Tobacco and Firearms
BDOC—Base Defense Operations Center
BE—Bioenvironmental Engineering
BIP—Blow-in-Place
BIT—Built-In Test
BLAHA—Basic Load Ammunition Holding Area
BOS-I—Base Operating Support-Integrator
BRU—Bomb Rack Unit
BTO—Base Transportation Officer
CA—Chemical Agents
CADS—Cartridge Activated Device
cal/cm²—Calories per Square Centimeter
CALA—Combat Aircraft Loading Area
CAPA—Combat Aircraft Parking Area
CBGS—Confined by Ground Surface
CBM—Confined By Missile
CBR—Chemical, Biological, Radiological
CBU—Cluster Bomb Unit
CCA—Contract Construction Agents
CCDR—Combatant Commander
CCI—Controlled, Cryptographic Items
CE—Civil Engineering; Civil Engineer; Conditional Exemption
CEA—Captured Enemy Ammunition
CFA—Controlled Firing Area
CFR—Code of Federal Regulations
CG—Compatibility Group
CIC—Commercial Intermodal Container
CIF—Halogen Fluorides
CJCSI—Chairman of the Joint Chiefs of Staff Instruction
CNU—Container Unit
COB—Contingency Operating Base
CoE—Corps of Engineers
COCO—Contractor Owned Contractor Operated
CONUS—Continental United States
COP—Combat Out Post (from CJCSI 4360.01A)
C&RI—Consequence and Risk Identification
CSC—Central Security Control
CSO—Concurrent Servicing Operation
CSS—Chemical Safety Submission, see MRCSS
CWM—Chemical Warfare Materiel
DCMA—Defense Contract Management Agency
DDES—Department of Defense Explosives Safety Board
DFARS—Defense Federal Acquisition Regulations Supplement
DMM—Discarded Military Munition
DoD—Department of Defense
DoDAC—DoD Ammunition Code
DOE—Department of Energy
DOT—Department of Transportation
DPE—Demilitarization Protective Ensemble
DUSD—Deputy Under Secretary of Defense
DUSD (I&E)—Deputy Under Secretary of Defense (Installations and Environment)
E3—Electromagnetic Environmental Effects
ECC—Emergency Communication Center
ECM—Earth-Covered Magazine
EID—Electrically Initiated Device
EIDS—Extremely Insensitive Detonating Substances
EIRP—Equivalent Isotropically Radiated Power
ELCG—Energetic Liquid Compatibility Group
EMCON—Emission Control
EME—Electromagnetic Environment
EMR—Electromagnetic Radiation
EOD—Explosive Ordnance Disposal
EOR—End-of-Runway
EPA—Environmental Protection Agency
EPCRA—Emergency Planning Community Right-To-Know Act
ERO—Engine Running onload/offload
ERP—Effective Radiated Power
ES—Exposed Site
ESMP—Explosives Safety Management Program
ESMRM—Explosives Safety and Munitions Risk Management
ESP—Explosives Site Plan (may also be referred to as a QD safety submission (QDSS))
ESQD—Explosives Safety Quantity-Distance
EZ—Evaluation Zone
F—Front
FAA—Federal Aviation Administration
FAE—FuelAir Explosives
FAR—Federal Acquisition Regulation
FARP—Forward Arming and Refueling Point
FB—Front Barricaded
FCC—Federal Communications Commission
FLIP—Flight Information Publication
FOB—Forward Operating Base
FSC—Federal Supply Class
FSS—Force Support Squadron
FU—Front Unbarricaded
FUDS—Formerly Used Defense Site
GCA—Ground Control Approach
GCC—Geographic Combatant Commander
GOCO—Government Owned Contractor Operated
GOV—Government Owned Vehicle
GP—General Purpose
GSA—General Services Administration
H—Heavy Wall
HA—Holding Area
HAN—Hydroxylammonium Nitrate
HARM—High-Speed, Antiradiation Missile
HAS—Hardened Aircraft Shelter
HC—Hazard Class; Hexachlorethane
HD—Hazard Division
HDD—Hazardous Debris Distance
HE—High Explosive
HEDP—High Explosive Dual—Purpose
HEI—High Explosive Incendiary
HERO—Hazards of Electromagnetic Radiation to Ordnance
HEW—High Explosive Weight
HFD—Hazardous Fragment Distance
HMMWV—High Mobility Multipurpose Wheeled Vehicle
H₂O₂—Hydrogen Peroxide
HPM—High Performance Magazine
H/R—Heavy Wall/Roof
HSS—Hybrid Safety Submission
IA—International Agreement
IATO—International Ammunition Technical Guidelines
IAW—In Accordance With
IB—Inhabited Building
IBD—Inhabited Building Distance
ICBM—Intercontinental Ballistic Missile
IED—Improvised Explosive Device
IFR—Instrument Flight Rules
IHE—Insensitive High Explosive
IL—Intraline
ILD—Intraline Distance
IM—Intermagazine
IMD—Intermagazine Distance
IMO—International Maritime Organization
IR—Infrared
IRFNA—Inhibited Red Fuming Nitric Acid
ISM—Installation Spectrum Manager
ISO—International Standardization Organization
JCS—Joint Chiefs of Staff
JHCS—Joint Hazard Classification System
JTF—Joint Task Force
JP—Joint Publication
Kg—Kilogram
kPa—Kilopascal
kV—Kilovolt
LARA—Launch Area Risk Analysis
LCF—Launch Control Facility
LCL—Less Than Carload
LEPC—Local Emergency Planning Committees
LF—Launch Facilities
LH—Liquid Hydrogen
LIMFAC—Limiting Factor
LOA—Letter of Agreement
LOX—Liquid Oxygen
LP—Liquefied Petroleum
LPS—Lightning Protection System
LSRM—Large solid Rocket Motor
LSRN—Largest Single Round Net Explosive Weight for Quantity Distance
m—Meter
MAJCOM—Major Command
MCE—Maximum Credible Event
MCP—Military Construction Program
MDAS—Material Documented as Safe
MDEH—Material Documented as an Explosive Hazard
MEC—Munitions and Explosives of Concern
MED—Minimum Evacuation Distance
MEQ—Mission Essential Quantities
MER—Multiple Ejector Rack
MFD—Maximum Fragment Distance
MHE—Materials Handling Equipment
MHT—Minuteman Handling Team
MILCON—Military Construction
MIL-STD—Military Standard
MILVANS—Military Vans
MK—Mark
mm—Millimeter
MME—Modern Mobile Emitter
MMHE—Munitions Materials Handling Equipment
MMRP—Military Munitions Response Program
MOB—Main Operating Base
MOD—Model
MON—Mixed Oxides of Nitrogen
MPPEH—Material Potentially Presenting an explosive hazard
MPS—Maritime Prepositioning Ship
MR—Munitions Rule
ms—Millisecond
MSA—Munitions Storage Area
MSD—Minimum Separation Distance
MSS—Munitions Support Squadron
MWD—Military Working Dogs
MWR—Morale, Welfare, and Recreation (now known as Force Support Squadron)
NAF—Numbered Air Force
NALC—Navy Ammunition Logistic Code
NASAMS—Norwegian Advanced Surface to Air Missile System
NATO—North Atlantic Treaty Organization
NAVFAC—Naval Facilities Engineering Command
NEC—National Electrical Code
NEW—Net Explosive Weight
NEWQD—Net Explosive Weight for Quantity Distance
NFESC—Naval Facilities Engineering Service Center
NFPA—National Fire Protection Association
NGB—National Guard Bureau
NIN—National Identification Number
NIOSH—National Institute Occupational Safety and Health
NNMSB—Nonnuclear Munitions Safety Board
NORAD—North American Aerospace Defense Command
NORTHCOM—Northern Command
NPW—Net Propellant Weight
NSN—National Stock Number
NWSSG—Nuclear Weapon System Safety Group
OB—Open Burning
OCE—Office, Chief of Engineers
OCONUS—Outside the Continental United States
OD—Open Detonation
OI—Operating Instruction
OMA—Operations and Maintenance, Army
OSHA—Occupational Safety and Health Administration
OT&E—operational test and evaluation
PACAF—Pacific Air Forces
PADS—Propellant Actuated Devices
PAL—Permissive Action Link
PAN—Percussion Actuated Neutralizer
PAS—Protective Aircraft Shelter
PCO—Procuring Contract Officer
PDC—Programming, Design and Construction
PES—Potential Explosion Site
PETN—Pentaerythritol Tetranitrate
PNAF—Prime Nuclear Airlift Force
POC—Point of Contact
POL—Petroleum, Oils, and Lubricants
POV—Privately Owned Vehicle
PPE—Personal Protective Equipment
psi—Pounds per Square Inch
PTR—Public Traffic Route
PTRD—Public Traffic Route Distance
PWP—Plasticized White Phosphorus
QA—Quality Assurance
QD—Quantity-Distance
R—Rear
RAPCON—Radar Approach Control
R&D—Research and Development
RCRA—Resource Conservation and Recovery Act
RCS—Report Control Symbol
RCWM—Recovered CWM
RDT&E—Research, Development, Test and Evaluation
RDX—Cyclotrimethylenetrinitramine, or Dry Cyclonite
RF—Radio Frequency
RFID—Radio Frequency Identification
RFTF—Response Force Tactical Facility
RM—Risk Management
RPA—Remotely Piloted Aircraft
RSCA—Rocket Storage, Checkout, and Assembly
RSP—Render Safe Procedure
RSU—Runway Supervisory Unit
RV—Reentry Vehicle
S—Side
SAF—Secretary of the Air Force
SCBA—Self Contained Breathing Apparatus
SCPS—Survivable Collective Protection System
SD—Sympathetic Detonation
SDP—Source Data Package
SDS—Safety Data Sheet
SDW—Substantial Dividing Walls
SDZ—Surface Danger Zones
SG—Sensitivity Group
SOFA—Status-of-Forces Agreement
SOH—Safety and Occupational Health
SOP—Standard Operating Procedures
S/APOD—Seaport/Aerial Port of Debarkation
S/APOE—Seaport/Aerial Port of Embarkation
SPO—System Program Office
SSCBM—Shipping and Storage Containers, Ballistic Missile
SSD—Safe Separation Distance
STAMP—Standard Air Munitions Package
STMS—Secure Transportable Maintenance Truck
TAPES—Toxicologic Agent Protective Ensemble, Self-Contained
TE—Transporter Erector
TEA—Triethyl Aluminum
TER—Triple Ejector Rack
TFE—Traditional Fixed-location Emitter
THAAD—Terminal High Altitude Area Defence
TLV—Threshold Limit Value
TM—Technical Manual
TNT—Trinitrotoluene
TO—Technical Order
TOFC—Trailers on Flat Cars
TP—Technical Paper
TPA—Thickened TEA
TWA—Time-Weighted Average
U—Unbarricaded
UALS—Universal Ammunition Loading System
UDMH—Unsymmetrical Dimethylhydrazine
UFC—United Facilities Code
UL—Underwriters’ Laboratories
UN—United Nations
US—United States
USACE—U.S. Army Corps of Engineers
USAFE-AFRAFRICA—United States Air Forces in Europe-United States Air Forces Africa
USAFCENT—United States Air Forces Central
USCG—United States Coast Guard
UXO—Unexploded Ordnance
VFR—Visual Flight Rules
WAU—Weapon Adapter Unit
WCDO—War Consumables Distribution Objective
WDU—Weapon Delivery Unit
WMT—Weapons Maintenance Truck
WP—White Phosphorus
WRM—War Reserve Materiel
WSA—Weapons Storage Area
WSM—Weapons Safety Manager
WST—Weapons Safety Tool
WSV—Weapons Storage Vault

Terms

Aboveground Magazine (AGM)—Any building or structure, except an operating building, used for the storage of explosives. Magazines are of two general types: igloo (earth-covered) and aboveground (no earth covering). An aboveground magazine is any structure or facility, without sufficient earth covering, used for the storage of explosives. For igloo see “Earth-covered Magazine”. Also includes open air munitions stocks, trucks, trailers, railcars or cargo aircraft loaded with explosives.

Aboveground Structure/Site (AGS)—Any aboveground, non-earth-covered structure/site.

Acceptor/Donor—A total quantity of stored AE may be subdivided into separate storage units in order to reduce the MCE. The separation distances between distinct storage units, with or without an intervening barrier, need to be sufficient (i.e., IMD) to ensure that propagation between units does not occur. The storage unit that reacts initially is termed the donor and nearby units, which may be endangered, are termed acceptors.

Active Installation—A military installation that is currently in service and being regularly used for military activities.
Administration Area—The area containing administrative buildings that support the installation as a whole, excluding those offices located near and directly serving AE storage and operating areas.

AE Aircraft Cargo Area—Any area specifically designated for, aircraft loading or unloading of transportation configured AE or parking aircraft loaded with transportation configured AE.

AE Area—An area specifically designated and set aside from other portions of an installation for the development, manufacture, testing, maintenance, storage, or handling of AE.

AE Facility—Any structure or location containing AE.

Aircraft Battle Damage Repair Sites—These are sites where battle damage is simulated on aircraft hulls by detonating up to two ounces of explosives packed inside a length of steel pipe.

Aircraft Explosives Cargo Parking Area—Any area, commonly called a hot cargo pad, specifically designated for parking aircraft loaded with transportation-configured explosives cargo, or those being loaded, unloaded, or awaiting loading.

Aircraft Passenger Transport Operations—Passenger transport operations are defined for the purposes of QD as follows: Passenger transport traffic involving military dependents and civilians other than those employed by or working directly for DoD Components. The following are not considered passenger transport operations: 1) Infrequent flights of base and command administrative aircraft that may, on occasion, provide some space available travel to authorized personnel. 2) Travel of direct hire appropriated funds personnel employed by any DoD Component. 3) Travel of such personnel as contractor and technical representatives traveling to or from direct support assignments at DoD installations.

Ammunition—Generic term related mainly to articles of military application consisting of all kinds of bombs, grenades, rockets, mines, projectiles, and other similar devices or contrivances.

Ammunition and Explosives (AE)—Includes, but is not necessarily limited to, all items of U.S.—titled (i.e., owned by the U.S. Government through DoD Components) ammunition; propellants, liquid and solid; pyrotechnics; HE; guided missiles; warheads; devices; devices, and chemical agent substances and components presenting real or potential hazards to life, property and the environment. Excluded are wholly inert items and nuclear warheads and devices, except for considerations of storage and stowage compatibility, blast, fire, and nonnuclear fragment hazards associated with the explosives.

Ammunition Storage Unit (ASU)—All types of explosives storage magazines including outdoor or indoor, open storage areas, sheds, bunkers, and earth-covered and above-ground magazines.

Anomaly Avoidance—Techniques employed on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, to avoid contact with potential surface or subsurface explosive or CA hazards, to allow entry to the area for the performance of required operations.

Auxiliary Building or Facility—Any building or facility, e.g., power plant, change house, paint and solvent locker, and similar facilities, related to or maintained and operated to serve an operating building, line, plant, or pier area. AE is not present in an auxiliary building.
Bar—This is the barometric pressure at sea level. One Bar = 14.5 psi; 3-Bar = 45 psi; 7-Bar = 100 psi.

Barge Piers—Piers and wharves used exclusively for loading/unloading explosives on barges or utility craft.

Barge Units—See Ship Units.

Barricade—An intervening natural or artificial barrier of such type, size, and construction that limits the effects of an explosion on nearby buildings or exposures in a prescribed manner.

Barricaded Open Storage Module—A series of connected, barricaded cells with hard surface storage pads.

Base Operating Support Integrator (BOS-I)—The individual assigned to provide facilities-based infrastructure support at a non-enduring location (e.g., contingency bases) in a GCC’s area of responsibility or at an enduring location under the responsibility of a Military Department.

Blast Impulse—The area under the positive phase of the overpressure time curve.

Blast Overpressure—The pressure above ambient in a shock wave.

Bonding—A physical and electrical connection between a metal object and the LPS. This produces electrical continuity between LPS and the object and minimizes electromagnetic potential differences. Bonding is done to prevent side-flash. Methods of bonding include mechanical, compression and thermal types.

Break Room—A room in an operating building or a separate facility used by personnel to take breaks and eat meals

Buddy System—At least two persons are present so that one may give assistance to the other if an emergency occurs.

Bunker Suit—Apparel that consists of trousers or overalls tucked into a pair of boots; it is designed for dressing quickly when answering an alarm.

Burning Areas—Locations sited for disposal of AE by burning.

Burning Reaction—The energetic material ignites and burns non-propulsively. The case may open, melt or weaken sufficiently to rupture non-violently, allowing mild release of combustion gases. Debris primarily remains within the area of the reaction. The debris is not expected to cause fatal wounds to personnel or be a hazardous fragment beyond 50 feet [15.2 m].

Catenary LPS—An LPS consisting of one or more overhead wires suspended from poles connected to a grounding system via down conductors. The objective is to intercept lightning flashes and provide a zone of protection.

Cavern Storage Site—A natural or manmade cavern adapted for the storage of AE.

Chain of Custody—From the time of collection through release from DoD control, the procedures and their implementation, including documentation, marking, and securing, that maintain positive control of MPPEH, MDEH, and MDAS.

Chamber Storage Site—An excavated chamber or series of excavated chambers especially suited to the storage of AE. A cavern may be subdivided or otherwise structurally modified for use as a chamber storage site.
**Change House**—A building for employees to change in to and out of work clothes. Such buildings may be provided with sanitary facilities, drinking fountains, lockers, and eating facilities.

**Chemical Agent (CA)**—A chemical compound (to include experimental compounds) that, through its chemical properties, produces lethal or other damaging effects on human beings, and is intended for use in military operations to kill, seriously injure, or incapacitate persons through its physiological effects. Excluded are research, development, test, and evaluation solutions; riot control agents; chemical defoliants and herbicides; smoke and other obscuration materials; flame and incendiary materials; and industrial chemicals.

**CA Hazard**—A condition where danger exists because CA is present in a concentration high enough to present potential unacceptable effects (e.g., death, injury, damage) to people, operational capability, or the environment.

**CA Safety**—A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of a mishap involving chemical warfare material (CWM) and CA in other than munitions configurations.

**Chemical Warfare Material (CWM)**—Items generally configured as a munition containing a chemical compound that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM includes V- and G-series nerve agents or H-series (mustard) and L-series (lewisite) blister agents in other-than-munition configurations; and certain industrial chemicals (e.g., hydrogen cyanide (AC), cyanogen chloride (CK), or carbonyl dichloride (called phosgene or CG)) configured as a military munition. Due to their hazards, prevalence, and military-unique application, CA identification sets are also considered CWM. CWM does not include: riot control devices; chemical defoliants and herbicides; industrial chemicals (e.g., AC, CK, or CG) not configured as a munition; smoke and other obscuration producing items; flame and incendiary producing items; or soil, water, debris or other media contaminated with low concentrations of chemical agents where no CA hazards exist.

**CWM Response**—Munitions responses and other responses to address the chemical safety; explosives safety, when applicable; human health; or environmental risks presented by CA-filled munitions and CA in other than munitions configurations. (See munitions response).

**Classification Yard**—Classification Yard – A railroad yard used for receiving, dispatching, classifying, and switching of cars.

**Clear Zone**—The area surrounding a potential explosion site which is determined by the required IBD separation. The IBD separation will be based on the sited, waived, exempted, or actual explosives limits of the potential explosion site, whichever is greatest.

**Closure Block**—A protective construction feature designed to seal the entrance tunnel to an underground storage chamber in the event of an explosion within the chamber.

**Cluster Bomb/Dispenser Unit (CBU)**—CBU weapons that are designed to carry and dispense submunitions. (See also sensitivity group (SG)). For purposes of determining case fragment distances for intentional detonations, these military munitions are considered as nonrobust munitions.

**Cold Iron**—The status of a ship that has shut down its main power plant and is dependent on shore power. A ship in cold iron is not capable of providing immediate propulsion.
Combat Aircraft Parking Area (CAPA)—Any area specifically designated for: 1) Aircraft loading or unloading of munitions. 2) Parking aircraft loaded with combat-configured munitions.

Combat Aircraft Parking Group—Two or more aircraft loaded with combat-configured explosives that are parked at less than IMD.

Combat Configured Aircraft—Any aircraft armed with explosives used for direct combat. This could be fighters, bombers, or armed cargo aircraft such as the AC-130.

Combat Outpost (COP)—A non-enduring temporary operating location directly involved in combat operations where operations do not last more than 365 days and involve 49 or fewer US military personnel. (Source: CJCSI-4360.01A)

Combustible Construction—Construction that uses materials that readily ignite and burn when exposed to fire (i.e., wood frame structures are an example of combustible construction).

Combustible Content—Combustible materials exceeding small quantities kept in metal/noncombustible containers for immediate shop use (e.g., paints, solvents, lubricants, lumber, dunnage, packing material, wood/cardboard boxes, powered lawn equipment, hazardous waste, etc).

Compatibility—AE are considered compatible if they may be stored or transported together without significantly increasing either the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident.

Compatibility Group (CG)—Letter designation assigned to AE to indicate what may be stored or transported together without significantly increasing either the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident.

Concurrent Operations—Two or more explosives operations within a single facility or location.

Conditional Exemption (CE)—An exemption from the regulatory definition of hazardous waste (and therefore from compliance with specific environmental requirements pertaining to the storage of hazardous waste) conditioned on compliance with certain criteria requirements, as in 40 CFR Part 266.205 (reference (am)).

Conductor—An LPS component designed to transfer the current of a lightning flash to the earth electrode system. Conductors are usually heavy metallic cables. However, metallic building structural members (e.g., steel I-beams) can also function as conductors.

Confined by Ground Surface (CBGS)—This is a failure mode of a liquid propellant launch vehicle that does include impact velocities of the liquid propellant tankage (i.e., fallback onto the pad immediately after liftoff). Propellant mixing occurs as well as ignition.

Confined by Missile (CBM)—This is a failure mode of a fueled liquid propellant launch vehicle on a launch pad where an interior bulkhead failure occurs allowing the two propellants to come into contact. Ignition occurs, but there is effectively no impact velocity associated with mixing of the two propellants.

Connected Chamber Storage Site—A chamber storage site consisting of two or more chambers connected by ducts or passageways. Such chambers may be at the ends of branch tunnels off a main passageway.
Constriction—Constrictions are short lengths of tunnel whose cross-sectional areas are reduced to one-half or less of the normal tunnel cross-section. Constrictions reduce the airblast effects passing through them. To be effective, place constrictions within five tunnel diameters of the tunnel exit or to the entrances of storage chambers.

Container—A package designed to protect AE from hazardous environments during transportation and storage.

Contingency—A situation requiring military operations in response to natural disasters, terrorists, subversives, or as otherwise directed by appropriate authority to protect US interests. Due to the uncertainty of the situation, contingencies require plans, rapid response, and special procedures to ensure the safety and readiness of personnel, installations, and equipment. (JP 5-0)

Contingency Operating Base (COB)—A non-enduring temporary operating location directly involved in combat operations where operations do not last more than 365 days and involve 50, but not more than 100, U.S. Military personnel. (Source: CJCSI-4360.01A)

Control Site—Location where essential personnel congregate at the time of ignition or initiation of an intentional burn or detonation.

Counterpoise—A type of an earth electrode system consisting of conductor cables buried around the structure to be protected. Generally, a counterpoise will have more surface area contacting the earth than ground rod systems.

Dangerously Unserviceable Munition—A munition or explosive that has a critical defect identified in the specific item technical order. This defect can result in a higher probability of inadvertent activation or functioning. This may include partially or fully armed or partially expended, broken, damaged, or leaking items, etc., (not necessarily ADRs).

Debris—Any solid particle thrown by an explosion or other strong energetic reaction. For aboveground explosions, debris refers to secondary fragments. For explosions in underground facilities, debris refers to both primary and secondary fragments.

Debris Trap—A protective construction feature in an underground facility that is designed to capture fragments and debris from an explosion within the facility.

Definitive Drawing—A design (e.g., a control bunker, a 3- or 7-bar ECM, a missile test cell, or a barricade) that has been documented by a DoD Component on numbered drawings and approved by the DDESB. The purpose of a definitive drawing is to provide a standard design to insure consistency in construction. Upon approval by the DDESB, there is no need for the definitive drawing to be reviewed again, provided the design has not been changed.

Deflagration Reaction—Ignition and rapid burning of the confined energetic materials builds up high local pressures leading to nonviolent pressure release as a result of a low strength case or venting through case closures (e.g., loading ports or fuze wells). The case might rupture but does not fragment; closure covers might be expelled, and unburned and burning energetic materials might be thrown about and spread the fire. Propulsion might launch an unsecured test item, causing an additional hazard. No blast or significant fragmentation damage to the surroundings is expected, only heat and smoke damage from the burning explosive substances.

Demilitarization—To mutilate, disarm, or accomplish any other action required to prevent the further use of equipment and materiel for its original intended military or lethal purpose.
Designated Aircraft Parking Area—An aircraft parking area meeting airfield parking criteria.

Detonation Reaction—A supersonic decomposition reaction propagates through the energetic materials and produces an intense shock in the surrounding medium and very rapid plastic deformation of metallic cases, followed by extensive fragmentation. All energetic materials will be consumed. Effects will include large ground craters for items on or close to the ground; holing, plastic flow damage, and fragmentation of adjacent metal structures; and blast overpressure damage to nearby structures.

Deviation—Written authorization allowing a specific departure from a mandatory requirement of this regulation other than QD criteria.

Discarded Military Munition (DMM)—See section 2710(e) (2) of Reference (e). Generally, military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include UXO, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations.

Disposal—End-of-life tasks or actions for residual materials resulting from demilitarization or disposition operations.

Disposition—Reusing, recycling, converting, redistributing, transferring, donating, selling, demilitarizing, treating, destroying, or fulfilling other life-cycle guidance, for DoD property subject to these standards.

Dividing Wall—A wall designed to prevent, control, or delay propagation of a reaction involving AE on opposite sides of the wall.

DoD Component—An organization within the DoD (e.g., the Air Force.)

DoD Explosives Operations/Storage—Explosives operations conducted by DoD, or other federal agency, under DoD oversight, procedure, or control and IAW the explosives safety standards of DoD 6055.09-M. This term is applicable only to DoD and federal explosives operations, and to non-DoD commercial enterprises directly supporting DoD and federal explosives contractual efforts.

DoD Explosives Safety Board (DDESB)—The DoD organization charged with promulgation of AE safety policy and standards, and with reporting on the effectiveness of the implementation of such policy and standards.

Donor/Acceptor—See “Acceptor/Donor”.

Down Conductor—See “Conductor”.

Dunnage—Inert material associated with the packaging, containerization, blocking and bracing of AE.

Earth-Covered Magazine (ECM)—An aboveground, earth covered structure that meets soil cover depth and slope requirements of this Standard. ECM have three possible strength designations (7-bar, 3-bar, or Undefined). The strength of an ECM’s headwall and door determines its designation.
Earth Electrode System—A component of a LPS that transfers the current of a lightning flash to the earth. The earth electrode system (e.g., ground rods, counterpoise, buried metal plates, or Ufer grounds) is connected to down conductors and is in direct contact with the earth.

Electric Power House—An electric power generation facility that provides prime or stand-by auxiliary electrical power where no commercial power is available to meet operational requirements. Also called an electric power plant. A powerhouse can contain generators, fuel storage and supply, switch gear, and transformers (if required). Powerhouses supplying primary power to an installation or group of facilities are normally staffed. Power plants supplying only stand-by auxiliary power to individual facilities are usually unoccupied.

Electric Substations—The point of supply for a base electrical distribution system or portion thereof. The main substation is usually the dividing point between government facilities and those of a utility company. A substation subdivides the power supply and contains protective and control devices for the incoming supply circuit, transformers (when required), voltage regulators, and indicating or recording instruments. A substation that has no transformers is sometimes called a switching station.

Electric Transformer Station—An electrical facility which converts incoming power from the distribution system to lower voltage suitable for use directly by lights, motors, and other appliances.

Electrically Initiated Device (EID)—An EID is a single unit, device, or subassembly that uses electrical energy to produce an explosive, pyrotechnic, thermal, or mechanical output (e.g., electro explosive devices (such as hot bridge wire, semiconductor bridge, carbon bridge, and conductive composition), exploding foil initiators, laser initiators, burn wires, and fusible links). (MIL-HDBK-240)

Electromagnetic Environment (EME)—The resulting product of the power and time distribution, in various frequency ranges, of the radiated or conducted electromagnetic emission levels encountered by a military force, system, or platform when performing its assigned mission in its intended operational environment. It is the totality of electromagnetic energy, from manmade and natural sources, where a platform/system, or subsystem/equipment will be exposed within any domain, that is, land, air, space, and sea, while performing its intended mission throughout its operational life cycle (in the case of munitions, during its stockpile-to-safe separation sequence). When defined, the EME will be for a particular time and place. Specific equipment characteristics, such as operating frequencies, emitter power levels, and receiver sensitivity, operational factors such as distances between items and force structure, and frequency coordination all contribute to the EME. In addition, transient emissions and their associated rise and fall times such as from EMP, lightning, and p-static also contribute. (JP 3-13.1 and MIL-HDBK-237)

Electromagnetic Environmental Effects (E3)—E3 is the impact of the EME upon the operational capability of military forces, equipment, systems, and platforms. It encompasses all electromagnetic disciplines, including electromagnetic compatibility (EMC) / electromagnetic interference (EMI); electromagnetic vulnerability (EMV); electromagnetic pulse (EMP); electronic protection (EP); hazards of electromagnetic radiation to personnel (HERP), military munitions--ordnance (HERO), and volatile materials such as fuel (HERF); and the natural phenomena effects of lightning and precipitation static (p-static). (MIL-HDBK-240)
Electromagnetic Radiation (EMR)—Radiation made up of oscillating electric and magnetic fields and propagated with the speed of light. Includes gamma radiation, X-rays, ultraviolet, visible, and infrared radiation, and radar and radio waves. (JP 1-02, DoD Dictionary)

Emergency Withdrawal Distance—Distance to which personnel are removed from an ES during an explosive accident or incident.

Emission Control (EMCON)—The selective and controlled use of electromagnetic, acoustic, or other emitters to optimize command and control capabilities while minimizing, for operations security detection by enemy sensors, mutual interference among friendly systems; and/or enemy interference with the ability to execute a military deception plan. (JP 1-02, DoD Dictionary)

Enduring Location—(Main Operating Bases) DOD use and established lexicon for the types of overseas (in foreign countries or US territories overseas) locations from which it operates in its global defense posture framework. A location is enduring when the Department intends to maintain access and or use of that location for the foreseeable future. Enduring locations play a critical role in allowing the Department to surge, deploy, or employ U.S. forces when and where necessary, but need not have a continuous presence or permanent structure sustained or constructed through U.S. appropriations. Combatant Commanders nominate locations as enduring and OSD validates these nominations in consultation with the State Department. The following types of sites are considered enduring for U.S. Government purposes: Main Operating Bases (MOB), Forward Operating Site (FOS), and Cooperative Security Location (CSL). All three types of locations may be composed of more than one distinct site.

Energetic Liquid—A liquid, slurry, or gel, consisting of, or containing an explosive, oxidizer, fuel, or combination of the above, that may undergo, contribute to, or cause rapid exothermic decomposition, deflagration or detonation.

Energetic Materials—Energetic materials are chemical compounds, or mixtures of chemical compounds, that are divided into three groups according to use: explosives, propellants, and pyrotechnics. Explosives and propellants that have been properly initiated evolve large volumes of hot gas in a short time. The difference between explosives and propellants is the rate the reaction proceeds. In explosives, a fast reaction produces a very high pressure shock in the surrounding medium. This shock is capable of shattering objects. In propellants, a slower reaction produces a lower pressure over a longer period of time. This lower sustained pressure is used to propel objects. Pyrotechnics evolve large amounts of heat but much less gas than propellants or explosives. Various external stimuli can cause release of the energy contained in energetic materials. Knowing the response of individual energetic materials to specific stimuli is important from the point of view of safety. Energetic materials are sensitive to four external stimuli. These are: impact, shock, electrostatic, and thermal. Eliminating or controlling these stimuli is key to eliminating the unintentional initiation of energetic material. The focus of this Manual is on these four areas. The hazards associated with energetic material are blast, fragments, mass fire, fire and toxicity.

Engineering Controls—Management of facility operations through the use of engineering principles (e.g., facility design, operation sequencing, equipment selection, or process limitations).

En Route Infrastructure—The fundamental structures and systems required for the employment of both organic and commercial strategic lift capacity.
**Entry Control Point (ECP)**—A location or facility used to control pedestrian or vehicular access to controlled or restricted areas. It is commonly found at the entrance to MSAs and CAPAs. If it is a permanent facility, it is sometimes also called a Gate House.

**Environmental Regulators and Safety Officials**—Includes, but may not be limited to, environmental regulators, environmental coordinators, or hazardous material coordinators, law enforcement officers, and safety personnel of the U.S. Environmental Protection Agency, State, interstate, and local governments (which may include Federally recognized Indians tribes and Alaska Native entities), and other Federal land managers. When appropriate, public health officials of various agencies may also be involved.

**Essential Personnel**—Individuals necessary for the safe and effective completion of a specific explosives operation.

**Evaluation Zone**—The area around an ES where the PESs, if filled to maximum capacity, could violate QD to that ES. (Remember, a PES is also an ES). This zone determines the PESs that must be listed on the AF Form 943 for evaluation.

**Exception**—The inclusive term for any departure from the requirements of this Manual. Exceptions are further divided into deviations, event waivers, waivers, exemptions, and Secretary of the Air Force (SECAF) waivers and exemptions for new construction.

**Exemption**—A relatively long-term departure from a mandatory requirement of QD standards of this regulation. See definition of “waiver”.

**EX Number**—A reference number, preceded by the prefix EX, which is assigned by DOT to AE that have been evaluated under the provisions of 49 CFR Part 173.56.

**Expansion Chamber**—A protective construction feature in an underground storage facility designed to reduce the overpressure exiting the facility by increasing the total volume of the tunnel chamber complex. It may also function as an operating area within the underground facility or as a debris trap.

**Explosion Proof**—Used in referring to electrical equipment; specifically, to equipment enclosed in a case that can withstand an internal burning or explosion of elements inside the case, and can prevent ignition by spark, flash, or explosion of any outside gas or vapor surrounding the enclosure.

**Explosion Reaction**—Ignition and rapid burning of the confined energetic materials builds up high local pressures leading to breakup of the confining structure. Metal cases are fragmented (e.g., brittle fracture) into large pieces that are often thrown long distances. Unreacted or burning energetic materials are also thrown about. Fire and smoke hazards will exist. Air shocks are produced that can cause damage to nearby structures. The blast and high velocity fragments can cause minor ground craters and damage (e.g., breakup, tearing, gouging) to adjacent metal plates. Blast pressures are lower than for a detonation reaction.

**Explosive**—A substance or a mixture of substances that is capable by chemical reaction of producing gas at such temperature, pressure and speed as to cause damage to the surroundings. The term explosive includes all substances variously known as HE and propellants, together with igniter, primer, initiation, and pyrotechnic (e.g., illuminant, smoke, delay, decoy, flare and incendiary compositions.
Explosive Accident—Accidents resulting in damage or injury from: 1) An explosion or functioning of explosive materials or devices (except as a result of enemy action). 2) Inadvertent actuation, jettisoning, and releasing or launching explosive devices. 3) Impacts of ordnance off-range.

Explosives Anchorage—A designated area of water used for AE loading and unloading of vessels and for anchoring vessels carrying a cargo of AE.

Explosives Area or Location—Any area or location specifically designated and set aside from other areas and used for manufacturing, testing, maintenance, storage, demilitarization, shipping and receiving, and other similar type explosives operations. Such areas may also be referred to as explosives parking or loading areas when armed or explosives-loaded aircraft are involved.

Explosives Content (of a PES)—Determination based on the type, quantity, packaging and hazard class division of the explosives present. Expressed as a net explosives weight (NEWQD) in pounds.

Explosive Equivalent—The weight of a standard explosive, usually taken as TNT, required to produce a selected shockwave parameter of equal magnitude at a specific location to that produced by a unit weight of the explosive in question.

Explosive Facility—Any structure or location containing AE.

Explosive Ordnance—All munitions and improvised or clandestine explosive devices, containing explosives, propellants, nuclear fission or fusion materials, and biological and chemical agents. (JP 3-42)

Explosive Ordnance Disposal (EOD)—1. The detection, identification, onsite evaluation, rendering safe, recovery, and final disposal of UXO and of other munitions that have become an imposing danger (e.g., by damage or deterioration). 2. The organization engaged in such activities. (JP 3-42)

EOD Personnel—Military personnel who have graduated from the Naval School, Explosives Ordnance Disposal; are assigned to a military unit with a Service-defined EOD mission; and meet Service and assigned unit requirements to perform EOD duties. EOD personnel have received specialized training to address explosive and certain CA hazards during both peacetime and wartime. EOD personnel are trained and equipped to perform RSP on nuclear, biological, chemical, and conventional munitions, and on IEDs.

EOD Unit—Personnel with special training and equipment who render explosives ordnance safe, make intelligence reports on such ordnance, and supervise the safe removal thereof. (JP 3-42)

Explosive Hazard—A condition where danger exists because explosives are present that may react in a mishap with potential unacceptable effects to people, property, operational capability, or the environment. (JP 3-42)

Explosives Loaded Aircraft—An aircraft is "explosives-loaded" when it carries munitions or explosives, internally or externally. The term does not include explosive components of aircrew escape systems or pyrotechnics installed in survival kits.
Explosives Operations Office—Any office adjacent to or within an explosives area where operational administrative functions pertaining to explosives are performed. Also known as a field office.

Explosives Safety—A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of potential mishaps involving DoD military munitions or other encumbering explosives or munitions.

Explosives Safety Distance (Quantity-Distance)—An expression of the quantity versus distance principle involved, or the toxic hazard distance used in determining acceptable separations between given explosives sources and given exposures to the hazard. For the purposes of this regulation, the term "Quantity-Distance" or "QD" will be used (see "quantity-distance").

Explosives Safety Management—A cost-effective RM process, including policies, procedures, standards, engineering, and resources, that addresses potential probabilities and consequences of mishaps involving DoD military munitions or other encumbering explosives or munitions, to sustain operational capabilities and readiness and to protect people, property, and the environment.

Explosives Safety Munitions Risk Management (ESMRM)—A systematic approach that integrates risk analysis into operational planning, military training exercises, and contingency operations with the goal of identifying potentially adverse consequences associated with munitions operations, risk reduction alternatives, and risk acceptance criteria for senior officials to make the risk decision.

Explosives Safety Submission (ESS)—See Munitions Response ESS (MRESS).

Explosives Site Plan (ESP)—May also be referred to as a QD Safety Submission (QDSS)—Package consisting of all information necessary to assess compliance with explosives safety standards (especially QD standards) for explosives storage or operating location. Once approved, this package identifies storage and operational limitations, and provides a tool for management of risks associated with the storage or operating location. Note: An ESP can also be prepared for a non-explosives exposed site.

Explosives Sited CAPA—An aircraft parking area meeting both explosives safety and airfield criteria.

Explosives Storage Area—A designated area of explosives-containing facilities set aside for the exclusive storage or "warehousing" of explosives stocks. Facilities include igloos, magazines, warehouses, operating buildings, modules, revetments, and outdoor storage pads.

Exposed Explosives—Explosives that are open to the atmosphere (such as unpackaged bulk explosives, or disassembled or open components) and that are susceptible to initiation directly by static or mechanical spark, or create (or accidentally create) explosive dust, or give off vapors, fumes, or gases in explosives concentrations. This also includes exudation and explosives exposed from damaged munitions such as gun powder or rocket motors.

Exposed Site (ES)—A location exposed to the potential hazardous effects (e.g., blast, fragments, debris, or heat flux) from an explosion at a potential explosion site (PES).

Extremely Heavy Case Munitions—These munitions are defined as having a cylindrical section case weight to explosive weight ration > 9 (e.g., 16” projectiles and most armor piercing...
(AP) projectiles). For purposes of determining Sensitivity Group, Extremely Heavy Case Munitions are considered as Robust Munitions. (See the Fragmentation Data Review Form (FDRF) located on the DDESBN secure web page to determine if a specific item is classified as an Extremely Heavy Case Munition)

**Extremely Insensitive Detonating Substance (EIDS)**—A substance, although capable of sustaining a detonation, has demonstrated through tests that it is so insensitive that there is a very low probability of accidental initiation.

**Faraday Cage**—A LPS where the area to be protected is enclosed by a heavy metal screen (similar to a birdcage) or continuous metallic structure with no un-bonded metallic penetrations. Lightning current flows on the exterior of the structure, not through its interior.

**Faraday-Like Shield**—A LPS that is not an ideal Faraday Cage, but is formed by a contiguous conductive matrix that is properly bonded and grounded (e.g., electrically continuous steel arches and reinforcing bars of concrete end-walls and floors of steel arch magazines, reinforcing bars of ECM, or the metal shell of pre-fabricated "portable" magazines and metal buildings).

**Field Office**—See "explosives operations office."

**Firebrand**—A burning or hot projection that may transfer thermal energy to the surroundings.

**Firebreaks**—An area free of all readily combustible material, such as dry grass, leaves, brush or dead wood.

**Fire Resistive (Structural)**—The type of construction where the structural members, including walls, partitions, columns, floor, and roof construction are of "noncombustible" materials that either do not burn or have specific fire resistance ratings in terms of hours.

**Fire Retardant**—Combustible materials or structures that have been treated or had surface coverings designed to retard ignition or fire spread.

**Fire Wall**—A wall of fire-resistive construction designed to prevent the spread of fire from one side to the other. Also referred to as a fire division wall.

**Flightline Munitions Holding Area**—A designated area where munitions and components are temporarily positioned awaiting transfer to aircraft (e.g., Ready Service Igloo, Ready Service Magazine, Ready Service Module, Standard Air Munitions Package (STAMP) marshaling area, and Aerial Port of Embarkation (APOE) marshaling area).

**Formerly Used Defense Site (FUDS)**—Properties previously owned, leased, or otherwise possessed by the U.S. and under the jurisdiction of the Secretary of Defense; or manufacturing facilities where real property accountability rested with DoD but operation was performed by contractors (government owned-contractor operated) and later the facilities were legally disposed.

**Forward Arming and Refueling Point (FARP)**—A temporary facility, organized, equipped and deployed to provide fuel and AE necessary to support aviation maneuver units in combat. The FARP permits combat aircraft to rapidly refuel and rearm and is normally located in the main battle area closer to the area of operation than the aviation unit’s combat service area.

**Fragmentation**—Fracture of AE confining cases and structures as the result of an initiation.
**Fragment Distance**—The limiting range, based on a specific density of hazardous fragments, expected from the type and quantity of explosives involved. Used in establishing certain QD criteria, a fragment is considered hazardous when it has an impact energy of 58 foot-pounds or greater. Hazardous fragment density is a density of hazardous fragments exceeding one per 600 square feet.

**Fragmenting AE**—Items that have cases that are designed to fragment (e.g., naturally fragmenting warheads, continuous rod warheads, items with scored cases and items that contain pre-formed fragments) (see also Sensitivity Group). For purposes of determining case fragment distances for intentional detonations, these munitions are considered as robust munitions.

**Frost Line**—The depth to which frost will penetrate soil (region dependent).

**Gatehouse**—A permanent facility used to control pedestrian and vehicular access manned by multiple personnel. Sometimes referred to as an Entry Control Point (ECP) when used at the entrance to controlled or restricted areas. Gatehouses used at base entrances are sometimes called Traffic Check Houses and cannot be considered related to explosives operations. (e.g., a structure used to house security response forces)

**General Public**—Persons not associated with a DoD installation’s mission or operations. Including but not limited to Non-DoD card holders, guests of personnel assigned to the installation, or persons not employed or contracted by DoD or the installation. This definition also includes installation personnel not directly related to the potential explosives site mission.

**Government Assets**—Government assets may include, but are not limited to, facility, ground support equipment, airborne vehicle equipment, real property, explosives, and other items owned by the DoD and its components. It also includes property owned by NASA or other government agencies.

**Grounding**—The method used for providing an electrical path to the earth or to the earth electrode system. Good grounding is a function of the earth itself; temperature and moisture condition; an ionizing medium such as naturally occurring salts; or the volume of the earth electrode.

**Ground Shock**—Coupling of energy to the ground as a result of an AE reaction. Localized movement of the ground or structures in the vicinity will occur.

**Guard Shelter**—A location or facility used solely by the person guarding the PES or explosives area. It is permanent or temporary structure providing protection from the weather for a single guard (e.g., a one-person structure used by someone guarding a nuclear weapons-loaded aircraft or munitions storage area).

**Hardened Aircraft Shelter (HAS)**—A structure designed to minimize aircraft QD separation distances and yet provide a high level of aircraft protection. Defined as being one of the following structure types addressed by this Standard: **First Generation TAB VEE.** 24 feet [7.3 m] radius semicircular arch, 48 feet [14.7 m] wide by 100.8 feet [30.7 m] long. Double corrugated steel liner covered by a minimum of 18 inches [45.7 cm] of reinforced concrete cover. Front closure is prow-shaped and is produced when two vertically-hinged, recessed doors come together. (The closure is recessed approximately 20 feet [6.1 m] from the front of the arch, providing a smaller internal space for aircraft.) 24-inch [61.0 cm] thick reinforced concrete rear wall, with an interior 0.1255-inch [0.3188 cm] thick steel spall plate. Rear wall has an exhaust
opening (normally closed) for venting when engines are running (Also known as a USAFE-AFAFRICA TAB VEE). **TAB VEE Modified.** 24 feet [7.3 m] radius semicircular arch, 48 feet [14.7 m] wide by 100.8 feet [30.7 m] long. Double corrugated steel liner covered by a minimum of 18 inches [45.7 cm] of reinforced concrete cover. Front closure is prow-shaped, laterally opening, external flush door. 24-inch [61.0 cm] thick reinforced concrete rear wall, with an interior 0.1255-inch [0.3188 cm] thick steel spall plate. Rear wall has an exhaust opening (normally closed) for venting when engines are running.  

**Second Generation.** 29.4 feet [9.0 m] double-radius, pseudo-elliptical arch; 82 feet [25 m] wide by 124 feet [37.8 m] long. Double corrugated steel liner covered by a minimum of 18 inches [45.7 cm] of reinforced concrete cover. Front closure is a vertical reinforced concrete panel, laterally opening, sliding, external flush door. 24-inch [61.0 cm] thick reinforced concrete rear wall, with an interior 0.1255-inch [0.3188 cm] thick steel spall plate. Rear wall has an exhaust opening (normally closed) for venting when engines are running.  

**Third Generation.** 27.4 feet [8.4 m] double-radius, pseudo-elliptical arch; 70.8 feet [21.6 m] wide by 120 feet [36.6 m] long. Double corrugated steel liner covered by a minimum of 18 inches [45.7 cm] of reinforced concrete cover. Front closure is a vertical reinforced concrete panel, laterally opening, sliding, external flush door. A personnel door is located out one side and is protected by a barricade. 24-inch [61.0 cm] thick reinforced concrete rear wall, with an interior 0.1255-inch [0.3188 cm] thick steel spall plate. Rear wall has an exhaust opening (normally closed) for venting when engines are running.  

**Korean TAB VEE.** 24-feet [7.3 m] radius semicircular arch, 48 feet [14.7 m] wide by 100.8 feet [30.7 m] long (same dimensions and arch design as a First Generation). Double corrugated steel liner covered by a minimum of 18 inches [45.7 cm] of reinforced concrete cover. Either no front closure or a non-hardened front closure. 18-inch [45.7 cm] thick reinforced concrete rear wall, with a 10-guage (0.1382-inch) [3.51mm] steel liner. Rear wall has an exhaust opening (normally closed) for venting when engines are running; exhaust opening is protected only by an exterior blast deflector earth-filled steel bin barricade. **Korean TAB VEE Modified.** Same as a Korean TAB VEE, except a First Generation TAB VEE or TAB VEE Modified hardend front closure has been installed. **Korean Flow-Through.** 27.4 feet [8.4 m] double-radius, pseudo-elliptical arch; 70.8 feet [21.6 m] wide by 120 feet [36.6 m] long (same dimensions and arch design as a Third Generation). Double corrugated steel liner covered by a minimum of 18 inches [45.7 cm] of reinforced concrete cover. Has an open front and rear. **HAS Pair.** Two side-by-side HAS with either a First, Second or Third Generation arch design, separated by a minimum 6-inch [15.24 cm] air gap. The design may be a flow-through, or may have a rear wall or a front and rear wall. **Maintenance HAS.** A First, Second, or Third Generation HAS used for non-explosive combat aircraft maintenance operations.

**Hardened Aircraft Shelter (HAS) Ready Service ECM/AGM**—Facility intended to provide a holding area between HAS for quick-turn munitions. Limited to 22,000 lbs [9,979 kg] NEWQD (originally based on four quick-turn loads per HAS).  

**Hazard Classification**—Process by which hazardous materials are assigned to one of the nine U.N. recognized classes of dangerous goods.  

**Hazard Division (HD)**—One of six divisions designating the predominant hazard within UN Class 1, Explosives.  

**Hazardous Fragment or Debris**—Fragments or debris having an impact energy of 58 foot-pounds [79 J] or greater.
Hazardous Fragment Density—Areal number density of hazardous fragments or debris exceeding one per 600 \( \text{ft}^2 \) [55.7 \( \text{m}^2 \)].

Hazardous Fragment Distance—The distance at which the areal density of hazardous fragments or debris becomes one per 600 \( \text{ft}^2 \).

Hazardous Locations for Electrical Equipment—Locations where flammable gases or vapors are, or may be, present in an explosive or ignitable mixture, or where combustible dust or easily ignitable particles or fibers may be present.

Hazardous Operation (Space Launch)—A specific operation requiring the establishment of a Safety Control Area; nonessential personnel will be evacuated from the Safety Control Area. Range Safety designates certain functions and procedures as hazardous operations when LSRM segments are being processed. Because these operations have a greater than normal potential for causing mishaps, certain controls are implemented. A solid rocket motor segment being lifted by a crane is an example of a hazardous operation. In addition to the activation of a Safety Control Area, these operations require supervision by people designated as the individuals responsible for safety standards compliance.

Hazards of Electromagnetic Radiation to Ordnance (HERO)—The danger of accidental actuation of electro-explosive devices or otherwise electrically activating ordnance because of radio frequency electromagnetic fields. Situations in which transmitting equipment (e.g., radios, radar, electronic countermeasures, electronic counter-countermeasures, ground penetrating radar, etc.) or other electromagnetic emitting devices can generate radiation of sufficient magnitude to induce or otherwise couple electromagnetic energy sufficient to exceed specified safety and/or reliability margins in EIDs contained within ordnance, or cause radiation-induced damage or degradation of performance in military munitions containing EIDs. (JP 3-04 and MIL-HDBK-240)

Headwall—An ECM’s front wall. It is a critical feature that is directly associated with the strength designation assigned to an ECM.

Heavy Armor—Main battle tanks or other vehicles that are expected to contain fragments and reduce blast overpressure generated from an internal explosion of its AE stores.

High Explosives (HE)—An explosive substance designed to function by detonation (e.g., main charge, booster or primary explosives).

High Explosives Equivalent or TNT Equivalent—The amount of a standard explosives, when detonated, will produce a blast effect comparable to the effect that results at the same distance from the detonation or explosion of a given amount of the material for which performance has been evaluated. It is usually expressed as a percentage of the total net weight of all reactive materials contained in the item or system. (For the purpose of this regulation, TNT is used for comparison.) See “Explosive Equivalent”.

High Performance Magazine (HPM)—An earth-bermed, 2-story, box-shaped structure with internal non-propagation walls designed to reduce the MCE.

High Pressure Closure—See Closure Block.

Holding Area Munitions (HAMS)—Designated location on the flightline where built up munitions are temporarily placed pending delivery to combat aircraft or return to storage. HAMS must meet flightline munitions holding area QD criteria.
Holding Yard—A specified area designed or used to accommodate explosives-laden carriers before movements to a storage area or to their next destination. (Called "wharf yard" at seaports.)

Hybrid Propellants—A propellant charge using a combination of physically separated solid and liquid (or gelled) substances as fuel and oxidizer.

Hybrid Safety Submission (HSS)—An ESP containing waivers or exemptions to QD criteria. Once the Air Force accepts the risks associated with the violations, the HSS will be forwarded to the DDESB for approval of the paired relationships meeting QD criteria.

Hygroscopic—A tendency of material to absorb moisture from its surroundings.

Hypergolic—A property of various combinations of chemicals to self-ignite upon contact with each other without a spark or other external initiation source.

Igloos (All Types)—See "Earth-covered magazine."

Improvised Explosive Device (IED)—A weapon that is fabricated or emplaced in an unconventional manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals designed to kill, destroy, incapacitate, harass, deny mobility, or distract. (JP 3-15.1)

Incapacitating Agent—A chemical agent, which produces temporary disabling conditions that can be physical or mental and persist for hours or days after exposure to the agent has ceased. (JP 3-11)

Incremental Distance—The distance based solely on overpressure protection (K factor) without regard to fragment protection (e.g., for 5000 pounds NEWQD, the incremental K40/50 distance would be 685 feet instead of the 1,250 feet IBD separation required because of minimum fragment protection.)

Inert—Contains no explosives, active chemicals, or pyrotechnics, but is not necessarily noncombustible.

Inhabited Building Distance (IBD)—Distance to be maintained between a PES and an inhabited building.

Inhabited Buildings—Structures, other than AE-related buildings, occupied by personnel or the General Public, both within and outside DoD establishments (e.g., schools, churches, residences, quarters, Service clubs, aircraft passenger terminals, stores, shops, factories, hospitals, theaters, mess halls, post offices, or post exchanges).

Inspection Station—A designated location where trucks and railcars containing AE are inspected.

Installation-Related Personnel—Military personnel (including family members), DoD employees, DoD contractor personnel, and other personnel having either a direct operational (military or other Federal personnel undergoing training at an installation) or logistical support (e.g., vendors) relationship with installation activities.

Installed Explosives—Explosives items installed on aircraft or contained in survival kits such as flares, signals, egress system components, squibs, and detonators for jettisoning external stores, engine-starter cartridges, fire extinguisher cartridges, destructors in electronic equipment,
explosives components of emergency equipment, and other such items or materials necessary for safe flight operations.

**Integral Air Terminal LPS**—A LPS that has strike termination devices mounted on the structure to be protected. The strike termination devices are connected to the earth electrode system via down conductors.

**Integral Part of a Space Launch Facility**—Any permanent structure or item in the immediate vicinity of the launch pad or test facility that directly supports launch/test operations.

**Intentional Burn or Detonation**—Burn or detonation of AE purposefully ignited or initiated in a planned sequence of events.

**Interchange Yard**—An area on a DoD installation set aside for exchanging railroad cars or vehicles with a common carrier.

**Intermagazine Distance (IMD)**—Distance to be maintained between two AE storage locations.

**Intraline Distance (ILD)**—The distance to be maintained between any two AE related buildings or sites within an AE related operating line.

**Intrusive Weapons Maintenance Operations**—Operations extending within the sealed case of a weapon.

**In-use Ammunition**—Ammunition required at the posted location or during roving patrols that is issued and available for immediate, lifesaving, security, or law enforcement situations.

**Joint DoD - Non-DoD Use Runway/Taxiway**—A runway or taxiway serving both DoD and commercial aircraft. A runway or taxiway serving solely DoD, DoD chartered, or NonDoD aircraft on DoD authorized business is not joint use.

**Joint Hazard Classification System (JHCS)**—A data base containing hazard classification and safety data for DoD AE.

**Joint Storage**—AE storage in a facility that includes both DoD-titled and non-DoD-titled AE. In other than ownership, the stored AE items are similar.

**Joint Use Airfield**—An airfield serving both DoD and commercial aircraft. An airfield serving solely DoD, DoD chartered, or non-DoD aircraft on DoD authorized business is not joint use. ATF, DOE, DEA, and other federal use aircraft are not considered commercial; therefore, joint-use standards do not apply.

**Joint Use Space Launch Facility**—A space launch facility serving both governmental and authorized commercial users.

**K Factor**—The factor in the formula \( D = K W^{1/3} \) used in QD determinations where \( D \) represents distance in feet and \( W \) is the NEWQD in lb. The K factor is a constant and represents the degree of protection that is provided.

**Largest Single Round NEWQD (LSRN)**—Equal to the largest single round NEWQD HD 1.2.3 item present. Because it is not expected that there will be an HD 1.2.3 item with an LSRN greater than 450 pounds, and to simplify calculations, cap the LSRN at \( \leq 450 \) pounds.
Launch Complex—A group of facilities used to assemble, test, check out and launch spacelift vehicles. A launch complex must include two similar launch pads, ground liquid propellant tankage, solid rocket motor facilities, etc.

Launch Mount—The load bearing base, apron, or platform where the centerline of a rocket, missile, or space vehicle rests during launching.

Launch Pad—The load-bearing base, apron, or platform where a rocket, missile, or space vehicle and its launcher rest prior to launch.

Leadless EID—Any devices having nothing connected to them that might act as an antenna and provide a structural mechanism for the energy to be captured/coupled.

License—Formal permission to store explosives or munitions outside the sited explosives storage area.

Light Construction (Structure)—Light metal structure or concrete masonry unit (block wall) construction without concrete fill or reinforcement (e.g., butler type buildings).

Liquid Propellant—Energetic liquids used for propulsion or operating power for missiles, rockets, AE and other related devices.

Loading Density \((w)\)—Quantity of explosive per unit volume expressed as lbs/ft\(^3\) [kg/m\(^3\)].

Loading Docks—Facilities, structures, or paved areas used for transferring AE between modes of transportation.

Lunchroom—Facilities where meals may be distributed by food service personnel or brought by operating personnel for consumption. It may serve more than one PES.

Magazine—Any building or structure, except an operating building, used for the storage of explosives. Magazines are of two general types: igloo (earth-covered) and aboveground (no earth covering). An aboveground magazine is any structure or facility, without sufficient earth covering, used for the storage of explosives. For igloo see “Earth-covered Magazine.”

Magazine Area—Same as "Explosives Storage Area."

Main Operating Base (MOB)—A facility outside the US with permanently stationed operating forces and robust infrastructure. Main operating bases are characterized by command and control structures, enduring family support facilities, and strengthened force protection measures. (JP 1-02. SOURCE: CJCS CM-0007-05)

Major Weapons Maintenance Operations—Disassembly or the performance of any maintenance operations, as currently approved, that breaches the “minimum configuration” providing “appropriate lightning protection” resulting in exposure of the weapon’s internal components to electrical energy of any kind. Major maintenance operations do not include PAL procedures.

Marshaling Yard—A designated area near a port facility where a unit or activity consolidates their equipment and prepares for movement.

Mass Detonating Explosives—HE, black powder, certain propellants and pyrotechnics, and other similar explosives. They may be alone or in combination, or loaded into various types of ammunition or containers. Most of the entire quantity can explode instantaneously when a small portion is subjected to fire, to severe concussion or impact, to the impulse of an initiating agent,
or to the effect of a considerable discharge of external energy. Such an explosion will generally cause severe structural damage to adjacent objects. The explosion may cause detonation of other items of AE stored near enough to (and not adequately protected from) the initially exploding pile, so that the two or more quantities must be considered as one for QD purposes.

**Mass Explosion**—Explosion that affects almost the entire quantity of AE virtually instantaneously.

**Mast LPS**—An LPS that consists of one or more poles with a strike termination device connected to an earth electrode system by down conductors. Its purpose is to intercept lightning flashes and provide a zone of protection.

**Material Documented as an Explosive Hazard (MDEH)**—MPPEH that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

**Material Documented as Safe (MDAS)**—MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

**Materials Handling Equipment (MHE)**—Equipment used at air, ground, and sea ports to handle large cargo. These items are generally available from commercial sources. (JP 4-01.5)

**Material Potentially Presenting an Explosive Hazard (MPPEH)**—Material owned or controlled by the DoD that, prior to determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris) or potentially contains a high enough concentration of explosives that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization, or disposal operations). Excluded from MPPEH are: Military munitions and military munitions-related materials, including wholly inert components (e.g., fins, launch tubes, containers, packaging material), that are to be used or reused for their intended purpose and are within a DoD Component-established munitions management system. Non-munitions-related material (e.g., horseshoes, rebar, other solid objects), munitions related solid metal fragments that do not realistically present an explosive hazard. Other items that may present explosion hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions.

**Maximum Credible Event (MCE)**—In hazards evaluation, the MCE from a hypothesized accidental explosion, fire, or toxic chemical agent release (with explosives contribution) is the worst single event that is likely to occur from a given quantity and disposition of AE. The event must be realistic with a reasonable probability of occurrence considering the explosion propagation, burning rate characteristics, and physical protection given to the items involved. The MCE evaluated on this basis may then be used as a basis for effects calculations and casualty predictions.

**Maximum Fragment Distance**—The calculated maximum distance where a fragment from the cylindrical portion of an AE case is expected to be thrown by the design mode detonation of a single item. This distance does not address fragments produced by sections of nose plugs, base plates, boattails, and/or lugs. These special fragments, from the non-cylindrical portions of the
AE case, can travel to significantly greater distances (i.e., >10,000 feet) than the calculated maximum distances. The maximum fragment distance may also be the measured distance, based on testing, where any fragment from an AE item is thrown.

**Military Munitions**—All ammunition products and components produced or used by or for the U.S. DoD or the U.S. Armed Services for national defense and security, including military munitions under the control of the DoD, the U.S. Coast Guard, the U.S. DOE, and the National Guard personnel. The term “military munitions” includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by the DoD Components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. “Military munitions” do not include wholly inert items, IEDs, and nuclear weapons, nuclear devices, and nuclear components thereof. However, that term does include nonnuclear components of nuclear devices, managed under the DoE’s nuclear weapons program, after all required sanitizing operations under the “Atomic Energy Act of 1954,” as amended, have been completed (40 CFR Part 260.10, reference (am)).

**Military Munitions Response Program (MMRP)**—A DoD developed program in 2001 to address munitions-related concerns, including explosive safety, environmental, and health hazards from releases of UXO, discarded military munitions (DDM), and munitions constituents (MC) found at locations other than operational ranges on active and Base Realignment and Closure (BRAC) installations and Formerly Used Defense Sites (FUDS). The MMRP addresses non-operational range lands with suspected or known hazards from munitions and explosives of concern (MEC) occurring prior to September 2002, but are not already included with an Installation Response Program (IRP) site cleanup activity.

**Mishap**—An accident or an unexpected event involving DoD AE.

**Mitigation**—A feature that reduces, limits or controls the consequences of an AE reaction.

**Modules**—A barricaded area composed of one or more connected cells (revetments) with hard surface storage pads separated from one another by the prescribed barricade. A light metal building may be used in individual cells.

**Multinational Operations**—A collective term to describe military actions conducted by forces of two or more nations, usually undertaken within the structure of a coalition or alliance. (JP 1-02. Source: JP 3-16)

**Munitions**—A complete device charged with explosives; propellants; pyrotechnics; initiating composition; or chemical, biological, radiological, or nuclear material for use in operations including demolitions. (JP 3-42)

**Munitions MHE**—(MMHE)—Powered or non-powered equipment specifically designed to interface with and/or support munitions shipping, storing, assembly/disassembly, transporting, loading, or unloading operations. MMHE must be certified by either the nuclear certification board or NNMSB. Nuclear certified items are certified for nonnuclear use.

**Munitions-Related Operations Road**—Any on-base road used only by personnel involved in munitions-related operations such as flightline service roads supporting combat and hot cargo
aerial operations; roads outside the MSA used by security forces supporting MSA operations; roads inside the MSA; roads around the CAPA used strictly to support combat aircraft operations. These roads are exempt of QD criteria.

**Munitions Residue**—Includes scrap powder, initiating or sensitive explosives, sweepings from explosive operations, and explosive contaminated rags.

**Munitions Response**—Response actions, including investigation, removal actions, and remedial actions to address the explosives safety, human health, or environmental risks presented by UXO, DMM, or MC, or to support a determination that no removal or remedial action is required. Munitions response actions/activities are those actions conducted on munitions response areas (MRA), and munitions response sites (MRS), or formerly used defense sites (FUDS) per 32 CFR Part 179, Munitions Response Site Prioritization Protocol (MRSSP).

**Munitions Response Chemical Safety Submission (MRCSS)**—An MRCSS (also referred to as a chemical safety submission or CSS) that addresses the potential effects of an inadvertent release of chemical agent from a chemical munition or from a configuration that is not a munition during munitions response activities (e.g., intrusive field work). In addition, involves either the intentional physical contact with MEC (i.e., chemical munitions) or chemical agents in other than munitions configurations, or the conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain MEC or chemical agents in other than munitions configurations. When explosive hazards are known or suspected to exist along with chemical agent hazards within a response area (e.g., the munitions response area (MRA) or munitions response site), a submission that addresses both explosives and chemical agent safety is required.

**Munitions Response Explosives Safety Submission (MRESS)**—An MRESS (also referred to as an explosives safety submission, or ESS) addresses explosives safety requirements for munitions responses (e.g., field activities) that involve the intentional physical contact with MEC or the conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain MEC. A DoD Explosives Safety Board (DDESB) approved document that ensures all applicable DoD explosives safety standards are specified prior to a military munitions response activity and that details the scope of the project, the planned work activities, and potential hazards (including the MCE), and the methods for their control to ensure material potentially posing an explosives hazard (MPPEH) is remediated to a level that is safe for current or reasonably anticipated future land use.

**Munitions Response Explosives Site Plan**—A plan required for MRS investigations or characterizations that involve intentional physical contact with MEC or CAs, regardless of CA configuration. MRS investigation and characterization are used to collect the information needed to design the required munitions response and to prepare, as appropriate, an MRESS or MRCSS for the selected response.

**Navigable Streams**—Those parts of streams, channels, or canals capable of being used in their ordinary or maintained condition as highways of commerce over which trade and travel are, or may be, conducted in the customary modes. Streams that are not capable of navigation by barges, tugboats, and other large vessels are not included, unless they are used extensively and regularly for the operation of pleasure boats.
Net Explosive Weight (NEW)—The total weight of all explosives substances (i.e., high explosive weight (HEW), propellant weight, and pyrotechnic weight) in the AE, expressed in pounds. NEW is used for transportation purposes.

Net Explosive Weight for QD (NEWQD)—The total quantity, expressed in pounds [kilograms], of HE equivalency in each item or round to be used when applying QD criteria or other standards. The NEWQD is equal to the NEW unless hazard classification testing has shown that a lower weight is appropriate for QD purposes. Note: If the NEWQD is less than the NEW, the reason is usually that propellant or other substances do not contribute as much to the blast effect as the same amount of HE would.

New Construction—for the intended purpose of this Manual “new construction” is the introduction of any facility “portable, temporary or permanent” inside the IB and must have an ESP accomplished and approved before authorizing construction or positioned in place.

Nitrogen Padding (or Blanket)—The nitrogen filled void or ullage of a closed container used to prevent oxidation or to avoid formation of a flammable mixture, or a nitrogen atmosphere in or around an operation or piece of equipment.

Non-Combustible Construction—Construction that uses materials that do not readily ignite and burn when exposed to fire (i.e., concrete, masonry, and metal structures are examples of non-combustible construction).

Non-DoD Components—Any entity (government, private, or corporate) that is not a part of the DoD.

Non-DoD Operations/Storage—Explosives operations/storage conducted on DoD property IAW Table 12.29, BATF, FAA or other federal, state, and local explosives safety requirements. Under these type operations, DoD will be responsible only for insuring IM standards are met as outlined in ESP submissions. This does not constitute “DoD oversight” as intended in the definition of “DoD Operations/Storage.”

Non-Enduring Location—A contingency location outside the US that supports and sustains operations during named and unnamed contingencies or other operations as directed by appropriate authority and is categorized by mission life-cycle requirements as initial, temporary, or semi-permanent.

Non-Essential Personnel—Individuals not necessary for the safe and effective completion of a specific explosives operation.

Non-Explosives Related Facility—Air Force-owned facility where administrative functions or operations are conducted that provide direct support to an Air Force explosives area or explosives operation.

Non—Hazardous Location—A location where fire or explosion hazards are not expected to exist specifically due to the presence of flammable gases or vapors, flammable liquids, combustible dusts, or ignitable fibers or filering’s.

Non-Robust Munitions—Those HD 1.1 and HD 1.2 AE that are not categorized as SG 1, SG 3, SG 4, or SG 5. Examples of Non-Robust Munitions include torpedoes and underwater mines (see also Sensitivity Group). For purposes of determining case fragment distances for intentional detonations, non-robust munitions are those munitions not meeting the definition of robust munitions.
Nuclear Weapon—A complete assembly (i.e., implosion type, gun type, or thermonuclear type), that upon completion of the prescribed arming, fuzing, and firing sequence, is capable of producing the intended nuclear reaction and release of energy.

Occupied Facility—A facility where personnel are usually present. Includes maintenance facilities, field offices, administrative facilities, etc. An occupied facility may at any given time not have personnel present. (See unoccupied facility.)

Operating Building—Any structure, except a magazine, where operations associated with AE are conducted (e.g., manufacturing, processing, handling, loading, or assembling).

Operating Line—A group of buildings, facilities, or related workstations so arranged as to permit performance of the consecutive steps of operations associated with AE (e.g., manufacture, loading, assembly, modification, or maintenance).

Operating Location—A building, facility, or site where operations pertaining to the manufacturing, processing, handling, or assembling of AE are done. This includes preload facilities for aircraft multiple and triple ejector racks. However, flightline explosives loading activities are defined as "explosives areas or locations" are not operating locations for siting purposes.

Operational Shield—A barrier constructed at a particular location or around a particular machine or operating station to protect personnel, material, or equipment from the effects of a localized fire or explosion.

Ordnance—Explosives, chemicals, pyrotechnics, and similar stores (e.g., bombs, guns and ammunition, flares, smoke, or napalm).

Outdoor Storage Sites—An open location selected within an explosives area or location for storage of explosive items or components.

Overpressure—The pressure resulting from the blast wave of an explosion referred to as “positive” when it exceeds atmospheric pressure and “negative” during the passage of the wave when resulting pressures are less than atmospheric pressure. (JP 3-11)

Packaging, Inner and Outer—Material used to surround and protect substances and articles during transportation and storage. They are generally made of lightweight materials such as fiberboard or fiberglass.

Passenger Railroad—Any steam, diesel, electric, or other railroad that carries passengers for hire.

Pier—A landing place or platform built into the water, perpendicular or oblique to the shore, for the berthing of vessels.

Portal Barricade—A barricade that is placed in front of an entrance into an underground storage facility. Its function is to reflect that portion of the shock wave moving directly outward from the entrance, thereby, reducing the pressures along the extended tunnel axis and increasing the pressures in the opposite direction. The result is a more circular IBD area centered at the portal.

Potential Explosion Site (PES)—The location of a quantity of AE that will create a blast, fragment, thermal, or debris hazard in the event of an accidental explosion of its contents.
Primary Fragment—A fragment from material in intimate contact with reacting AE.

Prohibited Area—A designated area at airfields, seadromes, or heliports where AE facilities are prohibited.

Prompt Propagation—See “Simultaneous Detonation.”

Propagating Explosion—The communication of an explosion (detonation or deflagration) from one potential explosion site to another by fire, fragment, or blast (shock wave), where the interval between explosions is long enough to limit the total overpressure at any given time to that which each explosion produces independently. This condition, where detonation occurs, would be evidenced by a distinct shock wave from each detonation, with a discernible pressure drop between each explosion (see "simultaneous detonation").

Public Exclusion Distance—The calculated distance from the toxic chemical agent source at which no more than 10.0, 4.3, and 150 milligrams per minute per cubic meter is present for GB, VX, and mustard, respectively, or the explosives safety IBD, whichever is greater.

Public Highway—Any public street, road, or highway used by the general public for vehicular traffic.

Public Traffic Route (PTR)—Any public street, road, highway, navigable stream, or passenger railroad, including roads on a military reservation that are used routinely by the general public for through traffic.

Public Traffic Route Distance (PTRD)—Distance to be maintained between a PES and a PTR exposure.

Qualified Receiver—Individuals or entities that have personnel who are trained and experienced in the identification and safe handling of used and unused military munitions, and any known or potential explosive hazards that may be associated with the MPPEH they receive; and are licensed and permitted or otherwise qualified to receive, manage, and process MPPEH.

Quantity-Distance (QD)—The quantity of explosive material and distance separation relationships that provide defined levels of protection. The relationships are based on levels of risk considered acceptable for specific exposures and are tabulated in applicable QD tables. These separation distances do not provide absolute safety or protection. Use greater distances than those in the QD tables, if practical.

QD Safety Submission (QDSS)—see Explosives Site Plan (ESP)

Radially Aligned—Two missiles are radially aligned if the fragment pattern from either warhead intersect (90° angle) the other warhead.

Railroad—See “Passenger Railroad.”

Ready Ammunition Storage—Location where AE is stored for near term tactical or training uses.

Ready Service Storage Facility—Holding area for AE limited to a maximum NEW of 22,000 lbs, located between hardened aircraft shelters.

Real Property—Lands, buildings, structures, utilities systems, improvements and appurtenances thereto. Includes equipment attached to and made part of buildings and structures (such as heating systems) but not moveable equipment (such as plant equipment)
**Reinforced Concrete Walls**—These concrete walls vary in thickness, but are at least 12 inches thick and constructed as specified in TM5-1300. Concrete compressive strength must be 2,500 psi or greater.

**Related Activity**—Activities directly associated with munitions storage or operations.

**Related Facility**—Any non-explosives facility closely supporting a PES. It does not include utilities.

**Renewable Energy Source Generation**—Equipment installed for the purpose of providing renewable energy, such as wind turbines and solar panel farms must be located beyond PTR distance. Any associated inhabited structures must be sited beyond IBD. Siting requests for these facilities must identify the energy customer and the equipment owner (i.e., Navy, commercial power company), and include a letter of risk acceptance from the owner for potential damage to equipment and power disruption, access routes for maintenance personnel and a HERO certification. Any associated power lines must meet the requirements of **paragraph 5.10**. This does not preclude the use of individual solar generated power units for lighting or security systems within ordnance areas, provided grounding and bonding is installed IAW **Chapters 5 and 6** and explosives safety site approvals are obtained.

**Residue**—See “Munitions Residue.”

**Responsible Commander**—The Commander(s) having responsibility for the resources under consideration.

**Revetment**—Barricades constructed to limit or direct a blast to reduce damages from low flying fragments and limit simultaneous detonation. Often used to form modules for open storage of munitions or protected aircraft parking.

**Risk**—Probability and severity of loss linked to hazards. (JP 5-0)

**Risk Assessment**—A method of determining and documenting hazards that may be present and controls for mitigating or eliminating those hazards.

**Robust Munitions**—AE that meet two of the following criteria: 1) Have a ratio of the explosive weight to empty case weight less than 1.00. 2) Have a nominal wall thickness of at least 0.4 in. 3) Have a case thickness/NEWQD$^{1/3} > 0.05$ in/lb$^{1/3}$. (e.g. 20mm, 25mm, and 30mm cartridges, GP bombs, artillery projectiles, and penetrator warheads) (See also Sensitivity Group). For purposes of determining case fragment distances for intentional detonations, Robust Munitions are those that meet the definition above, or meet the definition of Fragmenting Munitions. (See also Extremely Heavy Case Munitions and Fragmenting Munitions.)

**Rock Strength**—Designations (e.g., strong, moderately strong or weak rock) that provide a general classification of rock types.

**Runway**—Any surface on land designated for aircraft takeoff and landing operations or a designated lane of water for takeoff and landing operations of seaplanes.

**Safe Haven**—On-installation parking for emergency situations such as, but not limited to, vehicle breakdown, driver illness, terrorist or criminal suspicious activity, civil disturbance, or natural disaster. A temporary storage granted to DOE classified shipment transporters at DoD facilities in order to assure the safety and security of nuclear material and/or nonnuclear
classified material. It also includes parking for commercial vehicles containing Class 1 explosives.

**Scuttling Site**—A designated area of water for positioning a ship for its flooding or sinking under emergency situations.

**Secondary Fragment**—Fragments produced by the impact of primary fragments or air blast into surrounding structures, AE or earth.

**Secretarial Exemptions or Certifications**—A written authorization granted by the Service Secretary for strategic or compelling operational reasons that permits long-term noncompliance with a mandatory requirement of DoD explosives safety criteria.

**Secure Hold**—On-installation parking for after-hours AA&E arrivals during non-emergency circumstances. Secure hold must meet constant surveillance requirements through either driver attended, installation security forces, or enclosed fenced area with monitored CCTV.

**Secure Non-Explosives Holding Area**—An area designated for the temporary parking of commercial carriers' motor vehicles transporting Categorized DoD Arms, classified (SECRET or CONFIDENTIAL) materials, and CCI. (See Part 205 of reference (ab)).

**Sensitivity Group (SG)**—A category used to describe the susceptibility of HD 1.1 and HD 1.2 AE to sympathetic detonation (SD) for the purpose of storage within a HPM, or where revetments or SDW are used to reduce MCE. Each HD 1.1 and HD 1.2 munition is designated, based on its physical attributes, into one of five SG (the SG can be found in the JHCS); directed energy weapons are further identified by assigning the suffix “D” following the SG designation. The SGs are: **SG1** – Robust munitions (see Robust Munitions). **SG2** – Non-robust munitions (see Non-Robust Munitions). **SG3** – Fragmenting munitions (see Fragmenting Munitions). **SG4** – CBU weapons (see Cluster Bomb/Dispenser Unit munitions). **SG5** – SD Sensitive Munitions. Munitions for which HPM non-propagation walls are not effective. Munitions are assigned to SG5 when either very sensitive to propagation or the sensitivity has not been determined. 

**Note:** For purposes of determining case fragment distances for intentional detonations, SG1 items will be either Robust or Extremely Heavy Case Munitions, SG3 items are considered Robust Munitions, and SG2, SG4, and SG5 munitions are considered Non-Robust Munitions.

**Service Magazine**—An auxiliary building servicing an operation used for the intermediate storage of explosives.

**Shared Launch Facility**—Any space or orbital launch facility that supports both DoD and non-DoD launch services and operations, as determined by the DoD Component involved or by mutual agreement when multiple DoD Components are involved.

**Ship or Barge Units**—Combination of AE ships (including submarines at berth), barges or piers/wharves not separated by required IMD.

**Sideflash**—The phenomenon where lightning current will arc through a non-conductive medium in order to attach to other objects. An electrical spark caused by differences of potential that occurs between conductive metal bodies or between such metal bodies and a component of the LPS or earth electrode system.

**Simultaneous Detonation**—The detonation of two or more items that are near each other, with one item detonating after the next, and with such short intervals between detonations, that the
overall detonation appears to have emanated from a single item. Pressures produced by these independent detonations grow together (coalesce) within very short distances from their sources to cause peak overpressures greater than that of each independent source. Preventing simultaneous detonation is equivalent to providing IMD.

**Single-Chamber Storage Site**—An excavated chamber with its own access to the natural ground surface that is not connected to any other storage chamber.

**Source Emission Limits**—The amount of toxic chemical agent that may be released at a particular point that allows for natural dilution, ventilation, and meteorological conditions.

**Spall**—The material broken loose from any surface of an acceptor chamber or cell by a shock wave transmitted through the wall. Spall is also used to describe this process.

**Staging for Space Launch**—Staging of LSRM segments refers to a condition/configuration of the Solid Rocket Motor (SRM), while it remains in the Motor Operations and Staging Facility, until the launch complex is ready to receive it.

**Standoff Distance**—Minimum separation distance between a wall or barrier and the edge a stack of AE.

**Static Missile Battery**—Deployed ground-based missiles meant to be employed in a non-mobile mission for offensive or defensive purposes.

**Static Motor Firing**—Intentional ignition or initiation (via the design mode of ignition or initiation) of a motor (liquid or solid propellant) on a static test stand where the test item is restrained from becoming propulsive, or on a rail sled where propulsive movement of the test item is controlled to a defined path.

**Static Test Stand**—Locations where liquid energetic engines or solid propellant motors are tested in place.

**Strike Termination Device or System**—A component or feature of a LPS intended to intercept lightning strikes. They may include overhead wires or grids, air terminals, or a building’s grounded structural elements.

**Substantial Dividing Walls**—These walls are normally used between bays to prevent propagation of an explosion from one bay to the other. They provide limited personnel protection. They are made of reinforced concrete at least 12 inches thick. The reinforcing consists of #4 bars (1/2 inch), or larger, on 12 inch centers each way on each wall face. The bars on the two wall faces are staggered with respect to each other (e.g., vertical bars on one face start 12 inches from the end and on the other face they start 6 inches from the end). Similarly, horizontal bars on one face start 12 inches from the floor and on the other face they start 6 inches from the floor.

**Support Facilities**—Facilities that support AE operations (e.g., field offices, AE support equipment maintenance, forklift charging stations, dunnage storage, or inert storage buildings).

**Surge Suppression/Protection**—The attenuation, suppression or diversion of lightning induced electrical energy to ground.

**Suspect Truck and Railcar Holding Areas**—A designated location for placing motor vehicles or railcars either containing AE that are suspected of being in a hazardous condition or motor vehicles or railcars that may be in a condition that is hazardous to the AE.
Sympathetic Detonation (SD)—The detonation of AE produced by the detonation of adjacent AE.

SD Sensitive Munitions—Munitions for which HPM non-propagation walls are ineffective. AE are assigned this category when either very sensitive to propagation or the sensitivity has not been determined.

Tactical Facilities—Prepared locations with an assigned combat mission (e.g., missile launch facilities, alert aircraft parking areas, or fixed gun positions).

Taxiway—Any surface designated as such in the basic airfield clearance criteria specified by a DoD Component publication or Federal Aviation Regulation.

Technical Support Area for Space Launch—A personnel work station located inside a Motor Operations and Storage Facility, or an explosives operating facility. It provides a work location for test team personnel who are directly supporting operations involving explosive components.

Toxic Chemical Agent—A substance that is intended for military use with lethal or incapacitating effects upon personnel through its chemical properties. Excluded from toxic chemical agents for purposes of this Standard are riot control agents, chemical herbicides, smoke- and flame-producing items, and individual dissociated components of toxic chemical agent munitions.

Toxic Chemical Agent Accident—Any unintentional or uncontrolled release of a toxic chemical agent as follows: 1) Reportable damage occurs to property from contamination, or costs are incurred for decontamination. 2) Individuals exhibit physiological symptoms of toxic chemical agent exposure. 3) The toxic chemical agent quantity released to the atmosphere is such that a serious potential for exposure is created by exceeding the applicable AEL for unprotected workers or the general public or property.

Toxic Chemical Agent MCE—The hypothesized maximum quantity of toxic chemical agent that could be accidentally released from AE without explosive contribution, bulk container, or process as a result of a single unintended, unplanned, or accidental occurrence. It must be realistic with a reasonable probability of occurrence.

Toxic Chemical Munitions—AE that through its chemical properties, produces lethal or other damaging effects to human beings, except that such term does not include riot control agents, chemical herbicides, smoke and other obscuration materials (40 CFR Part 266.201 and 50 USC Section 1521 (j) (1)).

Transferred Within or Released from DoD Contro—A receiver has acknowledged receipt of MDEH or MDAS material by signed documentation (e.g., DD Form 1348-1A, “Issue Release/Receipt Document,” or an equivalent document) and has taken physical custody of the MDEH or MDAS.

Transportation Mode—Any in-transit movement of explosives by any mode (rail, highway, air or water).

Ufer Ground—An earth electrode system that consists of solid conductors encased along the bottom of a concrete foundation footing or floor and is in direct contact with earth.
Underground Storage Facility—Underground Storage Facilities may consist of a single chamber or a series of connected chambers and other protective construction features. The chambers may be either excavated or natural geological cavities.

Unexploded Ordnance (UXO)—Explosive ordnance that has been primed, fuzed, armed or otherwise prepared for action, and has been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installations, personnel or material and remains unexploded either by malfunction or design or for any other cause.

Unit Risk—The risk to personnel or facilities that is associated with debris, fragment or blast hazards that is the result of the detonation of a single round of AE.

United States (US)—The States, the District of Columbia, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa; and the Commonwealth of The Northern Mariana Islands, Johnston Atoll, Kingman Reef, Midway Island, Nassau Island, Palmyra Island, Wake Island and any other territory or possession over which the US has jurisdiction, and associated navigable waters, contiguous zones, and ocean waters of which the natural resources are under the exclusive management authority of the US.

Unoccupied Facility—A facility where personnel are not usually present. Includes magazines, unmanned sewerage treatment plants, hardened aircraft shelters, etc. An unoccupied facility may at any given time have personnel present. (See occupied facility.)

Utilities—Utilities include water, natural gas, steam, air lines, electrical lines, communication lines and environmental facilities or equipment. The term “Utility” does not apply to services provided to individual or group explosives facilities when that service is not also secondarily provided to other parts of the installation or community (this includes underground POL lines servicing hardened aircraft shelters).

Vulnerable Construction—Buildings of vulnerable construction (e.g., schools, high-rise buildings, restaurants, large warehouse-type retail stores) are of three main types: 1) Buildings of curtain wall construction that have four stories or more and are constructed with external non-load bearing panels on a separate sub-frame that are supported off the structural frame or floors for the full height of the building. 2) Buildings of largely glass construction that have four stories or more and have at least 50 percent of their wall areas glazed. 3) The third type of vulnerable construction is impracticable to define precisely. This covers any large building that employs non load-bearing cladding panels. Definition of this type of construction cannot be more precise because of the variation in types of modern structures.

Waiver—Written authority to temporarily deviate from requirements of this Manual when situations occur without sufficient time to comply with formal site planning procedures.

Warehouse—These are facilities for storing material and supplies where personnel are infrequently present. The material may, or may not be associated with AE. Facilities must be sited as warehouses if they are used to store inert munitions components as part of the accountable munitions stockpile.

Waste Military Munition—Military munitions are waste when they are solid or hazardous waste under the regulations (42 U.S.C. 9601, et seq., reference (ao)) implementing 40 CFR Subpart EE Part 264, reference (am) RCRA, or defined as a waste under a DoD Component’s written procedures. Waste military munitions are defined in 40 CFR Part 266.202. (Note:
Make decisions about whether specific munitions are or are not waste with reference to of 40 CFR Part 260.10 and Parts 266.200 through 266.206. An unused military munition is a solid waste when any of the following occurs: 1) The munition is abandoned by being disposed of, burned, detonated (except during intended use), incinerated, or treated before disposal. 2) The munition is removed from storage in a military magazine or other storage area for the purpose of being disposed of, burned, or incinerated, or treated prior to disposal. 3) The munition is deteriorated or damaged (e.g., the integrity of the munition is compromised by cracks, leaks, or other damage) to the point that it cannot be put into serviceable condition, and cannot reasonably be recycled or used for other purposes; or, 4) An authorized military official has declared the munition a solid waste. (Note: Declaration by an “authorized military official” that munitions are waste (40 CFR Part 266.202(b) (4)) has a very limited meaning and applicability. The only example is a declaration by the Army in 1984 that M55 rockets are waste. The Environmental Protection Agency expects that such a declaration would be in writing. A decision that munitions are unserviceable, or that they are to be transferred into a demilitarization account does not, by itself, constitute a decision that the munitions are solid waste). A used or fired military munition is a solid waste if: 1) when transported off range or from the site of use, where the site of use is not a range, for the purposes of storage, reclamation, treatment, disposal, or treatment before disposal; or, 2) if recovered, collected, and then disposed of by burial, or land filling either on or off a range. For the RCRA (Section 1004(27) of reference (am), a used or fired military munition is a solid waste, and, therefore, is potentially subject to RCRA corrective action authorities under Section 3004(u) and 3004(v), and 3008 (h) of reference (am), or, imminent and substantial endangerment authorities under Section 7003, of reference (am) if the munition lands off-range and is not promptly rendered safe and/or retrieved. Any imminent and substantial threats associated with any remaining material must be addressed. If remedial action is not possible, the operator of the range must maintain a record of the event for as long as any threat remains. The record must include the type of munition and its location (to the extent the location is known). (For further clarification see 40 CFR Part 266.202 under “Definition of Solid Waste.”)

**Wharf**—A landing place or platform built into the water or along the shore for the berthing of vessels.

**Wharf Yard**—An AE area close to a pier or wharf where railcars or trucks are temporarily held in support of pier or wharf operations.

**Wingwall**—A wall located on either side of an ECM's headwall. It may slope to the ground or may join a wingwall from an adjacent ECM. It may be monolithic (of single construction) or separated by expansion joints from the headwall. The purpose of a wingwall is to retain the earth fill along the side slope of an ECM.

**With its own means of initiation**—An AE item with its normal initiating device, such as a detonator or detonating fuze, assembled to it or packed with it, and this device is considered to present a significant risk during storage and transport, but not one great enough to be unacceptable.

**Without its own means of initiation**—An AE item without its normal initiating device assembled to it or packed with it. The term also applies to an AE item packed with its initiating device, provided the device is packed so as to eliminate the risk of causing detonation of the AE item in the event of accidental functioning of the initiating device. In addition, the term applies
to an AE item assembled with its initiating device provided there are protective features such that the initiating device is very unlikely to cause detonation of the AE item under conditions that are associated with storage and transport. For hazard classification purposes, a means of initiation that possesses two independent effective protective features is not considered to present a significant risk of causing the of an AE item under conditions associated with storage and transport.

**Zone of Protection**—The space beneath the LPS that is substantially immune to direct lightning.
MEMORANDUM FOR NAF/SEW

FROM: 3415 TTW/CC
867 Bourbon St
Lowry AFB, CO 80230-5309

SUBJECT: Explosives Site Plan (ESP) Submission, ATC-LOWRY-10-S001, WITH EXCEPTIONS, Aboveground Magazine (AGM) 433, Lowry Air Force Base, CO

1. Request routine processing and final approval of subject site plan for increasing net explosives weight for quantity distance (NEWQD) limits for an existing AGM. Once approved, this ESP replaces ESP ATC-LOWRY-87-S008. This facility does not comply with all explosives safety standards. There are exceptions associated with this ESP. This ESP has been coordinated with the base comprehensive plan; there are no future plans that impact this ESP. The following information is provided for analysis purposes.

a. This ESP sites an AGM for storage of AE. The requested NEWQD for each hazard division (HD) is as follows:

<table>
<thead>
<tr>
<th>Facility</th>
<th>HD 1.1</th>
<th>HD 1.2.1</th>
<th>HD 1.2.2</th>
<th>HD 1.2.3</th>
<th>HD 1.3</th>
<th>HD 1.4</th>
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<tbody>
<tr>
<td>433</td>
<td>2,500</td>
<td>800&lt;99</td>
<td>125,000</td>
<td>(06) 125,000&lt;450</td>
<td>125,000</td>
<td>Capacity</td>
</tr>
</tbody>
</table>

b. The attached AF Form 943 and map documents all paired potential explosion site (PES) and exposed site relationships within the IBD clear zone.

c. This ESP was accomplished using the Automated Explosive Safety Siting Program, Version XX (Current Version).

d. The required evaluation zone (EZ) of 874 feet falls within the IBD clear zone, therefore is not depicted on the location map. The EZ was based on K11 for 500,000 pounds NEWQD of HD 1.1 IAW AFMAN 91-201, Table 14.1.

e. A glass breakage survey determined there are occupied facilities containing windows within IBD of this magazine. Analyses revealed no risk to personnel from glass breakage. Detailed analyses are attached.

f. There are no electromagnetic radiation hazards to AE at this magazine.

g. An LPS is installed. The LPS meets all criteria within AFMAN 91-201, Chapter 5. Drawings are attached.

h. Mixing quantities of HD 1.1, 1.2.x and 1.3 AE will comply with the requirements of DoD 6055.9-M, Volume 1.

i. This ESP has been coordinated with all applicable agencies. There are no tenant units exposed by this magazine.

2. There are two paired relationships where QD criteria cannot be met. Use of compensatory measures cannot negate these exceptions. As a result, there are two exemptions, NAF-LOWRY-10-E01 and ATC-LOWRY-10-E01, that require NAF and MAJCOM approval respectively. All information pertaining to these exceptions are contained in the attached nomographs.

3. Should you have additional questions or concerns, please contact 3415 TTW/SEW, at DSN: 926-2666 or email: 3415TTW.SEW@lowry.af.mil.

ELISHA A. MANNING III, Col, USAF
Commander

6 Attachments:
1. AF Form 943  
2. Location Map  
3. LPS Drawings  
4. Glass Breakage Analyses  
5. NAF-LOWRY-10-E01, Exception Decision Nomograph and Narrative  
6. ATC-LOWRY-10-E01, Exception Decision Nomograph and Narrative
SAMPLE NARRATIVE FOR AIR FORCE QD EXCEPTION REQUEST

Figure A3.1. Exception Decision Nomograph – Operations.

Title: ATC-LOWRY-10-E01
Type: ILD
Standards Not Met
Detail the requirements that cannot be met.

Justification
State the strategic or compelling operational reason(s) for the exception.

Alternatives
List option(s) that were considered and discounted. Provide rationale that precluded implementation.

Control Measures
Discuss measures implemented to reduce associated risk or plans to eliminate the exception.

Risk Assessment

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<th>PES Facility Number</th>
<th>ES Facility Number</th>
<th>Number of Personnel</th>
<th>Required K-Factor</th>
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<th>Required Distance</th>
<th>Actual Distance</th>
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<td>0M 0C</td>
<td>K18</td>
<td>15.9</td>
<td>245'</td>
<td>216'</td>
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</tbody>
</table>

Notes:
1. Direct propagation of explosion is not expected.
2. Propagation of an explosion may occur at the ES, as either a direct result of a fire or as a result of equipment failure.
3. Unstrengthened buildings' damage may approximate 50 percent, or more, of the total replacement cost. Sensitive electronic equipment is expected to stop functioning.
4. Personnel may suffer serious injuries from fragments, debris, firebrands, or other objects. There is a two percent chance of eardrum damage to personnel.
5. Transport vehicles will incur extensive, but not severe, body and glass damage consisting mainly of dishing of body panels and cracks in shatter-resistant window glass.
Attachment 4

SELECTED SECRETARY OF THE AIR FORCE EXEMPTIONS

Figure A4.1. Example SECAF Exemption Memorandum.

MEMORANDUM FOR AF/SE
SUBJECT: SECAF Exemption to Explosives Quantity-Distance (QD) Standards at Aviano AB Allowing for Construction of a US Army Heavy Drop Rigging Complex

1. Commanders in United States Air Forces in Europe and United States Army Europe are required to enhance the support of joint DoD operations during times of contingency. To this end, the US Army has asked to build a new Heavy Drop Rigging Complex (HDRC) at Aviano AB to enhance 173rd Airborne Brigade deployment activities. The proposed eight construction projects associated with this complex are less than the required explosives QD separation standards prescribed in DoD 6055.09-M and AFMAN 91-201 for 44 paired relationship explosives safety evaluations.

2. The departures from the safety standards involve insufficient separation between the proposed structures and the installation boundary and between USAF and USA explosives and non-explosives locations. The most serious of these departures is to the base boundary. Italian civilians in fields adjacent to the base boundary are at risk of death should an explosive mishap occur at either of the US Army HDRC explosives structures. Although the fields adjacent to the base boundary are currently used for agriculture, and are infrequently occupied by civilians, residential or business development of this land would increase the number of civilians in harm’s way. It is my understanding; however, that a restrictive easement has been approved by the Italian regional panel limiting civilian exposure to risk by freezing use of the land at current levels, and prohibiting future development.

3. After due consideration, I find that compelling operational requirements necessitate deviation from DoD explosives QD standards with regard to the location of a new US Army HDRC at Aviano AB. Based on the concurrence provided by the highest US Army approval authority for explosives safety exemptions, DASA (I & E), and the absence of viable alternatives, I conclude that exemptions for the US Army HDRC are appropriate, and approve the start of this US Army-funded project.

4. I hereby approve the exemptions for the eight US Army HDRC locations. Permanent copies of this memorandum will be maintained at AFSEC/SEW, USAFE- AFAFRICA, and Aviano AB. This exemption will be reviewed every five years at the appropriate level for the continued use of this exception IAW AFMAN 91-201 and to verify the continued accuracy of the risk assessment provided.

Note: Some offices and symbols have changed.
MEMORANDUM FOR AF/SE

SUBJECT: SECAF Exemption to Explosives Quantity-Distance (QD) Standards at Osan AB Allocating for Construction of Fighter Squadron Operations/ Aircraft Maintenance Facility Addition

1. Commanders in Korea have a requirement to enhance the support of combat aircraft operations during times of contingency and wartime operations. As a result, the expansion of aircraft support facility 1702 is required to enhance the 51st Fighter Wing's ability to maintain combat assets.

2. Based on the proposed expansion location and its proximity to three nearby 3rd generation hardened aircraft shelters, the required explosives QD separation standards as prescribed in AFMAN 91-201 are not met. As a result, personnel and assets located in the facility could be subjected to blast overpressure and fragmentation far in excess of those prescribed during exercise and contingency operations. Should a mishap occur at the closest of the three aircraft shelters, consequences to the building 1702 expansion could include up to five fatalities, serious injuries, mission interruption, and up to $500,000 in damage.

3. I have weighed the need for the 25th fighter squadron operations/aircraft maintenance facility expansion at Osan AB against the expected impact in the event of a mishap. In the absence of available alternatives, I conclude that an exemption for the construction of the aircraft support facility expansion is appropriate, and approve the expenditure of construction funds.

4. Permanent copies of this memorandum will be maintained at AFSEC/SEW, HQ PACAF, and Osan AB. This exemption will be reviewed every five years at the appropriate level for the continued use of this exception IAW AFMAN 91-201.
Attachment 5

QD GUIDANCE FOR ON-BASE ROADS

A5.1. QD Guidance for On-Base Roads. In order to prevent the generation of a significant number of QD exemptions, DoD 6055.09-M requirements allow the DoD components to establish procedures for assessing, documenting, and accepting the risks associated with application of QD criteria to on-base roads for on-base road relationships existing prior to 1 October 2000. QD criteria are based on the traffic density (PTR or IBD). After 1 October 2000, any changes to a PES increasing explosives safety risk, increasing QD arc, constructing a new PES, or constructing a new on-base road, requires application of QD criteria to on-base roads traveled by personnel not involved in munitions related operations. If QD criteria cannot be met, the formal exemption requirements of AFMAN 91-201 must be followed. (T-1).

A5.2. Sited PES/On-Base Road Relationships. For those sited PES/on-base road relationships existing prior to 1 October 2000; the following risk assessment and documentation are required to be accomplished: (T-1).

A5.2.1. On a copy of the installation map, identify the following:
   A5.2.1.1. All PESs having QD arcs (PTR or IBD based on traffic density) encompassing on-base roads traveled by personnel not involved in munitions-related operations.
   A5.2.1.2. The NEWQD of the above PESs.
   A5.2.1.3. The applicable QD arcs (PTR or IBD) of the above PESs based on the traffic density.
   A5.2.1.4. The segments of the applicable on-base roads passing through the above arcs.

A5.2.2. Perform a risk assessment of the relationships shown above IAW RM procedures. Some factors to consider include:
   A5.2.2.1. Operational necessity.
   A5.2.2.2. The operation being performed (e.g., static storage, maintenance, and production).
   A5.2.2.3. Operational activity cycles.
   A5.2.2.4. Alternate routes.
   A5.2.2.5. Traffic density.
   A5.2.2.6. Accident records.
   A5.2.2.7. Time interval of exposure.
   A5.2.2.8. Type and quantity of munitions in proximity to the area transited.
   A5.2.2.9. The closest distance from the area transited to the PES.
   A5.2.2.10. The need for installation-related personnel to transit the ESQD arc.

A5.2.3. Document the Commander’s risk acceptance through a formal memorandum and review upon change of the approval authority. (T-1). This memorandum must include the map showing the relationships for which he/she is accepting risk, a summary of the risk
assessment, and a statement that the subject relationships existing as of 1 October 2000. (T-1).

**A5.3. Risk Assessment and Documentation.** It is highly recommended that the above risk assessment and documentation be accomplished to accurately capture the relationships, existing as of 1 October 2000. The Commander’s risk acceptance and attached map must be included in amendments to site plans (for PESs existing prior to 1 October 2000), or referenced if previously submitted with another site plan amendment, that does not increase the QD arc. (T-1). As stated previously, after 1 October 2000, any changes to a PES that increases its QD arc, construction of a new PES, construction of a new on-base road, or increases traffic density requires application of QD criteria to on-base roads traveled by personnel not involved in munitions related operations (see paragraph 12.16.). (T-1).
**Attachment 6**

EXPLOSIVES SITE PLAN REVIEW ELEMENTS

Table A6.1. Site Plan Package Requirements.

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<th>Site Plan Package Requirements</th>
<th>N/A</th>
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<td>Statement of Reconciliation with Base Comprehensive Plans</td>
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<td>Statement of EMR Analysis</td>
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<td>Restrictive Easement (If Applicable)</td>
<td></td>
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<tr>
<td>Army/Navy Coordination (If Applicable)</td>
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<tr>
<td>Airfield Waivers (If Applicable)</td>
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</tbody>
</table>
### Table A7.1. MRESS Review Requirements.

<table>
<thead>
<tr>
<th>MRESS REVIEW REQUIREMENTS</th>
<th>BASE/SITE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UNIT</td>
</tr>
<tr>
<td></td>
<td>MAJCOM</td>
</tr>
<tr>
<td></td>
<td>COMMENTS</td>
</tr>
<tr>
<td><strong>1. BACKGROUND</strong></td>
<td></td>
</tr>
<tr>
<td>Verify:</td>
<td></td>
</tr>
<tr>
<td>- reason for the munitions response</td>
<td></td>
</tr>
<tr>
<td>- purpose of the MRESS</td>
<td></td>
</tr>
<tr>
<td>- project scope or range of actions</td>
<td></td>
</tr>
<tr>
<td>- significant differences or absence of munitions response activities within MRA or MRS are described</td>
<td></td>
</tr>
<tr>
<td><strong>2. MAPS</strong></td>
<td></td>
</tr>
<tr>
<td>Ensure submission contains:</td>
<td></td>
</tr>
<tr>
<td>- regional map of MRA or MRS</td>
<td></td>
</tr>
<tr>
<td>- map of munitions response area or areas</td>
<td></td>
</tr>
<tr>
<td>- map with ESQD arcs for HFD and MFR-H for unintentional and intentional detonations of MGFD</td>
<td></td>
</tr>
<tr>
<td>- map with ESQD arc for planned or established demolition area</td>
<td></td>
</tr>
<tr>
<td><strong>3. ESQD for MGFD</strong></td>
<td></td>
</tr>
<tr>
<td>Verify:</td>
<td></td>
</tr>
<tr>
<td>- selection of MGFD</td>
<td></td>
</tr>
<tr>
<td>- explanation of demolition requirements to include BIP, consolidated shots, and collection points</td>
<td></td>
</tr>
<tr>
<td>- maximum NEW is requested if consolidated shots are planned</td>
<td></td>
</tr>
<tr>
<td>- EMM explosives safety distances are provided with required shielding and 9-decibel protection</td>
<td></td>
</tr>
<tr>
<td><strong>4. TYPES OF MEC</strong></td>
<td></td>
</tr>
<tr>
<td>Verify:</td>
<td></td>
</tr>
<tr>
<td>- explanation of types of MEC expected to encounter</td>
<td></td>
</tr>
<tr>
<td><strong>5. START DATE</strong></td>
<td></td>
</tr>
<tr>
<td>- self explanatory</td>
<td></td>
</tr>
<tr>
<td><strong>6. MEC MIGRATION</strong></td>
<td></td>
</tr>
<tr>
<td>- description of existing naturally occurring phenomena that could cause migration or exposure of MEC</td>
<td></td>
</tr>
<tr>
<td>- procedure for monitoring/managing migration of MEC is provided</td>
<td></td>
</tr>
</tbody>
</table>
7. DETECTION EQUIPMENT AND RESPONSE TECHNIQUES

Verify:
- techniques for detection and removal of MEC are outlined
- types of detection equipment and areas of use are explained
- methods to establish expected detection capabilities are addressed, to include rationale for use and limitations of detection methods
- exclusion zone procedures are described
- QA/QC standards are described

8. DISPOSITION TECHNIQUES

Verify:
- planned engineering controls are adequately described
- disposition techniques (e.g., OB, OD, BIP, consolidated shots, incineration), if not previously explained, are described
- scrap determination and disposal procedures are covered

9. ENVIRONMENTAL, ECOLOGICAL, CULTURAL, AND OTHER CONSIDERATIONS

Verify:
- environmental, ecological, and cultural factors that impact the selected munitions response are addressed

10. TECHNICAL SUPPORT

Verify:
- any required UXO-technician or EOD support is provided

11. RESIDUAL RISK MANAGEMENT

Verify:
- LUCs to be maintained or implemented are listed
- any long-term management requirements are summarized

12. SAFETY EDUCATION PROGRAM

Verify:
- methods used to educate the public about MEC risks are addressed

13. STAKEHOLDER MANAGEMENT

Verify:
- stakeholder concerns are addressed

14. CONTINGENCIES

Verify:
- alternative actions to reduce the need to submit future amendments, if desired, are outlined

15. REFERENCES

- self-explanatory

1 Italicized items may or may not be required based on the munitions response.
Attachment 8

NO DOD ACTION INDICATED (NDAI) MRESS REVIEW ELEMENTS

Table A8.1. ESS Review Requirements.

<table>
<thead>
<tr>
<th>ESS REVIEW REQUIREMENTS</th>
<th>BASE/SITE</th>
<th>UNIT</th>
<th>MAJCOM</th>
<th>COMMENTS</th>
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<tr>
<td>1. BACKGROUND</td>
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<tr>
<td>Verify:</td>
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<tr>
<td>- site location,</td>
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<tr>
<td>description, and</td>
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<tr>
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<td>5. REFERENCES</td>
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<tr>
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