

CHAPTER 10

MILITARY OPERATIONS OTHER THAN WAR, CONTINGENCY AND COMBAT OPERATIONS

A. General

1. Full compliance with other chapters may not be possible during military operations other than war (MOOTW), contingency and combat operations. This Chapter sets the minimum levels of acceptable risk for ammunition operations supporting such operations. Services may establish implementing regulations that are more protective than this Standard. In situations involving combined or joint operations, the Commander-In-Chief of Unified or Specified Commands (CINC) or the U.S. Commander of a Joint Task Force will designate the Service explosives safety criteria to be used.

2. This Chapter provides operational flexibility not available in other parts of this Standard. The use of asset preservation criteria contained in this Chapter is intended to maintain mission capability; however, these reduced levels of protection may impair or delay mission capability in the event of an explosives accident. This chapter's explosives safety quantity-distance (Q-D) standards include the following two levels of protection:

a. Asset preservation distance. The distance that prevents propagation or reaction between potential explosion sites (PESs). (Assets at the exposed site {ES} are expected to be usable following an incident.)

b. Minimum separation distance. The distance that prevents prompt propagation; however, late time propagation of reactions between PESs is possible. (Mission capability will likely be impaired.)

B. Scope. The provisions of this Chapter apply only to:

1. Department of Defense (DoD) ammunition and explosives (A&E) activities associated with MOOTW, contingency, and combat operations outside the continental United States (OCONUS), its territories and its possessions, when permitted by host nation laws, per Status of Forces agreements.

2. CINC's, U.S. Commanders of Joint Task Forces or Service Component Commanders in the management of A&E during MOOTW, contingency and combat. When necessary, commanders may delegate certain explosives safety responsibilities to designated subordinate commanders to ensure appropriate controls.

3. Contingency and combat training within the Continental United States (CONUS) and OCONUS when specifically authorized by appropriate Service headquarters or Unified Commander. Prior to approval of this training, a risk analysis that thoroughly assesses asset preservation and identifies the risk associated with the training will be conducted. Q-D distances provided for asset preservation shall be used for training, except where Chapter 9 permits lesser distances to be used.

C. Risk Management. Consistent with operational requirements, it is DoD policy to manage risks associated with A&E. (See Chapter 1)

1. **Equivalent protection.** Exceptions to this chapter's standards are:

a. Situations where an appropriate level commander determines based on risk analysis that an acceptable degree of safety is provided.

b. Situations where the commander, based upon analysis, determines that the use of protective construction or other specialized safety features provides the required degree of safety.

2. **Risk analysis.** Risk analysis is a systematic procedure consisting of the following four steps:

a. An event analysis to identify and describe possible events such as the site, type of occurrence, probability and quantity of explosives;

b. An effects analysis of the dangerous effects of the possible events to persons in the surroundings such as blast pressure, fragmentation, and thermal hazards;

c. An exposure analysis of the places, protection and time history of possibly exposed persons in the hazardous areas; and

d. A calculation of the risk.

3. **Risk control.** Risk control is the action a commander takes to minimize acceptable risk. Such actions include:

a. Development, implementation, and enforcement of appropriate control measures that eliminate the hazard or reduce its risk.

b. Continuous evaluation of the effectiveness of those measures implemented.

D. Site plan process

1. **Site approval.** All explosives locations falling within the scope of this Chapter shall be approved by the DDESB or at the appropriate level of command (see paragraph B.2.), as outlined in sub-paragraph 2 below. Site plan packages shall be submitted for the following:

a. Storage locations.

b. Holding areas, such as basic load ammunition holding Areas (BLAHAs), flight line holding areas, port and railhead holding areas, and marshalling areas.

c. Handling and operating locations, such as ports, ammunition maintenance, repair, and renovation areas and sling out areas.

d. Forward arming and refueling points (FARPs).

e. Combat aircraft parking areas (CAPAs) and hot cargo parking areas.

f. Static missile batteries.

g. Locations used for the treatment or disposal (open burn or open detonation) of munitions. Exceptions are those locations used in an emergency response, for burning excess propellant resulting from munitions use, and those involved in direct-combat operations.

2. **Documentation requirements.** The type of documentation required will be determined by the operational situation and the type and duration of explosives operations conducted at the site or facility. The following general categories of operations apply:

a. **Contingency and combat training.**

(1) **Definition.** Those operations at permanent or recurrent locations that simulate combat environments using live A&E to simulate real-world operations to achieve training goals.

(2) **Documentation requirement.** Facilities or areas for training activities must have either a DDESB approved site plan or a risk analysis approved at the appropriate level, or both.

b. **Permanent.**

(1) **Definition.** Those facilities where operations are planned for more than 12 months.

(2) **Documentation requirement.** A DDESB approved site plan for such locations must be obtained once the CINC (or Service headquarters where appropriate) determines operations will require the facilities' use to exceed 12 months.

c. **Recurrent.**

(1) **Definition.** Includes facilities for periodic explosives operations such as deployments or other contingency responses. These locations may be planned using compensatory actions, such as facility evacuation or change-of-use, to minimize the risks involved by exposure to explosives operations. Use of such facilities shall be planned, coordinated, documented and approved before operations commence.

(2) **Documentation requirement.** These locations must have a DDESB (or appropriate level of command when applicable) approved site plan before commencing operations.

d. **Temporary.**

(1) **Definition.** Those facilities for operations that are either not expected to last for protracted periods of time (12 months or less) or are of such short-notice that advanced planning and approval are impossible.

(2) **Documentation requirement.** In all cases, a plan for the specific scenario shall be approved by the appropriate level commander. The plan shall detail the following:

(a) A risk assessment for the proposed operation. This assessment will weigh the need for the facility against the potential effect of a mishap in terms of mission impact, loss of resources, turnaround times, etc.

(b) Milestones for transitioning the function to a "permanent" type of operation or for the cessation of explosives operations.

3. **Site plan packages.** Site plan request packages shall contain the items (minimum requirements) listed below. Where operational requirements prohibit full documentation, as many of these requirements as possible will be included (At a minimum, all documentation will include a map or drawing, the NEW, and the Q-D arc).

a. A letter of transmittal that details the proposal, along with changes, modifications, or specific precautionary measures considered necessary.

b. Maps and drawings.

(1) Drawings of site plans at a scale of 1-inch equals not more than 400 feet, or metric equivalent. Drawings of a smaller scale may be necessary to properly reflect certain distances and

structure relationships within the area surrounding a given site. A reduction in scale in such instances is acceptable.

(2) When standard drawings (definitive) for a building or group of buildings exist that have been reviewed by the DDESB and declared acceptable, the definitive drawings are not required. In these cases, only a site plan is required noting the definitive drawings for each building or structure to be constructed.

(3) In the absence of suitable maps or drawings, information (e.g., sketches, photographs, or other information) required to clarify the request will be provided.

c. A drawing indicating the distances between the facility to be constructed, modified or used and other installation facilities, the installation boundary, public railways, and public highways, including power transmission and utility lines.

d. A document that identifies all other facilities or functions including their occupancy and use within the inhabited building distance (IBD) of the facility or location to be constructed, modified or used.

e. A description of hazardous materials or items to be in the PES or ES such as bombs, rockets, artillery ammunition, liquid propellants, or other items requiring protective measures of this Standard.

f. The quantities, classes, and divisions of ammunition, explosives, liquid and solid propellants, or other hazardous material proposed for the subject facility or location.

g. The anticipated personnel limits for the subject facility or location including a breakdown by room or bay when appropriate.

h. The general details regarding construction materials, lightning protection and grounding systems, electrical power, heating systems and hazardous materials.

i. A brief summary of the design procedures used if engineering protection is used to reduce the Q-D. This summary shall include a statement of the design objectives in terms of protection categories to be obtained, explosives quantities involved, design uploads applied, material properties and structural behavior assumptions, references, and sources of methods used. Detailed calculations are not required provided the protective designs used to reduce the Q-D have been approved by the DDESB. Design of explosion resistant facilities shall be accomplished by an organization or individual experienced in the field of structural dynamics using design procedures accepted by professionals in the field.

j. Information on the type and arrangement of explosives operations.

k. A topography map with appropriate contours when terrain features are considered to constitute natural barricading, or topography otherwise influences layout. When such are not available, sketches, photographs, or other items that will provide information for approval will be submitted.

l. An explanation of any deviations from pertinent safety standards caused by local conditions.

m. A copy of the risk analysis performed by the Service Component, if one was performed, to demonstrate equivalent protection.

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4. Approval authority for waivers and exemptions. The CINC, U.S. Commander of Joint Task Forces or Service Component Commander, for strategic and other compelling reasons may authorize waivers to the explosives safety standards herein for the planning or conduct of MOOTW, contingency, and combat operations. All waivers shall be coordinated with the host nation, as appropriate, and consistent with international agreements. A necessity to deviate from minimum Q-D standards as outlined elsewhere in this Chapter should not be construed as reason to conduct explosives operations with little or no planning or controls. **All operations require adequate documentation and approval from the appropriate level of command.**

a. Requests for waivers and exemptions to Q-D criteria will be per Service directives when only one Service is affected. When joint operations are being conducted from a single base or location, waivers and exemptions that affect another Service must be coordinated between the affected Service Component and approved by the designated Service Component Command.

b. Requests for waivers and exemptions to Q-D criteria shall contain the following:

(1) A risk analysis for the proposed operation weighing the need to conduct the operation and violate the standards against the potential effect of a mishap in terms of mission impact, loss of resources, turnaround times, etc.

(2) A timeline listing milestones which will eliminate the need for the waiver or exemption.

E. Technical assessment. The following paragraphs provide criteria for specific types of locations.

1. General:

a. When applying Asset Preservation distances use public traffic route (PTR) distance $D=9.5Q^{1/3}$ / $D=12Q^{1/3}$ (K24/K30) unless otherwise specified. At this distance, assets at an ES are expected to be usable following an incident at a nearby PES. For HD 1.1 apply $D=9.5Q^{1/3}$ / $D=12Q^{1/3}$ (K24/K30) and for HD 1.2, HD 1.3, and HD 1.4 apply the PTR distance from the appropriate tables in chapter 9. Note that Q is used to represent the explosive quantity in kilograms whereas W is used to indicate weight in pounds.

b. When using the Q-D criteria of this Chapter the fragmentation distance criteria contained in Chapter 2, paragraph E-2 shall be applied. Minimum fragment distance applies to facilities, locations, or supplies deemed critical to the mission. Housing (both DoD personnel and local national) and health and morale facilities (except those morale facilities that do not involve construction of buildings such as baseball diamonds, soccer fields, and running tracks or trails) are examples of such locations. For example, an above ground water supply in a desert environment should meet the fragment distance criteria in addition to the Q-D criteria contained in this Chapter. Where it is not possible to meet minimum fragment distance, engineering solutions such as sandbags and barricades may be used.

2. Basic load ammunition holding areas (BLAHAs).

a. **General.** To fulfill their missions, certain units must keep their basic load ammunition in readiness within the immediate vicinity of their barracks, in armored vehicles, trucks, trailers, structures, or on pads. This involves acceptance of risks to unit personnel, facilities, and equipment that are greater than permitted by other Chapters. The concept of BLAHA storage may also be used to provide Q-D separations during mobile operations.

b. **Mixing of basic load ammunition.** Storage compatibility requirements of Chapter 3 do not apply to BLAHA facilities.

c. **Net explosive quantity (NEQ) NEQ net explosive weight (NEW).** Net explosive quantity (NEQ) in kilograms (net explosive weight (NEW) in pounds) for use with BLAHA Q-D criteria will be determined as follows:

(1) The sum of the weights of all energetic compositions contained in munitions hazard classified as Hazard Division 1.1 or 1.5 will be used.

(2) The sum of the explosive weight of all Hazard Division 1.2 munitions will be used. The propellant weight of a Hazard Division 1.2 item (if present) may be disregarded.

(3) The weights of energetic compositions hazard classified as 1.3 may be omitted. If the site only contains Hazard Division 1.3 items the criteria contained in Chapter 9 applies.

(4) The weights of energetic compositions classified as Hazard Division 1.4 need not be considered for Q-D computations for BLAHA's.

(5) The explosives weight of Hazard Division 1.6 will be computed as follows:

(a) When Hazard Division 1.6 is stored alone or with Hazard Division 1.4 ammunition items, the Q-D criteria of Chapter 9 applies.

(b) When Hazard Division 1.6 is stored with ammunition classified as Hazard Division 1.1, 1.2 or 1.5 add the explosives weight of the 1.6 items into the NEQ calculations.

(c) When Hazard Division 1.6 is stored with ammunition classified as Hazard Division 1.3 add the explosives weights of Hazard Division 1.3 and Hazard Division 1.6. The Q-D criteria of Chapter 9 applies.

d. **Explosives limits.**

(1) The maximum NEQ (NEW) at any single site in a BLAHA storing mixed compatibility must not exceed 4,000 kg (8,800 lb). A single BLAHA may have multiple 4,000 kg (8,800 lb) sites, provided the BLAHA sites are separated by the appropriate D1, D2, or D3 distances given in Table 10-1.

(2) When the BLAHA or a site within a multiple bay BLAHA exceeds 4,000 kg (8,800 lb), the Q-D computations for that BLAHA site will be per with Chapter 9 and explosives compatibility storage criteria of Chapter 3 applies.

e. **Quantity-Distance (Q-D) Computations.**

(1) The total NEQ of ammunition in each site shall be used for computation of Q-D provided the required distances necessary to prevent propagation separate these sites. If the distances are not met the entire BLAHA shall be considered one site.

(2) The intermagazine separation requirements of Chapter 9 apply when using standard (3-bar or 7-bar) earth-covered magazines.

(3) Table 10-1 contains the Q-D separation for BLAHAs as explained below:

(a) Column D1 is used for:

1 Side-to-side, side-to-rear and rear-to-rear exposures between undefined earth-covered magazines (ECMs), provided the earth cover complies with paragraph C.4 of Chapter 5, and the explosives are stored at least one meter (3 feet) from the end of the shelter.

2 Non-armored sites to non-armored sites when an adequate barricade is located between the sites.

3 Light armored vehicles to non-armored ES's when an adequate barricade is present near the non-armored ES.

4 Light armor or non-armored PES's to light armored ES's when an adequate barricade is located between the sites.

(b) Column D2 is used for:

1 Front-to-front exposures involving undefined ECMs when there is an adequate barricade at the ES.

2 Non-armored or light armored sites to the side or rear of an undefined ECM.

(c) Column D3 is used for:

1 Non-armored sites to non-armored sites without an adequate barricade.

2 Light armored vehicles to non-armored sites without an adequate barricade at the non-armored site.

3 Undefined ECM's to undefined ECM's when positioned front-to-front and no barricade is present.

4 Non-armored sites, light armored sites or undefined ECM's to the front of undefined ECM's when no barricade is present at the ES.

(d) Column D4 is used for PTR separations from non-armored and light armored vehicles or sites.

(e) Column D5 is the IBD separation from non-armored and light armored vehicles or sites.

(f) Column D6 is used to determine the IBD and PTR separation from heavy armor vehicles. When NEQ exceeds 150 kg (330 lb) the IBD and PTR separation distances specified in chapter 9 apply.

(4) Heavy armored vehicles are expected to largely contain the blast and fragments from an internal explosion and are well protected from an external explosion. For this reason there is no required separation from heavy armor to light or non-armored ES's. Additionally, heavy armor requires no separation from other sites (heavy armor being the ES). The hatches of heavy armored vehicles must be kept closed to consider them as heavy armor.

(5) The Q-D requirements for heavy, light and non-armored vehicles or sites are contained in table 10-1A.

(6) Use $D=9.5Q^{1/3}$ / $D=12Q^{1/3}$ (K24/K30) instead of D1, D2 and D3 for asset preservation.

Table 10-1. Quantity-Distance for Basic Load Ammunition Holding Areas

NEQ	NE W	D-1	D-1	D-2	D-2	D-3	D-3	D-4	D-4	D-5	D-5	D-6	D-6
KG	LB	M	FT	M	FT	M	FT	M	FT	M	FT	M	FT
5	11	2	7	5	17	9	30	180	591	270	886	20	66
10	22	2	7	6	20	11	43	180	591	270	886	20	66
20	44	3	10	7	23	14	46	180	591	270	886	20	66
30	66	3	10	8	27	15	49	180	591	270	886	20	66
40	88	3	10	9	30	17	56	180	591	270	886	20	66
50	110	3	10	9	30	18	59	180	591	270	886	20	66
60	132	4	13	10	33	19	62	180	591	270	886	26	85
75	165	4	13	10	33	21	69	180	591	270	886	26	85
100	220	4	13	12	40	23	75	180	591	270	886	32	105
125	275	4	13	12	40	24	79	180	591	270	886	38	125
150	330	5	16	13	43	26	85	180	591	270	886	42	138
175	385	5	16	14	46	27	89	180	591	270	886		
200	440	5	16	14	46	29	95	180	591	270	886		
250	550	6	20	15	50	31	102	180	591	270	886		
300	660	6	20	16	53	33	108	180	591	270	886		
350	770	6	20	17	56	34	112	180	591	270	886		
400	880	6	20	18	60	36	118	180	591	270	886		
450	990	7	23	19	63	37	121	180	591	270	886		
500	1,100	7	23	19	63	39	128	180	591	270	886		
600	1,320	7	23	20	66	41	135	180	591	270	886		
700	1,540	8	26	22	73	43	141	180	591	270	886		
800	1,760	8	26	23	76	45	148	180	591	270	886		
900	1,980	8	26	23	76	47	154	180	591	270	886		
1,000	2,200	8	26	24	79	48	157	180	591	270	886		
1,200	2,640	9	30	26	86	52	171	180	591	270	886		
1,500	3,300	10	33	28	92	55	180	180	591	270	886		
1,750	3,850	10	33	29	96	58	190	180	591	270	886		
2,000	4,400	11	36	30	99	61	200	180	591	270	886		
2,500	5,500	11	36	33	109	66	217	180	591	270	886		
3,000	6,600	12	39	35	115	70	230	200	656	305	1,001		
3,500	7,700	13	43	36	119	73	240	215	705	330	1,083		
4,000	8,800	13	43	38	125	77	253	230	755	350	1,148		
Distance Functions		D1= 0.8Q ^{1/3}	K2	D2= 2.4Q ^{1/3}	K6	D3= 4.8Q ^{1/3}	K12	D4= 3.6Q ^{1/2}	8W ^{1/2}	D5= 5.5Q ^{1/2}	12.2W ^{1/2}		

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Table 10-1A. Quantity Distance for Armored Vehicles

FROM	TO				
	HEAVY	LIGHT	NON-ARMORED	PTR	IBD
HEAVY	N/R	N/R	N/R	D6	D6
LIGHT	N/R	D1	D3	D4	D5
NON-ARMORED	N/R	D1	D3	D4	D5
N/R = Not required					

3. Ports.

a. **General.** The following criteria shall apply to ports where A&E are off-loaded or on-loaded.

b. Required separations.

(1) Explosives piers.

(a) Aboveground intermagazine ($D= 4.4Q^{1/3}$, K11) distance shall be maintained between explosives piers.

(b) Intraline distance ($D= 7.1Q^{1/3}$, K18) shall be maintained from an explosives pier to a non-explosives pier used for the handling of military cargo.

(c) Aboveground intermagazine distance ($D= 4.4Q^{1/3}$, K11) shall be maintained to ammunition and explosives holding areas (A&E HA) based on the NEQ (NEW) at the pier.

(d) Marshalling Yards shall be located at PTR distance from explosives piers.

(e) Railheads used for long-term storage or as a transfer depot shall be sited at aboveground intermagazine ($D= 4.4Q^{1/3}$, K11) distance from an explosives pier, based on the NEW at the pier.

(2) **Explosives anchorages.** The criteria of Chapter 9 applies to the use of explosives anchorages, with the following exceptions:

(a) Intraline distance ($D= 7.1Q^{1/3}$, K18) shall be provided between the explosives loading or unloading section and the loaded ship section of an explosives anchorage.

(b) An explosives anchorage should be located at $D= 16Q^{1/3}$ (K40) distance from all piers. However, where necessary for security or navigational reasons, this distance may be reduced to intraline distance ($D= 7.1Q^{1/3}$, K18) when the piers are utilized for only DoD operations. PTR distance shall apply for asset preservation. A separation distance of $D= 16Q^{1/3}$ (K40) shall be maintained to all non-DoD related piers.

(c) Intraline distance ($D= 7.1Q^{1/3}$, K18) is permitted between an explosives anchorage and a non-explosives DoD related anchorage. A separation distance of $D= 16Q^{1/3}$ (K40) shall be maintained between an explosives anchorage and a non-explosives, non-DoD related anchorage.

(3) Explosives facilities.

(a) **A&E Holding Areas (HAs).** These holding areas are used in support of A&E on-loading and off-loading of ships. Typically, A&E being held at these locations is present for short term holding only. The NEQ (NEW) associated with the A&E HA is based on all A&E present at the site. The following apply to A&E HA:

1 Intraline distance ($D=7.1Q^{1/3}$, K18) shall be maintained to both explosives and non-explosives piers, based on the NEQ (NEW) present at the A&E HA.

2 PTR distance shall be maintained to a Marshalling Yard, either explosives or non-explosives.

3 Railheads used for A&E HA storage or as a transfer depot shall be sited at aboveground intermagazine distance ($D=4.4Q^{1/3}$, K11) from an A&E HA, based on the NEQ (NEW) at the A&E HA.

(b) **Marshalling Yards.** PTR distance shall be maintained between marshalling yards and explosives piers or A&E HAs the location of the marshalling yard will typically be governed by the NEQs (NEWs) at these other PESs. When operational necessity dictates, marshalling yards may be separated by intraline distance ($D=7.1Q^{1/3}$, K18) to nearby manned explosives operations and aboveground intermagazine distance ($D=4.4Q^{1/3}$, K11) to nearby unmanned explosives storage operations. The criteria of paragraph E.1 of this Chapter applies.

(c) **Railheads.** Railheads shall be sited on the basis of use, e.g., classification yard, holding area or loading dock.

(d) **Loading Docks.** Loading docks shall be sited at intermagazine distance ($D=4.4Q^{1/3}$, K11) from all ESs.

(e) **Classification Yards.** Use criteria provided in Chapter 5.

4. Field storage and handling areas.

a. **General.** Field storage and handling areas shall be sited per Table 10-2. Use separation distances from the applicable Q-D tables in Chapter 9 for the type and quantity of explosives involved with the PES.

b. **Field storage and handling area layouts.** Field storage and handling areas may consist of all or only some of the following areas:

(1) **Storage sections.** A location where A&E is stored. The principal objective of the field storage concept is the dispersion of ammunition to minimize loss in case of fire, accidental explosion, or enemy action. Each type of ammunition should be stored in multiple, widely separated storage sections to prevent the loss of any one section from seriously handicapping military operations. Storage section separation distances are designed to prevent simultaneous detonation from adjacent storage sections.

(2) **A&E staging area.** A&E staging areas are normally used as a holding area for outgoing A&E and for ready access to combat aircraft loading areas.

(3) **Captured enemy ammunition area.** A separate area shall be provided for the storage of captured enemy A&E. Captured enemy munitions that can not be identified shall be treated as Hazard Division 1.1.

(4) **A&E operations area.** An area used for operations such as minor maintenance and repair of A&E or their containers, surveillance, segregation, or weapons assembly.

(5) **A&E destruction area.** An area used for the destruction of A&E and may consist of a burning area or a demolition area.

(4) **A&E operations area.** An area used for operations such as minor maintenance and repair of A&E or their containers, surveillance, segregation, or weapons assembly.

(5) **A&E destruction area.** An area used for the destruction of A&E and may consist of a burning area or a demolition area.

(6) **Sling out area.** An area used for the movement of A&E by rotary wing aircraft.

(7) **Administration and billeting areas.** Inhabited locations not directly related to the daily operations of the field storage area.

(8) **Boundaries.** The clear zone surrounding the field storage area bound by the IBD arcs. No unrelated, occupied structures are permitted within these arcs.

(9) **Manned non-explosives support facilities.** Facilities that directly support A&E operations, such as field offices and A&E support equipment maintenance facilities.

(10) **Un-manned non-explosives support facilities.** Unmanned locations that support A&E operations such as forklift charging stations, dunnage storage, and buildings that store inert materials. A minimum 15 meter (50 foot) separation distance shall be maintained from these locations to PESs.

c. **Modular storage.** Modular storage refers to a barricaded area comprised of a series of connected cells separated from each other by barricades. The use the criteria in Chapter 5.

d. **Segregation of A&E.** A&E shall be segregated by storage compatibility groups per Chapter 3.

e. **Storage in existing facilities.** A&E may be stored in caves and tunnels as prescribed in Chapter 9.

f. **Barricades and revetments.** The construction and use of barricades and revetments shall be per Chapter 5.

g. **Commercial Intermodal Containers (CIC).** Containers used for transporting ammunition may be used for A&E storage and shall be sited as above-ground magazines. The containers may be sited individually or by groups.

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Table 10-2. Quantity-Distance for Field Storage and Handling Areas

From:	Storage Sections	A&E Staging Area	Captured Enemy Ammunition Area	A&E Operations Area	Sling Out Area	A&E Destruction Area
Storage Sections	IM	IM	PTR	IM	IM	IN ACCORDANCE WITH CHAPTER 5
	Note 2	Note 2	PTR	Note 2	Note 2	
A&E Staging Area	IM	IM	PTR	IM	IM	
	Note 2	Note 2	PTR	Note 2	Note 2	
Captured Enemy Ammunition Area	IM	IM	IM	IM	IM	
	Note 2	Note 2	PTR	Note 2	Note 2	
A&E Operations Area	IM	IM	PTR	IM	IM	
	Note 2	Note 2	PTR	Note 2	Note 2	
Sling-Out Area	NR	NR	PTR	IM	IM	
	Note 2	Note 2	PTR	Note 2	Note 2	
Administrative and Billeting Area	IBD	IBD	IBD	IBD	IBD	
	IBD	IBD	IBD	IBD	IBD	
Boundaries	IBD	IBD	IBD	IBD	IBD	
	IBD	IBD	IBD	IBD	IBD	
Manned Non-Explosive Support Facility	IL	IL	IBD	IL	IL	
	Note 2	Note 2	IBD	Note 2	Note 2	
Un-Manned Non-Explosive Support Facility	NR	NR	PTR	NR	NR	
	Note 2	Note 2	PTR	Note 2	Note 2	
A&E Destruction Area	IN ACCORDANCE WITH CHAPTER 5					

Notes for Table 10-2:

1. The distance criterion in the upper half of each row is the minimum separation distance in accordance with Chapter 9.
2. The distance criterion in the lower half of each row is the asset preservation distance. For HD 1.1 material apply $D=9.5Q^{1/3}$ / $D=12Q^{1/3}$ (K24/30) separation. For HD 1.2, 1.3, or 1.4 apply PTR distances from Chapter 9 tables.
3. IM= Intermagazine Distance
4. PTR= Public Traffic Route (Includes minimum fragment distance)
5. IL= Intraline Distance
6. IBD= Inhabited Building Distance (Includes minimum fragment distance)
7. NR= Not Required

5. Hardened Aircraft Shelters (HAS).

a. As a minimum, HASs and associated storage facilities shall be separated one from another according to Table 10-3. At these distances there will be 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 ammunition therein may be rendered unserviceable.

b. HAS and associated storage facilities spaced according to Table 10-4 will provide a higher degree of asset preservation than those provided in Table 10-3. An explosion in one shelter or ready storage facility may destroy it and its contents, but aircraft within adjacent shelters will be undamaged provided the doors are closed. These aircraft may not be immediately removable due to debris.

c. Areas of hazard to front, side, or rear of HASs or ECMs as PESs or ESs lie in the arcs shown in Figure 10-1. A particular face of an ES is threatened by a PES face when both of these faces lie within the arc of threat or hazard of the other.

d. When the PES is a third-generation HAS containing up to 5,000 kg (11,000 lb) NEQ (NEW) minimum distances from the front, sides, and rear given in Table 10-4A shall be used to protect an unhardened ES against debris and blast. The quantity-distance criteria given in Table 10-4 A apply to all Hazard Division 1.1 ammunition and explosives regardless of any minimum fragment distance denoted by (xx)1.1.

e. When operational necessity dictates, distances less than those contained in Tables 10-3 and 10-4 may be approved for ESs. However it must be shown that protection equivalent to K18 is being provided.

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Table 10-3. Minimum Quantity-Distance for Hardened Aircraft Shelters for Propagation Prevention

FROM PES TO ES		1ST GENERATION HAS			2ND AND 3RD GENERATION HAS (SEE NOTE)			READY SERVICE ECM				READY SERVICE AGM	
		S	R	F	S	R	F	S	R	FB	FU	B	U
1 ST GEN HAS	S	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}
	R	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}
	F	K6 2.4Q ^{1/3}	K4.5 1.8Q ^{1/3}	K8 3.2Q ^{1/3}	K6 2.4Q ^{1/3}	K4.5 1.8Q ^{1/3}	K9 3.6Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K6 (2) 2.4Q ^{1/3}	K9 (2) 3.6Q ^{1/3}	K6 2.4Q ^{1/3}	K9 (2) 3.6Q ^{1/3}
2 ND & 3 RD GEN HAS (SEE NOTE)	S	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}
	R	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}
	F	K4.5 1.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K5 2.0Q ^{1/3}	K4.5 1.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K6 2.4Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K1.25 (1) 0.5Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K2.75 (2) 1.1Q ^{1/3}	K6 2.4Q ^{1/3}	K2.75 1.1Q ^{1/3}
READY SERV ECM	S	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}						
	R	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2 0.8Q ^{1/3}	K2 0.8Q ^{1/3}	K2.75 1.1Q ^{1/3}						
	F B	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K5 2.0Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K6 2.4Q ^{1/3}						
	F U	K6 2.4Q ^{1/3}	K4.5 1.8Q ^{1/3}	K8 3.2Q ^{1/3}	K6 2.4Q ^{1/3}	K4.5 1.8Q ^{1/3}	K9 3.6Q ^{1/3}						
READY SERV AGM	B	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K6 2.4Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K6 2.4Q ^{1/3}						
	U	K11 4.4Q ^{1/3}	K11 4.4Q ^{1/3}	K11 4.4Q ^{1/3}	K11 4.4Q ^{1/3}	K11 4.4Q ^{1/3}	K11 4.4Q ^{1/3}						

Legend: ECM-earth covered magazine; AGM-above ground magazine; S-side; R-rear; F-front; B-barricaded; U-unbarricaded

Notes for Table 10-3:

- 1 Use $D=0.8Q^{1/3}$ (K2) if the loading density of the ECM exceeds 20 kg NEQ per cubic meter (1.25 lb NEW per cubic foot). Do not exceed the maximum NEQ (NEW) limit of 10,000 kg (22,000 lb).
- 2 If required, use the separation shown regardless of loading density. Do not exceed the maximum NEQ (NEW) limit of 10,000 kg (22,000 lb).
- 3 Second and third generation HASs are limited to a minimum of 5,000kg (11,000 lb) per shelter.

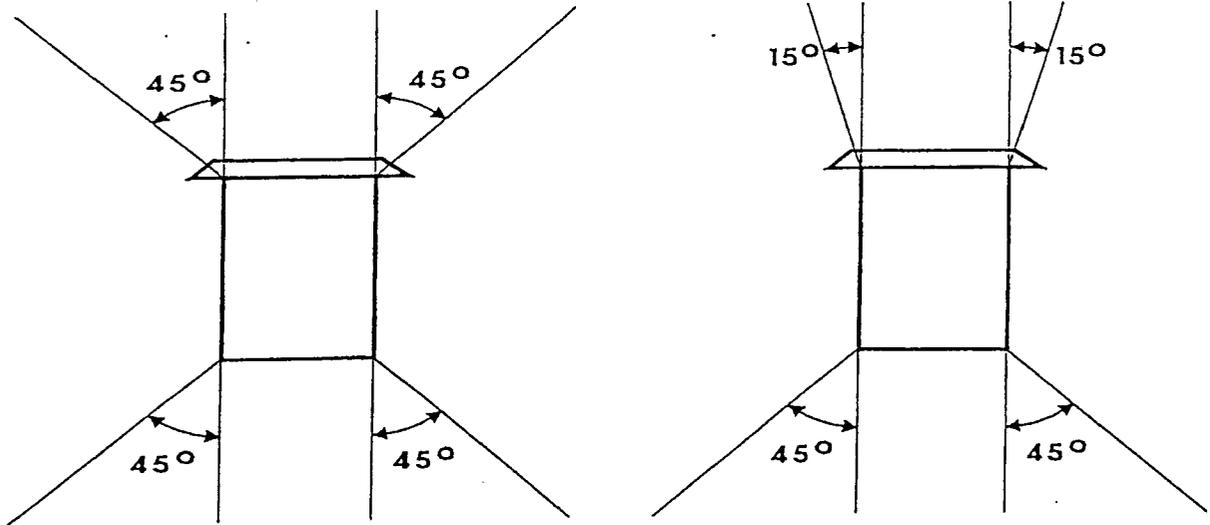
Table 10-4. Minimum Quantity-Distance for Hardened Aircraft Shelters for Asset Preservation

FROM PES TO ES	1ST GENERATION HAS			2ND AND 3 RD GENERATION HAS			READY SERVICE ECM (SEE NOTE)				READY SERVICE AGM		
	S	R	F	S	R	F	S	R	FB	FU	B	U	
1 ST GEN HAS	S	K9 3.6Q ^{1/3}	K6 2.4Q ^{1/3}	K9 3.6Q ^{1/3}	K9 3.6Q ^{1/3}	K6 2.4Q ^{1/3}	K9 3.6Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	R	K8 3.2Q ^{1/3}	K5 2.0Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K5 2.0Q ^{1/3}	K8 3.2Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	F	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K11 4.4Q ^{1/3}	K9 3.6Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}
2 ND & 3 RD GEN HAS	S	K9 3.6Q ^{1/3}	K6 2.4Q ^{1/3}	K9 3.6Q ^{1/3}	K9 3.6Q ^{1/3}	K6 2.4Q ^{1/3}	K9 3.6Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	R	K8 3.2Q ^{1/3}	K5 2.0Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K5 2.0Q ^{1/3}	K8 3.2Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	F	K11 4.4Q ^{1/3}	K9 3.6Q ^{1/3}	K18 7.1Q ^{1/3}	K11 4.4Q ^{1/3}	K9 3.6Q ^{1/3}	K18 7.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K2.75 1.1Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
1 ST GEN MAINT IAS (SEE NOTE)	S	K9 3.6Q ^{1/3}	K8 3.2Q ^{1/3}	K9 3.6Q ^{1/3}	K9 3.6Q ^{1/3}	K8 3.2Q ^{1/3}	K9 3.6Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	R	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	F	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K11 4.4Q ^{1/3}	K9 3.6Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}	K18 7.1Q ^{1/3}
2 ND OR 3 RD GEN MAINT HAS (SEE NOTE)	S	K9 3.6Q ^{1/3}	K8 3.2Q ^{1/3}	K9 3.6Q ^{1/3}	K9 3.6Q ^{1/3}	K8 3.2Q ^{1/3}	K9 3.6Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	R	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}
	F	K11 4.4Q ^{1/3}	K9 3.6Q ^{1/3}	K18 7.1Q ^{1/3}	K11 4.4Q ^{1/3}	K9 3.6Q ^{1/3}	K18 7.1Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}	K8 3.2Q ^{1/3}

Legend: S-side; R-rear; F-front; B-barricaded; U-unbarricaded

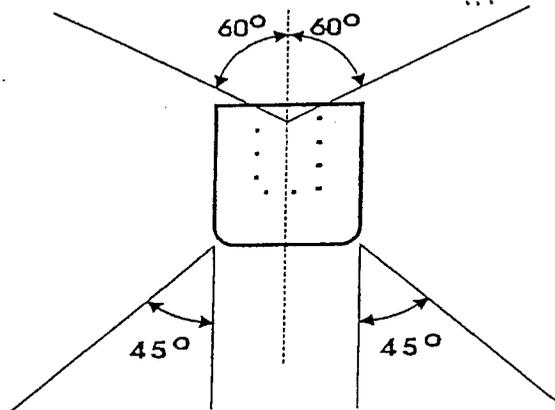
Notes for Table 10-4:

1. Maintenance HAS may not be located closer than 91M (300 feet) from any PES HAS sited for more than 225 kg NEQ (500 lb NEW).
2. Second and Third generation HAS's are limited to a maximum of 5,000 kg (11,000 lb) per shelter.
3. Ready service ECM storage is used to support daily loading and is limited to 10,000 kg (22,000 lb) per magazine and loading density not more than 20 kg NEQ per cubic meter (1.25 lb NEW per cubic foot).



HAS as Exposed Site (ES)

HAS as Potential Explosion Site (PES)



Igloo as ES or PES

Figure 10-1. Areas of Hazard.

Table 10-4A. Quantity-Distances from a U.S. Third-generation Hardened Aircraft Shelter PES to an Unhardened Exposed Site.^{1,2}

NEQ (kg) [NEW (lb)]		Note	Front (meters) [feet]	Sides (meters) [feet]	Rear (meters) [feet]
from (>)	to				
0	2 [4.4]	3	15 [50]	15 [50]	15 [50]
2 [4.4]	50 [110]	3	70 [230]	15 [50]	15 [50]
50 [110]	225 [500]	3	70 [230]	15 [50]	15 [50]
225 [500]	500 [1100]	3	70 [230]	120 [394]	50 [164]
500 [1100]	5,000 [11,000]	4	20Q ^{1/3} [K50]	25Q ^{1/3} [K63]	16Q ^{1/3} [K40]

Notes for Table 10-4A:

1. Separations are based on shelter doors remaining closed, except for aircraft towing, fueling, servicing, run-up, or taxi and during integrated combat turnarounds or short periods when maintenance equipment or munitions are being moved into or out of the shelter. Where doors are left open for extended periods, normal combat aircraft parking area criteria apply.
2. Munitions should be separated from the HAS walls at a distance sufficient to prevent breaching. For less than 500 kg, (1100 lb) a one meter (three foot) separation from the wall is sufficient.
3. The quantity-distance criteria in the table apply to inhabited building distance, public traffic route, and intraline exposures for quantities less than or equal to 500 kg (1100 lb).
4. For quantities greater than 500 to 5,000 kg (1100 to 11,000 lb), the quantity-distance criteria in the table only apply to IBD exposures. Use 50% of the IBD criteria for PTR exposures with a 91 meter (300 foot) minimum distance (out the front or rear) or a 120 meter (394 foot) minimum distance (off the sides). Use 35% of the IBD criteria for intraline exposures with a 91 meter (300 foot) minimum distance (out the front and rear) or a 120 meter (394 foot) minimum distance (off the sides).

6. Forward Arming and Refueling Points (FARPs).

a. **General.** The storage of ammunition and fuel at the same location is inherently hazardous and should be avoided when possible. If it is necessary to refuel and rearm aircraft at the same location, all precautions must be made to minimize the hazards involved in these operations.

b. **Required separations.** FARPs shall be separated by IBD from all non-associated inhabited buildings. The ready ammunition storage (that ammunition staged to support the next load) shall be separated by aboveground magazine distance from the armament pads, with only armament pads considered as the PES. Ready ammunition storage structures and locations shall be separated from other ready ammunition storage structures and locations by aboveground magazine distance. Build-up locations shall be separated by aboveground intermagazine distances from all other explosives storage and operations with only the build-up locations considered as the PES. Distances prescribed by the owning service shall separate other support structures and sites. Use $D=9.5Q^{1/3}$ (K24) for asset preservation between FARPs and other ESs.

c. **Fuel storage.** A&E shall be separated from operational fuel supplies by at least 30 meters (100 feet). Fuel supplies shall be diked or placed downhill from A&E.

d. **Armament pads.** Armament pads shall contain the minimum amount of ammunition to conduct efficient operations. For example, where armament pads support only one aircraft, that pad will be restricted to the amount of ammunition necessary to rearm that aircraft.

7. Airfield Operations

a. General.

(1) Special consideration must be given to phased plans where the peacetime operation and positioning of aircraft transitions to contingency operations with increased quantities and use of explosives. Exposures given adequate protection under the peacetime phase may be at greater risk during the contingency phase. Commanders must consider these changes when approving these plans.

(2) The proper use of such features as barricades or earth-filled, steel-bin-type barricades (ARMCO Revetment or equivalent) (Refer to Chapter 5) can decrease the size of a potential explosive event and increase the explosives capacity of limited areas.

b. Airfield Q-D criteria.

(1) **Potential Explosives Site criteria.** Table 10-5 provides criteria for airfield PESs.

(2) **Exposed Site criteria.**

(a) **Runways, taxiways and combat cargo aircraft.** For military use runways and taxiways use table 10-5. For joint use runways and taxiways, use criteria in Chapter 9.

(b) **Combat aircraft support facilities.** Unhardened combat aircraft support facilities shall be separated from munitions storage and operating facilities by $D=12Q^{1/3}$ (K30). For asset preservation, apply incremental $D=16Q^{1/3}$ to $20Q^{1/3}$ (K40 to K50) based on the NEQ (NEW). If these functions are located in a HAS, separation may be reduced to $D=7.1Q^{1/3}$ (K18) to the sides or rear. Site other hardened facilities as approved by the DDESB. When operational necessity dictates, distances less than K18 may be approved for ESS, however it must be demonstrated that protection equivalent to K18 is being provided.

8. **Static missile battery separation.** To ensure optimal effectiveness, offensive and defensive missile batteries must often be deployed in the proximity of other explosive operations such as field storage or flightlines in a static (non-mobile role). The following criteria apply to deployed static missile batteries (e.g., Patriots, Hawks, and Rolands) and associated support functions.

a. Intermagazine separation of $D=4.4Q^{1/3}$ (K11) shall be maintained between missile launchers, reloads and other munitions storage locations to include parked explosives loaded aircraft.

b. Missile batteries deployed within the IBD clear zone of munitions storage areas may be sited at $D=7.1Q^{1/3}$ (K18) to manned functions considered related to area explosives operations. Likewise, missile batteries deployed in the clear zones of flightline operations may be sited at $D=7.1Q^{1/3}$ (K18) to manned flightline facilities.

c. Those functions solely providing support to static missile units, such as motor pools, may be sited at $D = 7.1Q^{1/3}$ (K18) to batteries and other explosives activities when the missile battery is located in these areas. For asset preservation, use PTR distance.

d. No separation is required between missile batteries and the security force structures exclusively supporting them.

Table 10-5. Quantity-Distance for Contingency Airfields

FROM AIRFIELD PESs TO:	MINIMUM SEPARATION DISTANCE	ASSET PRESERVATION DISTANCE
Manned functions not related to the combat mission	IBD	IBD
Base boundaries without an easement unless manifestly unsuitable	IBD	IBD
Crew support and billeting areas	IBD	IBD
Central airfield support facilities	IL	Note 1
Functions related to the explosives mission (manned)	IL	Note 1,2
Flightline fire and rescue services	IL	Note 1
Manned munitions operating locations (assembly, maintenance, refurbishment, etc)	IL	Note 1
To any other explosives loaded aircraft or CAPA	IM	Notes 1,2
Flightline Munitions Holding Area	IM	Note 1,2
Military use runways and taxiways	$D = 1.8Q^{1/3} / K4.5$	Note 1,2

Notes for Table 10-5:

1. For HD 1.1 material apply $D = 9.5Q^{1/3} / 12Q^{1/3}$ (K24 / K30) separation. For HD1.2, 1.3, or 1.4 use PTR distances from the appropriate Chapter 9 tables.
2. For aircraft, asset preservation distances may not provide protection from fragments. To protect against low-angle, high-energy fragments, aircraft should be barricaded.

9. **Emergency destruction.** When it becomes necessary to destroy stores of munitions to prevent them from falling to the enemy, care must be taken to ensure that assets otherwise not in danger of falling to the enemy are not destroyed by blast or fragments. Service's shall develop specific guidance for the implementation of and training for emergency destruction of munitions. Normal disposal operations shall be conducted in accordance with Chapter 5.

10. **Separation from fuel.**

- a. **Bulk fuel storage (More than 18,900 liters (5,000 gallons)).** Treat per Chapter 5.
- b. **Operational storage from 1,900 to 18,900 liters (501 to 5,000 gallons).** Shall be separated from each PES by at least 30 meters (100 feet). Fuel should be located downhill and diked to contain a possible fuel spill.

c. **Operational Storage (1,890 liters (500 gallons) or less).** Shall be separated from each PES by at least 15 meters (50 feet). Fuel should be located downhill and diked to contain a possible fuel spill.