CHAPTER 6

QUANTITY DISTANCE AND COMPATIBILITY

ASSOCIATED WITH PORT OPERATIONS

(NAVSEA OP 5, Volume 1)

NOTES

d. Flight line passenger service functions.

e. Main power houses that provide vital utilities to a major portion of an installation.

f. Storehouses and shops that because of their vital or strategic importance or the intrinsic high value of their contents, should not be placed at risk.

g. Functions that, if momentarily out of action, would cause an immediate secondary hazard because of their failure.

7-10. Q-D DETERMINATIONS AT PIER, WHARF, AND ANCHORAGE FACILITIES

The following Q-D standards apply to the separation of ships, piers, wharves, associated explosives handling facilities, inhabited buildings, public traffic routes, and other adjacent facilities at Navy and Marine Corps activities. They also apply to piers and wharves and associated facilities where explosives or ammunition may be handled or be present as cargo in ships' holds or service conveyances. These standards do not apply to ammunition or explosives stowed in ships magazines that are intended for use by shipboard armament or aircraft as defined in paragraphs 7-10.1 or 7-10.2, or for maintenance movements or weapons system operability tests of this ammunition. They do apply, however, during the loading and offloading of this ammunition or explosives. Specific ship categories are addressed in paragraphs 7-10.1 through 7-10.3. The total quantity of explosives on board a ship shall be determined as specified in paragraph 7-3.2. Quantity-distance requirements specified in this section apply to Class/Division 1.1 explosives. When the only hazards involved are those associated with nonmass-detonating ammunition and explosives, Class/Division 1.2 through 1.4 and Class/Division 2.3 or 6.1, these hazards shall be considered as specified in paragraphs 7-7.2, 7-7.3, 7-7.4, 7-7.5 and elsewhere in this chapter. There are two categories of ammunition handling piers: ammunition terminal facilities (paragraph 7-10.4) and general ship berthing facilities (paragraph 7-10.12).

7-10.1 COMBATANTS. The ammunition carried in a ship's magazines, launchers, or ready-service lockers, which are to be used solely in support of the ship's mission by installed shipboard weapons systems or by shipboard aircraft, are exempt from the application of ESQD requirements, except when it is being handled or in the process of being stowed. This is known as the combatant exemption. Only the NEW of the ammunition being handled and/or staged on the pier need be considered. Criteria for when the ammunition is considered secured onboard is provided by paragraph 7-5.2.9. The exception to this rule involves the opening of missile hatches onboard SSBNs. If the hatches are open for any operation related directly to the missile (i.e., loading or maintenance) the total NEW of all missiles onboard must be applied.

7-10.2 AMPHIBIOUS WARFARE SHIPS. Amphibious warfare ships carrying Landing Force Operation Reserve Materiel (LFORM) ammunition and explosives in LFORM storage spaces in support of the ship's mission are exempt from ESQD criteria under the combatant exemption (paragraph 7-10.1), except during handling evolutions, provided the ammunition and explosives are stored under the conditions delineated in NAVSEA OP 4.

7-10.3 CARGO AMMUNITION SHIPS. Explosives and ammunition are stowed relatively close to each other onboard cargo type vessels such as an AE, TAE, AD, AS, AOE, AO-177 Class, Military Prepositioning Force ships, and point-to-point shipments in Military Sealift Command (MSC) or commercial vessels. Collectively, these ships, when carrying cargo ammunition, will generate an ESQD arc, based on the amount of cargo ammunition onboard. Ammunition carried to support the ships' self defense weapons systems is not factored into the total cargo load, nor will that ammunition generate an ESQD arc in the absence of cargo ammunition. A detonation in the mass-detonating part of the cargo would receive considerable support from parts of the cargo normally considered fragment or fire hazards. Accordingly, the total NEW should be calculated using the net weight of HE filler plus weighted values for propellants and other fillers in TNT equivalents as delineated in paragraph 7-3.2. For planning purposes, the following general ratios may be used; however, these ratios cannot be accepted for siting or waiver/exemption requests.

a. For a general explosive cargo - 30 percent of the gross packaged weight.

b. For a solid cargo of bombs - 40 percent of the gross packaged weight.

c. For an ammunition ship (AE) - 25 percent of the gross packaged weight.

d. For FBM Class/Division 1.1 propellants - the additive weight of all rocket motors in cargo status.

Determination of ESQD arcs for Maritime Prepositioning Ships (MPS) can be established using K=40.85 with a 4,400 foot minimum fragments distance for inhabited building distance and K=24.01 for public traffic route distance. These reduced distances are applicable provided no more than 52 percent of the NEW is Class/Division 1.1 material. Above 52 percent, the K-factor increases as shown in table 7-24. Above 65 percent hazard Class/Division 1.1 material, the values in table 7-9 apply. The amount of hazard Class/Division 1.3 does not affect the result.

7-10.4. AMMUNITION TERMINAL PORT FACILITIES. The application of Q-D standards in various explosive cargo ammunition ship unit situations at explosives handling piers (piers used primarily for handling explosive cargo), scuttling sites, and explosives anchorages is illustrated in figure 7-2. References to the appropriate Q-D tables for each relationship shown appear in notes to the figure. The Q-D considerations involved between ship units and other target areas are specified in table 7-26. Table 7-9 shall be used to determine separation distances between explosives pier or wharf facilities and such ES's as administrative or industrial areas, terminal boundaries, the main ship channel, and public traffic routes.

7-10.5. OBJECTIVES OF SHIP OR BARGE UNIT SEPARATION. The basic objectives of ship or barge unit separation are:

a. To separate ship or barge units at the same pier by a sufficient distance to avert, or greatly reduce, the possibility of mass detonation of an adjacent ship or barge unit when a detonation

occurs on one ship or barge. These standards also provide separation from other targets on the basis of the greatest amount of mass-detonating explosives in any one ship or barge unit. Separation of any two ship or barge units by the distances specified in table 7-15 column 11 provides as much protection against communication of an explosion as is provided for aboveground magazines. At these distances, the coalescence of shock waves from two adjacent explosions is unlikely, and therefore the quantities of explosives in the two need not be combined for Q-D purposes. If separation distances less than specified in table 7-15 column 11 must be used to separate adjacent ship or barge units, the amount of explosives in both units must be totaled for determining separation distances to other targets.

b. To separate ship or barge units at different piers by a sufficient distance as shown in table 7-27 column 4 to avert, or greatly reduce, the possibility of communication of an explosion. The separation is sufficient if damage to ships in adjacent units from blast and fragments will be limited to the superstructure and nonvital members, and the possibility of deaths and injuries will be reduced to a minimum.

NOTE

Separation distance requirements for quantities of explosives not provided in table 7-27 can be interpolated or extrapolated using the formulas cited in the column headings.

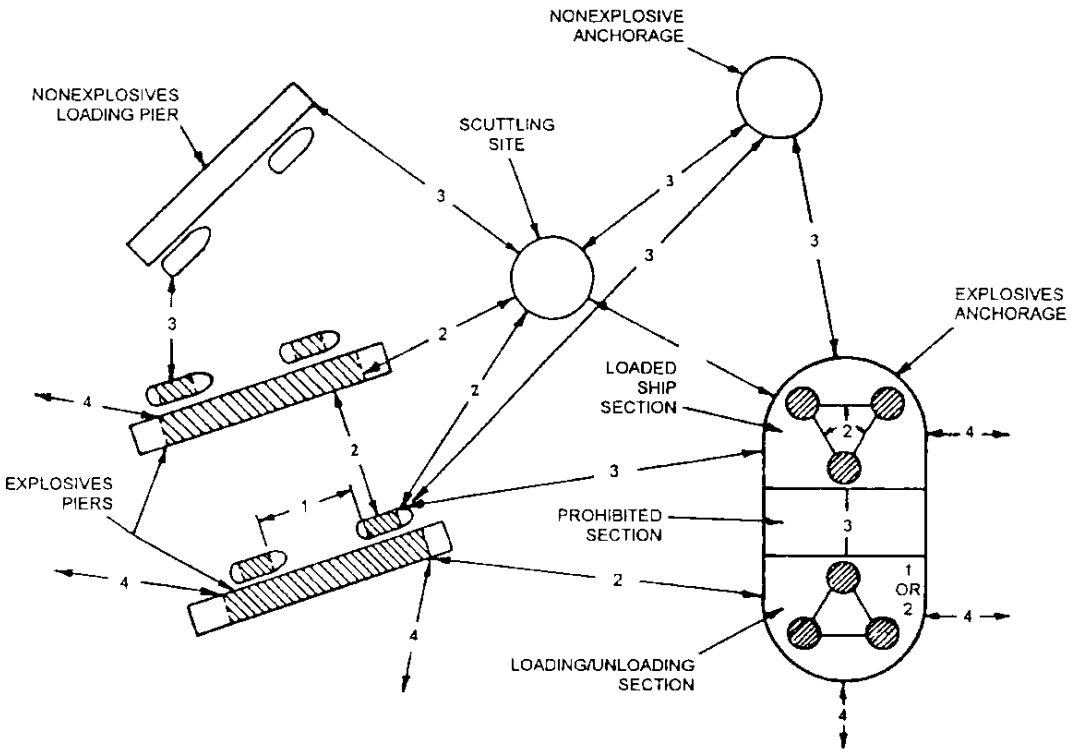
c. To separate ships or barge units loaded with explosives from nonexplosive piers or cargo ships by a sufficient distance as shown in table 7-27 column 5, to limit damage of nonexplosive ships to that of a minor nature, thereby virtually eliminating deaths and serious injuries.

d. Separation requirements for tenders are provided in paragraph 7-10.6.1.

e. If separation distances between ship units do not comply with the preceding subparagraphs, the greatest separation consistent with existing operational requirements shall be maintained. Communication between explosive units without intervening protection is considered virtually certain at separation distances of 300 feet or less. At separation distances of more than 300 feet the probability of communicating an explosion decreases as the distance increases even though a finite probability value cannot be assigned to different separation distances. For any given separation, the probability of communication is lessened if ships are moored in tandem rather than in parallel, and if their hatches are closed instead of having exposed ammunition on deck and in open holds.

7-10.6. DETERMINING SEPARATION DISTANCES.

7-10.6.1. Separation Distance Between Piers. The separation distance between piers shall be measured from the nearest point of the ship unit at one pier to the nearest point of the ship unit at the other pier. The ship unit is created by the portion of the pier that would have explosives staged for movement, the ship's explosives cargo magazines and adjacent explosives-loaded barges not meeting adequate



LEGEND

Separation Distance	Refer to
1	Table 7-15, Column 11 (K=11)
2	Table 7-27, Column 4 (K=18)
3	Table 7-27, Column 5 (K=40)
4	Table 7-9, Columns 5 and 9 (K=40 and K=50) Ship and Barge Units

Figure 7-2. Application of Quantity-Distance at Ammunition Terminals

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separation to prevent propagation. The staging area will include space used for laydown area as well as staging explosives-laden railcars and trucks. When this combined unit cannot meet the required separation distance specified in figure 7-2 to prevent propagation, ship units at the same pier must be added together and the total NEW used to determine separation based on the requirements of figure 7-2. Separation of tenders at different (existing) piers can be accomplished using the distances specified in table 7-27 column 3, if the distances in figure 7-2 cannot be met. Existing piers are those that were operational prior to 1 January 1975. Construction of new piers, intended for tender berthing, must meet unbarricaded intraline distance of table 7-11, column 3 when one or both tenders are at the new pier. The measurement for separation distance is made from the closest bulkhead of the major weapons magazine area on one tender to the like bulkhead on the other tender. Where permitted by pier strength, slip width and location of utilities, tenders will be berthed only at the seaward end of piers.

7-10.6.2. Separation from Scuttling Sites or Explosives Anchorages. Measurements from scuttling sites or explosives anchorages to outside targets will generally begin at the boundary of the designated scuttling site or anchorage zone. For explosives anchorages, the separation distance from the boundary of the designated anchorage zone to outside targets will depend on whether the ship units being loaded or unloaded in their designated area within the zone are properly separated from loaded ship units in another area, for the amount of explosives involved and whether loaded ships within the loaded ship area are properly separated from each other. (See figure 7-2.) If loaded ships in the loaded ship area are not properly separated from each other, the total NEW for all ships in the area shall be used to determine the proper separation distance to outside targets. The ship unit equivalent for an explosive anchorage is a circle having a radius equal to the distance from the mooring buoy or the ship's anchor to the stern of the ship or the stern of any ammunition lighters alongside when the anchor line is taut. To maintain proper separation distances between loading or unloading ship units in the explosives anchorage, the ships should moor or anchor so that they never have a separation distance less than specified in table 7-15 column 11.

7-10.6.3. Separation of Ships Moored to Dolphins. When ships are moored to dolphins or interrupted quays, the separation distance shall be from the outer corners of ship's explosives cargo hold to the nearest cargo hold of another ship.

7-10.6.4. Separation from Ship or Barge Units Moored at Pier to Fixed Shore Targets. The measurement of separation distance from ship unit moored at a pier to fixed targets on land shall be from the nearest portion of the ship's cargo hold or barge unit to the nearest fixed target.

7-10.6.5. Separation Between Ship Units and Other Targets. It is not practical to specify separation distances for every situation that may arise at a pier, wharf or anchorage. Many conditions must be considered to decide on the degree of protection needed. It is the responsibility of the naval activity involved to determine what level of

protection is acceptable after considering the standards and the hazards involved. Tables of separation distances and the advice given in other parts of this volume should be used as guides when making these determinations.

7-10.7. Q-D REQUIREMENTS AT AMMUNITION TERMINAL PIERS. The relationship of ships, barges and explosive loading piers to other facilities is provided in table 7-26. The term "ship unit" includes any combination of ship, barge, or pier/wharf not separated from one another by the required distance to prevent propagation between the units as defined in paragraph 7-10.6.1. Common siting scenarios are further defined in the following paragraphs.

7-10.7.1. Ship to Ship. Measurements of separation distances between ship units at explosives loading piers as given in table 7-15 column 11 shall be from the nearest portion of one ship's explosive cargo hold to the nearest portion of the other. Railcar or motor vehicles that pass between the ship units are considered an operational risk. However, spotted railcars and motor vehicles must be considered as part of the ship unit. It is generally impractical to separate berths at a single pier by a sufficient distance to prevent the mass detonation of ships containing complete cargoes of Class/Division 1.1 ammunition. When operationally feasible, scheduling should reduce the number of these exposures and the total time required for each exposure. Ships moored in tandem or on opposite sides of the same pier, together with the pier and adjacent working space are considered as one ship unit. The total quantity of the explosives present shall be considered for Q-D purposes. However, ships moored at the same pier should be separated as much as possible to reduce the likelihood of an explosion communicating due to fragments or fire. When two ships cannot be separated by the distance specified in table 7-15 column 11 the spotting of railcars and the loading of hatches in both ships should be planned so that the greatest possible distance between open hatches of both ships, and between motor vehicles and railcars servicing the two ships will be created. When possible, ship loading should be staggered. Mooring two ships in tandem rather than opposite each other will help decrease the fragment hazard to the explosives cargo of the second ship because of the additional protection afforded by the bows and sterns of the ships.

7-10.7.2. Pier to Pier. Q-D relationships between explosives loading piers shall comply with table 7-27 column 4. This Q-D relationship is based on the premise that if a ship with a full load of mass-detonating explosives and ammunition exploded as a unit at one pier, the possibility of communicating the explosion to another ammunition ship at the other pier would be remote. Also, damage to other ships from fragments and blast would be limited to some damage by fragments to decks and superstructure, the cutting of some electrical wiring, the buckling of some doors and bulkheads on weather decks, and the disarrangement of some radio and radar antenna and equipment. However, flying fragments or secondary effects of the blast including being thrown overboard, losing footing, or being struck by loose objects could possibly injure or kill exposed personnel.

7-10.7.3. Ship Unit to Nonexplosives Loading Pier or Other Ships. The Q-D relationship between cargo ammunition ships and nonexplosives

loading piers or other nonexplosives carrying ships (excluding Navy combatants or service craft) shall comply with the requirements in table 7-27 column 5 (K=40). If a ship with mass-detonating explosives exploded, ships separated from it by these distances would suffer only minor superficial damage from the blast wave and only a few fragments would probably hit the ship. The

possibility of fatalities or serious injuries would be small. The distances shown in table 7-27 column 5 are recommended for the protection of loaded ammunition ships, nonexplosive carrying ships, and laid-up ships. After an ammunition ship has been loaded, it should not be subjected to the hazards of a possible explosion from an ammunition ship that is still loading. The same precaution applies to nonmilitary and passenger ships. For protection of ships that are underway, the Q-D relationship specified in table 7-9 column 9 shall be used.

The ESQD arcs between MPS and nonexplosives loading piers or other nonexplosives carrying ships can be established using K=32 with a 3,500 foot minimum fragment distance for MPS loads where no more than 52% of the total NEW is hazard Class/Division 1.1 material. Above 52%, the K-factor increases as shown in table 7-25. Above 65% hazard Class/Division 1.1 material, a value of K=40 applies. The amount of hazard Class/Division 1.3 material does not affect the result.

7-10.7.4. Ship Unit to Inhabited Building, Passenger Railroads, and Public Highways. The Q-D relationship between ship units and inhabited buildings is specified by table 7-9 column 5, and between ship units and passenger railroad or public highway by table 7-9 column 9.

7-10.7.5. Ship Unit to Explosives Operating Areas. Explosives operating areas shall be separated by intraline distances from ship or barge units. Ship or barge units will be separated from explosives operating areas by inhabited building distance, based on the explosive limit of the operating area, unless the operating area directly supports the ship or barge unit, in which case intraline distance can be used.

7-10.7.6. Ship Unit to Wharf Yard. Wharf yards shall be separated from ship units and other facilities as described in paragraph 7-12.14.

7-10.8. Q-D REQUIREMENTS AT EXPLOSIVES ANCHORAGES.

7-10.8.1. Loading and Unloading Section to Loaded Ship Section. The Q-D relationship between the shiploading and unloading section and the loaded ship section of an explosives anchorage shall comply with table 7-27 column 5 based upon the quantity of explosives in the ships when they are fully loaded.

7-10.8.2. Ship Unit to Ship Unit at Loading and Unloading Section. When the explosives anchorage is used only for loading and unloading ships, to prevent mass detonation, ships in the explosives anchorage shall be separated by the separation distances shown in table 7-15 column 11. Whenever possible, distances provided by table 7-27 column 4 should be used to reduce the loss potential from any incident.

7-10.8.3. Ship Unit to Ship Unit at Loaded Ship Section. The Q-D separation between loaded ships at a loaded ship section of an explosives anchorage shall be in accordance with table 7-27 column 4.

7-10.8.4. Explosives Anchorage to Explosives Pier. The Q-D relationship between the loaded ship section of an explosives anchorage and an explosives pier shall comply with the standards of table 7-27 column 5. This relationship should provide sufficient protection for loaded ships in the explosives anchorage from damage and protection for personnel from injuries. The Q-D relationship between the loading and unloading ship section of an explosives anchorage and an explosives pier shall comply with the standards given in table 7-27 column 4.

7-10.8.5. Explosives Anchorage to Nonexplosives Pier or Anchorage. The Q-D relationship between an explosives anchorage and a nonexplosives pier or anchorage shall comply with the standards in table 7-27 column 5.

7-10.8.6. Explosives Anchorage to Main Ship Channel. The Q-D relationship specified by table 7-9 column 9 shall apply between an explosives anchorage and the main ship channel as well as other routes normally used by ships entering or leaving the harbor. In addition to the requirements of table 7-9, the turning circles and stopping distances of ships in the main channel or other normally used routes should be considered. Assuming that the diameter of the turning circle of a ship is 1,000 yards (915 meters) the explosives anchorage should be located so that a ship with a jammed rudder in the channel would clear an anchored explosives-laden ship. From the turning circle standpoint, the separation distance should not be less than 1,000 yards. 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 Q-D requirements.

7-10.8.7. Explosives Anchorage to Inhabited Buildings or Public Traffic Routes. The Q-D relationship between an explosives anchorage and inhabited buildings shall comply with the requirements in table 7-9 column 5, and between an explosives anchorage and public traffic routes with table 7-9 column 9.

7-10.9. Q-D REQUIREMENTS AT SCUTTLING SITES. A properly located scuttling site shall be provided, if possible, where a vessel that has caught fire can be flooded or sunk to avoid damage to piers or other ships. The scuttling site shall have sufficient sea room and water depth to permit sinking the largest vessel handled at the installation so its holds will be completely flooded at low water. Because an explosion may occur while the vessel is being towed, the scuttling site shall be located where the best available protection will be provided to other ships, piers and shore installations. The location of the scuttling site should reflect the greatest NEW that may be in a single ship at one time. The following Q-D requirements shall apply to scuttling sites:

a. To nonexplosive piers and anchorages, use the standards in table 7-27 column 5.

b. To explosives anchorages, use the standards in table 7-27 column 5.

c. To explosives piers, use the standard in table 7-27 column 4.

d. To inhabited buildings, use the standards in table 7-9 column 5.

e. To public traffic routes, use the standards in table 7-9 column 9.

7-10.10. Q-D REQUIREMENTS AT WHARF YARDS. See paragraph 7-12.14.

7-10.11. GENERAL CARGO AND VEHICLES AT AMMUNITION TERMINALS. Mission-related general cargo, vehicles, and ammunition may be transferred concurrently through a terminal for the purpose of loading and/or offloading the same ship. Concurrent operations involving other ships shall be conducted at applicable Q-D separations. Inert materials and equipment in holding areas shall be separated to the extent possible, in order to limit the exposure of unnecessary personnel and reduce congestion of the terminal area. Any labor intense activity shall take place at applicable Q-D separation.

7-10.12. GENERAL BERTHING FACILITIES. Berthing of ships that do not have cargo ammunition onboard is permitted at any berthing pier since ESQD arcs are not applicable to their service ammunition as defined in paragraph 7-10.1. Limited ammunition handling is permitted provided the following conditions are met:

a. Appropriate ESQD requirements.

b. Restrictions on inport handling evolutions defined in paragraph 2-5.2.

c. CNO approval or waiver of the handling site.

Handling at piers other than ammunition terminal piers are intended only for top-offs of ammunition allowances, not complete loadouts. Q-D considerations will be based solely on the ammunition being handled on the pier and that which has not been secured onboard the ship. The expression "secured onboard" is explained fully in paragraph 7-5.2.9. The ESQD arcs will be struck from the area of the pier where the handling occurs and where ammunition is staged, and the portion of the ship where the ammunition is secured. If handling is from a barge, the barge unit and the portion of the ship where the ammunition is secured will generate ESQD arcs rather than the pier. In addition to the ESQD requirements in tables 7-9, 7-16 through 7-20, 7-14 and 7-15 for respective Class/Division of ammunition, table 7-10 can be used to reduce ESQD requirements for limited handling of specific weapons. There are no specific ship to ship or pier to pier separation requirements other than the limitations defined in paragraph 2-5 with the exception that unbarricaded intraline distance requirements of table 7-11 column 3 shall be maintained at all times between separate handling operations based on the largest net explosives present at any single transfer or handling point.

hazard classes are expected to be loaded, the area should be sited using appropriate distances based on the greatest hazard. In addition, appropriate airfield flight safety criteria also should be observed when determining the site. Separation between combat loaded aircraft shall be the minimum unbarricaded aboveground magazine distance based on the hazard class of munitions loaded and shall be measured from munitions to munitions. For Class/Division 1.1 munitions use table 7-15 column 11. Maintaining this distance between loaded aircraft prevents simultaneous detonation of mass-detonating explosives on nearby aircraft, thereby reducing the maximum credible event on the pad to one aircraft. When this distance can be maintained, ESQD arcs drawn from the pad to other facilities can be based on the maximum load at the nearest aircraft spot to the ES. If unbarricaded aboveground distance cannot be maintained, the net explosive weight of aircrafts must be combined. Ammunition staged on the pad or adjacent to the pad must be separated by intermagazine distance from the nearest aircraft. ESQD arcs to other facilities must consider the total NEW staged.

7-11.3. AMMUNITION AND EXPLOSIVES PROHIBITED AREAS (AIRFIELD EXPLOSIVE PROHIBITED AREA). All ammunition and explosives shall be prohibited in areas within approach and departure zones at all fixed and rotary wing aircraft landing facilities, including DOD, other federal joint-use, and civil facilities. The approach and departure zones for aircraft are those areas designated and described in detail for the various types of facilities in airfield and airspace criteria directives. In general, the approach and departure zones begin near the end of a runway or landing area and extends outward a given distance along, and symmetrically on each side of, the extended runway centerline or the aircraft approach axis of a heliport. These zones flare uniformly from the landing areas outward to a specified limit. Figure 7-3, sheets 1 and 2 illustrate typical examples of approach and departure zones. Specific examples may be found in NAVFAC Design Manual DM-21 or MIL-HDBK-1021, and NAVFAC Definitive Drawings P-272 (series). Aircraft overfly restrictions are identified in paragraph 2-1.7.

NOTE

No construction is permitted within the primary surface area, within 1000 feet on either size of runway centerline or 750 feet at established installations. Beyond this, surface facilities may be constructed that do not penetrate the 7:1 slope transition surface. Also, it is necessary that zones 3,000 feet beyond the end of the runway be free from obstructions. (See figure 7-3, sheet 1.)

7-12. Q-D DETERMINATION AT MISCELLANEOUS EXPLOSIVES FACILITIES

7-12.1. SEGREGATION FACILITIES. Segregation facilities shall be sited as explosive operating buildings with respect to other explosive operations and magazines. Typical segregation facilities are described in paragraph 8-4.3. Refer to paragraph 12-7.5 for regulations governing operations.

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7-12.2. Deleted.

7-12.3. HOLDING YARDS. Holding yards shall be separated from other facilities by the applicable quantity distance. Separation distance between each unit car-group is measured from the closest distances between unit car-groups (similar to ship and barge unit measurement). Where the type of rail holding yard is formed by running two parallel ladder tracks connected by diagonal spurs, the parallel tracks and the diagonal spurs shall be separated by applicable aboveground magazine distances for the unit-group quantities of high explosives. When the rail holding yard is in the "Christmas tree" arrangement, consisting of a ladder track with diagonal dead-end spurs projecting from each side at alternate intervals, the spurs should be separated by the applicable aboveground magazine distance for the net quantity of high explosives in the railcars on the spurs. The spurs shall accommodate not more than 10 railcars.

7-12.4. CLASSIFICATION YARDS. For protection of the classification yard from external explosions, separation distances shall be at least the applicable magazine distance as determined by the hazard classification and quantity of the material at other potential explosive sites. Specific quantity-distance separation is not required from classification yards to facilities other than explosive locations when the yard is used exclusively for purposes listed in paragraph 8-4.6. If the yard is used at any time for any other purpose, such as placing or removing dunnage or explosive items into or from the railcars, or trucks, Q-D requirements as determined by the quantity and hazard classification of the material applies.

7-12.5. INSPECTION AND WEIGHING STATIONS. Specific Q-D requirements are not applicable to explosive-loaded railcar and motor vehicle inspection and weighing stations. However, these stations should be as remote as possible from hazardous or populated areas. Activities performed at inspection and weighing stations are described in paragraph 8-4.9. If any other activity is conducted at the inspection station, applicable quantity-distances shall apply.

7-12.6. SUSPECT CARGO SITES. Suspect cargo sites will be sited at inhabited building distance to all other facilities except magazines which will be separated by appropriate intermagazine distances. Use of suspect cargo sites is described in paragraph 8-4.10.

7-12.7. VACUUM ACCUMULATOR BUILDING. The vacuum accumulator building shall be separated from the loading building by an intraline distance based on the quantity of high explosive allowed in the vacuum

accumulator building. The vacuum collection system shall meet the design requirements of paragraph 9-2.3.

7-12.8. SHIPPING RAMPS, PLATFORMS, AND LOADING DOCKS. Separated loading docks, when not part of an existing facility or magazine, shall be sited on the basis of use. When servicing magazines, they must be separated from the magazines by intermagazine distances. When servicing operating buildings, they must be separated from the operating buildings by intraline distances.

7-12.9. EXPLOSIVE-LOADING RAILCARS AND MOTOR VEHICLES. Explosive-loaded railcars or motor vehicles must be considered as surface magazines, with respect to the hazard involved, when parked in unbarricaded areas. When explosive-loaded cars or motor vehicles are parked within a barricaded area, such as a barricaded siding, the railcars or motor vehicles may be considered barricaded in all directions except at unbarricaded open ends of the location. The provisions of paragraph 7-3.5.2 shall apply and the siting criteria for aboveground, non-earthcovered magazines as given in tables 7-5 and 7-19 shall be used. Where the open ends of such locations are not barricaded, unbarricaded distances shall be used and the locations oriented so that the open ends are directed toward other barricades or unoccupied space to the extent of unbarricaded distance requirements. Railcar or motor vehicle NEW will be added to the explosive weight of adjacent facilities and must not violate siting criteria.

7-12.10. DISPOSAL/DEMOLITION SITES. The disposal of ammunition, explosives, or similarly hazardous materials shall be undertaken ashore only in those areas or locations that have been specifically site approved for that purpose in accordance with paragraph 8-1.2. In emergencies at activities not having approved disposal areas, such sites or areas considered to be suitable for the purpose shall be submitted through the site approval process with sufficient detailed information to permit approval. The site selected for the demolition and burning of explosives and ammunition shall be located in accordance with requirements of chapter 13. Also, refer to OPNAVINST 3770.2 (series) for FAA clearance requirements. In planning disposal operations and selecting disposal sites, consideration shall be given to the effect of disposal operations on the population in the area surrounding the site as well as the danger of damage to property or building by fragements or shock. Sites for demolition and burning of explosives shall be separated from other facilities based on the hazards associated with the quantity and type of material to be destroyed. Additional requirements for areas where ammunition and explosives will be disposed of by burning or detonation are described in paragraphs 13-2.2 and 13-3.2.

7-12.11. SAFE HAVEN. Commanding officers and officers in charge of Navy and Marine Corps CONUS activities are authorized to grant refuge to military and military-sponsored shipments of explosives, hazardous materials, or other sensitive items endangered by civil disturbance or natural disaster as described in NAVSEA OP 2165 Volume 1. To the extent possible, the compatibility restrictions, and the Q-D and lightning protection requirements of this manual will be observed. For Department of Energy controlled shipments, refer to OPNAVINST 5740.12 (series).

7-12.12. TEMPORARY PARKING. All Navy and Marine Corps activities engaged in receiving, storing, and issuing ammunition and explosives shall establish a program for parking explosives-loaded commercial vehicles as described in NAVSEA OP 2165 Volume 1. These vehicle holding yards will meet the Q-D requirements of NAVSEA SW020-AC-SAF-010/020/030 for (at a minimum) the greatest hazard classification of material handled on-station as well as lightning protection requirements.

7-12.13. AIRCRAFT EGRESS AND EMERGENCY LIFE SAVING DEVICES SHOPS. Facilities or rooms within nonexplosives facilities that are used for storage and work on aircraft egress devices, signalling devices, life vests and life rafts can be approved for limited amounts of Class/Division 1.3 and 1.4 material without regard to Q-D or the specific siting, design and construction requirements of paragraph 8-3. Such facilities include aircraft hangars, troop buildings and manufacturing or operating buildings. Approval can be accomplished by NAVORDCEN (N71) or NAVORDCEN LANTDIV/PACDIV ESSO. Unless specified in the approval, these areas must have a fire symbol posted on the facility and outside the interior room, panic hardware on a minimum of one door and for a newly constructed facility, a sprinkler system, if hazardous material remains in the area overnight. Existing facilities should have sprinkler systems for overnight storage, but can operate without, provided there is an alarm monitored during offduty hours and the shop does not retain more than 25 pounds NEW of Class/Division 1.3 and 1.4 material overnight.

7-12.14. WHARF YARDS. A wharf yard shall be separated, when practical, from the pier it serves by a distance clearly sufficient to prevent immediate propagation of an explosion as shown in table 7-15 column 11. Where this distance is not practical, the wharf yard shall be considered a part of the ship or barge unit and added to it when computing the total amount of explosives for Q-D purposes. The outer limit of the wharf yard shall then be considered the ship unit boundary for determining applicable Q-D requirements. The wharf yard shall be separated from all other inhabited facilities by at least 1,800 feet.

7-12.15. TRANSPORTATION CHANGE MODE LOCATIONS. Transfer points for roll-on, roll-off operations (where no lifting occurs) involving ammunition and explosives do not require Q-D application when the ammunition is moved in compliance with national/international/host country specific transportation regulations. Off-station MILVAN/ISO container inter-/intramodal transfers (involving highway and rail modes only) are also authorized without Q-D application, provided containers are not stored or other operations performed.

7-13. Q-D DETERMINATION AT NON-EXPLOSIVE FACILITIES

7-13.1. ADMINISTRATION AND INDUSTRIAL AREAS. Administration and industrial areas shall be separated from explosives concentrations by inhabited building distances. Auxiliary facilities such as heating plants, line offices, break areas, briefing rooms for daily work schedules or site safety matters, joiner ships, security posts, and similar functions may be at explosives operations and serve only one building or operation shall be located and constructed so as to provide fire protection.

7-13.2. RECREATION AND TRAINING FACILITIES. Open areas between explosives concentrations and non-explosives buildings and structures should be carefully controlled for recreation or training use. As a general rule, the fragement hazard will be severe from the explosion site to allowable railroad and public traffic route distances. Accordingly, outdoor recreation and training facilities, where people are in the open, shall be sited at not less than public traffic route distances, and preferably as near inhabited building distances as practical. When structures, including bleacher stands, are included as part of these facilities, they shall be sited at not less than inhabited building distances. However, blast and fragment Q-D requirements may be relaxed when used only by military personnel at Navy and Marine Corps activities for off-duty recreation at the PES. See paragraph 7-9.4.1c.

7-13.3. SECURITY BUILDINGS. Inhabited building distances need not be applied to facilities for the housing of security personnel who are required by their mission to have quick reaction capability in the immediate vicinity of a PES. Such security facilities should be provided with a minimum intraline distance separation of $9W^{1/3}$. Peak incident overpressures expected from an explosion at this distance will be about 11 psi, sufficient to render personnel within the building militarily ineffective. Strengthening the building to withstand small arms fire should provide reasonable protection against fragments and building debris, but not necessarily against blast. Therefore, consideration should be given to strengthening the building to provide blast protection to the occupants (refer to paragraph 7-7.1.1c). These criteria apply to any security facility regardless of continuous occupancy and numbers of duty personnel, but may not be extended to barracks used as permanent quarters for assigned troops.

7-13.4. GUARD SHELTERS, GATE HOUSES, SENTRY POST, AND SIMILAR STRUCTURES. Guard shelters and similar structures, if they serve a specific area, are not subject to Q-D separation standards, and should be located to provide prudent fire protection for the explosives facility.

7-13.5. DUNNAGE LUMBER YARDS. Dunnage storage, preparation, salvage, and disposal yards shall be located sufficiently remote from piers and wharves so as not to constitute a fire hazard to waterfront facilities or areas surrounding lumber storages. Dunnage yards may be sited at K9 (intraline distance) from a PES if utilized only by personnel at the PES. Adequate fire hydrants and firefighting equipment shall be provided at dunnage operations. Refer to paragraph 4-1.4.5 for further requirements regarding dunnage lumber yards.

7-13.6. INERT STORAGE. It is the responsibility of NAVORDCEN (N71) to determine acceptable protection for inert storage areas after consideration of the value of material in relation to the mission of the installation, the operational conditions, exposure of personnel, and the availability of the space.

7-13.7. ABOVEGROUND TANKS. Large permanent storage facilities are of primary concern when applying quantity-distance (Q-D) criteria to storage tanks. For installation of smaller tanks, it may be desirable to weigh the cost of distance/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. Reduced distances may be approved if these losses are acceptable and if spill containment is provided so other exposures are not endangered. Small quantities of petroleum products (POL) and other hazardous materials used for operational purposes require no specific separation distance for explosives safety; however, operating procedures must be implemented to limit adverse environmental impacts in the event of an accidental explosion. Unprotected aboveground storage tanks shall be separated from other PESs at IBD per table 7-9, column 5, as a minimum and shall be diked. Distances less than those for unprotected tanks may be used when an aboveground storage tank is provided sufficient protection from blast and fragment hazards to prevent rupture or collapse. Where service tanks in sole support of explosives operating areas or lines are supplied by an underground pipe system that is protected from blast and fragments, the tank may be sited at incremented (K40/50) inhabited building distance with a minimum distance of 400 feet from the PES provided that:

a. A dike system is provided according to the requirements in NFPA 30, and

b. The service 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.

7-13.8. TANKS WHICH SUPPORT A SINGLE PES. Where service tanks are in support of a single PES, the tanks may be located at the appropriate fire protection distance from the PES as prescribed by NFPA requirements. Distances from other PES's shall be in accordance with subparagraph b above.

7-13.9 STORAGE TANKS FOR WATER. When loss of tank is unacceptable, Q-D for unprotected aboveground storage tanks in this category shall meet the siting requirements of table 7-9, column 5. See paragraph 4-2.3.2d for firefighting water storage requirements. Buried tanks and associated components of like value shall meet the siting requirements of paragraph 7-13.8. When loss of tank is acceptable, Q-D criteria do not apply to storage tanks and associated components in this category.

7-13.10. UNDERGROUND TANKS OR PIPELINES. Underground tanks or pipelines shall be separated from buildings or stacks containing ammunition and explosives of Class/Division 1.2 through Class/Division 1.4 by a minimum distance of 80 feet. The separation distance for hazard Class/Division 1.1 should be at least $3W^{1/3}$ or a minimum distance of 80 feet unless the donor building is designed to contain the effects of an explosion. Information regarding earth cover required for underground tanks may be found in NFPA 30, chapter 2. Siting of water mains is covered in paragraph 4-2.3.5a. See paragraph 4-2.3.5a for siting water mains used for firefighting.

7-13.11. NAVIGABLE WATERWAYS. Navigable waterways as defined in appendix A shall be considered public traffic routes and subject to the requirements for customary highways of commerce. Occasional use by small fishing and pleasure craft may be ignored.

7-13.12. PARKING AREAS. Parking areas for privately owned automobiles belonging to personnel employed at or stationed at multiple PES's shall be sited at intraline distance from each PES. When a parking area supports a single PES, it may be separated at less than intraline only from its associated facility. A minimum distance of 100 feet is required to the associated facility to protect it from vehicle fires. Access for emergency vehicles must be provided. Parking areas for administrative areas shall be located at public traffic route distance from all PES's (minimum fragment distance shall apply.) At waterfront areas, parking areas may be sited at less than intraline distance to achieve best efficiency and production.

7-13.13. LIQUID OXYGEN FACILITIES. Liquid oxygen storage facilities, other than when used for liquid propellant storage, shall be placed a minimum of 50 feet from explosives storage and operating facilities. Liquid propellant storage requirements are discussed in paragraph 7-9.

7-13.14. PAINT AND SOLVENT STORAGE. Paint and solvent storage buildings used for ready storage of paints, lubricating agents, and solvents (including inhibiting solvents) shall be placed a minimum of 50 feet from operating buildings. Ready storage of limited quantities of paint and solvents within operating buildings is permissible. NFPA approved paint lockers/containers shall be used for such storage.

7-13.15. BOILER HOUSE. If a boiler house is required as part of a plant, it shall be located at the intraline distance required by the appropriate Q-D table.

7-13.16. CHANGE HOUSE. The change house shall contain facilities for bathing, clothes changing for both men and women, lunch rooms for all employees, and may house the plant office. The change house shall be located at an unbarricaded (K18) intraline distance from the nearest building containing explosives based on the quantity and type of explosives allowed in that building, unless it is part of an operating line and used exclusively by personnel employed in that line, in which case it can be located at barricaded (K9) intraline distance. See paragraphs 7-9.1 and 7-9.2.

7-13.17. INTERSERVICE SUPPORT AND TACTICAL FACILITIES. Appropriate safety distances shall be applied between facilities of one military service and those of another service regardless of the location of the boundary between the two installations. The safety criteria based on toxicity, noise, thermal radiation, flight trajectory, fragmentation and incendiary or other hazards are greater than explosives safety distance criteria, the criteria based on the predominant hazard should be considered. The following Q-D relationships shall apply to the separation of facilities of two services, neither of which is a tenant of the other.

a. Explosives storage facilities of one service shall be separated from explosives storage facilities of another service, as a minimum, by the appropriate intermagazine distance.

b. Explosives storage or operating locations of one service shall be separated from explosives operating locations of another service by the appropriate inhabited building distance. When

operations in each facility present a similar degree of hazard or for joint or support operations, this separation may be reduced to the appropriate intraline distance, as though both facilities belonged to a single service.

7-13.18. INSTALLATION BOUNDARIES. Installation boundaries will be treated as inhabited buildings respective of siting criteria unless land outside the boundary is unsuitable for construction or is government-controlled land not open to the public. In such cases, inhabited building Q-D arcs may penetrate the boundary. Certification of such encumbrances must be obtained through the site approval process as defined in paragraph 8-1.2.

7-14. Q-D REQUIREMENTS FOR UNDERGROUND STORAGE

7-14.1. GENERAL. This section details Q-D standards for storing all types of ammunition and explosives in natural caverns or in excavated chambers below the natural ground surface, or in any storage facility providing the overpressure confinement effects typically encountered in underground storage. Use criteria of this section when the minimum distance from the perimeter of a storage area to an exterior surface exceeds 0.25 $W^{1/3}$. This minimum distance most often, but not always, equals the thickness of the earth cover. This section addresses explosives safety criteria both with and without rupture of the earth cover. Figure 7-4 illustrates a facility layout and shows key parameters to be used in these criteria. Expected ground shock, debris, and airblast hazards from an accidental explosion in an underground storage facility depend on several variables, including the local geology and site specific parameters. These parameters vary significantly from facility to facility, so criteria listed here will likely be safety conservative for some geologies and configurations. Siting distances other than those listed may be used when validated by approved experimental or analytical results showing equivalent protection to that required. Q-D siting requirements of this section may be determined from applicable equations or by interpolating between table and figure entries. The provisions of this section do not apply to storage in earth-covered magazines built above grade.

7-14.2. TYPES OF UNDERGROUND STORAGE SITES. Two types of underground storage commonly used are the chamber type and the cavern type. The chamber type of underground facility may be a single chamber or a series of connected chambers. The chamber type usually has rectangular chambers excavated at sufficient depth to provide the required cover thickness without having to construct a descent for access. The cavern type of underground facility, usually a large area of irregular shape, is often divided into smaller areas by natural formations.

7-14.3. EXPLOSION EFFECTS IN UNDERGROUND STORAGE SITES. Confinement caused by the very limited space in underground storage will cause very high pressures of prolonged duration from an accidental explosion. Blast waves and dynamic flow fields will travel at high velocity throughout the underground facility, causing ground shocks and potential break-up of the cover with attendant debris throw. Under conditions of heavy confinement and high loading density

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Table 7-9. Class/Division 1.1 Inhabited Building and Public Traffic Route Distance

Distance in Feet to Inhabited Building From					Distance in Feet to Public Traffic Route From			
NEW (lbs)	Earth-Covered Magazine			Other PES	Earth-Covered Magazine			Other PES
	Front	Side	Rear		Front	Side	Rear	
Col 1	Col 2[1,8]	Col 3[1,8]	Col 4[2,8]	Col 5[3]	Col 6[8]	Col 7[5,8]	Col 8[6,8]	Col 9[7]
1	500	250	250	1,250	300	150	150	750
2	500	250	250	1,250	300	150	150	750
5	500	250	250	1,250	300	150	150	750
10	500	250	250	1,250	300	150	150	750
20	500	250	250	1,250	300	150	150	750
30	500	250	250	1,250	300	150	150	750
40	500	250	250	1,250	300	150	150	750
50	500	250	250	1,250	300	150	150	750
100	500	250	250	1,250	300	150	150	750
150	500	250	250	1,250	300	150	150	750
200	700	250	250	1,250	420	150	150	750
250	700	250	250	1,250	420	150	150	750
300	700	250	250	1,250	420	150	150	750
350	700	250	250	1,250	420	150	150	750
400	700	250	250	1,250	420	150	150	750
450	700	250	250	1,250	420	150	150	750
500	1,250	1,250	1,250	1,250	750	750	750	750
600	1,250	1,250	1,250	1,250	750	750	750	750
700	1,250	1,250	1,250	1,250	750	750	750	750
800	1,250	1,250	1,250	1,250	750	750	750	750
900	1,250	1,250	1,250	1,250	750	750	750	750
1,000	1,250	1,250	1,250	1,250	750	750	750	750
1,500	1,250	1,250	1,250	1,250	750	750	750	750
2,000	1,250	1,250	1,250	1,250	750	750	750	750
3,000	1,250	1,250	1,250	1,250	750	750	750	750

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Table 7-9. Class/Division 1.1 Inhabited Building and Public Traffic Route Distance (Continued)

Distance in Feet to Inhabited Building From					Distance in Feet to Public Traffic Route From			
NEW (lbs)	Earth-Covered Magazine			Other PES	Earth-Covered Magazine			Other PES
	Front	Side	Rear		Front	Side	Rear	
Col 1	Col 2[1,8]	Col 3[1,8]	Col 4[2,8]	Col 5[3]	Col 6[8]	Col 7[5,8]	Col 8[6,8]	Col 9[7]
4,000	1,250	1,250	1,250	1,250	750	750	750	750
5,000	1,250	1,250	1,250	1,250	750	750	750	750
6,000	1,250	1,250	1,250	1,250	750	750	750	750
7,000	1,250	1,250	1,250	1,250	750	750	750	750
8,000	1,250	1,250	1,250	1,250	750	750	750	750
9,000	1,250	1,250	1,250	1,250	750	750	750	750
10,000	1,250	1,250	1,250	1,250	750	750	750	750
15,000	1,250	1,250	1,250	1,250	750	750	750	750
20,000	1,250	1,250	1,250	1,250	750	750	750	750
25,000	1,250	1,250	1,250	1,250	750	750	750	750
30,000	1,250	1,250	1,250	1,250	750	750	750	750
35,000	1,250	1,250	1,250	1,310	750	750	750	785
40,000	1,250	1,250	1,250	1,370	750	750	750	820
45,000	1,250	1,250	1,250	1,425	750	750	750	855
50,000	1,290	1,290	1,250	1,475	775	775	750	885
55,000	1,330	1,330	1,250	1,520	800	800	750	910
60,000	1,370	1,370	1,250	1,565	820	820	750	940
65,000	1,405	1,405	1,250	1,610	845	845	750	965
70,000	1,440	1,440	1,250	1,650	865	865	750	990
75,000	1,475	1,475	1,250	1,685	885	885	750	1,010
80,000	1,510	1,510	1,250	1,725	905	905	750	1,035
85,000	1,540	1,540	1,250	1,760	925	925	750	1,055
90,000	1,570	1,570	1,250	1,795	940	940	750	1,075
95,000	1,595	1,595	1,250	1,825	960	960	750	1,095
100,000	1,625	1,625	1,250	1,855	975	975	750	1,115

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Table 7-9. Class/Division 1.1 Inhabited Building and Public Traffic Route Distance (Continued)

Distance in Feet to Inhabited Building From					Distance in Feet to Public Traffic Route From			
NEW (lbs)	Earth-Covered Magazine			Other PES	Earth-Covered Magazine			Other PES
	Front	Side	Rear		Front	Side	Rear	
Col 1	Col 2[1,8]	Col 3[1,8]	Col 4[2,8]	Col 5[3]	Col 6[8]	Col 7[5,8]	Col 8[6,8]	Col 9[7]
110,000	1,740	1,740	1,290	1,960	1,045	1,045	770	1,175
120,000	1,855	1,855	1,415	2,065	1,110	1,110	850	1,240
125,000	1,910	1,910	1,480	2,115	1,165	1,165	890	1,270
130,000	1,965	1,965	1,545	2,165	1,180	1,180	925	1,300
140,000	2,070	2,070	1,675	2,255	1,245	1,245	1,005	1,355
150,000	2,175	2,175	1,805	2,350	1,305	1,305	1,085	1,410
160,000	2,280	2,280	1,935	2,435	1,370	1,370	1,160	1,460
170,000	2,385	2,385	2,070	2,520	1,430	1,430	1,240	1,515
175,000	2,435	2,435	2,135	2,565	1,460	1,460	1,280	1,540
180,000	2,485	2,485	2,200	2,605	1,490	1,490	1,320	1,565
190,000	2,585	2,585	2,335	2,690	1,550	1,550	1,400	1,615
200,000	2,680	2,680	2,470	2,770	1,610	1,610	1,480	1,660
225,000	2,920	2,920	2,810	2,965	1,750	1,750	1,685	1,780
250,000	3,150	3,150	3,150	3,150	1,890	1,890	1,890	1,890
275,000	3,250	3,250	3,250	3,250	1,950	1,950	1,950	1,950
300,000	3,345	3,345	3,345	3,345	2,005	2,005	2,005	2,005
325,000	3,440	3,440	3,440	3,440	2,065	2,065	2,065	2,065
350,000	3,525	3,525	3,525	3,525	2,115	2,115	2,115	2,115
375,000	3,605	3,605	3,605	3,605	2,165	2,165	2,165	2,165
400,000	3,685	3,685	3,685	3,685	2,210	2,210	2,210	2,210
425,000	3,760	3,760	3,760	3,760	2,250	2,250	2,250	2,250
450,000	3,830	3,830	3,830	3,830	2,300	2,300	2,300	2,300
475,000	3,900	3,900	3,900	3,900	2,340	2,340	2,340	2,340
500,000	3,970	3,970	3,970	3,970	2,380	2,380	2,380	2,380
600,000				4,215				2,530

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Table 7-9. Class/Division 1.1 Inhabited Building and Public Traffic Route Distance (Continued)

NEW (lbs)	Distance in Feet to Inhabited Building From Earth-Covered Magazine Front	Side	Rear	Other PES	Distance in Feet to Public Traffic Route From Earth-Covered Magazine Front	Side	Rear	Other PES
Col 1	Col 2[1,8]	Col 3[1,8]	Col 4[2,8]	Col 5[3]	Col 6[8]	Col 7[5,8]	Col 8[6,8]	Col 9[7]
700,000				4,400				2,640
800,000				4,640				2,785
900,000				4,825				2,895
1,000,000				5,000				3,000
1,250,000				5,385				3,230
1,500,000				5,725				3,435
1,750,000				6,025				3,620
2,000,000				6,300				3,780
2,250,000				6,550				3,930
2,500,000				6,785				4,070
2,750,000				7,005				4,205
3,000,000				7,210				4,325
3,250,000				7,405				4,445
3,500,000				7,590				4,555
3,750,000				7,770				4,660
4,000,000				7,935				4,760
4,250,000				8,100				4,860
4,500,000				8,255				4,955
4,750,000				8,405				5,045
5,000,000				8,550				5,130
5,500,000				8,825				5,295
6,000,000				9,085				5,450
6,500,000				9,330				5,600
7,000,000				9,565				5,740
7,500,000				9,785				5,870

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Table 7-9. Class/Division 1.1 Inhabited Building and Public Traffic Route Distance (Continued)

Distance in Feet to Inhabited Building From					Distance in Feet to Public Traffic Route From			
NEW (lbs)	Earth-Covered Magazine			Other PES	Earth-Covered Magazine			Other PES
	Front	Side	Rear		Front	Side	Rear	
Col 1	Col 2[1,8]	Col 3[1,8]	Col 4[2,8]	Col 5[3]	Col 6[8]	Col 7[5,8]	Col 8[6,8]	Col 9[7]
8,000.00				10,000				6,000
8,500.00				10,205				6,125
9,000.00				10,400				6,240
9,500.00				10,590				6,355
10,000.00				10,770				6,465
11,000.00				11,120				6,670
12,000.00				11,445				6,870
13,000.00				11,755				7,055
14,000.00				12,050				7,230

[1]Basis for columns 2 and 3 distances:

1-45,000 lb - debris hazard - lesser distances permitted if proved sufficient to limit hazardous debris to 1/600 ft^2. Formula $D=35W^{1/3}$ (blast overpressure) may be used if fragments and debris are absent.

45,000-100,000 lb - blast overpressure hazard. Computed by formula $D=35W^{1/3}$.

100,000-250,000 lb - blast overpressure hazard. Computed by formula $D=0.3955W^{0.7227}$.

250,000 lb and above - blast overpressure hazard. Computed by formula $D=50W^{1/3}$.

(Notes continued on next page)

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Table 7-9. Class/Division 1.1 Inhabited Building and Public Traffic Route Distance (Continued)

[2]Basis for column 4 distances:

1-100,000 lb - debris hazard - lesser distances permitted if proved sufficient to limit hazardous debris to 1/600 ft^2. Formula $D=25W^{1/3}$ (blast overpressure) may be used if fragments and debris are absent.

100,000-250,000 lb - blast overpressure hazard. Computed by formula $D=0.004125W^{1.0898}$.

250,000 lb and above - blast overpressure hazard. Computed by formula $D=50W^{1/3}$.

[3]Basis for column 5 distances:

1-30,000 lb - fragments and debris hazard. Lesser distances permitted as follows: (a) thin-cased ammunition and bulk explosives with NEW to 100 lb -670 ft (see subparagraph 7-5.2.1), (b) bare explosives in the open, distances computed by formula $D=40W^{1/3}$. Distances other than 1,250 ft to be used when required by table 7-16.

30,000-100,000 lb - blast overpressure hazard. Computed by formula $D=40W^{1/3}$.

100,000-250,000 lb - blast overpressure hazard. Computed by formula $D=2.42W^{0.577}$.

250,000 lb and above - blast overpressure hazard. Computed by formula $D=50W^{1/3}$.

[4]Column 6 distances have the same hazard bases and are equal to 60% of column 2 distances.

[5]Column 7 distances have the same hazard bases and are equal to 60% of column 3 distances.

[6]Column 8 distances have the same hazard bases and are equal to 60% of column 4 distances.

[7]Column 9 distances have the same hazard bases and are equal to 60% of column 5 distances.

[8]Earth-covered magazines with floor area equal to or greater than 1560 square feet (26 feet x 60 feet) are to use columns 2, 3, 4, 6, 7 and 8. All other earth-covered magazines with a floor area less than 1560 square feet must use columns 5 and 9 distances.

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Table 7-10. Minimum Fragment Protection Distance for Approved Class/Division 1.1 Items[1,7]

NOMENCLATURE	DISTANCE REQUIRED IN FEET			
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
	1 Unit	2 Units	5 Units	10 Units[3]
AGM-65/A	400	500	500	500
AIM-7, MK 38 Whd	700	700	700	700
AIM-9	400	400	400	400
ASROC	500	500[5]	1250	1250
Bomb, 750 lb. M117A2	690	820	1020	1470
Bomb, 500 lb. MK 82	670	860	1080	1240
CHAPARRAL	400	400	400	400
HARPOON	500	1250	1250	1250
IMPROVED HAWK	900	900	900	900
NIKE HERCULES	900	1150	1150	1150
PENGUIN	500	500[4]	1250	1250
Projectile, 175mm, M437A2	450	580	830	2070
Projectile, 155mm, M107	400	510	720	1490
Projectile, 105mm, M1[2]	270	350	500	1000
Projectile, 8 in, MK 25	520	750	960	1240
Projectile, 5 in, MK 49	280	430	660	1000
TOMAHAWK	500	600[5]	1250	1250
Torpedoes (Navy) MK 48, MK 48 Mod 4 and ADCAP	500	500	1250	1250
Torpedo MK 46	500	500	500	500[6]

[1]The minimum distance for protection from hazardous fragments is based on the debris producing characteristics and does not exceed a hazardous fragment density of one hazardous fragment per 600 square feet (56 m^2). Refer to paragraph 7-5.2.8 for application of this table.

[2]105 mm projectiles and 105 mm complete rounds are not in standard storage and shipping containers and are Class/Division 1.1.

[3]Ten units or more until the point is reached at which this distance is exceeded by the requirements of table 7-15 column 5.

[4]This distance applies for a maximum of three units.

[5]In their launch capsules and shipping containers, may be loaded side-by-side in a nose-to-tail configuration on the bed of the truck, driven onto a pier.

[6]Torpedo MK 46 Mod 0 limited to eight units.

[7]Distances listed in columns 2 through 5 represent minimum inhabited building distance requirements. Intraline distances for items listed in column 1 can be derived from the NEW of the Class/Division 1.1 material in the weapon(s) generating the hazard.

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Table 7-11. Intraline Distances for Class/Division 1.1 Items[1]

NEW lbs	Distance in Feet Barricaded $D=9W^{1/3}$	Unbarricaded $D=18W^{1/3}$	NEW lbs	Distance in Feet Barricaded $D=9W^{1/3}$	Unbarricaded $D=18W^{1/3}$
Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	Col. 3
50[2]	30	60	70,000	370	740
100	40	80	75,000	380	760
200	50	100	80,000	390	780
300	60	120	85,000	395	790
400	65	130	90,000	405	810
500	70	140	95,000	410	820
600	75	150	100,000	420	840
700	80	160	125,000	450	900
800	85	170	150,000	480	960
900	85	175	175,000	505	1,010
1,000	90	180	200,000	525	1,055
1,500	105	210	225,000	545	1,090
2,000	115	230	250,000	565	1,135
3,000	130	260	275,000	585	1,170
4,000	145	290	300,000	600	1,200
5,000	155	310	325,000	620	1,240
6,000	165	330	350,000	635	1,270
7,000	170	340	375,000	650	1,300
8,000	180	360	400,000	665	1,330
9,000	185	370	500,000[3]	715	1,430
10,000	195	390	600,000	760	1,520
15,000	225	450	700,000	800	1,600
20,000	245	490	800,000	835	1,650
25,000	265	530	900,000	870	1,740
30,000	280	560	1,000,000	900	1,800
35,000	295	590	1,500,000	1,030	2,060
40,000	310	620	2,000,000	1,135	2,270
45,000	320	640	2,500,000	1,220	2,440
50,000	330	660	3,000,000	1,300	2,600
55,000	340	680	3,500,000	1,365	2,730
60,000	350	700	4,000,000	1,430	2,860
65,000	360	720	5,000,000	1,540	3,080

[1]Intraline separations shall mean the distance to be maintained between any two operating buildings and/or sites within an operating line, at least one of which contains or is designed to contain explosives. The distance from service magazines for the line to the nearest operating building shall be not less than the intraline separation required for the quantity and/or type of explosives contained in the service magazine(s) and not in the operating building. This table is applicable to all installations regardless of construction dates.

[2]For less than 50 lb, less distances, determined by formulae for columns 2 and 3, may be used when structures, blast mats, and the line 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.

[3]Quantities above 500,000 lb NEW are authorized only for Group IV liquid propellants.

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Table 7-12. Class/Division 1.1 Intraline Distances from Earth-Covered Magazines

NEW (lbs)	K9 Application			K18 Application		
	Front	Side	Rear	Front	Side	Rear
50	35	25	20	60	60	45
100	45	30	30	80	75	55
200	60	40	35	100	95	70
300	65	45	40	120	105	80
400	75	50	45	130	120	90
500	80	55	50	140	125	95
600	85	60	50	150	135	100
700	90	60	55	160	140	105
800	90	65	55	170	150	110
900	95	70	60	175	155	115
1,000	100	70	60	180	160	120
1,500	115	80	70	210	185	135
2,000	125	90	75	230	200	150
3,000	145	100	85	260	230	175
4,000	160	110	95	290	255	190
5,000	170	120	100	310	275	205
6,000	180	125	110	330	290	220
7,000	190	135	115	340	305	230
8,000	200	140	120	360	320	240
9,000	210	145	125	370	330	250
10,000	215	150	130	390	345	260
15,000	245	175	150	450	395	295
20,000	270	190	165	490	435	325
25,000	290	205	175	530	470	350
30,000	310	220	185	560	500	370
35,000	325	230	195	590	525	390
40,000	340	240	205	620	545	410
45,000	355	250	215	640	570	425
50,000	370	260	220	660	590	440
55,000	380	265	230	680	610	455
60,000	390	275	235	700	625	470
65,000	400	280	240	720	645	480
70,000	410	290	245	740	660	495
75,000	420	295	255	760	675	505
80,000	430	300	260	780	690	520
85,000	440	310	265	790	705	530
90,000	450	315	270	810	715	540
95,000	455	320	275	820	730	545
100,000	465	325	280	840	745	555
125,000	500	350	300	900	800	605
150,000	530	370	320	960	850	650
175,000	560	390	335	1010	895	700
200,000	585	410	350	1055	935	745
225,000	610	425	365	1090	975	795
250,000	630	440	380	1135	1005	840
275,000	650	455	390	1170	1040	890
300,000	670	470	400	1200	1070	935

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Table 7-12. Class/Division 1.1 Intraline Distances from Earth-Covered Magazines (Continued)

	K9 Application			K18 Application		
NEW (lbs)	Front	Side	Rear	Front	Side	Rear
325,000	675	520	465	1240	1135	1035
350,000	680	570	530	1270	1200	1130
375,000	685	615	600	1300	1265	1230
400,000	690	665	665	1330	1330	1330
500,000	715	715	715	1430	1430	1430

Table 7-13. Relative Intraline Distance Factors from Earth-Covered Magazines

Exposure To	New Range (lb)	Vice K9	Vice K18
Front	1 - 300K[1]	10	18
	300K - 500K	10 - 9	18
Side	1 - 300K	7	16
	300K - 400K	7 - 9	16 - 18
	Over 400K	9	18
Rear	1 - 100K	6	12
	100K - 300K	6	12 - 14
	300K - 400K	6 - 9	14 - 18
	over 400K	9	18

[1]300K = 300,000

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Table 7-14. Application of Intermagazine Distances for Class/Division 1.1 Items

The numbers at an intersection of horizontal and vertical columns in this table indicate the column number to be used in table 7-15. Letters in parenthesis are references to the notes for this table.		1. Standard Earth Covered Magazine (a)				2. Non-Standard Earth Covered Magazine (b)				3. Above-ground Magazine (not earth-covered) (c)		4. Module	
												Module	Cell
FROM		a. Side	b. Rear	c. Front - Unbarricaded	d. Front - Barricaded	a. Side	b. Rear	c. Front - Unbarricaded	d. Front - Barricaded	a. Unbarricaded	b. Barricaded	Barricaded	Barricaded
1. Standard Earth Covered Magazine (a)	a. Side	3	3	5	5	3	3	9	9	9	7(e)	3	3
	b. Rear	3	3	4	4	3	3	9	9	9	7(e)	3	3
	c. Front Unbarricaded	5	4	(d)	(d)	5	4	11	9	11	9	9	9
	d. Front Barricaded	5	4	(d)	(d)	5	4	9	9	9	9	9	9
2. Non-Standard Earth Covered Magazine (b)	a. Side	3	3	5	5	3	3	9	9	9	9	3	3
	b. Rear	3	3	4	4	3	3	9	9	9	9	3	3
	c. Front Unbarricaded	9	9	11	9	9	9	11	9	11	9	9	9
	d. Front Barricaded	9	9	9	9	9	9	9	9	9	9	9	9
3. Above-ground Magazine (not earth covered) (c)	a. Unbarricaded	6	6	11	9	6	6	11	9	11	9	9	9
	b. Barricaded	6	6	9	9	6	6	9	9	9	9	9	9
4. Module — Module	a. Barricaded	3	3	9	9	3	3	9	9	9	9	3	3
4. Module — Cell	b. Unbarricaded	3	3	9	9	3	3	9	9	9	9	3	3

(a) Standard Earth-Covered Magaines. These magazines, when sited in accordance with entries in this table labeled "Standard Earth-Covered Magazine," are approved for all quantities of explosives up to 500,000 pounds (227,273 kg) NEW, with the exception of NAVFAC box-types C, D, E and F which are rated for 350,000 pounds NEW. These maximum NEW limits may be raised to 500,000 pounds NEW when these magazines are sited as "Aboveground Magazines."

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Table 7-14. Application of Intermagazine Distances for Class/Division 1.1 Items (Continued)

(1) Reinforced concrete, arch-type, earth-covered magazines whose construction is at least equivalent in strength to the requirements of the Office of Engineers (OCE), Department of the Army, drawings 652-686 through 652-693, 27 December 1941, as revised 14 March 1942, drawings 33-15-06, 33-15-58 (atomic blast resistant), 33-15-61 and 33-15-74. For new construction use drawings 33-15-74.

(2) Magazines constructed according to Navy drawings 357428 through 357430, 9 August 1944, and modified in accordance with NAVFAC drawing 626739, 19 March 1954; and NAVFAC drawings 627954 through 627957, 764597, 658384 through 658388, 724368, 751861, 764596, 793746, and 793747. For new construction use NAVFAC drawings 1404310 through 1404324, September 12, 1983.

(3) Box-type A magazines constructed according to NAVFAC drawings 1404000 through 1404007 and box-type B magazines constructed to NAVFAC drawings 1404018 through 1404025; box-type C magazines constructed according to NAVFAC drawings 1404430 through 1404444, 20 September 1985; box-type D magazines constructed according to drawings 1404465A through 1404478, 20 September 1985; box-type E magazines constructed according to NAVFAC drawings 1404523 through 1404537, 4 June 1987; and box-type F magazines constructed according to NAVFAC drawings 1404541 through 1404555, 9 June 1987.

(4) Earth-covered, corrugated steel, arch-type magazines at least equivalent in strength to those shown on Army OCE drawing AW 33-15-63, 5 March 1963; AW 33-15-64, 10 May 1963; 33-15-65, 10 January 1963; and NAVFAC drawings number 1059128-30, 1059132, 1069906, and 1355460-61. OCE 33-15-73 (oval 1-gage steel arch) and NAVFAC drawings numbered 1404026-1404034 (oval 1-gage steel arch) are no longer approved for new construction; however, existing magazines are considered "standard." For new construction of large magazines of this type use the earth-covered steel, semicircular-arch magazines design shown on Army OCE drawing 421-80-01 and for new construction of smaller magazines of this type use OCE drawing AW 33-15-65 addressed above.

(5) Earth-covered circular composite arch magazine described in NAVFAC drawings 1404375 through 1404389, 31 October 1985, and the earth-covered oval composite arch magazine described in NAVFAC drawings 1404390 through 1404398, 31 October 1985.

(b) Nonstandard, Earth-Covered Magazines. These magazines, when sited in accordance with entries in this table labeled "Nonstandard Earth-Covered Magazine," are approved for all quantities of explosives up to 250,000 pounds (113,636 kg) NEW. This maximum NEW may be raised to 500,000 pounds NEW when these magazines are sited as "Aboveground Magazines."

(1) Earth-covered magazines whose construction is not equivalent in strength to the requirements of subparagraph (a), above.

(2) Magazines constructed in accordance with NAVFAC drawings 649602 through 649605, 793748, and 803060.

(c) Aboveground magazines are all types abovegrade, not earth-covered, magazines or storage pads.

(d) Reference paragraph 7-7.1.8.b.

(e) Separation distance of 125 ft is authorized where an earth-covered magazine contains only Class/Division 1.2 ammunition.

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Table 7-15. Class/Division 1.1 Intermagazine Hazard Factors and Distances for Use with Table 7-14

NEW	$1.1W^{1/3}$	$1.25W^{1/3}$	$2W^{1/3}$	$2.75W^{1/3}$	$4W^{1/3}$	$4.5W^{1/3}$	$5W^{1/3}$	$6W^{1/3}$	$8W^{1/3}$	$11W^{1/3}$
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11
100	7	7	9	13	18	21	24	28	36	51
200	7	7	12	16	24	26	30	35	48	64
300	7	8	13	18	26	30	32	40	52	74
400	8	9	15	20	30	33	36	44	60	81
500	9	10	16	22	32	36	40	48	64	87
600	9	11	17	23	34	38	44	51	68	93
700	10	11	18	24	36	40	44	53	72	98
800	10	12	19	26	38	42	48	56	76	102
900	11	12	19	27	38	43	48	58	76	106
1,000	11	13	20	28	40	45	50	60	80	110
1,500	13	14	23	31	46	52	56	69	92	126
2,000	14	16	25	34	50	57	64	76	100	139
3,000	16	18	29	40	58	65	72	86	116	158
4,000	17	20	32	44	64	72	80	95	128	175
5,000	19	21	34	47	68	77	84	103	136	188
6,000	20	23	36	50	72	82	92	109	144	200
7,000	21	24	38	53	76	86	96	115	152	210
8,000	22	25	40	55	80	90	100	120	160	220
9,000	23	26	42	57	84	94	104	125	168	230
10,000	24	27	43	59	86	97	108	130	172	235
20,000	30	35	55	75	110	120	140	165	220	300
30,000	35	40	60	85	120	140	160	185	240	340
40,000	40	45	70	95	140	150	170	205	280	375
50,000	40	45	75	100	150	170	180	220	300	405
60,000	45	50	80	110	160	180	200	235	320	430
70,000	45	50	80	115	160	185	210	245	320	455
80,000	45	55	85	120	170	195	220	260	340	475
90,000	50	55	90	125	180	200	220	270	360	495

Table 7-15. Class/Division 1.1 Intermagazine Hazard Factors and Distances for Use with Table 7-14 (Continued)

NEW	$1.1W^{1/3}$	$1.25W^{1/3}$	$2W^{1/3}$	$2.75W^{1/3}$	$4W^{1/3}$	$4.5W^{1/3}$	$5W^{1/3}$	$6W^{1/3}$	$8W^{1/3}$	$11W^{1/3}$
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11
100,000	50	60	95	130	190	210	230	280	380	510
125,000	55	65	100	140	200	225	250	300	400	550
150,000	60	65	105	145	210	240	260	320	420	585
175,000	60	70	110	155	220	250	280	335	440	615
200,000	65	75	115	160	230	260	290	350	460	645
225,000	65	75	120	165	240	270	300	365	480	670
250,000	70	80	125	175	250	285	320	380	500	695
300,000	75	85	135	185	270	300	340	400	540	735
350,000	80	90	140	195	280	320	350	425	560	775
400,000	80	90	145	205	290	330	370	440	580	810
450,000	85	95	155	210	310	345	380	460	620	845
500,000	85	100	160	220	320	360	400	475	640	875
600,000	95	105	170	230	340	380	420	505	680	930
700,000	100	110	180	245	360	400	440	535	720	975
800,000	100	115	185	255	370	420	460	555	740	1,020
900,000	105	120	195	265	390	435	480	580	780	1,060
1,000,000	110	125	200	275	400	450	500	600	800	1,100
1,250,000	120	135	215	295	430	485	540	645	860	1,185
1,500,000	125	145	230	315	460	515	570	685	920	1,260
1,750,000	135	150	240	330	480	540	600	725	960	1,325
2,000,000	140	160	250	345	500	570	630	755	1,000	1,385
2,250,000	145	165	260	360	520	590	660	785	1,040	1,440
2,500,000	150	170	270	375	540	610	680	815	1,080	1,495
2,750,000	155	175	280	385	560	630	700	840	1,120	1,540
3,000,000	160	180	290	395	580	650	720	865	1,160	1,585
3,250,000	165	185	295	405	590	670	740	890	1,180	1,630
3,500,000	165	190	305	415	610	680	760	910	1,220	1,670
3,750,000	170	195	310	430	620	700	780	930	1,240	1,710

Table 7-15. Class/Division 1.1 Intermagazine Hazard Factors and Distances for Use with Table 7-14 (Continued)

NEW	$1.1W^{1/3}$	$1.25W^{1/3}$	$2W^{1/3}$	$2.75W^{1/3}$	$4W^{1/3}$	$4.5W^{1/3}$	$5W^{1/3}$	$6W^{1/3}$	$8W^{1/3}$	$11W^{1/3}$
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11
4,000,000	175	200	315	435	630	715	790	950	1,260	1,745
4,250,000	180	200	325	445	650	730	810	970	1,300	1,780
4,500,000	180	205	330	455	660	740	830	990	1,320	1,815
4,750,000	185	210	335	460	670	760	840	1,010	1,340	1,850
5,000,000	190	215	340	470	680	770	860	1,025	1,360	1,880
5,500,000	195	220	355	485	710	795	880	1,060	1,420	1,940
6,000,000	200	225	365	500	730	820	890	1,090	1,460	2,000
6,500,000	205	235	375	515	750	840	930	1,120	1,500	2,055
7,000,000	210	240	385	525	770	860	960	1,150	1,540	2,105
7,500,000	215	245	390	540	780	880	980	1,175	1,560	2,155
8,000,000	220	250	400	550	800	900	1,000	1,200	1,600	2,200
8,500,000	225	255	410	560	820	920	1,020	1,225	1,640	2,245
9,000,000	230	260	415	570	830	935	1,040	1,250	1,660	2,290
10,000,000	235	270	430	595	860	970	1,080	1,295	1,720	2,370
11,000,000	245	280	445	610	890	1,000	1,110	1,335	1,780	2,415
12,000,000	250	285	460	630	920	1,030	1,140	1,375	1,840	2,520
13,000,000	260	295	470	645	940	1,060	1,160	1,410	1,880	2,585
14,000,000	265	300	480	665	960	1,085	1,210	1,445	1,920	2,640
15,000,000	270	310	495	680	990	1,110	1,230	1,480	1,980	2,715

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Table 7-16. Quantity-Distance Requirements for Category (04), Class/Division 1.2 Items[1,2]

NEW	DISTANCE IN FEET				
	Inhabited Building Distance	Public Traffic Route Distance	Intraline Distance	Aboveground Magazine Distance	Earth-Covered Magazine Distance
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
No limit specifically required for safety reasons	400	240	200	200[3]	See Note 4

[1]Refer to SW020-AC-SAF-010/020/030 for the list of category (04) Class/Division 1.2 items.

[2]For reasons of operational necessity and as approved by NAVORDCEN or NAVORDCEN LANTDIV/PACDIV ESSO, limited quantities of items in this class, except 20 mm, may be stored in facilities such as hangars, troop buildings, and manufacturing or operating buildings without regard to quantity-distance. Examples of such items include small destructors, fuzes, firing devices, 40 mm grenades, and aircraft egress devices. Fragmentation shielding shall be provided.

[3]Refer to paragraph 8-2.4.4 for module storage criteria.

[4]Earth-covered magazines may be used to their physical capacity for this category of material provided they comply with the construction and siting requirements for any quantity of Class/Division 1.1 material. See paragraph 7-7.1.8f.

Table 7-17. Quantity-Distance Requirements for Category (08), Class/Division 1.2 Items[1,2]

NEW	DISTANCE IN FEET				
	Inhabited Building Distance	Public Traffic Route Distance	Intraline Distance	Aboveground Magazine Distance	Earth-Covered Magazine Distance
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
No limit specifically required for safety reasons	800	480	400[2]	300[3]	See Note 4

[1]Refer to NAVSEA SW020-AC-SAF-010/020/030 for the list of category (08) Class/Division 1.2 items.

[2]If the high explosives in (08) 1.2 items at an operating line PES is limited to 5,000 lb, intraline distance may be reduced to 200 ft.

[3]Refer to paragraph 8-2.4.4 for module storage criteria.

[4]Earth-covered magazines may be used to their physical capacity for this category of material provided they comply with the construction and siting requirements for any quantity of Class/Division 1.1 material. See paragraph 7-7.1.8f.

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Table 7-18. Quantity-Distance Requirements for Category (12), Class/Division 1.2 Items[1,2]

	DISTANCE IN FEET				
NEW	Inhabited Building Distance	Public Traffic Route Distance	Intraline Distance	Aboveground Magazine Distance	Earth-Covered Magazine Distance
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
500,000 lb.	1,200	720	600[3]	300[4]	See Note 5

[1]Refer to NAVSEA SW020-AC-SAF-010/020/030 for the list of category (12) Class/Division 1.2 items.

[2]Items of this category present a risk of propagation to adjacent aboveground magazines, particularly when packed in combustible containers. Storage in earth-covered magazines is preferred.

[3]If the high explosives in (12) 1.2 items at an operating line PES is limited to 5,000 lb, intraline distance may be reduced to 200 ft.

[4]Refer to paragraph 8-2.4.4 for module storage criteria.

[5]Earth-covered magazines may be used to their physical capacity for this category of material provided they comply with the construction and siting requirements for any quantity of Class/Division 1.1 material. See paragraph 7-7.1.8f.

Table 7-19. Quantity-Distance Requirements for Category (18), Class/Division 1.2 Items[1,2]

	DISTANCE IN FEET				
NEW	Inhabited Building Distance	Public Traffic Route Distance	Intraline Distance	Aboveground Magazine Distance	Earth-Covered Magazine Distance
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
500,000 lb.	1,800	1,080	900	300	See Note 3

[1]Refer to NAVSEA SW020-AC-SAF-010/020/030 for the list of category (18) Class/Division 1.2 items.

[2]Items of this category present a risk of propagation to adjacent aboveground magazines, particularly when packed in combustible containers. Storage in earth-covered magazines is preferred.

[3]Earth-covered magazines may be used to their physical capacity for this category of material provided they comply with the construction and siting requirements for any quantity of Class/Division 1.1 material. See paragraph 7-7.1.8f.

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Table 7-20. Quantity-Distance Requirements for Class/Division 1.3 Items [1,2]

NEW (lbs)[5,6]	IBD or PTR[3] (ft)	Aboveground IMD or ILD[4] (ft)	NEW (lbs)[6]	IBD or PTR[3] (ft)	Aboveground IMD or ILD[4] (ft)	NEW (lbs)[6,7]	IBD or PTR[4] (ft)	Aboveground IMD or ILD[4] (ft)
1,000	76	50	110,000	307	206	660,000	671	436
2,000	88	57	120,000	315	210	670,000	676	437
3,000	96	63	130,000	322	216	680,000	679	439
4,000	106	69	140,000	330	220	690,000	684	441
5,000	115	76	150,000	337	225	700,000	688	443
6,000	123	81	160,000	345	230	710,000	692	445
7,000	130	86	170,000	362	236	720,000	696	447
8,000	137	91	180,000	360	240	730,000	700	449
9,000	144	96	190,000	367	245	740,000	704	451
10,000	150	100	200,000	375	250	750,000	708	453
12,000	159	105	210,000	383	255	760,000	712	455
14,000	168	111	220,000	390	260	770,000	716	457
16,000	176	118	230,000	398	265	780,000	720	459
18,000	183	120	240,000	405	270	790,000	724	461
20,000	190	126	250,000	413	275	800,000	728	463
22,000	195	130	260,000	420	280	810,000	732	465
24,000	201	134	270,000	428	285	820,000	735	467
26,000	206	138	280,000	435	290	830,000	739	469
28,000	210	142	290,000	443	295	840,000	743	471
30,000	215	145	300,000	450	300	850,000	747	472
32,000	219	147	310,000	458	305	860,000	750	474
34,000	224	149	320,000	465	310	870,000	754	476
36,000	228	151	330,000	473	315	880,000	758	478
38,000	231	153	340,000	480	320	890,000	761	480
40,000	235	156	350,000	488	325	900,000	765	482
42,000	238	157	360,000	495	330	910,000	769	484
44,000	242	159	370,000	503	335	920,000	772	486
46,000	245	161	380,000	510	340	930,000	776	487
48,000	247	163	390,000	518	345	940,000	779	489
50,000	250	165	400,000	525	350	950,000	783	491
52,000	252	167	410,000	533	355	960,000	786	493
54,000	254	169	420,000	541	361	970,000	790	495
56,000	256	171	430,000	548	366	980,000	793	496
58,000	258	173	440,000	556	371	990,000	797	498
60,000	260	176	450,000	564	376	1,000,000	800	500
62,000	262	177	460,000	571	381			
64,000	264	180	470,000	579	386			
66,000	266	182	480,000	586	391			
68,000	268	183	490,000	593	395			
70,000	270	186	500,000	600	400			
72,000	272	186	510,000	605	402			
74,000	274	187	520,000	609	404			
76,000	276	188	530,000	614	407			
78,000	278	189	540,000	618	409			
80,000	280	190	550,000	623	411			
82,000	284	191	560,000	627	413			
84,000	287	192	570,000	632	415			
86,000	290	193	580,000	636	418			
88,000	293	194	590,000	641	420			
90,000	295	195	600,000	645	422			
92,000	296	196	610,000	649	424			
94,000	297	197	620,000	654	426			
96,000	298	198	630,000	658	428			
98,000	299	199	640,000	662	430			
100,000	300	200	650,000	667	432			

[1]Items shall be placed in this Class/Division if they qualify for assignment to it after evaluation in accordance with paragraph 7-4.

[2]For reasons of operational necessity and as approved by NAVORDCEN or NAVORDCEN LANTDIV/PACDIV ESSO, limited quantities in this hazard Class/Division, such as document destroyers, signaling devices, and riot control munitions may be stored without regard to quantity-distance in accordance with fire protection regulations in facilities such as hangars, arms rooms and manufacturing or operating buildings.

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Table 7-20. Quantity-Distance Requirements for Class/Division 1.3 Items [1,2] (Continued)

[3]The same distances are used for Inhabited Building Distance and Public Traffice Route Distance.

[4]The same distances are used for aboveground Intermagazine Distance and Public Traffic Route Distance. Earth-covered buildings may be used to their physical capacity for this division provided they comply with the construction and siting requirements for any quantity of Class/Division 1.1.

[5]Use the required distances specified for 1,000 pounds for quantities less than 1,000 pounds. A lesser distance may be approved when supported by test data and/or analysis.

[6]Linear interpolation of NEW quantities between table entries is permitted.

[7]For quantities above 1,000,000 pounds, the values given in table 7-20 shall be extrapolated by means of cube root scaling, as follows:

For Inhabited Building Distance use $D = 8W^{1/3}$;
For Public Traffic Route use $D = 8W^{1/3}$;
For Intermagazine Distance use $D = 5W^{1/3}$;
For Intraline Distance use $D = 5W^{1/3}$.

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Table 7-21. Quantity-Distance Requirements for Class/Division 1.3 Bulk Smokeless Powder, Ballistite in Process[1] and Not in Containers

Quantity in Pounds Of Smokeless Powder Or Ballistites		Distance in Feet		
Over	Not Over	Inhabited Building Distance	Public Traffic Route Distance	Intraline Distance
100	1,000	100	100	50
1,000	5,000	150	150	75
5,000	10,000	200	200	100
10,000	20,000	250	250	125
20,000	30,000	285	285	145
30,000	40,000	310	310	155
40,000	50,000	330	330	165
50,000	60,000	345	345	175
60,000	70,000	360	360	185
70,000	80,000	375	375	190
80,000	90,000	390	390	195
90,000	100,000	400	400	200
100,000	200,000	500	500	250
200,000	300,000[2]	600	600	300

[1]Such as in propellant dry houses.

[2]Maximum quantity permitted in any one location.

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Table 7-22. Quantity-Distance Requirements for Class/Division 1.4 Items[1,2]

NEW	DISTANCE IN FEET				
	Inhabited Building Distance	Public Traffic Route Distance	Intraline Distance	Aboveground Magazine Distance	Earth-Covered Magazine Distance
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Limited Quantities					
Larger Quantities	100	100	50 (100 if combustible construction)	50 (100 if combustible construction)	No specific separation
No limit specifically required for safety reasons					

[1]Refer to NAVSEA SW020-AC-SAF-010/020/030 for the list of Class/Division 1.4 items.

[2]With reasonable care in storage, Class/Division 1.4 materials may be stored in any weatherproof warehouse area for general supplies provided warehouses used for the storage of Class/Division 1 4 ammunition are separated from all other warehouses by at least the aboveground magazine separation distance specified.

[3]When approved by NAVORDCEN or NAVORDCEN LANTDIV/PACDIV ESSO, limited quantities of items in this Class, except 20 mm HE and incendiary rounds, may be stored in facilities such as hangars, troop buildings, and manufacturing or operating buildings without regard to quantity-distance in order to meet operational requirements. Examples include small-arms ammunition, riot control munitions and pyrotechnics for alert or security purposes. Also, small magazines, when used essentially in the same manner, may be separated by appropriate fire protection distances Marine Corps activities will obtain authorization for storing limited quantities of this class in accordance with MCO 8020.1 (series).

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Table 7-23. Quantity-Distance Criteria for EIDS and Class/Division 1.6 Articles

NEW (lbs)	IBD or PTR (ft)	Aboveground IMD or ILD (ft)	NEW (lbs)	IBD or PTR (ft)	Aboveground IMD or ILD (ft)
100	37	23	75,000	337	211
200	47	29	80,000	345	215
300	54	33	85,000	352	220
400	59	37	90,000	359	224
500	64	40	95,000	365	228
600	67	42	100,000	371	232
700	71	44	110,000	383	240
800	74	46	120,000	395	247
900	77	48	125,000	400	250
1000	80	50	130,000	405	253
2000	101	63	140,000	415	260
3000	115	72	150,000	425	266
4000	127	79	160,000	434	271
5000	137	86	170,000	443	277
6000	145	91	175,000	447	280
7000	153	96	180,000	452	282
8000	160	100	190,000	460	287
9000	166	104	200,000	468	292
10,000	172	108	225,000	487	304
15,000	197	123	250,000	504	315
20,000	217	136	275,000	520	325
25,000	234	146	300,000	536	334
30,000	249	155	325,000	550	344
35,000	262	164	350,000	564	352
40,000	274	171	375,000	577	361
45,000	285	178	400,000	589	368
50,000	295	184	425,000	601	376
55,000	304	190	450,000	613	383
60,000	313	196	475,000	624	390
65,000	322	201	500,000	635	397
70,000	330	206			

[1]The same distances are used for aboveground inter-magazine distances (IMD) and intra-line distances (ILD). Earth-covered magazines may be used to their physical capacity for this division, provided they comply with the construction and siting requirements for Class/Division 1.1.

[2]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 analysis.

[3]Interpolation is permitted. For inhabited building distance (IBD) and public traffic route (PTR) use $D = 8W^{1/3}$. For aboveground IMD and intra-line distance (ILD) use $5W^{1/3}$.

[4]Unit risk distance applies as a minimum; that is, for IBD or PTR, $D = 40W^{1/3}$ or minumum fragment distance, whichever is greater, and for aboveground IMD or ILD $D = 18W^{1/3}$ based on a single round of ammunition. Minimum fragment distance is based on hazardous fragment areal density requirements as determined for Class/Division 1.1 munitions.

[5]For Class/Division 1.6 items packed in non-flammable pallets or packing, stored in earth-covered steel or concrete arch magazines when acceptable to NAVORDCEN (N71) and the DDESB on a site-specific basis, the following quantity-distance criteria apply, unless table 7-23 permits a lesser distance requirement; IBD and PTR--100 ft; aboveground IMD and ILD--50 ft; earth-covered IMD--no specified requirements.

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Table 7-24. Variation of Maritime Prepositioning Ships Inhabited Building Distance/Public Traffic Route

PERCENT HD 1.1	IBD *	PTR
UP TO 52%	40.85	24.01
53	40.97	24.08
54	41.10	24.16
55	41.22	24.23
56	41.35	24.30
57	41.47	24.37
58	41.59	24.44
59	41.71	24.52
60	41.83	24.59
61	41.95	24.66
62	42.07	24.73
63	42.19	24.80
64	42.30	24.86
65	42.42	24.93

NOTE: If HD 1.1 percentage is greater than 65%, use table 7-9.

* Minimum distance is 4,400 feet.

Table 7-25. Variation of Maritime Prepositioning Ships Ship-to-Ship Distance with Loadout

PERCENT HD 1.1	SHIP-TO-SHIP *
UP TO 52%	32.00
53	32.10
54	32.19
55	32.29
56	32.39
57	32.48
58	32.58
59	32.67
60	32.77
61	32.86
62	32.95
63	33.05
64	33.14
65	33.23

NOTE: If HD 1.1 percentage is greater than 65%, use 40W ^ 1/3.

* Minimum distance is 3,500 feet.

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Table 7-26. Minimum Quantity-Distance Separation Between Ship Units (Ship, Barge, and/or Pier) and Other Areas [Note (a)]

Item Number	To Determine Separation Between Ship (or Barge) Units and Following Targets	Note (b) Toward Target Use		Note (c) From Target Use		Remarks
		Table	Column	Table	Column	
1	Terminal Boundary	7-9	5	N/A		
2	Main Ship Channel	7-9	9	N/A		See note (d)
3	Public Highway & Passenger RR	7-9	9	N/A		
4	Admin & Industrial Areas	7-9	5	N/A		
5	Inert Storage Area	N/A		N/A		See paragraph 7-13.6
6	Recreation Area	7-9	9	N/A		See paragraph 7-13.2
7	Steel Tanks on Surface	7-27	5	N/A		See paragraph 7-13.7
8	Explosive Anchorage					
	a. Loaded Ship Area	7-27	5	7-27	5	Larger distance governs
	b. Loading & Unloading Area	7-27	5	7-27	5	Larger distance governs
	c. Ship or Barge Unit (Both in same anchorage)	7-27	4	7-27	4	Larger distance governs
	d. Ship or Barge Unit	7-27	5	7-27	5	Larger distance governs
9	Classification Yard	7-15	9, 11 (g)	N/A		Applicable intermagazine distance for Class/Division 1.1 material

(Table continued on next page)

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Table 7-26. Minimum Quantity-Distance Separation Between Ship Units (Ship, Barge, and/or Pier) and Other Areas [Note (a)] (Continued)

Item Number	To Determine Separation Between Ship (or Barge) Units and Following Targets	Note (b) Toward Target Use		Note (c) From Target Use		Remarks
		Table	Column	Table	Column	
10	Explosives Operating Area	7-11	2,3	7-9	5(f)	Larger distance governs
11	Ammunition & Explosives Storage	7-15	9, 11 (g)	7-9	5(e)	Larger distance governs
12	Holding Yard	7-15	9, 11 (g)	7-9	5	Larger distance governs
13	Truck Holding Yard	7-15	11	7-9	5	Larger distance governs
14	Scuttling Site	N/A		7-27	4 or 5	See figure 7-2
15	Suspect Truck or Car Site	N/A		7-9	5	See paragraph 7-12.6
16	Helipad (Explosives Cargo)	7-11	3	7-9	5	Larger distance governs

NOTES:

(a) The term "ship unit" includes any combination of ship, barge, or pier/wharf not separated from one another by the required distance to prevent propagation between units as defined by paragraph 7-10.6.1.

(b) Use quantity of explosives in ship or barge unit.

(c) Use quantity of explosives at target.

(d) When the minimum separation distance of table 7-9, column 9 cannot be obtained, it is recommended that arrangements be made to stagger the loading and passing of vessels so that the hazards of an explosion during loading of a vessel will be minimized at the closer distances.

(e) Columns 2, 3, and 4 of table 7-9 can be used if the magazine size requirements defined in note 8 of table 7-9 are met.

(f) See paragraph 7-10.7.5.

(g) Table 7-15, column 9 is used when barricades are provided; column 11 when no barricade or inadequate barricades exist.

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Table 7-27. Separation Distances for Pier and Wharf Facilities

Net Explosive Weight (million pounds)	Distance (feet) $6W^{1/3}$ $11W^{1/3}$ $18W^{1/3}$ $40W^{1/3}$			
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
0.001[1]	60	110	180	400
0.01	130	235	390	860
0.10	280	510	835	1855
0.25	380	690	1135	2520
0.50	475	875	1430	3175
0.60	505	930	1520	3375
0.70	535	975	1600	3550
0.80	555	1020	1670	3715
0.90	580	1065	1740	3860
1.00	600	1100	1800	4000
1.25	645	1185	1940	4310
1.50	690	1265	2060	4580
1.75	725	1325	2170	4820
2.00	755	1385	2270	5040
2.25	785	1440	2360	5240
2.50	815	1495	2445	5430
2.75	840	1540	2520	5605
3.00	865	1585	2595	5770
3.25	890	1630	2665	5925
3.50	910	1670	2735	6075
3.75	930	1705	2795	6215
4.00	955	1750	2855	6350
4.25	970	1780	2915	6480
4.50	990	1815	2970	6605
4.75	1010	1850	3025	6725
5.00	1025	1880	3080	6840
5.50	1060	1950	3175	7060
6.00	1090	2000	3270	7270
6.50	1120	2055	3360	7465
7.00	1145	2100	3445	7650
7.50	1175	2155	3525	7830
8.00	1200	2200	3600	8000
8.50	1225	2245	3675	8165
9.00	1250	2290	3745	8320
9.50	1270	2330	3815	8470
10.00	1290	2365	3880	8620
11.00	1330	2440	4005	8895
12.00	1375	2520	4120	9160
13.00	1410	2585	4230	9405
14.00	1445	2655	4340	9640
15.00	1480	2715	4440	9865

[1]The distance given for 0 to 1,000 lb NEW constitutes the minimum spacing permitted.

NOTES