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Safety

Ammunition and Explosives Safety Standards

By Order of the Secretary of the Army:

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History. This publication is a major revision.

Applicability. This pamphlet applies to the Regular Army, the Army National Guard/Army National Guard of the United States, and the U.S. Army Reserve, unless otherwise stated. It also applies to all Army Civilian personnel in a duty status, on, or off a Department of Defense installation; and to all persons at any time on an Army installation. Department of Defense military munitions under U.S. title, even though stored in a host country, remain the responsibility of the U.S. Commander. Storage will conform with Army standards for explosives safety unless the use of more stringent criteria has been agreed to or is mandatory. This pamphlet is applicable during full mobilization.

Proponent and exception authority. The proponent of this pamphlet is the Director of Army Staff. The proponent has the authority to approve exceptions or waivers to this pamphlet that are consistent with controlling law and regulations. The proponent may delegate this approval authority, in writing, to a division chief within the proponent agency or its direct reporting unit or field operating agency, in the grade of colonel or the civilian equivalent. Activities may request a waiver to this pamphlet by providing justification that includes a full analysis of the expected benefits and must include formal review by the activity's senior legal officer. All waiver requests will be endorsed by the commander or senior leader of the requesting activity and forwarded through higher headquarters to the policy proponent. Refer to AR 25–30 for specific requirements.

Suggested improvements. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to usarmy.pentagon.hqda-aso.mbx.army-safety-office@army.mil.

Distribution. This publication is available in electronic media only and is intended for the Regular Army, the Army National Guard/Army National Guard of the United States, and the U.S. Army Reserve.

*This pamphlet supersedes DA Pam 385–64, dated 24 May 2011.

Contents (Listed by chapter and page number)

Chapter 1
Explosives Safety Management Program

1–1. Purpose
This pamphlet explains the Army's safety standards for operations involving ammunition and explosives (AE) (also referred to as military munitions) prescribed by AR 385–10, DoDD 6055.09E, and Defense Explosive Safety Regulation (DESR) 6055.09 for the U.S. Army and Government-owned, contractor-operated facilities and property. Throughout this pamphlet, the term "chemical agent" refers to DoD chemical agent as defined in the glossary.

1–2. References, forms, and explanation of abbreviations
See appendix A. The abbreviations, brevity codes, and acronyms (ABCAs) used in this electronic publication are defined when you hover over them. All ABCAs are listed in the ABCA database located at https://armypubs.army.mil/abca/.

1–3. Associated publications
Policy associated with this pamphlet is found in AR 385–10.

1–4. Records management (recordkeeping) requirements
The records management requirement for all record numbers, associated forms, and reports required by this publication are addressed in the Records Retention Schedule–Army (RRS–A). Detailed information for all related record numbers, forms, and reports are located in Army Records Information Management System (ARIMS)/RRS–A at https://www.arims.army.mil. If any record numbers, forms, and reports are not current, addressed, and/or published correctly in ARIMS/RRS–A, see DA Pam 25–403 for guidance.

1–5. Provisions
This pamphlet includes mandatory procedures and guidance and preferred and acceptable methods of complying with these procedures and guidance.

a. The words "will" and "must" state mandatory requirements. Deviation from these provisions requires a DA Form 7632 (Deviation Approval and Risk Acceptance Document (DARAD)) in accordance with AR 385–10 and paragraph 1–13.

b. The word "should" indicates an optional or preferred method of accomplishment.

c. The word "may" indicates an acceptable or suggested means of accomplishment.

1–6. Explosives safety management programs
a. Per AR 385–10, Army Commands (ACOMs), Army Service Component Commands (ASCCs), and Direct Reporting Units (DRUs) will develop, implement, and manage a written explosives safety management program (ESMP) as an element of the command's overall safety and occupational health programs.

b. Senior commanders (SCs) safety office, or designated safety office, will monitor the ESMPs for all tenant units and activities with AE missions.

c. Commanders or directors of tenant organizations located on Army installations with an AE mission will establish and implement a written ESMP that complies with *paragraph 1–6b*. See AR 385–10 for ESMP requirements.

d. Commanders at and below brigade level or activity will establish an ESMP based on and consistent with the SC's ESMP and complies with AR 385–10 and this pamphlet. As applicable, the ESMP will address the following:

(1) Program oversight, management, coordination, and evaluation.

(2) Technical support requirements from Quality Assurance Specialist (Ammunition Surveillance) (QASAS) personnel, Logistics Assistance Representatives, and ammunition managers.

(3) Explosives safety training for personnel who conduct activities involving munitions.

(4) Internal explosives safety surveys and inspections to determine compliance with AR 385–10 and this pamphlet.

(5) The development and approval of:

(a) Explosives safety policy, directives, and standing operating procedures (SOPs).

(b) Required explosives safety submissions (RESSs) and licenses (per ACOM, ASCC, or DRU policy).

(6) Investigating and reporting mishaps and incidents involving AE, including submission of serious incident reports and chemical event reports and documentation and dissemination of explosives safety lessons learned.

(7) Fire prevention and protection.

(8) Appoint an occupational safety and health manager per AR 385–10 who is qualified under Office of Personnel Management standards to serve as the point of contact (POC) for the ESMP.

(9) Ensure personnel who initiate and review explosives safety risk acceptances for AE-related operations, facilities, or equipment are qualified to provide the commander with the information needed to make an informed decision regarding the risk being accepted.

(10) Ensure operating, training, and construction plans and budgets provide adequate resources to comply with ESMP requirements and mitigate to the extent possible explosives safety hazards per AR 385–10.

1–7. Functions of safety managers

a. ACOM, ASCC, and DRU safety directors must—

(1) Conduct periodic evaluations to ensure the effectiveness of their respective and subordinate commands' ESMPs.

(2) Keep their leadership and staff informed of ESMP requirements and issues and the status of the commander's ESMP.

(3) Brief new commanders of their installation or organizational ESMP status within 30 days of assignment.

b. Safety managers with an AE mission will—

(1) Serve as the POC for all ESMP-related actions.

(2) Identify and validate requirements for RESSs, explosives licenses, explosives safety DARADs, and approved deviations, including measures to mitigate risk, and coordinate, as appropriate, with staff (for example, J–3/G–3/S–3, J–4/G–4/S–4, engineering, and logistics elements) and garrison, installation, and/or unit support personnel.

(3) Ensure potential explosion sites (PESs) and exposed sites (ES) associated with DoD or commercial munitions operating facilities are indicated on approved RESSs.

(4) Ensure that plans and protective construction designs for munitions operating facilities (for example, production, renovation, testing, storage, surveillance, maintenance, munitions response, demilitarization, and disposal) are reviewed for compliance with safety standards by appropriately trained personnel.

(5) Ensure a safety inspection is conducted annually for areas where AE-related activities (for example, production, handling, storage, use, maintenance, munitions response, demilitarization, and disposal) routinely occur. Maintain a list of all such areas and records of inspections.

(6) Monitor AE uploads and other activities that involve the transportation and storage of AE to ensure that applicable requirements are met.

(7) Serve as the focal point for and coordinate ESMP requirements with tenant unit commanders, and provide concurrence on tenant unit ESMPs.

(8) Review, during design phases, the garrison or installation master plan to ensure planned construction or placement of structures are not located within or affected by existing explosives safety quantity-distance (ESQD) arcs and comply with applicable DoD and Army explosives safety standards.

(9) Review policies, hazard analyses, SOPs, and directives for compliance with explosives safety requirements.

(10) Review DARADs and deviations for completeness and accuracy before forwarding for installation staff and/or command level approval.

(11) Maintain a list of approved DARADs and deviations, and advise incoming commanders within 30 days of assignment of status and plans for lasting corrective action(s).

(12) Actively participate in the garrison or installation master planning process and annually review the installation master plan to ensure the construction or placement of structures is not planned inside ESQD arcs. When construction unrelated to AE operations is required within ESQD, ensure the appropriate QS safety submission and explosives licenses are updated and approved at the appropriate staff and/or command level.

(13) Ensure procedures are developed and in place for—

(a) Maintaining fire and chemical hazard symbols current with actual AE stored at a particular location.

(b) Ensuring that personnel responsible for managing AE keep current information on the type and location of AE storage or within other munitions operating facilities and provide this information to safety and firefighting personnel.

(c) Training of personnel responsible for AE-related operations, operational personnel, including security personnel, and firefighters in fire symbols and chemical hazard symbols and in precautions and procedures for fighting fires that involve munitions, including fires within areas (for example, operational range impact areas and demolition sites) known or suspected to contain munitions that are unexploded ordnance (UXO) or DMM.

(d) Existence of adequate communications between safety, firefighting, security, emergency response, and munitions managers (for example, ammunition surveillance and storage personnel).

(e) The maintenance of current maps, showing all explosives locations with the appropriate fire and chemical hazard symbols, and current facility response cards and notebooks for AE storage by fire station communication centers.

(14) Annually review the garrison's or installation's facilities master plan and associated maps to ensure encroachment within ESQD arcs has not occurred and compliance with requirements for RESSs and explosives licenses.

c. Ensure the annual review is documented and maintained within the safety office responsible for the installation ESMP.

(1) Monitor selected AE operations conducted on Army garrisons or installations to ensure all DoD, Federal, State, local, and contractor participants understand and comply with applicable explosives safety standards.

(2) Monitor, periodically, AE-related activities to evaluate explosives safety and the integration of RM. Activities that must be monitored include the following:

(a) AE storage, handling, and operating sites.

(b) AE transportation activities.

(c) AE disposal and demilitarization activities.

(d) Munitions responses conducted at a munitions response site (MRS) and related activities (for example, range clearance activities).

(e) Weapon systems modifications, special exercises, and test programs, particularly those that involve AE.

(f) Planning for contingencies.

(g) Combat load and reload operations.

(h) Explosives safety training records for unit personnel.

(i) Public demonstrations to include "Boss lift," "Organization day," "Open house," and "4th of July" type activities.

(3) Assist commanders and staff with resolving explosives safety concerns associated with real property known or suspected to contain UXO, DMM, or munitions constituents (MC) that are explosive and in concentrations that pose an explosive hazard that, upon evaluation, are determined to be munitions and explosives of concern (MEC).

(4) Investigate and report AE incidents and mishaps per DESR 6055.09, AR 385–10, and DA Pam 385–40, and document and disseminate explosives safety lessons learned.

(5) Brief their command and staff, as necessary, to keep the leadership informed of explosives safety requirements and issues and the status of the commander's ESMP.

1–8. Explosives safety support

Explosives safety-related personnel must be trained in accordance with figure 1–1 and qualified in AE safety, risk management, and munitions-related operations (for example, handling, storage, and production) that support each of the munitions operations conducted. The SC is overall responsible for the ESMP, but the SC may delegate, in writing, SC's ESMP-related responsibilities to the safety directors and managers.

1–9. Explosives safety training

a. All personnel (supervisory and non-supervisory) who conduct AE-related activities must complete explosives safety training appropriate for their actions. Such personnel must receive refresher training to help retain the requisite knowledge and competency in explosives safety.

b. In addition to any explosives safety training specified for career programs in AR 690–950 and related publications and training mandated by local, state, or federal requirements, explosives safety training is indicated in figure 1–1 and will be completed.

(1) Refer to chapter 19 for training and certification requirements associated with AE transportation.

(2) Ordnance and Explosives Safety Specialists must follow the minimum requirements of the Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP)–27 and the Career Program 12 Explosives Safety Handbook.

c. ACOM, ASCC, and DRU safety directors may—

(1) Approve alternative courses that are tailored to the organization's missions, and functions provided the courses provide the same degree and level of training as those listed in figure 1–1.

(2) Allow substitution of equivalent experience for the courses listed.

d. Initial training, as specified in figure 1–1, must be provided as soon as practical based on mission, funding, and resource constraints. As appropriate, garrison, installation, and unit safety managers must develop and provide training officers with the training programs required to ensure garrison, installation, and unit personnel are trained to conduct AE operations safely.

Training Courses	Title of Position Held and Specific Duties Performed										
	Personnel in 0017, 0018 and 0803 Job Series	Safety and Occupational Health Professionals with Explosives Safety Responsibilities	Quality Assurance Specialist/ Ammunition Surveillance (QASAS)	Ammunition Area and Operations Supervisors and Planners	Ammunition Handling and Operating Personnel	Personnel who Prepare, review or Recommend Approval of Site Plans	Personnel Who inspect/Test Grounding, Bonding, and/or Lightning Protection Systems	Personnel Who Handle or Manage Waste Military Munitions	Personnel Who Monitor the Safety of Contractors Handling AE (AE)	Drivers of AE Trucks	Unit Personnel that Request, Pick-up or Turn-in AE
AMMO-28	S	M	M	S	S	M	M		M		
AMMO-31		S	S	S	S			M			
AMMO-45	M	M	M	M [2]	M [2]	M		M	M		M [5]
AMMO-54		M	M	M [2]	M [2]	S	S				
AMMO-63	M	M	M	S	S	M		M	M		
AMMO-64											M [5]
AMMO-67										M [5]	
AMMO-68	S	M	M [6]	S	S			M [75]	S		
AMMO-78	M	M	M	S	S	M			M		
AMMO-82	S	M	M	S	S	M					
AMMO-97		M	M						S		
AMMO-99	S	M	M	S	S	M					
AMMO-100		M	M			M					
AMMO-101		M	M			M					
AMMO-107 [2]	M	M	M	S	S	M			M		
AMMO-112	S	M	M	S	S				M		
Advanced Explosives Safety Management Workshop	S	M	S						S		
Explosives Safety in Tactical Environments Workshop		M [8]	M [8]		M [8]						
Explosives Safety in RDT&E and Industrial Environments Workshop		M [4]	S								
M – mandatory	**S – suggested**										

Figure 1–1. Army explosives safety courses (applicable to military and civilian personnel) 1

LEGEND:

Course Number:	Title:
AMMO-28 (4E-F33/645-F17)	Army Electrical Explosives Safety (CERT)
AMMO-31 (9E-F64/920-F32)	Environmental Considerations for Ammo Pers
AMMO-45 (9E-F67/920-F35)	Introduction to Ammunition (CERT)
AMMO-54 (9E-F68/920-F36)	Risk Mgmt & Prep of SOP for Ammo & Exp (CERT)
AMMO-63 (4E-F44/645-F28)	U.S. Army Expl Safety Familiarization (CERT)
AMMO-64 (4E-F45/645-F29)	Class V Issue & Turn-in Proc for Using Units
AMMO-67 (9E-F69/920-F37)	HAZMAT Familiarization/Safety in Trans (CERT)
AMMO-68 (4E-F46/645-F30)	Military Munitions Rule (Cert)
AMMO-78 (4E-F62/645-F46)	Ammunition Publications (CERT)
AMMO-82 (4E-F24/431-F8)	U.S. Army Explosives Safety Quantity Distance and Site Planning
AMMO-97 (4E-F64/645-F48)	Munitions History Program (MHP)
AMMO-99 (4E-F65/645-F49)	Application of U.S. Army ESQD Principles (CERT)
AMMO-100 (4E-F25/431-F9)	Army Explosives Safety Site Planning (CERT)
AMMO-101 (4E-F25/431-F9)	Tutorial for Using DDESB Approved Automated QD Calculator (Army)
AMMO-107 (4E-F26/431-F10)	Intro to Expl Sfty Mgmt for Sfty Pros (CERT)
AMMO-112 (4E-F28/645-F12)	Ammunition and Explosives Storage Safety (CERT)

NOTES:

Notes:	Description:
1	"DL" indicates distance learning course
2	Prerequisite courses for AMMO-107 are AMMO-45, AMMO-63 and AMMO-78
3	Commanders will designate in writing the Ammunition Area/Operations Supervisors and AE handling and/or operating personnel for which this training is mandatory based on their duties.
4	Mandatory for safety professionals with explosives safety roles and responsibilities in industrial and research, development, test and evaluation (RDTE) missions and functions; recommended for safety professionals with explosives safety roles and responsibilities in munitions response missions and functions.
5	Annual Refresher Training Required
6	Biennial Refresher Training Required
7	Required at locations where WMM are stored, handled, or treated.
8	Mandatory for those that may have tactical deployment responsibilities, recommended for others.

Figure 1–1. Army explosives safety courses (applicable to military and civilian personnel) 1 - continued

1–10. Explosives safety inspections

a. Inspections must be conducted to evaluate the safety of munitions operating facilities (for example, storage, production, packing, handling, surveillance, maintenance, demilitarization, and disposal) at an interval not to exceed 365 days from the last inspection cycle. Inspections must use a team approach and include those subject matter experts (SMEs) with ESMP-assigned responsibilities (for example, safety, explosives safety, QASAS, logistics, fire, security, industrial hygiene, and public works). Findings must be documented, references cited, and recommendations provided. A report will be forwarded to the responsible commander/director. Follow-up actions will be recorded to ensure the implementation of effective and lasting corrective action(s).

b. At the minimum, inspections must address the following:

(1) Availability of approved RESSs and explosives licenses.

(2) Storage inventory, by facility (for example, earth-covered magazine (ECM), above-ground magazine (AGM), arms room), showing AE (by Department of Defense Identification Code (DoDIC), national stock number (NSN), nomenclature, quantity, and total net explosive weight (NEW)) complies with explosives safety standards.

(3) Comparison of actual storage versus that authorized by the approved ESP or explosives license.

(4) Identification of storage compatibility violations.

(5) Munitions storage practices (for example, stacking and, storage magazine planographs) and adequacy of AE packaging, housekeeping, compliance with explosives safety standards, and ammunition storage drawings.

(6) Operations conducted - versus those permitted - in and outside magazines.

(7) Conditions under which AE are stored.

(8) Verify ESQD separation requirements stipulated in approved ESP and explosives licenses.

(9) Evaluation of storage facilities and areas, including the adequacy of earth cover on ECMs, barricades, lightning protection systems (LPS) and ventilators, and LPS inspection and test reports.

(10) Training firefighters; adequacy of plans and procedures for responding to emergencies involving AE; conduct of fire and emergency drills; and availability and adequacy of firefighting equipment, fire symbols, and chemical hazard symbols.

(11) Identify and control electrical hazards, including the classification of hazardous locations and the availability and adequacy of approved equipment.

(12) Safety of material handling equipment (MHE).

(13) Safety of munitions operating facilities and equipment (for example, renovation, modification, and preservation and packaging (P&P)).

(14) Adequacy and availability of explosives safety training for personnel involved in munitions-related activities (for example, storage, packing, handling, surveillance, maintenance, demilitarization, and disposal).

(15) Safe storage of waste military munitions (WMM).

(16) Adequacy and availability of hazard analyses and SOPs and coordination/review/approval process for hazard analyses and SOPs.

1–11. Ammunition and explosives transportation surveys

a. Garrisons, installations, and units must conduct periodic surveys of AE transportation activities to evaluate compliance with explosives safety standards. Surveys must use a team approach and include those SMEs with logistical/transportation assigned responsibilities (for example, contracting, safety, QASAS, logistics, fire, and security). Findings must be documented, references cited, and recommendations provided. A report will be forwarded to the responsible commander/director. Follow-up actions will be recorded to ensure the implementation of effective and lasting corrective action(s).

b. At the minimum, surveys must address the following:

(1) Compatibility of AE in transport.

(2) Training and certification of personnel involved in AE handling and transport.

(3) Sufficiency of installation and unit personnel who maintain an active Transportation Geospatial Information System (TGIS) account to meet requirements.

(4) Actions, where applicable, taken to address Shipments Requiring Satellite Motor Surveillance Service (SNS) Identified as “Not in System” (NIS) in TGIS/Defense Transportation Tracking System Entering the Public Domain.

(5) Inspection of motor vehicles, railcars, shipping containers, and trailers for safety and serviceability.

(6) Compliance with blocking and bracing, placarding, and container stack height requirements.

(7) Training of firefighters; adequacy of plans and procedures for responding to emergencies involving the transportation of munitions; the conduct of fire and emergency response drills; procedures for requesting explosive ordnance disposal (EOD) support; and the availability and adequacy of firefighting equipment, fire symbols, and chemical hazard symbols.

(8) Serviceability and adequacy of MHE for assigned operations.

(9) Proper training and use of ground guides.

(10) Inspection of tactical vehicles used for transport of AE and operator training and licensing.

1–12. Installation ammunition and explosives location maps and geospatial data

a. Each installation must maintain a map showing locations of munitions operating facilities (for example, storage, ammunition holding area (AHA), ATP, and production). This map must be developed jointly by the installation's master planning office, Geographic Information System (GIS) or public works office, plans, operations, safety, security, fire, and logistics offices. The Installation Real Property Utilization Board will use this map when evaluating or proposing new uses or changes in the use of installation real estate. The map and geospatial data must be developed in accordance with AR 115–13 and the latest Spatial Data Standards for Facilities, Infrastructure, and Environment-Vector (SDSFIE–V), Army Adaptation version. Geospatial data must include metadata in accordance with the latest SDSFIE-Metadata (SDSFIE–M) version. The Installation Master Planner must maintain AE location maps.

b. The installation explosives location map, which will be annotated with the date the map and geospatial data were last validated, will include:

(1) Highest hazard class and hazard division (HC/HD) authorized at that site (refer to each ESP or installation master storage plan for NEW limits assigned and approved).

(2) ESQD arcs for each munitions operating facility.

(3) Primary and alternate routes for transporting AE through the garrison or installation.

(4) Locations outside of designated range impact areas authorized for the conduct of AE operations to include on or off-loading and combat aviation AE operations.

(5) Airfield locations designated for jettisoning or addressing hung AE and gun-clearing operations.

(6) Tracked vehicle upload and download areas outside the installation's range complex.

(7) The AE support facilities, such as AHAs, stuff pads, rail receiving yards, safe haven yards, or Hazard of Electromagnetic Radiation to Ordnance (HERO) suspect holding yard.

(8) Real property and facilities known or suspected to contain MEC where a munitions response (cleanup) has been completed or may be required.

1–13. Risk management and explosives safety deviations

a. In accordance with AR 385–10 and DA Pam 385–10, Army leaders will integrate risk management across functional areas (for example, planning, training, research, and development, procurement, testing, and construction) and into every aspect of military missions and operations and by eliminating or controlling adverse and risky conditions that will degrade their execution and value to the Army. Risk management will be applied to Soldiers, Army Civilians, contractors, and, as appropriate, the public throughout the munitions lifecycle.

b. Explosives safety standards are designed to manage the risks associated with AE by providing the minimum criteria required to minimize serious injury, loss of life, and property damage. Although Army policy and these explosives safety standards are considered in mission and operational planning, it is sometimes necessary to deviate from these standards during mission execution.

c. Deviations will not be used for convenience or for ease of operations.

d. Deviations (waivers, exemptions, and secretarial certifications (SecCerts)) from explosives safety standards must be documented using DA Form 7632. Appendix B contains instructions for completing DA Form 7632. The following support documentation must accompany the DA Form 7632 for AE or chemical agent deviations: map or diagrams which depict the hazard area, including QD arcs and/or downwind hazard areas, preferably unclassified, clearly identifying locations and/or facilities of concern; timeline, listing milestones, to eliminate the need for deviation; and other supporting documents as necessary. The DA Form 7632 may cover multiple risks if supported by accompanying documentation describing each hazard and associated risk.

e. An event waiver is a written authority that permits a temporary exception to explosives safety standards for strategic or other compelling reasons when conditions or circumstances requiring the waiver arise unexpectedly, and there is not enough time to comply with formal waiver submission and documentation procedures. Event waivers are for one time emergencies, not to exceed one month. Event waivers do not apply to recurring missions. The responsible commander must approve the event waiver in writing before the onset of operations. Copies of event waivers involving AE or chemical agent s must be provided to the organization's ACOM, ASCC, and/or DRU safety office and the Defense Ammunition Center (DAC) United States Army Technical Center for Explosives Safety (USATCES) for data collection and analysis. Event waivers involving AE or chemical agent s may be documented using a memorandum or command-specific format. Event waivers will include:

(1) Type and NEW QD of munitions involved.

(2) Type of ES. If people are present, estimate the number of civilians and military.

(3) Strategic or other compelling reasons that require the waiver's approval.

(4) Distance required versus distance available and explosives safety standard not met.

(5) Narrative explanation outlining the reasons that explosive standards cannot be met, the reasonable alternatives considered and rejected, and measures to be taken to mitigate the associated risk.

(6) Expected duration of event waiver.

(7) POC name, grade, phone, and email.

f. A waiver is a written authority that permits temporary deviation from explosives safety standards for strategic or compelling operational requirements. Waivers are granted for a period not to exceed five years, pending termination of the waiver or correction of the waived conditions. Exceptional situations may require a waiver to be reissued to allow either completion of the operation requiring the waiver or time for completion of the corrective action. In such cases, the next higher approval authority will reissue the waiver. Copies of waivers to explosives safety standards and reviews of such will be provided to the organization's ACOM, ASCC, and/or DRU safety office, and USATCES for data collection and analysis. AE and chemical agent deviation waivers are reviewed annually to ensure risk assessments are current, to ensure that all exposures, risks, and mitigating actions are identified, and to validate the need for a continuance.

g. An exemption is a written authority that permits long-term noncompliance with Army explosives safety standards for strategic or compelling operational requirements. Exemptions may be granted by law, Congressional action, or in accordance with table 1–1. Exemptions are granted for periods over five years, including permanent situations. Copies of exemptions and reviews involving AE or chemical agents must be provided to the organization's ACOM, ASCC, and/or DRU safety office, and USATCES for data collection and analysis. AE exemptions are reviewed at intervals not exceeding five years to ensure risk assessments are current, all exposures, risks, and mitigating actions are identified, and to validate the need for a continuance.

h. A SecCert is required for new construction that violates explosives safety standards. A SecCert is written authority granted by the Assistant Secretary of the Army for Installations, Energy, and Environment (ASA (IE&E)) to build or perform a major modification on a facility or structure in violation of DoD and Army explosives safety standards. SecCerts only require one time approval for construction and/or modification of the facility or structure: they do not require revalidation or renewal unless there is new construction and/or modification not previously approved. However, upon completion of construction and initiation of AE or chemical agent operations, an exemption must be developed for these operations. Such exemptions are executed and reviewed in accordance with requirements in *paragraph 1–13g*.

(1) SecCerts must be approved by the ASA (IE&E) prior to the expenditure of funds for the project.

(2) A package needs to be completed and submitted through the organization's chain of command having responsibility and authority over the structure to be constructed and/or modified. The submission package will include:

(a) Memorandum requesting SecCert, detailing the operational necessity or compelling reason that requires the SecCert, alternative solutions considered, and mitigation measures, with the chain of command endorsements that validate the operational need or persuasive reason for the SecCert.

(b) The estimated cost and project number (if assigned).

(c) The required contents of associated ESP.

(d) The DA Form 7632 detailing the risk associated with the deviation and acceptance by the appropriate level of command for the use of the facility and/or structure per table 1–1.

(e) Endorsement by the combatant commander or other Military Services involved, if applicable.

(3) Requests for SecCerts are routed through the command channels most responsible for the operation or facility. The commander at each level must approve the request, accepting the risk generated by the deviation, before forwarding the packet to the next review level. The ACOM, ASCC, or DRU commander, Joint Forces Land Component Command (JFLCC) commander, Joint Task Force general officer (GO), or Director, Army National Guard (ARNG) is required to certify that such projects are essential due to operational necessity or other compelling reasons and must explicitly accept the risk generated by the deviation.

(4) Requests for SecCerts for construction and/or modification of an Army facility and/or structure on other Services' installations will be submitted through the Army and the other Service's chain of command. The ASA (IE&E) coordinates the approved submission package with the appropriate official for the other Service.

(5) Requests for SecCerts involving off-installation exposures in foreign nations must be coordinated with the host nations in accordance with applicable international treaties and Status of Forces Agreements before submission to the ASA (IE&E).

Table 1–1
Risk acceptance authority for safety standards deviation

Risk acceptance matrix [2, 3, 4, 5]				
Duration of risk				
	Event waiver	**Waiver**		**Exemption**
Category of risk	1 month or less	1 month to 1 year	1 year to 5 years	Permanent or greater than 5 years
Extremely high risk	General officer (GO)	Army Headquarters Commanding General (CG)	Army Headquarters CG	Army Headquarters CG
High risk	Brigade commanding officer (CO) or responsible O–6	GO	GO	GO
Medium risk	Battalion CO[1] or responsible O–5	Brigade CO[1] or responsible O–6	GO[1]	GO[1]
Low risk	Company CO or responsible O–3	Battalion CO[1] or responsible O–5	Brigade CO[1] or responsible O–6	Brigade CO[1] or responsible O–6

In organizations led by Army Civilian leaders, equivalent civilian grades may be substituted for military ranks. The term "Army Headquarters CG" used in the table refers to ACOMs, ASCCs (including JFLCC and GO level Joint Task Forces (JTFs)), DRUs, and the Director, Army ARNG.

Notes:

[1] May delegate in writing authority to accept at the next lower command level.

[2] For deviations involving violations of AE or chemical agent safety standards during Joint operations planning, training, and execution, refer to CJCSI [43] 60.01 and Service risk acceptance guidance. See also paragraph 1–13k.

[3] High risk (beyond 1 month) or extremely high risk will always be accepted by a GO or flag officer.

[4] For hazards discovered in fielded acquisition programs, risk will be accepted per DA Pam 385–16.

[5] Deviations from range standards and procedures are addressed in AR 385–63.

i. DA Form 7632s must be coordinated and deconflicted with the official responsible for the installation master plan.

j. Deviations from range standards and procedures are addressed in AR 385–63 and DA Pam 385–63. Facility system safety will apply the risk management principles contained in DA Pam 385–16. A DA Form 7632 or System Safety Risk Assessment should be used for chartered system development programs unless another similar document has been identified in accordance with MIL–STD–882, DA Pam 385–16, or the approved System Safety Management Plan. For Joint weapon systems, the Army Weapons System Safety Review Board will review and concur with all system safety risk assessments or equivalent documents per DA Pam 385–16.

k. When Army units, facilities, or operations are tenants on another Service's or allied nation's installation or are subordinate to another Service's or allied nation's lead during Joint operations, Army risk management must include Joint and/or multi-national risk management methodology considerations. Joint operations at non-enduring locations will use the process and procedures in Chairman of the Joint Chiefs of Staff Instruction 4360.01C for deviations from AE safety standards.

(1) CJCSI 4360.01C outlines the consequence and risk identification assessment process for identifying and managing hazards and risks associated with these deviations. Army-led operations determine risk levels per AR 385–10 and DA Pam 385–10.

(2) CJCSI 4360.01C contains requirements for the acceptance of risk associated with waivers and exemptions by geographic combatant commanders and their subordinates when delegated.

(3) CJCSI 4360.01C also outlines the process for gaining military Service Secretary approval (for example, SecCert) for military construction that cannot meet AE or chemical agent safety requirements.

l. DARAD approvals must be kept current. When the organizational leadership transitions, the incoming leadership must be briefed on the existing risks associated with the DARAD and accepts the risk

within 15 days of assignment. However, the expiration date will not extend past the previously approved expiration date.

m. SCs will conduct and document reviews of deviations, per timelines listed above, and provide a copy of the review, with documentation of the approved deviations and mitigation measures, through the chain of command to USATCES for centralized management and oversight no later than 45 days after the date of the review.

n. SCs will report the cancellation of deviations through the chain of command to USATCES no later than 45 days after the date of cancellation.

1–14. Operational range safety

Commands with operational ranges must establish a range safety program consistent with AR 385–63 and DA Pam 385–63. (See figure 1–2 for locations of DA Pam 385–64 tables.)

1–15. Reporting and investigating explosives incidents and mishaps

All AE accidents, incidents, and mishaps must be reported and investigated in accordance with AR 385–10 and DA Pam 385–40. Malfunctions must be reported in accordance with AR 75–1.

1–16. Recognize, retreat, report explosives safety education programs

a. To protect Soldiers and their families who live on Army installations, Army employees and contractors who work on Army installations, and the public, particularly those who live in communities that surround Army installations, SCs will ensure that the command's ESMP includes a requirement for the installation to implement and maintain a 3Rs Program (see https://www.3rs.mil.)

b. When areas (for example, operational, or former operational ranges) that are known or suspected to contain military munitions that may be UXO or DMM are present on an Army installation, including installations affected by base realignment and closure (BRAC), or within Formerly Used Defense Sites (FUDS), the installation or district commander will:

(1) Implement a 3Rs Program (see https://www.3rs.mil) to inform people of the actions to take should they encounter or suspect they have discovered a munition AE. Such training should also be offered to first responders, schools, and community centers on or in close proximity to the installation or FUDS on a periodic or requested basis.

(a) For Army and NG installations, the 3Rs Program should include the provision of 3Rs training or informational material (for example, brochures, fact sheets, videos, on-post television broadcasts, and public service announcements) to people who reside, work, or visit the installation; and the surrounding communities.

(b) For FUDS, when DoD does not control the area, in addition to complying with the notice requirements, public participation, and community relations requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP), the district will implement a 3Rs Program. The 3Rs Program will be implemented in a manner that advises property owners and affected communities of the actions to take should they encounter or suspect they have encountered a munition. Such 3Rs Program may include PSA on local channels, public notices placed in public media venues, and conduct of 3Rs Program training at community centers or public meetings.

(2) The command or district will determine how and the frequency at which training will be provided to the affected populations.

c. The Army's 3Rs Program is a publicly accessible program available at https://www.3rs.mil. The SC's, garrison's, or district's safety office will coordinate with appropriate Public Affairs office and personnel (for example, risk communicators, explosives safety professionals, EOD) who may be requested to support the training. This training requirement will be documented as part of the SC's ESMP. It will indicate the populations (for example, residents, employees, and visitors) receiving or offered 3Rs Program-related training, schools and, grades to which training or 3Rs educational material was provided, and the nature and frequency of the training conducted.

Topic	Subtopic	Description	Table	Title
Courses	Safety Courses	Explosives safety courses	1–1	Army Explosives Safety Courses
Deviations	Risk acceptance	Category and duration of risk Responsible authority	1-2	Risk acceptance authority for safety standards deviation
Distance	Exposed Site (ES)	Measuring distances from ES	8–2	Measuring Distance from ES
	ES Types	Distance, overpressure expected efforts, severities	8	Type of ES and Safe Separation Distance Required
	Safe Separation Distances and Severities	Distance, overpressure expected efforts, severities	8–1	Safe Separation Distances and Expected Severities
	Compatible and incompatible operations	Performance of multiple operations with similar AE hazards	8-6	Concurrent operations
	Conveyor systems	Safe separation distances on conveyor systems at maintenance lines	E–1	Safe conveyor spacing
Distances	HD 1.1, Fragments	HD 1.1 Fragment distance unknown	8–5	Fragment unknown distance for HD 1.1
	HD 1.6, QD	QD separations for HD 1.6	7–2	QD criteria for configuration of HD 1.6 components and assemblies with other HD components

Figure 1–2. List of explosives safety standard tables and locations

Topic	Subtopic	Description	Table	Title
Distances	Ordnance sensitivity groups	Ordnance description/ compatibility groups	15–2	Sensitivity Groups
	Service tanks	QD for unprotected/above ground explosive service tanks	8-4	QD for unprotected above ground service tanks supporting explosives storage or operating complexes
EIDS	Extremely insensitive detonating substance (EIDS) ammunition	EIDS ammunition hazard classification/division	7–1	EIDS and EIDS ammunition hazard divisions
Electrical Hazards	Grounding	Lighting protection electrical test requirements for earth-covered magazines Visual inspection procedures Resistance value between equipment and earth electrode subsystem	16–1	Grounding system inspection and test requirements
	Grounding rod	Ground rod quantity requirements	16–2	Ground rod quantity requirements
	Safe separation for transmitting	Frequency ranges with distance equations	16-3a	Minimum Safe Separation Distance Exceptions
	Safe separation for transmitting	Safe, susceptible, and unsafe classifications defined	16-3b	Safe Separation Distance Calculations
	Lightning Protection	Describes requirements for; materials to use, and how to maintain lightning protection system Identifies type of conductors Details on grounding Bonding strap size and material requirements Air terminal specifications and restrictions	16–4	Lightning protection systems
	Earth electrode system	Ground rods, ground loop/ counter- poise, grid, radial, plates, Test probe C & P distances	B–1	Test probe C and P distances
Fire Prevention	Extinguishing agents	Types of fires by class and their extinguishing agents	6–1	Extinguishing agents for fires
General	Explosive safety tables	List and location of all DA Pam 385–64 Tables	1–3	List of Explosives safety standard tables and Locations
MEC	Explosive residue	Classification of operation and ex- tent of explosive residue	18–1	Phase and extent of explosives residues
	Explosive residue	Explosive absorption based on type of material and explosive phase	18–2	Absorption of explosives as a function of type of material and phase of explosive
	Site plan requirements for munitions of concern	Site plan requirements based on MEC activity	18–3	Explosives safety submission and ESQD site plan requirements for MEC activities
Temperatures	Critical temperatures	Type of explosive, allowable steam temperature, and gage pressure	15-1	Critical Temperatures of Common Explosives

Figure 1–2. List of explosives safety standard tables and locations - continued

Chapter 2
General Ammunitions and Explosives Safety

2–1. Observation and response to imminent danger situations or unsafe acts

When an imminent danger situation or unsafe act is discovered or observed, anyone may stop the operation until responsible parties can rectify conditions per procedures as detailed below.

a. In the event an imminent danger is discovered or observed, immediately cease operations, withdraw personnel from the hazard, and notify the supervisor or activity head. If the supervisor cannot immediately eliminate the hazard within the confines of the approved SOP, the supervisor will inform the activity/unit

safety manager. The safety manager will provide technical advice to the on-scene supervisor, who will either correct the condition to allow affected operations to continue or prohibit operations from proceeding. If mitigation requires revision to a relevant SOP, full revision procedures will be implemented to include a hazard assessment and SOP approval before restarting the operation.

b. If an unsafe act is discovered or observed, immediately stop the operation and report it to a supervisor. Supervisors will ensure the operation is stopped and address any unsafe conditions. If an unsafe act is found to be within the practical application of the applicable SOP, the SOP will be reviewed and revised as necessary before restarting the operation. Interim procedures that correct the unsafe condition may be implemented based on risk assessment pending approval of the revised SOP.

c. All imminent danger situations and unsafe acts observed or reported to a supervisor will be documented by the immediate supervisor with copies provided to the safety office or designated safety officer. Commanders may authorize other personnel to submit this documentation. Among others, a commander may provide such authorization to:

(1) A safety, health, or fire inspector.

(2) A radiation protection officer.

(3) Operators or team members responding to specific SOP instructions regarding identification and reaction to a hazardous or potentially hazardous condition or defined quality defect.

(4) An explosives safety specialist (0017), QASAS, MOS 89B Soldiers assigned as ammunition inspectors in any Army organization, and wage grade ammunition inspectors (WG–6501 series). In addition, local, national equivalents may be authorized to submit such documents outside the continental United States (OCONUS) locations.

2–2. Risk assessments

All operations involving AE will be reviewed to identify and manage the potential risk associated with the operation in accordance with DA Pam 385–10 and this issuance.

2–3. Standing operating procedures

a. SOPs will be developed in accordance with AR 385–10 for each AE operation to ensure workers are informed of information and procedures needed to perform their assigned tasks safely. At a minimum, an SOP must inform those involved in an operation of the hazards involved; the NEW limits for the operation, and, when applicable, each procedural step; the personal protective equipment (PPE), tools, equipment, and materials required and authorized for use during the operation; each worker's authority to stop operations should they observe an unsafe act and responsibly to report unsafe acts; and the approval process for deviating and documenting deviations from the approved SOP. SOPs will be based on an approved job hazard analysis and/or risk assessment to identify the hazards and risks related to the overall operation and, when applicable, the procedural steps involved. Proposed engineering or other controls will be evaluated for effectiveness to mitigate or eliminate the hazards or reduce the risk involved in the operation or, when appropriate, procedural steps to an acceptable level.

b. Before initiating a new AE operation or one that required modification of the applicable SOP:

(1) The responsible authority will approve the SOP, and each operator and supervisor involved will review and sign or, when appropriate, initial the SOP; and

(2) A pre-operational walkthrough will be conducted to ensure each operator understands the tasks for which they are responsible and has the PPE, tools, equipment, and materials required.

2–4. Personnel and explosives limits

Operations must be conducted in a manner that exposes the minimum number of people, for the minimum period of time, to the minimum amount of explosives required to perform safe and efficient operations.

a. Personnel and explosives' NEW limits must be clearly posted in operating bays, readily available for other operations, and must not be exceeded during the operation. Personnel and explosives limits for AE operations will be included in SOPs.

b. Where concurrent operations must be performed in a single building, the layout will be planned to separate operations by a minimum of unbarricaded intraline distance IL(U) unless an adequate barricade is present.

c. Nonessential personnel will be prohibited from visiting the location of operations. This restriction does not prohibit official visits by safety, quality control (QC), management, inspection, or other personnel authorized by the commander.

d. Tasks not necessary to the AE operation will be conducted at an appropriate safe separation distance. Each worker will be responsible for ensuring explosives limits for the work area are not exceeded. Limits will be expressed in total NEW and by the number of munitions, trays, boxes, pallets, or other units that are easily determined and controlled.

e. Explosive limits will be based on the minimum quantity of AE required for the operation and will not exceed the amount of AE required during half a work shift (for example, four, or five hours) consistent with authorized ESQD separation criteria. When required by mission needs, the commander may approve positioning of a greater quantity of AE based on a risk assessment that an approved DARAD document in accordance with paragraph 1–13 and ACOM, ASCC, or DRU policy.

f. The maximum amount of AE of each HD allowed will be clearly posted in each room, cubicle, or building used for storage of AE. The explosives limits for each operation will be clearly posted for operating locations.

g. Organizations or individuals (for example, maintenance, utility, and temporary workers) not associated with explosives operations and their equipment may, when necessary, operate within an explosives area without applying ESQD from a PES provided:

(1) The Army has assessed the potential risks associated with allowing access within an ESQD.

(2) The Army and the organization or individual have a signed contract, lease, or MOU specifying work to be performed. The completed documentation will define the period and conditions under which access will be allowed and under what conditions Army may temporarily or permanently deny access.

(3) The Army and the organization or individual must have documented, assessed, and accepted, in writing, the potential risk associated with the AE operations and the work to be allowed within the ESQD. The documentation will define the period of time and conditions under which access will be allowed and under what conditions such access may be temporarily or permanently denied.

(4) Equipment may be stored within the ESQD arc for an unlimited period of time, provided it does not increase the risk of a fire or explosion. The organization storing non-Army equipment at Army locations must acknowledge, in writing, acceptance of the risk of potential loss or damage to equipment should a fire or explosion occur.

(5) The Army re-assesses the risk posed should a change occur (for example, an increase in the NEW limit) that impacts the area to which access or storage was authorized.

2–5. Material handling equipment

a. General requirements for MHE are listed below.

(1) MHE (for example, forklift trucks, tow motors, powered pallet jacks, and electric hand trucks) will be used safely and efficiently per the local MHE licensing program. In addition to the training required by local licensing programs, operators will be trained on the unique requirements and hazards associated with handling AE.

(2) The MHE operator will inspect mandatory inspection points for MHE to be used before daily use and, as necessary, during sustained use. The operator will also check the MHE for unsafe conditions before and during sustained use.

(3) Unsafe MHE and associated equipment (for example, lifting devices) will not be used until repairs are made.

(4) Safety devices (for example, dead-man switches) will not be circumvented.

(5) Forklifts will meet the requirements of applicable DoD and Occupational Safety and Health Administration (OSHA) standards, whichever is more stringent.

(6) Operators will not use MHE to move loads that exceed the rated capacity of the MHE at the prescribed load center.

(7) MHE will be used only for its intended purpose (for example, forklifts will not be used as towing tractors or for the destruction of waste products).

(8) Containers, pallets, and other material will only be lifted in an authorized manner. Deviations from standard lifting procedures must be approved in writing.

(a) Material will be lifted using forklift pockets, if present, or slung from lifting lugs/eyebolts, if present.

(b) If multiple skids or pallets are to be lifted together, the material must be secured together to ensure the integrity of the lift.

(9) Ground guides will be used by the MHE operator whenever vision is obstructed (for example, obstructed by MHE mast or by cargo movement) or there is a potential for MHE forks to catch, pull, or push adjacent material (for example, weapons, AE, containers).

b. Battery-powered MHE will comply with the following additional requirements.

(1) Battery-powered MHE will be:

(a) Equipped with a dead-man switch and a main-service switch that can be activated from the driver's position.

(b) Provided with a fire extinguisher having a minimum rating of 5 BC (1–A: 10–B: C is recommended).

(c) Used for handling AE inside buildings or poorly ventilated areas. If internal combustion engine-powered MHE has to be used in place of battery-powered MHE, then a risk assessment will be performed, documented, and coordinated through the appropriate safety office for the commander's or director's approval.

(2) Battery-powered equipment used within an explosives area will have electrical cables mounted to prevent catching on stationary objects or damage by cutting or abrasion. Cables will be protected to prevent short-circuiting.

(3) Batteries will be securely fastened. Battery boxes will provide ample ventilation, with ventilation openings that prevent access to the cell terminals from the outside.

(4) Battery charging stations must be separated from AE facilities by the applicable distance (see chapter 8).

(5) The rated equipment defined in the National Fire and Protection Association (NFPA) 505, types E, EE, ES, and EX, are approved for use for handling all classes of AE packed per Department of Transportation (DOT) regulations.

(6) Types EE and ES battery-powered MHE may be used for handling in process AE (for example, sub-assemblies and explosives-loaded components) in corridors or ramps connecting hazardous operations.

(7) Types EE and ES MHE will not be used in areas containing explosive dusts or with explosives that, through handling, may produce explosive dusts.

(8) Type EX MHE is the only MHE approved for use in areas with explosive dusts (NFPA 505). EX equipment does not carry a dual rating and can be used only in hazardous areas for which it is specifically designed.

c. Gasoline, diesel, and liquid petroleum-gas powered MHE will comply with the following additional requirements:

(1) These MHE are appropriate for handling every class of munitions packed per DOT regulations and provided the material is not located in a hazardous location as defined by the NFPA 70, provided precautionary measures and devices (see paragraphs 2–5c(3)-(6) and 2–5*d*) are used. The exterior of packaging materials or exposed AE (for example, projectiles) must not be visibly contaminated with explosive residues or contain exposed explosives.

(2) Use in AGMs or ECMs:

(a) Due to the inherent hazards of operation, gasoline-powered or LP-gas-powered MHE are not recommended for use in AGMs or ECMs.

(b) Diesel-powered equipment may be used in AGMs, and ECMs provided the concentrations of combustion products and noise emitted by the MHE meet the criteria established by OSHA and the Surgeon General.

(3) MHE and other gasoline and diesel-powered equipment used in an AE area will be provided with a fire extinguisher having a minimum rating of 5 BC (1–A: 10–B: C is recommended).

(4) Gasoline and diesel-powered MHE will be equipped with backfire deflectors securely attached to the throat of the carburetor. These deflectors will be of the oil-bath or screen type. Certain types of air cleaners can serve as backfire deflectors. An adequately vented tight fitting cap will be placed on the fuel fill pipe at all times except during refueling. A flame arrester will be installed in the fill pipe. If necessary, a deflector plate will be installed to prevent any overflow from the fuel tank from reaching the motor or the exhaust pipe. On gravity feed systems or pump systems, where siphoning might occur, a shutoff valve will be installed at the fuel tank or in the feed line to permit shutting off the fuel flow during an emergency or break in the fuel line or carburetor. Provisions will be made to protect against vibration rupturing the fuel lines.

(5) Gasoline and diesel-powered MHE and equipment must be checked before being put into operation to ensure sufficient fuel is available to minimize refueling requirements.

(6) Fueling of MHE and other gasoline and diesel-powered equipment will be done in accordance with *paragraph 6–8e*.

d. Liquid petroleum-gas powered MHE will comply with the following additional requirements:

(1) LP-gas-powered MHE and other LP-gas-powered equipment used in AE areas will be provided with a fire extinguisher having a minimum rating of 5 BC (1–A: 10–B: C is recommended).

(2) The LP-gas powered MHE for handling inert material will be type LPS. All fuel lines, fittings, and containers will be designed and installed per NFPA Standard 58 to provide maximum protection against damage to the system by vibration, shock, or objects striking it and against failures from other causes.

(3) The LP-gas-powered MHE and any other LP-gas-powered equipment used in AE must be checked before an operation to ensure all fuel lines, fittings, and containers are secure and sufficient gas is available to reduce refueling or replacement of fuel containers.

e. MHE storage will be in accordance with the following:

(1) Battery, gasoline, or diesel-powered MHE equipment may be stored in:

(a) ECM and other munitions magazines that are empty or only contain inert materials.

(b) Storehouses and other suitable locations designed for that purpose.

(2) Stored MHE must be:

(a) At least 10 feet from combustible material.

(b) Spaced to minimize the spread of fire from one MHE to another.

(3) MHE essential for day-to-day operations may, when necessary, be parked in fire-resistant buildings containing AE, provided the below minimum requirements are met:

(a) The MHE must be stored in an area that is suitably and wholly separated (by firewalls and closed doors) from the bays, rooms, or cubicles that contain AE.

(b) Designed fire-resistant ratings for the bays, rooms, or cubicles containing AE that are not degraded.

(4) When necessary for efficient operation, battery-powered MHE is permitted to be used in buildings or magazines containing AE or other hazardous materials. Such MHE may be temporarily stored in magazines containing packaged AE, and inert warehouses provided the following conditions (designed to prevent fires or other mishaps from occurring during unattended periods) are met:

(a) Periods of idle storage must not exceed four days.

(b) After each workday, MHE will be inspected for hot brakes, leaking oil, or fluid. If found, the affected MHE will be removed from the building.

(c) MHE will be made inoperative (for example, by removing ignition keys, activating shutoff switches, seat control disconnects, and so forth). Battery cables of MHE will not be disconnected within AE storage locations due to the possible arcing when terminals are separated.

(d) MHE will be parked at the maximum distance allowed from munitions and secured.

(e) MHE will not be stored in an operating building that contains exposed explosives, including explosives residues.

2–6. Precautions with ammunition and explosives handling and movement

a. Supervisors will be trained to identify hazards, situations that pose an imminent danger, and unsafe acts and to take corrective actions.

b. Personnel handling AE will be trained to understand the hazards and risks associated with each operation and to recognize situations that pose an imminent danger and unsafe acts.

c. Precautions include:

(1) Use separate protective containers, which prevent item-to-item contact and are marked to identify the contents when moving or handling detonators, initiators, squibs, blasting caps (electrical and nonelectrical), and other initiating devices.

(2) Using only proper equipment for handling AE.

(3) Avoiding penetrating protective coverings when making repairs or securing covers. (Nails may be used to secure covers or repair AE containers only if there is minimal risk to the AE involved.)

(4) Ensuring packing materials and procedures, including nails, comply with technical packing orders, military specifications, or DOT specifications applicable to the respective AE.

(5) Ensuring proper container handling and avoiding tumbling, dragging, or dropping of AE containers. Containers designed with skids may be cautiously pushed or pulled for positioning unless otherwise marked on the container.

(6) Ensuring MHE does not create additional risk. Examples of MHE that need to be evaluated are conveyors, chutes, hand trucks, and forklifts.

(7) Confirming supported or interlocking sections are secured when sectionalized roller conveyors are used to move AE. Munitions containers or boxes will not be used to support conveyors.

(8) Using only authorized and adequately maintained tools that are non-sparking or made of spark-resistant materials (for example, wood, brass, titanium) and under normal conditions will not produce sparks in locations that contain hazardous concentrations of flammable dusts, gases, vapors, or exposed explosives.

(a) Hand tools or other implements used near hazardous materials will be checked for serviceability at the start and end of each work shift. These tools and implements must be handled carefully and kept clean. All tools.

(b) Ferrous-metal hand tools, while generally prohibited, may be used when necessary for their strength. The immediate area must be free from exposed explosives and other highly combustible materials. The use of ferrous-metal tools must be included in the approved hazard analysis (HA) and SOP and approved by the responsible commander or director.

(c) Hand tools containing copper or zinc (for example, brass, or bronze) will not be used in proximity to lead azide or where residuals from the treatment of lead azide may be present. Additionally, avoid allowing lead or copper azide to contact material containing zinc, as there is the possibility of a reaction that could yield a product that has a much higher shock sensitivity.

2–7. Housekeeping

AE storage, handling, and operating facilities and areas associated with AE will be maintained free of debris and rubbish, with an emphasis on avoiding the accumulation of highly combustible materials and waste. Particular attention must be paid to materials and waste which are subject to spontaneous combustion.

a. Hazardous material and waste will be managed as follows:

(1) Highly combustible waste (for example, solvent, oil, or flammable adhesive-soaked rags) and hazardous materials (for example, explosives scrap) will not be mixed with wood, paper, and combustible packing materials. This category of waste will be carefully controlled and must be kept in fire-resistant covered containers until removed from the worksite at the end of each shift. Waste material containers will be marked appropriately.

(2) Except for specific containers designated to be within the AE facility for operational requirements, waste containers will be placed outside the AE facilities at designated and approved locations.

(3) Spontaneously combustible materials (for example, solvent-soaked rags) present an unusual hazard and must be treated with extraordinary care. When materials are known or suspected to be spontaneously combustible, the following applies:

(a) Only approved containers with covers will be used for temporary storage.

(b) Containers will be located outside the AE facility whenever practicable. They will be separated from other combustible materials to prevent the possibility of the spread of combustion in the event of ignition.

(c) Local SOPs must detail the disposition of spontaneously combustible materials to ensure fire hazards are minimized and that such materials are not permitted to accumulate.

b. Containers. Containers for explosive scrap will have covers, preferably self-closing; however, only approved containers with covers will be used for scrap black powder, self-initiating, scrap explosives of similar sensitivity, and rags contaminated with such explosives.

c. Hazard mitigation. When fluid is used in containers for scrap pyrotechnic, flare, and similar mixtures, dangerous gases may be created and released. To minimize the hazards from these gases, scrap will be placed in containers in a manner that provides immediate immersion. These containers must contain enough water, No. 10 mineral oil, or fuel oil for certain pyrotechnic, tracer, flare, and similar mixtures of contaminated rags to be completely immersed.

d. Waste disposal and management. At a minimum, hazardous waste will be removed from all AE facilities and taken to an approved disposal area or temporary collection point at the end of each shift. More frequent intervals (for example, at each break) may be necessary.

(1) Hazardous waste must be managed in accordance with applicable federal, state, and local regulatory requirements.

(2) Hazardous wastes must only be disposed of in authorized facilities.

(3) An SOP will provide detailed disposal procedures for waste management operations.

(4) The organization responsible for hazardous waste disposal will include a list of authorized disposal facilities on waste disposal permits, as the Environmental Protection Agency (EPA) requires.

e. Facilities and cleanup. A regular cleaning program will be established. To ensure safety, the frequency of cleaning, especially in operating buildings, will depend on workplace conditions.

(1) Facility cleaning prior to weekends, holidays, prolonged periods of shutdown, or prior to maintenance will not be done during explosives operations or while AE are in the facility. The SC can authorize special circumstances upon accomplishment of a HA or risk assessment, and the special circumstance(s) are adequately identified in an SOP; for example, a bomb production facility has palletized bombs awaiting transport to storage, and the facility supervisor wants to initiate post-production cleanup processes.

(2) Where there are exposed explosives or risks from accumulating explosive substances (for example, dust), structural members, radiators, heating coils, pipes, electrical fixtures, and similar equipment will be kept clean.

f. Sweeping will be in accordance with the following:

(1) Sweeping compounds containing wax or oil will not be used on conductive floors.

(2) Cleaning agents that include caustic alkalis must not be used in locations containing exposed explosives because sensitive explosive compounds may form.

(3) Where there may be exposed explosives on the floor, hot water or steam is the preferred cleaning method.

(4) When sweeping compounds must be used, they will be nonabrasive.

(5) Sweeping compounds may be combustible but will not be volatile (closed cup flashpoint will not be less than 230 degrees Fahrenheit (F)).

(6) Loose explosives recovered as sweepings will be destroyed.

(7) Explosives that are or have the potential to be contaminated with dirt, dust, grit, or metallic objects must be processed to remove foreign matter before they can be reused; otherwise, they will be destroyed.

Chapter 3
Principles of Ammunition and Explosives Storage

3–1. General requirements

This chapter sets forth the requirements for storage of AE within the U.S. Army. AE must be stored in buildings designed, designated, and isolated for this purpose.

a. When standard ECM or other munitions storage facilities (for example, ABG, Service magazines - see DDESB TP No. 15) are unavailable, buildings used for AE storage must afford protection against moisture and excessive changes in temperature and have means for adequate ventilation. Floors will not be wood or of a material that produces dust. Only authorized heating equipment will be used in structures where heat is permissible, as specified in the approved ESP. Open fires or heating by stoves is not permitted. When munitions are present, buildings will not be used for any other purpose. AE will not be stored in buildings used for other purposes (for example, basements, attics, barracks, company supply rooms, and general storehouses). The exception is small arms ammunition (SAA) that may be stored in arms rooms authorized by an explosives license.

b. The AE will be stacked by lot number and arranged so air can circulate freely beneath and throughout the stack. When multiple lots are stored, all items or containers of a single lot should be kept together. The line of separation between lots must be clearly indicated on a DA Form 3020–R (Magazine Data Card), equivalent marking, or physical separation. Lots of AE must never be mixed randomly. In ECMs, AE will not touch the ceiling or sides of the ECM. Except in ECMs, the tops of AE stacks will be below the level of the eaves but no closer than 18 inches to the roof to avoid the heated space directly below the roof. AE stacks in heated warehouses or other buildings will not be closer than 18 inches to radiators, heaters, or sprinkler heads. The bottom layer should be raised from the floor about 3 inches. Stacks must be level; if necessary, dunnage, shims, or wedges will be used to prevent the stacks from tipping. Stacks will not be so high that AE or AE containers in the lower layers will be crushed or deformed.

c. Boxes, cases, and other containers of AE should be clean and dry before being stored. AE containers will not be opened in a magazine (except as detailed in *paragraph 3–2i*). AE containers must not be stored after having been opened unless securely closed. The exception is that damaged containers in the process of being repaired may be stored overnight. When necessary to store AE in damaged containers overnight, such containers must be separated from serviceable containers of AE. AE containers may be

repaired or exchanged at intraline distance (ILD) from the AE storage facility based on NEW within the container repair or exchange site. However, regardless of NEW, the ILD applied will be a minimum distance of 100 feet from combustible storage structures and 50 feet from noncombustible structures. During container repair or exchange, the AE storage facility's doors will be kept open.

d. Unpackaged munitions or components will not be stored loose in an AE storage facility containing other AE packed per approved drawings. Empty containers, excess dunnage, or tools may be permitted to remain in a magazine only during the period of time required to complete the operations for which they are being used. Oily rags, paint, and other flammable materials will not be left within unoccupied AE storage facilities.

e. Liquid propellants, flammable liquids, gases, corrosives, and oxidizers will not be stored with AE. Nonflammable gas (for example, argon) may be stored in the same storage structure as the AE it supports. When the nonflammable gas is stored with the AE, the gas container's valves must be protected from accidental impact or packed in approved DOT containers. Refer to AR 700–68, Storage, and Handling of Liquefied and Gaseous Compressed Gasses and Their Full and Empty Cylinders for specific management requirements.

f. Munitions containing explosives or combustibles (for example, black powder, tracer composition, or pyrotechnic mixtures) that can deteriorate rapidly in damp or high temperature environments must be stored in AE storage structures that protect against dampness and have adequate ventilation. When such structures are unavailable, they will be under the best cover.

g. Excess combustible materials (for example, wrapping, dunnage, pallets) will not be allowed to accumulate within AE areas. When such materials are no longer required or at the end of each day, they must be removed from magazines and storage areas.

h. Excess non-combustible materials such as banding will be removed and properly disposed of at the end of each day.

i. When a magazine becomes empty, the following procedures will be followed:

(1) When the last AE is removed, the hazard symbols will be removed, and the responsible parties will inspect the magazine and document the inspection. An empty magazine needs not to be inspected before being reused for storage provided:

(a) It was inspected after it was emptied.

(b) Magazines and storage formerly used to store CAs have been certified free of toxic hazards.

(c) All defects noted during the inspection have been verified as being corrected.

(2) Empty magazines must be sealed with a numbered seal to ensure that AE is not stored without proper notification of the AE security and surveillance organizations. Local procedures will be developed to provide appropriate notice to agencies responsible for fire, security, and safety. The integrity of the seals will be inspected at intervals not to exceed 12 months.

(3) Empty magazines at installations selected for base closure will not be used for storage of DoD AE. Once inspected, certified empty, and sealed with a numbered seal, these magazines will no longer require visual inspections or electrical testing for the lightning protection and grounding systems.

3–2. Magazine storage of ammunition and explosives

a. DDESB TP–15 provides a listing of 7-bar and 3-bar structures approved for new construction. The U.S. Army Corps of Engineers (USACE), Huntsville Center has plans and specifications for ECMs and other structures approved for new construction. See the Whole Building Design Guide (WBDG) ammunition storage website (https://www.wbdg.org/building-types/ammunition-explosive-magazines) for drawings and approval letters.

b. A segregated area will be set aside for the munitions storage areas (for example, an ammunition supply point (ASP)). Within such places, magazines, or open revetted storage pads may be used for storing munitions-related inert items.

c. Magazines will be classified as follows:

(1) ECMs. This group includes reinforced concrete-oval arch, Stradley igloo, steel semicircular-arch type, hillside, and subsurface-type magazines. ECMs are preferred for the storage of all AE, requiring special protection for safety and security.

(2) Standard AE magazines (commonly called standard magazines), classed as aboveground magazines. These magazines were designed to store fixed rounds or separate loading projectiles. For future use, such magazines should be restricted to storing HD 1.2, 1.3, and 1.4 materials (excluding rockets and

rocket motors). The NEW storage capacity of the magazines is not stated in definite figures because the amount of NEW that can be stored is regulated by the appropriate ESQD tables.

(3) HEs and black powder magazines, classed as AGM. These magazines, which were designed to store bulk explosives (for example, black powder, trinitrotoluene (TNT), Tetryl, and Explosive D), may be used for this purpose if more desirable storage space cannot be obtained.

(4) Primer and fuze-type magazines, classed as AGMs. These magazines were designed for storing primers, primer detonators, adapters, and boosters, and fuzes. When used, these AGMs should be restricted to storing Classes/Divisions 1.2.2, 1.3 (except rockets and rocket motors), and 1.4 AE.

(5) Service magazines and service storage buildings. These buildings are used for the temporary storage of the minimum amount of AE necessary for safe and efficient processing operations at an associated AE operation. Construction details of such magazines vary, depending upon local circumstances. However, consideration must be given to using fire-resistant materials and/or fire-resistive construction.

d. AE stored in ECMs are better protected from external sources of initiation than AE held in AGM. ECMs provide better temperature control than AGMs and are particularly desirable for storing solid propellants and pyrotechnics.

e. Sudden temperature changes may damage airtight AE containers or result in excessive condensation. If the ambient temperature in an AGM exceeds 100 degrees F for a period of more than 24 hours, the AGM should be cooled by wetting its exterior, opening the doors and ventilators after sunset, and closing them in the morning. If this does not lower the temperature, the commander will decide whether the materials should be removed to some other magazine.

(1) Storage magazines, in general, should not be heated. The exception is when heating may be necessary to prevent condensation, maintain a constant temperature, or for other reasons.

(2) When an approved heater is used within a magazine, the heating element will be at least 18 inches AE in storage.

f. The following requirements will be met wherever AE are stored:

(1) Loose AE (munitions) components, packing materials, conveyors, forklifts, skids, dunnage, empty boxes, and other similar material will not be stored in a magazine containing AE.

(2) Vegetation around AE storage locations will be controlled to minimize fire hazards. (Refer to *para 6–8c*, Vegetation control).

(3) Workers must have an unimpeded path to an exit when personnel are working in a magazine or structure having:

(a) More than one door; at least two doors must be unlocked and ajar.

(b) A single entrance with double doors; both doors must be ajar.

(c) A single entrance with two jack-up style doors; only one door must be open.

g. Stacking will be in accordance with the following:

(1) AE will be stored in containers as prescribed by approved drawings and specifications and must be stacked and arranged in a magazine per approved drawings listed in U.S. Army Materiel Command (AMC) Drawing 19–48–75–5. AE in stacks will be grouped and identified by lots. The general rules in (2) and (3) below should be followed in the absence of applicable storage drawings or when operational necessity prevents adherence to such drawings.

(2) Methods used for stacking must provide ventilation to all parts of the stack. Adequate dunnage will be used, when necessary, for this purpose.

(3) Aisles will be maintained so that AE in each stack may be inspected, inventoried, and removed for shipment or surveillance test. This will allow personnel to escape quickly in emergency situations; aisles will not be obstructed.

(4) The AE returned from users without proper packaging should be repackaged per approved drawings and specifications prior to storage.

h. Unpackaged AE (such as loose rounds) or single fiber containers of AE will not be stored in magazines containing AE that are packed per approved drawings. Unpackaged AE may be stored in structures set aside exclusively for such storage. Incomplete boxes of AE may be stored in magazines containing AE packed per approved drawings. Unfinished boxes of AE, which must be clearly marked to identify the content and quantity of AE, will be stored in designated locations within a magazine. AE in damaged containers will not be stored in a magazine with AE in serviceable containers (see *paragraph 3–1c* for exceptions). Such containers will be repaired or the contents transferred to new or serviceable containers. Open AE containers and AE with covers that do not securely fasten will not be stored in magazines

except for material in service magazines, for which a HA has verified that the storage configuration does not decrease safety, consistent with security requirements.

i. Operations that are specific to storage, inspection, inventory, or shipping are permissible inside a magazine. The presence or absence of an environmental shelter at the magazine does not alter the scope of the following permitted operations. The below operations are permitted within a magazine, provided space, and a rapid egress route is available. Otherwise, they should be performed outside a magazine or on an adjacent apron.

(1) Palletizing and replacement of defective banding.

(2) Removal and replacement of shipping bands on bombs.

(3) Removal and replacement of grommets on separate loading projectiles.

(4) Removal of bomb and projectile plugs for inspection of fuze cavities, cavity liners, and threads.

(a) Do not apply undue force during any phase of a plug removal operation. The only acceptable plug removal tool is a torque wrench designed to break away at excessive torque levels. Power-driven tools, highly flammable or toxic solvents, or ferrous brushes will not be used for this purpose.

(b) Prior to removing a plug, the exterior surface of the projectile or bomb must receive a thorough (360 degrees) visual inspection for signs of exposed explosives or explosive residues. Loosening or removing plugs is not permitted where there is evidence of exposed explosives called exudates on the round or around the plug.

(c) When exposed explosives or explosive residues are observed, plug removal will be stopped and moved to a designated maintenance area per local HA and SOP.

(d) When there are no exposed explosives or explosive residues in the threads or cavities, the projectile or bomb may be cleaned, and preservatives applied.

(e) Plugs will be removed from the magazine for cleaning.

(5) Marking of containers:

(a) Open containers of flammable liquids are not permitted within a magazine or in close proximity to AE.

(b) Use of minimum essential quantities of flammable liquids is allowed outside of the magazine.

(6) Air test of propelling charge containers.

(7) Outer containers of AE may be opened in storage locations for inventory or desiccant change-out provided access to the AE is precluded; however, AE containers will not be opened within a storage location for issuing AE.

(8) For magazines that only store HD 1.4, P&P, unpacking, inspecting, and repackaging are allowed, provided there is sufficient room in the magazine, and standard precautions are taken.

(9) Operations incident to liquid level determination using a probe sensor, ultrasonic device, or x-ray device.

(10) Operations incident to visual inspection and inventory of HD 1.4 AE. HD 1.1, 1.2, and 1.3 may be visually inspected on the magazine apron or in an approved shelter; if disassembly that would expose explosives is not required, the AE does not contain electrically initiated components, the AE does not hold its own means of initiation, and no testing of the AE is required.

Note. AE requiring fire division symbols 1, 2, or 3, regardless of HD, may not be unpackaged in magazines.

(11) Operations incident to visual inspection of the exterior packaging of separately packed propelling charges and bulk solid propellants.

(12) Removal of storage container lids for the visual inspection of cluster bomb units (CBUs) and container units.

(13) Operations incidental to the electronic retrieval of surveillance or telemetry data from missiles are provided for in the appropriate technical documentation for the missile system.

j. Inspections and repairs may be done in the open, provided the following separation distances are maintained:

(1) At least 100 feet or ILD, whichever is greater, from AGMs and the unbarricaded door end of ECMs.

(2) At least 50 feet or intermagazine distance (IMD), whichever is greater from the sides and rear of ECMs. This distance will be based on the quantity of NEW of the AE involved in the operation.

(3) Operations incident to the inspection of separately packed propelling charges and bulk solid propellants.

(4) Operations conducted outside of reduced QD magazines will be per the latest DDESB guidance for the specific magazine.

(5) Loading and unloading operations of conveyances (for example, truck, trailer, railcar, or military van container) are permitted at a magazine without regard to QD between the magazine and the operation. "At a magazine" means loading and unloading operations at a loading dock attached to the magazine, on the pad or apron in front of the magazine, or within the established boundaries of an AGM. Loaded conveyances will be removed as soon as practical but must not exceed 24 hours.

k. AE, particularly pyrotechnics, solid propellants, and propelling charges, are adversely affected by dampness and extreme heat. Storage drawings in AMC Drawing 19–48–75–5 provide stacking schemes that should provide adequate ventilation.

l. Repairs to magazines will be in accordance with the following:

(1) Magazines will not be repaired until prevailing deficiencies have been evaluated and it has been decided whether the contents must first be removed.

(a) Repairs will not be made to the interior of magazines containing bulk explosives.

(b) Under normal conditions, roofs, ventilators, air terminals, doors, and other parts of or appendages to the exteriors of magazines containing bulk explosives may be repaired without first removing the explosives.

(c) Minor repairs may be made to the interior of magazines containing finished AE, including those storing only AE components.

(2) Application of this pamphlet's general safety requirements, particularly those to eliminate the risk of fire, and the special requirements below are mandatory during repairs.

(a) Repairs must be made by trained and qualified personnel.

(b) The floor in the immediate vicinity of repairs must be thoroughly cleaned.

(c) Repairs that require soldering, melting of asphalt, or using flame or heat-producing equipment within a magazine storing AE requires an approved risk assessment with mitigating controls and a hot work permit (see para 6–8). When the commander authorizes hot work or the use of heat-producing items (for example, melting pots and lighters) in a munitions storage area, the equipment authorized for use will be kept at least 90 feet from munitions. If necessary, baffles, and screens will be used to confine sparks and flames.

(d) Magazines in which repair work has been done will be inspected by qualified personnel (for example, facilities engineers) once the work is completed.

m. Telephone communication must be provided in AE magazine storage areas. Telephones located outdoors must be protected from the weather.

3–3. Outdoor storage

a. Outdoor storage of serviceable AE should only be used as an emergency expedient. Even when necessary, outdoor storage must be considered a temporary expedient and must not be employed in place of magazines for long-term storage. If magazine storage is not available, every effort will be made to provide covered storage.

b. When used, outdoor storage sites will be separated from magazines, other facilities, and each other per the QD requirements of chapter 8.

c. Outdoor storage sites will be level, well-drained, and free from readily ignitable and flammable materials.

d. Timbers or platforms upon which AE is stored will be well constructed to prevent AE from falling, sagging, or shifting. Steel dunnage should be used where practicable.

e. To ensure stack stability and free circulation of air, 3 inches or more of dunnage should be used between the bottom of the stack and the earth floor.

f. Fire-resistant, waterproof overhead covers should be provided for AE, with an air space of not less than 18 inches maintained between the top of the AE stack and the cover. The sides of covered AE stacks should be protected by nonflammable or fire-resistant covers, with a minimum of three inches of clearance maintained on each side of the stack for ventilation.

g. Frequent inspections will be made to detect unstable stacks and accumulations of trash between or under stacks.

h. Excess dunnage should not be stored between outdoor sites and magazines nor between magazines. Excess dunnage storage sites should comply with applicable QD requirements, except during

outdoor storage operations, service supplies of dunnage may be located no more than 50 feet from the stack being processed.

i. Suitable types of firefighting equipment and symbols should be provided. Fire and Emergency Services (FES) personnel should be used to assist in determining the type, size, and placement of equipment.

3–4. Termination of use of storage facilities

When a storage facility is no longer used to store AE, it must, within 180 days from the day of last use, undergo a process to ensure that all AE has been removed and that no visible explosives residues are present. These procedures help eliminate any potential explosive hazard or threat to human health and the environment.

Note. Ammunition storage units that have been used to store WMM must also comply with the closure procedures in chapter 18. These procedures include the following:

a. Remove AE and related materials.

b. Clean the storage facility to remove visible explosive residue and chemical contamination.

c. Inspect the storage facility for AE or visible explosive residue. A knowledgeable individual that the garrison, installation, or responsible activity commander appoints will conduct this inspection.

d. Remove fire and chemical hazard symbols and mark the storage facility as empty.

e. Secure the storage facility and seal with a numbered seal to prevent unauthorized use or access. The integrity of the seals will be verified once every 12 months.

f. Notify emergency response and regulatory authorities of the storage facility's use change.

g. Record, in permanent real estate records, the date the storage facility was inspected, the name and position of the inspector, and the results.

3–5. Storage of specific types of ammunition and explosives

a. Improved conventional munitions (ICMs) contain submunitions that, if inadvertently ejected from an ICM, may become armed and sensitive to initiation. Emphasis will be given to blast and fragment mitigation and prevention of ejection in layout plans and process equipment for renovation, demilitarization, and similar industrial operations.

b. Black powder storage will be in accordance with the following precautions:

(1) Black powder should be stored in dry magazines. Black powder will not be handled or stored in inhabited buildings, general supply rooms, or any building heated by stoves or open fires.

(2) Magazines storing black powder must have conductive floors.

(3) Safety conductive (non-sparking) shoes will be worn in a magazine containing black powder.

(4) The only work allowed in magazines storing black powder is storage operations and the cleanup of spilled grains of black powder.

(5) Conductive nonferrous nonmetallic mats will be used at locations where operations such as repacking black powder are performed.

(6) Containers of saluting, practice, and smoke-puff charges will be stored with tops up.

(7) Containers of black powder will be carefully examined on receipt for weak spots and holes, with special attention to looking for small holes, such as nail punctures that are not immediately evident.

(8) Damaged black powder containers will not be repaired; their contents will be transferred to serviceable containers.

(9) If any black powder is spilled, work will stop until the spillage is carefully taken up and the spot washed with water. The powder taken up will be destroyed by dumping in water and later disposed of by appropriate methods.

c. Military dynamite, M1, which provides a medium velocity blasting explosive in military construction, quarrying, and demolition work, should be used in lieu of 60 percent commercial dynamite whenever possible. Unlike commercial dynamite (see para 10–5), military dynamite does not contain nitroglycerin and will not freeze in the cold or exude nitroglycerin in hot weather. M1's composition does not absorb or retain moisture, and its shipping containers do not require turning in storage. Additionally, safety during transport, storage, and handling is better than that of commercial dynamite.

d. Bulk initiating explosives must be stored alone or with similar compatible compounds. Such bulk explosives must not be stored dry and will not be exposed to the direct rays of the sun. If long-term storage in shipping containers is contemplated, the container must be equipped with a cover with a port for

observing the level of liquid therein. The viewing port must be covered with transparent plastic, which is known to be compatible with the initiating explosive being stored. When mission essential, bulk initiating explosives may be stored in shipping containers that are not so equipped, provided they are stored in frostproof ECMs with containers on end, only one tier high, and with passageways for inspection and handling.

e. Bulk solid propellant and separate loading propelling charges will be stored as follows:

(1) Propellant should be stored in well-ventilated and dry magazines.

(2) Containers should be stored so the cover can be readily inspected or removed so that containers may be air tested in storage.

(3) Bulk solid propellant and separate loading charges are packed in airtight containers for storage. When a shipment is received, every pallet load will be given a visual inspection to ensure that it is not damaged. Containers will remain airtight until the propellant is used. If damaged or leaking containers are discovered, examine the contents for decomposing propellant's nitrous/nitric odor. If such an odor is detected, the propellant will be segregated, reported, and disposed of per National Inventory Control Point instructions. Propellants and propelling charges in containers should be stored so that they can be readily inspected. Only the minimum number of containers will be opened and then, only for the shortest time, consistent with safe and efficient operations. Containers of bulk solid propellant and separate loading charges will not be exposed to the sun's direct rays.

(4) Metal containers for propelling charges are fitted with a test hole in the cover to allow testing for air tightness after the containers have been opened and closed. During testing, motor-driven air compressors will not be taken into a magazine in which AE are stored. If a gasoline motor drives a compressor, the motor should be placed no closer than 50 feet to the magazine or to any explosive material. An electrically continuous path to the ground will be maintained between the tested supply tank and the propellant container. The entire system will be grounded prior to testing.

(5) The normal odor in a solid propellant magazine is a faint odor of alcohol-ether. If this odor is strong, it probably indicates a leaky container. Leaking containers will be repaired or the contents transferred to an airtight container. If the contents of a container show evidence of dampness or moisture, they should be segregated and reported. Leaks due to defective covers or gaskets may be repaired without removing the charge from the container or the container from the magazine, provided care is taken to guard against sparks. Repair of leaks in other parts of the container will be undertaken only after the container is removed from the structure and the charge is removed from the container. Containers determined to be unserviceable should have the propellant charge removed and placed into an appropriately marked serviceable container. Empty, unserviceable containers must be tagged and may be left in the stack until the time of the shipment, or they are returned to storage. No other repair operations on solid propellants or propelling charge containers will be permitted in a magazine containing AE.

(6) Personnel engaged in air-testing must be familiar with decomposing propellant odor and appearance. The odor of decomposing propellant is so characteristic that it cannot be mistaken for the normally present odor of alcohol-ether. Personnel engaged in air-testing should examine each container opened for an air test for the presence of the acrid odor of nitrous/nitric fumes instead of the characteristic odor of alcohol-ether. The odor of nitrous/nitric fumes is one of the first pieces of evidence of dangerous deterioration.

(7) Some fine-grain solid propellants with high nitroglycerin percentages are almost as sensitive as black powder, and the same precautions will be observed. Inspection schedules must be maintained to ensure that deterioration will be detected in the early stages.

f. Separate loading projectiles will be stored as follows:

(1) During storage, steel dunnage is preferred to wood; for storage other than an ECM, steel dunnage should be connected by electrical conductors and grounded. If it is necessary to use wood dunnage, the amount used should be kept to a minimum. Unfuzed projectiles will be fitted with eyebolt lifting plugs. Fuzed projectiles will not be rolled.

(2) Palletized projectiles will be stacked per approved drawings.

(3) Projectiles containing ICMs will have a fusible lifting plug.

g. Pyrotechnics require protection against moisture, dampness, and high temperature. Pyrotechnic AE must be given high priority for the best available AE storage facilities that provide the best protection against moisture. Pyrotechnic material (PT) that is or has been wet is hazardous to store. Pyrotechnic boxes that show signs of dampness (for example, humidity, moistness, moisture) will be removed from a storage site and inspected. If the PT is wet, it will be destroyed. Certain kinds of these pyrotechnics

deteriorate with age and have an expiration date on the containers. Loose pyrotechnic tracer composition, flare composition, and similar mixtures that have spilled from broken containers should be carefully taken up and covered entirely with the Society of Automotive Engineers 10 (EO–10) engine oil and removed for appropriate disposal.

h. Shaped charges focus blast effect into a directional jet, resulting in greater penetrating ability than an equivalent-sized unfocused charge. Because of this directional effect, the following special storage considerations apply.

(1) When packaging and storage criteria allow, shaped charges will be pointed toward the floor. When this is not possible, shaped charges should be pointed toward an exterior wall. In an ECM, shaped charges should face the side or rear walls.

(2) Shaped charges should not be pointed at walls with AE stored on the opposite side (for example, multi-cubicle magazine).

i. Rockets, rocket motors, and missiles will be stored as follows:

(1) Rockets, rocket motors, and missiles should be stored out of the direct sunlight in a dry, cool magazine or other locations where temperatures would not exceed 120 degrees F. Prolonged rockets, rocket motors, or missiles' exposure to high or low temperatures may increase the normal rate of deterioration or render the motors more susceptible to ignition if mishandled.

(2) Specific storage requirements apply when rockets, rocket motors, and missiles are stored in a propulsive state.

(a) ECMs are the preferred mode of storage. Refer to the approved storage drawing (AMC Drawing 19–48–75–5) for the orientation of rockets, rocket motors, and missiles. Small rockets and missiles may be stored without regard to the direction in which they are pointed, except they will not be pointed upward or toward the door or headwall.

(b) AGMs may be used when ECMs are not available. Orient rockets, rocket motors, and missiles in the direction that presents the least exposure to personnel and property or toward strong artificial or natural barriers.

(c) If approved storage drawings (AMC Drawing 19–48–75–5) allow, propulsive items should be stored pointed down.

(3) Rockets, rocket motors, and missiles that are not in a propulsive state may be stored without regard to the direction in which they are pointed.

(4) Care must be exercised to protect electrically initiated rockets or rocket motors from being ignited by stray electrical currents (for example, currents that might result from contact with extension cords, lights, or electrical tools) or in close proximity to radio transmissions.

3–6. Inert (empty) or dummy ammunition and explosives

a. Inert or dummy AE will not be stored in magazines with live AE when other storage space is available. When necessary to store inert AE with live AE, inert AE will be clearly identified and segregated from live AE.

b. Inert AE includes practice and service AE and components (for example, projectile bodies) manufactured empty or inerted by authorized EOD. Inert AE may be used in training, display boards, demonstrations, public functions, and other authorized purposes. AE will only be rendered inert by technically qualified personnel per established procedures. Activity, garrison, or SCs will ensure that empty and inert AE, including inert AE components, are properly marked (identified) and under their positive during use.

c. Stenciling, painting, applying decals, or labeling inert or empty AE and inert AE components are not sufficient to identify them permanently as empty or inert. Therefore, more positive identification is needed. The following procedures apply:

(1) Four holes no smaller than one-fourth inch will be drilled through each complete item. This includes a fuze, body section, and cartridge case. The holes will be 90 degrees apart. When components such as detonators are too small for the one-fourth-inch holes, fewer holes of smaller diameter may be drilled. Exceptions are indicated below.

(a) Inert or empty AE (for example, inert practice projectiles used in loading drills, inert bombs used in crew training or drills) or other empty or inert AE whose intended use would be impaired by drilled holes.

(b) Inert AE listed in supply manuals as standard for issue.

(c) Inert AE on permanent display in Army museums if such drilling would diminish their historical value. Such inert AE are suitably identified when permanently marked (for example, metal stamped) with “INERT” or “EMPTY.”

(d) Approved training inert SAA (for example, 5.56mm, M199A1; 7.62mm, M63A1, and .50 caliber, M2A1) are exempt, provided they are nickel plated and fluted.

(e) Approved training inert SAA that are nickel plated and fluted. Training 9 mm and M917A1, too small to flute, will be nickel plated with two holes based on Program Manager guidance to prevent damage when used in applicable weapons systems.

(2) In addition to being drilled, empty, or inert ammunition, including components, will be stamped or stenciled with the marking "EMPTY" or "INERT." Markings must be clear and obvious.

(3) Inert, cloth-covered components (for example, bagged propelling charges) will be marked "INERT." Markings will be in durable, waterproof, fade-proof ink.

(4) Inert mortar sheet propellants will have the word "INERT" cut through each propellant increment.

(5) SAA or small inert AE components mounted on wall plaques or display boards, in display cases, or in permanent museum exhibits will have the word "INERT" on an attached plate. The plate could be of metal, wood, or plastic permanently affixed to the display.

d. EOD or other technically qualified personnel will inspect each inert AE that is part of a permanent museum display. Museum curators will use DA Form 2609 (Historical Property Catalog) to record the date of the inspection and the inspecting unit. The museum curator will note in the remarks section of DA Form 2609 that the AE was found to be or made inert.

e. A qualified individual will inventory and inspect static display inert items annually to ensure serviceability and accountability.

3–7. Unserviceable ammunition and explosives

a. A number of factors can result in AE becoming unserviceable. These include deterioration of metal parts or energetics; improper storage, handling, packaging, or transportation; or manufactured defects. Ammunition handlers should be trained to recognize indicators that AE may be unserviceable AE and report unserviceable or suspected unserviceable AE for inspection by qualified personnel.

b. Suspended AE will be clearly marked, and the lot-locator and magazine card will be posted to preclude issue. Within a magazine or single storage location (and where practical), unserviceable or suspect AE will be clearly marked and segregated from serviceable AE on separate pallets. The AE determined to be unsafe for continued storage will be disposed of as soon as reasonably possible. The AE determined to be unsafe for continued storage that cannot be immediately destroyed will, when possible, be moved to a separate magazine or storage location or segregated from serviceable AE.

c. Disposition of AE will be in accordance with the following:

(1) AE determined unsafe for storage will be disposed of as soon as possible to preclude further deterioration and potentially unsafe conditions. In most cases, EOD should be contacted to support destroying munitions determined unsafe for continued safe storage.

(2) When the commander of an ammunition unit or installation becomes aware of AE that has been determined by qualified personnel (for example, QASAS, or explosives safety specialist) to be unsafe for continued storage, the commander will order the destruction of AE and report this action to the appropriate headquarters and the designated disposition authority.

(3) The AE encountered on or off an installation or turned in under an installation's amnesty program will be managed as unserviceable until inspected by qualified personnel (for example, QASAS, and EOD) and either returned to the stockpile or destroyed. Commercial AE recovered under any circumstances will normally be destroyed or turned over to local law enforcement.

3–8. Storage of captured enemy ammunition

Captured enemy ammunition requirements are contained in CJCSI 4360.01C and DESR 6055.09.

3–9. Chemical munitions

Chemical munitions are munitions that contain fillers that include lethal chemical agents (including weaponized industrial chemicals), riot control, incapacitating agents, smoke-producing agents, and incendiaries. These munitions often contain a burster that, upon use, disperses the fill. The effects of chemical munitions depend primarily upon the chemical filler. Some chemical fills may also be contained and stored in bulk containers.

a. For storage and handling purposes, chemical fills are divided into the groups below based on the action of the fill, the degree, and type of hazard, and the type of protection required.

(1) Chemical Group A are chemical agents (see DA Pam 385–61). These lethal fillers can be toxic or incapacitating at extremely low doses by inhalation, ingestion, or by absorption through the skin.

(2) Chemical Group B consists of choking agents, blood agents, riot control agents, and screening smokes. Common examples include 2-chlorobenzalmalononitrile (CS), dibenzoxazepine (CR), chloroacetophenone (CN), sulfur-trioxide chlorosulfonic acid solution (FS), titanium tetrachloride (FM), and red phosphorous (RP). Wearing a suitable protective mask is required to protect personnel against inhalation of vapors, particles, or smoke from burning agents. Because these agents will cause varying degrees of skin irritation, approved types of protective clothing (for example, coveralls, protective masks, and gloves) will be provided and worn. These fills can be toxic or incapacitating by inhalation, ingestion, or by absorption through the skin.

(3) Chemical Group C includes chemical fills (for example, white phosphorous (WP) and plasticized white phosphorous (PWP)) that are spontaneously combustible when exposed to air. Group C requires special firefighting techniques and materials. Personnel protection will be of a type that protects against fire and heat. Toxic fumes are an associated hazard.

(4) Chemical Group D consists of signaling smokes, incendiary, and flammable munitions (for example, thermite (TH), isobutyl methacrylate with oil, napalm, PT, and hexachloroethane (HC)) material for which conventional firefighting methods, with the exception of the use of water, may be used. Protection from inhalation of smoke from burning incendiary mixtures is required.

b. The same group designations used for fillers will be used for chemical munitions.

c. Chemical munitions or agents will not be stored in magazines with floors that are made of wood or other porous material that could absorb chemical agents, making decontamination difficult.

d. Chemical munitions must be handled carefully. They should not be dropped or jarred.

e. If it is necessary to store Chemical Group B and C munitions outdoors, prior approval must be obtained on a case-by-case basis from the ACOM, ASCC, or DRU on a case-by-case basis. When stored outside, these munitions should be covered with tarpaulins to protect them from the sun's direct rays and exposure to the elements. The exception is when the container affords reasonable protection from the elements. These munitions will be stacked in a manner that permits free circulation of air. Covering tarpaulins should be supported to permit a free flow of air under the tarpaulins.

f. Handling unserviceable chemical munitions or containers of chemical agents will be in accordance with the following:

(1) Reporting of leaking or unserviceable chemical munitions or containers of chemical agents. Leaking or damaged chemical munitions or containers will be immediately reported to the supervisor of the storage area. The supervisors will initiate procedures required to address the situation (for example, overpack) and report the situation to ACOM, ASCC, or DRU in accordance with reporting requirements.

(2) Processing unserviceable munitions or containers of chemical agent. When damaged, leaking, or otherwise unserviceable munitions or containers are discovered, they will be marked immediately for easy identification. When practical, these munitions or containers will be promptly over-packed and removed from the storage structure for immediate disposal. If immediate disposal is not practical, then leaking munitions or containers should be segregated in a structure or area reserved for storage of unserviceable AE or defective containers.

(3) Bulk chemical fillers and chemical munitions or containers will not be disposed of by open detonation (OD), land burial, or disposal into waterways. Disposal by OD is also prohibited unless specifically authorized by the Secretary of the Army or a designee. Material (for example, production equipment, munitions, munitions residue, and other items) that has been contaminated with Chemical Group B, C, or D fillers will not be disposed of or released for sale as scrap until it has been thoroughly decontaminated per Chapter 14 and documented as not presenting a chemical agent or explosives hazard. Specific decontamination procedures in applicable publications for such items take precedence over Chapter 14.

g. Appropriate first aid and decontamination equipment will be readily available at each work site. Employees involved in operations that involve chemical munitions will receive:

(1) Annual first aid training on signs and symptoms of exposure to chemical fills.

(2) Appropriate first, self, and buddy aid for specific chemical fills.

(3) Training on how to use applicable first aid supplies and equipment.

h. Destruction of chemical fillers will be accomplished per requirements outlined in applicable regulations for the specific type of chemical agent involved. Open burn of incapacitating chemical filler or chemical munitions is prohibited. OD of chemical munitions that contain a toxic chemical agent or industrial chemical fill will not be conducted without specific authorization by the office of the Deputy Assistant

Secretary of the Army for Environmental, Safety, and Occupational Health (DASA–ESOH). Information on methods used for destroying large quantities of chemical fillers and munitions may be obtained, through channels, from the Director, U.S. Army Chemical Materials Activity (AMSCM–D), 8435 Hoadley Road, Aberdeen Proving Ground, MD 21010–5424.

i. Chemical fillers, chemical munitions, and components will be packed, marked, and prepared for shipment per current drawings and specifications for the item involved (AMC Drawing 19–48–75–5). In addition, all applicable DOT regulations governing the shipment of chemical fillers and chemical munitions will be observed.

3–10. Chemical group B

a. Chemical Group B munitions and containers should be stored in ECMs. Concrete floors treated with sodium silicate should be used. Ruberoid or other floor coverings should not be used.

b. Periodic pressure testing and, in some instances, sampling of containers is required to detect increases in internal pressure before the pressures become dangerously high. Surveillance also includes inspection to detect leaks, breaks, or other defects in containers and valves.

c. Specific entry procedures will be incorporated into the movement and storage SOPs. If munitions or containers are leaking, protective masks will be worn, and doors and ventilators will be opened. The leaking chemical munition or container will be located and disposed of per approved procedures (see *para 3–10e*).

d. Protective masks must be readily available to all personnel working in magazines that contain Chemical Group B munitions and containers. Protective gloves will be worn when handling unboxed chemical munitions with corrosive fillers (FM and FS). Unboxed chemical munitions and containers may be handled without protective gloves, provided there is no chemical agent contamination noted. At least one person, who would be able to summon help if needed, should be carrying a protective mask in case of an incident.

(1) PPE consisting of protective masks, coveralls, and appropriate protective gloves, sufficient in number to equip all personnel required to work with Chemical Group B munitions or containers, will be centrally stored and maintained under close supervision. Personnel will be issued only serviceable protective masks, coveralls, and protective gloves. Personnel handling liquid corrosive chemical fillers will be issued and will wear eye protection, rubber boots, aprons, and gloves.

(2) When performing operations involving Chemical Group B, all operations will be conducted with not less than two persons (buddy-system), with each person visible to the other at all times. Employees will be trained to recognize early symptoms in other personnel and be fully capable of administering first aid promptly and efficiently. After first aid treatment is completed, the victim will be evacuated for medical treatment (FM 4–02.285).

(3) The following first aid equipment will be centrally stored and issued to the person in charge of a group of personnel required to work with Chemical Group B munitions and containers:

(a) Gas casualty first aid kit and individual first aid kits.

(b) Stretchers or litters.

(c) Woolen blankets.

(4) The appropriate decontamination material and equipment, as identified in the chemical's safety data sheet (SDS), will be immediately available to respond to an accident or detect leaking chemical munitions or containers. Personnel will wear the minimum PPE described in the SDS unless otherwise directed by the local medical support organization.

e. Leaking Chemical Group B munitions and containers must be disposed of per approved procedures. Personnel handling leaking chemical munitions or containers that contain corrosive Chemical Group B will wear appropriate rubber boots, rubber aprons, and rubber gloves in addition to protective masks normally worn. A leaking agent should not be allowed to contact skin or clothing. Pending final disposal, leaking munitions will be removed from the magazine and temporarily stored per directions in the SOP.

f. If Chemical Group B has leaked from chemical munitions or containers and has contaminated the floor or other containers, containment, and cleanup will be in accordance with the applicable SDS and SOP. Protective masks, appropriate gloves, and boots will be worn during the procedure; if a corrosive agent is involved, adequate rubber boots and aprons will be worn.

g. If a fire involves or threatens buildings in which Chemical Group B munitions or containers are stored, all persons within three-quarters of a mile will be notified to evacuate the area until the associated danger has passed. FES and other personnel involved in fighting the fire who may be exposed must wear

a protective mask and coveralls. Danger to personnel downwind from a fire involving Chemical Group B munitions and containers are not great unless noncombustible toxic fillers such as phosgene are involved. Chemical munitions or containers exposed to fire will be considered dangerous and inspected by qualified EOD personnel to determine their condition after the fire. A report of the fire will be prepared per the provisions of AR 420–1 and DA Pam 385–40.

3–11. Chemical group C

a. Chemical Group C munitions should be stored in fire-resistive magazines with crack-free concrete floors. Storage in ECMs is preferred. Chemical Group C munitions will be stored per current drawings (AMC Drawing 19–48–75–5) and directives.

b. PPE consisting of fire-resistant gloves and coveralls and safety face shields, sufficient in number to equip personnel required to work with Chemical Group C munitions, will be centrally stored and maintained under close supervision. This PPE will be issued to personnel working with WP or PWP filled and worn whenever a leak develops or is suspected. Approved protective masks will be immediately available at all times.

c. Self-aid comprises those aid measures that individuals can apply to themselves.

(1) If burning particles strike and stick to clothing, take off the contaminated clothing quickly before the phosphorous burns through to the skin. The immediate supervisor must decide whether to allow the burning clothing to burn itself out or extinguish it.

(2) If burning particles strike the skin, smother the flame with water, wet cloth, or wet sand. Keep the phosphorous covered with wet material to keep out air until the WP or PWP particles can be removed. WP and PWP will continue to burn unless deprived of oxygen.

(3) Try to remove WP or PWP particles with a knife, stick, or another available object. It may be possible to remove some particles with a wet cloth.

(4) Should WP or PWP get into the eyes, flush the eyes immediately with water. Tilt the head to one side, pull the eyelids apart with the fingers, and pour water slowly into the eye so that it will run off the side of the face to avoid spreading the WP or PWP.

(5) Report to the medical services as soon as possible.

d. First aid comprises the emergency actions undertaken to restore or maintain vital body functions in a casualty. Detailed procedures will be developed by local medical officials and documented in SOPs.

(1) When a casualty in a chemically contaminated area cannot put on their protective mask, the nearest person able to do so will mask the individual to prevent further exposure.

(2) Every individual able to do so must perform personal decontamination. If an individual is incapacitated, anyone present who can do so will decontaminate the individual.

(3) When WP or PWP particles are burning flesh, the affected portions of the body should be plunged under water to stop the burning. However, if WP or PWP particles are burning an individual’s face or eyes, apply a continuous, gentle stream of water to the afflicted area or apply wet compresses until medical help is obtained.

e. Once the WP or PWP particles are removed, they must be placed in water-filled containers pending subsequent disposal to prevent additional injuries and eliminate the fire potential.

f. When WP-filled AE are being handled, water-filled tubs, barrels, or tanks large enough to hold the largest WP-filled AE being handled will be located adjacent to magazines, outdoor stacks, or other work areas.

g. Leaking munitions will be handled in accordance with the following.

(1) Leaks in WP munitions can be detected immediately by the white smoke arising from the leak. As air contacts, the WP, spontaneous ignition occurs. The most significant risk is fire with this group's leaking Chemical Group C munitions.

(2) Upon discovering leaking munitions *d*uring operations, the person finding leaking AE will immediately, where practical, submerge the leaker in one of the water-filled tubs, barrels, or tanks provided. (Rubber protective equipment will not give adequate protection when exposed to high temperatures such as burning WP. When burning, WP, or PWP adheres to gloves; the gloved hand should be dipped into water.)

(3) When a single leaking item has been discovered and immersed in water, it should be disposed of, per locally-developed procedures, in an area where fragmentation will not be a hazard, smoke will not create a nuisance, and dry vegetation will not cause a fire.

h. Removal of Chemical Group C contamination will be in accordance with the following.

(1) If phosphorus (WP, PWP, or RP) has leaked on the floor or other parts of a magazine and has been extinguished, a fire guard must be stationed at the building until the spill has been completely removed. The water used in firefighting will evaporate and permit the chemicals to reignite; however, it may remain on the floor for some time before reigniting. Phosphorus that has extinguished itself by forming a crust can be reignited if the crust is broken.

(2) Provided all AE in the vicinity has been removed, small amounts of phosphorus can be removed best by first scraping off as much as possible and then remove the rest by burning with a blowtorch or similar appliance.

(3) A magazine contaminated with Chemical Group C contamination will be kept under surveillance for at least two weeks, as fire may break out again. Deep cracks or crevices in the floor will be cleaned and filled up with cement mortar before AE is stored in the magazine.

i. In the event of a fire in a magazine containing Chemical Group C munitions that are explosively configured (fuze or burster), the magazine will be evacuated if the fire cannot be rapidly controlled (fires in ECMs will not be fought.) Firefighting efforts will be confined to saving adjacent magazines. In fires involving Chemical Group C munitions that are not explosively configured, the firefighting precautions in paragraphs (2) and (3) below will be observed.

(1) Phosphorus, once extinguished, will either be immersed in water or continually sprayed to prevent the flames from breaking out anew.

(2) The lowest water pressure stream that allows an approach to the fire should be used. High-velocity streams of water tend to spread the fire.

(3) Firefighters will be closely supervised when fighting a fire in magazines containing Chemical Group C munitions because such munitions may explode with moderate violence, throwing burning munitions or WP for some distance. Firefighters will be withdrawn to safe distances should this danger becomes apparent. Once ignited, red phosphorus has the same characteristics as WP and should be treated using the same precautions.

3–12. Chemical group D

a. Munitions containing Chemical Group D may be stored in any dry fire-resistive magazine.

b. Boxed and unboxed munitions containing Chemical Group D may be handled without special protective equipment; however, it is advisable to have protective masks available where incendiary materials or munitions are involved. Protective masks will be worn when exposed to burning munitions or bulk chemicals.

c. No unusual first aid treatment is required for personal injuries occurring from Chemical Group D. Burns should be treated in the same manner as those caused by flame. Persons severely affected by high concentrations of smoke should be evaluated by medical personnel.

d. Leaking munitions containing Chemical Group D will be segregated. Instructions for disposing of large quantities of such munitions will be requested from Headquarters, U.S. Army Materiel Command (AMCPE–standard form), 4400 Martin Road, Redstone Arsenal, AL 35898. If necessary to destroy small quantities of leaking munitions of this group, they should be burned in a standard burning pit. Leaking bombs may be fired statically as a means of destruction in a pit of a demolition ground where the fire risk is negligible. If the bombs do not contain an explosive charge and barricade protection for personnel is not available, a minimum distance of 300 yards will be maintained. Use criteria outlined in chapter 8 if the bombs contain an explosive charge.

e. Fires in ECMs containing Chemical Group D munitions will not be fought. The firefighter's primary efforts will be confined to preventing the spread of the fire.

(1) Normally, water will not be used to fight fires of TH or mixtures containing fine metallic powders such as magnesium or aluminum. Incipient fires may be smothered by spraying the dry chemical from extinguishers or covering it with sand. Fire in a magazine containing Chemical Group D munitions will not be fought with water except where large quantities are used in proportion to relatively small quantities of these types of munitions.

(2) Triethylaluminum (TEA) will explode when brought into contact with water. Inert materials (for example, sand, or dirt) are the best means to extinguish a TEA fire.

3–13. Energetic liquids

a. This section applies to the storage of energetic liquids in every type of container, including rocket and missile tankage. This section does not govern the storage or handling of energetic liquids for uses

other than in space launch vehicles, rockets, missiles, associated static test apparatus, and ammunition items.

b. Reference DESR 6055.09, Volume 5, enclosure 4 for energetic liquids safety standards. These ESQD requirements are based only on the energetic liquids' energetic reactions (blast overpressure and container fragmentation) and do not consider the toxicity or potential downwind hazard. Therefore, ESQD may not be the only factor that needs to be considered when selecting a location for storage and operations of energetic liquids.

c. The SC will ensure that the materials of construction are compatible with the energetic liquids, facilities are of appropriate design, fire protection and drainage control techniques are employed, and other specialized controls (for example, nitrogen padding, blanketing, and tank cooling) are used when required.

(1) When additional risks associated with AE are involved, the safety distances prescribed in other sections of the DoD manual must be applied as appropriate.

(2) DoD standards are based upon the estimated credible damage resulting from an incident without considering probabilities or frequency of occurrence.

d. SCs with missions involving energetic liquids must ensure that ESMPs are updated to reflect the appropriate regulatory guidance that helps ensure safe and efficient personnel and material assets management.

Chapter 4
Quantity-Distance Safety Submissions

4–1. Explosives safety site plans and chemical agent site plans

a. QD safety submissions provide a process to review, evaluate, and approve methods to protect DoD employees and the public from the explosive hazards associated with operations that involve DoD military munitions. Using this process, commands identify, document, and evaluate the relationship between PES and ES based on deterministic QD criteria and requirements established in this pamphlet and DESR 6055.09 for exposure, placement, and construction of a PES and ES.

b. QD safety submissions help manage the risks associated with AE activities to reduce the risk to personnel, equipment, and assets while meeting mission requirements. Understanding the relationships between PES and ES is a key element of the site planning process.

c. ESPs and chemical agent site plans (CSPs) will clearly describe the relationships between PESs and ESs, DoD personnel and the public, and DoD and public assets in text and graphics. Such plans, which incorporate risk management, describe construction specifications for facilities (for example, protective construction; evaluations of blast or fragment hazards; glass hazard risk assessment) and specifications for, and the placement of, required auxiliary equipment (for example, grounding, bonding, and LPS; electrical component installation). Among other factors, site planning also considers operational requirements, survivability, natural, or man-made terrain features, economic, security, environmental, and legal criteria. See DDESB TP No. 26.

d. QD safety submissions will be submitted through command channels to the USATCES for review and Army approval and submission to the DDESB for independent review and approval. Questions or concerns about the site planning process or a QD safety submission should be addressed to USATCES. Direct correspondence between a submitter and the DDESB is counterproductive and not authorized.

4–2. Contents of explosive site plans and chemical agent site plans

The Army Explosives Safety Site Plan Developer's Guide (see https://www.dau.edu/cop/ammo/pages/default.aspx) will be used to help ensure ESPs and CSPs are complete.

4–3. Explosives siting software

Explosives siting software (ESS) is a software application that automates the ESQD analysis supporting the development of an ESP. The ESS uses existing installation GIS map data combined with Real Property Inventory and PES data to calculate, analyze, and generate ESQD arcs as part of the overall analysis. Use of ESS is mandatory. Requests to submit by other means must be justified in writing and submitted to USATCES for consideration. USATCES may be contacted for ESS technical assistance.

4–4. Risk-based safety submission and hybrid safety submission

a. A risk-based safety submission (RBSS) addresses ESs and PESs that cannot meet DoD's deterministic QD criteria but meet the DDESB-approved, risk-based siting acceptance criteria of DESR 6055.09. These safety submissions are evaluated using a quantitative risk assessment tool such as Safety Assessment for Explosives Risk (commonly known as SAFER) or an equivalent DDESB-approved quantitative risk assessment tool.

b. A hybrid safety submission (HSS) addresses facilities and operations that may not conform to DoD's deterministic QD criteria of DoDI 6055.16 or risk-based criteria.

4–5. Real property master plan

ESPs must be included in the development of the Real Property Master Plan. See this publication, AR 210–20, and Unified Facilities Criteria (UFC) 2–100–01 for details.

Chapter 5
Explosives Licensing

5–1. Explosives licenses

Explosives licenses are required for each location where AE will be processed or stored on a permanent, routine, or recurring basis and do not have an Army- or DDESB-approved ESP. For those locations that require a RESS, the license will be interim authorization for munitions to be stored or processed until the RESS is approved.

5–2. Procedures

a. The SC's designated Safety POC (per designation in the ESMP) will:

(1) Review license requests when submitted by operating or using units.

(2) Coordinate the hazard analyses for operations at the location, the SOP developed for the location, and the limitations to be imposed with installation directorates (for example, physical security, FES, and ammunition surveillance) to determine the appropriateness of a proposed location for licensing.

(3) Request that operating or using units initiate either a RESS or the licensing process when the presence of an unlicensed AE location is identified.

(4) Provide the final staff signatory concurrence prior to forwarding the license to the designated official for approval.

b. Tenant commanders, directors of safety office, or Safety POC will:

(1) Develop a licensing program as part of the command's respective ESMP based upon mission requirements.

(2) Coordinated the hazard analyses for operations at the location, the SOP developed for the location, and the limitations to be imposed with installation elements (for example, physical security, FES, and ammunition surveillance) to determine the appropriateness of the locations for licensing.

(3) Prepare a HA for each location not covered by a DDESB-approved ESP or CSP. The HA will be submitted with the license for coordination by the approving officials. Documentation of the HA will be maintained in the designated safety office. Additionally, the HA documentation will accompany each copy of the license.

(4) Forward the license to the respective Safety Office for review, staffing, and submission to the designated official for approval.

c. Licenses will be reviewed at intervals not to exceed 12 months for compliance, changes in operational requirements, and encroachment and reissued upon change of command.

(1) Reviews, which will include an on-site inspection by a qualified individual, will be documented and maintained by the respective safety office or logistics directorate.

(2) Satellite imagery may be used for the annual review, provided the imagery date on file is not older than six months. The "Snipping Tool" within the "Windows Accessories" folder or similar software should be used to capture the online image with an embedded date. Dates manually typed on image documents are not acceptable.

d. Licenses will be posted along with the (1) HA for the AE stored, when necessary to develop a license if the location is not sited, per paragraph 5–2b(3); and (2) SOPs within each respective location (for example, arms room, or AE storage facility).

e. Copies of explosives licenses will be maintained at the office that controls the AE operations and the appropriate safety office.

f. Each tenant activity will comply with host installation licensing requirements.

5–3. Required information on all licenses

The below information will be included within the license for each licensed location:

a. Location name.

b. AE facility's location.

c. Date of issuance.

d. The analyst's full name.

e. Authorized limits of each HD expressed in pounds (NEW) or kgs (net explosive quantity, NEQ).

f. The limiting ES with the distance to that site. Arms rooms are excluded from this requirement.

g. The highest level of risk associated with the licensed location. The associated HA must be on file and accessible upon request.

h. Notes (for example, deviations that may be applicable) pertinent to the licensed location.

i. The signing official's full name and title and date of issuance.

j. The full name of the inspector who conducted the periodic inspection required to ensure compliance with the license and the inspection's date.

5–4. Geographic combatant commander non-enduring locations

Non-enduring AE locations, as defined by the geographic combatant commander, which cannot be sited in accordance with this pamphlet, must comply with CJCSI 4360.01C, Enclosure C.

Chapter 6
Fire Prevention, Protection, and Suppression

6–1. Fire prevention management

a. Army policy is that firefighters:

(1) Will not fight fires that directly involve munitions, are supplying heat to munitions, or are too large to be extinguished with the equipment at hand. In such cases, firefighters will sound the alarm; firefighters, firefighting equipment, and other personnel must be evacuated according to the SC's ESMP.

(2) May fight fires within munitions operating facilities (for example, storage, production, demilitarization areas) that do not directly involve munitions or in which heat from a fire is not affecting the munitions.

(3) Senior firefighting personnel should assess whether to fight a fire involving areas known or suspected to contain munitions (for example, operational ranges, former ranges); however, such fires should not typically be fought. The area affected by fires that are not fought will be evacuated and not entered until it has cooled for at least 24 hours.

(4) Firefighting equipment assigned to the immediate area will be used to contain combustible fires to prevent propagation to AE items or materials.

(5) Should a fire threaten a munitions operating facility, non-essential personnel will immediately evacuate to a designated location in compliance with the SC's ESMP and evacuation plans. Should the fire or heat from the fire threaten or engulf munitions, essential personnel and firefighting equipment will evacuate to a location designated in compliance with the SC's ESMP and evacuation plan. (Refer to DESR 6055.09, Table V1.E10.T10. for withdrawal distances and follow the orders of the incident commander/fire chief.)

b. Fire and excessive heat are two of the greatest hazards to AE. Many AE items are extremely sensitive to heat and react at temperatures substantially lower than those required to ignite ordinary wood, paper, or fabrics. Even indirect heat generated by fire could initiate a reaction and result in an explosion. This chapter addresses procedures for dealing with these hazards.

c. Fires that may occur in buildings or magazines containing AE will vary in intensity and effect, depending on the material involved. Certain explosives will ignite immediately on contact with a spark or flame or when subjected to frictional heat or concussion. Some explosive substances may burn freely, while others will be subject to explosion.

d. Advanced planning is essential for firefighting operations that may involve munition in storage or areas (for example, operational range impact areas, former impact areas) known or suspected to contain

UXO or DMM. Servicing fire Departments will be informed of the munitions operating facilities and areas where munitions (for example, UXO) are known or suspected to be present. This information must be kept current. Firefighting personnel will understand the risks involved in each fire hazard group and the best methods of fighting fires for the hazard groups under their protection. They must be trained and qualified to properly use and maintain their PPE.

e. Commands involved in AE operations will develop fire response plans in accordance with AR 420–1. These plans will be incorporated into the installation level ESMP and coordinated through the responsible chain of command. Plans will cover all AE areas and possible exposures of AE to fire. In addition to the requirements of AR 420–1, the overall plan will specify responsible individuals and alternates, their organizations, and training and include a description of the emergency function of each department or outside agency. Personnel responsibilities will include the following as a minimum:

(1) Reporting the fire.

(2) Directing orderly evacuation of personnel to include reassembly points for accountability (refer to DESR 6055.09, Table V1.E10.T10. for withdrawal distances).

(3) Notifying personnel in nearby locations of impending dangers.

(4) Activating means of extinguishing or controlling the fire involving only combustible materials.

(5) Meeting and advising the firefighters on the details of the fire up to the time of their arrival.

f. Each Army fire station's central communications center will have an area map showing all AE operating areas and areas (for example, operational, and former ranges, permitted demilitarization facilities) known or suspected to contain UXO or DMM. Locations with less than 1,000 rounds of HD 1.4 SAA (.50 caliber or less) are exempt. The command responsible for munitions operating facilities will ensure the Fire Station's Central Communications Center is informed of changes in the types of munitions being stored or processed in each munitions operating facility that requires a change of fire or chemical hazard symbols.

g. A written permit is required where AE, highly flammable, or energetic materials are involved using heat-producing equipment capable of reaching a temperature higher than 228 degrees F (109 degrees Celsius (C)). (See *para 6–8a* and AR 420–1 for additional guidance.)

h. Matches or other flame or spark-producing devices will not be permitted in any magazine area or explosives area unless the CO or their designated representative provides written authority. When such authority has been received, a carrying device too large to fit into the pockets will be used for matches, lighters, and similar materials.

i. Carrying or using "strike anywhere" (kitchen) matches is prohibited in/around AE facilities.

j. Battery-operated devices intended for use in the presence of exposed explosives or vapors must be intrinsically safe (I.S.) or evaluated by a recognized testing laboratory for that specific type of exposure.

6–2. Instructions for fighting fires involving ammunition and explosives

Personnel assigned AE duties will not fight fires involving AE. Firefighting equipment assigned to the immediate area will be used to contain combustible fires to prevent propagation to AE items or materials. Upon involvement of AE items in a fire, all personnel will evacuate to a designated location in compliance with the SC's ESMP and evacuation plans (refer to DESR 6055.09, Table V1.E10.T10. for withdrawal distances) and follow the orders of the incident commander/fire chief.

a. When personnel observe smoke or other evidence that a munitions storage structure (for example, ECM) is on fire, they will activate an alarm as quickly as possible, initiate notification procedures, and evacuate to a designated location in compliance with the SC's ESMP and evacuation plans. Personnel will not enter a burning building or munitions storage area nor open such structures if a fire is suspected.

b. If a fire or signs of a potential fire are observed in grass or other combustible material near or within a munitions storage structure, an alarm should be immediately given. Using available firefighting tools, personnel should attempt to extinguish or control the fire until firefighting forces arrive. Attempting to extinguish grass fires is vital, especially when they are close to munitions storage structures or areas.

c. If a fire or signs of a potential fire are observed in a munitions operating facility where munitions-related operations are ongoing and munitions are present, an alarm will be given, and personnel present will immediately evacuate the building. At least one responsible individual (for example, a supervisor or crew leader) will be dispatched in the direction from which FES is expected to come to inform firefighters of the fire's location, nature, and extent. The incident commander/fire chief in charge of firefighters will not permit firefighting personnel to advance toward the fire until accurate information about the existing hazards is available and concludes that the advance is safe.

6–3. Smoking

Smoking is prohibited within munitions operating facilities (for example, storage, production, demilitarization) except as permitted below.

a. Smoking may be allowed in specially designated and posted "authorized smoking areas" within a munitions operating facility. Certification of approval by the responsible commander or their appointed representative (fire chief, fire marshal, or fire warden), in coordination with the safety office, will be displayed in each designated smoking location.

b. In "Authorized Smoking Areas," the following minimum precautions will be taken:

(1) Suitable receptacles for cigarette and cigar butts and pipe heels will be provided. (Smoking residue will not be placed in trash receptacles.)

(2) If electric power is available, push-button electric lighters that cut off when pressure is released will be used. Lighters will be permanently installed to prevent removal and use outside the designated area.

(3) Where intervening noncombustible walls are not available to separate a potential smoking area from an area where AE are present, the smoking area must be separated by a distance of at least 50 feet from the AE.

(4) At least one portable fire extinguisher with a 1A or greater rating will be located within each designated smoking area.

(5) Personnel whose clothing is contaminated with explosives or other hazardous materials will not be allowed to smoke.

(6) Personnel working with hazardous chemicals or materials must wash their hands before smoking.

(7) A "No Smoking" sign will be posted at each entrance to all AE storage areas. Where applicable, a notice that flame-producing devices must be turned over to the entry controller or placed in a container will be posted.

(8) Smoking is prohibited in, on, or within 50 feet of motor vehicles, trailers, railcars, or MHE loaded with AE items.

(9) Smoking is prohibited in any AE-laden compartment of an aircraft.

(10) Electronic cigarettes (E-cigs) and other electronic smoking devices are prohibited in AE areas. Electronic smoking devices, regardless of type, are only authorized to be stored or used within approved smoking areas.

6–4. Training

Personnel who perform AE-related operations or who are responsible for fighting fires at a munitions operating facility must be trained in precautions related to firefighting fires that involve or threaten munitions operating facilities and emergency procedures. This training will include the meaning and placement of each type of fire hazard symbol, fire reporting procedures, alarm activation, area evacuations, and the type and use of appropriate firefighting equipment. Personnel responsible for conducting AE operations will be trained in the general principles of using fire extinguishers and the hazards involved in fighting various stages of fires that threaten or involve munitions. This must be done upon initial employment and at least annually thereafter.

6–5. Fire drills and exercises

Commands with munitions-related missions will conduct fire drills at intervals of 6 months or less (refer to DESR 6055.09, Table V1.E10.T10. for withdrawal distances).

a. Drills will be conducted to train firefighting personnel, personnel responsible for the conduct of munitions operations, and others, as determined necessary, on their responsibilities, DoD's policy for fighting fires that involve or threaten munition operating facilities, alarm systems, the use of prepositioned firefighting and supporting equipment, routes for evacuation, and the location of evacuation areas.

b. Fire drills involving an FES response will be coordinated with the fire chief, as a minimum. This does not preclude unannounced tests of FES response capabilities provided adequate coordination with the fire chief has been accomplished. Exercise and evaluation teams who conduct these tests will ensure personnel in the area, as appropriate, are informed of a scheduled drill or exercise and notified just prior to its commencement.

6–6. Fire exit drills

Fire exit drills should be held when warranted by the size of the building and the number of occupants assigned. These drills will cover the use of emergency exits if they are provided. Exits, including emergency

exits, will have clearly visible exit signs. Exit signs will meet the requirements of 29 CFR 1910 Subpart E - Exit Routes, Emergency Action Plans (EAPs), and Fire Prevention Plans; The Life Safety Code (NFPA 101).

6–7. Alarms

In addition to fire detection systems required by AR 420–1 or other applicable directives, an audible, manually operated fire evacuation alarm system should be installed in each AE operating building. All alarm systems will be clearly labeled.

6–8. Fire prevention requirements

a. A DA Form 5383 (Hot Work Permit) is required before the use of heat-producing devices that produce temperatures higher than 228 degrees F (109 degrees C) in munitions operating facilities. Such use must be essential and temporary. Written instructions must cover the location at which the device may be placed, and the purpose, duration, and details of general and explosives safety precautions to be used must also be developed before placement of the heat-producing device in the facility. Approved building furnaces, electrical space heaters, and electrical cigarette lighters that have been approved for use and properly installed are exempt. Bilingual instructions are required in foreign countries where local employees are included in the workforce.

b. W*ax pots will comply with the following requirements:*

(1) Wax pots, regardless of size, will be equipped with a power indicator light, lids with a fusible link, and placed on non-combustible surfaces.

(2) Wax pots with an excess of one-gallon capacity must be equipped with dual temperature controls.

c. Vegetation control limits the potential spread of an uncontrolled fire in AE storage and operating locations. Controlling combustible materials, such as long dry grass or brush, heavy clippings, or dead wood, is intended to slow the spread of a fire. The responsible civil engineering, FES, and safety office(s) must jointly determine the vegetation control measures required. Based on this determination, they must jointly develop a vegetation control program. The following must be considered in a vegetation control program:

(1) Except for firebreaks, grounds in or near AE locations should be maintained as unimproved grounds.

(2) Annual and periodic maintenance (for example, mowing, or application of herbicides) must be accomplished. Such maintenance should prevent erosion and suppress fires.

(3) Vegetation control requirements must be balanced with other operational factors such as cost to control, security, erosion prevention, and passive defense (camouflage). Each of these factors must be weighed in determining the level of vegetation control required.

(4) Varieties of vegetation resistant to burning should be used where feasible. If the removal of vegetation will cause soil erosion, soil sterilants will not be used. Shrubs and trees planted on the earth cover of magazines must be selected so that their weight or root system will not damage the structure. Dead or cut vegetation will not be allowed to accumulate.

(5) If animals are used for vegetation control, overgrazing of barricade surfaces and the earth cover of ECMs must be avoided to help prevent erosion.

(6) Where vegetation growth is ineffective in preventing erosion, a layer of approximately 2 inches of pressure-applied concrete (Gunite/shotcrete) or asphalt mixture may be used.

(7) When using controlled burning as a vegetation control measure, the garrison or installation must conduct a HA and develop a burn plan and SOP for controlled burns. The burn plan, which must address state and local requirements for outdoor burns, will be coordinated internally with the safety office, munitions surveillance office, and the installation FES. When appropriate, external coordination with environmental regulators, safety officials, and FES providing mutual support to the installation will be addressed in the burn plan and SOP. At a minimum:

(a) Controlled burns are not allowed within 100 feet of AE operating locations, including munitions storage areas and open storage pads. The windows, doors, and ventilators of all magazines and/or operating buildings within close proximity to the 100-foot minimum controlled area will be closed.

(b) Controlled burns, including vegetation on top of the earth cover, are allowed within munitions storage areas containing ECMs. When burning vegetation on or near the earth covering, the ECMs front vents will be closed and the rear vent covered.

(c) Firebreaks will be inspected for adequacy prior to a controlled burn.

(d) Firefighting personnel and equipment that the fire chief determines necessary will be on-site before and throughout the controlled burn.

(e) Training will be provided to all personnel involved before the controlled burn.

(f) Controlled burns will not be conducted if the wind speed is less than 5 miles per hour or exceeds 15 miles per hour, or is higher or lower than allowed by local ordinance requirements, whichever is more restrictive.

d. Flammable liquids will not be used for cleaning within munitions operating facilities or open explosives, except as authorized by an approved HA and SOP. Flammable liquids will be used in AE areas only when authorized by an approved HA and SOP. In use stocks will:

(1) Not exceed one workday's supply.

(2) Be kept in approved safety containers or dispensers.

(3) Be removed at the end of each workday.

e. The NFPA Standard 30 specifies fire clearance criteria from petroleum, oil, and lubricants (POL) locations. If required fire clearances are greater than those required by this regulation, use the greater required separation.

(1) Anti-siphon systems will be used where applicable.

(2) Aboveground petroleum storage tanks that have a capacity of 2,000 gallons or more must be enclosed within a dike area as prescribed in 29 Code of Federal Regulation (CFR) 1910.106 and NFPA Standard 30. The volumetric capacity of the diked site must not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. The capacity of the diked area enclosing more than one tank must be calculated by deducting the volume of the tanks other than the largest tank below the height of the dike.

(a) For quantities of 500 gallons or less:

(b) Anti-siphoning devices will be used where tanks serve equipment (such as oil heaters or diesel generators) located in explosives buildings. They are not needed if the level of the tank installation is such that siphoning is impossible.

(c) Above-ground petroleum facilities (such as tanks, pumps, or pump houses) will be located a minimum of 50 feet from AE locations.

(3) Parking areas for fuel service trucks will be located a minimum of 50 feet from AE locations.

(4) There must be at least 100 feet between explosives and any mobile petroleum dispensing unit operating within an AE area unless a shorter distance is needed during transfer operations to an underground tank (refer to para 6–8e(2)).

(5) Liquid petroleum (LP) gas facilities will meet the requirements of this section.

(6) Gasoline and diesel-powered vehicles and equipment will not be refueled inside any structure in the AE storage area, facility, site, revetment, or other building containing AE, regardless of location. When being refueled, vehicles will be at least 100 feet from structures or sites containing AE. When refueling is completed, the refueling vehicle must be removed promptly from the AE storage area.

(a) Use the smallest available refueling unit consistent with the mission.

(b) An electrically continuous bonding path between the refueling vehicle or the vehicle being filled and the service tank or pump will be maintained. The entire system will be properly grounded.

(c) Smoking or open flame devices will not be allowed within 50 feet of gasoline or diesel refueling. One person must be present during the entire refueling operation. During refueling, the motor of both the vehicle being refueled and the refueling vehicle will be shut off. The exception is when the refueling truck's engine drives the refueling pump.

(d) Immediately notify the installation FES if a spill occurs. The motors of the refueling truck or the unit being refueled will not be restarted until FES indicates it is safe to do so.

(e) Refueling will not be done within 50 feet of buildings or loading docks storing munitions-related inert material (for example, pallets, packaging, boxes).

(7) The following exceptions to the above requirements apply:

(a) Separation of POL facilities and aircraft during combat or simulated combat operations.

(b) Separation between POL hydrants set on the flight line flush with the pavement and AE-loaded aircraft or AE loading or unloading operations.

(c) Diesel-powered generators may be equipped with an operational "day-tank" of the smallest size needed to operate the motor properly. Supply tanks will be separated by the applicable underground or aboveground criteria.

(8) Do not locate AE within the drainage path downstream of temporary or permanent POL sites.

f. Stocks of flammable materials, such as paints and solvents required to support munitions maintenance operations, may be stored in an explosives storage area in accordance with 29 CFR 1910.106. Such stocks will be kept to the minimum required to support operations during a normal work day.

(1) Combustible materials, such as wood, paper, and rags, will not be stored with flammable materials.

(2) Containers of flammable materials:

(a) Will be closed and properly stored, except when in use.

(b) May be stored outdoors if in approved weatherproof containers.

(c) Will be grounded and bonded when the contents are being dispensed.

(3) Flammable storage will be located at least 50 feet from AE locations.

(4) A limited supply of paint, not to exceed a one-day requirement, may be stored in AE operating facilities if stored inside cabinets designed for flammable material storage.

(5) At least one fire extinguisher, suitable for the type of materials stored, will be readily available for use (see table 6–1).

g. Vehicle parking will be in accordance with the following:

(1) Vehicles, except during loading or unloading, will not be parked closer than:

(a) 50 feet to structures composed of non-combustible materials storing munitions; or

(b) 100 feet to structures composed of combustible materials.

(2) The APE 1965, Mobile Ammunition Inspection Shelter or other similar shelters approved for use during munitions inspections may be parked at munitions storage structures (for example, ECM, and AGM):

(a) While in use; and

(b) May remain parked unattended as long as munitions have been removed from the shelter and returned to proper storage.

h. Support equipment that is powered by internal combustion engines and used with munitions that are not regulated under paragraph 2–5:

(1) Must be located 50 feet or more from AE when conditions permit but must be no less than 25 feet from AE operations or facilities. When support equipment includes built-in generators, the generator will be housed in an exterior compartment physically separated from any AE by a minimum of 50 feet from munitions or the supported munitions storage structure.

(2) Only qualified personnel will use the equipment.

(3) The equipment will be inspected for cleanliness, visual defects, and appropriate inspection forms signed off prior to each use. Equipment determined to have defects that pose a hazard will be immediately removed from the operational site for repairs.

(4) One fire extinguisher rated 10BC or higher (1–A: 10–B: C recommended) for flammable or combustible liquid fires (Class B fire) and electrical fires (Class C fire) will be readily available within the area of the equipment.

(5) Equipment powered by gasoline or diesel fuel will not be refueled within 100 feet of AE locations.

(6) LP gas-powered equipment may have its fuel containers replaced as long as:

(a) Munitions are in the munitions storage structure, and the structure’s doors are closed;

(b) There are no other munitions operations in progress at the site;

(c) The equipment is not in use during fuel container exchange.

i. Containers, dunnage, lumber, and other material will be stacked orderly with stacks limited to an area of no more than 1,500 square feet.

(1) Bulk stacks of combustible materials must not be closer than ILD from locations containing munitions (refer to chap 8 for minimum separations).

(2) Working quantities may be stacked in the vicinity of ongoing munitions operations. Portable fire extinguishers should be provided in these areas. To determine the minimum number and size of portable fire extinguishers, contact the local FES.

j. If needed to prepare for combat operations, empty containers, dunnage, and lumber that cannot be removed during operations may be temporarily stacked in or near the munitions storage area, provided:

(1) The stacks are stable and are separated from the operations as far as practical.

(2) The materials are immediately removed upon completion of the operation or at the end of the work day.

6–9. Firebreaks

Firebreaks will be kept clear of combustible material, such as dry grass, dead wood, or brush. The level of vegetation permitted within firebreaks should be minimal (see *para 6–8c*).

a. A 50-foot firebreak will be maintained around munitions operating facilities, including munitions storage structures (for example, AGM) and areas including outdoor munitions storage and ready munitions storage.

b. A 5-foot firebreak will be maintained:

(1) Around ECM ventilators.

(2) On both sides of fences (for example, magazine area fences, production line fences, and boundary fences). Where access to the outside of the fence is not available (such as garrison or installation boundaries), the fire break will be doubled on the interior side of the fence.

6–10. Auxiliary firefighting equipment - fire extinguishers

Fire extinguishers are designed to put out small fires using an extinguishing agent. Extinguishers are labeled according to whether it is to be used extinguishing fires involving wood or cloth, flammable liquids, electrical, or metal sources. Using the right type of extinguisher when putting out a fire is important because using the wrong type can make the fire worse.

a. Personnel assigned munitions duties will not fight fires involving munitions. Firefighting equipment assigned to the immediate area will be used to contain combustible fires to prevent the propagation to munitions or material. Upon involvement of munitions in a fire, personnel will evacuate to a designated location as in the ESMP and follow the orders of the incident commander/fire chief.

b. In areas where fire extinguishers are required, a minimum of two fire extinguishers suitable for the combustible hazards involved will be available for use.

(1) Fire extinguishers need not be permanently located at a site.

(2) Each fire extinguisher will be:

(a) Conspicuously placed and readily accessible.

(b) Kept in a fully charged and serviceable condition.

Table 6–1
Extinguishing agents for fires [1]

Type of Fire	Extinguishing Agent
Class A: Combustible materials such as wood, plastics, paper, rubbish, or grass	Water; chemical foam; dry chemical
Class B: Flammable and combustible liquids such as oil, gases, tars, solvents, lacquers, grease, or paint	Carbon dioxide (CO2); dry chemical; aqueous film-forming foam (AFFF)
Class C: Electrical (electrical equipment)	CO2; halon [2]; dry chemical
Class D: Combustible metals such as magnesium, potassium, beryllium, metal shavings	Dry powder (suitable for the specific combustible metal involved)
Class K: Cooking appliances where vegetable, animal oils, or fats are used	Wet chemical (Potassium acetate based)

Notes:

[1] For specific guidance, refer to material-specific SDS, NFPA publications, or consult fire protective services for guidance.

[2] Halon extinguishers are no longer made but may still be in use. Dangerous gases are formed when halon is used to put out fires. Wear proper respiratory equipment, particularly in enclosed spaces. After use, do not allow anyone to enter the area until it has been well-ventilated.

c. Personnel responsible for using fire extinguishers will receive training on general principles of their use and the hazards involved with firefighting. This training will be conducted upon initial assignment and at least annually.

d. Fire extinguishers the Army has approved for use are addressed in Technical Bulletin (TB) 5–4200–200–10. If in question, consult with your installation FES.

6–11. Storage of water for firefighting

a. Adequate water to fight fires must be readily available at munitions operating facilities. The amount of water required to support firefighting will be calculated in accordance with UFC 3–600–01 and local FES.

b. The minimum water supply required is 3,000 gallons.

c. The guidelines below will be used for separating water supplies from munitions:

(1) Water tanks must be separated from munitions in accordance with table 8–1.

(2) Sectional control valves will protect the water distribution system so that damaged sections of the main line can be isolated without degrading the operational capability of the remaining system.

(3) Water mains will not be located under railroads or roads used for conveying large quantities of munitions, as a detonation may cause a main to break from shock.

6–12. Public withdrawal distances

a. Emergency withdrawal distances for nonessential personnel apply in emergencies.

(1) The emergency withdrawal distances required for non-essential personnel for fires involving or threatening munitions depends on whether the type of munitions (for example, hazard classification, fire division, and quantity of AE) is known.

(2) The withdrawal distance for essential personnel at accident sites must be determined by emergency authorities on-site. Emergency authorities must determine who essential personnel are.

b. If a fire involves or threatens munitions, the initial withdrawal is inhabited building distance (IBD).

(1) When emergency authorities determine a fire is or may become uncontrollable and may result in deflagration or detonation of nearby AE material, nonessential personnel will be withdrawn to the emergency withdrawal distance listed in DESR 6055.09, Table V1.E10.T10.

(2) If the fire is not affecting or threatening explosives, then emergency authorities must determine the withdrawal distance based on the situation at hand.

c. Structures or protected locations that provide equivalent protection for the distances listed in DESR 6055.09, Table V1.E10.T10 may be used instead of evacuating personnel from either the structure or fire's location to the specified emergency withdrawal distance.

d. Commanders will develop evacuation plans for their respective units. These plans will be consistent with the ESMP and reference the appropriate withdrawal distances. The commander must alert civilian authorities of any explosive mishap that may affect the local community and provide authorities with appropriate emergency withdrawal distances.

6–13. Firefighting guidance symbols

Two types of hazard symbols (fire and chemical) provide the information needed by fire departments and others.

a. There are four fire divisions. Fire division 1 indicates the greatest hazard. The hazard decreases as the fire division numbers increase, as shown in DESR 6055.09, Table V1.E10.T7.

b. Each of the four fire divisions is indicated by four distinct symbols showing the number of the fire division. These symbols are easily recognizable to firefighters approaching a fire scene. The hazard symbols differ in shape for easy identification from long range (see DESR 6055.09, Table V1.E10.T8. and Figure V1.E10.F2).

c. Symbols will be removed, covered, or reversed when munitions are not present within the munitions operating facility. The person in charge of the operation will post or change the symbols. FES will be notified each time fire, or hazard symbols are changed.

d. The dimensions in DESR 6055.09, Figure V1.E10.F2., Figure V1.E10.F3., and Figure V1.E10.F4 are the normal minimum sizes. Half-size symbols may be used where appropriate, for example, on doors and lockers inside buildings.

e. Decals for fire and chemical hazard symbols may be requisitioned from the Defense Logistics Agency (DLA). DESR 6055.09, Figure V1.E10.F2., Figure V1.E10.F3., and Figure V1.E10.F4 provide the NSNs of standard and half-size decals.

f. Non-explosively configured chemical munitions may be stored as Class 6, Division 1 poisons (6.1). Munitions that contain chemical compounds (for example, WP, signaling smoke, incendiary) that are explosively configured may be stored with munitions containing explosives, and the same chemical compound fills.

6–14. Posting fire symbols

a. The fire symbol that applies to the most hazardous material present will be posted on or near munitions operating facilities. Fire symbols will be visible from every approach road.

(1) Only one symbol, which is posted on or near the ECM's door, is normally required on an ECM.

(2) One or more symbols may be required on other munitions operating structures.

b. When munitions of different HDs are stored in individual multi-cubicle bays or module cells, the proper fire symbol will be posted on each bay or cell. The highest fire symbol applicable to the munitions in storage will be appropriately posted outside.

c. Fire symbols will be placed on entrances to arms rooms that contain munitions. If munitions are stored in a locker or similar container, the container will also be marked with the appropriate fire symbol. Symbols are not required on the exterior of the building, providing the building is exempt from QD in accordance with provisions of this pamphlet.

d. If topography or vegetation that cannot be removed would prevent personnel from seeing a fire symbol until arrival at a storage structure, the command will maintain a current master list indicating each location for which fire symbols cannot be seen and fire division symbols that apply. The command will provide this master list to emergency forces (for example, guard forces and fire departments).

e. The fire symbols required by DESR 6055.09, Table V1.E10.T7, and this pamphlet will be used. The exception is if the host nation's symbols are required by the Status of Forces Agreement or other international agreements.

6–15. Exceptions on posting fire symbols

a. Fire symbols are not required for locations storing 1,000 rounds or less of SAA that are HD 1.4.

b. At the Army's discretion, circumstances (for example, security) may make it undesirable to post-fire symbols at a specific munitions storage structure or area.

c. Storage of munitions or commercial explosives at FUDS may be exempt from posting fire symbols unless mandated by local fire officials.

d. If vehicles or aircraft are in a designated explosives parking area, fire symbols need not be posted provided such areas are described in a local publication, such as the vehicles and aircraft parking plan, which includes the following:

(1) The HC/D involved.

(2) The governing fire symbol for the parking area.

(3) Procedures to be followed during an emergency.

(4) A requirement to notify FES when munitions are present.

6–16. Posting chemical hazard symbols

a. Chemical hazard symbols must be posted with the appropriate fire division symbols when explosively configured chemicals and munitions containing pyrotechnic compounds are present in a munitions operating facility. Chemical hazard symbols will be posted when non-explosively configured munitions are present in munitions operating facilities.

b. Requirements for posting and removing chemical hazard symbols are similar to those for posting fire symbols, as follows:

(1) Each munitions storage structure, including storage pads, will be posted with a hazard symbol to identify each chemical agent appropriately stored.

(2) Facilities used for chemical agent operating facilities (for example, manufacturing, filling, and processing) will be identified by posting the appropriate chemical agent hazard symbols at entrances into the area and on each separate building when more than one building is involved.

(3) If topography or vegetation that cannot be removed would prevent personnel from seeing a chemical hazard symbol until arrival at a storage structure, the command will maintain a current master list indicating each location for which fire symbols cannot be seen and the fire division symbol that applies. The command will provide this master list to emergency forces (for example, fire department and security forces). Wooded areas within or immediately adjacent to the border of chemical munitions exclusion areas can significantly reduce the 1-percent lethality distances to both on-post, nonrelated, and off-post inhabited buildings. Except for maintaining the required firebreak around each magazine and the clear security zone around the perimeter of a chemical exclusion area, cutting, or harvesting trees is prohibited within the 1-percent lethality distance unless approved explicitly by the ACOM, ASCC, or DRU. Normal selective thinning not to exceed 70 square feet basal area is acceptable.

c. Explosively configured chemical munitions may be stored in the same structure as class 6.1 munitions with the same fill.

6–17. Automatic sprinkler systems

a. Provide automatic sprinkler protection in accordance with UFC 3–600–01.

b. Automatic sprinkler systems will not be deactivated unless repairs or modifications to the system are required. When an interruption is required, or deactivation of a system is necessary, the criteria and precautions outlined in UFC 3–601–02 will be followed. Where heating is a problem, wet systems should be converted to automatic dry systems. Valve rooms will be heated during the winter.

c. Inspection and maintenance of automatic sprinkler systems will conform to requirements of UFC 3–601–02.

d. Local water flow alarm facilities are required for automatic sprinkler systems installed in explosives operating buildings; however, transmitted water flow alarms may not be required.

6–18. Deluge systems for explosives operations

Must provide deluge systems in accordance with UFC 3–600–01.

6–19. Emergency planning

a. Installations and garrisons must comply with 42 United States Code (USC) sections 11001–11022 (commonly known as the “Emergency Planning Community Right-To-Know Act (EPCRA)”) and applicable DoD policy and Army implementing policies. As such, they will develop an SOP or plans designed to protect human health and the environment during an emergency.

b. These plans will be coordinated with the appropriate Federal, state, and local emergency response authorities (such as law enforcement, FES, and hospitals) and any established Local Emergency Planning Committees. At a minimum, these SOPs or plans must address:

(1) Procedures for the prompt notification of emergency response and environmental agencies and potentially affected communities in an emergency involving munitions.

(2) Include a HA that identifies the hazards present or potentially present.

(3) Guidance addresses emergency preparedness, contingency planning, and security. Security guidance will indicate access controls to munitions operating facilities.

(4) A requirement to comply with applicable explosives safety criteria that protect human health and the environment.

Chapter 7
Hazard Classification and Compatibility Groups

7–1. Explosives hazard classification procedures

All AE must be hazard classified before any transportation or storage. Joint TB 700–2 contains procedures for identifying and classifying AE hazards and Hazard Classification Authority. AE without a final hazard classification and not in the Joint Hazard Classification System (JHCS) will require an interim hazard classification (IHC). An IHC authority may issue an IHC for a variety of reasons (for example, research, and development, foreign AE exploitation, demilitarization, or for a final hazard classification process). An IHC is valid for DoD storage worldwide and domestic and international transportation by a military carrier. Each mode may have restrictions or limitations based on hazard classification (for example, HD 1.1 AE are forbidden on commercial passenger aircraft) and may have unique requirements regarding compatibility and use.

a. The Army component sponsoring development or first adopting AE is responsible for providing the required data to the IHC authority for each new IHC or renewal.

(1) Test assets sufficient to support the requirements of Chapter 5 of TB 700–2 may not be available for AE needing an IHC. At a minimum, UN Series 3 or UN Series 4 test results or a statement of the rationale supporting the conclusion that the AE is not forbidden for transportation is required.

(2) Additional hazard classification test data may be required to support an IHC other than HD 1.1. The additional tests will be dependent on the AE configuration and may include tests such as the Naval Ordnance Laboratory Card Gap Test, Armament Research, Development, and Engineering Center Solid

Propellant Initiation Sensitivity Test, Expanded Large Scale Gap Test, or Super Large Scale Gap Test. Appropriate tests need to be coordinated with the IHC authority.

(3) Analogies to existing AE with a final hazard classification may be used for assigning IHC.

(4) Situations may arise where descriptive data and test data for AE needing an IHC is limited (for example, foreign exploitation AE or demilitarized AE). An IHC authority may issue an IHC provided qualified personnel (for example, EOD personnel) have evaluated and determined the AE safe for transport.

(5) A nation's hazard classification from the National Competent Authority may be used in lieu of UN Series 3 or UN Series 4 data. North Atlantic Treaty Organization (NATO) and partner nations' classification data may be shared via the Munitions Safety Information Analysis Center.

b. IHCs are valid for transportation for up to one year and for storage for up to two years.

c. All IHCs require a request for justification for the continued need. IHC are authorized for transportation in commerce in accordance with DOT Special Permit 15448 or current DOT regulations.

d. IHC are valid for storage beyond one year if the Army Hazard Classifier permits.

e. Once the IHC is assigned, a change in the AE (that is, design, or explosive components) or its packaging must be re-examination by the IHC authority to ascertain the need for new hazard classification.

f. The following data, as applicable, will be provided as a part of the IHC request:

(1) AE nomenclature.

(2) NSN or Material Control Number/Manufacturer Part Number that is cataloged in the Army Enterprise Systems Integration Program (AESIP).

(3) Prime contractor.

(4) Vendor.

(5) System with which the AE is associated.

(6) Next higher assembly with which the AE is used.

(7) Dimensions of unpackaged AE.

(8) Weight of unpackaged AE.

(9) Explosive substance compositions, types, and weights.

(10) Hazard classification test data for new AE or analogous AE.

(11) Physical description of AE.

(12) Functional description of AE.

(13) Packaging data, with Performance Orientated Packaging.

(14) Description of fuze safety features.

g. A copy of the applicable DoD IHC and DOT Special Permit 15448 must be carried aboard each vehicle transporting interim hazard classified AE.

7–2. Hazard classes and divisions

The DoD hazard classification system consists of nine hazard classes plus a non-regulated category that applies when explosives and hazardous materials are present in an item but not to the degree that meets the criteria for assignment to one of the nine classes. Refer to DESR 6055.09, paragraph V1.E6.2.1, for detailed guidance.

7–3. Storage and transportation compatibility groups

The 13 compatibility groups (CGs) are assigned to AE based on similarity of function, features, and accident effects potential. Refer to DESR 6055.09, paragraph V1.E6.2.2, for detailed guidance.

7–4. Storage and compatibility principles

Separate storage of AE by HD and type provides the highest degree of safety. Because separate storage is generally not feasible, mixed storage, subject to compliance with these standards, is normally implemented when such storage facilitates safe operation and promotes overall storage efficiency. Refer to DESR 6055.09, paragraph V1.E6.3, for detailed guidance.

7–5. Mixed storage

a. Figure 7–1 shows how different CGs of AE can be mixed in storage. Exceptions are listed below. A "Z" at an intersection indicates that when warranted by operational considerations or magazine non-availability, and when safety is not sacrificed, mixed storage of limited quantities of some items from different groups may be approved in writing. Approval of such storage will be at a level consistent with the risk

acceptance authority criteria of DA Pam 385–30; however, a DA Form 7632 is not required. Documentation of this approval must be kept on hand by the installation or garrison safety office.

b. Certain locations within the United States, its territories, and possessions designated by the Army and with site approval from the DDESB to store ammunition in rapid response configurations and BLAHAs outside the United States are authorized to store ammunition without regard to compatibility. The maximum NEQ at any of these locations storing mixed compatibility ammunition must not exceed 4000 kilograms (kg) (8,818 pounds NEW) calculated in accordance with DESR 6055.09, paragraphs V4.E5.24. Through V4.E5.24.3.2. AE of different CGs may only be mixed in storage, as indicated in figure 7–1. The exceptions are when the provisions for tactical operations to include tactical training operations are being applied (reference CJCSI 4360.01C and DESR 6055.09) and at specific CONUS locations that the Army designates to store AE packaged and configured for rapid response (for example, Rapid Deployment Force) for which the DDESB has approved the site plan. Such designated locations are authorized to mix CGs without complying with the compatibility and mixing requirements, as operationally required to achieve the optimum load needed by the intended receiving troops. The maximum credible event (MCE) allowable at these storage sites must be limited to 8,818 lbs. NEW for net explosive weight for quantity-distance (NEWQD) (4,000 kg NEQ). When computing QD requirements for such sites, Chapter 8 applies. However, propelling charges in HD 1.2 fixed, semi-fixed, mortar, and rocket AE are excluded for NEWQD determination at such storage sites.

c. Complete round storage concept (near equal numbers of projectiles, propellant, fuzes, and primers) is acceptable for locations OCONUS where rapid response is essential.

Group	A	B	C	D	E	F	G	H	J	K	L	N	S
A	X	Z											
B	Z	X	Z	Z	Z	Z	Z					X	X
C		Z	X	X	X	Z	Z					X	X
D		Z	X	X	X	Z	Z					X	X
E		Z	X	X	X	Z	Z					X	X
F		Z	Z	Z	Z	X	Z					Z	X
G		Z	Z	Z	Z	Z	X					Z	X
H								X					X
J									X				X
K										Z			
L													
N		X	X	X	X	Z	Z					X	X
S		X	X	X	X	X	X	X	X			X	X

Figure 7-1 Notes:

- "X" indicates that these groups may be combined in storage; otherwise, mixing is either prohibited or restricted according to note #2. A “Z” at an intersection indicates that when warranted by operational considerations or magazine non-availability, and when safety is not sacrificed, mixed storage of limited quantities of some items from different groups may be approved in writing. Approval of such storage will be at a level consistent with the risk acceptance authority criteria of DA Pam 385–30, table 4–2; however, a DA Form 7632 (Certificate of Risk Acceptance) is not required. Documentation of this approval must be kept on hand by the installation or garrison safety office. Mixed storage of items within groups where no X or Z exists at that pair’s intersection beyond the prohibitions and limitations of note 7 below: however, requires a Certificate of Risk Acceptance per DA Pam 385–30. USATCES shall determine which items may be stored with Group K. Group K may also require separate storage within the group. Articles of compatibility Groups B and F shall each be segregated in storage from articles of other compatibility groups by means that are effective in preventing propagation of those articles through fire or detonation (a sand bag wall at least one foot thick and high enough to prevent line of sight exposure will provide this protection). Examples of acceptable storage combinations are: (a) HD 1.1A initiating explosives with HD 1.1B fuzes not containing two or more effective protective features; (b) HD 1.3C bulk propellants or bagged propelling charges with HD 1.3G pyrotechnic substances.

- Compliance with compatibility criteria is not required for mission essential or operationally necessary quantities of explosives in class/division 1.4 or 6.1 (excluding toxic chemical munitions); up to 100 lbs. NEW class/division 1.3; and up to 50 lbs. NEW Class/Division 1.2.2. See paragraph 8–2b for QD requirements and additional information concerning small quantities of explosives.

Figure 7–1. Storage compatibility mixing chart

- Equal numbers (to the nearest pack or pallet as applicable) of separately packaged components of complete rounds of any single type of ammunition may be stored together. When so stored, compatibility is that of an assembled round, for example, WP filler in Group H, HE filler in Groups D, E, or F, as appropriate.

- Ammunition items without explosives that contain substances properly belonging to another U.N. hazard class may be assigned to the same compatibility group as items containing explosives and the same substance, and be stored with them.

- DA may authorize ammunition designated 'practice' by National Stock Number (NSN) and nomenclature to be stored with the fully loaded ammunition it simulates.

- In addition to the authority in paragraph 7-4b, above, and Z compatibility storage in Note 2 above, the ACOM, ASCC, or DRU may also authorize the mixing of compatibility groups in quantities not exceeding 1000 pounds NEW per storage site; EXCEPT items in Groups A, K, and L.

- For purposes of mixing, all items must be packaged in approved storage/shipping containers. Items shall not be opened for purposes of issuing unpackaged munitions in storage locations. Outer containers may be opened in storage locations for inventorying; for removing munitions still inside an approved inner package in limited amounts, and for magazines storing only hazard division 1.4 items, unpacking, inspecting, and repacking the hazard division 1.4 ammunition.

- If dissimilar CG N munitions are mixed together and have not been tested to ensure non-propagation; the mixed munitions are considered to be HD 1.2, CG D for purposes of transportation and storage. When mixing CG N munitions with CGs B through G, see paragraph 8-7 about changing QD class/divisions.

- For storage purposes, fuzes assigned to CG D are also compatible with fuzes assigned to CG B.

Figure 7–1. Storage compatibility mixing chart - continued

7–6. Extremely insensitive detonating substance and ammunition

a. Extremely insensitive detonating substance (EIDS) is comprised of substances that have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport. These materials are assigned to HD 1.5 for transportation purposes only. For storage, these materials are assigned to HD 1.1.

b. EIDS ammunition consists of extremely insensitive articles with no mass explosive hazard. The articles contain only EIDS and demonstrate (through test results) a negligible probability of accidental initiation or propagation. These materials are assigned HD 1.6.

c. QD application:

(1) QD separation for HD 1.6 AE will be based on table 7–1.

(2) IBD for bulk HD 1.6 explosives will be in accordance with Table V3.E3.T16 of DESR 6055.09.

7–7. Class 1 or 6 chemical agent hazards or combined chemical agent and explosives hazards

a. Items in these classes are chemical agent-filled ammunition, chemical agents, and chemical agent-filled components. Depending upon the type of agent, its persistency, toxicity, or other characteristics, the primary safety considerations may be the area of agent dispersal rather than blast or fragment considerations.

b. Items that contain only toxic chemical components are assigned to HD 6.1. Items that contain both explosives and toxic chemical components are included in UN Class 1 AE, as appropriate. HD 6.1 requirements must also be applied to consider the explosives and toxic chemical hazards.

7–8. Underground storage

Ammunition with smoke-producing, incendiary, flammable liquid, or toxic chemical agent fillers may be stored in single-chamber underground facilities but must not be stored in multi-chamber facilities. Other than this restriction, AE of all CGs may be placed in underground storage in compatible combinations as permitted above.

Table 7–1
Extremely insensitive detonating substance ammunition hazard divisions Continued

Type	QD HD CG

Table 7–1
Extremely insensitive detonating substance ammunition hazard divisions—Continued

EIDS bulk	1.5D
EIDS loaded projectiles and/or warheads w/o fuzes or with EIDS fuzes [1, 2]	1.6N
EIDS fuzes [1]	1.4D
EIDS loaded projectiles and/or warheads w/HD 1.3 propelling charges and without fuzes or with EIDS fuzes [1,2]	1.3C/1.2C
EIDS loaded projectiles and/or warheads with non-EIDS fuzed and without HD 1.3 propelling charges	1.2D [3, 4]
EIDS loaded projectiles and/or warheads with non-EIDS [2,4] fuzes and with HD 1.3 propelling charges	1.2E [3, 4]

Notes:

[1] EIDS fuzed means that the fuze has an EIDS booster with an out-of-line non-EIDS explosive and two or more independent safety features. The fuze must be certified as invulnerable to accidental detonation of the warhead.

[2] Fuzed configurations must be tested for propagation.

[3] Unit risk may be justified on a case-by-case basis.

[4] Fuze must have two or more independent safety features and be independently classified group D.

Chapter 8
Explosives Safety Separation Distance (Quantity-Distance)

8–1. Explosives safety quantity-distance

The severity of damage or injury from an explosion is dependent upon the distance between the PES and the ES; the type of explosives involved (see DESR 6055.09, paragraph V1.E6.2. for an explanation of types); the quantity of explosives at the PES; the ability of the PES to suppress blast overpressure, fragments, and debris; and the ability of the surrounding ESs to withstand explosion effects. This chapter prescribes Army-unique explosives safety ESQD standards and requirements that augment the standards and requirements of DESR 6055.09. Compliance with ESQD standards and requirements of this pamphlet and DESR 6055.09 is mandatory. The key to successful and safe explosives operations is to expose the minimum number of personnel; for the minimum amount of time; to the minimum amount of ammunition consistent with safe and efficient operations. In all situations, effort should be expended to ensure nonessential persons are not exposed to risks associated with AE needlessly.

8–2. Quantity-distance exceptions

The following exceptions are permitted for reasons of operational necessity:

a. Limited quantities of HD 1.2.2 items, not to exceed 50 pounds NEW, may be stored in facilities such as hangars, troop buildings, and manufacturing or operating buildings without regard to quantity or distance. Fragmentation shielding will be provided. The items will be stored in their original DOT-approved packaging.

b. Limited quantities of HD 1.3 items, not to exceed 100 pounds NEW, may be stored in facilities such as hangars, troop buildings, and manufacturing or operating buildings without regard to quantity or distance. The items will be stored in their original DOT-approved packaging.

c. Compliance with QD and compatibility criteria is not required for mission essential or operationally necessary quantities of AE in hazard class and division (HD) 1.4 or 6.1 (excluding toxic chemical munitions).

d. For document destroyers of HD 1.3, quantities in excess of 100 pounds may be positioned for use without complying with QD and compatibility if their Command finds this necessary for security reasons.

8–3. Structural response to blast

a. Conventional structures are designed to withstand roof snow loads of 50 pounds per square foot (1.44 kilopascals) and wind loads of 90 miles per hour (161 kilometers per hour). The loads equate to 0.2 pounds per square inch (psi).

(1) Air-blast overpressure at HD 1.1 IL(B) is 12 psi (82.7 kPa); at IL(U) is 3.5 psi (24 kPa); and at IBD is 0.9 to 1.2 psi (6.2 to 8.3 kPa).

(2) Comparing these loads with the design capacity, it is evident that conventional buildings will be damaged even at IBD.

(3) Conventional structures, which include aboveground storage facilities, contribute little to propagation protection from either blast or fragments. Distance and/or barricades provide propagation protection. The amount of damage to be expected at various pressure levels is described in figure 8–1.

(4) Examples of Distance, protection factor, and incident pressure equivalents can be found in DESR 6055.09, Table V1.E8.T2.

Distance	Over-pressure (psi)	Expected effects	Severity
Inhabited building distance	***1.2 - 0.90***	Unstrengthened buildings are likely to sustain damage up to about 5 percent of the replacement cost.	**Moderate**
W<100,000 lbs.	***1.2***	Personnel are provided a high degree of protection from death or serious injury, with likely injuries principally being caused by broken glass and building debris.	
W>250,000 lbs.	***0.9***	-Personnel in the open are not expected to be injured seriously directly by the blast. Some personnel injuries may be caused by fragments and debris, depending largely upon the potential explosion site structure and the amount of ammunition and its fragmentation characteristics.	
Public Traffic Route distance	**2.3 - 1.7**	-Personnel in the open are not expected to be killed or seriously injured directly by blast. There may be some personnel injuries caused by fragments and debris, depending largely upon the potential explosion site structure and the amount of ammunition and its fragmentation characteristics. -Vehicles on the road should suffer little damage unless hit by a fragment or unless the blast wave causes momentary loss of control. -Aircraft should suffer some damage to appendages and sheet metal skin from blast and possible fragment penetration; however, the aircraft should be operational with minor repair. -Cargo ships should suffer minor damage to deck structure and exposed electronic gear from blast and possible fragment penetration, but such damage should be readily repairable.	**Critical**
W<100,000 lbs.	**1.7**	Unstrengthened buildings are likely to sustain damage approximating 20 percent of the replacement cost.	
W>250,000 lbs.	**2.3**	Occupants of exposed structures may suffer temporary hearing loss or injury from secondary blast effects such as building debris and the tertiary effect of displacement.	
Unbarricaded intraline distance (IL(U))	**3.5**	-Direct propagation of explosion is not likely. -Delayed communication of an explosion may occur from fires or equipment failure at the exposed site. -Damage to unstrengthened buildings will be serious and approximate 50 percent or more of the total replacement cost.	**Critical**

Figure 8–1. Safe separation distances and expected severities (Hazard Division 1.1)

		-There is a 1 percent chance of eardrum damage to personnel. -Serious personnel injuries are likely from fragments, debris, firebrands, or other objects. -Cargo ships would suffer damage to decks and superstructure from being struck by fragments and having doors and bulkheads on the weather deck buckled by overpressure. -Aircraft can be expected to suffer considerable structural damage from blast. Fragments and debris are likely to cause severe damage to aircraft at distances calculated from the formula 18W1/3 when NEWs under 9,000 pounds are involved. -Transport vehicles will incur extensive, but not severe, body and glass damage consisting mainly of dishing of body panels and cracks in shatter-resistant window glass.	

Distance	Over-pressure (psi)	Expected effects	Severity
Intermagazine distance – unbarricaded (IM(U))	**8**	-Damage to unstrengthened buildings will approach total destruction. -Personnel are likely to be injured seriously by the blast, fragments, debris, and translation. -There is a 20 percent risk of eardrum rupture. -Explosives vessels are likely to be damaged extensively and delayed propagation of explosion may occur. -Aircraft will be damaged heavily by blast and fragments; ensuing fire will likely destroy them. -Transport vehicles will sustain severe body damage, minor engine damage, and total glass breakage.	**Catastrophic**
Barricaded intraline distance (IL(B))	**12**	-Unstrengthened buildings will suffer severe structural damage approaching total destruction. -Severe injuries or death to occupants of the exposed site may be expected from direct blast, building collapse, or translation. -Aircraft will be damaged beyond economical repair both by blast and fragments. If the aircraft are loaded with explosives, delayed explosions are likely from subsequent fires. -Transport vehicles will be damaged heavily, probably to the extent of total loss. -Immediate spread of the fire between two explosives locations is unlikely when barricades are interposed between them to intercept high-velocity low-angle fragments. Delayed propagation is possible from lobbed munitions and burning materials.	**Catastrophic**

Figure 8–1. Safe separation distances and expected severities (Hazard Division 1.1) - continued

		-Improperly designed barricades or structures may increase the hazard from flying debris, or may collapse increasing the risk to personnel and equipment. -Control at IL (B). Barricading is required. Exposed structures containing equipment of high monetary value or critical mission importance or where personnel exposure is significant may require hardening to protect personnel and equipment.	
Intermagazine distance barricaded (IM(B))	**27**	-Unstrengthened buildings will be destroyed completely. -Personnel will be killed by direct action of blast, by being struck by building debris, or by impact against hard surfaces. -Transport vehicles will be overturned and crushed by blast. -Explosives vessels will be damaged severely, with propagation of explosion likely. -Aircraft will be destroyed by blast, thermal, and debris effects.	**Catastrophic**

Figure 8–1. Safe separation distances and expected severities (Hazard Division 1.1) - continued

b. ECMs identified in DDESB TP–15, separated one from another by the minimum distances required in DESR 6055.09, provide virtually complete protection against propagation of explosion by blast, fragments, and fire; however, there may be some cracking of concrete barrels and rear walls, possible severe cracking and some spalling of front walls, and some damage to doors and ventilators.

c. Underground facilities sited and constructed as specified in DESR 6055.09.

d. Barricaded open storage modules provide a high degree of protection against propagation of explosion by blast and fragments. However, if flammable materials are present in nearby cells, subsequent propagation of explosion by fire is possible.

(1) When K=1.1 distances separate items from a donor explosion, the items will be covered with earth thrown by a nearby explosion and unavailable for use until extensive uncovering operations and possibly maintenance are completed.

(2) When items are separated by K=2.5 distances from the PES, the items should be readily accessible.

(3) As depicted in DESR 6055.09, Figure V2.E5.F3, a module is a barricaded area comprised of a series of connected cells with hard surface storage pads separated from each other by barricades. A light metal shed or other lightweight fire-retardant covers may be used to protect individual cells from the weather. Heavy structures (reinforced concrete, dense masonry units) or flammable material will not be used. Note that for Army applications of this figure, roadway widths are determined by the traveled-way width. The lane width normally required for wheeled vehicles is 11 feet/3.5 meters or up to 25 feet/7.62 meters for total road width.

(4) Module storage (open storage) may be used as determined necessary by the Army. However, from the standpoint of explosives safety as well as reliability, covered storage (ECMs) is preferred for items requiring protection from the elements. Module storage is considered a temporary expedient and may not be employed in place of standard methods for long-term storage.

(5) The maximum NEW permitted to be stored within each cell is 250,000 pounds (113,636 kg) (total of the explosives fill of all HD 1.1 and/or HD 1.2 ammunition).

(6) Authorized storage will be:

(a) Limited to HE bombs (fuzed or unfuzed, with, or without fins), similarly cased HD 1.1 ammunition, and the following contained in nonflammable or metal shipping containers: 30 mm and smaller ammunition, CBUs, inert munitions components, and HD 1.4 munitions.

(b) Stocks in each module normally will be limited to one type of item in the standard shipping configuration unless the controlling authority permits mixed storage.

(c) Module storage of ammunition in flammable outer pack configurations will be minimized. Combustible dunnage or another flammable materiel must not be stored in or within 100 feet of modules.

(7) When fire-retardant tarpaulins are used as a cover, there must be a minimum of 18 inches between the tarpaulins and the stored ammunition.

(8) Siting criteria—Distance between the nearest edges of stacks of munitions in adjacent cells and modules will be as shown for appropriate explosives weights in DESR 6055.09, Table V2.E5.T1.

(a) When cell explosives loadings are established for weights other than those shown, minimum distances between stacks will be determined by the formula D=1.1W1/3.

(b) The distance between a module and other magazines will be determined by applying the IMDs specified in DESR 6055.09. Tables V3.E3.T5, V3.E3.T7 and V3.E3.T8.

(c) The distances between the explosives in the cells of a module and all other targets will be determined between the nearest edge of the munitions stack in the controlling cell and the nearest point of the ES.

e. The high-performance magazine (HPM) identified in DDESB TP 15, with the minimum IMD required by DESR 6055.09, Table V3.E3.T6, provides virtually complete protection against propagation of explosion by blast, fragments, and fire.

f. The second-story transfer area is enclosed by a pre-engineered metal building which an explosion at a nearby PES may severely damage.

g. The amount of damage to be expected at various pressure levels is described in figure 8–1.

(1) Unless special design requirements are imposed, access to ammunition items at less than K30 from a donor explosion may require extensive cleanup and a mobile crane to assist in recovery and cleanup.

(2) For the HPM, the NEW, for determining separation distances, is based on the MCE. The MCE is determined by adding the NEW in an individual cell to the NEW at the loading dock. Safe separation distances are calculated using the MCE of the HPM. The MCE for the HPM must not exceed 60,000 pounds.

8–4. Substantial dividing walls

Substantial dividing walls (SDWs) are designed to prevent the bay to bay simultaneous detonation of HD 1.1 materials. Construction of new SDWs must conform to requirements in UFC 3–340–02.

8–5. Calculation of explosives quantity

The total quantity of explosives in a facility is calculated as shown below. Where the DDESB has approved high explosive (HE) equivalence for propellant and/or pyrotechnic, the HE equivalence may be used to determine NEW. In such cases, the sum of the high explosive weight (HEW) plus the HE equivalence of the propellant and/or pyrotechnic will be the applicable NEW. The JHCS provides explosive weights for all DoD Hazard Classified AE.

a. For mass explosion (HD 1.1)*, t*he NEW is the total weight of all HE plus the total net propellant weight (NPW) of all the HD 1.1 items combined.

b. Requirements for a non-mass explosion, fragment producing (HD 1.2) are as follows:

(1) When HC/D 1.2.1 items are stored in structures that may contribute to the debris hazard, the IBD is determined by using the larger of the following two distances: either that for the appropriate explosive weight (number of items x NEWQD) or that given for the appropriate MCE. When HC/D 1.2.1 MCE is a consideration, refer to DESR 6055.09, paragraph V3.

(2) The NEWQD for HC/D 1.2.2 is the HEW plus the NPW in all HC/D 1.2.2 items.

(3) The NEWQD for HC/D 1.2.3 is the HEW plus the NPW in all HC/D 1.2.3 items. This material is treated as HD 1.3; however, a minimum IBD must apply.

c. The NEWQD for mass fire, minor blast, or fragment (HD 1.3) is the HEW plus the NPW plus the total weight of all propellant and pyrotechnics in all HD 1.3 items.

d. The NEWQD for moderate fire, no blast, or fragment (HD 1.4) is the HEW plus the NPW plus the total weight of pyrotechnics in all HD 1.4 items.

e. The NEWQD for *e*xplosive substance, very insensitive (with mass explosion hazard) (HD 1.5), is the HEW plus the NPW in all HD 1.5 items. For HD 1.5, NEWQD equals the NEW.

f. The NEWQD for an explosive article, extremely insensitive (HD 1.6), is the total weight of EIDSs in all HD 1.6 items. However, the weight of EIDSs in a single HD 1.6 item must also be considered, as specified in DESR 6055.09, Table V3.E3.T16, for determining QD.

g. Munitions' fillers that do not contribute to explosive effects (for example, colored, and HC smoke, dyes, irritants, WP, PWP, and thickened pyrophoric agent (TPA)) are excluded when determining NEWQD.

h. If DDESB-approved buffer configurations are provided, the NEW is the explosives weight of the largest stack plus, if applicable, the explosives weight of the buffer material, excluding the NEW of HD 1.4.

8–6. Determining the net explosive weight for quantity-distance for mixed hazard divisions

a. The presence of HD 1.4 does not affect the NEWQD of mixed HDs. However, for QD determinations, HD 1.4 criteria must be considered.

b. When HD 1.1 is mixed with any other HD, treat the mixture as HD 1.1 except as noted in *paragraph 8–6e*.

c. When HD 1.5 is present, always treat it as HD 1.1.

d. When dissimilar HD 1.6 are mixed and have not been tested to ensure non-propagation, the mixed HD 1.6 AE must be individually considered to be HC/D 1.2.1 or HC/D 1.2.2, based on their individual NEWQD or overriding fragmentation characteristics.

e. HD 1.1 with HD 1.2 (HC/D 1.2.1, HC/D 1.2.2, and HC/D 1.2.3). Use whichever of the following generates the largest QD:

(1) Sum the NEWQD for HD 1.1 and NEWQD for HD 1.2 and treat the mixture as HD 1.1.

(2) The NEWQD of the mixture is the NEWQD of the HD 1.2 subdivision requiring the largest QD.

f. HD 1.1 with HD 1.3. Sum the NEWQD for HD 1.1 and the NEWQD for HD 1.3 and treat the mixture as HD 1.1.

g. HD 1.1 with HD 1.6. Sum the NEWQD for HD 1.1 and the NEWQD for HD 1.6 and treat the mixture as HD 1.1.

h. HC/D 1.2.1 with HC/D 1.2.2. The NEWQD for the mixture is the NEWQD of the subdivision requiring the largest QD.

i. HC/D 1.2.1 with HC/D 1.2.3. The NEWQD for the mixture is the NEWQD of the subdivision requiring the largest QD.

j. HC/D 1.2.2 with HC/D 1.2.3. The NEWQD for the mixture is the NEWQD of the subdivision requiring the largest QD.

k. HC/D 1.2.1 with HC/D 1.2.2 with HD 1.2.3. The NEWQD for the mixture is the NEWQD of the subdivision requiring the largest QD.

l. HD 1.2 (HC/D 1.2.1, HC/D 1.2.2, and HC/D 1.2.3) with HD 1.3. The NEWQD for the mixture is the NEWQD of the HD requiring the largest QD.

m. HD 1.2 (HC/D 1.2.1, HC/D 1.2.2, and HC/D 1.2.3) with HD 1.6. Treat the HD 1.6 as HC/D 1.2.3 and determine NEWQD.

n. HD 1.3 with HD 1.6. Sum the NEWQD for HD 1.6 and the NEWQD for HD 1.3 and treat the mixture as HD 1.3.

8–7. Calculating quantity-distance for two or more potential explosion sites

When several PESs are located near each other, the relationship between the PESs must be considered in order to arrive at either the appropriate quantities of explosives or appropriate safe separation distances that should be maintained for each. The simplest relationship is where all PESs are equal distance from each other since the quantities permitted in each will be identical for the same HD. The inverse is also simple when all quantities of explosives are the same; the same QD separation is required. Therefore the proper QD can be determined using the appropriate QD tables in this chapter.

a. When quantities of explosives stored at PESs vary or distances between PESs are different, the determination of QD becomes more complex. To determine the appropriate QD, the relationship between all the PESs must be examined. This is accomplished by considering each PES as both a PES and an ES.

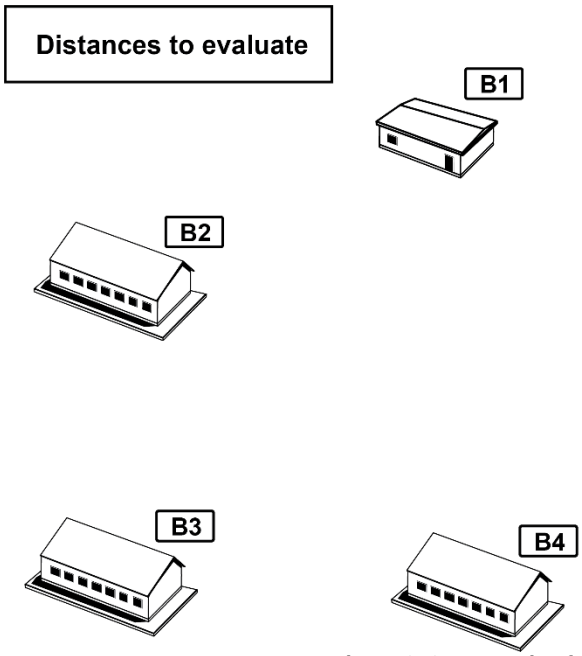
(1) First, each location is considered a PES, and the other PESs are considered ESs. Using the appropriate QD tables, either the permitted quantity or required safe separation distance is determined between

the first PES and all other PESs as ESs. Normally, the distances are fixed; therefore, the quantity of explosives is varied to meet QD requirements.

(2) The process is repeated for each PES in turn once more, considering it as the PES and the other PESs as ESs.

(3) Once all the quantities or distances for each PES have been determined, the permissible QD is then either the least amount of explosives or the greatest distance required by any one of the combinations. See figure 8–2 for an example.

b. One exception is for service magazines that are part of operating lines. The distances are based on the quantity and type of AE in the service magazine or magazines, not the operating line. This protects the operating line from an explosion at the service magazine, while the inverse is not provided for.



Quantity Permitted Based Upc Distance			
PES 1	**Distance**	**NEW (lbs)**	**Authorized Amt**
B1	B2	2500	2500
B1	B3	4000	
B1	B4	3000	
PES 2			
B2	B1	2500	
B2	B3	1500	1500
B2	B4	2000	
PES 3			
B3	B1	4000	
B3	B2	1500	
B3	B4	1000	1000
PES 4			
B4	B1	3000	
B4	B2	2000	
B4	B3	1000	1000

Figure 8–2. Example of multiple potential explosion sites

8–8. Quantity-distance relationships of Department of Defense components

Apply DESR V4.E5.T10 to the separation of facilities of two Services.

8–9. Criteria for non-Department of Defense explosives activities (ammunition and explosives operations and storage) on Army installations

a. Non-DoD explosives activities must only be conducted on Army property per DESR 6055.09, Table V4.E5.T10.

b. For these types of non-DoD explosives activities, the Army must be responsible for ensuring that IMD and IBD requirements only, as outlined in QD ESP, are met.

c. Review of building design, lightning protection, and so forth is unnecessary unless design features are used to justify reducing ESQD arcs.

8–10. Measuring distance

For determining the separation distances from the structure or room containing explosives to various types of ESs, measure in accordance with the guidelines in figure 8–3.

Measure from Type of exposed site	Distance measured to/from	Comments
Structure not subdivided	Treat as complete structure	To prevent mass detonation between compartments
Structure Subdivided	From outside nearest wall to the compartment containing the greatest explosive hazard	To prevent mass detonation between compartments
Open Storage (such as, modules, and revetments)	From stack face to stack face	
Explosives Outdoors/Vehicle Parked in the Open	To explosive	
Protective Shelters	External wall of the shelter or stall containing the explosive or explosive-loaded vehicle	Measure from center of large missiles, launchers, or pads
Exposed Site	To nearest point of non-explosives area, location, building, vehicle, aircraft, or taxiway To centerline of runway To nearest edge of ship's channel To nearest edge of open recreational areas	
Golf courses	To nearest edge of the tee or green or to centerline of the fairway	

Figure 8–3. Measuring distance from exposed site

8–11. Ammunition and explosives risk

The major risks associated with AE involve the hazards of primary fragments, secondary fragments, blast, and thermal. Therefore these effects must be considered when determining ESQD safe separation distances between PESs and ESs.

8–12. Primary and secondary fragments

a. Fragments can be either classified as primary or secondary fragments depending on their origin. A fragment is considered hazardous when it has an impact energy of 58 ft-lb or greater.

b. Primary fragments are formed as a result of the shattering of the explosive container. The container may be the casing of conventional munitions; the kettles, hoppers, and other metal containers used in the manufacture of explosives; the metal housing of rocket engines; and similar items. These fragments usually are small in size and travel initially at velocities of the order of thousands of feet per second.

c. Secondary fragments are formed as a result of high blast pressures on structural components and other material in close proximity to the explosion. These fragments are somewhat larger in size than primary fragments and travel at lower speeds.

d. HD 1.1 and HD 1.2 both produce primary fragments.

e. Firebrands can be produced. Firebrands are normally associated with HD 1.3 AE.

f. Fragment distance minima are to protect personnel in the open; firebrand distance minima are to protect facilities.

8–13. Blast considerations

a. IBD is the minimum distance required between a PES and any unrelated ES. Even at this distance, structures may not be protected from the blast. The greatest hazard may be broken glass since the weakest portions of any structure are the windows.

b. Public Traffic Route Distance (PTRD) is the minimum distance separating a PES from a public traffic route (PTR) exposure. PTRD is typically 60 percent of IBD.

(1) Typical PTR exposures are:
(a) Roads used by the general public.
(b) Railways.
(c) Navigable waterways.
(d) Open air recreation areas.
(e) Administrative parking areas.
(2) On-base roads, as follows: The Army may provide protection of less than 60 percent of IBD to installation-related personnel (refer to glossary for definition) transiting QD arcs when the risks are evaluated, documented, and in accordance with DoD established procedures. All new construction of AE storage and operating facilities, and any change in operations within existing facilities that increases the explosives safety risk, should provide both the general public and installation-related personnel who are not involved in munitions-related operations protection that provides a minimum of 60 percent of IBD. When the Army determines exposures at less than 60 percent of IBD are necessary, the Army must use some written method to inform transients of potential risks (for example, written acknowledgment of the risk by contractors, vendors, or others with a recurring need to transit the ESQD area, warning signs, flashing lights, physical barriers).
(3) The Army's decision to provide transients protection at less than 60 percent of IBD must be supported by a qualitative risk assessment considering factors such as:
(a) Operational necessity.
(b) The operation being performed (for example, static storage, maintenance, and production).
(c) Operational activity cycles.
(d) Alternate routes.
(e) Traffic density.
(f) Accident records.
(g) Time interval of exposure.
(h) Type and quantity of AE in proximity to the area transited.
(i) The closest distance from the area transited to the PES.
(j) The need for installation-related personnel to transit the ESQD arc.
(4) Must be reviewed as changes occur to either operations, which would increase the explosives safety risk, or the number of exposed, and upon change of the approving authority.
c. IL(U) is the minimum distance required for AE operating locations from other PESs when not separated by barricades.
d. IL(B) is the minimum distance required for AE operating locations from other PESs when separated by barricades, and the locations are successive steps in the same operation.
e. IMD(U) is the minimum distance required between AE storage locations when not separated by barricades. IMD(U) is sufficient to prevent prompt propagation.
f. IMD(B) is the minimum distance required between AE storage locations when separated by barricades. IMD(B) is sufficient to prevent prompt propagation.
g. IMD is a generic term for the minimum distance between locations where AE is present.

8–14. Exposed site
The ES is a location that will be damaged by the hazardous effects (for example, blast, fragments, debris, or heat flux) from an explosion at the PES. The type and use of the location will determine the amount of risk that has been accepted for it by the standards contained in this pamphlet. It is important to understand that employing these standards, even though based upon actual testing and accident data, they do not guarantee significantly greater damage may not occur. As stated earlier, too many variables may affect the actual results. Table 8–1 provides a list of various types of structures and activities and the type of safe separation distances required for them. When feasible and mission execution allows, greater separation distances should be used. Table 8–2 provides information on QD for unprotected aboveground service tanks (AST) supporting explosives storage or operating complexes.

Table 8–1
Type of exposed sites and safe separation distance required—Continued

Type of structure/activity	Safe separation distance required	Notes
Aboveground storage tanks	See table 8–2	1. The guidance below will be followed to prevent rupture and collapse of unprotected aboveground storage tanks for hazardous materials (such as POL, industrial chemicals). Exceptions: Large permanent bulk storage facilities are of primary concern when applying IBD to storage tanks. For smaller tanks, it may be best to weigh the cost of distance and protective construction against the strategic value of the stored material, the ease of replacement after an accident, and the potential environmental impact. The command may approve distances less than IBD without formal risk assessment and acceptance through such a risk management process, but only if spill containment is provided to safeguard adjacent facilities. 2. Distances less than IBD may be used when an engineered design protects against ruptures and collapse from fragments and blast. 3. Small quantities of POL and other hazardous materials used for operational purposes require no specific QD separation distance for explosion safety. 4. A service tank supporting a single PES must be separated from the PES by the appropriate NFPA distance (see NFPA, parts 30 and 31). The distance from the service tank to other PESs must be the NFPA distance or the QD distance between the PESs, whichever is greater. Consider the following example: An explosion operating line consists of two buildings, A, and B. For QD purposes, A, and B are separated by 200 feet ILD. A service tank supports A. The NFPA requires 25 feet from the tank to A. The distance between the tank and the other PES (Building B) is the greater of the NFPA distance (25 feet) or the QD distance between A and B (200 feet). Therefore, the distance required between the tank and B is 200 feet. 5. QD from underground ammunition storage to above-ground storage tanks must be determined on a site-specific basis taking account of crater, blast, ground shock, debris hazards, and potential adverse environmental impacts.
Administrative areas	IBD	
Administrative area parking lots	PTRD	Minimum fragment distances apply.
Bleachers - training and recreational	IBD	Open areas between explosive storage and handling sites and between these sites and non-explosive buildings and structures must be controlled carefully regarding use for recreation or training facilities. As a general rule, the fragment hazard will be severe from the explosion site out to approximately the PTRD.
Break rooms	Prudent fire protection distance	
Briefing rooms for daily work schedules or on site safety matters	Prudent fire protection distance	
Classification yard from other structures	Magazine distance	Trucks, trailers, or railcars must not remain in the yard for more than 24- hours without proper deviation approval. (Requires DA Form 7632, DARAD).
Classification yard to other structures	Appropriate safe separation distance applies to non-explosives locations as well as explosives locations if the yard is used at any time for any purpose other than listed at right	Classification yards are used primarily for receiving, dispatching, classifying, and switching of railcars; interchanging of trucks, trailers, or railcars between the common carrier and the DoD activity; conducting external inspection of motor vehicles and railcars; or opening free rolling railcar doors for the purpose of removing documents and making a visual inspection of the cargo. Trucks, trailers, or railcars must not remain in the yard for more than 24 hours without proper deviation approval. (Requires DA Form 7632, DARAD).
Electrical distribution lines	Distribution lines, the poles or towers supporting them, and electrical substations directly connected to distribution lines will be separated from PESs by PTRD, based on blast only. (Use formulas contained in notes to DESR 6055.09, Table V3.E3.T1.)	These are normally lines solely supplying multiple installation locations.
Electrical service lines serving a	No closer than the distance between the supporting poles or towers.	1. Line must be run underground for the last 50 feet to an explosives facility. 2. Service lines are those lines supplying individual installation locations.

Table 8–1
Type of exposed sites and safe separation distance required—Continued

Type of structure/activity	Safe separation distance required	Notes
combustible facility or an open PES.		3. If an effective means is provided to ensure that energized lines, upon breaking, cannot come into contact with the combustible facility or an open PES or its appurtenances, then they may be closer than the distance between the poles. Examples of effective means include messenger lines, cable trays, and ground fault circuit interrupters. Before implementing any of these means, a safety submission must be approved.
Electrical transmission lines - 69 kV or more	A. IBD, based on blast — if the line is part of a grid system serving a large off-post area use. B. PTRD based on blast only - If loss of the line will not create a serious social or economic hardship use.	1. A minimum distance equal to the length of the lines between the supporting poles or towers, if loss of the line does not cause loss of power (that is, power is rerouted through other existing lines and/or networks). This distance may be further reduced if an effective means is provided to ensure that energized lines, upon breaking, cannot come into contact with facilities of combustible construction or an open PES. 2. Transmission lines are those lines supplying locations outside the installation uniquely, or in common with the installation. Any line carrying 69 kV or more must be classified as a transmission line for QD purposes.
Heating plants	Prudent fire protection distance	
Industrial areas	IBD	
Inert storage	Related to explosives mission – No QD Required, Commands determine separation distances. Not directly related to explosives mission – IBD blast only, minimum fragment distance do not apply.	1. Commands must determine acceptable locations for inert storage that is directly related to the explosives mission and for inert storage that is not directly related but where control of and access to such inert storage is restricted only to personnel directly related to the explosives mission. 2. Commands must determine what constitutes "directly related." The following apply to inert storage: a. Locations for inert storage must be determined only after consideration of personnel exposure, the importance of the materiel in relation to the explosives mission, the operational conditions, and the availability of space. b. Inert storage that will be accessed by personnel not related to the explosives mission must be sited as inhabited buildings (based on blast only). Minimum fragment distances do not apply.
Joint service support and tactical facilities	See para 8–8.	1. Common requirements. 2. Appropriate safety distances provided herein will be applied between Army facilities and facilities of another military service regardless of the boundary between the Army and other service installations. 3. Safety criteria based on toxicity, noise, thermal radiation, flight trajectory, incendiary, or other hazards may be greater than explosives safety distance criteria. In these cases, the criteria based on the greatest hazard will be considered.
Joiner (wood/metal) shops	Prudent fire protection distance	
Line offices	Prudent fire protection distance	
Loading docks servicing firing ranges	ILD	1. Separated from firing points having either unarmored vehicles or unprotected personnel by ILD. 2. For firing points with armored vehicles when personnel are in the vehicles with the hatches closed, no QD applies, but a 100 feet fire protection distance must be maintained from the firing point to the loading dock. 3. Separate loading docks will be sited on the basis of use.
Loading docks servicing magazines	IMD	Separate loading docks will be sited on the basis of use.
Loading docks serving operating buildings	ILD	Separate loading docks will be sited on the basis of use.
POV parking Lots for administrative areas	PTRD	Minimum fragment distances apply.
POV parking Lots for personnel at PESs	100 ft / 50 ft	1. 100 ft minimum 2. 50 ft if PES are non-combustible and sufficient measures are in place between POV parking spaces and PESs to prevent a parked vehicle from rolling to

Table 8–1
Type of exposed sites and safe separation distance required—Continued

Type of structure/activity	Safe separation distance required	Notes
		within 50 ft of PESs (for example, sloping grade, curbs, vehicle barriers, drainage features).
Rail holding yards	Aboveground magazine	Rail holding yards will be laid out on a unit car-group basis with each car-group separated by the applicable aboveground magazine distance. Separate from other facilities by applicable QD criteria.
Rail holding yards - Christmas tree	Aboveground magazine	1. Separated by the applicable aboveground magazine distance for the net quantity of HE in the cars on the spurs. 2. Will be separated from other facilities by the applicable QD criteria. 3. Arrangement consisting of a ladder track with diagonal dead-end spurs projecting from each side at alternate intervals.
Rail yards two parallel ladder tracks connected by diagonal spurs	Aboveground magazine	1. Separated by applicable aboveground magazine distance for the unit-group quantities of HE. 2. Will be separated from other facilities by the applicable QD criteria.
Railcar holding yards	QD separations are not required	May be used to interchange truck trailers or railcars between the commercial carrier and the Army activity and to conduct visual inspections.
Railcar inspection stations	QD separations are not required	1. They should be as remote as practical from hazardous or populated areas. 2. Activities that may be performed at the inspection station after rail- cars containing AE are received from the delivering carrier and before further routing within the installation are as follows: External visual inspection of the railcars. 3. Visual inspection of the external condition of the cargo packaging in vehicles (such as, trailers, railcars) that have passed the external inspection indicated above. 4. Interchange of railcars or military demountable container (MILVANs) between the common carrier and the Army activity.
Railcar Interchange yards	Reference DESR 6055.09 V4.E5.5	
Recreational facilities - open air (no structures)	Sited at not less than PTRD and preferably as near IBD as practical.	Open areas between explosive storage and handling sites and between these sites and non-explosive buildings and structures must be controlled carefully regarding use for recreation or training facilities. As a general rule, the fragment hazard will be severe from the explosion site out to approximately the PTRD. For an exception, see reference DESR 6055.09, paragraph V3.E3.1.2.1.2.
Recreational facilities – structures (including bleachers)	Sited at not less than IBD.	Open areas between explosive storage and handling sites and between these sites and non-explosive buildings and structures must be controlled carefully regarding use for recreation or training facilities. As a general rule, the fragment hazard will be severe from the explosion site out to approximately the PTRD. For an exception, see reference DESR 6055.09, paragraph V3.E3.1.2.1.2.
Roll-on or roll-off (RO/RO) operations (not involving lifting)	QD criteria apply to all RO/RO operations.	Site plans will be submitted in accordance with current Army criteria. When QD requirements cannot be met the following mitigation factors should be considered: 1. Total NEWQD present must not exceed 50,000 lbs. 2. Conducted on installations under U.S. control, when possible, to limit exposures to the public. 3. All AE present (such as, in trailers, rail- cars, barges, and ships) must be associated only with the RORO operation being conducted. 4. RORO operations must not exceed 24 hours following arrival of AE, including AE staged at a transshipment point. 5. RORO operations must be located as remote as practicable from populated areas, in order to minimize exposure of unrelated personnel. 6. Off-installation military vans/International Standardization Organization (MILVAN/ISO) container inter- or intra-modal transfers (involving highway and rail modes only) where containers are not stored or other operations performed.
Secure explosives holding area.	Aboveground magazine	1. Will be laid out on a unit truck-group basis with each group separated by the applicable aboveground magazine distances. 2. Will be separated from other facilities by the applicable QD criteria. 3. An area designated for the temporary parking of commercial carriers' motor vehicles transporting DoD-owned (AA&E), classified (SECRET or CONFIDENTIAL) materials, and controlled cryptographic item (CCI). There are

Table 8–1
Type of exposed sites and safe separation distance required—Continued

Type of structure/activity	Safe separation distance required	Notes
		two types of se- cure holding areas. Note: Although the intent of such areas is to pro- vide a secure storage location for commercial carriers while in-transit, or during emergencies or other circumstances that are beyond a carrier's control, this Standard imposes no requirement for installations to have such areas. The term Secure Holding Area is applicable to areas (CONUS, Hawaii, Alaska, and Puerto Rico) governed by Part 205 of Defense Transportation Regulation (DTR) 4500. 9–R, Part II Cargo Movement.
Secure Non-explosives Holding Area	The holding of HD 1.4S materials, without regard to QD, is permitted at this location.	No siting required if located outside all QD arcs. If located within a QD arc, provide appropriate safe separation distance.
Security posts and similar locations	Prudent fire protection	May be at explosives operations servicing only one building or operation.
Service tanks – Unprotected	May be sited in accordance with table 8–2 provided the conditions in the notes are met	1. Unprotected service tanks which support aboveground explosives storage or operating complexes, but not inhabited buildings (such as those in administrative, supply, industrial, and housing areas). 2. The Command must accept the possible loss of the tanks and any collateral damage that a fire might cause if the tanks were punctured by fragments. 3. A dike system must be installed meeting the requirements of NFPA 30 to provide spill containment. 4. If the tank is supplied by a pipe system as opposed to a tank truck, then the supply pipe must be protected from blast and fragments to prevent a spill larger than the contents of the tank. If the supply pipe is underground, it will be located from PESs in accordance with below. If it is aboveground, use IBD or protective design in accordance with this pamphlet.
Storage tanks for water	-QD does not apply if the loss of the water tank is acceptable -IBD applies if the loss of the water tank is unacceptable -Buried tanks and associated components of like value must meet the siting requirements below for underground tanks	1. A key QD consideration is whether loss of the water tank is acceptable. If a water tank is used for firefighting and no adequate alternate water supplies exist, the tank is essential and its loss is unacceptable. If adequate alternate water supplies do exist, loss of the tank may be acceptable. However, consider other factors, such as the replacement cost of the tank and the effect of its loss on the installation mission, before making a final determination. 2. The Command must designate the approval authority level for the siting of aboveground water tanks within IBD of PESs, and for buried tanks or pipelines sited at less than the distances required see "Underground pipelines".
Training facilities - open air (no structures)	Sited at not less than PTRD, preferably as near IBD as practical.	Open areas between explosive storage and handling sites and between these sites and non-explosive buildings and structures must be controlled carefully regarding use for recreation or training facilities. As a general rule, the fragment hazard will be severe from the explosion site out to approximately the PTRD. For an exception, see DESR 6055.09, paragraph V3.E3.1.2.1.2.
Training facilities – structures (including bleachers)	IBD	Open areas between explosive storage and handling sites and between these sites and non-explosive buildings and structures must be controlled carefully regarding use for recreation or training facilities. As a general rule, the fragment hazard will be severe from the explosion site out to approximately the PTRD. For an exception, see DESR 6055.09, paragraph V3.E3.1.2.1.2.
Transportation mode change locations	QD criteria apply to all transfer operations involving AE	Movement and transfer of AE must comply with national, international, and host country-specific transportation regulations with the appropriate safe separation distance for each exposed site based on it type and use.
Truck holding yards	Aboveground magazine	1. Where feasible, trucks will be separated individually or in truck- groups by the applicable aboveground magazine distance. 2. Will be separated from other facilities by the applicable QD criteria.
Inspection stations	QD separations are not required but they should be as remote as practical from hazardous or populated areas.	Activities that may be performed at the inspection station for motor vehicles containing AE after they are received from the delivering carrier and before further routing within the installation are as follows: 1. External visual inspection of the vehicles. 2. Visual inspection of the external condition of the cargo packaging in vehicles (such as trucks, trailers, railcars) that have passed the external inspection indicated above. 3. Interchange of trucks, trailers, railcars, or MILVANs between the common carrier and the Army activity.

Table 8–1
Type of exposed sites and safe separation distance required—Continued

Type of structure/activity	Safe separation distance required	Notes
Interchange yards	Applicable QD tables apply un- less meets remarks.	Truck, interchange yards are not subject to QD regulations when they are used exclusively: -For the interchange of vehicles containing AE between the commercial carrier and Army activities. -To conduct external inspection of the trucks, trailers, or MILVANs containing AE. -To conduct visual inspection of the external condition of the cargo in vehicles (such as trucks, trailers, and MILVANs) that passed the external inspection.
Underground pipelines	-Separation for HD 1.1 use D=3.0W1/3 with a minimum distance of 80 feet. -Separated HDs 1.2 through 1. 4 by a minimum distance of 80 feet.	
Underground tanks	-Separation for HD 1.1 use formula D=3.0W1/3 with a mini- mum distance of 80 feet. -Separated for HDs 1.2 through 1.4 by a minimum distance of 80 feet.	
Weather structures	No ESQD application required	-Structures necessary for providing personnel or equipment weather protection (including provision of power for such equipment) located at a PES sited at IMD from other PESs (for example, holding yards, detached loading docks, barge piers), and that support a single PES or operation, may be located at that PES without application of QD separation from any other PES. These facilities must meet electrical and LPS standards referenced in chapter 16. An ESP is required for these structures.

Table 8–2
Quantity-distance for unprotected aboveground service tanks supporting explosives storage or operating complexes Continued

PES NEW		Distance required from the PES to AST
Over	Not over	
0	1,000	D=400 feet
1,000	30,000	$D=40W^{1/3}$
30,000	100,000	$D=40W^{1/3}$ or use V3.E3.T1 of DESR 6055.09
100,000	250,000	$D=2.42W^{0.577}$ or use V3.E3.T1 of DESR 6055.09
250,000	500,000	$D=50W^{1/3}$ or use V3.E3.T1 of DESR 6055.09

8–15. Blast tables for Hazard Division 1.1 ammunition and explosives

DESR 6055.09, Table V3.E3.T1 is used to determine the appropriate safe separation distance or permissible NEW for HD 1.1 AE based on the PES, NEW, or distance available, use, and type of ES, barricades, and orientation.

8–16. Hazard Division 1.1 fragments

a. Hazard class-division 1.1 AE produce fragments. As the quantity of HD 1.1 increases above a certain amount, the effects of the blast wave represent a greater severity than the fragment hazard. Therefore the blast wave is given greater weight in calculating QD.

b. In some HD 1.1 situations, the resulting damage due to fragments can be as severe on the mission capability as the damage due to the blast. Therefore, the fragment hazard should always be evaluated when conducting a risk assessment. DESR 6055.09, Table V3.E3.T2 provides fragment distances based

on NEW amounts up to 450 pounds. Above 450 pounds NEW, a maximum fragment distance of 1,250 feet has been established.

c. DESR 6055.09, paragraph V3.E3.1.2.1.2 describes locations requiring the larger of either fragment distance minima or firebrand distance minima, and DESR 6055.09, paragraph V3.E3.1.2.1.3 describes locations where minimum fragment and firebrand distances need not be applied.

(1) The minimum distance for protection from hazardous fragments must be based on primary and secondary fragments from the PES and the population and/or traffic density of the ES. It is defined as the distance at which the density of hazardous fragments becomes 1 per 600 ft^2.

Note. This distance is not the maximum fragment range.

(2) Secondary fragments include debris from structural elements of the facility and non-confining process equipment likely to rupture into enough pieces to contribute significantly to the total number of expected fragments.

(3) Primary fragments include items such as those discussed in paragraph 8–12 and those from items listed in DESR 6055.09, Table V3.E3.T3.

(4) DDESB-approved analyses and/or approved tests may be used to determine minimum distances for both primary and secondary fragments. DDESB TP 13 is an example of a method to determine minimal distances for building debris, while DDESB TP 16 provides similar information to determine minimal distances for primary fragments.

(5) The minimum hazard fragment IBD for HD 1.1 will be 1,250 ft., except as shown in DESR 6055.09, Table V3.E3.T2, or otherwise defined in paragraphs V3.E3.1.2.1.2 and V3.E3.1.2.1.3. Lesser distances are permitted if supported by a structural analysis of the PES. Facilities sited at 1,235 ft. or 1,245 ft. per past standards will be considered to be in compliance with the 1,250 ft. minimum requirement.

(6) PTRD fragment distance is 60 percent of hazard fragment distance, including distances shown in DESR 6055.09, Table V3.E3.T2, and Table V3.E3.T3 with the exception defined in paragraph V3.E3.1.2.1.3.

(7) In the absence of appropriate analyses and/or tests, default hazardous debris distances defined below apply.

(a) In the absence of appropriate analyses and/or tests, default hazardous debris distances defined below apply. For populous locations, for example, those areas and/or functions identified in DESR 6055.09, paragraph V3.E3.1.2.1.2, where military, civilian employees, dependent, and/or public personnel are located, the minimum distance must be that distance at which fragments, including debris from structural elements of the facility or process equipment, must not exceed a hazardous fragment density of one hazardous fragment per 600 ft^2 (56 m^2).

(b) If this distance is not known, table 8–3 will apply.

(c) For tabulated data for intermagazine separation distances for barricaded storage modules for mass detonating explosives, see DESR 6055.09, Table V2.E5.T1. For tabulated data for hazardous fragment distances for open stacks of selected HD 1.1 items, see DESR 6055.09, Table V3.E3.T3.

Table 8–3
Unknown fragment distance for Hazard Division 1.1 Continued

HFD for Hazard Division 1.1 NEWs in quantities </= 450 lbs.

(hazard fragment distance equates to IBD)

Structure	Load Density[1]	Distance Table	
7-Bar or a 3-Bar ECM		Use DESR 6055.09, Table V3.E3.T1	
For HD 1.1 in an Undefined ECM	<= 0.028 lbs/ft^3	Use ECM distances shown in DESR 6055.09, Table V3.E3.T1	
For HD 1.1 in an Undefined ECM	> 0.028 lbs/ft^3	Use "ECM – side and rear" distances within DESR 6055.09, Table V3.E3.T1 and for a front exposure, apply the greater of the "ECM – front"	PTRD: 60 percent of IBD or hazard fragment distance, as applicable

Table 8–3
Unknown fragment distance for Hazard Division 1.1—Continued

		IBD distance of DESR 6055.09, Table V3.E3.T1, or the HFD DESR 6055.09, Table V3.E3.T2, for the NEW in the ECM	
ECM (designed/analyzed, and tested to have a reduced IBD and approved by DDESB)		Use DDESB-approved criteria	PTRD: 60 percent of IBD
For HD 1.1 in a structure (excluding ECM) capable of stopping primary fragments, but which can contribute to the debris hazard Structures that are capable of stopping primary fragments include all above-ground sites (AGS) heavy wall (H) and heavy wall/roof (H/R) type construction. All other structures (other than ECM) are considered incapable of stopping primary fragments		DESR 6055.09, Table V3.E3.T2, use HFD	PTRD: 60 percent of IBD

HFD for Hazard Division 1.1 NEWs in quantities </= 450 lbs.

(hazard fragment distance equates to IBD)

Structure	**Load Density[1]**	**Distance Table**
For primary fragment producing HD 1.1 in the open or in a structure incapable of stopping primary fragments		Use the HFD listed in DESR 6055.09, Table V3.E3.T2
For non-primary fragment producing explosives in any structure (excluding ECM), truck, trailer, or railcar that may contribute to the debris hazard		Use the HFD listed in DESR 6055.09, Table V3.E3.T2
For bare explosives in the open		Distance is computed by the formula $d = 40W^{1/3}$

HFD for Hazard Division 1.1 NEWs in ranges > 450 but </= 30,000 lbs. PTRD is 60 percent of hazard fragment distance

Structure	**Load Density[1]**	**Distance Table**
Bare explosives in the open		Distance is computed by the formula $d = 40W^{1/3}$
ECM (7–Bar or 3–Bar)		Use DESR 6055.09, Table V3.E3.T1
Undefined ECM	<= 0.028 lbs/ft^3	Use ECM distances shown in DESR 6055.09, Table V3.E3.T1
For HD 1.1 in an Undefined ECM with minimum internal dimensions of 26 ft [7.92 m] wide and 60 ft [18.29 m] long		Use “ECM – side and rear” distances within DESR 6055.09, Table V3.E3.T1, and “Other PES” distances of DESR 6055.09, Table V3.E3.T1, for a frontal exposure
For HD 1.1 in an Undefined ECM with internal dimensions less than 26 ft [7.92 m] wide and 60 ft [18.29 m] long	> 0.028 lbs/ft^3	Use “Other PES” distances within DESR 6055.09, Table V3.E3.T1, for front, side, and rear exposures

HFD for Hazard Division 1.1 NEWs in ranges > 30,000 lbs. but </= 250,000 lbs. PTRD is 60 percent of hazard fragment distance

Structure	**Load Density[1]**	**Distance Table**

Table 8–3
Unknown fragment distance for Hazard Division 1.1—Continued

For HD 1.1 in an ECM (7–Bar or 3–Bar) where internal dimensions are a minimum of 26 ft [7.92 m] wide and 60 ft [18.29 m] long		Use ECM distances shown in DESR 6055.09, Table V3.E3.T1
For HD 1.1 in an ECM (7–Bar or 3–Bar) where internal dimensions are less than 26 ft [7.92 m] wide and 60 ft [18.29 m] long		Use "Other PES" distances of DESR 6055.09, Table V3.E3.T1 for front, side, and rear exposures
For HD 1.1 in an Undefined ECM with minimum internal dimensions of 26 ft [7.92 m] wide and 60 ft [18.29 m] long		Use "ECM – side and rear" distances within DESR 6055.09, Table V3.E3.T1 and "Other PES" distances of DESR 6055.09, Table V3.E3.T1 for a frontal exposure
For HD 1.1 in an Undefined ECM with internal dimensions less than 26 ft [7.92 m] wide and 60 ft [18.29 m] long		Use "Other PES" distances within DESR 6055.09, Table V3.E3.T1 for front, side, and rear exposures

d. Structures (other than ECM) that are capable of stopping primary fragments include all heavy wall (H) and heavy wall/roof (H/R) AGSs as defined in DESR 6055.09, glossary. All other structures (besides ECM) are considered incapable of stopping primary fragments.

e. Items, through testing, have been hazard classified with a specific hazard fragment distance presented in the format HD (xx) 1.1. The hazard fragment distance for these items is specified in hundreds of feet (in parenthesis) and may not be listed in DESR 6055.09, Table V3.E3.T3. The distances for these select items apply only to items in the open. Secondary debris and primary fragments must be considered when in facilities. If in a facility that can contain primary fragments, apply criteria of DESR 6055.09, V3.E3.1.2.1.1.1.1 through V3.E3.1.2.1.1.1.5. If in a facility that cannot stop primary fragments, use the greater distance from DESR 6055.09, Table V3.E3.T3 (for the item being considered) or the hazard fragment distance associated with the (xx) 1.1 item or from DESR 6055.09, Table V3.E3.T2 for determining the applicable hazard fragment distance.

f. Selected items have been evaluated for minimum hazard fragment distance with results shown in DESR 6055.09, Table V3.E3.T3. The distances of select items apply only to items in the open. When these items are placed in a facility, apply the criteria of DESR 6055.09, V3.E3.1.2.1.1.1.1 through V3.E3.1.2.1.1.1.5 above. If in a facility that cannot stop primary fragments, use the greater distance from DESR 6055.09, Table V3.E3.T3 (for the item being considered) or from DESR 6055.09, Table V3.E3.T2 for determining the applicable hazard fragment distance.

8–17. Hazard Division 1.2

The quantity and distances specified for HD 1.2 ammunition provide minimum protection against immediate hazards from an incident.

Note: Events involving HD1.2 items lob large amounts of unexploded rounds, components, and subassemblies, which will remain hazardous after impact. Such items are likely to be more hazardous than in their original state because of possible damage to fuse safety devices or other features by heat and impact. Many types of ammunition contain submunitions, which can be projected out to distances as great as the relevant IBDs. Furthermore, it is impractical to specify quantity and distances, which allow for the maximum possible flight ranges of propulsive items.

a. V3.E3.T13 of DESR 6055.09 explains how to determine the QD for HD 1.2 and the appropriate HD when different subgroups of HD 1.2 AE are stored together.

b. V3.E3.T9 of DESR 6055.09 is the summary table for HD 1.2 items. An additional reference providing the appropriate IBD, PTRD, and ILD for HD 1.2.X ammunition when stored in above-ground facilities are DESR 6055.09, V3.E3.T10 through V3.E3.T12.

(1) The QD criteria for HD 1.2.1 items are based on the hazards from primary fragments when stored in structures that may contribute to the debris hazard (secondary fragments), the IBD for HD 1.2.1 items whose MCE is greater than 31 lbs. [14.1 kg] is determined by using the larger of two distances: those given for the appropriate explosive weight or those given for the appropriate MCE. Structures that may contribute to the debris hazard for storage of HD 1.2.1 AE include:

(a) All ECM frontal exposures (side and rear exposures have fixed minimum distances for IBD).

(b) All AGS, including heavy wall (H), heavy wall and roof (H/R), and light (L), unless data or analyses are provided to show that the structural debris contribution is less.

(2) IMDs depend on the types of structures acting as both the PES and the ES. V3.E3.T9 of Reference DESR 6055.09 provides a matrix of the appropriate separations for the various combinations of PES to ES's.

(3) PTRDs are given consideration to the transient nature of the exposure in the same manner as for HD 1.1. PTRD is computed as 60 percent of the IBD for items in this HD, with a minimum distance equal to the IMD given in DESR 6055.09, Table V3.E3.T10 through T12.

(4) ILD considers the progressive nature of explosions involving these items (normally resulting from fire spread), up to the magnitude of the MCE, and the ability to evacuate personnel from endangered areas before the progression involves large numbers of items. Projections may extensively damage exposed structures, and delayed propagation of explosions may occur due to the ignition of combustibles by projections. ILD is computed as 36 percent of the IBD for items of this HD, with a minimum distance equal to the IMDs given in DESR 6055.09, Table V3.E3.T10 through T12.

(5) The IBD for HD 1.2.3 is determined using HD 1.3 QD for the NEWQD of the HD 1.2.3 item multiplied by the number of rounds present, but with a minimum, IBD is determined as follows:

(a) If the AE are in a structure that can interrupt primary fragments but can contribute to debris, the minimum IBD is the Hazardous Fragmentation Distance (HFD) for an MCE equal to the NEWQD of a single round.

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

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

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

2. If the single-round NEWQD is < than 1.6 lbs. [0.73 kg], consider the items as HD 1.2.2, based on the total NEWQD present.

(d) For storage of mixed HD 1.2.3 AE, multiply the NEWQD for the HD 1.2.3 items by the corresponding number of HD 1.2.3 rounds and use HD 1.3 QD with the HFD for the mixture based on the largest HFD for the HD 1.2.3 AE in storage. Use the distances given in Table V3.E3.T13 of DESR 6055.09 when HD 1.2.3 AE is located with any other HD 1.2 sub-division. The HD 1.2.3 AE is considered HD 1.2 (HD 1.2.1 or HD 1.2.2, according to NEWQD) for QD purposes when HD 1.2.3 AE is located with any other HD AE. The mixing rules provided in DESR 6055.09, Table V3.E3.T13 apply to the combination of the HC/Ds. For tabulated data for: Minimum fragment distances for HD 1.2.1 items stored in structures, which can contribute to the debris hazard, see reference DESR 6055.09, Table V3.E3.T11.

(e) For tabulated data for Minimum fragment distances for HD 1.2.1 items stored in structures, which can contribute to the debris hazard, see reference DESR 6055.09 Table V3.E3.T11.

(f) For tabulated data for HD 1.2.2 IBD, PTRD, and ILD QD, see DESR 6055.09, Table V3.E3.T12.

8–18. Hazard Division 1.3

HD 1.3 includes items that burn vigorously with little or no possibility of extinguishment in storage situations. Explosions normally will be confined to pressure ruptures of containers and will not produce propagating shock waves or damaging blast overpressure beyond the magazine distance specified in Table V3.E3.T14 of DESR 6055.09. A severe hazard of the spread of fire may result from tossing about burning container materials, propellant, or other flaming debris.

8–19. Hazard Division 1.4

AE present a fire hazard with minimal blast, fragmentation, or toxic hazards. Separate facilities for storage and handling of these AE must be located in accordance with Table V3.E3.T15 of DESR 6055.09.

a. In mixed storage, the NEWQD of HD 1.4 is not additive to other HDs. However, QD criteria for each HD present, including HD 1.4, must be determined, and the largest value must be used.

b. HD 1.4S AE (see para V1.E8.5.5 of DESR 6055.09.) may be stored (including associated handling) without regard to the QD criteria in Table V3.E3.T15 of DESR 6055.09.

8–20. Hazard Division 1.6

QD separations for HD 1.6 AE must be based on the storage location and configuration. This information is detailed in DESR 6055.09, Table V3.E3.T16. A maximum of 500,000 lbs. (226,795 kg) NEWQD may be permitted at any one location. Any special storage configuration and siting approved for HD 1.1 AE may be used for storage of like explosive weights of HD 1.6 AE.

8–21. Propulsive units

It is impractical to specify QD separations allowing for the designed flight range of propulsive units (rockets, missile motors, and catapults) that properly belong in HD 1.1, HD 1.2, or HD 1.3. Therefore, maximum designed flight ranges for units in a propulsive state will be disregarded.

8–22. Concurrent operations

a. When operating lines/facilities, whether, or not barricaded, host multiple operations with similar AE hazards, then concurrent operations may be authorized provided specific criteria is met as indicated below:

(1) If USATCES has not approved a facility for concurrent operations, the operations will be accomplished in separate facilities. The following information will be provided to USATCES for review and approval:

(a) An ESP for the facility for which concurrent operations are being requested.

(b) An engineering analysis to include: protective construction, design factors, shielding, and process flow within the facility.

(c) HA of the concurrent operations to be conducted within the facility.

(d) Operational and Life-Cycle proponents acknowledgment.

(2) The quantities of explosives and the number of personnel exposed at each concurrent operation will be held to the minimum, consistent with safe and efficient operations.

b. Table 8–4 identifies types of operations that may be considered for concurrent operations. Compatibility is determined by the initiation sensitivity and level of risk involved with both operations to be performed concurrently. Application of table 8–4 is not all-inclusive, and prudent risk analysis must be performed in all cases for process determination. Table 8–4 identifies operations by row and has the corresponding operations numbers across the top of the table. If the block at this intersection is blank, the operations are compatible and may be performed concurrently with proper USATCES approval. If the block contains a number referring to a footnote, the footnote requirements must be met to make the operations compatible, thus allowing them to be performed concurrently with proper USATCES approval. If the block contains an "x," the operations may be incompatible. In all cases, requests for the use of concurrent operations will require the information listed above.

(1) An example of a compatible operation is as follows: Generally, concurrent missile inspection operations in a single operating building can be treated as similar processes based on the same initiation sensitivities. However, the ESQD separation requirements dictate a minimum IL distance between the two operations. Since they present similar hazards, they may be authorized for concurrent operations in the same operating building without compromising explosives safety.

(2) An example of an incompatible operation is as follows: Warhead pressing operation is being performed in a production building where there is consideration of including an inspection process for a completely dissimilar and non-related AE component/item. Since the initiation sensitivity of the pressing operation is invariably different and poses an extremely high risk potential to process workers than the inspection process, it can be determined that both processes are dissimilar in the type of operation and the level of risk involved. Therefore, concurrent operations may not be authorized.

8–23. Ammunition and explosives transportation mode change locations

Movement and transfer of DoD-titled AE must comply with national, international, and host country-specific transportation regulations. QD criteria apply to all transfer operations involving DoD-titled AE, except RO/RO operations, that meet these requirements:

a. If a sited location is available, it must be used. If a sited location is unavailable, then the selected location must be as remote as practicable from populated areas to minimize exposure of unrelated personnel.

b. The total NEWQD present must not exceed 30,000 lbs.

c. All AE present (for example, trailers, trucks, barges) must be associated only with the RO/RO operation being conducted.

d. AE should be located on-site for the minimum time necessary, but the operations must not exceed 24 hours following the arrival of the AE.

8–24. Remote operations

Remote AE operations are required when a risk assessment determines that an AE operation presents an unacceptable probability of initiation. The intent is to assure the protection of process operators and other people who might otherwise be exposed to the consequences of an accidental explosion/fire event. Effective physical protection could involve the use of cell structures, SDWs, hardened control rooms, physical separations, barricades, or a control room in a separate building situated at a distance so that the incident pressure from an accidental explosion is less than 2.3 psi.

8–25. Locations used for intentional detonations

See DESR 6055.09, paragraph V5.E3.2.

8–26. Explosive ordnance disposal operations

See DESR 6055.09, V5.E3.2.11.

8–27. Airfields and heliports

For ESQD criteria pertaining to airfields and heliport operations, refer to the DESR 6055.09, paragraph V4, for guidance.

8–28. Pier and wharf facilities

For ESQD criteria pertaining to pier and wharf operations, refer to the DESR 6055.09, paragraph V4, for guidance.

Table 8–4
Concurrent operations

No.	Operation	Same numbered operations as in left column														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	Inspection of Projectile						X	X		1,2	X	1	X	X	X	X
2	Inspection, test, replacement, of non-energetic components							X		2	X		1,2	X	X	X
3	Maintenance Calibration						X	X		2	X		1	X	X	X
4	Inspection, test, assembly, disassembly, training item							X		2	X		1	X	X	X
5	Soldering							X		2	X		1	X	X	X
6	Welding	X		X				X		2	X		1,2	X	X	X

Table 8–4
Concurrent operations—Continued

7	Abnormal Operations (See note 3)	X	X	X	X	X	X		X	X	X	X	X	X	X	X
8	Demilitarization (Non-explosive, non-nuclear)							X		2	X		1,2	X	X	X
9	Operations Involving Inert Items	1,2	2	2	2	2	2	X	2		2	2	1,2	X	X	X
10	Operations Involving Explosive Components	X	X	X	X	X	X	X	X	2		X	1,2	X	X	X
11	Missile inspection, IC Card replacement. No open energetic							X		2	X		1	X	X	X
12	Bomb prep, painting, tar coating	X	1,2	1	1	1	1,2	X	1,2	1,2	1,2	1		X	X	X
13	Energetic press operations	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14	Propulsive unit swap	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15	Projectile and propulsive unit integration	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Notes:

See para 8–22b for use of table

[1] Operation must be incompatible if energetic components are involved.

[2] Permitted provided operations are related.

8–29. Chemical agents

a. The risk to personnel at any point in the path of a chemical agent cloud released from munitions, containers, or processing facilities as a result of an accident or leakage is a function of the agent and its concentration. The mean concentration is influenced by the general climatic conditions, particular temperature gradients near the ground, and the topographical features.

b. Persistent agent concentrations are even more affected by natural conditions because, in view of the time factor involved, much wider variations are likely to occur, altering diffusion and cloud travel characteristics. Evaporation from the source is an additional factor that varies considerably with temperature, wind speed, and the vapor pressure of the agent.

c. The accidental functioning of the burster charge in a chemical munition results in the greatest aerosolizing of the agent filler requiring prompt action to identify the path and downwind concentration of the agent cloud.

d. In consideration of the variables involved, operational facilities, activities, and storage sites must be selected to provide the maximum separation distance to unrelated personnel located on the installation or garrison as well as to the public.

e. In accordance with standards established by DoD and this pamphlet, the potential for an accident or incident must be carefully analyzed to determine the MCE that could occur and cause agent release.

(1) The MCE must be realistic with a reasonable probability of occurrence considering the explosion propagation, burning rate characteristics, and physical protection given to the items involved. For chemical munitions that are explosively configured, the MCE will be based on the functioning of the most disruptive explosive component present that would produce the maximum release of chemical agent. The potential for the functioning of the explosive component, the propagation characteristics of the munitions given packaging, and the potential for damage to adjacent munitions sufficient to cause a sympathetic detonation or release of the agent filler must be considered and should be addressed. The MCE evaluated on this basis may then be used as a basis for effects calculations and casualty predictions.

(2) For chemical munitions that are not explosively configured, the potential for spillage or leakage of the agent fill usually provides the basis for the MCE. Other factors affecting the MCE are the rate of release, puddle size, time of decontamination, type of surface, and the agent's characteristics.

f. The public exclusion distance (PED) is defined as the greater of the IBD (based on the fragment hazard distance or the NEW of the munitions) or the 1-percent lethality distance defined below.

(1) For siting purposes, personnel not directly associated with chemical operations are not to be allowed within the PED. Personnel who have a means of evacuation, a briefing on evacuation procedures, and access to a warning system (automated, radios, or manual) that would enable them to escape prior to agent exposure may be allowed within the PED in lieu of absolute exclusion. Details of the evacuation procedures will be included in the site plan and safety submission.

(2) The 1-percent lethality distance is calculated from a given MCE and meteorological conditions (temperature, wind speed, and so forth) and is established as the distance at which the dosage from an MCE or actual agent release would be 150 milligrams (mg)-min/m^3 for H and HD agents, 75 mg-min/m^3 for HT agent, 150 mg-min/m^3 for L, 10 mg-min/ m^3 for GB agent, 4.3 mg-min/m^3 for VX vapor, and 0.1 mg for inhalation or deposition of liquid VX.

(a) The meteorological conditions used will be the existing conditions in the event of an actual agent release, or the realistic, worst-case conditions used will be the existing conditions for siting purposes. Meteorological information must be obtained from an accurate source, with the methodology presented in DDESB TP–10.

(b) Use of a computer program or model (for example, D2PC, D2Puff) to predict downwind hazards must be consistent with DDESB TP–10. Any downwind hazard prediction model requires Headquarters, Department of Army (HQDA) approval. Requests for approval to use a new model or to modify an approved model will be sent to the Director U.S. Army Nuclear and Combating Weapons of Mass Destruction Agency for technical review. Submissions will include the rationale and benefits of using the proposed model. The request will contain a copy of the documentation to include source codes, verification, validation test results, and any other test data, including U.S. Army Nuclear and Combating Weapons of Mass Destruction Agency will conduct necessary technical and operational review staffing and forward justification and recommendation to Office of the Director of Army Safety for approval.

8–30. Acute exposure guideline levels

a. Acute Exposure Guideline Levels (AEGLs) are intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals.

(1) AEGLs are to be used to protect populations unrelated to chemical agent operations. AEGLs deal with emergencies involving spills or other catastrophic exposures. Acute exposure is defined as a single, non-repetitive exposure for not more than 8 hours.

(2) AEGLs are to be used as public exposure guidelines, not siting criteria for operations, facilities, or storage of chemical agents. For the agent of concern, if there are no AEGL available and a 1 percent lethality cannot be calculated for the chemical in question, it will be evaluated using worst-case situations with maximum public and worker safety considerations.

b. Each AEGL includes three tiers, defined as follows:

(1) AEGL–3 is the airborne concentration (expressed as mg/m^3 (mgs per cubic meter)) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

(2) AEGL–2 is the airborne concentration (expressed as mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

(3) AEGL–1 is the airborne concentration (expressed as mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

c. All three tiers--AEGL–1, AEGL–2, and AEGL–3 are developed for each of five exposure periods: 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours. If AEGLs are to be used for siting criteria, in the absence of an established 1 percent lethality standard, AEGL–2 will be used with the worst-case exposure (maximum mg/m^3) of the five periods.

d. AEGLs are listed at https://www.epa.gov/aegl.

Chapter 9
Tactical and Tactical Training Operations

9–1. General requirements for tactical and training operations
Force protection standards are based on physical criteria that do not change when AE is located in the field. Compliance with this pamphlet is mandatory during all tactical and tactical training operations. Deviations require a DA Form 7632 and approval by the proper risk assumption authority prior to execution of field operations. Refer to Reference CJCSI 4360.01C, DESR 6055.09, and US Army Tactical Guide to Explosives Safety (available from USATCES) for additional criteria.

9–2. Upload exercises
The live ammunition upload exercise, testing reaction times, load times, and trafficability plans are the most common Army go-to-war exercises performed by forward-deployed troops. These exercises are authorized, without regard to QD criteria at upload sites, with the following restrictions:

a. There will be no relaxation in standards governing vehicle, fire prevention, ammunition handling, or transportation safety required by other portions of this pamphlet.

(1) Vehicles must be inspected before entering the ammunition storage area. Vehicles that do not pass the inspection will not participate further in the upload portion of the exercise unless deficiencies are corrected.

(2) Fire or spark-producing devices, including matches and cigarette lighters, will not be permitted in the ammunition storage area. Smoking will not be permitted except in authorized areas. When ammunition is handled, two handheld fire extinguishers (see para 6–10) must be present and ready for immediate use at each pad, building, and so forth.

(3) Ammunition must be handled carefully. Containers must not be tumbled, dropped, thrown, or rolled. Only containers designed for dragging may be dragged.

(4) Loaded weapons will not be allowed in storage structures containing ammunition.

(5) During the loading or unloading of vehicles, the parking brakes must be set, the engine turned off, and at least one wheel chocked. Vehicles uploaded with ammunition must have the weight properly distributed and the load secured to prevent movement. The unit commander must ensure the load is checked and complies with governing transportation requirements before the load is moved. Palletized loads of ammunition on vehicles with load-bearing sideboards must not have over one-third the height of the pallet extending above the sides or tailgates, and unpalletized loads must not extend above the sides or tailgates. All vehicles must be uploaded in accordance with the loading and tiedown procedures contained in the approved drawings.

b. Exposure of units to their ammunition will be limited to the minimum number of persons, for a minimum amount of time, and the minimum amount of ammunition consistent with safe and efficient operations.

(1) Only personnel essential to the uploading or downloading of ammunition will be permitted at the loading site.

(2) Nonessential personnel or those waiting to access magazines will be kept at the maximum practical distance from the loading site.

(3) Upon completion of the upload portion of the exercise, the unit will immediately download unless:

(a) The uploaded vehicle is blocking the access of another unit or vehicle to its ammunition.

(b) The exercise involves moving the ammunition to a local dispersal area.

(c) Safety considerations, such as darkness or weather conditions, intervene.

c. Local dispersal areas, or other collection points for uploaded vehicles, will meet the QD requirements of chapter 8.

d. Uploaded vehicles awaiting download will be directed to locations within the garrison or installation that do not compromise external QD restrictions and present the least internal hazard.

e. Where space on the garrison or installation permits, uploaded vehicles will be parked a minimum of 10 meters from other uploaded vehicles to facilitate isolating a burning vehicle.

(1) Where space on a garrison or installation does not permit 10 meters separation between uploaded vehicles, collection points may be established. These collection points will be treated as aboveground magazines provided the NEQ/NEW does not exceed 4000 kg/8820 pounds. If these weights are exceeded, the collection point will be treated as a holding yard and sited in accordance with chapter 8.

(2) Under no circumstances should vehicles be forced off a storage site garrison or installation onto public roads for the sole purpose of meeting QD restrictions.

9–3. Packaging considerations

a. To the maximum extent possible, units must ensure AE remains in its original packing or, upon being opened, is repacked per appropriate drawings or specifications, using its original packaging material. This practice is critical to both safety and QC.

b. AE issued for training will remain packaged immediately before use, and only the quantity expected to be immediately used will be unpackaged. Save all packing material for repacking upon completion of field operations.

(1) Replace all safety devices such as shorting clips on 2.75-inch rockets, electrical shunts on all electrically initiated devices (EIDs), and pads protecting primers on medium and large caliber AE before repacking.

(2) Properly repack any open AE before transporting it in motor vehicles, aircraft, or watercraft.

(a) Verify and adjust, as, or when required, quantities listed on the packaging.

(b) Adjust inventory and certification document DD Form 2890 (DoD Multimodal Dangerous Goods Declaration), as required.

9–4. Malfunctions

Refer to AR 75–1 for procedures to be followed in the event of a malfunction (see glossary). Care must be taken to ensure that any AE involved in a malfunction are segregated from other AE and clearly identified pending a response from ammunition/safety specialists. Typically, this segregation includes all AE with the lot number of the ammunition that has malfunctioned.

9–5. Additional information

Reference CJCSI 4360.01C and DESR 6055.09 for additional information.

Chapter 10
Transportation, Storage, Handling, or use of Non-Standard Ammunition and Explosives (Ammunition and Explosives without Current Hazard Classification)

10–1. Background

This chapter provides guidance and requirements for the transportation, storage, handling, and use of DoD non-standard AE on Army installations. For the purposes of this chapter, these items will be referred to collectively as “non-standard AE.” Standard AE is AE produced for DoD, which are in the JHCS or for which an Interim Classification is in effect. For non-DoD procured commercial explosives that will be used for commercial purposes (non-DoD missions/operations), further authorizations and guidance contained in 10 USC 2692 may be required in addition to the requirements of this chapter.

10–2. Use

The transportation, storage, handling, or use of non-standard AE must be specifically authorized by the SC or an authorized delegate (see *para 10–3a*). SC or an authorized delegate approval is not required for:

a. Storage of commercial SAA used by contract security personnel for use in non-military weapons, provided the ammunition is stored in a properly licensed arms room and segregated from government-owned ammunition.

b. Commercial explosives used for production (for example, used in the final assembly of military munitions) or in research, development, test, and evaluation (RDTE) activities.

10–3. Procedures

a. Requests for written approval should contain as much of the information required by *paragraph 10–3e* as possible. Obtain approval from the SC or authorized delegate prior to purchase, or, if non-standard AE is otherwise obtained, prior to transportation, storage, handling, or use.

b. The HD and CG information will be requested from USATCES and should be received before purchase or, if non-standard AE is otherwise obtained, prior to transportation, storage, handling, or use.

c. When commercial explosives are transported onto an Army installation for same day use and will not be stored overnight in Army facilities, a request for HD and CG information is not required from USATCES; however, the commercial explosives must have a DOT–EX letter, or be ORM–D. DOT documentation assigning HD and CG for transportation must accompany the shipment.

d. When non-standard AE is received without an HD and CG, it will be stored as HD 1.1, CG L. SAA items (.50 caliber and below, in which the projectile does not contain energetic other than tracer material), and ORM–D will be stored as HD 1.4, storage compatibility group G.

e. The HD and CG will be obtained by providing the following information to Director, USATCES.

(1) Documentation of an HD assignment by a competent authority; that is DOT, Bureau of explosives, Bureau of Mines (BOM), or foreign government; or reports of HD testing or function testing accomplished by a competent authority; or results of small-scale laboratory tests conducted by a competent authority.

(2) Complete item nomenclature.

(3) Part number, drawing number, marking, or other identifying feature uniquely identifies the item in its storage configuration. Coordination with AESIP is required for storage and transportation on Army installations.

(4) Explosives composition and weight. A chart or listing of explosive materials with their weights is preferred. The NEW will be calculated based on the actual weight of the explosive or TNT equivalent weight, whichever is larger.

(5) Packaging data.

(6) Number of independent safety features if the item is a fuze, contains a fuze, or has features similar to a fuze.

(7) Any other information that may reflect the explosive's function or effects.

(8) A POC and telephone number for the responsible Army organization.

(9) Receipt inspection criteria (visual inspection for damage in transit) to be conducted upon receipt of non-standard AE for storage on an installation.

(10) Pre-use inspection criteria (for example, visual inspection, electrical, or mechanical test) ensure the explosives are serviceable before use.

(11) Duration of the mission for which the non-standard AE is required.

(12) Disposition for unused non-standard AE when the mission is completed. Notification that final disposition has been accomplished will be provided to the installation offices cited in *paragraph 10–3f*. Non-standard AE identified to remain on the installation in excess of its periodic inspection interval must be entered into and monitored in accordance with the installation’s ammunition surveillance program.

(13) For storage greater than 24 months, surveillance, and disposition information must be provided to include as a minimum;

(a) Shelf life and service life.

(b) Periodic inspection interval (not to exceed two years).

(c) Periodic inspection criteria (for example, visual inspection, gauging, electrical, or mechanical test).

f. The information required in *paragraph 10–3e* must be provided to the installation safety office, the ammunition surveillance office, and the storage facility manager.

g. Non-standard AE must be stored in a location designated for the storage of AE in an approved site plan.

h. Nonstandard propellant, including rocket motors, bulk propellant, and components containing propellant, with valid stabilizer test data results, are safe for handling and storage pending the next test date. Nonstandard propellant received without valid stabilizer test data results will be destroyed within 60 days of receipt unless new test data results indicate items are safe for continued handling and storage. However, propellants in configured munitions that are less than 5 inches in diameter do not fall under the Army Propellant Stability program.

i. Army facilities with non-standard AE not in compliance with this regulation will schedule assets for local disposal or retrograde to a facility that can process the material in accordance with ARs.

j. Funding for handling, inventory, inspection, storage, transportation, and demilitarization will be provided by the material owner and/or developer in accordance with AR 73–1. In situations where the material owner/developer cannot be determined, the storing activity is responsible for obtaining funding.

10–4. Binary explosives

a. The restrictions in this section apply to all binary explosives to include use for disposal of AE, training, or by Rod and Gun Clubs located on Army property. The use of a binary explosive on an Army-

owned installation or Army-controlled real property must have written approval from the SC or authorized delegate.

b. Binary explosives are pre-packaged products consisting of at least two separate non-energetic components, usually an oxidizer and a fuel. Although the separated components are non-explosive, they may have other hazardous properties (for example, corrosive, combustible, toxic). When the binary components are combined, the resulting mixture is explosive material.

c. The SC and ACOM must receive the request to bring binaries on an Army installation in writing no less than 90 days in advance. Binary compound components must be identified by name, and a list of trained persons must accompany the request.

d. The binary components are not explosive until mixed, but they are Hazardous Materials and must be stored as such (in accordance with respective SDS).

e. The Hazardous Materials lockers must be at fire protection distance (100 ft.).

f. An A & B type lock system is recommended but not required; however, no one person must have access to more than one compound component until it is time to mix them to manufacture the explosive.

g. Local Safety and Environmental Authority must approve the storage plan for components of the binary as a hazardous material. An explosives safety site plan is not required for the components, as they are not explosives.

h. The compound components must be transported on separate vehicles.

i. Compound components must be stored in separate locked hazardous material lockers.

j. All persons handling the components must be trained to handle the components and trained to handle hazardous material.

k. Only persons trained to handle binary compounds are allowed to use and detonate binary explosives.

l. The compound components must only be mixed by a person trained to mix that particular binary.

m. Once mixed, the binary explosives are considered HD CG 1.1L.

n. When detonating binary explosives, all explosives safety requirements apply. Use the intentional detonation criteria of V5.E3.2 of DESR 6055.09.

o. Army and DDESB must approve an ESP before the use of a binary explosive. The ESP must be staffed in accordance with this pamphlet and arrive at USATCES at least 90 days before expected use. The location of the detonation must be identified on the site plan and include the name of the binary explosive, the manufacturer, and the licensed contractor.

p. Contractors mixing binaries must hold an alcohol, tobacco, and firearms explosives manufacturing license and have local safety approval and command approval.

q. Storage of mixed binary explosives is not allowed. Prior to mixing binary explosives, an approved disposal procedure must be in place. All mixed binary explosives not used for their intended purpose must be destroyed at an approved location as explosive hazardous waste. Transportation of mixed binary explosives is only allowed in accordance with approved disposal procedures. Do not mix more binary explosives than is expected to be required at one time.

10–5. Commercial dynamite

a. Dynamite is sensitive to heat and shock. Containers suspected of containing sticks of dynamite that may exhibit signs of exudation or crystallization (generally, these boxes have an oily appearance) will be removed and inspected by EOD or trained personnel. Individual sticks with exudation or crystallization will be disposed of or destroyed immediately by burning or detonation. The remainder may be repacked and returned to storage. Empty containers that have been used for dynamite will be destroyed by burning. Oily stains of nitroglycerin on magazine floors will be carefully scrubbed up with a mixture of solution A (Sodium sulfide - 9 parts by weight and water - 30 parts by weight.) and Solution B (Denatured ethyl alcohol - 70 parts by weight and acetone - 20 parts by weight) after the magazine has been emptied of all other explosives. Immediately before decontaminating the nitroglycerin, combine the solutions. If the solutions are mixed and then stored, the potency diminishes in storage. Limit the use of this mixture to very small quantities. Ensure the oily film that adheres to surfaces has been removed with non-sparking tools, sponges, or absorbed in wood pulp or sawdust. Residue from cleanup operation must be destroyed by burning. Operators using this solution must wear rubber gloves and face shields.

b. Store cases of commercial dynamite initially right side up, so cartridges will lie flat. However, to reduce the possibility of exudation of nitroglycerin from the cartridges of straight dynamite 60 percent or

over in strength, it will be necessary to turn the cases based on average storage temperature (see Table 10–1).

c. The first turning will leave the cases bottom side up, with the cartridges still in a horizontal position. The second turn of the boxes will place the boxes right side up. Each turn of the boxes will be 180 degrees. Frozen dynamite will not be turned. With the exception of straight dynamite, 60 percent and over in nitroglycerin strength, other types of dynamite-ammonia, ammonia-gelatin, and gelatin need not be turned into storage. However, after the year's warmest season, a representative sample will be selected, and the containers will be examined for evidence of nitroglycerin on the exterior of the cartridge and/or packing materials.

Table 10–1
Turning of commercial dynamite—(

Average storage temperature (F)	Interval between turnings
Below 30 degrees	Do not turn
30 to 60 degrees	Every 4 months
60 to 75 degrees	Every 3 months
Over 75 degrees	Every 6 weeks

Chapter 11
Special Considerations

11–1. Arms room storage

Compliance with QD and compatibility criteria is not required for mission essential or operational required quantities of AE in HD 1.4 or 6.1 (excluding toxic chemical munitions) stored in arms rooms.

a. Storage of HD 1.4 ammunition is preferred in AHA or ASP unless such use would adversely impact operations or result in an unnecessary commitment of resources (for example, require unit personnel, to provide 24-hour security or extended travel).

b. Up to 100 pounds NEW HD 1.3 and up to 50 pounds NEW HD 1.2.2 may be stored.

c. When HD 1.2.2 is stored inside or at less than IBD from inhabited buildings such as barracks or office buildings, fragment barriers will be provided. Minimum acceptable fragment barriers are 1/4 inch of mild steel plate, one layer of sandbags, 12 inches of loose sand or dirt, or equivalent protection.

d. Storage of ceremonial ammunition is not considered an operational necessity. However, a limited quantity of HD 1.3 and HD 1.4 ceremonial ammunition (such as 75 mm blank and 105 mm blank) may be stored in an arms room provided no other practical alternative exists. The amount of HD 1.3 and HD 1.4 ceremonial ammunition stored will not exceed 100 pounds NEW and will be considered during the calculation of HD 1.3 quantities in *paragraph 11–1b*.

e. Prior to a unit storing ammunition in an arms room, the responsible commander will approve the risk assessment that justifies the storage based on operational necessity and safety considerations. In approving this assessment, the commander will consider the need to expose personnel to the proposed amount of explosives for the length of time proposed. The risk assessment will be coordinated with the senior installation safety office, logistics, security, fire protection, and ammunition surveillance personnel. The risk assessment will be posted in the arms room, and all arms room personnel will be briefed, at least annually, on its contents. The responsible commander will ensure the arms room is documented with their respective ESMP. The unit commander, or equivalent-level individual, will ensure that:

(1) Munitions are stored in their original container with original packaging (otherwise, an explosives safety site plan is required) because containerization and packing are considerations in determining a munitions HD. However, arms rooms that support guard forces or military police may have one outer pack of each caliber of SAA open for use.

(2) Storage will be consistent with the safety requirements of this pamphlet and the security requirements of AR 190–11. The use of metal storage containers or cabinets is required, and ammunition must be stored under the same criteria as it would in an approved ammunition storage facility (for example, no combustibles, solvents, petroleum products, or radioactive items in the vicinity of the ammunition).

(3) The appropriate fire and/or chemical hazard symbols are properly posted on the door to the storage area. Appropriate symbols need not be posted on the exterior of the building if only storing HD 1.4 ammunition.

(4) Property book, hand receipt, accountability, and inventory procedures will be consistent with 710-series regulations and pamphlets.

f. When storage in an AHA or ASP would adversely impact operations or result in an unnecessary commitment of resources (for example, require unit personnel to provide 24-hour security or extended travel) and storage in an arms room is necessary, the acceptable duration of storage will be determined by the commander based on a documented risk assessment considering the risks of storage versus the risks of transportation against training mission requirements. Training ammunition will be separated spatially from operational ammunition and listed separately on the arms room inventory.

g. Munitions are stored in accordance with storage compatibility requirements.

h. Quantities in excess of the above must comply with all QD requirements of this chapter, including submission of an explosives safety site plan.

11–2. Testing, disassembly, and modification of ammunition and explosives

a. Only trained and qualified technicians will test, disassemble, renovate, or conduct modification of AE. Such actions will be performed in accordance with approved SOPs. The supervisor will ensure all necessary drawings and specifications are available.

b. Modification, testing, or disassembly of AE is only permitted when:

(1) Specifically authorized, with the approval of ACOM, ASCC, or DRU commander and the item manager or system program office;

(2) Conducted per approved publications; or

(3) Conducted as part of an approved organization mission, including RDTE of AE or AE equipment.

c. Only EOD personnel, as defined in AR 75–15, may perform emergency render safe procedures.

d. When authorized, only EOD or other qualified personnel whose mission requires them to do so may disassemble unused- or rendered safe munitions for the purpose of analysis, testing evaluation, and assessment of capabilities and vulnerabilities.

e. When authorized, only EOD or other qualified personnel whose mission in support of foreign material exploitation (such as the Foreign Material Program as defined by DoDD S–3325.01) requires them to do so may disassemble unused- or rendered safe foreign munitions for the purpose of analysis, testing, evaluation, scientific, and technical intelligence, assessment of capabilities and vulnerabilities.

f. Operational shields, remote-controlled devices, fire protection systems, and ventilator systems must be evaluated and approved for installation by a professional engineer where needed to protect personnel and property. Any modifications to the same process equipment must require additional professional engineer approval.

(1) Operations involving continuity checks of electrically actuated explosives devices, propellant cutting, explosives component assembly, modification, or disassembly, and demilitarization requiring personnel protection must be evaluated and approved by a professional engineer.

(2) Operational shields and remote control systems will be designed based on the explosive material involved and tested to provide complete protection against any potential hazards (for example, blast, fragments, fire, heat, radiation, high-intensity light, toxic vapors) and must be approved for installation by a professional engineer.

(3) When protective devices of specific designs are required by a technical manual (TM), the TM's proponent must ensure the devices have been thoroughly tested and determined to be safe.

(4) When a user command requires protective devices of specific designs, the command must ensure the devices have been thoroughly tested and determined to be safe.

11–3. Inerting ammunition and explosives

The conversion of live AE to inert items may only be performed by EOD personnel authorized explicitly in accordance with AR 75–15 to convert such munitions. Converted inert AE must be marked per MIL–STD–709.

11–4. Rod and gun clubs, retail sales, and reloading

a. Each club that sells, trains with, or hand-loads ammunition on Army property or any Morale, Welfare, and Recreation activities with those activities must operate according to the standards in this

pamphlet and the installation ESMP. Responsible organizations will develop and coordinate an ESMP through the SC or designated safety official for review and approval. Refer to AR 385–10 for minimum ESMP requirements. As an element of the coordinated ESMP, a trained and qualified member will be designated in writing to ensure explosives safety criteria are developed and enforced.

b. For stores where only retail sales are made, the facility will be managed and licensed similarly to an Arms Room (refer to para 11–1).

(1) Based on a documented risk assessment, the SC or director may waive compliance with QD standards for reasonable quantities (for example, 100 pounds of propellant and 25,000 primers in their original shipping containers) of SAA in a retail environment only.

(2) HD 1.3 propellant must only be placed in its original shipping containers. Use of other containers must be avoided. Containers that could result in extreme confinement of gases should the propellant be ignited are not authorized.

(3) When complying with paragraphs (1) and (2) above, an exception to QD and fire symbol requirements for HD 1.1 primers will apply. Fire symbol 3 may be used to designate the presence of propellant and primers. The symbol need not be changed during temporary periods when the propellant has been sold out, but primers are still in stock.

c. Hand loading operations will only be conducted in a room or building solely used for this purpose and will be separate from the retail environment. In addition to the requirements in *paragraph 11–4a*, a risk assessment, and SOP must be developed, coordinated, and approved by the garrison safety office. The SOP must be posted in the immediate area where reloading is taking place. The reloading area or facility will be managed and licensed similarly to an arms room (refer to para 11–1). The SOP will, at a minimum, require:

(1) The qualified supervisor must:

(a) Be physically present at all times when reloading is taking place.

(b) Ensure each potential user of the equipment is trained and capable of reloading safely.

(2) Only authorized personnel trained in hand loading and knowledgeable about safety provisions and the hazards involved will be allowed hand-loading privileges. All personnel involved in reloading will wear ballistic certified safety eyewear or face shields. Trainees must be strictly supervised. The instructor-to-student ratio will be 1:1 until such time as the instructor has signed off on the trainee's documentation, indicating they have demonstrated comprehension of the tasks and are capable of performing the operation with minimal to no supervision. Members using the reloading area must sign consent forms agreeing to comply with rules before being allowed to reload.

(3) Smoking, matches, or flame-producing devices will not be allowed in any loading room, building, or associated storage locations.

(4) No more than 10 pounds of propellants, 5,000 primers, and 5,000 assembled rounds will be allowed in the handloading area at one time.

(5) Storage lockers will be provided for the AE per AR 190–11. Lockers will be locked when not in use. Lockers will be bonded to ensure electrostatic dissipation.

(a) Only quantities required to sustain an immediate operation will be transferred to the loading point. The loading point is defined as an area encompassing the press, the loading case tray, projectiles, powder, and primers for immediate use.

(b) Only one packing tray at a time will be removed from primer storage.

(c) Unused components will be repacked in their original containers and returned to the storage locker at the end of each loading operation.

(d) Only one specific set of ammunition components/items will be allowed at any one loading point.

(6) Good housekeeping practices will be observed at all times.

(7) Floors and walls must be free of cracks that could accumulate explosives, dust, and foreign materials.

(8) In case of a spill, all operations will cease until the explosives are cleaned up.

(a) Place all salvaged propellants in a metal container with water.

(b) All damaged components or damaged complete rounds will be placed in a separate, properly marked container.

(c) Salvaged propellant, damaged rounds or components, and empty explosives containers will be disposed of by qualified personnel.

(9) Only commercial-type loading tools, dies, scales, powder measures, and other equipment will be used during hand loading operations. Modifications to these tools or equipment are not authorized.

(10) Bullet molding will not be done within 50 feet of any location where hand loading is or has taken place.

d. The reloaded ammunition produced:

(1) May be taken from the premises only by the member producing it. Reloaded ammunition may not be sold or otherwise transferred on the premises.

(2) Must be in ready-to-fire condition. No loose powder, primers, or cartridges may be taken away from the reloading area.

e. Detailed procedures to be followed must be prominently displayed.

f. Fire protection must comply with the NFPA requirements.

g. Garrison safety and FES must perform annual inspections with written reports being provided to the using activity.

11–5. Public demonstrations, exhibitions, and celebrations

a. Participation of Army personnel (military or civilian) in public demonstrations, exhibitions, or celebrations, including the shooting of motion pictures involving the use of military AE or other munitions (for example, commercial explosives, pyrotechnics), is not advisable, except in rare instances. Requests for the participation of Army personnel in such AE demonstrations, exhibitions, or celebrations either in an official or semi-official capacity must be discouraged.

b. In the event such official participation is considered advisable, detailed plans for demonstrations, exhibitions, or celebrations involving Army personnel, activities, equipment, or materials will be submitted through safety channels to the appropriate command level based on the risk acceptance level, but at no time any lower than the SC for approval.

(1) Should demonstrations, exhibitions, or celebrations that involve Army personnel, activities, equipment, or materials be conducted on a host installation, the participating tenant organizations will submit a request through safety channels for its ACOM, ASCC, or DRU commander's approval and then submit the request through the SC's safety office for approval.

(2) Requests for participation by the presenting organization must include a risk assessment, operation plan specifying responsibilities and procedures to be followed, fire, and medical support plans, and storage and control procedures for any AE, including commercial munitions to be used during the demonstration, exhibition, or celebration.

c. Commercial fireworks used in holiday celebrations on U.S. Army Garrisons or installations will be transported, set up, and, when possible, used on the same day. Only commercial firms or licensed pyrotechnic technicians will transport, set up, or use commercial fireworks. Such use will comply with local laws and NFPA 1123. When commercial fireworks of any kind are confiscated or found on an Army installation, an authorized official will request EOD support per AR 75–15.

11–6. Display of ammunition and explosives

Live AE will not be used for display, loaded, or installed on display vehicles or aircraft. AE will not be rendered inert for this purpose unless authorized by the item manager or the system program office (see para 11–3).

a. Live and expended AE must be removed from weapons and weapons systems, including those weapons integral to operational vehicles and aircraft.

b. Cartridge actuated devices (CADs) and/or propellant actuated devices do not need to be removed from egress or life support systems; however, safety precautions will be taken per applicable TMs. Visitors will be precluded from access to actuating controls.

c. When feasible, ejection cartridges will be removed from external release systems. If not removed, ensure:

(1) Safety pins and devices are in place and cannot be easily removed.

(2) Firing circuits are isolated (for example, circuit breakers are pulled).

d. Procedures for a static display of vehicles and aircraft are contained in the specific vehicle or aircraft TMs.

11–7. Explosives training aids for military working dogs

a. Realistic and effective training of military working dogs (MWD) to detect explosives requires simulated searches using real explosives samples in normally inhabited areas. These training operations typically include handling explosives, cutting, or dividing explosive training aids, removing explosives from

shipping and storage containers, and repackaging explosives into other containers. To minimize the inherent risks of these conditions, training operations must:

(1) Be conducted in accordance with AR 190–12.

(2) Be conducted in locations and facilities that meet QD and other requirements of this pamphlet.

(3) Have detailed risk assessments and SOP developed, coordinated, and approved before initiation of any hands-on training or operations by army personnel in accordance with AR 385–10 and this pamphlet. The SOP must incorporate all elements of this paragraph.

(4) Not be conducted when lightning is detected or reported within 10 miles of the training area.

(5) Have procedures established and approved that identify the total quantity of explosives permitted during an exercise based on the risk assessment.

(6) Ensure that explosives are properly stored and secured in facilities meeting applicable safety, fire, and security criteria.

(7) Provide non-essential personnel and real property assets with the following:

(a) 100-ft. [30.5 m] separation distance from the training site for NEWQD < 15 lbs. [6.8 kg].

(b) 40W1/3 [15.87Q1/3] separation distance from the training site if more than 15 lbs. [6.8 kg] NEWQD are used for the exercise. W = NEW in pounds, Q = NEW in kgs.

(8) Minimize the number of samples and the quantity of explosives for each sample. The responsible organization must determine the total quantity of explosives permitted during an exercise considering:

(a) The value and importance of the exposed facilities.

(b) The exercise operating conditions.

(c) The available separation distance for nonessential personnel.

(9) Separate samples a sufficient distance apart to prevent an explosion from propagating from one sample to another.

(10) Not use any initiating devices or initiating explosives.

(11) Not place explosives near any heat or spark-producing items (for example, bare electrical wiring, radiators, electric heaters, and heating vents).

(12) Not place explosives in metal containers or other means of confinement that could produce fragments in the event of an accidental explosion.

(13) Maintain positive control/accountability of all explosive items. Collect all explosive samples/training aids and conduct a physical inventory documenting 100 percent accountability of items at the cessation of MWD training or operational event.

b. The installation MWD program manager, security officer, provost marshal, or the military police unit commander must establish and implement a written ESMP that complies with chapter 1 and the Installation/site ESMP.

11–8. Outdoor recreational and cultural activities

The SC or director may issue written permits authorizing outdoor recreational or cultural activities within areas where AE-related activities (for example, live-fire training or testing with SAA, demilitarization) have taken place based on a risk assessment, provided the activities can be controlled to ensure the safety of people and property. The exceptions are areas known or suspected to contain UXO.

a. When the SC authorizes access:

(1) Maps and signage will clearly define the areas in which the recreational activity may occur, routes to and from the area, and areas to which access is prohibited.

(2) Participants will be thoroughly briefed on the potential hazards and actions to be taken in the event they encounter or suspect they may have encountered a munition, the areas to which access is allowed, areas to which access is prohibited, and installation-specific requirements.

b. In addition to the requirements of subparagraph *a*. above, authorized hunting will conform to applicable state, federal, or host nation regulations.

c. SC or director will:

(1) Prohibit unnecessary access (for example, livestock grazing; recreational uses, such as hunting and hiking) and take appropriate action to deter unauthorized access to areas under their control that are known or suspected to contain UXO or DMM that have experienced abnormal environments (for example, attempted demilitarization by detonation). Such areas will be indicated within the command's ESMP, real property records, and on maps.

(2) Limit access to such areas, particularly operational range impact areas, to personnel who have an operational requirement to enter such areas (for example, safety, range maintenance, environmental

monitoring, and security). A risk assessment to evaluate the potential hazards associated with the proposed activity must be completed, and methods to mitigate (for example, provision of qualified escorts) potential exposures will be implemented before authorizing access. The command's safety office will retain a copy of the risk assessment approved by the SC or a delegated authority.

(3) Take actions to prohibit or deter access that may include establishing access controls (for example, fencing the area, establishing roving security patrols) and providing public notifications (for example, posting UXO hazard warning signs, implementing a Recognize, Retreat, Report (3Rs) Explosives Safety Education Program) of the potential hazards present. When used, pictorial signs should be used (see 3Rs.mil). Wording on signage must be legible and, if appropriate, multilingual.

11–9. Amnesty

a. Every installation will establish an AE Amnesty Program as directed by AR 710–2 and DA Pam 710–2–1. The AE Amnesty Program provides an opportunity for individuals to return AE inadvertently kept, found, or stolen without fear of prosecution. The AE Amnesty Program, intended to ensure the maximum recovery of military AE outside the supply system, is not intended to circumvent normal turn-in procedures. The AE Amnesty Program, which should, at a minimum, be designed to accommodate military AE used by the installation, should address the hazards associated with discarded AE and allow anyone (military or civilian) who wants to turn-in military AE under the Amnesty Program to do so.

b. Installations will post information about their Amnesty Programs throughout the military community. Every Amnesty Program will include collection points that are available 24 hours, 7 days a week. The use of amnesty containers is a required method of collection. Installations:

(1) Should check with the Joint Munition Command's Ammunition Peculiar Equipment (APE) program manager for the availability of amnesty containers.

(2) Will establish Amnesty Programs that best meet the installation's needs using regulatory requirements and guidelines.

(3) Will establish amnesty collection points at all ASP and may authorize such points at other locations.

c. Amnesty collection points must be checked and cleared daily or as necessary based on the installation's history of amnesty collections. The intervals must be frequent enough to ensure no unwarranted accumulations of military AE and to reduce any potential explosive hazard. Qualified ASP personnel should conduct these checks. Amnesty collection points will not require site plans under DoD 6055.9–STD, DoD AE Safety Standards; however, a risk assessment will be completed with risk acceptance at the military rank of Lieutenant Colonel or above or by a civilian of equivalent rank.

(1) Amnesty containers large enough to receive AE greater than SAA must be annotated on installation master plans and maps.

(2) Amnesty containers must:

(a) Be marked with a contact phone number that is available 24/7.

(b) Automatically lock to prevent unauthorized access.

(c) Provide for viewing of container contents prior to accessing for collection (for example, impact-resistant acrylic plastic inner door or back camera).

(3) Only Command-designated DoD personnel (for example, EOD, QASAS, MOS 910A, and 89B) or civilian employees, including contract personnel, that are properly trained to evaluate AE will collect AE from amnesty collection points.

(4) Recovered AE must be properly handled and inspected.

(5) EOD will be notified if there is doubt about the AE's condition, safety, or proper handling, transportation, or storage.

(6) The Amnesty Program should encourage users to notify the POC and to advise the POC that AE has been placed in/at the amnesty collection point.

11–10. Homemade explosives and improvised explosive devices

a. The homemade explosives (HME) and improvised explosives (IE) safety standards in this section augment the HME/IE policy in AR 385–10.

b. Finished or in process (incomplete) IE/HME and chemical precursor materials can be extremely dangerous, often of unknown chemical composition and explosive characteristics, inherently unstable, extremely sensitive, and, if handled improperly, could result in serious injury or death.

(1) Solvents, fuels, and powdered metals can be flammable and can be reactive with water or exposure to moisture.

(2) Small particle-size metals can be sensitive to electrostatic discharge (ESD). Energetic materials in a powder/dust form are especially susceptible to ignition by ESD, and the potential for ESD typically increases in dry/warm conditions. Conductive plastic containers which mitigate ESD hazards should be used to transfer energetic materials from one container to another. The use of metal containers should be avoided.

(3) Appropriate PPE should be worn when handling explosives, and chemical precursor materials as explosives and chemical precursor materials may be extremely toxic by ingestion, inhalation, skin contact, or absorption.

(4) Eating, drinking, smoking, or use of chewing tobacco products is prohibited where IE/HME and precursor materials are being stored or mixed.

(5) Individuals experiencing exposure symptoms or health-related problems known or suspected to be due to handling explosives and chemical precursor materials should seek immediate medical assistance.

c. When suspected IE/HME is encountered during operations, the responsible commander will:

(1) Use EOD units and assets to the fullest extent possible to assist in the survey, segregation, render safe, and disposal of IE/HME.

(2) Not allow unauthorized personnel to handle IE/HME.

(3) Ensure IE/HME is secured in place and personnel are adequately protected from detonation.

(4) Immediately notify the supporting EOD unit to confirm, analyze, collect, transport, and render safe or dispose of the IE/HME; in situations where tactical considerations do not permit such security or notification, only those individuals trained in identification and explosive disposal procedures will interact with IE/HME, regardless of quantity.

(5) Enforce the following general safety practices:

(a) Limit personnel proximity to the IE/HME to the maximum extent possible.

(b) Do not use flame or spark-producing devices in the vicinity of IE/HME.

(c) Do not handle, step on, or apply unnecessary pressure to IE/HME.

(d) Prohibit exposure of IE/HME to potential sources of stray electrical current, such as electromagnetic radiation (EMR) (from devices such as radios, cell phones, or other electronic equipment) and static electricity.

(e) Test confined spaces for the lethal toxic atmosphere or low oxygen levels and follow confined space requirements.

(6) Implement additional precautions as advised by EOD (Special reporting code 09 89D enlisted, 89E officer), qualified explosives safety personnel (that is, civilian job series 0018, 0017, or 0803), or QASAS personnel.

d. EOD operations and personnel:

(1) Will assist commanders in assessing the risks and dangers posed by IE/HME.

(2) May identify, assess, handle, transport, store, render safe or dispose of IE/HME when required, per local EOD unit commander's operational orders, guidance, or EOD technical procedures for operations involving IE/HME.

(3) For overseas contingency operations, will take only the minimal amount of sample of IE/HME required for identification, forensic exploitation, attribution, origin, or EOD technical purposes to support the intelligence cycle once the tactical situation allows. Theater guidance should provide specific clarifying/supplemental guidance for sampling requirements.

e. Unique requirements for Special Operations Forces (SOF) operations/personnel are as follows (see also ATP 3–05.1):

(1) SOF personnel will assist commanders in assessing the risks and dangers posed by IE/HME.

(2) When EOD unit personnel are not available in combat or contingency operations in support of Army Special Forces Operational Detachments Alpha, SOF commanders (O–5 and above) may authorize SOF engineer sergeants (Primary MOS 18C) and SOF Multi-Purpose Canine (MPC) Teams to survey, sample, segregate, employ, manufacture, and destroy IE/HME. Army SOF personnel may execute other IE/HME activities as required and approved by their operational chain of command in support of global Army SOF operational requirements.

(3) SOF MPC operations will comply with applicable references in appendix A.

f. MWD operations will comply with paragraph 11–7 as well as AR 75–15, AR 190–12, and AR 385–10.

g. EOD support of explosives or munitions emergency response in support of a DoD installation or response to a request from U.S. civil law enforcement authorities will comply with EOD policy and procedures and applicable DoD and ARs and Federal laws and regulations.

(1) Only EOD units and Military Police MWD personnel will support a request from civil authorities for support of an explosives or munitions emergency that involves or is suspected to involve IE/HME. EOD support may include technical assistance to civil authorities or the conduct of rendering safe and disposal operations. When requested, Military Police MWD/DES personnel may provide support to the responding EOD unit or requesting civil authority.

(2) IE/HME encountered in support of civil authorities or on a DoD installation will be reported as a serious incident per AR 190–45.

(3) Recovered IE/HME will only be stored and transported (typically to local disposal areas) in accordance with *paragraph 11–10k* as well as applicable local, state, and federal regulations and standards and ACOM/ASCC/DRU and installation policy.

h. Army personnel will participate only in DA-approved IE/HME training courses. A list of approved courses is available from the Department of the Army Homemade Explosives Safety Working Group (DA HME Safety WG) at usarmy.pentagon.hqda-aso.mbx.iehme@army.mil.

(1) Given the risks associated with IE/HME, Army personnel will not attend training in which students synthesize primary IE/HME unless the course has been approved by the DA HME Safety WG, as published on the DA HME Safety WG website.

(2) Requests for approval to attend other government or contracted IE/HME training courses not listed on the DA HME Safety WG website will be submitted to the DA HME Safety WG at usarmy.pentagon.hqda-aso.mbx.iehme@army.mil. Requests will be submitted as early as possible to the DA HME Safety WG to allow sufficient time to review course risk assessments, SOPs, training programs of instruction (POI) and material, and training facilities and conduct an on-site course approval assessment of course safety via a practice run prior to actual training. Final DA HME Safety WG course approval must be obtained before training is scheduled or coordinated.

(3) Requests for DA HME Safety WG approval of an IE/HME course must:

(a) Be routed through the chain of command (unit, SC, and Army Headquarters levels) and be coordinated with and endorsed by the appropriate Safety Offices.

(b) Include justification for approval (that is, what specific MOS or other training requirement is the course intended to satisfy) and relevant supporting documentation (risk assessments, course outline, course manual or SOP, and other material required for safety review) as prescribed on the IE/HME Course Evaluation Checklist published on the DA HME Safety WG website.

(c) Be submitted as early as possible to the DA HME Safety WG to allow sufficient time to review course risk assessments, SOPs, training program of instruction and material, and training facilities and conduct an on-site assessment of course safety via a practice run. The cost associated with DA HME Safety WG review, including on-site assessment, will be borne by the entity requesting the approval.

(4) DA HME Safety WG approvals are valid for the life of the course unless the course is modified in any way. The DA HME Safety WG must approve any modification to the course: unapproved modifications will invalidate the course approval. Notification of proposed course changes and coordination with the DA HME Safety WG is recommended as soon as the need for course change is identified.

(5) IE/HME training, to include training sponsored by NATO and allied partners, must have U.S. Government Department/Agency oversight, meet all applicable agency explosive safety standards, and be conducted on property suitable and approved for such activities.

(6) Additional requirements are as follows:

(a) Approved POI/SOPs will detail HME recipes and will identify the correct method(s) of mixing (for example, diapering v. mixing in a ceramic mortar).

(b) A qualified chemist will conduct QC checks to ensure actual HME recipes are in accordance with HME recipes detailed in the approved POI/SOPs at least annually.

(c) The quantity of HME material involved in a mix or procedure will be based on the approved and validated recipe.

(d) A qualified instructor will remain at each mixing table while mixing operations are being performed.

(e) The Range Safety Officer (RSO) will be qualified in the operations being conducted by completing the same level of training as required for the instructor for the particular course.

(f) The RSO will be required to position themselves to best observe procedures being performed.

(7) The DA HME Safety WG reserves the right to conduct on-site reviews of approved courses to assess course safety conditions.

i. During IE/HME MWD and SOF MPC IE/HME imprinting and training, trainers may use energetic compounds and, when possible, will use non-energetic compounds. Storage, transportation, and use of IE/HME used for MWD imprinting and training will comply with *paragraph 11–10k*. MWD imprinting and training will be conducted in accordance with paragraph 11–7, and AR 190–12.

j. IE/HME used in SOF training must be specifically authorized by the Commanding General, U.S. Army Special Operations Center of Excellence.

k. Storage and transportation of HME will be in accordance with the following:

(1) Recovered IE/HME will not be stored on an Army installation except for specific instances. Laboratory quantities (that is, 0.5 grams or less per sample; multiple samples authorized) of recovered IE/HME may be temporarily stored on an Army installation for confirmation, testing, forensic, or legal purposes until turned over to civil or military authorities or its destruction. Storage of quantities greater than 0.5 grams must be justified, requires risk assessment and acceptance as outlined in paragraph 2–2 and must be authorized by the SC. Storage and handling of IE/HME will comply with requirements in this pamphlet and applicable ACOM/ASCC/DRU and installation policy. Special Operations ground force commanders are authorized to approve variation from these quantity limits and storage requirements upon execution of risk assessment and acceptance as outlined in paragraph 2–2.

(2) When allowed, storage of IE/HME will comply with the following:

(a) Qualified explosives safety personnel (such as Explosives Safety, QASAS, Ammunition logistics assistance representative (LARs), ammunition warrant officers, or supporting EOD unit personnel) will provide safety guidance in establishing IE/HME holding areas.

(b) IE/HME without an IHC will be stored as HD/HC 1.1 CG L.

(c) Fire prevention measures (such as separation from flammable or combustible material and use of firefighting equipment, informing FES of hazards) will be employed. These measures will be inspected on a regular basis.

(d) IE/HME will be stored in sited and licensed locations.

(e) The SC and affected EOD, installation DES, and explosive safety personnel will be informed of any safety considerations specific to any IE/HME materials on an installation.

(3) IE/HME training venues will keep only the minimum amount of IE/HME required to execute training, and explosives transportation, storage, handling, and disposition will comply with the requirements of this pamphlet.

(4) The emergency transport of IE/HME should be avoided. Transportation of recovered IE/HME, when required, will not be conducted until IE/HME has been positively identified and is only authorized to be transported to a local disposal area by qualified EOD personnel after consultation with first responders (for example, law enforcement), when required, or the Incident Commander.

(5) Recovered IE/HME encountered by EOD personnel in support of civil support operations will not be transported on or disposed of on an Army installation (see *para 11–10g*). The exception is samples of IE/HME used for analysis, forensic, technical, and legal requirements at the specific request of the supported military or civilian agency. Examples of IE/HME Materials stored relative to an EOD response to civil law enforcement will be turned over or transferred to the supported law enforcement entity with jurisdiction as soon as practical and safe to do so or upon disposition instructions (that is, disposal).

(6) Movement and transfer of IE/HME must comply with transportation laws and regulations.

Note: IE/HME precursors may be classified as chemicals, explosives, or hazardous material. Storage and transportation requirements are dependent on this classification.

l. Requirements in combat and contingency operations are as follows:

(1) Qualified explosives safety personnel (such as Explosives Safety, QASAS, Ammunition LARs, ammunition warrant officers, or supporting EOD unit personnel) will provide safety guidance in establishing IE/HME holding areas.

(2) IE/HME without an IHC will be stored as HD/HC 1.1 CG L.

(3) Fire prevention measures (such as separation from flammable or combustible material and use of firefighting equipment, informing FES of hazards) will be employed. These measures will be inspected on a regular basis.

(4) IE/HME will be stored in sited and licensed locations.

(5) The SC, affected EOD, key leaders in the U.S. operating footprint, and explosives safety personnel will be informed of any safety considerations specific to any IE/HME materials.

(6) IE/HME training venues will keep only the minimum amount of IE/HME required to execute training.

(7) Transportation of recovered IE/HME, when required, should not be conducted until IE/HME has been positively identified and is only authorized to be transported to a local disposal area(s) by qualified EOD or Special Operations HME trained personnel.

(8) In combat and contingency operations, Special Operations HME trained personnel are authorized to operate in accordance with 11–10*e*.

(9) In combat and contingency operations, MWD, and MPC HME trained personnel are authorized to transport and store the minimum quantity of IE/HME for training and mission support.

m. Use of IE/HME during RDTE testing requires a detailed test plan and SOP and will be limited to the use of precursor chemicals. Deviations will be approved by the DA HME Safety WG.

11–11. Underground storage

See DESR 6055.09, paragraph V2.E5.8.

Chapter 12
Process Safety Management for Ammunition and Explosives Production Related Processes

12–1. General

a. Process Safety Management (PSM) requirements are outlined in 29 CFR 1910.119 (OSHA PSM Standard). The OSHA PSM Standard emphasizes the management of hazards associated with highly hazardous chemicals and establishes a comprehensive management program that integrates technologies, procedures, and management practices.

b. The OSHA PSM Standard is embodied in 14 program elements. It is a performance-based standard that affords organizations the flexibility to design the local PSM program to meet the intent of preventing or minimizing catastrophic releases, spills, fires, and explosions. Additionally, the OSHA PSM Standard is aligned with the cardinal principle of explosive safety, “Expose the minimum number of people to the minimum amount of explosive for the minimum amount of time,” in that it aims to prevent and minimize the negative outcomes of catastrophic events. To that end, this chapter aims to provide guidance for local organizations to develop effective PSM programs for local implementation.

c. Per the OSHA PSM Standard, PSM is required for all manufacturing operations involving explosives, including mixing, blending, extruding, synthesizing, assembling, disassembling, and other activities involved in making a chemical compound, mixture, or device that is intended to explode. Unlike other highly hazardous chemicals covered by PSM, explosive materials do not have a listed threshold quantity. If any quantity of explosives is manufactured as discussed above, then the manufacturing process is covered by the OSHA PSM Standard. The OSHA PSM is not intended for RDTE operations.

12–2. Applicability and scope

a. Operations that only involve highly hazardous chemicals listed in 29 CFR 1910.119(a)(1), and exceed applicable threshold quantities, are required to comply with the OSHA PSM Standard. However, operations that only involve highly hazardous chemicals listed in 29 CFR 1910.119(a)(1) and contain no energetic material are not addressed in this chapter. The nature of these operations involving highly hazardous chemicals, listed in 29 CFR 1910.119(a)(1), and containing no energetic material, are such that the additional guidance provided in this chapter is not warranted. For such operations, organizations must implement PSM in accordance with the requirements outlined in 29 CFR 1910.119.

b. AE and pyrotechnic manufacturing operations are the mixings, blending, extruding, synthesizing, assembling, or disassembling involved in making a chemical compound, mixture, or device designed to explode. Army AE and pyrotechnic manufacturing and demilitarization activities meeting the following descriptions must develop a written program implementing the requirements of this chapter.

(1) For production operations, PSM requirements are applicable from the time energetic materials are introduced/removed from DOT packaging until the finished article is placed in DOT-approved packaging configuration unless configured into a 1.4 hazard classification configuration. This includes the extraction of samples from an active AE and pyrotechnic manufacturing process.

(2) For maintenance/demilitarization operations, PSM requirements are applicable to operations that change the physical state of energetic material (melt out, steam out, cryofracture, hydrolysis) or disassembly of a finished article which exposes energetics (for example, removing fuze well liners).

(3) For Load Assemble Pack (LAP) Operations, PSM requirements apply to LAP operations until the item is placed in DOT-approved packaging configuration.

c. In addition to exclusions outlined in 29 CFR 1910.119, the following operations are not considered PSM-covered processes. Operations only involving:

(1) Amalgamation of constituents to develop novel explosives and pyrotechnics for military applications involving small-scale formulation to be evaluated for safety and performance by means of static detonation experiments for verification of theoretical calculations.

(2) Prototyped RDTE armaments and countermeasure systems fabricated solely for the purpose of retrieving energetic performance data by means of static detonation and/or initiation for verification of theoretical calculations. This includes, but is not limited to:

(a) Product testing and analysis, which is not part of any in production sampling and testing of the explosive manufacturing process.

(b) Chemical and physical property analysis of explosives and propellants and pyrotechnics formulations.

(c) Scale-up research chemical formulations to develop production quantity formulations.

(d) Analysis of age tests conducted on finished products.

(e) Failure analysis tests conducted on pre-manufactured or finished products.

(f) X-raying.

(g) Evaluating environmental effects, such as hot, cold, jolt, jumble, drop, vibration, high altitude, salt, and fog.

(h) Assembly of engineering research and development models.

(3) Research and Development of energetics (explosives, propellants, and pyrotechnics), related materials, and warhead design for military applications involving laboratory, small-scale, and pilot plant formulation, munition/propulsion system prototyping, and safety/limited performance testing.

(4) Activities where there is no consequences of any hazard that results in a catastrophic release of toxic, reactive, flammable, or explosive chemicals, as determined by and documented in a process hazards analysis that complies with 29 CFR 1910.119(e).

(5) The intentional functioning of standard, non-standard and experimental AE (ballistic testing, lot acceptance testing, flashing, use of APE 1236 Deactivation Furnace).

(6) The assembly/disassembly of finished articles in a final configuration that does not expose energetics (for example, installing, or removing a fuze from a projectile or replacing like components in a maintenance operation that does not expose energetic material).

(7) Quality Assurance (QA) functions (for example, surveillance inspections, repackaging).

(8) Storage of ammunition, explosives, and pyrotechnics.

12–3. Process safety management programs

a. Commanders must ensure organizations develop, implement, and manage a written PSM program as an element of their overall safety and occupational health program.

b. The process safety management programs (PSMPs) must address process safety for all PSM-covered operations, including PSM-covered AE and pyrotechnic operations during production, maintenance, demilitarization, and disposal operations as defined in paragraph 12–2, Applicability, and scope.

c. The written PSMP program must address the following:

(1) Appointment of PSM focal point as the POC for all aspects of the PSMP. The PSM focal point does not have to be a safety and occupational health professional.

(2) Appointment of PSM QA system focal point for all aspects of the Mechanical Integrity program outlined in 12–12.

(3) Define PSM-covered processes.

(4) Prescribe requirements, responsibilities, and procedures for compliance with the 14 program elements of PSM in accordance with 29 CFR 1910.119, to include:

(a) Employee Participation.

(b) Process Safety Information (PSI).

(c) Process Hazard Analyses (PHA).

(d) Operating Procedures.

(e) Training.
(f) Contractors.
(g) Pre-Start-up Safety Review.
(h) Mechanical Integrity.
(i) Hot Work Permits.
(j) Management of Change.
(k) Incident Investigations.
(l) Emergency planning and response.
(m) Compliance Audits.
(n) Trade Secrets.
(5) Prescribe integration of process safety into policy, procedures, and activities.
(6) Outline the responsibilities of all organizations, including installation and tenant activities with an explosives mission involving PSM-covered AE and pyrotechnic operations.

12–4. Employee participation

a. Organizations must develop a written plan of action regarding implementing employee participation. Where applicable, the written plan must include a list of key personnel with specific responsibilities assigned to them in accordance with the requirements of the Employee Participation program within the PSM Program.

b. Organizations must consult with employees and their representatives on the conduct and development of PHA and the development of the other elements of PSM in this chapter.

c. Organizations must provide employees and their representatives with access to PHA and to all other information required to be developed under this standard.

12–5. Process safety information

a. PSI is the keystone of a PSM Program in that it provides critical information about the equipment, hazardous materials, operational environment, and the process. To be compliant with the OSHA PSM Standard, the PSI must include information about the hazards of the highly hazardous chemicals used or produced by the process, information about the technology of the process, and information about the equipment in the process.

b. Information pertaining to the hazards of the highly hazardous chemicals in the process.

(1) Per the OSHA PSM Standard, information pertaining to the hazards of the highly hazardous chemicals in the process must consist of at least the following:
(a) Toxicity information.
(b) Permissible exposure limit.
(c) Physical data.
(d) Reactivity data.
(e) Corrosivity data.
(f) Thermal and chemical stability data.
(g) Hazardous effects of inadvertent mixing of different materials could occur.

(2) For Army AE and pyrotechnic operations, information pertaining to the hazards of the highly hazardous chemicals should be provided in the following:
(a) Hazardous Component Safety Data Statements.
(b) Material SDSs/safe separation distances.
(c) Sensitivity data on the mechanisms of initiation.
(d) Technical data on hazardous ingredients, constituents, and by-products of energetic material.

c. Information pertaining to the technology of the process must include information in sufficient detail to support an accurate assessment of the fire and explosion characteristics, reactivity hazards, the safety and health hazards to workers, and the corrosion and erosion effects on the process equipment and monitoring tools.

(1) Per the OSHA PSM Standard, organizations must include:
(a) A block flow diagram or simplified process flow diagram.
(b) Process chemistry and its properties.
(c) Maximum intended inventory.
(d) Safety upper and lower limits for such items as temperatures, pressures, flows, or compositions.

(e) An evaluation of the consequences of deviations, including those affecting the safety and health of the employees.

(2) For Army AE and pyrotechnic operations, Information pertaining to the technology of the process should be provided by compiling the minimum required PSI related to the technology of the process, including:

(a) Process layout/block flow diagram.

(b) Hazardous Component SDSs.

(c) Material SDSs/SDSs.

(d) DDESB or Army RESSs.

(e) Explosive licenses.

(f) Facility Construction/Structural Analysis (if applicable).

(g) Locally Identified Hazards.

d. Information pertaining to the critical equipment in the process should include information in sufficient detail to support an accurate assessment that the design and construction of equipment is suitable for the intended use and can be maintained, inspected, tested, and operated safely. Critical equipment is defined as equipment where a failure of engineering and administrative controls can result in a catastrophic release of toxic, reactive, flammable, or explosive chemicals, as determined by and documented in a process hazards analysis that complies with paragraph 12–6, Process Hazards Analysis.

(1) Per the OSHA PSM Standard, organizations must compile information pertaining to each piece of critical equipment and must include the following, as applicable:

(a) Materials of construction;

(b) Piping and instrument diagram (P&ID), including P&ID for fire suppression systems;

(c) Electrical classification;

(d) Relief system design and design basis;

(e) Ventilation system design;

(f) Design codes and standards employed;

(g) Material and energy balances for processes built after May 26, 1992;

(h) Safety system (for example, interlocks, detection, or suppression systems);

(i) Ground and bonding of equipment; and

(j) LPSs.

(2) For Army AE and pyrotechnic operations, critical equipment should be identified based on the characteristics and hazards of the energetic materials and the process operations. It should include the following (not all-inclusive):

(a) Pressure vessels and tanks.

(b) Relief devices.

(c) Ventilation system design.

(d) Rotating equipment.

(e) Mixing bowls and mix kettles.

(f) Overhead conveyors, monorails, and cranes.

(g) Pollution abatement systems.

(h) Emergency shutdown devices and interlocks.

(i) Safety instruments and control devices.

(j) Material feed and weighing systems.

(3) Organizations must document that equipment complies with recognized and generally accepted good engineering practices (RAGAGEPS). RAGAGEPS must apply to process equipment design, installation, operation, and maintenance, inspection, and test procedures, and inspection and test frequencies as defined within 29 CFR 1910.119 (see glossary for the definition of recognized and generally accepted good engineering practice). These include:

(a) Published and widely adopted codes (for example, National Fire Protection Association and National Electric Code);

(b) Published consensus documents (for example, American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI));

(c) Published non-consensus documents (for example, DDESB TPs, peer-reviewed technical articles);

(d) Military standards and specifications (for example, Department of Defense (DoD) Instructions and Manuals, ARs, and DA Pams, AMC regulations); and

(e) Appropriate internal standards (for example, standards that supplement published RAGAGEPs, to establish design, installation, maintenance, inspection, and testing requirements for unique processes).

(4) When process equipment is specified to meet a certain standard, Organizations must ensure that certificates of conformance are requested as part of the acquisition process.

e. For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the Organization must determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner.

f. Older equipment in PSM-covered operations may not have been designed and constructed under an applicable RAGAGEP because none existed at the time of design and construction. Where the original technical information no longer exists or was never developed, such as older or legacy equipment, information should be developed in conjunction with the process HA (see paragraph 12–6) in sufficient detail to support the analysis.

g. Minimum required PSI for information pertaining to the equipment in the process must include as much of the information prescribed in paragraph 12–5c(2) as is available and a statement by competent technical personnel that the equipment is designed, maintained, inspected, tested, and can be operated in a safe manner. It is important to establish and document the age and installation date of the relevant process and equipment, the dates and extent of process and equipment modifications, as well as the exact RAGAGEP, including the edition and publication date.

12–6. Process hazards analysis

a. Risk management is the Army's primary process for assisting organizations and individuals in making informed risk decisions in order to reduce or offset risk, thereby increasing effectiveness and the probability of mission success. It is a systematic, cyclical process of identifying and assessing hazards, then mitigating the associated risks. All commanders, staff, leaders, Soldiers, and Army Civilians must integrate risk management into all planning and operations.

b. All operations involving PSM-covered AE and pyrotechnics must be reviewed to identify and manage the potential risk associated with the operation per MIL–STD–882E when appropriate. Organizations must ensure that a process HA using risk management is performed on PSM-covered processes.

c. Due to the multifaceted risks posed by a process, Organizations must ensure PSI, per MIL–STD–882E, is used to provide the workforce with an all-inclusive risk management process that analyzes the hazards and develops control for both human factors and system design.

d. Organizations must determine and document the priority order for conducting risk management based on a rationale that includes such considerations as the extent of the process hazards, number of potentially affected employees, age of the process, and operating history of the process.

e. One or more of the following methodologies that are appropriate to the complexity of the process must be used to determine and evaluate the hazards of the process being analyzed:

(1) What-if/checklist.

(2) Hazard and operability study.

(3) Failure mode and effects analysis.

(4) Fault tree analysis.

(5) An appropriate equivalent methodology. Organizations are responsible for assessing and evaluating the equivalent methods to ensure the chosen equivalent methodology permits and achieves compliance. Equivalent PHA methodology may be documented on local hazards analysis forms, and Risk Assessments recorded using DD Form 2977 (Deliberate Risk Assessment Worksheet). Instructions for DD Form 2977 can be found in appendix B.

f. The PHA must address:

(1) The hazards of the process.

(2) The identification of any previous incident which had a likely potential for catastrophic consequences in the workplace. The existing Army databases for mishaps can be used to identify similar processes and previous incidents (U.S. Army Combat Readiness/Safety Center Army Safety Management Information System and other databases for use in accident analysis, USATCES explosives safety technical database).

(3) Engineering and administrative controls applicable to the hazards and their interrelationships, such as the appropriate application of detection methodologies to provide early warning of releases.

(4) Consequences of failure of engineering and administrative controls.

(5) Facility siting.

(6) Human factors.
(7) Qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace.

g. The PHA must be performed by a team with expertise in engineering and process operations. All team members must be trained and qualified in the specific HA methodology. Organizations can use the existing Hazard Analysis Working Group (HAWG) to develop, support, and manage the PHA development process. Membership of existing HAWGs may need to be modified to comply with PHA requirements of the OSHA PSM Standard. The PHA team must, as a minimum, include the following:
(1) One employee with experience and knowledge specific to the evaluation process.
(2) One person knowledgeable in the specific process HA methodology being used.
(3) Safety representative with experience and knowledge specific to the evaluated process.
(4) SOP Developer.
(5) Appropriate engineering representatives having experience and knowledge specific to the process being evaluated.
(6) Industrial hygiene representative having experience and knowledge specific to the process being evaluated.

h. It is also recommended that the PHA team include others deemed necessary to provide adequate technical support, including:
(1) FES representative having experience and knowledge specific to the process being evaluated.
(2) Environmental representative having experience and knowledge specific to the process being evaluated.
(3) Representative having experience and knowledge specific to the process being evaluated.
(4) Logistics representative having experience and knowledge specific to the process being evaluated.
(5) Ammunition Surveillance.

i. Organizations must establish a system to promptly address the team's findings and recommendations; assure that the recommendation(s) are resolved in a timely manner, and the resolution is clearly defined and documented; document what actions are to be taken; complete actions as soon as possible; develop a written schedule of when these actions are to be completed; communicate the actions to operating, maintenance, and other employees whose work assignments require process involvement or who may be affected by the recommendations or actions.

j. The PHA/Risk Assessment/DD Form 2977 must be updated and revalidated as necessary by a team meeting the requirements in *paragraph 12–6g*. to ensure the risk assessment remains consistent with the current process.

k. The PHA/Risk Assessment/DD Form 2977 must become a permanent part of the record copy of the SOP and is required for all operations involving the handling and/or processing of energetic/hazardous materials. Updates or revalidations for each process covered by this section, as well as the documented resolution of recommendations described in *paragraph 12–6i,* must be documented for the life of the process.

12–7. Standing operating procedures

SOPs describe tasks to be performed, data to be recorded, operating conditions to be maintained, samples to be collected, and safety and health precautions to be taken. The SOP must be technically accurate, understandable to employees, and revised periodically to ensure that they reflect current operations. The PSI package is to be used as a resource to better assure that the SOP and practices are consistent with the known hazards of the chemicals in the process and that the operating parameters are accurate. The SOPs must be reviewed by the team identified in *paragraph 12–6g*. to include operating personnel, thus ensuring accuracy and providing practical instructions on executing job tasks safely.

a. Organizations must develop and implement written operating procedures that comply with AR 385–10 and DA Pam 385–10.

b. Each SOP must be based upon and supported by a PHA (refer to para 12–6). The PHA must become a permanent part of the controlled copy maintained in a centralized SOP library upon completion of staffing.

c. SOPs must address, as a minimum, the following elements:
(1) Steps for each operating phase:
(a) Initial startup.
(b) Normal operations.

(c) Temporary operations. Organizations must define temporary operations in the local PSM program.

(d) EAPs define emergency shutdown, including the conditions under which emergency shutdown is required and the assignment of shutdown responsibility to qualified personnel, ensuring that emergency shutdown is executed safely and promptly.

(e) EAPs to include contractor's notifications and accountability.

(f) Normal shutdown.

(g) Startup following a turnaround or after an emergency shutdown.

(h) Non-routine work authorization activities.

(2) Operating Limits:

(a) Consequences of deviation; and

(b) Steps required to correct or avoid deviation.

(3) Safety and health considerations:

(a) Properties of, and hazards presented by, the chemicals used in the process;

(b) Precautions necessary to prevent exposure, including engineering controls, administrative controls, and PPE;

(c) Control measures to be taken if physical contact or airborne exposure occurs;

(d) QC for raw materials and control of hazardous chemical inventory levels; and

(e) Any special or unique hazards (for example, ignition sources, clothing care, prohibited accessories).

(4) Safety systems and their functions.

d. Computerized process control systems add complexity to operating instructions. These operating instructions must describe the software's logic and the relationship between the equipment and the control system(s); otherwise, it may not be apparent to the operator. In addition, some processes may require compliance with International Electrotechnical Commission (IEC) 61511. IEC 61511 provides guidance on safety instrumented systems. Safety instrumented systems play a crucial role in process control to achieve safety and productivity. Their purpose is to take a process to a safe state when predetermined set points are exceeded. Safety instrumented systems are also called emergency shutdown systems, safety shutdown systems, and safety interlock systems.

e. SOPs must be readily accessible to employees who work in or maintain a process.

f. SOP must be reviewed by the following criteria:

(1) Demilitarization/disposal SOPs require review and concurrence annually by all signatories.

(2) Toxic Chemical SOPs require an annual review by the proponent and installation safety manager.

(3) Other active SOPs require review every two years by the organization performing the work and the Safety Office.

g. Preparation of an inactive SOP for use must require the same approval process as a new SOP unless operations fluctuate regularly (for example, quarterly) between active and inactive. Organizations must define inactive PSM-covered AE and pyrotechnic operations in the local PSM program.

h. Organizations must ensure modifications resulting from management of change are incorporated into operating procedures.

i. Organizations must develop written safety programs complying with OSHA regulatory guidance assuring the control of hazards during operations such as lockout/ tag-out; confined space entry; opening process equipment or piping, and control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel. These safe work practices must apply to all installation and contractor employees.

12–8. Deviation from standards

Waivers, exemptions, DARAD, and DA Pam 385–10 are not authorized for PSM requirements.

12–9. Training

a. Initial training must include a minimum of:

(1) Process training for all employees involved in PSM-covered operations, which include as a minimum:

(a) An overview of the process.

(b) SOPs as specified in paragraph 12–7.

(c) Emergency evacuation and response.

(d) Non-routine work authorization activities.

(2) In lieu of initial training for those employees already involved in operating a process, a supervisor may certify in writing that employees have demonstrated a continued level of competency, skill, and proficiency to safely carry out their duties and responsibilities as specified in the SOP.

(3) SOP familiarization training that employees sign/date the employee/operator's statement upon completion of training indicating familiarization and understanding of the SOP.

b. Refresher training must be provided at least every three years, and more often if necessary, to each employee involved in operating a process to assure that the employees understand and adhere to the current process SOP. The supervisor, QA, or local training authority, and safety specialist must determine the appropriate frequency of refresher training in consultation with the employees involved in operating the process.

c. A document must be prepared and maintained by the supervisor attesting to the fact that each employee involved in process operations has received and understands the training required by paragraph 12–9 and any additional training as required locally. This written record is signed and dated by the employees indicating the date of training familiarization and understanding of the SOP instructions.

12–10. Contractors

Many categories of contract labor may be present at an Army Jobsite; such workers may actually operate the facility or perform only a particular aspect of a job because of specialized knowledge or skill. Others work only for short periods when there is a short-term requirement for increased production, such as in turnaround operations.

a. This section applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to (within IBD) the covered process. It does not apply to contractors providing incidental services that do not influence process safety, such as janitorial, food, and drink, laundry, delivery, or other supply services.

b. Army construction contracts fall within the purview of the USACE Safety and Health Requirements Manual, EM 385–1–1, and Part 1910, Title 29, CFR (29 CFR 1910) and Part 1926, Title 29, CFR (29 CFR 1926) that establish legal requirements. When applicable, Organizations must incorporate requirements of 29 CFR 1926.64, Safety, and Health Regulations for Construction, and PSM of highly hazardous chemicals in contract requirements.

c. Contracting Officers must ensure contract activities:

(1) Obtain and evaluate information regarding the contract employer's safety performance and programs when selecting a contractor, to include as a minimum the following:

(a) Written QA program.

(b) All written occupational safety plans necessary to execute their contractual obligations.

(c) Verify employee training documentation before issuing a notice to proceed with contractual work.

(d) Assure the action-recall documents are up-to-date.

(e) Apply the requirements of DoDI 5000.2, MIL–STD–882E, and DA Pam 385–10 to acquisitions. Incorporate MIL–STD–882E in the list of contractual compliance documents, and include the potential of a developer to execute section 4 requirements as source selection evaluation criteria.

(2) Inform contract employers of any known hazard(s) potential for fire, explosion, or toxic release related to the contractor's work and processes in close proximity to their work site(s).

(3) Explain to contract employers the applicable provisions of the EAP required by paragraphs 12–6 and 12–7.

(4) Develop and implement safe work practices consistent with paragraphs 12–6 and 12–7 to control the entrance, presence, and exit of contract employers and contract employees in covered process areas.

(5) Periodically evaluate the performance of contract employers in fulfilling their obligations.

(6) Obtain or maintain a contract employee injury and illness log related to the contractor's work in process areas.

d. Contracting Officer must ensure the following contractor responsibilities are incorporated into contracts:

(1) Each contract employee is trained in the work practices necessary to perform their job safely.

(2) Each contract employee is instructed on the known potential fire, explosion, or toxic release hazards related to their job, the process, and the applicable provisions of the EAP.

(3) Each contract employee has received and understands the training required by this paragraph (prepare a record that contains the identity of the contract employee, the date of training, and the means used to verify that the employee understood the training).

(4) Each contract employee follows the facility's safety rules, including the safe work practices required by paragraph 12–7.

(5) Present to the Contracting Officer (CO) or Contracting Officer Representative (COR) in writing any unique hazards presented by the contractor's work or of any hazards found by the contractor's work.

e. For additional criteria, reference Federal Acquisition Regulations, Defense Acquisition Regulations through your CO/COR; DoD 4145.26–M, DoD Contractors Safety Manual for AE and ACOM, ASCC, and DRU command requirements as applicable.

12–11. Pre-startup safety review

Pre-startup review is a final systematic check initiated by a trigger event. Organizations must define trigger events in the local PSM program before using a new or changed aspect of a process. The initial startup procedures must be fully evaluated utilizing criteria defined in paragraphs 12–5 through 12–9 as part of the pre-startup review to ensure a safe transfer into the normal operating mode.

a. Organizations must require a pre-startup safety review for new facilities and modified facilities when the modification is significant enough to require a change in the PSI.

b. Organizations must require a pre-startup safety review for inactive PSM-covered AE and pyrotechnic operations before the start of the operation. Organizations must define inactive PSM-covered AE and pyrotechnic operations in the local PSM program.

c. The pre-startup safety review must confirm that prior to the introduction of energetic materials to a process:

(1) Construction and equipment are in accordance with design specifications.

(2) Safety, operating, maintenance, and emergency procedures are in place and are adequate.

(3) For new facilities, a process HA has been performed, recommendations have been resolved or implemented before startup, and modified facilities meet the requirements contained in paragraph 12–14.

(4) Training of each employee involved in operating a process has been completed and documented.

12–12. Mechanical integrity

Mechanical integrity encompasses the activities necessary to ensure that equipment/assets are designed, fabricated, installed, operated, and maintained to provide the desired performance in a safe, environmentally protected, and reliable fashion. Mechanical Integrity requirements apply to the critical process equipment for PSM-covered operations as defined in 12–5*d*. Critical process equipment should be identified based on the characteristics and hazards of the energetic materials and the process operations.

a. The critical process equipment, as identified in *paragraph 12–5d*, must comply with paragraphs *12–12b* through *12–12f*.

b. Organizations must establish and implement written procedures to maintain the ongoing integrity of all process equipment. The following elements, as a minimum, must be included in the written procedures:

(1) Identifying and categorizing equipment and instrumentation.

(2) Inspections and tests to include frequency.

(3) Maintenance procedures.

(4) Training of maintenance personnel.

(5) Criteria for acceptable test results.

(6) Documentation of test and inspection results.

(7) Documentation of manufacturer recommendations for equipment and instrumentation.

c. Each employee involved in maintaining the ongoing integrity of process equipment must be trained in an overview of that process, associated hazards, and the procedures applicable to the employee's job tasks to assure that the employee can safely perform the job tasks (refer to paras 12–9 and 12–10).

d. Inspection and testing must follow the following criteria:

(1) Inspections and tests are performed on process equipment.

(2) Inspection and testing procedures follow RAGAGEPS.

(3) The frequency of inspections and tests of process equipment are consistent with applicable manufacturers' recommendations and good engineering practices and more frequently if determined to be necessary by prior operating experience.

(4) Each inspection and test that has been performed on process equipment is documented, identifying the date of the inspection or test, the name of the person who performed the inspection or test, the

serial number or other identifiers of the equipment on which the inspection or test was performed, a description of the inspection or test performed, and the results of the inspection or test.

e. Deficiencies in equipment that are outside acceptable limits (defined by the PSI in paragraph 12–5) must be corrected before further use or in a safe and timely manner when necessary means are taken to assure safe operation.

f. A QA system is needed to help ensure that the proper materials of construction are used, that fabrication and inspection procedures are complied with, and that installation procedures recognize field installation concerns. The QA program is an essential part of the mechanical integrity program and will help to maintain the primary and secondary lines of defense that have been designed into the process to prevent unwanted releases or those which control or mitigate a release. Organizations must ensure:

(1) A QA system that assures that equipment as it is fabricated is suitable for the process application for which they will be used is established, and the QA system ensures:

(a) Appropriate checks and inspections are performed to ensure that equipment is installed properly and consistent with design specifications and the manufacturer's instructions.

(b) Maintenance materials, spare parts, and equipment are suitable for the process application for which they will be used. Before purchasing any tools or parts for AE-related processes, follow the guidance within AR 385–10, chapter 9, and DA Pam 385–10, chapter 4.

(c) "As built" drawings, together with certifications of process equipment and materials of construction, are verified and retained in the QA documentation. Equipment installation jobs need to be properly inspected in the field for the use of proper materials and procedures and to ensure that qualified personnel are used to perform the job.

(2) The use of appropriate gaskets, packing, bolts, valves, lubricants, and welding rods need to be verified in the field by competent personnel. Procedures for installation of safety devices need to be verified, such as the torque on the bolts on ruptured disc installations, uniform torque on flange bolts, and proper installation of pump seals. If the quality of parts is a problem, then investigation of the suppliers may be warranted to assure better proper purchases of required equipment are suitable and meet specifications as required. Any changes in equipment that may become necessary need to go through the management of change procedures in paragraph 12–14.

12–13. Hot work permit

a. Organizations must be in close coordination with the installation FES to develop and implement a process for the issuance of hot work permits for hot work operations conducted on or near a covered process.

b. As a minimum, the permit must be documented on DA Form 5383 and must be compliant with 29 CFR 1910.252 and chapter 6 of this pamphlet.

c. The permit must be kept on site until completion of hot work operations as well as on file for the designated time period after operation determined by local policy.

d. Any changes in site conditions that increase the hazard potential to workers or process equipment must be reported immediately to FES and the site supervisor for appropriate action.

12–14. Management of change

a. Management of change covers such modifications as changes in process technology and changes to equipment and instrumentation. Changes in process technology can result from changes in production rates, raw materials, experimentation, equipment unavailability, new equipment, new product development, change in catalyst, and changes in operating conditions to improve yield or quality.

b. In accordance with 29 CFR 1910.119, change includes all modifications to equipment, procedures, raw materials, and processing conditions other than "replacement in kind," which refers to a replacement that satisfies design specifications.

c. Organizations must establish and implement written procedures to manage changes to process chemicals, technology, equipment, and procedures; and changes to facilities that affect a covered process. The procedures must ensure the following considerations are addressed at a minimum prior to any changes:

(1) The technical basis for the proposed change;

(2) Impact of change on safety and health;

(3) Modifications to operating procedures;

(4) Necessary time period for the change; and

(5) Authorization requirements for the proposed change.

d. Employees involved in operating a process and maintenance and contract employees whose job tasks will be affected by a change in the process must be informed of and trained in the change prior to start-up of the process or affected part of the process (refer to paragraph 12–9 for further guidance).

e. If a change covered by this paragraph results in a change in the PSI required by paragraph 12–5, such information must be updated accordingly.

f. If a change covered by this paragraph results in a change in the operating procedures or practices required by paragraphs 12–5 through 12–7, such procedures or practices must be updated accordingly.

g. Temporary changes have been causal in a number of catastrophic events over the years. Temporary changes are subject to the management of change provisions. In addition, the management of change procedures are used to ensure that the equipment and procedures are returned to their original or designed conditions at the end of the temporary change. Proper documentation and review of these changes is invaluable in assuring that the safety and health considerations are being incorporated into the operating procedures and the process. Organizations must:

(1) Establish ways to detect temporary changes as well as those defined in paragraphs *12–14a* through *12–14c*.

(2) Establish and monitor limitations for temporary changes (time limits, process operating limits, maximum production quantities/lots) since, without control, these changes may tend to become permanent.

12–15. Mishap investigations

a. A crucial part of the PSM program is a thorough investigation of accidents and near-miss incidents to identify the chain of events and causes so that corrective measures can be developed and implemented. The investigation plan is a systematic procedure that will ensure continuity of effort from the preliminary examination of the mishap site to the submission of the final report.

b. Organizations must assure each mishap resulting in a catastrophic incident or release of highly hazardous chemical in the workplace (Army Class A or Class B mishap) is investigated in accordance with AR 385–10 and must ensure:

(1) A mishap investigation is initiated as promptly as possible, but not later than 48 hours following the incident.

(2) An mishap investigation team be established and consist of at least one person knowledgeable in the process involved, including a contract employee if the incident involved the work of the contractor, and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident.

(3) The mishap investigation report includes, at a minimum:

(a) Date of incident;

(b) Date investigation began;

(c) A description of the incident;

(d) The factors that contributed to the incident; and

(e) Any recommendations resulting from the investigation.

(4) A system to promptly address and resolve the mishap report findings and recommendations is established. Resolutions and corrective actions must be documented in accordance with DA Pam 385–40.

(5) Mishap reports are reviewed with all affected personnel whose job tasks are relevant to the incident findings, including contract employees, where applicable.

(6) All records that are created or received in the course of conducting an incident investigation are maintained in accordance with applicable DoD Component records disposition schedules or a minimum of five years, whichever is greater. These records include those in electronic format.

c. For near-miss incidents that could reasonably have resulted in a catastrophic incident or release of highly hazardous chemical in the workplace or the workplace resulting in a fatality, permanent total disability, permanent partial disability, or hospitalization of three or more personnel are hospitalized as inpatients from a single occurrence (near-miss Army Class A or Class B mishap) Organizations must ensure:

(1) A near-miss incident investigation is initiated as promptly as possible but not later than 48 hours following the incident.

(2) A near-miss incident investigation team is established. It consists of at least one person knowledgeable in the process involved and others with appropriate knowledge and experience to investigate and analyze the incident thoroughly.

(3) An Army Ground Mishap Report (AGMR) is completed and retained locally for at least five years, including the current fiscal year and the previous five fiscal years.

(4) The AGMR includes:

(a) Date of incident;

(b) Date investigation began;

(c) A description of the incident;

(d) The factors that contributed to the incident;

(e) Any recommendations resulting from the investigation.

(5) A system to promptly address and resolve the near-miss incident report findings and recommendations is established, and resolutions and corrective actions are documented.

(6) The report is reviewed by all affected personnel whose job tasks are relevant to the near-miss incident findings, including contract employees, where applicable.

(7) Incident investigation reports are retained for at least five years, including the current and previous fiscal years.

12–16. Emergency planning and response

a. It is essential that the EAPS are developed to be site specific with respect to emergency conditions evaluated, evacuation policies and procedures, emergency reporting mechanisms, and alarm/alerting systems.

b. Organizations must establish and implement an EAP for the entire installation that is compliant with the provisions of 29 CFR 1910.38 and DA Pam 525–27 and must ensure:

(1) The EAP includes the following items as a minimum:

(a) Procedures for handling small releases.

(b) Individual roles and responsibilities.

(c) Threats, hazards, and protective actions.

(d) Notification, warning, and communications procedures.

(e) Means for locating Family members in an emergency.

(f) Emergency response procedures.

(g) Evacuation, shelter, and accountability procedures.

(h) Location and use of common emergency equipment.

(i) Emergency shutdown procedures.

(j) Emergency public information.

c. Activities covered under PSM may also be subject to the hazardous waste and emergency response provisions contained in 29 CFR 1910.120 (a), (p), and (q). Consult with your ACOM, ASCC, and DRU command functions for appropriate guidance.

d. Organizations must ensure that each employee, upon initial assignment, is trained in accordance with this chapter. The training must include, as a minimum:

(1) Parts of the EAP that the employee must know to protect themselves in the event of an emergency.

(2) Parts of the fire prevention plan the employee must know to protect themselves in the event of an emergency.

e. The written plans must be readily available to the employees and kept at the workplace.

f. Tenant organizations (specific command and/or unit residing on an Army installation) must develop and employ required emergency management (EM) capabilities to support functions identified in the installation EM plan as required by 29 CFR 1910.33–39, DoDI 2000.16, DoDI 6055.17, and DA Pam 525–27, Tenant EAPs. The primary focus of the tenant EAP should be to synchronize tenant organization actions during an emergency with the operations of the installation in order to:

(1) Support and execute protective actions for assigned personnel.

(2) Support response and recovery operations when required.

g. Visitors, guests, and contractors in accordance with 29 CFR 1910.33–39, the tenant EAP applies to all visitors, guests, and contractors.

12–17. Compliance audits

a. Organizations must ensure that compliance audits conducted on their respective installations are compliant with the provisions in 29 CFR 1910.119, this chapter, and the local PSMP. Organizations must ensure:

(1) Army safety compliance audits are being performed at intervals not to exceed 36 months.

(2) High-hazard areas are properly evaluated by the installation safety manager and other organizational directors as appropriate to determine if audit cycles require an increased frequency due to the level of evaluated risk.

b. The compliance audit must be conducted by at least one person knowledgeable in the process.

c. A report of the findings from the audit must be developed and presented to the appropriate Commander/director.

d. Commander/directors must promptly determine the appropriate response to each finding, ensure deficiencies have been corrected, and ensure that responses and deficiencies are documented. If deficiencies cannot be immediately corrected, refer to DA Pam 385–10 chapter 8 for appropriate guidance.

e. Activities must retain the two most recent compliance audit reports.

12–18. Trade secrets and proprietary information

a. Access to classified and sensitive information must be consistent with the interests of national security and in accordance with AR 380–67. The DoD and Department of the Army Personnel Security Program requirements take precedence over all other departmental issuances affecting these programs.

b. Organizations must make all information necessary to comply with the section available to those persons responsible for compiling the PSI, those assisting in the development of the PHA or risk assessment, those responsible for developing the operating procedures, and those involved in incident investigations, emergency planning, and response and compliance audits in accordance with Army Security Program requirements.

c. Nothing in this paragraph must preclude the Organizations from requiring the persons to whom the information is made available from entering into a confidentiality agreement acknowledging non-disclosure of the information as set forth in 29 CFR 1910.1200.

Chapter 13
Maintenance of Ammunition and Explosives

13–1. General information

a. Maintenance is maintaining AE in a serviceable condition or restoring them to that condition. It includes such operations as renovation, modification, and P&P.

b. Maintenance includes all operations from the time of delivery of the ammunition to the maintenance building to the time it is ready for shipment to storage or issue. Maintenance operations involve the following: line layout, establishing barricades as appropriate, setting up equipment, partial, or complete disassembly of ammunition items, cleaning parts or subassemblies, repair, or replacement of mechanical parts, replacement of explosive components, reassembly, repainting, and remarking, and the repacking and remarking for shipment and delivery to an ammunition issuing point.

c. Renovation or modification of AE will be accomplished only with specific approval from Joint Munitions Command, Aviation, and Missile Command, or other authority as appropriate. This does not include inerting (see para 11–3).

d. The necessary P&P may be performed on unserviceable ammunition and components when a requirement exists.

13–2. Safety requirements

a. Written procedures will be developed and used for each AE operation. The HA will be developed by identifying initial risks related to the process or operation to include defining mitigating actions emplaced to reduce the risk to an acceptable residual level. SOPs will be developed in accordance with AR 385–10 for all AE operations to ensure workers have the information necessary to perform their assigned tasks safely and efficiently. SOP development for all AMC AE production operations must be in accordance with DA Pam 700–107. SOPs for AE and related operations will identify potentially hazardous conditions and controlling or mitigating measures. All Army AE production operations must comply with requirements outlined within 29 CFR 1910.109 where applicable. Where a conflict of compliance information exists, the stricter the directives must be complied with.

(1) Controlled tests may be necessary to establish HA/SOPs for certain operations. The HA/SOPs will include, as a minimum, such items as safety requirements, personnel, and explosives limits, equipment

designation, location, and sequence of operations. PSM criteria found in chapter 12 will be analyzed and applied to all AE processes as applicable.

(2) A HAWG will be formed with the minimum organizations present:

(a) Safety.

(b) Fire.

(c) Industrial Hygiene.

(d) QASAS.

(e) HA/SOP writers.

(f) Engineers as appropriate.

(g) Maintenance personnel as appropriate.

(3) The HAWG will evaluate the process utilizing inert components to ensure the HA/SOP includes all necessary tools, equipment, and procedures that are adequate to safely and efficiently perform the operation.

b. Operations must be conducted to expose the minimum number of people for the minimum period of time to the minimum amount of explosives required to perform safe and efficient operations.

(1) Personnel and explosives limits must be clearly posted in operating bays and readily available for all AE operations. Personnel and explosives limits will not be exceeded without a coordinated and approved DA Form 7632, DARAD, by the appropriate risk approval authority. The completed DARAD for the temporary deviation will be kept on file and readily available at the safety office.

(2) Where concurrent operations must be performed in a single building, the layout will be planned to protect personnel from blast overpressure and provide for the separation of dissimilar explosives risks by using SDWs, barricades, or other means to provide the maximum protection allowed to personnel.

(3) Nonessential personnel will be prohibited from visiting the site of operations. This restriction does not prohibit official visits by safety, QC, management, inspection, or other personnel authorized by the commander/director.

(4) Tasks not necessary to the AE operation will be conducted at an appropriate safe separation distance. Each worker will be responsible for ensuring explosives limits for the work area are not exceeded. Limits will be expressed in total NEW and by the number of munitions, trays, boxes, pallets, or other units that are easily determined and controlled.

(5) Explosives limits will be based on the operation's minimum quantity of AE required.

(a) Explosive Limits will not exceed the quantity of AE required during half a work shift consistent with authorized QD separation criteria. When mission necessity requires, the commander/director may approve positioning of a greater quantity of AE through an approved DA Form 7632, DARAD, in accordance with ACOM, ASCC, or DRU policy.

(b) The maximum amount of AE of each HD allowed will be clearly posted in each room, cubicle, or building used for storage of AE. The explosives limits for each operation will be clearly posted for operating locations. Material limits need not be posted.

(6) Organizations or individuals (such as utility or farm workers) not associated with explosives operations and their equipment may, when necessary, operate within an explosives area without applying ESQD from a PES provided:

(a) The Army and the organization or individual have a signed contract, lease, agreement, or MOU specifying specific work to be performed within the ESQD arc of a PES.

(b) The Army and the organization or individual must have documented, assessed, and accepted, in writing, the potential risk associated with the operations being undertaken by both the Army and the organization or individual. Documentation will clearly define the period of time and conditions under which access will be allowed and under what conditions such access may be temporarily or permanently denied.

(c) The Army assesses the potential risks associated with access to the ES when any element (such as operations performed, materials involved, hours of operation, nature of the activities conducted) of the PES or ES changes to determine whether continued access is appropriate.

(d) Equipment may be stored within the ESQD arc of a PES for an unlimited period of time, provided it does not increase the risk of a fire or explosion. The organization storing non-Army equipment at Army locations must acknowledge in writing acceptance for potential loss or damage to their equipment should a fire or explosion occur.

c. Deviation from regulatory guidance or local procedure is not authorized unless the respective commander/director approves the deviation in accordance with paragraph 1–11.

d. Renovation will be performed in an isolated area or building specifically designed and approved for that purpose. These operations will be carried out in accordance with the QD requirements of chapter 8.

e. Internal movement of explosives will be in accordance with the following:

(1) Items or groups of items of AE that are transported from bay to bay within an operating building will be separated to preclude creating a potential for the propagation of an explosion or fire between bays. For this purpose, the minimum spacing between items or groups of items will be ILD, K9 through K18, as applicable. Suitable shields or barricades may be used to interrupt the propagation path between objects on a conveyor when approved. Appendix C shows the approved safe separation distances of conveyor spacing for specified items based on the configuration of the item, position on the conveyor, the distance between items, and, if needed, the shield or barricade.

(2) The use of less than ILD (with or without barricades or other substitutes for distance) will require testing and engineering analysis to prove that shorter distances are safe.

f. Concurrent operations will be evaluated and performed in accordance with paragraph 8–22.

g. Operations within a magazine area will comply with the following:

(1) AE must not be renovated, modified, or demilitarized within a magazine. These operations will not be performed within the magazine area unless the site, empty magazines, buildings, or rail cars in which the work is done are assigned exclusively to such work. Temporary operations outside of the magazine may be carried out as outlined in paragraph 13–2g(2). Permanent structures involving labor-intensive operations must be properly sited with a DDESB-approved site plan.

(2) The performance of P&P operations in the magazine area may be approved by the SC as field operations and separated from the PES by ILD based on the larger quantity of NEW at either the PES or ES. Such operations will be limited to removing rust, painting bombs and separate loading projectiles, opening, and repacking boxes and metal containers of AE (including chemical munitions), repacking ammunition into serviceable boxes and fiber containers, spot painting projectiles, maintenance of fuze cavities and base covers of separate loading projectiles, and other relatively safe operations of the same general type.

h. The division of large quantities of explosives material into a number of smaller quantities using SDWs, is intended to prevent the simultaneous detonation of the total quantity involved. If the explosives on both sides of an SDW are prevented from simultaneous detonation, the wall has achieved its purpose. If this requirement is met, then, for the purpose of ESQD computations, the quantities separated by SDWs need not be added together. The design of intervening barriers in accordance with the principles contained in UFC 3–340–02 will satisfy this requirement. Information on barricaded open storage modules meeting this criterion is provided in *paragraph 8–3d*.

13–3. Operational shields

a. Operational shields are required when the operation to be performed provides an unacceptable risk of exposure as defined in *paragraph 13–3b* below.

(1) When required, personnel protection must limit incident blast overpressure to 2.3 psi [15.9 kilopascals (kPa)], fragments to energies of less than 58 ft.-lbs [79 joules], and thermal fluxes to prevent the onset of second-degree burns (heat fluxes and exposure times experienced by personnel should be less than that given by the equation t=200q-1.46 where “t” is the time in seconds that a person is exposed and “q” is the received heat flux in kilowatts (kW) per m^2).

(2) Shields complying with MIL–STD–398 are acceptable protection. Shields that have not been tested in accordance with the requirements of MIL–STD–398 must be evaluated by U.S. Army Engineering and Support Center, Huntsville, Alabama, before authorized usage in AE operations.

(3) Determination of the MCE for the materials and operational scenario involved is an essential part of the evaluation of the operator protection requirements.

(4) K24 [Km9.52] distance only provides the required level of protection for blast and thermal effects.

b. In addition to those operations where a risk assessment in accordance with DA Pam 385–10 shows an unacceptable level of risk, operational shields will be provided to separate the operator from the item being processed for the following operations:

(1) Disassembly of loaded boosters, fuzes, primers, and blank ammunition.

(2) Removal of base plugs from loaded projectiles where the design of the projectile is such that explosive contamination of the base plug is not positively precluded.

(3) Removal of fuzes from pentolite-loaded projectiles.

(4) Disassembly of loaded bombs and warheads, except for removing shipping bands, nose, and tail closing plugs, fin locknuts, and washout of HEs bursting charge, unless covered by an approved letter of instruction / Depot Maintenance Work Requirement.

(5) Removal of fuzes from hand grenades loaded with HEs except as noted in paragraph 13–3c(6).

(6) Pull-apart of fixed ammunition, 20 mm and larger. In the pull-apart of rounds containing self-destroying tracer, the shield design will use initiation of the propellant and the projectile as the MCE. Pull-apart of ammunition with inert projectiles will use initiation of the propellant as the MCE. Pull-apart of ammunition with explosives-loaded projectile, but without self-destroying tracer, will use initiation of the propellant as the MCE.

(7) Disassembly of foreign ammunition or other ammunition of uncertain design and condition.

(8) Electrical testing of igniter circuitry of rockets, missiles, or any other electrically initiated explosives item. Electrical testing of igniter circuitry in missile and rocket motors and other propulsion systems must use initiation of the propellant as the MCE. Electrical testing of initiating components of warheads, projectiles, and similar items must use initiation of the warhead or projectile and propellant as the MCE unless hazards analysis shows the negligible probability that test-energized circuitry could cause explosives to function.

c. The operations (1) through (6) (below) and similar operations do not require operational shields to protect operators if the assembly has been normal and if regular equipment, tools, and methods used in the assembly are sufficient to accomplish the disassembly without the application of undue force. Undue force is considered to be any force greater than the maximum allowable disassembly torque specified on the current drawings for the item under consideration. Tools used for disassembly will not have a greater lever advantage than those required for the assembly. In these cases, care will be taken to ascertain that the assembly has been normal and the surfaces to be separated are not corroded and have not been sealed with metallic caulking, laminac, or epoxy resin whose strength exceeds the adhesive properties of Pettman Cement.

(1) Removal of loaded fuzes and fuze well cups from loaded projectiles.

(2) Removal of primers from mortar ammunition.

(3) Removal of ignition cartridges from mortar ammunition.

(4) Removal of boosters or bursters from loaded projectiles.

(5) Removal of setscrew from loaded projectiles. When drilling equipment is used to remove stake-punch marks and back out setscrews, positive stops on the drill must be provided to prevent the contact of the drill with the component parts of the fuze or booster which contain explosives or with the explosives in the projectile. Drills will be changed, and positive stop set only by competent mechanics. Only fully trained personnel will be used for such operations. Before the operation is begun, the projectile must be examined for the presence of exudates or other abnormal conditions.

(6) Removal of detonating fuzes from hand grenades designed with metal fuze well liners provided:

(a) The operation is performed immediately in front of a suitable protective tank having effective baffles for delay type fuzes into which the grenade can be deposited should it ignite prematurely. Baffle-type tanks will not be used for grenades having impact fuzes.

(b) Shielded trays are employed to receive fuzes removed from the grenades. The maximum fuzes allowed at each disassembly station must not exceed 50.

(c) Fuzes that will not readily disassemble from the grenade with the equipment adjusted to the appropriate torque are immediately removed from the holding fixture and transferred to adequately shielded locations where they may be removed in accordance with the requirements contained in *paragraph 13–3b*. Fuzes in this category will be inspected for any defects which would render the item unsafe for handling or further processing.

d. Disassembly operations will be in accordance with the following:

(1) Each disassembly operation will be separated from adjacent operations by operational shields designed to protect the operator at any operation from the blast and fragments arising from a possible explosion at any adjacent operation. Components will be protected from a possible explosion occurring at the disassembly operation.

(2) When disassembly of ammunition or components not generally included in paragraph 13–3 is contemplated, specific approval of the proposed methods and locations for the operations must be obtained in accordance with the procedures outlined in paragraph 11–2.

(3) When disassembly is required to be performed with the operator protected by any operational shield [disassembly means complete separation (threads or other connections) of component parts], the

operator must not loosen the components while shielded and then complete the disassembly without protection.

e. Explosives destined for the burning ground will be in the original closed packages or in containers of fire-retardant materials, which will not contribute to the existing hazard by readily producing sparks when contacting rocks, steel, or other containers. Bags or containers made from easily ignited material will not be used. Containers will have closures that will prevent spilling or leakage of contents when handled or if overturned. Closures will be of a type that will not pinch or rub explosives during closing and opening. The closures and surfaces of container openings will be thoroughly cleaned of explosive contamination to minimize the hazard during closing or opening.

13–4. Equipment for shielded operations

a. As used in this paragraph, the word "suitable" refers to a certified or tested item. Normally, the equipment required for shielded operations consists of a suitable shield, holding devices, operating devices, means of observing the operation, and means of safely transmitting power required for the operation. These special tools must be listed in the HA/SOP.

b. A suitable holding device located behind the operational shield may consist of some form of a vise or jig on either a fixed or an adjustable base, placed in such a manner as to hold the item in a position to apply the operating device.

c. A suitable operating device may be a wrench, screwdriver, or other tool designed to accomplish the work to be performed.

d. A suitable means for observation may be an indirect viewing system of mirrors or a television camera located so that personnel may operate at a safe distance. (A safe distance provides 2.3 psi protection to the operator.)

e. A suitable means of transmitting power to the operating device normally consists of a shaft extending through the shield. The shaft will have a positive stop in front of the shield to prevent the shaft from being blown through the shield toward the operator in the event of an explosion. Personnel will not be in a direct line with a shaft.

13–5. Tools, equipment, and supplies

a. The basic tools and equipment for ammunition renovation and field maintenance can be found in the appropriate supply catalog. Specific tools for AE operations are listed in the applicable TM. The supervisor and engineering staff must ensure that maintenance materials, spare parts, and equipment are suitable for the process application for which they will be used. Before purchasing any tools or parts for AE-related processes, follow the guidance within AR 385–10, chapter 19, and guidance for new equipment purchases in DA Pam 385–10.

b. Equipment that is designed specifically for ammunition is listed in TM 43–0001–47 and described in the operational and parts manual for each piece of equipment.

c. Other tools and equipment that have to be specially designed will meet strength requirements and guard against the introduction of chemical, mechanical, or electrical hazards over and above the normal hazard of the AE involved. Special tools and equipment designed and fabricated locally will require prior approval by the appropriate commodity command before use.

13–6. Protection of primers

Preventative measures must be taken in the design of equipment, transportation, and operations to protect not only loose primers but also primers in rounds or components from accidental impact or pressure. Where feasible, a protecting cap will be placed over the primer. Bodies of hand trucks and other conveyances used for transporting the primed items must be free from stones, protruding nails, and other projections and debris that might cause the primer to function. When primed items are transported on their bases, the containers or truck bed will be recessed at the point primers would otherwise make contact.

13–7. Cleaning ammunition

Power tools with nonferrous brushes may be used on ammunition or ammunition components only when there are no exposed explosives or thin-walled casings where brushing would create heat or friction sufficient to initiate the item involved.

13–8. Spray painting

a. All spray painting operations involving flammable and combustible liquids will comply with 29 CFR 1910.107, NFPA 33, NFPA 70, and NFPA 77.

b. Water wash or dry filter-type spray booths will be used exclusively for loaded ammunition and inert items. Filters for dry-type booths must not support combustion when clean and must be capable of effectively arresting paint overspray. They must be replaced whenever the type of paint being sprayed is changed and as directed to maintain required airflow measures. Paint-encrusted filters will be disposed of promptly when found.

c. Electrical equipment, devices, apparatus, and wiring must be designed and installed in accordance with the proper zone specifications provided in NFPA 70 Article 516.

d. Automatic sprinkler protection that complies with NFPA 13 and 29 CFR 1910.159 will be designed and installed as follows:

(1) Above each paint booth and 20 feet horizontally beyond the perimeter of the paint booth.

(2) Installed in exhaust ducts, 6 feet or more in length. If the ducts pass through combustible walls, ceilings, or roof structures, the sprinkler heads inside the ducts will be no more than 12 feet apart.

(3) For dry-type paint booths, automatic sprinklers will be installed behind the filters.

e. Controls for paint spray booth ventilating fan motors will be interlocked with the controls for the paint sprayer. With this arrangement, the failure of the ventilating system will shut off power to the paint sprayer.

f. For additional paint booth and flammable storage requirements, see NFPA 33 and 29 CFR 1910.94.

g. Where it is necessary to set up field operations and the requirements of *paragraph 13–8a* cannot be met, a DA Form 7632, DARAD, will be initiated identifying the limiting and proposed mitigating factors, then coordinated and approved by the appropriate risk assumption authority. Upon approval of the DARAD, spray painting of sizable quantities of loaded ammunition or inert items is permissible if:

(1) Paint booths are constructed of noncombustible material.

(2) An exhaust system with a fan is installed to remove paint fumes from the booth (a pneumatic motor must power the fan).

(3) A minimum of two portable suppression systems must be installed within the booth with rate-of-rise actuated nozzle attachments. The local civil engineering and fire department technical services must determine the system specifications based on current NFPA requirements. Two manual-type portable fire extinguishers must also be provided at the paint spray booth or operation. The type and size must be determined by the fire department technical services based on current NFPA requirements.

(4) Special precautions must be taken to keep the booth clean and prevent the accumulation of paint on the surface of the booth or fire extinguisher nozzles.

(a) Combustible coverings (thin paper, plastic sheeting, or coating) may be used for ease of cleanup inside of the booth as long as the material is static dissipative.

(b) All spraying areas must be kept free from the accumulation of deposits of combustible residues as practical, with cleaning conducted daily. Scrapers, spuds, or other tools used for cleaning must be of nonsparking material.

(c) Unless specifically approved for locations containing both deposits of readily ignitable residue and explosive vapors, there must be no electrical equipment in any spraying area where deposits of combustible residues may readily accumulate, except wiring in rigid conduit or boxes or fittings containing no taps, splices, or terminal connections.

1. The number of items in the booth at any one time is restricted to the minimum number required for efficient and continuous operation.

2. The area within 50 feet of the paint booth is kept free of combustible material, such as dry vegetation, wooden pallets, combustible crating, or packing materials.

3. Paint and chemical mixing operations, supplies, and air compressors are located at least 50 feet from the booth.

4. Personnel limits are maintained at the minimum, consistent with efficient, safe operation.

h. If the quantity of loaded ammunition or inert items to be spray painted in an outside location does not warrant providing a paint booth, the operation may be performed in the open provided:

(1) The area within 50 feet of the spray paint operation is kept clean and free from combustible materials, air compressors, and paint mixing operations.

(2) At least two class 10BC (or larger) portable fire extinguishers are provided at the spray painting operation.

(3) Personnel are protected from toxic materials by respirators, approved for the amount and type of exposure involved.

(4) Personnel limits are maintained at the minimum required for efficient and safe operation.

13–9. Electrostatic paint spraying and detearing of inert items in nonhazardous locations

a. Electrostatic paint spraying and detearing operations must comply with 29 CFR 1910.107, NFPA 33, NFPA 70, and NFPA 77.

b. Loaded ammunition items will not be electrostatically spray painted or deteared.

13–10. Infrared drying process

a. Infrared (IR) drying uses IR radiation (heat) to perform the drying process. You may not see it, but you can feel it. IR radiation is EMR in the range between visible light and microwaves and is perceptible in the form of heat. Sit by the fireplace, and the warmth you feel is IR radiation. As with most hazards, though, small doses don't pose a real threat. However, IR radiation exposure in the workplace is typically much more intense and presents a risk for high-level exposures in daily work-related tasks. Therefore, a thorough HA must be performed and appropriate precautions observed within the SOPs by all operators.

b. IR drying processes will not be used in the same room in which exposed explosives are present. Special precautions will be taken to ensure that all items from which explosives have been removed by processes such as "steam out" are free of explosives contamination before subjecting them to this process.

c. If sealed items containing explosives are to be subjected to IR drying processes, prior tests to determine maximum internal temperatures to which such rays will raise explosives will be conducted on duplicate sealed containers with an inert filler having thermal conductivity and specific heat similar to that of the explosives. Conveyer speed, time of exposure, and intensity of exposure to IR rays will be adjusted so that the maximum internal temperatures to which explosives are subjected do not exceed 170 degrees F. (76.7 degrees C.) during the entire period of exposure.

d. Before freshly dipped or painted items (inert or explosive-loaded) are processed in IR drying equipment, they will pass through a pre-dryer.

(1) This pre-dryer will be provided with positive mechanical ventilation, constructed of noncombustible materials, and will be provided with automatic sprinkler protection.

(2) The air exhausted from the pre-dryer will be discharged to the outside at a point where the possibility of reentry into the building is at a minimum. The pre-dryer need not be heated. The time the article must remain therein will be determined by an actual test when using the normal paint mixture.

(3) Freshly dipped or painted articles will be pre-dried until at least 85 percent of the volatile flammable vapors are removed. (In most instances, less than 2 minutes are required when air velocity past the article in the pre-dryer is 300 feet per minute (fpm), and the circulated air temperature is 70 degrees F.)

e. Within 20 feet of the pre-dryer, paint spray booth, or dip tank, the electrical equipment will be installed in accordance with NFPA 33.

f. Interlock the drying equipment with the exhaust fan so that the drying equipment cannot function unless the fan and conveyor are operating.

g. IR drying equipment will be installed in a large room at least six times as large in an unobstructed area as the area of the IR drying equipment.

h. Adequate ventilation, preferably exhaust ventilation of the pre-dryer, will be provided for the room to keep vapor air mixtures at least 25 percent below the lower explosives limit and below the health hazard threshold limit values. Periodic tests in the vicinity of the IR drying equipment will be made with a flammable vapor indicator to ensure low vapor concentrations.

i. The construction of IR drying equipment will be such that paint dripping from articles will not strike the lamps, reflectors, or wiring.

j. The construction and position of the IR drying and conveyor equipment will be such that contact between articles and bulbs is impossible.

k. Provisions will be made so that items being processed cannot drop off the hooks and lodge in the dryer unnoticed. If the drying equipment is constructed so that falling articles will not pass completely through it, arrangements will be made to automatically stop the conveyor and extinguish the lights concurrently using suitable protective devices.

l. The IR drying equipment will be screened, or the source of IR radiation-shielded to protect workers from prolonged or close exposure to radiation. If screening or shielding is not adequate to protect

employees' eyes while working in the vicinity of the drying equipment, safety goggles with Nos. 1–1/2 to 3 shade lenses will be worn by those exposed.

13–11. Drying freshly painted loaded ammunition

a. Ovens in which freshly painted loaded ammunition is dried must comply with 29 CFR 1910.107, NFPA 33, NFPA 70, and NFPA 77.

b. In addition, the following requirements will be met:

(1) Automatic thermostatic controls will be arranged to stop the application of heat upon reaching a predetermined maximum temperature which will not exceed 170 degrees F. (76.7 degrees C.).

(2) The oven will be equipped with an automatic sprinkler system installed in conformity with the requirements of NFPA 13. Electrical heat-actuated devices may accomplish the automatic operation of the system provided they are approved for and are installed in accordance with the requirements of Class I, Division 1, Group D hazardous location as defined in the NFPA 70.

(3) Heating may be by hot air or other means as long as AE do not come in contact with coils, radiators, or heating elements.

(4) If a conveyor system is employed, a provision will be made to shut off the heat supply automatically in the event of power failure to the conveyor.

(5) Electric drying units that are not approved for use in Class I hazardous locations, as defined in NFPA 70.

(6) Electric drying units will be designed to keep the atmosphere in the oven below 25 percent of the lower explosives limit of the mixture of solvent vapors and air.

13–12. Heat sealing equipment

a. Heat sealing is the process of sealing one thermoplastic to another similar thermoplastic using heat and pressure.

b. All Electric heat sealing equipment used by the Army will meet the following minimum requirements of Underwriters Laboratories (UL) 963, Standard for Safety Sealing, Wrapping, and Marking Equipment.

c. Electric heat sealing machines, used for sealing packages of uncased or exposed explosives, will be separated from all other operations by an operational shield large enough to limit the effects of an incident progressing through the rest of the facility.

d. Exception: This does not apply for sealing outer packages of cased or unexposed AE.

e. Temperature limits for heat sealing equipment will be established with a safety factor below the ignition temperature of the explosives, propellants, or pyrotechnics involved.

f. Sealing equipment will be limited to one machine per operating room, bay, or cubicle.

13–13. Soldering containers

a. When using soldering irons, recommend obtaining commercially available irons made of grounded anti-static plastic housings and equipped with devices capable of limiting short circuit current.

b. Containers to be soldered will be free from explosives, explosive dust, and flammable vapors. This does not prohibit soldering covers to metal liners containing completely closed ammunition.

13–14. Thread cleaning

a. When thread cleaning is necessary, it will be accomplished by the judicious use of nonferrous "picks."

(1) Non-sparking brushes may be used to clean threads of explosive-loaded projectiles providing a fuze seat liner separates the thread cleaning operation from the explosive charge. Operational shields are not required.

(2) Power-actuated "thread-chasing" tools may be used to clean loaded projectiles when threads are imperfect because of previously applied Pettman cement or other sealers, provided the operation is performed within a separate cubicle and by remote control.

(3) Hand-operated "thread-chasing" tools may be used, provided no explosives are present in the threads.

b. Thread cutting or correcting crossed threads will not be performed on projectiles containing explosives. Straightening of crossed threads is considered thread cutting.

13–15. Inert scrap components and packaging materials

a. All scrap components and packaging materials derived from ammunition and hazardous chemical renovation, P&P, modification, and demilitarization operations will be inspected by the activity generating the scrap to detect contamination. All packaging materials will be opened to ensure that no hazardous chemicals or ammunition items are present. Qualified personnel will certify such material to be inert and free of hazardous chemicals and explosives prior to reuse or transfer to the DLA or to an inert storage area.

b. For those items transferred to DLA, the qualified person(s) conducting the material inspection will submit a certificate of inertness as part of the turn-in document in accordance with the provision of DoDM 4160.21. Even though properly inspected and certified inert, materials generated from ammunition or other hazardous items will not be stored with other types of material, including scrap. The separation of inert projectiles, dummy ammunition rounds, and other types of material will be maintained. Refer to DoDI 4140.62 for guidance concerning Material Potentially Presenting an Explosive Hazard (MPPEH).

13–16. Sand or shot blasting operations

a. Because of possible hazards (resulting from hidden explosives, thin, or eroded cases, and certain characteristics of explosive filler), sandblasting or shot blasting is prohibited for items such as thin cased land mines, shoulder-fired rocket ammunition, fixed rounds of artillery ammunition, and cartridge cases containing propellant. Blast cleaning of solid propellant rocket motors may be accomplished only if the item manager approves in advance.

b. Explosive-filled or chemical-filled ammunition items assembled with tracers, fuzes, or other explosive-loaded components, which are not or cannot be adequately protected from direct contact with the abrasive, will have such components removed prior to blast cleaning. Where explosive-filled and chemical-filled items containing explosives-loaded components such as fuzes are or can be protected in a manner to permit blast cleaning, satisfactory safeguards must be installed to prevent rotational velocities and accelerations that will harm or otherwise affect the component parts.

c. In instances where items of ammunition are contained within a structurally suitable outer container, the container, if necessary, may be cleaned by sandblasting or shot blasting.

d. Each explosive or chemical-filled item must be carefully inspected for the presence of exuding explosives, chemical, and/or inert seal material prior to sand or shot blasting. If exudation can be properly removed with the application of approved solvents, such as acetone, the unit may then be returned for sandblasting or shot blast cleaning. Solvents must only be used in well-ventilated areas.

e. All metal processing equipment used at the sand or shot blasting operations will be electrically grounded and tested.

f. All operators directly engaged in sand or shot blasting operations will wear PPE. (When performing an HA and developing your SOP, confirm with the installation safety office and Industrial Hygienist that operations have been evaluated to determine whether workers are adequately protected).

g. The number of loaded items being sand or shot blasted at one time will be maintained at a level consistent with safe and efficient operations.

h. The sand or shot blasting equipment location will be separated from the remainder of the operations and personnel by an adequate barrier, dividing wall, or appropriate ESQD in a manner to limit the results of an explosion during the process effectively.

i. Steel wool will not be used for cleaning where possible contact with exposed explosives exists; nonferrous wool will be substituted in these instances.

j. Operations involving the processing of related inert components will not be performed in close proximity to the sand or shot blasting operations involving explosives-filled items. These operations will be accomplished at a location where safety from an explosion can be reasonably assured. Wherever practical, the independent processing of inert components such as cleaning metal grommets and the like will be accomplished at no less than the appropriate ILD separation from the explosive hazard.

13–17. Location of sand or shot blasting operations in explosives storage areas

a. IBD will be maintained from an ECM or open storage site to the point of operation when the point of operation is other than a permanent or semi-permanent structure.

(1) Permanent or semi-permanent structures for such operations will be located at a minimum of IBD from explosives storage locations, based on the larger quantity of explosives involved.

(2) Operations located at less than 100 feet from an ECM or open storage site containing AE are prohibited, regardless of circumstances.

(3) Where loading docks or other outdoor areas are used for sand and shot blast cleaning activity, unrelated concurrent operations will not be conducted in magazines or outdoor storage sites located closer than ILD.

b. A temporary earth barricade or other suitable protective barriers will be erected around sand or shot blasting operations conducted in the open within an ammunition storage area to protect adjacent personnel and the source of supply of explosive-filled items.

c. Air compressors and motor generator sets used at the operation are not to be located closer than 50 feet from the operational site and the nearest ECM or outdoor storage site. If they are gasoline-powered and are to be used for a period long enough to require refueling, they will be located 100 feet away or midway between ECMs that are separated by 185 feet. Care must be exercised in the selection of the location to preclude exposure of the entrance to the operation or to the ECM.

d. When it is necessary to use loading docks as operating sites for sand or shot blast cleaning operations, the docks will not be used for normal shipping and receiving activities.

13–18. Sand or shot blasting operations within a building in an operating line

When sand and shot blasting operations are performed within a facility that is an integral part of an operating line, the following safety measures are required in addition to the precautions listed in paragraphs 13–16 and 13–17:

a. The actual sand or shot blasting operation must be separated from all other operations in the building by walls or barriers that are designed to protect personnel if an incident occurs at that location.

(1) Openings in the walls or barriers will be limited to the minimum sizes required to facilitate handling items to and from the operation. These openings will be arranged in a manner to effectively control fragments and prevent propagation into adjoining cells or rooms.

(2) Openings to allow entry and exit of MHE will not be permitted within the protective walls or barriers unless specially designed to provide resistance to potential explosions equivalent to that provided by the wall. A personnel door may be provided into the cell or room if required.

(3) In existing buildings where 12-inch reinforced concrete dividing walls provide protection, the wall must extend to the exterior walls of the building. Under no circumstances will the height of the concrete dividing wall be lower than the lower rafters of the roof truss. Any opening between the top of the concrete wall and the underside of the roof will be closed on both faces with rigid fire-resistant material securely fastened to the wall and the underside of the roof.

b. Equipment for sand or shot blasting operations will be of the type not requiring operators in the immediate vicinity of the machine to control it. It will be automatically controlled and provided with interlocking switches that will stop the machine if any of its parts fail. Manually controlled stop switches will be provided at proper intervals to permit prompt stopping of the equipment in the event of an accident. When manually operated abrasive equipment is used, “dead-man” controls will be provided on the blast nozzle.

13–19. Electrical testing of ammunition and ammunition components

a. Electrical (including electronics) test equipment will use the weakest possible voltage source. Battery-powered equipment will be used in lieu of that with an alternating current power source. The power source will not be capable of initiating the explosive item under test. Where greater voltages must be used, positive means must be provided to prevent voltage delivery to the explosive item at a sufficient level to initiate the item. The possibility of an error on the part of operators and other personnel must be recognized and thoroughly documented in the HA and safeguards incorporated into the SOP.

b. Test equipment will not be placed in hazardous atmospheres unless absolutely necessary. When the test equipment or parts thereof must be placed in hazardous atmospheres, its suitability must be attested by receipt of a certificate of conformance by a Nationally Recognized Testing Laboratory such as UL (refer to 29 CFR 1910.7 for further guidance on Nationally Recognized Testing Laboratories).

c. If specific equipment items have no record of certification by a Nationally Recognized Testing Lab, then a DA Form 7632, DARAD will be developed to include supporting documentation from appropriate engineering staff, safety, fire, and industrial hygiene with recommendations for approval/disapproval presented to the responsible commander/director.

(1) Unless the test equipment is incapable of initiating the item being tested, operational shields are required to protect personnel (refer to paras 13–3 and 13–4 for further guidance).

(2) The most reliable means for attaining and retaining this initiation incapability is to protect the test equipment, including leads, from electromagnetic (induction and radiation fields) and electrostatic energy and to provide the test equipment with a weak power source.

(3) Where reliance is placed on resistors and other devices for limiting power delivered to the item being tested, operational shields will be provided.

d. Test equipment will be used only in the manner and for the purpose for which approval was granted. The equipment will be maintained in good working order by qualified personnel. Operator adjustments must be limited to those required by the design of the equipment. Before each day of use, test equipment will be validated to ensure it is within calibration.

e. The Army equipment data sheets, APE, TM 43–0001–47, may be used as a guide in selecting equipment for specific operations.

f. All test equipment will be turned into their respective Calibrated Test Measurement Diagnostic Equipment (TMDE) shop in accordance with AR 750–43.

13–20. Profile and alignment gaging operations

a. Each profile and alignment gaging operation, excluding SAA, will be so enclosed that adjacent operations are protected by operational shields complying with the requirements of paragraph 13–3. A documented HA and risk assessment are mandatory for all AE operations to validate the layout of operations, selection of materials and equipment, and process control parameters. The process layout of the equipment and operational procedures will be developed to minimize personnel injury and property damage in the event of an incident.

b. During chamber gaging of major caliber fixed ammunition, the gage will be pointed toward a dividing wall or other barriers, and the round inserted into the gage and removed by the same operator. In no case will the round be left in the gage. Rounds of mortar ammunition will be gauged prior to attaching propellant increments and, unless prohibited by design characteristics, prior to assembly of ignition cartridge.

13–21. Collection of explosives dusts

a. Dust collecting systems may be used to aid cleaning, lessen explosion risks, and minimize occupational diseases and dermatitis. Such operations and the specifics of the collection method used will be considered during the HA and mandated in the SOP.

b. Examples of HEs dusts which may be removed by a vacuum system are TNT, Tetryl, Explosive D, Composition B, pentolite, OSX–CAN Type II (IMX–101), and OSX–7 (IMX–104). A wet collector that moistens the dust close to the origin and keeps it wet until the dust is removed for disposal is preferred, except for Explosive D, which will only be collected in a dry system.

c. More sensitive explosives such as black powder, lead azide, mercury fulminate, tracer, igniter, incendiary compositions, and PTs may be collected by vacuum, provided they are maintained wet with the wetting agent, close to the point of intake.

(1) The vacuum (aspirator) systems must be so arranged that the various types of explosives are collected separately or in a manner to avoid a mixture of dissimilar risks; for example, black powder with lead azide.

(2) Provision will be made for the proper liberation of gases that may be formed.

(3) The use of vacuum systems for collecting these more sensitive materials will be confined to operations involving small quantities of explosives, for example, in operations involving fuzes, detonators, SAA, and black powder igniters.

(4) Potential fire and explosion hazards can be minimized by collecting scrap pyrotechnic, tracer, flare, and similar mixtures in number 10 mineral oil.

(a) Satisfactory techniques include placing the oil in catch pans and scrap transporting containers at the various operations throughout the plant and having individual oil containers serve as collection points for multiple operations. In the latter case, nominal (that is, small quantities of dry scrap not to exceed the number of explosives in a single item) quantities of dry scrap may accumulate at operating locations before they are delivered to collection points and placed in containers of oil.

(b) The oil level will be kept at least 1 inch above the level of any pyrotechnic mixture in the containers. Where oil is used, fire-fighting equipment satisfactory for class B fires will be available. Carbon dioxide or foam extinguishers are recommended.

(5) Containers in which collected scrap explosives and PTs will be removed from the operating buildings for destruction at least once per shift.

13–22. Location of collection chambers

a. Wherever practical, dry-type explosives dust collection chambers, except portable units as specifically provided for in paragraph 13–23, will be located outside operating buildings, in the open, or in buildings exclusively set aside for the purpose. To protect operating personnel from an incident involving the collection chamber:

(1) A protective barrier must be provided between the operating building and the outside location or a separate building where the collection chamber is placed.

(2) If the collection chamber contains 25 pounds of explosives or less, the protective barrier may be a 12-inch reinforced concrete wall located a minimum of 8 feet away from the operating building.

(3) The collection chamber must be separated from cubicle walls by at least 3 feet.

(4) If the collection chamber contains more than 25 pounds of explosives and is separated from the operating building by a 12-inch reinforced concrete wall, the wall must be separated from the operating building by a minimum of IL (U) distance.

(5) If the protective barrier meets the requirements of paragraph 13–3 for operational shields (including the required 3-foot distance between the barrier and explosives), for the quantity of explosives in the collection chamber, or if they comply with the requirements for barricades, the cubicle may be placed at a minimum of IL (B) distance from the operating building. Barricaded and unbarricaded ILD will be based on the quantity of explosives in the collection chamber.

b. When it is not practical to locate dry-type collection chambers outside the operating building, a separate room within the building may be set aside for the purpose. This room will not contain other operations, nor will it be used as a communicating corridor or passageway between other operating locations within the building when explosives are being collected. Walls separating the room from other portions of the operating buildings must meet the requirements of paragraph 13–3, and not more than one collection chamber will be in a single cubicle.

c. Stationary and portable wet type collectors may be placed in the explosives operating bays or cubicles provided the quantity of explosives in the collectors does not exceed 5 pounds.

(1) If placed in separate cubicles, the explosives limits for the collectors may be increased to the amount reflecting the capabilities of the cubicle walls as operational shields.

(2) For greater quantities, the location requirements set forth in this paragraph are applicable.

13–23. Design and operation of collection systems

a. Collection systems and chambers will be designed to:

(1) Prevent pinching explosives (especially dust or thin layers) between metal parts.

(2) Pipes or tubes through which dusts are conveyed will have flanged, welded, or rubber connections. Threaded connections are prohibited.

(3) The systems will be designed to minimize the accumulation of explosives dusts in parts other than the collection chamber. Accordingly, pipes, or ducts through which HEs are conveyed will have long radius bends with a center line radius at least four times the diameter of ducts or pipes. Short radius bends may be used in systems for propellant powder, provided they are stainless steel with polished interiors.

(4) The number of points of application of vacuum will be kept to a minimum. As far as practical, each collection system serving one bay will require a single header leading directly to the collector. A common header serving more than two bays is prohibited.

(5) No part of a collection system servicing an operation within a bay or cubicle will expose personnel outside that bay or cubicle.

(6) Wet primary collectors are preferred. Not more than two primary collectors (wet or dry) will be connected to a single secondary collector.

(7) If an operation does not create a dust concentration that may produce a severe health hazard, manual operation of the suction hose to remove explosives dusts is preferred over a permanent attachment to the explosive dust-producing machine. A permanent attachment increases the likelihood of propagation through a collection system of a detonation occurring at the machine.

(8) Interconnection of manually operated hose connections to explosives dust-producing machines will be avoided.

b. Two collection chambers will be installed in series ahead of the pump or exhauster to prevent explosives from entering the vacuum producer in dry vacuum collection systems.

c. Dry portable vacuum collectors may be placed in explosives operating bays or cubicles provided an engineering assessment/HA shows the minimum vacuum requirement (cubic feet per minute (CFM)) is

adequate to maintain a dust concentration below the explosive dust flammability or explosibility lean concentration limit. The vacuum must have an operational interlock that shuts down the dust-producing system if the vacuum falls below the minimum vacuum requirement. The quantity of collected explosives dust must not exceed 5 pounds and will be removed periodically (but not less frequently than once per shift) to eliminate hazardous concentrations of explosives.

d. Wet portable vacuum collectors may be placed in explosives operating bays or cubicles provided the quantity of explosives in the collector is limited in accordance with the requirements of paragraph 13–22.

e. For dry collection of quantities in excess of 5 pounds or wet collection of quantities in excess of 15 pounds, further provisions of paragraph 13–22 will apply.

f. The design of wet collectors will—

(1) Provide for proper immersion of explosives.

(2) Break up air bubbles to release airborne particles.

(3) Remove moisture from the air before it leaves the collector.

(4) Prevent moistened particles of explosives from entering the small piping between the collector and the exhauster or pump.

g. Explosives dust will be removed periodically from the collector chamber to eliminate unnecessary and hazardous concentrations of explosives but not less frequently than once every shift. The entire system will be cleaned, dismantling the parts if necessary, in accordance with the manufacturer's recommended maintenance cycle and when equipment is not scheduled to be used for more than three work days.

h. Slide valves for vacuum collection systems are permitted. There will be no metal-to-metal contact with the metal slide. An aluminum slide operating between two ebonite space bars will not constitute a hazard.

13–24. Solid propellant collection

a. Solid propellant being recovered from the fixed rounds that are being pulled apart will be removed from the pull-apart machine as soon as practical. This removal is best accomplished by a properly designed vacuum-type collecting system. Regardless of the collection system type, the operations and equipment will be arranged so that the operators and the pull-apart machine are not exposed to more than 15 pounds of solid propellants at any one time. If a vacuum collection system is not used, the requirements of *paragraph 13–24e* below must be followed:

b. Vacuum collecting systems for solid propellants will be designed, located, and operated in accordance with the requirements of paragraphs 13–22 and 13–23 and, where practical, will include wet collection features.

c. The common header connected to a primary collector will not serve nor be connected to more than three pull-apart machines. Not more than one header connected to a collector will be operated simultaneously. Additional collecting units will be installed complete for any additional pull-apart machines, limiting each additional collecting system to not more than three machines.

d. Pull-apart machines will be electrically interconnected with vacuum collection systems (piping and collectors) and grounded.

e. When vacuum collecting systems are not installed, the collection of solid propellants may be accomplished by means of a closed tube or chute leading from the pull-apart machine to a collection point located in a separate room or enclosure.

(1) This system depends on unimpeded gravity flow. Each tube or chute will be equipped with a properly designed flashback damper to prevent exposure of personnel to flame, toxic gas, and heat in the event of an incident within the collection station.

(2) The tubes, troughs, and containers at the collection station will be of non-sparking metal properly cross-bonded and electrically grounded.

(3) The collection station enclosure or room will be vented directly to the outside (preferably through the roof) to prevent the rupture of the room or enclosures.

(4) The total poundage of solid propellants at the collection station will be limited to a minimum amount necessary to fill one container (not over 200 pounds).

13–25. Destruction of solid wastes

Explosives waste products will be taken in closed containers, as soon as practical but at least once per work shift, to buildings set apart for treatment or to the burning ground to be destroyed in an appropriate manner.

13–26. Assembly and crimping of complete rounds

Each assembly and crimping machine will be separated from other operations by walls or operational shields that are sufficiently strong enough to retain any fragment that may be produced (refer to paragraph 13–3 for further guidance on shielding).

13–27. Machining of explosives

a. Items containing explosives may be drilled either while in a vertical or horizontal position. Vertical drilling is preferred since the withdrawal of explosive chips and dust is facilitated, and proper drill alignment is more easily attained and maintained.

b. To protect adjacent operators, HEs will be drilled, faced, milled, sawed, or otherwise machined within rooms or cubicles having reinforced concrete walls except as permitted by this paragraph.

(1) The following HEs, cased, or uncased, may be machined without protection for the operator and without coolant if there is no metal-to-metal contact: Amatol, Octol, TNT, Composition B, Explosive D, and Research Department Explosive (RDX)/TNT compositions containing 60 percent or less RDX.

(2) The following HEs, cased, or uncased, may be machined without protection being afforded to the operator provided a suitable noncombustible, nontoxic coolant is directed on the tool and explosives at their POC: baratols, pentolite (50–50 and 10–90), tetrytol, and cyclotols (Composition B less than 60–40; that is 70–30).

(3) When essential, any other HEs may be machined by remote control, with the operator protected by a suitable operational shield. Initiating explosives will not be machined if other means (for example, forming) may be used to obtain desired shapes or sizes. If a coolant is used when machining explosives containing aluminum, it must be of a waterless, noncombustible, and nontoxic type.

c. If drilling is being accomplished without protection for the operator, only a single drill will be used, and the drill must have a diameter greater than one-fourth inch. Operations involving the use of multiple drills or drills one-fourth inch or less in diameter must be performed by remote control, with the operator protected by an operational shield.

d. Machining of cased explosives is permitted if the operation requires the tool to remove metal prior to or after contact with the explosives filler, provided it is performed by remote control with the operators protected by operational shields complying with the requirements of paragraph 13–28.

e. Where wet machining is to be performed, positive automatic interlocking devices will be provided to ensure that machining cannot be started until the coolant is flowing. These controls also must be capable of stopping the machining if the flow of coolant is interrupted.

(1) When it is essential to cut off the flow of coolant to adjust machining tools, positive means must be devised to ensure that, when adjusted, the flow of coolant is restored and all automatic control devices are in operation before machining is permitted to continue.

(2) The manipulation of the manual means employed for making the automatic control devices temporarily inoperative will be under the direct control of some assigned, responsible person other than the operator.

f. The lineal and rotational speeds of tools used for machining cased or uncased explosives will be maintained at the minimum necessary to safely and efficiently perform the operation. Speeds will not exceed 210 linear fpm or 525 revolutions per minute. As far as practical, machining equipment will be used, that can accurately control the feed rate. The above rotational and feed speed rates are for HE charge machining.

(1) For propellant manufacture, machining rates and methods will be established for individual operations by accepted HA methods. The feed rate will be the lowest consistent with safe and efficient operations, depending upon the explosive materials being machined.

(2) When equipment provided with feed control mechanisms are used for machining HEs, the rate of feed used will not exceed .035 inch per revolution.

(3) Cavities required in explosives preferably will be made with forming tools rather than drills.

g. Pneumatic or hydraulic-driven machine tools are preferred for all machining operations on HEs. Electric tools may be used if the motors, switches, and wiring are of types suitable for the specific

hazardous exposure being produced. Control mechanisms for hydraulic or pneumatic equipment will provide positive control of the speed selected to prevent tampering by unauthorized personnel. Pressure relief devices will be installed where necessary.

h. Wherever practical, and when forming tools cannot be used, "fly-cutter" type tools and forming cutters will be used for producing cavities in HEs. When fluted drills must be used, the flutes will extend from the tip of the drill to a point beyond the entry of the drill into the cased or uncased explosives. HEs will not be drilled to a greater depth than 4 inches unless the operation is remotely controlled or the drill is stopped at increments of depth not greater than 4 inches, withdrawn, and loose explosives removed from the cavity and drill before continuing. When producing cavities in HEs with a "fly-cutter" type drill, a flow of air will be directed at or near the interior bottom of the cavity to aid in clearing explosives chips and dust through the exhaust systems.

i. In all machining operations on cased or uncased HEs, tool adjustments will be controlled by positive means to ensure proper depth, diameter, and contour of the cut. The positive control measures will include guides, bushings, or other alignment aids to prevent contact between moving parts of the machining equipment and metallic parts of the case or holding fixtures. Minor adjustments to machining tools may be made while operations are in progress; however, the total personnel exposure must not exceed that permitted for normal operation. Major repairs, modifications, or adjustments of machine equipment will not be undertaken while the machining of explosives is in progress.

j. Dull or damaged tools will not be used for machining HEs. Tools will be made of a material that will take and retain a satisfactory cutting edge and be compatible with the explosives being processed.

k. The explosives products resulting from drilling and other machining operations will be removed by an approved exhaust system or by immersion in a stream of fluid that is non-reactive with the explosives being machined.

(1) Explosives waste products will be collected at a point outside the operating room or cubicle and will be removed from the operating area at intervals frequent enough to prevent hazardous accumulations.

(2) The use of large capacity sumps immediately adjacent to the operating room or cubicle will be discouraged.

l. The quantity of cased or uncased explosives being machined will be the minimum necessary for safe and efficient operation. When the explosives intended for processing are on trays or transfer dollies, the unit being processed must be located as far as is practical from the remaining units waiting for processing.

m. Unless an operational shield is provided to protect operators, not more than two persons will be permitted in a room or cubicle when dry machining of explosives is being accomplished. Where wet machining of explosives is being performed, and the work is of a special nature that requires the presence of more than two persons, the number of personnel exposed will not exceed five.

13–28. Operational shields for munitions loading

Operational shields for munitions loading operations will comply with paragraph 13–3. On any equipment used for explosives processing, equipped with doors that function as operational shields, interlocking devices will be installed, preventing the operator from opening such doors while the equipment is in operation.

Chapter 14
Demilitarization of Excess, Obsolete or Unserviceable Ammunition and Explosives

14–1. Demilitarization (treatment)

As the Single Manager for Conventional Ammunition, the Army has responsibility for the demilitarization of DoD conventional AE. The Army is dedicated to protecting human health and the environment by handling, storing, and destroying excess, obsolete and unserviceable AE safely and in an environmentally responsible manner. As part of the munitions AE life-cycle, munitions that become excess, obsolete, or can no longer be used must be demilitarized. To reduce the requirement to demilitarize excess and obsolete AE, the Army seeks to:

a. Sell these AE through foreign military sales; and

b. Determine whether the AE can, in part or whole, be recycled or whether some of their components can be recovered for other uses.

14–2. Demilitarization (treatment) methods

a. A variety of contained technologies are used to demilitarize (treat) munitions. Some of the technologies use contained robust pollution abatement systems, while others limit some of the effects of the demilitarization process.

b. Army also relies upon the use of open burning (OB) and OD for the treatment of certain AE. Commands should reduce reliance on OB/OD and seek to reduce releases from OB/OD by removing, to the point it is no longer safe, material (for example, fins, plastics) that would contribute unnecessarily to a release to the environment.

(1) OB is primarily used to destroy bulk propellants, raw explosives (for example, contaminated explosive waste that cannot be treated in approved contained technology), or explosive-contaminated packaging that may not be able to be transported or to be demilitarized safely using other available technologies.

(2) OD is to destroy munitions that are recovered during an explosives or munitions emergency, munitions determined unsafe for storage or transport, and munitions that cannot be demilitarized by other means because of their size and explosive content.

(3) OB/OD is required to train Soldiers and support explosives or munitions emergencies and combat operations.

(4) Depots and plants rely on the use of OB/OD for safety to avoid the disassembly, preprocessing, and extra handling required to prepare an AE for processing.

(5) Contained technologies for the demilitarization of bulk energetics and propellants as a replacement for OB that are proven to meet safety and environmental standards are currently limited.

(6) Certain AE cannot be reasonably processed through most contained technologies due to the extreme forces and pressures generated when they are processed in such technologies. Additionally, the use of contained technologies routinely exposes personnel to more explosive safety hazards than those associated with the use of OB/OD.

14–3. Permitting and siting requirements

Industrial demilitarization facilities (treatment) will be permitted under applicable state and federal environmental laws and regulations and sited in compliance with reference DESR 6055.09 and 40 CFR 265.382. DoDM 4160.28 and DoDI 4140.62 provide overarching guidance for demilitarization.

14–4. Burning of explosive waste and explosives-contaminated waste

a. A variety of safe and sustainable closed-disposal technologies are commercially available that, if used, will eliminate or significantly reduce the use of OB for explosives wastes or explosives-contaminated waste. Such explosive waste and explosively-contaminated waste include:

(1) Waste material that is known or suspected to be contaminated with explosives residues or determined not to pose an explosive hazard but not suitable for release to the public. Such material includes cardboard-, plastic-, paper-, or wooden inner or outer packaging; pallets; paper towels and other materials used in support of munitions operations; filters; overgarments and other PPE; and dewatering filter socks.

(2) Explosives waste (for example, explosive-contaminated bags, limited quantities of production wastes, including contaminated explosives; or out-of-spec products unsuitable for use or reprocessing) that may pose an explosive hazard but for which the technology being used is designed to treat and approved for use by the DDESB. Such material includes out-of-specification products unsuitable for use or reprocessing and explosives-contaminated or saturated bags or packaging material.

b. The use of expert knowledge, which DoDI 4140.62 allows, is authorized to help determine the explosives status of such wastes and whether the technology to be used in place of OB can treat it safely.

c. Given the above, ACOMs will:

(1) Immediately make a concerted effort to reduce reliance on OB to dispose of the types of waste indicated above. At the end of the 2020 - 2024 Program Objective Memorandum (POM) cycle, OB will not be authorized to treat such material.

(2) Although commands have until the end of the 2020 - 2024 POM cycle to procure closed-disposal technology that supports their operational requirements, they should identify and procure technology appropriate to their requirements as soon as possible. This is important because many closed-disposal treatment technologies require environmental permits to operate and may involve the submission of a DDESB RESS or an amendment to an approved RESS for Army and DDESB approval.

d. Waste (for example, excess or deteriorated office furniture, building debris) that is not or could not possibly be contaminated with explosives residues in sufficient concentrations to pose an explosive hazard may not be treated by OB or used as fuel during OB operations.

14–5. Operational requirements

a. Demilitarization operation will only be conducted following an approved standard operating procedure.

(1) SOPs used will be locally reviewed at least annually for legal and regulatory compliance;

(2) SOPs that are not in continuous use or have not been used within the past six months will be reviewed and updated prior to commencement of a demilitarization operation.

(3) SOPs will, among other matters, address:

(a) The type of AE to be processed within the facility;

(b) Procedures for clearing the facility's range area both before and after the conduct of a demilitarization operation to include specifying the waiting period to be followed after completion of an operation;

(c) Actions to take in the event of a misfire, including mandating a waiting period of at least 60 minutes, will be observed prior to investigating the misfire.

(d) Parameters (for example, weather conditions and wind speeds) for the conduct of demilitarization operations.

(e) Demolition operations will be initiated remotely or by using a delay device. When a delay device is used, the time of the delay must be at least 50 percent longer than the time required for personnel to reach a shelter and be sheltered.

b. Explosive operations warnings will be as follows:

(1) A red range flag or light will be flown or lit at the permitted facilities entrance when operations are in progress. A red light will be used during operations that occur after sunset. If used, the:

(a) Red flag will be a minimum of 3 feet wide by 5 feet long and flown continuously until demilitarization operations have been completed and the facility has been cleared.

(b) Light will be of sufficient size and clarity to be seen from at least 100 feet under every weather condition in which operations occur and remain lit until demilitarization operations have been completed and the facility has been cleared.

(2) A sign explaining the flag's or light's meaning will be placed on the access road to the range. This sign, which will be lighted during night operations, will be located at least 100 feet from the gate. This sign will be in English and, if required, the predominant foreign language of the permitted facility's location.

c. First aid kit. A first aid kit containing at a minimum burn- and puncture-wound treatments will be present during demilitarization operations.

(1) The first aid kit will be maintained completely and inspected monthly.

(2) A local medical authority will review and approve the first aid kit's content based on the risks involved.

(3) Personnel present at the facility will be trained in the first aid kit's use and its limitations.

(4) Every individual who works at the facility is instructed on how to obtain medical support if such is required.

d. Communications. A means of communications between personnel at the OB/OD facility and the installation's command or operations office will be maintained in working order. A means of communications will also be maintained between personnel preparing AE on the facility's range for treatment and the OB's/OD's facility's control center.

(1) Radios will not be used when electrically initiated explosives are being used unless in compliance with table 16–3.

(2) Demilitarization operations will not be conducted if either of the above means of communications is not working.

e. Firefighting. Firefighting equipment will be present at facility to combat fires that may start due to operations. The amount and type of firefighting equipment may vary with local conditions and will be approved by the garrison or installation fire marshal.

f. Range and facility safety. After each demolition or burning operation, trained, and qualified personnel will search the facility's range area for AE (kickouts) that may pose an explosive hazard. The search will begin after the waiting period specified in the SOP for the operation.

(1) When a permitted facility is not under constant DoD control, the facility's range area will be searched before the start of operations to account for the authorized personnel present and ensure unauthorized personnel are not present.

(2) Guards, who are protected from the effects of an operation, will be posted to prevent entry into facility's range area.

g. Personnel protection will comply with the following:

(1) Shelters will protect personnel against overpressures greater than 2.3 psi and against noise louder than 140 decibels (dBs) if the noise level exceeds 140 dBs.

(2) Personnel will wear hearing protection in accordance with DA Pam 40–501. If the noise level is greater than 165 dBs, then earplugs must be worn in combination with a noise muff or a noise attenuating helmet.

14–6. Open burning treatment facilities

a. The facility's SOP must include written procedures for preventing the AE to be treated (burned) from being ignited by heat or residue remaining in burn pans.

b. Burn pans or trays, which may be locally fabricated, will be used, placed a pad large enough to prevent explosive contamination of the ground surface, and must be grounded properly.

c. The distance between each burn pan positioned on the pad will be sufficient to prevent a burning ember from landing on adjoining pans.

d. AE (for example, propellant, bulk explosives) to be burned must be spread evenly within the burn pan so that its depth does not exceed 3 inches. AE that exceeds 3 inches in diameter may be burned, provided the AE is not stacked.

e. OB sites will have a means of collecting remnants from each burn and disposing of hazardous wastes produced by the operation in compliance with applicable laws and regulations.

14–7. Expended small arms ammunition cartridge cases

a. Demilitarization operations for processing expended SAA cartridge cases (ESACC) may be considered a non-explosive operation provided the criteria of DESR 6055.09, paragraph V4.E5.18 are met.

b. ESACC for which the explosives safety status has been documented as Material Documented As Safe (MDAS) that is determined to contain less than live SAA will retain its MDAS status provided the quantity of SAA present does not exceed the quantity authorized for shipment by United Parcel Service (that is, 66 lbs. (30 kg)).

14–8. Siting of locations used for processing material potentially presenting an explosive hazard and material documented as explosive hazard

Locations used for managing and processing MPPEH or Material Documented as Explosive Hazard (MDEH) will be sited in accordance with DESR 6055.09 and DoDI 4140.62. Such locations used routinely will also be licensed. To establish a location for routine management and processing of MPPEH or MDEH, installations will:

a. Submit a QD safety submission (that is, an ESP) to USATCES for review and approval, and submission to the DDESB for review and approval; or

b. Locate the MPPEH or MDEH management and processing area within the boundary of an AE storage area with an existing USATCES- and DDESB-approved ESP, and amend the ESP as required by DESR 6055.09.

14–9. Management of material potentially presenting an explosive hazard, material documented as explosive hazard, and material documented as safe

a. The management and disposition of MPPEH, MDEH, and MDAS will comply with DESR 6055.09, DoDI 4140.62, and related issuances, applicable environmental laws, and regulations.

b. The use of expert knowledge to determine the explosives safety status of material within the Army is currently limited to the below; however, request to apply expert knowledge for processing MPPEH may be submitted through command channels to USATCES for review and coordination with and approval by the Office of the Director of Army Safety and Office of the Deputy Assistant Secretary of the Army for Environmental, Safety, and Occupational Health. Expert knowledge may be used by:

(1) EOD personnel to determine the explosives safety status of AE recovered during or the remnants of AE destroyed as a result of an explosives or munitions emergency or during support of an installation's requirement to destroy munitions determined unsafe for continued storage.

(2) UXO qualified personnel may determine that MPPEH poses an explosive hazard without verification by a second inspection.

(3) Explosive workers who the activity commander or an authorized delegate determines qualified may determine:

(a) Material known or suspected to be contaminated with explosives residues does not pose an explosive hazard but is not suitable for release. Such material should be destroyed using contained destruction technology (see DoDI 4140.62).

(b) Explosives waste (for example, explosive-contaminated bags) that may pose an explosive hazard may be processed in the contained technology used to destroy the material indicated in 14-9*b*(3)*(a)* above.

14–10. Certification of demilitarization

Demilitarization will be documented and, if required, certified, or verified in compliance with DoDM 4160.28 Volume 3. The certification of demilitarization may be combined on the same document as documentation of the material's explosives safety status, provided the appropriate data and signatures are included.

Chapter 15
Design and Construction of Ammunition and Explosives Facilities

15–1. Construction considerations

a. The primary objective of this section is to ensure design procedures and construction techniques used in siting explosives facilities provide the desired margin of protection for personnel, the environment, and valuable material. The secondary objective is to ensure that explosives facilities and other related facilities are constructed in a way that will maximize cost-effectiveness in both planning and facility utilization.

b. Use the DoD UFC found in the WBDG in selecting and designing explosives facilities.

c. By using the UFCs provided in the WBDG, organizations can ensure that the above objectives are met. Managers must carefully evaluate their need for explosives facilities and ensure that construction techniques match mission requirements.

d. Designers must have specialized experience in facilities explosives safety, including protective construction.

15–2. Buildings

a. Construction features and location are important safety considerations in planning facilities that are to be a PES or exposed to the damaging effects of potential explosions (an "ES"). The effects of potential explosions may be altered significantly by construction features that limit the amount of explosives involved, attenuate the resulting blast overpressure or thermal radiation, and reduce the quantity and range of hazardous fragments and debris. Proper location of ESs in relation to a PES ensures against unacceptable damage and injuries in the event of an incident.

b. The primary objective of an ECM is to protect its assets. To qualify for the default IMDs in DESR 6055.09, Table V3.E3.T6 and Tables V3.E3.T7 and T8, a magazine must not collapse when exposed to an accidental explosion and resulting overpressures. The magazine may flex, but these deformations should occur and be limited to the air gap around the AE in the magazine. The deformed magazine or its door should not strike the AE.

c. There are three types of ECMs. Each type corresponds to certain construction criteria and has headwalls and doors designed to withstand certain overpressures. These types are:

(1) Magazines with headwall and blast door hardness of '7–Bar' are designed to withstand overpressures of 100 psi.

(2) Magazines with headwall and blast door hardness of '3–Bar' are designed to withstand overpressures of 45 psi.

(3) Undefined magazines are magazines without reinforced concrete headwalls and are expected to offer the least resistance to overpressure.

d. The arch of an arch-shaped magazine needs to be designed to support conventional dead loads. The roof of a flat-roofed magazine must be designed for both dead loads and dynamic blast-induced loads. The side and rear walls of ECMs need only be designed to support conventional loads.

e. Each magazine will be provided with appropriate means of air circulation or dehumidification.

f. Each magazine will be provided with appropriate means of lightning protection in accordance with chapter 16, Section IV.

g. For buildings containing AE, the roof and walls should be as light in weight and as weak as practical. This does not apply to buildings or rooms which are built for containment or protection. Most buildings should be constructed and supported to allow the venting of an internal explosion, with the minimum number of large fragments. Exceptions are made where design requirements such as the following must be met:

(1) Firewalls.

(2) SDWs.

(3) Roof live and dead loadings (refer to UFC 3–301–01 and consult with your civil engineering structural engineers).

(a) Snow loading.

(b) Wind loading.

(4) External overpressure protection.

h. Specified manufacturing facilities. A list of magazines currently approved for construction can be found in DDESB TP–15, Appendix 1.

15–3. Interior finishes and floors

a. Noncombustible material will be used for interior surfaces of buildings.

(1) Where hazardous locations exist (as defined in para 16–2), interior surfaces should also be smooth, free from cracks and crevices, and with joints taped or sealed.

(2) If painted, the surfaces should be covered with a hard gloss paint that is easily cleaned. Horizontal ledges that might hold dust will be avoided or beveled. Cove bases at the junction of the walls and floor are recommended.

(3) If combustion-supporting materials are necessary for the interior of an operating building, treat, or cover all exposed surfaces with fire retardant material.

b. Conductive non-sparking floors are required where certain exposed explosives and materials, sensitive (easily detonated or ignited) to the uncontrolled discharge of static electricity, are present.

c. Where washing is required, floors must be able to withstand repeated applications of hot water or other compatible cleaners.

15–4. Firewalls

Firewalls separate buildings or subdivide a building to prevent the spread of fire and with a fire-resistance rating and structural stability. They must extend through the roof and walls of the buildings. If openings are required, they must be compliant with NFPA 80.

15–5. Facility means of egress

Existing means of egress (exits and doors) must conform to 29 CFR 1910.33–39, NFPA 101 &101B, and NFPA 80. New construction will comply with 29 CFR 1910.33, NFPA 101B, NFPA 80, and the UFC 3–600–01.

15–6. Safety chutes

a. Safety chutes and controlled descent devices are permitted to provide escape routes in special structures such as AE manufacturing environments.

b. Safety chutes will be provided as exits from multistoried, hazardous locations where rapid egress is vital and not otherwise possible.

c. Safety chutes are not authorized by U.S.-based codes for occupied buildings other than those indicated in paragraphs *15–6a* and *15–6b*.

d. At the minimum, safety chutes will be inspected for safety and serviceability annually.

15–7. Emergency exits and fire escapes
Use the ANSI/ Builders hardware manufacturers association A156.3, NFPA 101 &101B, NFPA 80, and UFC 3–600–01 as a guide in constructing emergency exits and fire escapes. All openings will be compliant with NFPA 101 & 101B.

15–8. Fixed industrial stairways
a. Fixed stairs must be provided for access from one structure level to another where operations necessitate regular travel between levels and for access to operating platforms having any equipment which requires attention routinely during operations.
b. Fixed industrial stairways must comply with 29 CFR 1910.25. Open risers (stairs without vertical members) should be avoided.

15–9. Fixed ladders
a. The term fixed ladders include minimum requirements for the design, construction, and use of fixed ladders and sets forth requirements for cages, wells, and ladder safety systems used with fixed ladders to minimize personal injuries. All parts and accessories necessary for a safe and efficient ladder must be considered integral parts of the design.
b. Fixed ladders must comply with 29 CFR 1910.23 and ANSI Safety Code A14.3.

15–10. Platforms, runways, and railings
Platforms, runways, and railings must comply with 29 CFR 1910.22–23, 29 CFR 1910.27, 29 CFR 1910.66, and NFPA 101.

15–11. Passageways
a. If weather-protected passageways (ramps) for communication between buildings or magazines are constructed, these passageways should be of noncombustible construction and should be provided with suitable fire doors to interrupt a fire in its progress through the passage; these provisions will be applied in new construction.
b. To prevent funneling of explosion forces, weak sections, openings, and abrupt changes in direction should be incorporated into the design and construction of passageways between explosives buildings.
c. Passageways must comply with 29 CFR 1910.33–39, NFPA 101 & 101B.

15–12. Roads, walks, and gates
a. Good all-weather roads should be provided to and within the AE areas.
b. Only one gate in the fence around an AE area is required. Planners will determine how many gates are needed after considering all elements of the situation (physical security, operations, explosives safety, fire protection, and so forth). Emergency egress for personnel must be evaluated and provided with antiterrorism/force protection compliance in accordance with AR 190–11. A directional control personnel gate for controlled access and emergency egress may be provided.
c. Road systems serving groups of magazines or AE buildings will be arranged without dead-ends so that motor vehicles carrying AE cannot be isolated. To prevent dead-ending, interconnecting roads for magazine service roads need to be designed to accommodate the typical vehicles used at the garrison or installation.
d. Roads serving a single magazine or AE processing building (including its service facilities) may dead- end at the magazine or building. The road system should be designed to eliminate the need to pass through an intermediate AE area to travel from one area to another.
e. Walkways and roads at the entrances to or between adjacent operating buildings containing explosives will be hard surfaced or boardwalks. These walkways and roads must be kept free from foreign material. Foot brushes, doormats, or scrapers should be provided at the entrance of each building, except for magazines. Special attention will be given to passageways, walkways, and stairs which have been subjected to the effects of inclement weather.

15–13. Windows and skylights
Overpressures that result from an explosion can cause standard window glass to break and form razor-sharp shards that can be projected inward at considerable velocity. Serious injuries to personnel can result from such fragments, even at distances where no significant effects from a blast or other types of

fragments would occur. ESQD separation distances prescribed by this pamphlet do not provide protection from glass hazards and associated risks, and prudent measures must be taken to minimize these risks. Accordingly, the following measures apply to structures and buildings that have continuous, frequent, or periodic personnel occupancy, either associated or not associated with AE operations (such as administrative or field offices, surveillance workshops, and operating lines). These requirements do not apply to structures that have brief and transitory occupancy (for example, forklift charging stations, structures storing fire-fighting equipment, or other similar non-explosives storage locations).

a. Skylights will not be used in buildings where AE are processed and should not be used in any personnel occupancy structure within K50 distance of a PES.

b. New construction will minimize or eliminate the number of glass windows entirely or reduce glass surface area to the absolute minimum in buildings or structures near a PES. Window glass will not be used within the IBD arcs of PESs. When windows are required for operational reasons, within the IBD arc, the following must apply:

(1) The number and size of the windows will be minimized.

(2) Blast-resistant windows or window glazing that precludes the projection of glass fragments will be used.

(a) An engineering analysis will be made to determine the type of blast-resistant window required to withstand the expected overpressure and the placement of windows inside the exposed building for optimum personnel safety.

(b) Window design need not be engineered to provide protection from overpressures exceeding 3.5 psi (K18).

(3) Window placement on structures will, to the maximum extent possible, be designed so that the windows are situated away from direct line-of-sight exposure to any PES.

(4) The window frame and frame connection to the structure must be of sufficient strength to retain both the window and/or window glazing and the window frame within the structure when struck by the blast wave.

(a) Window glazing can be designed to either fracture or not fracture.

(b) Window glazing and frame should be designed to remain in the window frame or, as a minimum, simply fall out and land proximate to the structure.

(c) New buildings will be designed and constructed using the standards and guidelines of UFC 3–340–02 to withstand the maximum expected overpressure from an explosion at the PES.

(d) Prior to the construction of a new AE facility, a glass breakage hazard risk assessment for all ESs within the IBD arc will be conducted, and risks from glass breakage will be mitigated where feasible.

(e) These requirements for new construction will be complied with upon a major modification of the construction features of the exposed building or when modifications to operations or explosives conditions at the PES significantly increase the risk to other exposed buildings.

c. For existing exposed structures, an assessment of ESs within the IBD arc of each PES will be assessed to determine if windows can be eliminated or the glass hazards mitigated. All feasible corrective actions must be taken. These may include:

(1) Replacement of standard glass windows, if possible, with blast-resistant windows or glass.

(2) The application of fragment retention films on window interiors (see *paragraph 15–13d*).

(3) Covering the inside of windows with ½-inch plywood and strengthen window frames.

(4) Install heavy curtains, blast curtains, or similar shields to catch or impede glass shards.

d. Glass types – in order of preference for use.

(1) Thermally tempered glass, when broken, is less hazardous than annealed glass but can form small, sharp-edged cubes that can be projected with dangerous effects. For new construction, the thermally tempered glass may be used out to K40–K50 distances (IBD). UFC 3–340–02 for these types of windows still applies.

(2) For existing ESs, the use of thermally tempered glass at distances less than K40–K50 distances (IBD) requires mitigating action as identified above.

(3) Polycarbonate glazes, used as commercial security glazing, including bullet-resistant applications, are effective in resisting overpressure and are satisfactory for new construction. UFC 3–340–02 for these types of windows still applies.

(4) Laminated glass has a clear plastic adhesive sheet made of polyvinyl butyral (or similar materials) between layers of annealed, heat strengthened, or thermally tempered glass. The use of laminated glass may be effective for minimizing projected fragments, but design criteria for resisting the effects of an

accidental explosion do not currently exist. Further research will be required before design criteria can be established for laminated glass. UFC 3–340–02 will be updated accordingly.

(5) Fragment retention films are clear plastic films applied to the interior of windows that act like laminated glass. The use of fragment retention films is for retrofit applications only and must not be used for new construction. The film thickness must be commensurate with the anticipated blast loading and determined using analytical procedures or test data. The film should be applied into the frame bite of the window or otherwise suitably secured. Fragment retention films have a five-six year shelf life. For additional information, refer to UFC 3–340–02.

(6) Annealed window glass easily breaks and forms dangerous shards. For new construction, annealed glass will not be used out to K40–K50 distances (IBD). For existing ESs, windows with annealed glass at distances less than K40–K50 distances (IBD) require mitigating action as identified above.

15–14. Drains and sumps

a. All drain lines handling explosive wastes must have sumps or basins of sufficient capacity for the removal of explosives by settling. The drains must be of adequate capacity, free of pockets, and with slopes of at least one-quarter inch per foot to prevent explosives from settling out in the drain line before reaching the collection point in the sump or settling basin.

b. Sumps must be so designed that suspended and settleable solid explosive material cannot be carried beyond the sumps in the wash waters and so that overflow must not disturb any floating solids. The material's settling rate and the usual flow rate must be considered in determining the sump's capacity. The design must also permit easy removal of collected explosives and must allow for retention of those that float on water until they can be skimmed off. Bolted sump tanks or other types of construction that permit the explosives to settle in obscure or hidden spaces are prohibited.

c. Care must be taken to prevent deposits of explosives from sump effluent onto the surfaces of the collection system due to drying, temperature changes, or interaction with other industrial contaminants. Sweeping and other dry collecting measures should be used to keep appreciably water-soluble explosives out of the drainage system.

d. Drains between the source of explosive and the sump must have troughs with rounded bottoms and with removable ventilated covers to facilitate inspection for accumulation of explosives. Waste liquids must not run into closed drains and sewers. Inspect and clean out drains periodically to prevent the buildup of explosives. Drains and sewers containing explosive waste must not connect to the normal sewage systems.

15–15. Hardware

a. Hardware in buildings containing exposed explosive materials, explosive dusts, or vapors should be of non-sparking material. Installation of hardware (piping and ducts) should not be affixed to blowout panels or walls.

b. Hardware must be secured firmly in place with locking devices if it might become loose and enter into an explosives mix. This precaution is crucial in manufacturing and renovation operations.

15–16. Tunnels

Tunnels are very sporadically used with underground storage locations and expansion chambers (refer to DESR 6055.09, V2 for further details). Tunnels must be drained, ventilated, well-lighted, and have at least two exits. Water and steam service lines in tunnels will be lagged with suitable insulation. Tunnels between buildings that contain explosives will be built to resist the shock wave and blast of an explosion. Only authorized personnel will enter the tunnels.

15–17. Powerhouse equipment

Powerhouse equipment, boilers, engines, and auxiliary equipment will be installed in compliance with the appropriate standard(s) such ASME, Boiler, and Pressure Vessel Code (includes Code for Unfired Pressure Vessels), the NFPA/National Electrical Code (NEC), and other codes, regulations, or standards accepted as standard good practice.

Note: Refer to 29 CFR 1910.6. The standards of agencies of the U.S. Government, and organizations that are not agencies of the U.S. Government, which are incorporated by reference, have the same force and effect as other standards. Only the mandatory provisions (that is, provisions containing the word

"must" or other mandatory language) of standards incorporated by reference are adopted as enforceable standards under the Occupational Safety and Health Act.

15–18. Refrigeration

Refrigeration equipment (including air conditioning) must be installed as required by the American Society of Heating, Refrigerating, and Air Conditioning Engineers. Systems design and maintenance must comply with American Society of Heating, Refrigerating, and Air Conditioning Engineers Safety Standard 15.

15–19. Laundries

a. Laundries should have facilities for washing and flame-proofing uniforms if such clothing is used.

b. The facilities will include a safe place to store uniforms and rags that are contaminated with explosives before washing. Sumps will also be provided to remove explosives from wastewater. There should be facilities available to test whether the contaminant (particularly any insoluble toxic substance) has been removed.

c. Commercial concerns about laundering such articles will be informed of the nature of the explosives contamination and possibly dangerous chemical reactions. These concerns should also have the facilities listed in *paragraph 16–19a*.

15–20. Steam for processing and heating

a. Facility steam used for heating operating buildings containing explosives must have a maximum pressure of 5 psi (228°F) [34.45 kPa (109°C)], except for facilities where freeze protection is required. Steam pressures in lines or vessels that may inadvertently come in contact with propellants or explosives must not exceed 15 psi (250°F) [103.35 kPa (121°C)].

b. Process steam is that which is in direct contact with explosives and used directly in their manufacture or which, in case of equipment failure, would exhaust directly into contact with explosives or explosive fumes. Process steam should be limited to 5 psi (228°F) [34.45 kPa (109°C)]. Where necessary, process steam may exceed 5 psi [34.45 kPa] but must not exceed 15 psi (250°F) [103.35kPa (121°C)] for routine operations. Requirements for steam pressure exceeding 15 psi [103.35 kPa] will include a HA.

c. The exterior of steam or hot water pipes in contact with wood, paper, or other combustible materials must not exceed 160°F [71°C]. An insulating pipe covering capable of reducing the surface temperature of the covering to 160 °F (71 °C) or less is acceptable. Piping containing hot water or steam in excess of 140°F [60°C] should be insulated in areas where personnel may contact them.

d. Where steam temperatures must exceed 228 degrees F (5 psi) [109°C (34.45 kPa)] in hazardous locations, steam lines must be covered and painted with an impervious material or otherwise protected against contact with explosives. Where a reducing valve is used, a relief valve should be installed on the low-pressure piping. Pressure-reducing valves must not be bypassed in a manner permitting circumvention of pressure reduction requirements. The production of super-heated steam that results from the throttling action of reducing valves must be prevented by positive means. Using a “water leg” or water column to control steam pressure of 5 psi [34.45 kPa] or less is recommended. Where close control of steam temperature is necessary, indicating, and recording pressure or temperature gages must be installed. Such devices must be periodically tested and the test results recorded.

e. Steam lines penetrating an AE facility must be properly bonded to a common ground that complies with NFPA 780.

f. Steam lines will be run the last 50 feet to the building underground.

g. Process steam exceptions can be reviewed in table 15–1.

Table 15–1
Critical temperatures of common explosives

Explosive	Maximum Allowable Steam Temperature (F)	Corresponding Gage Pressure (psig)
TNT	266	25
RDX	264	22

Table 15–1
Critical temperatures of common explosives—Continued

PETN	176	16 inch mercury vacuum
Comp B	235	8.5
Nitrocellulose	N/A	N/A
IMX–101	244	12
Octol (65/35)	234	8
PBXN–11	306	59
IMX–104	273	29
PBXN–9	279	34
CXM–3	253	17
CXM–10	347	115
CXM–11	352	122
TATB	347	75

15–21. Ventilation

a. Industrial ventilation generally involves supply and exhaust ventilation to control emissions, exposures, and chemical hazards in the workplace.

b. Before an appropriate ventilation system can be selected, designed, or installed, the organization must study emission sources, worker behavior, and air movements in the area. In these cases, the organization must seek the services of an experienced industrial hygienist and professional ventilation engineer knowledgeable in the proposed operations to assist in the data gathering.

c. A typical local exhaust ventilation system is composed of five parts: fans, hoods, ducts, air cleaners, and stacks. Local exhaust ventilation is designed to capture an emitted contaminant at or near its source before the contaminant has a chance to disperse into the workplace air.

d. Exhaust fans through which combustible dust or flammable vapor pass will be equipped with nonferrous blades (or casting lined with nonferrous material) and suitable motors.

e. Exhaust systems will be inspected, cleaned thoroughly, and serviced on a regular schedule. The organization will document and maintain these actions in accordance with AR 25–400–2 and for a term of no less than two years.

f. The entire ventilating system will be bonded electrically and grounded properly. NFPA 70, NFPA 495, and 5000 must be used when designing and installing such systems.

g. For buildings in which explosives dust is present, an air balance that gives a slight negative pressure within the building is required.

h. Where systems have integrated air conditioning and ventilation systems, they must be designed and installed in accordance with NFPA 90A, 90B, and 91.

15–22. Electrical equipment

The installation of electrical equipment within an AE area (building, magazine, shelter) must comply with NFPA 70 and 5000 as a minimum unless specified otherwise (see chapter 16).

15–23. Collection of explosives dusts

The HEs dusts, which may be removed by a vacuum system, are TNT, Tetryl, Explosive D, Composition B, pentolite, OSX–CAN Type II (IMX–101), and OSX–7 (IMX–104).

a. A wet collector which moistens the dust close to the point of origin and keeps it wet until it is removed for disposal is preferred. Explosive D should be collected in a dry system. More sensitive explosives (such as black powder, lead azide, mercury fulminate, tracer, igniter, incendiary compositions, and PTs) may be kept wet with a compatible wetting agent close to the point of intake.

(1) Vacuum (aspirator) systems must be arranged so that each type of explosive is collected separately or so dissimilar risks (for example, black powder with lead azide) are not mixed. Gases that may form must be properly liberated.

(2) Vacuum systems used to collect these more sensitive materials should be used only for operations with fuzes, detonators, SAA, and black powder igniters.

b. Dry explosives dust collection chambers, except as specifically provided for portable units, should be located outside operating buildings, in the open, or in buildings exclusively for the purpose. There must be a protective barrier between the operating building and the outside location or a separate building containing the collection chamber.

(1) If the chamber contains 25 pounds of explosives or less, this barrier may be an SDW located at least 8 feet from the operating building.

(2) If the chamber contains more than 25 pounds of explosives and is separated from the operating building by a 12-inch SDW, the wall must be separated from the operating building by a minimum of ILD.

(3) If the barrier meets the requirements for operational shields or barricades (for the quantity of explosives in the collection chamber), it will be at a minimum of IL (B) distance from the operating building.

(a) When it is not practical to locate dry collection chambers outside the operating building, a separate room within the building may be set aside. This room must not contain other operations and may never be used as a communicating corridor or passageway between other operating locations within the building when explosives are being collected. If more than one collection chamber is to be placed in the room, the room will be subdivided into cubicles. Not more than one collection chamber will be in a single cubicle.

(b) Dry portable vacuum collectors may be placed in explosives operating bays or cubicles provided an engineering assessment/HA shows the minimum vacuum requirement (CFM) is adequate to maintain a dust concentration below the explosive dust flammability or explosibility lean concentration limit. The vacuum must have an operational interlock that shuts down the dust-producing system if the vacuum falls below the minimum vacuum requirement. The quantity of collected explosives dust must not exceed 5 pounds and will be removed periodically (but not less frequently than once per shift) to eliminate hazardous concentrations of explosives. If they contain more than 5 pounds, the requirement for stationary collectors will be met.

c. If stationary and portable wet type collectors do not contain more than 5 pounds of explosives, they may be placed in operating bays or cubicles. If placed in separate cubicles, the limit for each one may be 15 pounds. If they contain more than 15 pounds, the location requirements for dry collectors will apply.

d. Collection systems and chambers will be designed so that metal parts do not pinch explosives or explosive dusts. Pipes or tubes through which the dust travels should have flanged, welded, or rubber connections. Threaded connections are not allowed. The system will be designed to reduce the accumulation of explosives dust in parts other than the collection chamber.

(1) Long radius turns (centerline radius at least four times the diameter of the duct) will be used in the ductwork. Short radius bends may be used in systems for propellant powder, provided they are stainless steel with polished interiors. The number of points of application of vacuum should be kept to a minimum. Each room requiring vacuum collection should have a separate exhaust line to the primary collection chamber. Not more than two bays will be serviced by a common leader to the primary collection chamber. Wet primary collectors are preferred.

(2) The vacuum line should be as short as possible from vacuum application points to the wet collectors. The number of wet primary collectors serviced by a single secondary collector should be kept to a minimum. Not more than two dry primary collectors should be connected to a single secondary collector (wet- or dry-type). If an operation does not create an airborne concentration of dust, a manually operated suction hose to remove explosives dust is preferred. A permanent attachment increases the risk of propagation through the collection system should a detonation occur at the dust-producing machine.

(3) Manually operated hoses should not be connected to explosives dust-producing machines. In dry vacuum collection systems, two collection chambers should be installed in series ahead of the pump or

exhauster. Wet collectors must provide immersion of explosives to break up air bubbles, release airborne particles, and remove airborne moisture before it leaves the collector. This will keep moistened particles of explosives from entering the small piping between the collector and the exhauster or pump.

(4) Explosives dust will be removed from the collection chamber at least once each shift to eliminate unnecessary and hazardous concentrations of explosives. The entire system should be cleaned weekly, dismantling the parts if necessary.

(5) The entire explosives dust collection system will be electrically grounded and the grounds tested semiannually.

(6) Wet collection systems subject to freezing may be protected with antifreeze provided the antifreeze formula has been certified as compatible chemically with the propellant or explosives dust in use.

15–24. Automatic sprinkler systems

Certain buildings in explosives manufacturing, surveillance, and inspection or ammunition workshop areas (for example, the receiving building in a load line) may require automatic sprinkler systems. Engineering studies of the risks involved should determine the proper system. Sprinkler systems in each building must be connected to the central alarm location. Sprinkler systems will be installed as prescribed in AR 420–1, NFPA 13, and NFPA 16.

15–25. Barricades

Refer to DESR 6055.09, V2.E5.4.

15–26. Policy on protective construction

Advances in protective construction allow a calculated degree of protection from explosion communication between adjacent bays or buildings. They also protect personnel in adjacent bays or buildings against death or serious injury from incidents and protect vital and expensive equipment installations. Therefore, the major objectives in facility planning will be as follows:

a. Protection against explosion propagation between adjacent bays or buildings and protection of personnel against death or serious injury from incidents in adjacent bays or buildings.

b. If personnel and facilities would be better protected or costs reduced significantly by having separate buildings to limit explosion propagation rather than using protective construction and separation of explosive units within one building, planning will reflect this.

c. Protection for vital and expensive equipment if the additional cost is warranted.

15–27. Strengthening (hardening of buildings)

Protective construction, such as hardening an ES or constructing a PES to suppress explosion effects to provide an appropriate degree of protection, may reduce the separation distances required by QD tables. The rationale and supporting data, including the site and general construction plans that justify any such ESQD reduction, must be submitted to the USATCES for review and recommendation for DDESB approval.

15–28. Substantial dividing walls

a. An SDW is a reinforced concrete wall having the following characteristics:

(1) Minimum thickness of 12 inches.

(2) A minimum steel reinforcing bar size of 1/2-inch (0.50) diameter (#4).

(3) Steel reinforcing bars are spaced not more than 12 inches on center horizontally and vertically, on both faces of the wall, with bars on one face staggered with the bars on the opposite face.

(4) Concrete cover over the steel reinforcing bars is approximately 2 inches thick.

(5) Concrete has a minimum compressive strength of 2,500 psi.

(6) SDW main steel is continuous into supports as follows:

(a) If the SDW is used for the prevention of either prompt detonation or propagation of burning reactions, it must, at a minimum, be adequately supported at the floor.

(b) If the SDW is used for personnel protection, from either detonation or burning reactions, for remote-controlled operations, it must, at a minimum, be adequately supported on at least two sides (for example, the SDW is supported at the floor and with at least one adjacent SDW.)

(7) When SDW described in paragraphs 15–28a(1) through (6) above are incorporated into a room or cubicle, additional structural considerations must be addressed in order to limit internal pressure build-up

within the room or cubicle and assure the capability of the SDW to provide prompt propagation protection to munitions in adjacent rooms or cubicles. For this reason, the following additional criteria apply to a room or cubicle incorporating one or more SDW:

(a) A minimum of two surfaces (wall or roof) of the room or cubicle must be open or frangible. A surface is considered frangible if it's unit weight = 10 lbs./ft^2. If a roof is treated as one of the frangible surfaces, then any potential additional dead load, snow load, or ice load must be considered when calculating the roof's unit weight.

(b) A minimum scaled vent area (Av /V213) of 1.85 will be provided, where Av = total area of frangible and open surfaces (ft^2) and V = volume of room (ft^3).

(c) When used as a firewall for the prevention of propagation of burning reactions, the SDW must be continuous from the floor to the roofline to mitigate thermal effects unless otherwise required by local fire codes to extend above the roof.

(d) Those rooms or cubicles containing only materials that are expected to exhibit burning reactions will have an adequate venting area; that is, a frangible wall or roof.

b. This guidance applies to 12-inch thick SDW with the explosives located at least three feet from the SDW between the bays. When used as a firewall for HD 1.3 AE, the 12-inch thick SDW must be continuous from the floor to the roofline to mitigate thermal effects unless otherwise required by local fire codes to extend above the roof. When used for personnel protection, the 12-inch thick SDW must be adequately supported on at least two sides.

Note. Existing 12-inch thick reinforced concrete walls constructed for explosives operations, explosives storage, or remotely controlled explosives operations at DoD facilities are considered adequate for this application.

c. Requirements for the use of SDWs.

(1) To prevent the simultaneous detonation of HE and propagation of reaction (burning) for HD 1.3 between adjacent bays:

(a) Each bay containing HE (to include any HD 1.3 contributions) must be limited to an MCE of no more than 425 pounds explosive weight of Sensitivity Groups (SG) 1, 2, 3, and/or 4 munitions (SG's are defined in table 15–2). (*Note*: See the JHCS and table 15–2 for additional information.) Test data does not currently support the use of a 12-inch thick SDW to prevent the simultaneous detonation of SG5 munitions. Therefore, when establishing the MCE, the explosive weight of all munitions in a bay that contains any SG5 munitions must be combined with the MCE for any adjacent bays that contain either greater than 8 pounds of HD 1.1 or greater than 300 pounds of HD 1.3. HD 1.4 AE does not contribute to the MCE.

Table 15–2
Sensitivity groups

Sensitivity Group		CG	Description	Acceptor Ordnance
#	Description			
1	Robust	C, D, E	Bombs, Projectiles, Thick cased munitions	MK82, MK83, MK84 bombs; M107-155mm projectiles; Walleye[1]
		J	AE with flammable liquids	Harpoon; Tomahawk
2	Non-robust	D, E	Thin-cased items; Most missiles; Rockets, Underwater mines and torpedoes	MK103/MK10; Torpedo warheads; MK55 Underwater Mine
3	Fragmenting	D, E	Fragmenting missile warheads	WAU17 Sparrow Warhead
4	Cluster bombs/dispenser munitions	D, E	Cluster bombs/dispenser munitions	M483 Bomblet; MK864 Bomblet
		J	AE with flammable liquids	Tomahawk

Table 15–2
Sensitivity groups—Continued

Sensitivity Group		CG	Description	Acceptor Ordnance
#	Description			
5	Sympathetic Detonation Sensitive	B	Detonators and initiating devices	#8 Blasting cap
		F, G	Fireworks, incendiary, illuminating, smoke or tear producing munitions; ammunition with initiating devices	M106 Grenade; M61 Grenade
		C, D, E	Demolition explosives, very thin cased items; Sheet explosives, sensitive non-robust	M118 PETN and MK36 H6 Demo blocks; TOW II/Hellfire

Note:

[1] Directed Energy Weapon. Stowage plan must orient directed energy jet away from non-propagation wall (NPW).

(b) Bays containing only packaged HD 1.3 AE should be limited to an explosive weight of no more than 5,000 pounds, and bays containing unpackaged HD 1.3 AE should be limited to an explosive weight of no more than 300 pounds; otherwise, the explosive weights of those bays must be combined with the MCEs for all adjacent bays. Those bays containing only HD 1.3 AE must have an adequate venting area; that is, a frangible wall or roof.

(2) To provide personnel protection for remotely controlled operations:

(a) Operations involving HE (to include any HD 1.3 contributions) must be separated either by the shorter K24 separation distance when measured over or around the 12-inch thick SDW or by the shortest distance that provides 2.3 psi level of protection to personnel.

(b) Operations involving only HD 1.3 AE, where a mass fire is assessed to be the response during an accident, must be separated by the shorter K8 separation distance when measured over or around the SDW or by the shortest distance that limits the thermal flux to personnel to 0.3 calories/cm^2/sec. Guidance in paragraph 15–28c(2)(a) above applies when the expected response during an accident is an explosion or detonation.

(c) Personnel must be protected from fragments and debris having energies of 58-foot-pounds or greater (hazardous fragments). A 12-inch thick SDW that is properly supported on two sides (such as a reinforced concrete floor and another 12-inch thick SDW) defeats and does not generate hazardous fragments for an MCE of up to 300 pounds of HD 1.3 AE or for up to 8 pounds of HE (to include any HD 1.3 contribution) of SG1, 2, 3, 4 and/or 5 in the operating bay. HD 1.4 AE does not contribute to the MCE.

d. These walls are one way of separating explosives into smaller groups to minimize the results of an explosion and allow a reduction in QD separation. See chapter 8 for criteria for the levels of protection offered by these walls based upon the quantity of explosives present and the design characteristics of the wall.

e. Blast doors that separate explosives working spaces or storage spaces in existing buildings will meet design-definitive drawing specifications. Such doors should be at least as strong as adjacent walls (see TM 5–1300 for design factors for new structures). These doors are not to be installed as a matter of convenience. Blast doors should be avoided when a continuous reinforced wall would not interfere unnecessarily with operations.

Chapter 16
Electrical Hazards and Protection

Section I

Electrical Service and Equipment

16–1. Overview

For the purposes of this chapter, the DoD and the Army have adopted Article 500 of the NFPA 70, also known and hereafter referred to as the "NEC." The installation and use of electrical equipment within AE facilities/sites, regardless of type or configuration, must comply with the latest NFPA 70 or applicable portions of the IEC 62305 unless stated otherwise in this chapter.

16–2. Hazardous locations

a. Locations are classified depending on the properties of the flammable vapors, liquids, or gases, or combustible dusts or fibers which may be present and the likelihood that a flammable or combustible concentration or quantity is present. Where pyrophoric (spontaneously igniting in the air) materials are used or handled, these locations will not be classified; rather, each room, section, or area will be considered individually in determining its classification. To qualify as a hazardous location, conditions listed in paragraphs *16–2a* through *16–2c* should either exist or be probable in the location. Interior electrical systems must be designed with site conditions and user requirements in mind. The area will be classified per the NEC. Hazardous locations are divided into three classes. Each class consists of Division 1 (more hazardous) and Division 2.

b. Hazardous locations require either explosives dusts, flammable vapors, or ignitable flyings (or fibers) to be present in a proper mixture with air sufficient to constitute a Class I, II, or II hazard as defined below. AE storage structures will not normally have the proper mixture and would not be considered a hazardous location within the context of this definition. Additional information can be found in the NEC.

c. Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. The equipment used in Class I hazardous locations are housed in enclosures designed to contain any explosion that might occur if hazardous vapors were to enter the enclosure and ignite. These closures are also designed to cool and vent the products of this explosion so as to prevent the surrounding environment from exploding. The lighting fixtures used in Class I hazardous locations must contain an explosion and maintain a surface temperature lower than the ignition temperature of the surrounding hazardous atmosphere.

(1) There are three different situations that could exist to classify an area as a Class I, Division 1 location:

(a) When the atmosphere of an area or location is expected to contain explosive mixtures of gases, vapors, or liquids during normal working operations (this is the most common Class I, Div. 1).

(b) An area where ignitable concentrations frequently exist because of repair or maintenance operations.

(c) The release of ignitable concentrations of gases or vapors due to equipment breakdown while at the same time causing electrical equipment failure.

(2) One of the following three situations must exist in order for an area to be considered a Class I, Division 2 location.

(a) An area where flammable liquids and gases are handled but not expected to be in explosive concentrations. However, the possibility for these concentrations to exist might occur if there was an accidental rupture or other unexpected incidents.

(b) An area where ignitable gases or vapors are normally prevented from accumulating by positive mechanical ventilation yet could exist in ignitable quantities if there was a failure in the ventilation systems.

(c) Areas adjacent to Class I, Division 1 locations where it is possible for ignitable concentrations of gas/vapors to come into this area because there isn't proper ventilation.

d. Class II hazardous locations are areas where combustible dust, rather than gases or liquids, may be present in varying hazardous concentrations. Class II hazardous locations make use of equipment designed to seal out dust. The enclosures are not intended to contain an internal explosion but rather to eliminate the source of ignition so no explosion can occur within the enclosure. These enclosures are also tested to ensure they do not overheat when covered with dust, lint, or flying fibers.

(1) Class II, Division 1 locations are those in which:

(a) Combustible dust is present in the air under normal operating conditions in such a quantity as to produce explosive or ignitable mixtures. This could be on a continuous, intermittent, or periodic basis.

(b) An ignitable and/or explosive mixture could be produced if a mechanical failure or abnormal machinery operation occurs.

(c) Electrically conductive dusts in hazardous concentrations are present.

(2) Class II, Division 2 locations are those in which:

(a) Where combustible dust is present but not normally in the air in concentrations high enough to be explosive or ignitable.

(b) If dust becomes suspended in the air due to equipment malfunctions and if dust accumulation may become ignitable by abnormal operation or failure of electronic equipment.

e. Class III hazardous locations contain easily ignitable fibers or flyings, but the concentration of these fibers or flyings are not suspended in the air in such quantities that would produce ignitable mixtures. These locations include combustible fiber manufacturing pressing plants, woodworking plants, and establishments involving similar hazardous processes or conditions. Easily ignitable fibers and flyings include rayon, cotton, hemp, oakum, excelsior, and other materials of similar nature.

(1) Class III, Division 1 locations are areas where easily ignitable fibers or items that produce ignitable flyings are handled, manufactured, or used in some kind of a process.

(2) Class III, Division 2 locations are areas where easily ignitable fibers are stored or handled.

f. Operating buildings and magazines are constructed to perform a specific function that dictates the requirements for electrical equipment installation. If the functions performed in the facility change or are rearranged, the safety officers must inspect, approve, or reclassify the hazardous locations.

g. In some areas of Army operating buildings or magazines, there may be risks from both dust and flammable vapors. If so, these areas will have dual or multiple classifications. A recognized testing agency must list electrical equipment used in these areas as suitable for use in all hazardous locations to which it will be subjected.

h. Hazardous locations are subject to the following s*pecial requirements:*

(1) To maintain maximum long-term flexibility of use for facilities, electrical equipment, and installations in Class I, II, or III, hazardous locations involving explosives should comply with the requirements of the code for Division 1 of the appropriate hazardous location class. Equipment and installations in locations that could be used as either a Class I or II hazardous locations will meet the requirements of both classes.

(2) An alternate source of power must be available for AE operations where the lack of a continuous power supply may cause a fire or explosion.

(3) Low power, solid state devices, which are intrinsically safe under the NFPA 70, Article 504, may be used in any hazardous location, provided they do not introduce a physical or EMR hazard.

i. More than ordinary care will be taken to maintain equipment and electrical installations in hazardous locations. The equipment must be periodically inspected and maintained by qualified personnel, with a written record kept of the inspections and maintenance. Where inspection frequency is not prescribed in a TM or other directive, the inspection period will be fixed by the local authority on the basis of the existing situation.

j. Electronic flash photography equipment may be used in AE areas after the completion of an assessment of the risks involved. Use of flash photography equipment in hazardous dust or vapor environments (concentrations of dust or vapors in the flammable/explosives range) is prohibited. Caution, using flash photography in the vicinity of active ultraviolet (UV) sensors for ultra-high speed deluge systems could result in the system's activation. Not shutting windows and doors during a lightning storm can also potentially activate the UV sensors for ultra-high-speed deluge systems.

16–3. Approved equipment

a. Electrical equipment listed by a recognized testing agency is acceptable only when used under the recommended environmental and operational conditions. Equipment will be approved not only for the class of location but also for the explosive properties of the specific gas, vapor, or dust that will be present. For additional details, see NFPA 70.

b. Electrical equipment not specifically listed by a recognized testing agency for the purpose or operating condition present may be certified for use by a qualified safety engineer or Authority Having Jurisdiction. This certification will be based on the following:

(1) Listed equipment is not available from any source.
(2) HA has determined that no additional risks would be created by using this equipment.

c. Unlisted equipment certification and justification thereof must be maintained at the installation until the equipment is withdrawn from service.

d. For underground storage facilities, refer to DESR 6055.09, V2, and V5.

16–4. Maintenance of electrical equipment

Only qualified personnel authorized to do such work will perform maintenance. Where explosives may have contaminated equipment, the explosives will be removed or neutralized before maintenance is started.

16–5. Electrical service lines in ammunition and explosives areas

a. Each service line will be run underground from a point at least 50 feet away from the building. The exterior line side of the main disconnecting switch or circuit breaker must have suitable lightning arrestors. See paragraph 8–14 and table 8–1 for separation distance for electrical lines.

b. Surge (lightning) arresters will be required and installed as specified in NFPA 70, Article 280.

16–6. Low voltage utility lines

Local telephone service and similar low voltage intercom or alarm systems must also comply with the same underground routing for the last 50 feet. Surge protection, even for lines that run underground, will be provided to shield against any severe electrical surges from a nearby lightning strike or excessive power through the line from other outside sources, such as broken power lines. Surge suppression for incoming conductors must include suppression at the entrance to the building from each wire to ground.

16–7. Portable lighting systems

a. Floodlight systems, which are listed by a recognized testing agency, may be used where required. These will be mounted on heavy portable stands and placed outside the magazine door or the outside working area. Service cords must be placed or protected so that they cannot be walked on or run over by equipment. These lights must be rated for the environment which is present; that is, if explosives, dusts, or vapors are present, the lights must be rated for that environment or must be placed outside the structure or outside the area where the dust/vapor hazard is present.

b. Flashlights and hand lanterns powered by low voltage dry cell batteries and miners' cap lamps, each approved as permissible by the U.S. BOM and by a recognized testing agency for Class I hazardous locations, are considered satisfactory for both Class I and II hazardous locations. In Class III hazardous locations and nonhazardous AE locations, any type of dry cell flashlight is acceptable. Devices which provide cold light through chemical action are acceptable for any hazardous location.

16–8. Permanent lighting for storage magazines

If permanent lighting is essential, an approved type of disconnect switch must be used. The switch will be placed outside the magazine and arranged so that it can be locked in the open position. The power will be on only when personnel are working in the magazine. The magazine doors will be opened, and the magazine interior will be visually inspected before actuating the switch. As a minimum, spark-proof or industrial-rated electrical systems in rigid metal conduits, enclosed junction boxes, and closure plates without opening and protective covers for lighting fixtures will be used. Explosion-proof lighting is required only for the hazardous locations listed in paragraph 16–2.

16–9. Flexible cords

Flexible cords must be type "S" hard service cords approved for extra hard usage in damp areas as defined in the NFPA 70, table 400.4. Splices are not authorized. All flexible cords with plugs must be equipped with a ground (neutral conductor) (refer to 29 CFR 1910.334). Flexible cords will not be used in place of fixed or installed electrical wiring. Place or protect each electrical cord so that it cannot be walked on or run over by equipment. Cords that are not serviceable will be removed from service in accordance with 29 CFR 1910.334.

Section II

Static Electricity

16–10. Static electricity charge dissipation subsystem

a. Static electricity is produced when two, unlike materials, are brought into contact and then separated. During contact, there is a redistribution of the charge across the area of contact, and an attractive force is established. When the materials are separated, work is done in overcoming these attractive forces. This work is stored as an electrostatic field set up between the two surfaces when separated. If no conducting path is available to allow the charges to bleed off the surfaces, the voltage between the surfaces can easily reach several thousand volts as they are separated. Static electricity is an annoyance to many individuals. Static shock may cause discomfort and even injury to a worker due to involuntary reaction. The fire and explosion hazard are far more dangerous aspects of static electricity. This hazard can occur in situations where a vapor air, gas-air, dust-air, or combination of these mixtures exists in the proper ratio. For static to cause ignition, four conditions must exist:

(1) An effective means of static generation.

(2) A means of accumulating the charges and maintaining a difference of electrical potential.

(3) A spark discharge of adequate energy.

(4) The spark must occur in an ignitable mixture.

b. The most common sources of static electricity are—

(1) Steam, air, or gas flowing from any opening in a pipe or hose, particularly when the stream is wet or when the air or gas stream contains particulate matter.

(2) Pulverized materials passing through chutes and pneumatic conveyors.

(3) Non-conductive power or conveyor belts in motion.

(4) Moving vehicles.

(5) All motion involving changes in relative position of contacting surfaces (usually of dissimilar substances), of which one or both must be a poor conductor of electricity. The following paragraph provides information and procedures on how to control static electricity charge dissipation.

c. Practically, all finely divided combustible materials, especially explosives, when suspended in the proper concentration in air or deposited in finely divided layers, can be ignited by an electrostatic spark. When exposed, the explosives or explosive mixtures sensitive to static discharge (electrostatic sensitivity of 0.1 joules or less) are generally primer, initiator, detonator, igniter, tracer, incendiary, and pyrotechnic mixtures. Ammonium picrate, tetryl, RDX compositions, and tetrytol are sensitive to static discharge when present in dust-air mixtures. The following are some of the explosives that can be ignited by a static electricity spark discharged from a person: black powder; diazodinitrophenol; igniter compositions; lead azide; lead styphnate; aluminum, magnesium, titanium, uranium, or zirconium powder exposed in layers; mercury fulminate; mixtures of flammable vapors; potassium chlorate mixed with flammable dusts; pyrotechnic mixtures; smokeless powder dust when present; and tetrazene.

d. Static electricity on insulated conductive objects, such as metal stands with rubber casters, or on a person, can discharge through the air to other objects at a sufficiently different potential. Such a discharge or spark, although too small to be felt, may contain enough energy to cause an electro-explosive device (EED), such as a primer or a detonator, to fire. Static discharges may also be strong enough to break down the insulation within the EED and cause it to fire.

e. Flammable mixtures of solvents and air can be ignited by the static charge that can be accumulated on a person. Typical flammable solvents are ethyl ether, ethyl alcohol, ethyl acetate, acetone, benzene, and naphtha.

f. Personnel who work in a hazardous location or who handle or install unpackaged EEDs and ammunition must avoid using rags and wearing outer garments made of materials that have high static-generating characteristics. Materials of 100 percent polyester, nylon, rayon, silk, or wool are highly static-producing. Wool socks, glove inserts, caps, and undergarments of synthetic fabrics or silk are less of a hazard. Nylon field jacket liners should not be worn as an outer garment. Cotton or cotton-synthetic blend materials are preferred.

g. Personnel, regardless of the type of clothing worn, can collect a charge of static electricity by being in contact with moving non-conductive substances or coming in contact with a mass that has been previously charged. Therefore, personnel must be conscientious about discharging their static electrical potential or equalizing it to that of the explosives item before the item is handled.

h. Garments will not be put on or removed while engaged in AE operations. This reduces the generation of static charges caused by the physical separation of materials. If outer garments need to be removed, personnel will step out of the immediate area of operation, remove the garment, ground themselves, and then reenter. Workers must not unfasten Velcro fasteners while present in an AE operation.

i. All test equipment must be calibrated by TMDE in accordance with the manufacture's specifications. DA Label 80 calibration label must be affixed to all test equipment.

j. The grounding method generally used to eliminate or reduce the hazard from static electricity is to provide an electrically continuous path to the earth electrode subsystem.

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

(2) When necessary, effective grounding must include a container's exterior and contents.

(3) Electrical continuity may be broken by oil on bearings, paint, or rust at any contact point. To get a continuous circuit, grounding straps should be used to bridge such locations. Equipment in contact with conductive floors or table tops is not adequately grounded.

(4) Grounds will not be made to telephone grounds; electrical conduit systems; gas, steam, water, or air lines; sprinkler systems; or air terminals of LPS (connection to the down conductor of the system at the ground level is authorized).

(a) Static electricity accumulations and subsequent discharges are usually impossible if the relative humidity is above 60 percent. Where humidification techniques are used to prevent static electricity accumulations, perform a daily preoperational check of the humidity levels before starting work. However, certain materials, such as metallic powders and some of the pyrotechnic mixtures, cannot be exposed to air with 60 percent or higher relative humidity because of the possibility of spontaneous ignition.

(b) Ionization is electrical neutralization and effectively removes static charges from certain processes and/or operations. Methods of application can be found in NFPA 77. Ionization methods of removing static charges must not be used in hazardous locations as defined in the NFPA 70 and paragraph 16–2 of this pamphlet. Unless the ACOM, ASCC, or DRU commander approves, do not use radioactive ionization sources due to the potential for radioactive material contamination during an AE accident or pyrotechnic fire.

k. The combination of conductive floors and shoes provides the static electricity charge a dissipation path to the earth electrode subsystem.

(1) Conductive floors, plates, mats, and runners will comply with the following general requirements:

(a) Conductive floors, plates, mats, and runners will be used together with conductive footwear to protect personnel at operations involving items and materials having an electrostatic sensitivity of 0.1 joules or less. A list of items and materials that are sensitive to this level are listed in *paragraph 16–10c*. Operations involving such items as loosely unpacked ammunition with electric primers, exposed EEDs, electrically initiated items with exposed electric circuitry, and other hazardous materials will be analyzed on a case-by-case basis to determine if conductive floors, plates, mats, runners, and footwear are required. This analysis will include an assessment of the electrostatic sensitivity of the item and the compensatory measures to be employed.

(b) Conductive floors are not required throughout a building or room if the hazard is localized. In these cases, conductive mats or runners may be used where appropriate. These mats or runners will be subject to all the specifications and tests that apply to conductive floors.

(c) Equipment in contact with conductive floors or tabletops will not be considered grounded solely due to their position on those surfaces.

(2) For new installation or renovation, conductive floors must be constructed of a material such as lead (not authorized for new construction), conductive rubber, or conductive flooring composition and must meet the following requirements:

(a) The surface of the installed floor must be free from cracks and reasonably smooth. The surface material must not slough off, wrinkle, or buckle under operating conditions. Conductive tiles are not recommended in areas where explosives dust can cause contamination. The large number of joints and the tendency of tiles to loosen can allow explosives dust to become lodged. The tiles are not easy to clean using normal cleanup procedures.

(b) The conductive floors must be compatible with the materials to be processed.

(3) Bonding requirements are as follows:

(a) Conductive floors will be bonded to the earth electrode subsystem. The bonding material will be selected in accordance with NFPA 70, Article 250.

(b) On former Naval installations, conductive floors will be bonded to the secondary ground girdle. The bonding material will be selected in accordance with NFPA 70, Article 250.

1. For visual inspection requirements, see Table 16–1 and appendix E, paragraph E–2.

2. For electrical test requirements, see Table 16–1 and appendix E, paragraph E–3.

a) Conductive floors will be tested at the time of installation, renovation, and at least every six months (semi-annually) thereafter.

b) Electrical tests will be conducted only when the room or area is free of exposed explosives and/or flammable gas mixtures.

3. Conductive floors will be kept clean, dry, and free of non-conductive material. Soaps, detergents, and solvents that leave a residue will not be used to clean conductive floors.

l. Conductive footwear will comply with the following requirements:

(1) Personnel who work on conductive flooring, conductive mats, or conductive runners must wear non-sparking conductive footwear. Under no circumstances will personnel working on electrical equipment or facilities wear conductive-sole safety shoes or other conductive footwear.

(2) Conductive shoes with conductive composition soles will meet the American Society for Testing Material F2413–05, Standard Specification for Performance Requirements for Foot Protection.

(a) Conductive footwear requires care to retain its conductive properties. When conductive footwear is not in use, it must be stored in lockers close to the room where it will be worn. Employees who have been issued conductive footwear must not wear them beyond the immediate work area. Conductive footwear worn outside the immediate work area will require retesting.

(b) Approved conductive "booties" of paper or cloth construction can be used by transient personnel while visiting operations requiring conductive footwear. Personnel from other departments or visitors who enter these areas and who walk on conductive flooring must wear non-sparking conductive footwear (conductive overshoes with ankle straps may be used). Leg stats are acceptable for transients only, as long as their basic footwear is of non-sparking construction.

(c) Ensure SOPs inform employees that foot powder will not be used and that socks made of silk, wool, or nylon will not be worn with conductive shoes. Foot powder insulates and retards the conductive ability of the shoes. Silk, wool, and nylon produce static electricity.

(3) For visual inspection requirements, see Table 16–1 and appendix E, paragraph E–2.

(4) For electrical test requirements, see Table 16–1 and appendix E, paragraph E–4.

m. The requirements for conductive floors will apply to conductive tables and tabletops.

n. Conductive conveyor belts must have a resistance not to exceed 5 megohms (5 million ohms) as measured between two electrodes placed on the belt and between the conductive conveyor belt and the ground. Conductive conveyor belting must be tested at the installation time and at least semiannually thereafter. In areas exposed to large variances in relative humidity, additional measurements must be made during times of lowest relative humidity to check the adequacy of belt conductivity. The results of the tests must be recorded and maintained. Bonding requirements are as follows:

(1) The belt must be electrically continuous.

(2) The combination of the belt tension and the weight on the belt provides the bonding of the belt to the pulleys and rollers.

(3) The static electricity charge dissipation from the belt to the pulley or roller will also dissipate through the bearings to the equipment. The equipment, in turn, must be bonded to the earth electrode subsystem. Static combs or sliding contacts may be used between pulleys and rollers to the equipment housing. Bonding straps can be used on the equipment housing. Braided straps will be required on equipment that vibrates.

(4) On former naval installations, this subsystem must be bonded to the secondary girdle.

(a) For visual inspection requirements, see Table 16–1 and appendix E, paragraph E–2. Conveyer belt and v-belt systems will be inspected at installation or renovation and daily before use after that.

(b) For electrical test requirements, see Table 16–1 and appendix E, paragraphs E–5 and E–6. All conveyor belt systems will be tested at installation or renovation and at least semi-annually. Conductive v-belts will be tested at the installation time (see para E–6) but need not be tested after installation.

o. Conductive leg stats will not be used in place of conductive shoes. Only transients will use leg stats when they require conductive footwear. Leg stats will be used in pairs (one on each leg) when they are required.

(1) Visual inspection requirements. See Table 16–1 and appendix E, paragraph E–2.

(2) Electrical testing requirements. See Table 16–1 and appendix E, paragraph E–7.

p. As a general rule, wrist stats should not serve as the primary method of dissipating electrostatic charges from the human body. Wrist stats may be supplemental when operations require more than normal precautions against ESD. Wrist stats may be used as the primary method of electrostatic control when directed by Army publications.

(1) For visual inspection requirements, see Table 16–1 and appendix E, paragraph E–2.

(2) For electrical testing requirements, see Table 16–1 and appendix E, paragraph E–8. The resistance value will be provided in the publication that requires the use of wrist stats.

q. For sling loading AE, the static charge on lifting cables/hook must be discharged to ground before attaching the cargo nets to the lifting cables/ hook (see TM 4–48.09).

r. Forklift trucks. Requirements, inspection, and test procedures are in TB 43–0142.

s. All machinery and equipment such as mixers for pyrotechnic, propellant, and explosive compositions, screening, and sifting devices, assembly, and disassembly machines, elevators, defuzing machines, presses, hoppers, and all associated equipment involved in loading or processing AE or AE materials will be bonded to the earth electrode subsystem.

(1) For visual inspection requirements, see Table 16–1 and appendix E, paragraph E–2.

(2) For electrical testing requirements, see Table 16–1 and appendix E, paragraph E–9. Machinery and equipment will be tested upon receipt and when any modifications are made.

t. During paint spraying operations, electrostatic dissipation will be accomplished per NFPA 33 and/or NFPA 77. Electrostatic paint systems will not be used or installed in explosives areas.

u. Aircraft, both rotary and fixed-wing, will be grounded when loading or unloading AE. The resistance value between the aircraft and the earth electrode subsystem must comply with the criteria in table 16–1.

v. Ground grab bars may be installed just outside the entrance doors to operating buildings or other buildings or structures where special hazards exist. A ground grab bar consists of a length of non-corroding conductive pipe fitted in brackets and connected to ground. All persons entering structures equipped with grab bars will momentarily grasp the bar to dissipate any possible accumulation of static electricity. To prevent the accumulation of a static charge, conductive floors, tables, footwear, and so forth must be used.

w. There will be times when, due to operational necessity, items such as conductive footwear and/or flooring will not be available. Paragraph 16–35 provides field expedient grounding techniques that may be used in these situations.

Section III

Grounding

16–11. Ordnance grounds

Ordnance grounds are used to ensure that electric currents do not flow between ordnance components when they come in contact or are assembled. These currents can be produced by common mode voltages induced in-ground loops, ESD of one component into another, and potential differences created in the facility's ground system due to direct lightning strikes or near misses.

a. Ordnance grounds are electrically separated from all other ground systems (and objects connected to other grounding systems). At former Navy installations, ordnance grounds and ground subsystems may be connected to the secondary ground girdle at a single point.

b. Where they exist, ordnance grounds will be maintained.

16–12. Instrument grounds

Instrument grounds are used to provide error-free operation of sensitive electronic instruments.

a. Instrument grounds are electrically separated from all other ground systems (and objects connected to them). At former Navy installations, instrument grounds will be connected to the secondary ground girdle at a single point.

b. Instrument grounds at those installations having them will be maintained.

16–13. Ammunition and explosives facility grounding

a. AE facilities will be provided with a ground system to provide personnel, equipment, and facility protection. Personnel safety is provided by low impedance grounding and bonding for personnel, equipment,

metallic objects, and piping to prevent voltages sufficient to cause a shock hazard or initiate AE within the facility.

b. A facility ground system is composed of the earth electrode subsystem and one or more of the following subsystems:

(1) Static electricity charge dissipation subsystem.
(2) Ordnance ground subsystem.
(3) Instrument ground subsystem.
(4) Lightning protection subsystem.
(5) Structural ground subsystem.
(6) Fault protection subsystem.
(7) Power service grounds subsystem.

c. The AE facility grounding system at all Army installations will be visually inspected and electrically tested at the required intervals for values specified in table 16–1.

(1) General requirements are as follows:

(a) The garrison or installation safety officer, unless an alternate officer is specifically designated by the garrison or SC, will maintain the inspection and test reports and/or records for the last six inspection cycles (12 years for records on a 24-month interval cycle).

(b) Personnel responsible for maintenance, inspection, and testing must be familiar with the fundamentals described in NFPA 780 and herein as they relate to AE facilities to ensure the requirements of this pamphlet are met.

(2) All required maintenance will be performed on all grounding systems.

(3) Results of all electrical tests will be recorded. Any unacceptable conditions will be reported to the appropriate office for resolution.

d. Grounding system material will be in accordance with NFPA 70, Article 250.

16–14. Earth electrode subsystem

The earth electrode subsystem establishes the electrical connection between the facility and the earth. This connection is necessary for static electricity dissipation, useful in power fault protection, and aids in minimizing electronic noise from communications and instrumentation. It is a network of electrically interconnected rods and/or cables installed to establish a low resistance contact with the earth. Electrodes are usually buried or driven beneath the earth’s surface. Older garrisons or installations may also find that buried metal plates, cones, pipes, grids, wells, and/or grounded railroad tracks are used as the earth electrode subsystem. Only ground rods, ground loops, combinations, variations, and saltwater grounds are authorized for new construction or major renovation projects.

a. Earth electrodes will be placed at uniform intervals about the protected facility as required; the grouping of earth electrodes on one side of a facility is prohibited. Earth electrodes will be set not less than 3 feet or more than 8 feet from the structure. The type and size of the earth electrode subsystem will depend on local soil conditions. Test borings and/or soil resistance tests performed in the areas before construction will be used for deciding on an adequate earth electrode system. All connections will be tested for electrical resistance, and the entire earth electrode subsystem will be tested to ensure that resistance to earth meets the requirements of table 16–1.

b. The subsystem must be tailored to reflect the characteristics of the site and requirements of the facility. It must be properly installed, and steps must be taken to ensure that it continues to provide a low resistance connection to earth throughout the facility's life. To achieve these objectives:

(1) Before beginning the design, conduct a survey of the site where the earth electrode subsystem is to be installed. Through this survey, determine the resistance of the soil, identify significant geological features, gather information on architectural and landscape features which may influence the design of the subsystem, and review local climate effects. (If possible, conduct this survey in advance of the final site selection to avoid particularly troublesome locations.)

(2) As the site survey's first step, measure the soil's resistance at several points over the area of the planned facility. Even the smallest facility, in so far as the earth electrode subsystem is concerned, will affect an area at least 15 meters by 15 meters (50 feet by 50 feet). For larger facilities, the area is assumed to extend at least 6 meters (20 feet) beyond the basic building or structural outline, the ground floor plan. The soil resistance must be known over the area encircled or covered by the earth electrode subsystem.

(3) Design an earth electrode subsystem appropriate for the site.

(4) Install the subsystem in accordance with the recommended procedures.

(5) Finally, measure the resistance to earth of the subsystem to verify that it meets the goals or design specifications.

c. Only ground rods, ground loops, combinations, and variations thereof, and saltwater grounds are authorized for new or renovation projects.

(1) Acceptable resistances to earth values are easiest to achieve when ground rods are driven to the depth determined by the soil resistance test.

(2) A ground loop (counterpoise) subsystem will be installed if one of the following conditions are met:

(a) The minimum numbers of ground rods are driven to the depth determined by the soil resistance test, and the required resistance to earth value is not achieved.

(b) For grounding systems other than lightning protection drive, as a minimum, two additional ground rods (see table 16–2 for minimum ground rod requirements) to the depth determined by the soil resistance test.

(c) For grounding systems for LPS drive, as a minimum, one additional ground rod (see table 16–2 for minimum ground rod requirements) to the depth determined by the soil resistance test.

(d) The results of the soil resistance test and cost analysis may indicate that installing ground rods would not be cost-effective due to the need for excessively long ground rods. The results of the soil resistance test and cost analysis must be kept on file.

(3) Access to the earth electrode subsystem will be provided by installing one or more grounding wells at each new facility or at facilities undergoing a major renovation. Acceptable types of grounding wells are shown in figure 16–1.

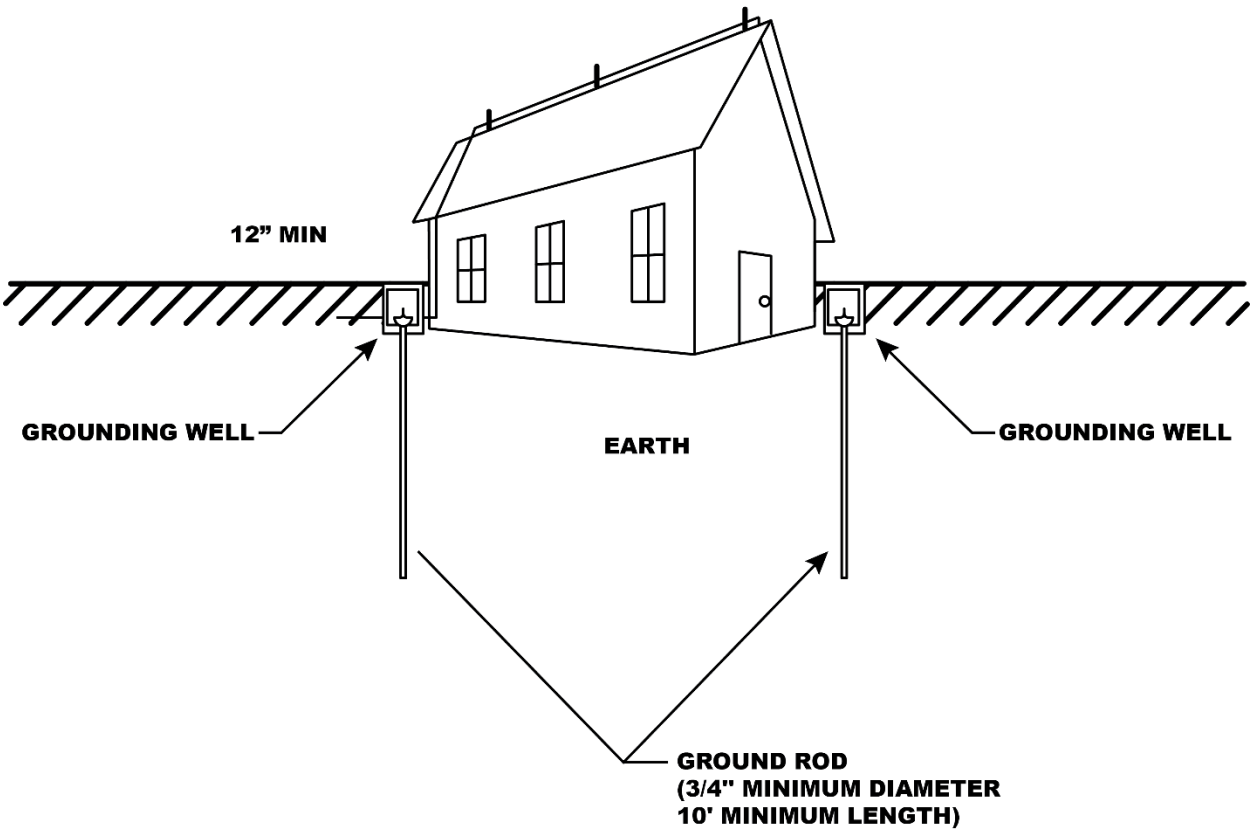


Figure 16–1. Typical ground rod installation

16–15. Bonding

Bonding is the joining of metallic parts to form an electrically conductive path determined by testing that will ensure electrical continuity and the capacity to safely conduct any current likely to be imposed. Bonding can be of two types: a direct bond and an indirect bond. A direct bond is the establishment of the desired electrical path between the interconnected members without the use of an auxiliary conductor. An indirect bond makes the connection of the primary ground girdle to the secondary ground girdle. However, the bonding jumper is directly bonded to the girdle on each end. Direct bonds may be either permanent or semi-permanent in nature. Permanent bonds may be defined as those intended to remain in place for the expected life of the installation and are not required to be disassembled for inspection, maintenance, or system modifications. Some bonded junctions (such as the connection of the ordnance ground to the secondary grounding girdle) may have to retain the capability of being disconnected without destroying or significantly altering the bonded members. All such connections not permanently joined are defined as semi-permanent bonds. These bonds include those which use bolts, screws, rivets, clamps, and other auxiliary devices for fasteners. When selecting these devices, the corrosive effects of dissimilar metals must be considered.

a. Examples of direct bonding techniques include welding, brazing, soft solder, bolts, and rivets.

(1) In terms of electrical performance, welding is the ideal method for a permanent bond. The intense heat (in excess of 4,000 ºF) involved is sufficient to boil away contaminating films and foreign substances. A continuous metallic bridge is formed across the joint; the conductivity of this bridge typically approximates that of the bond members. The bond's mechanical strength is high; a welded bond's strength can approach or exceed the bond members' strength. Since no moisture or contaminants can penetrate the weld, corrosion is lessened.

(a) Welds should be used whenever practical. Although welding may be a more expensive method of bonding, the reliability of the joint makes it attractive for bonds that will be inaccessible once construction is completed. Most metals that will be encountered in normal construction can be welded with one of the standard welding techniques such as gas, electric arc, Heliarc, and exothermic.

(b) The exothermic process is an effective welding technique for many bonding applications. In this process, a mixture of aluminum, copper oxide, and other powders is held in place around the joint with a graphite mold. The mixture is ignited, and the heat generated (in excess of 4,000 ºF) reduces the copper oxide to provide a homogenous copper blanket around the junction. Because of the high temperatures involved, copper materials can be bonded to steel or iron as well as to other copper materials. Figure 16–2 shows examples of the various bond configurations for which molds are readily available. When using this method, the manufacturer's direction must be followed closely. The mold should be dried or baked out as specified, particularly when the mold has not been used for several hours and may have absorbed moisture. The metals to be bonded should be cleaned of dirt and debris and should have the excess water dried off. Water, dirt, and other foreign materials cause voids in the weld, which may weaken it or may prevent a low resistance joint from being achieved. A further requirement is that the mold size must match the cable or conductor cross sections; otherwise, the molten metal will not be confined to the bond region.

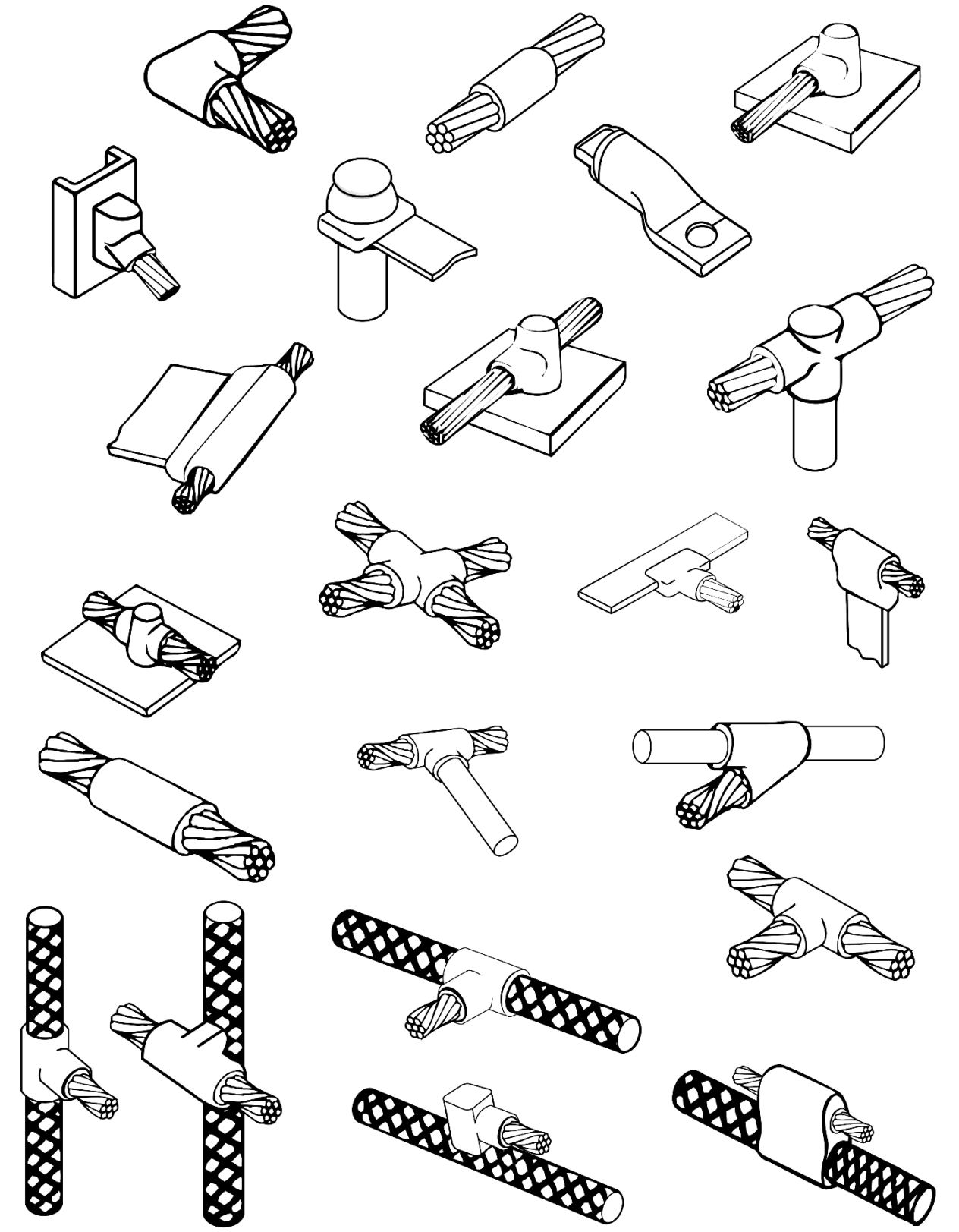
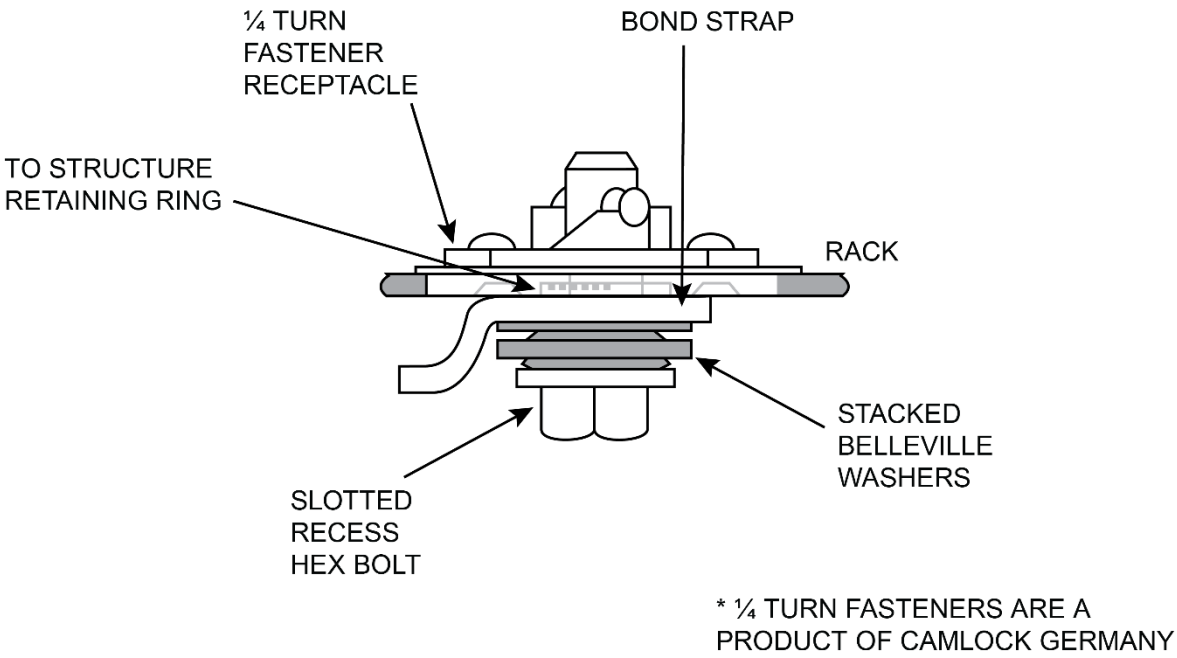


Figure 16–2. Examples of exothermic weld configurations

(2) Brazing (to include silver soldering) is another metal flow process for permanent bonding. In brazing, the bond surfaces are heated to a temperature above 800 ºF but below the melting point of the bond members. A filler metal with an appropriate flux is applied to the heated members, which wets the bond surfaces to provide intimate contact between the brazing solder and the bond surfaces. As with higher-temperature welds, the resistance of the brazed joint is essentially zero. However, since brazing frequently involves the use of metal different from the primary bond members, additional precautions must be taken to protect the bond from deterioration through corrosion.

(3) Soft soldering is not permitted for interconnections between elements of lightning protection networks by either the NFPA 780 or the Underwriter's Master Labeled System and is therefore not permitted at Department of the Army activities.

(4) The most common semi-permanent bond is the bolted connection (or one held in place with machine screws, lag bolts, or other threaded fasteners) because this type provides the flexibility and accessibility that may be required. The bolt or screw should serve only as a fastener to provide the necessary force to maintain the 1,200–1,500 psi pressure required between the contact surfaces for satisfactory bonding. Although the bolt or screw threads may provide an auxiliary current path through the bond, the primary current path should be established across the metallic interface. For this reason, proper cleaning of the surfaces to be bonded must be accomplished. Because of the poor reliability of screw thread bonds, only self-tapping screws are to be used when all other bonding methods are impractical or impossible. All screw thread bonds must be included in the facility's electrical test plan and visual inspection plan. Figure 16–3 shows some examples of bolted connections.



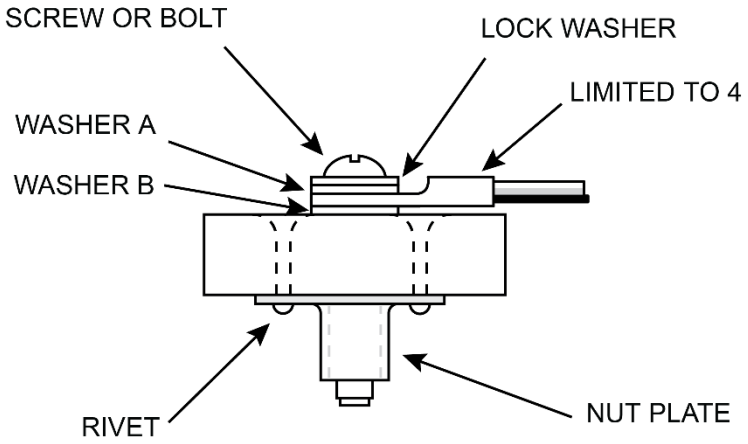


Figure 16–3. Examples of bolted bonds

(5) Riveted bonds are less desirable than bolted connections or joints bridged by metal flow processes. Rivets lack the flexibility of bolts without offering the degree of protection against corrosion of the bond surface that is achieved by welding, brazing, or soldering. Because the primary current path is established across the metallic interface, proper cleaning of the surfaces to be bonded must be accomplished.

b. The preferred bonding method is to connect the objects with no intervening conductor. Unfortunately, operational requirements or object locations often preclude direct bonding. When physical separation is necessary between the elements of an equipment complex or between the complex and its reference plane, auxiliary conductors must be incorporated as bonding straps or jumpers. Such straps are commonly used for the bonding of large pieces of equipment to a structural ground. They are also used for bypassing structural elements, such as hinges, or when carrying high-level currents.

(1) Bolted clamp connectors are the only permissible bonding method in grounding wells.

(2) All earth electrode subsystems protecting a facility will be bonded together. However, the following criteria apply where an earth electrode subsystem is installed and bonded to the existing earth electrode subsystem:

(a) All earth electrode subsystems will meet the most stringent resistance to earth value required for that facility.

(b) All earth electrode subsystems will be bonded together when maintenance is performed on the facility's grounding system.

(c) When a facility is renovated, all earth electrode subsystems will be bonded together.

c. For v*isual inspection requirements, s*ee Table 16–1 and appendix D, paragraph D–2.

d. For e*lectrical test requirements, s*ee Table 16–1 and appendix D, paragraph D–4.

e. Ground rods are any vertical rods or pipes driven into the ground. Ground rods are normally used where bedrock is more than 10 feet below grade. (See figures 16–4 and 16–5.)

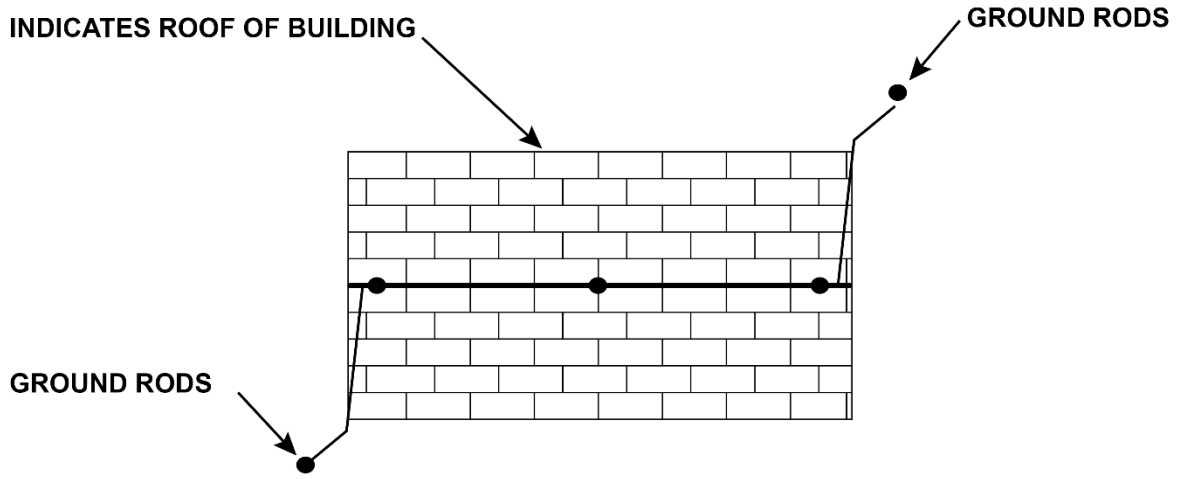


Figure 16–4. Typical multiple ground rod installation

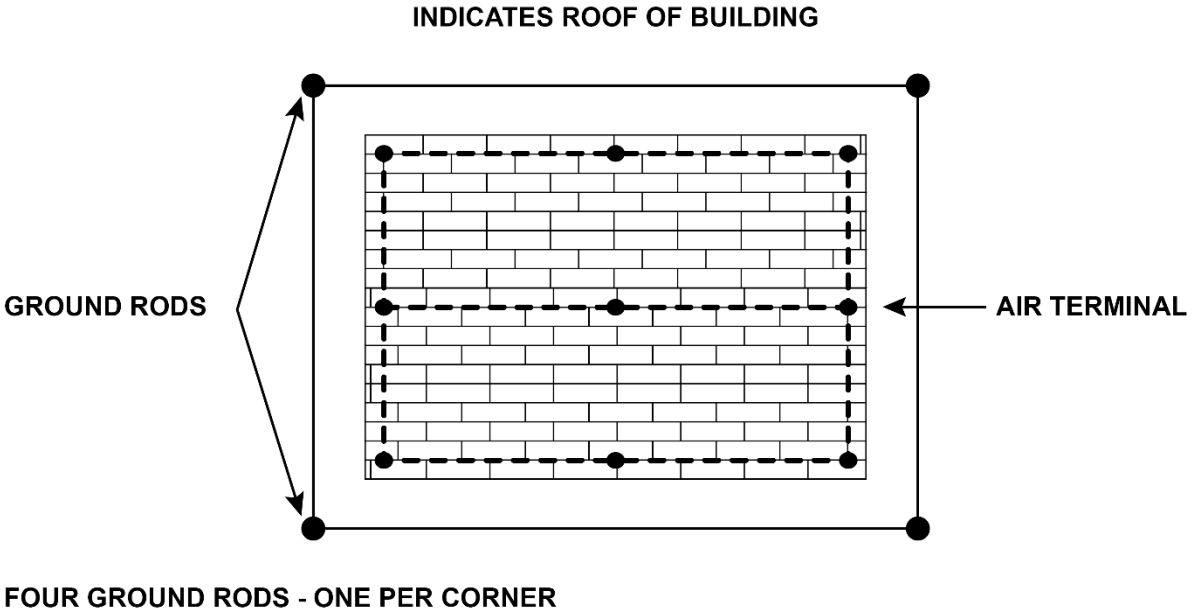


Figure 16–5. Typical ground loop installation

(1) New installation or renovation requirements are as follows:

(a) Ground rods will meet the requirements of NFPA 70 except when bonded to a lightning protection subsystem. They then will not be less than three-quarters of an inch in diameter and 10 feet in length. Rods will be copper-clad steel, solid copper, or stainless steel. Ground rods will be free of paint or other non-conductive coatings. Ground rods will be located clear of paved surfaces, walkways, and roadways. Rods will be driven so that the tops are at least 12 inches below the finished grade and located 3 to 8 feet beyond the perimeter of the building foundation. Mustow topsoil over bedrock or dense coral may make it impractical to bury ground rods or a counterpoise to the required level below grade. In these instances, using extended down conductors or buried open plates, as described in chapter 4 of NFPA 780, provides an acceptable alternative to the vertical burial of 10’ long rods. Protect threaded area of rods when driving the rods into the ground. Threaded couplings will be used when it is necessary to drive multiple lengths of ground rods into the earth.

(b) Ground rod quantity requirements. See table 16–2.

(2) For visual inspection requirements, see table 16–1 and appendix D, paragraph D–2.

(3) For electrical test requirements, see table 16–1 and appendix D, paragraph D–4.

(4) For Existing ground loop systems built under Navy specifications (see figure 16–6.)

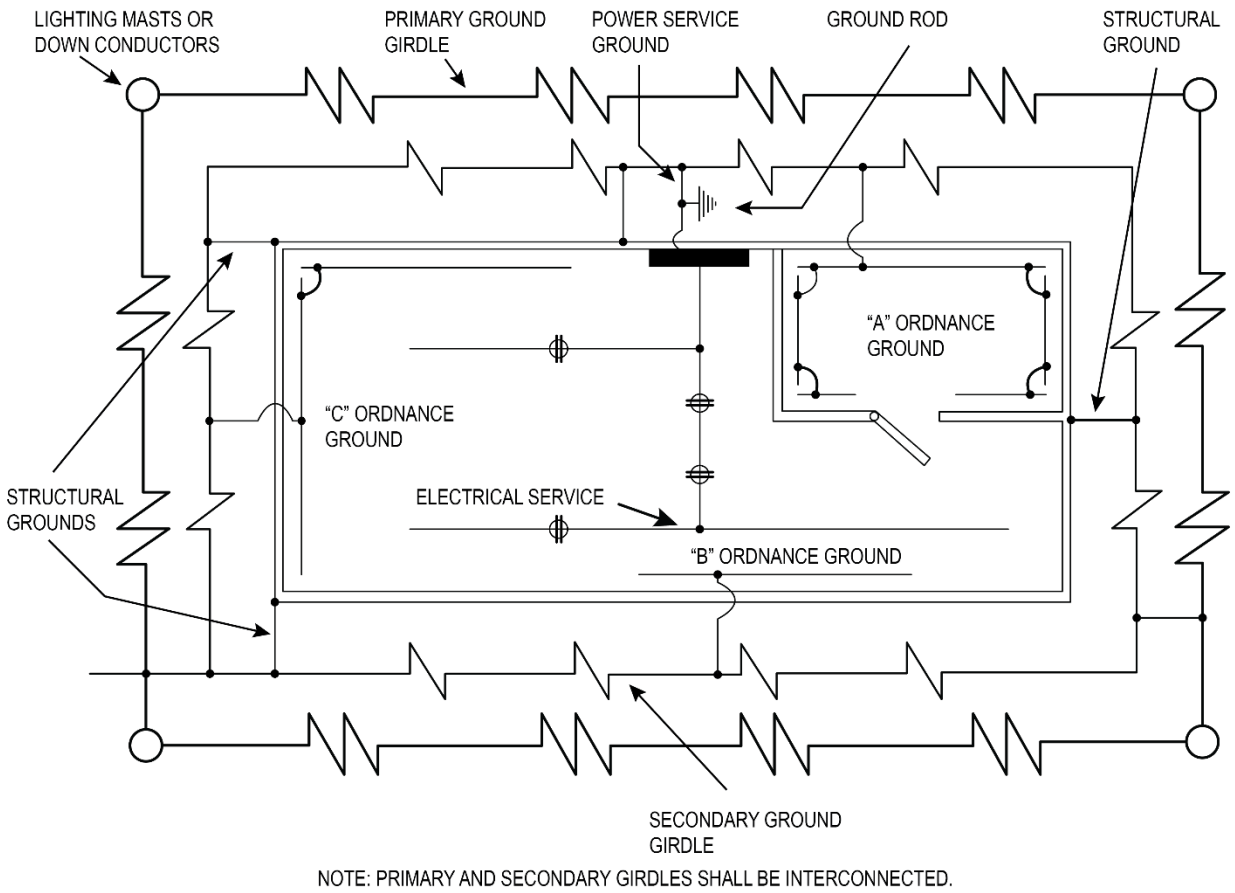


Figure 16–6. U.S. Navy designed earth electrode subsystem

(5) For new installation or renovation, ground loop cable will not be less than 1/0 American Wire Gage (AWG) stranded copper or copper-clad steel cable. The size of any strand will not be less than 17 AWG. A larger cable will be used in areas where the soil is highly corrosive. The cable will be buried not less than 30 inches below grade and not less than 3 feet or more than 8 feet from the building foundation or footing. All bends in the cable will not be less than 90 degrees. A minimum of two ground rods are required with a ground loop. One ground rod will be installed at each diagonal corner of the ground loop. (Existing ground loop systems built under Navy specifications (see figure 16–6) may have separate masts at each of the four corners of the ground loop with two each ground rods at each mast. This configuration meets Army standards.)

(6) For visual inspection requirements, see table 16–1 and appendix D, paragraph D–2.

(7) For electrical test requirements, see table 16–1 and appendix D, paragraph D–4.

f. A radial system (see figure 16–7) is a buried cable at each down conductor that extends radially from the facility.

(1) Radial system will not be used in building new facilities. Existing radial systems will be maintained using the same criteria defined for new installation or renovation of ground loop subsystems.

(2) For visual inspection requirements, see table 16–1 and appendix D, paragraph D–2.

(3) For electrical test requirements, see table 16–1 and appendix D, paragraph D–4.

g. The plate or cone system consists of a series of buried plates or cones attached to each down conductor at a facility (see figure 16–8). Water pipe or grounded railroad track systems also exist at some installations.

(1) Plate, cone, water pipe, and railroad track systems will not be used in the construction of new facilities. When plate, cone, water pipe, and railroad systems become unserviceable, they will be replaced using ground rods or ground loop systems as appropriate.

(2) For visual inspection requirements, see table 16–1 and appendix D, paragraph D–2.

(3) For electrical test requirements, see table 16–1 and appendix D, paragraph D–4.

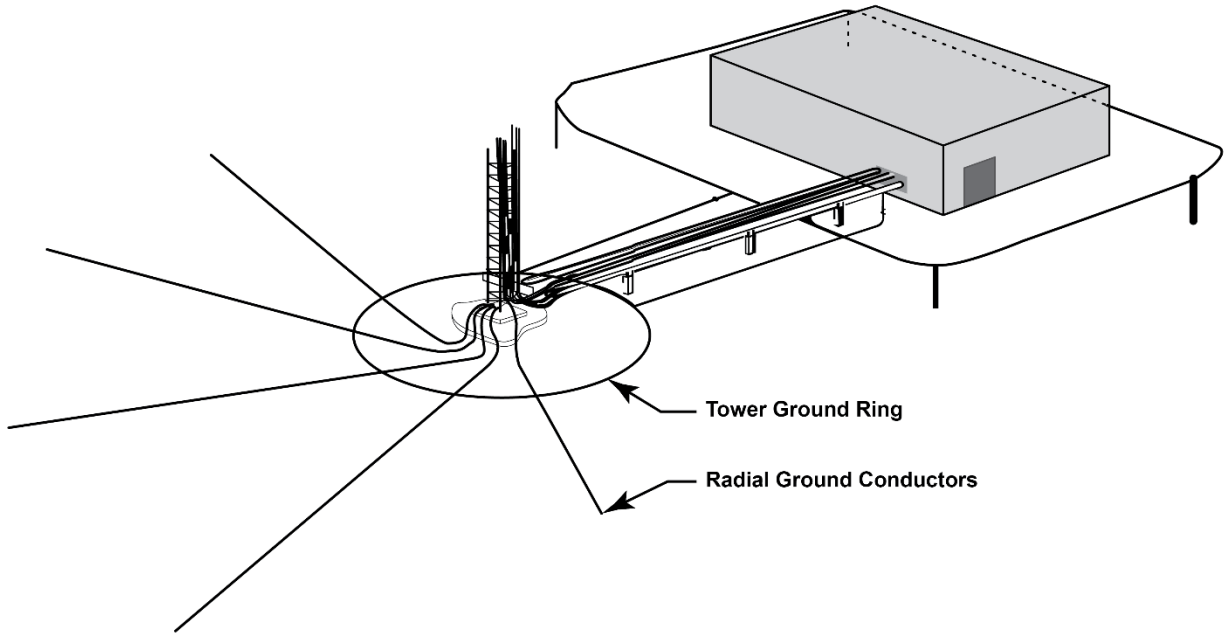


Figure 16–7. Radial grounding system example on a communication tower

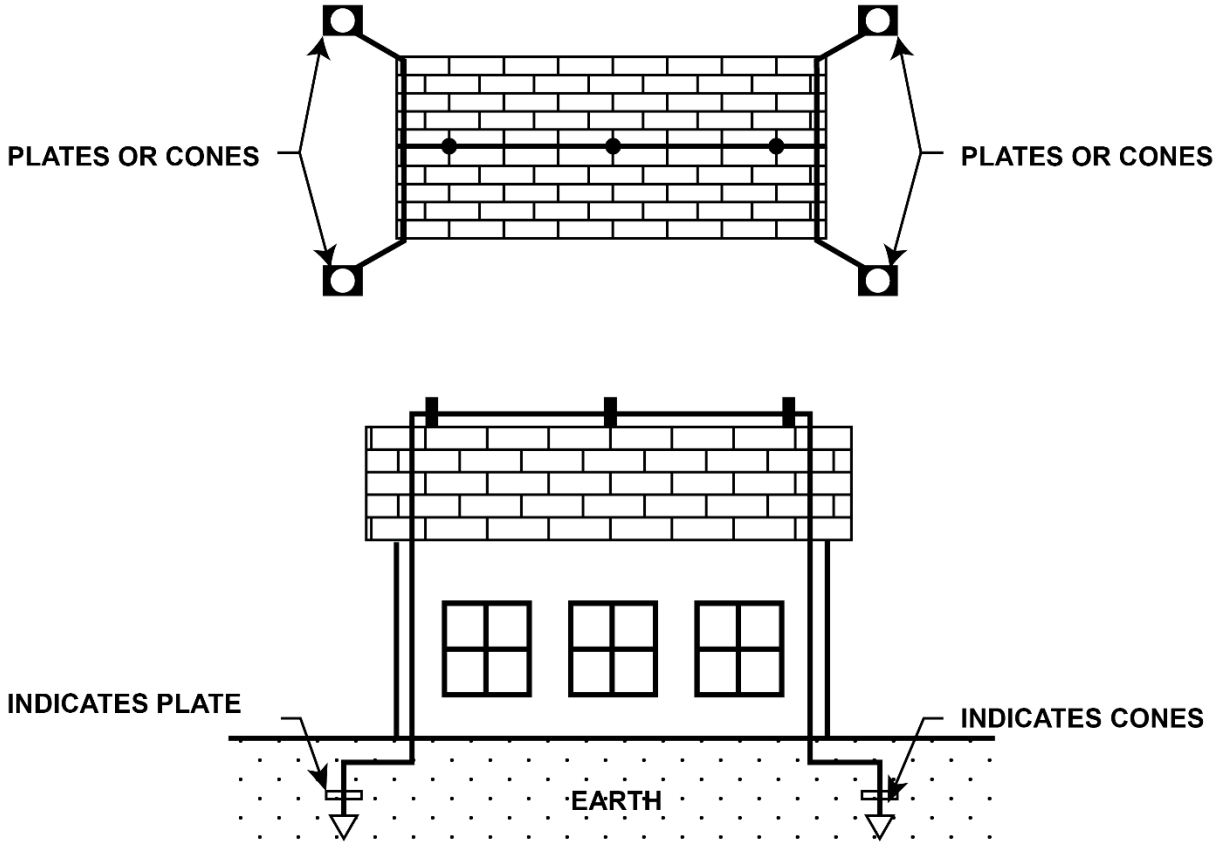


Figure 16–8. Typical buried plates or cones installation

Table 16–1
Grounding system inspection and test intervals and requirements

Grounding system component	Visual inspection	Electrical test	Required resistance
Earth electrode subsystem [1,2,3,4] ground rods, ground loop, grid, radial, plate, cones, railroad track, water pipes	12 months	2 years	25Ω
Static electricity charge dissipation subsystem	Daily before use	2 years	25 kΩ to 1 MΩ
Conductive floors, mats, table, tops, plates, runners [8,9]	Daily before use	6 months	25 kΩ to 1 MΩ
Metal mats [7,8,9,10]	6 months	2 years	25 kΩ to 1 MΩ
Conductive footwear, in use (on wearer)[8]	Daily before use	Daily before use	25 kΩ to 1 MΩ
Conductive belts, Conveyer belts	Daily before use	6 months	5Ω M max
V-belts	Daily before use	At installation	600 kΩ max at initial installation
Conductive hoses	Daily before use	6 months	250 k max
Leg stats [8,9]	Daily before use	Daily before use	25 kΩ to 1 MΩ
Wrist stats [5,8,9,10]	Daily before use	Daily before use	1 M Ω max

Table 16–1
Grounding system inspection and test intervals and requirements—Continued

Forklifts[6],	12 months	12 months	10kΩ
Equipment & machinery [9,11,12]	Daily before use	6 months	2Ω
Ordnance ground subsystem	12 months	24 months	25Ω
Instrument ground subsystem	12 months	24 months	25Ω
Lightning protection subsystem (bonding check)	12 months	24 months	1Ω

Notes:

[1] Only visible/accessible portions of the earth electrode subsystems will be inspected.

[2] In addition to the regular inspection/test interval, earth subsystems will be tested after initial installation, maintenance or renovation.

[3] The required resistance value is determined by what the earth electrode subsystem is bonded to. When more than one subsystem is bonded together, the most stringent requirement applies.

[4] Ground loop systems are required to exhibit a resistance to earth less than or equal to 25 ohms. When a higher resistance is measured, the test crew will perform a full three-point fall of potential test to determine if optimum probe locations will lower the result to an acceptable level. If the result is still above 25 ohms, the test crew will perform a four-point earth resistance test to determine if the high reading is due to soil conditions. If high soil resistance is the reason for the high initial reading, record this fact in the test record, and use this soil resistance reading for a new baseline value for future tests to detect any system deterioration. If the soil resistance is not the reason for the high resistance to earth, perform system maintenance.

[5] Testing of wrist stats must be conducted with a wrist strap tester or an appropriate digital readout ohmmeter. Wrist strap testers must be used in accordance with the manufacturer's instructions.

[6] Forklift inspection and test procedures are in TB 43–0142. (MIL–T–21869 provides procedures for testing forklift discharge straps.)

The inspection and test procedures are found in the following appendixes:

[7] a. Appendix D, earth electrode subsystems;

[8] b. Appendix E, static electricity dissipation subsystems;

[9] c. Appendix F, lightning protection subsystems (bonding tests).

[10] Test from one point on the metal mat to ground. It may be necessary to install a resistor between the metal mat and ground to achieve the required resistance.

[11] When utilizing electrically energized tools/equipment (110V or 220V), ground fault interrupters (GFIs) must be installed in the electrical circuits for personnel protection.

[12] Equipment bonds will be visually inspected together with scheduled or unscheduled maintenance entries into the bay area for operations that are continuous (three shifts, 24 hours per day), remotely controlled, conducted in separate bays, and can potentially create toxic atmospheres within the operating bay.

Table 16–2
Ground rod quantity requirements

Type of system	Minimum number of ground rods
Power	1
Fault	1
Instrument	1
Ordnance	1
Static	1
Communication	1
Lightning protection	2
Structure	4

Section IV

Hazards of Electromagnetic Radiation to Ordnance

16–16. Hazards of electromagnetic radiation to ordnance

a. The following criteria pertain only to EIDs. Ordnance without EIDs have no HERO requirements, are categorized as NO HERO REQUIREMENT (NHR), and are not subject to the requirements of paragraph 16–16.

(1) EIDs are items that, when exposed to sufficient amounts of stray energies, can be unintentionally functioned, rendered to an unsafe state, or create a dud. Explosives safety's concern lies with items that can be unintentionally functioned or rendered to an unsafe state.

(2) Army-specific policy, tactics, techniques, procedures, and standards must be followed when using these types of devices to avoid adverse effects on ammunition items.

(3) EID's circuits can be affected by many forms of stray energy. Examples include electromagnetic energy, lightning discharge, static electricity, triboelectricity (friction-generated) effects, and radio frequency (RF) energy from ground and airborne emitters.

(4) As mentioned above, EIDs are susceptible to initiation by exposure to the radiated fields of RF emitters. The degree of susceptibility depends on the threshold firing level of the EID; the ability of the leads or circuit to capture RF energy; the type and characteristics of RF energy, and methods of coupling which can introduce this energy into the EID; including the item itself and the platform from which it is fired.

b. Safe separation distance criteria are as follows:

(1) HERO must be considered in each of the ordnance's stockpile to safe separation sequence (S4) criteria. Table 16–3 must be used to calculate the safe separation distance between ordnance and the transmitting equipment for ammunition storage, transportation, maintenance, disassembly, and demilitarization.

(2) All emitters (low or high power) must be evaluated against table 16–3 before use in ammunition areas.

(3) If the HERO classification of an item is unknown, the item will be categorized as HERO UNSAFE until its classification can be determined.

(4) When the safe separation distances cannot be met due to a lack of real estate or other limitations, a power density/field intensity survey should be conducted and distances.

(5) Unless the emitter has been authorized by the command to be used near electrically initiated ordnance, maintain a minimum safe separation distance of 3 meters (10 feet) between emitters and electrically initiated ordnance items, regardless of their HERO classification. (This includes radios classified as "Intrinsically Safe." Such radios are designed to prevent a "spark" from being generated and therefore are necessary in an explosives atmosphere but emit RF radiation and need to be evaluated for HERO considerations.) The separation distance applies to the ordnance item itself as well as any metal object attached to the ordnance item, such as a gun mount, aircraft, or launcher. Exceptions are as authorized by table 16–3.

(6) In the event technically qualified personnel at the local level cannot resolve an electromagnetic hazard to ordnance concern, request assistance from the higher headquarters through command safety channels.

(7) Cellular phones and other wireless devices, unless authorized by the local commander, should not be used within 10 feet of electrically primed ammunition.

(8) If proper separation distances cannot be achieved or the mission requires shorter distances, the local commander will perform a risk assessment and develop a waiver in accordance with paragraph 2–2.

c. HERO controls will include the following:

(1) If necessary to transport HERO UNSAFE items, transport the item in completely enclosed metal, HERO SAFE containers, and/or packaging.

(2) Leave EIDs in their containers or protective packaging (for example, anti-static bags and RF packaging). Shorting clips should not be removed until ready for use. Personnel will avoid touching electrical contacts on electrically primed ammunition.

(3) Signage will be placed on and around locations containing HERO UNSAFE materials. Signage will state safe transmitting distance from the location and will advise rendering transmitters incapable of transmitting.

(4) If HERO UNSAFE ordnance is located on an Army installation or if ordnance will be rendered to a HERO UNSAFE condition, the SC will be notified. Operations that may render ordnance HERO UNSAFE include demilitarization, research, and development, engineering tests, maintenance operations, disassembly operations, and accidental damage.

(5) Do not handle umbilical cables and cable connectors unnecessarily.

(6) Do not allow electrical contacts, electrodes (primer buttons), or connector pins to touch any object capable of conducting EM energy during handling and loading operations. Objects capable of conducting electromagnetic energy include aircraft, launchers, hoists, bomb carts, bomb racks, cartridge breeches and connectors, tools, personnel, other cartridges, and CAD's. Intentional contact with CAD primer buttons and connector pins that is not required to complete authorized handling and loading and/or unloading operations is prohibited.

(7) Plan ordnance operations so that the ordnance has minimal exposure to the electromagnetic environment (EME).

16–17. Hazards of electromagnetic radiation to ordnance requirements for operations involving ordnance

a. The intent of this paragraph is to provide specific guidance for operations involving HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE when such ordnance is exposed to EME. The paragraph covers the process for reducing potential EMR hazards through proper ordnance handling operations. This paragraph also discusses determining the HERO classification of an ordnance item and general HERO requirements for ordnance operations. The general HERO requirements apply to all ordnance items containing EIDs regardless of their HERO classification. Note that this paragraph does not apply to ordnance that is completely inert or does not contain EIDs. This type of ordnance is classified as NHR.

b. For HERO classifications, refer to figure 16–9, "Process for Determining HERO Classification," and then to the DA-approved electromagnetic and environmental effects (E3) risk assessment database, which contains the HERO classification (NHR, HERO SAFE, HERO SUSCEPTIBLE, HERO UNSAFE) of all ordnance items that have been evaluated for HERO. These items are listed by DoDIC and/or NSN. For completeness, this database also contains ordnance that does not contain EIDs. These are the items identified with a HERO classification of NHR. The life cycle management command/ material support command Safety Office associated with the ordnance may also be contacted to assist in determining HERO Classification.

(1) Use of HERO data is as follows:

(a) If the ordnance item is listed in the DA-approved E3 risk assessment database as HERO SAFE ORDNANCE, only the general HERO requirements given in *paragraph 16–17c* must be followed.

(b) If the ordnance item is listed as HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE, then EME restrictions may be required in addition to the general HERO requirements of *paragraph 16–17c*.

(c) Ordnance listed as NHR have no HERO requirements.

(d) The data sheets stored in the DA-approved E3 risk assessment database provide specific information about the HERO test details of the ordnance item, including frequency, maximum allowable environment (MAE), and situations where the item is susceptible to EMEs. In some instances, the data sheet also provides procedures to mitigate potential HERO problems.

(2) HERO UNSAFE ORDNANCE is an ordnance item that contains an EID, an item whose EID status is unknown, or an item that has not been tested and is not listed in the DA-approved E3 risk assessment database must be treated as HERO UNSAFE ORDNANCE and handled in accordance with the guidance contained in paragraph 16–17 for HERO UNSAFE ORDNANCE. Contact the USATCES for specific guidance related to HERO UNSAFE ORDNANCE.

(a) Ordnance items normally classified as HERO SAFE or HERO SUSCEPTIBLE ORDNANCE can be degraded to HERO UNSAFE ORDNANCE during assembly, disassembly, or testing or by subjecting the items to unauthorized conditions and operations. Care should be taken to ensure that such conditions and operations occur in a RF-free environment. For HERO, the term RF-free environment refers to a condition that exists in operating and storage locations where the use of intentional RF emitters are restricted/controlled, and the ambient EME is below the HERO UNSAFE ORDNANCE curve presented in figure 16–10.

(b) Examples of conditions leading to HERO UNSAFE ORDNANCE are:

1. Assembly or disassembly of ordnance systems such as those undergoing modification, repair, upkeep, parts exchange, strike down.

2. Tests involving additional electrical connections to the ordnance system, such as resistance and continuity checks.

3. Squibs, primers, blasting caps, impulse cartridges, and other EIDs having exposed leads or primer buttons that are unshielded and/or unfiltered, such as flash signals, igniters, tracking flares, and have not been HERO-evaluated in these configurations.

4. Unshielded ordnance subassemblies such as rocket motors, warheads, exercise heads, and fuzes.

5. Damaged ordnance items that have internal components exposed, seams, or joints that are no longer intact, or HERO shielding breached.

(c) If the above conditions are encountered, and exposure to EMEs cannot be avoided, HERO UNSAFE ORDNANCE can be protected by completely enclosing the item in a sealed, all-metal container. Ordnance items packaged in a wooden, cardboard, or plastic container or stacked on a metal pallet are not protected from the EME. Further, HERO UNSAFE ORDNANCE must only be removed from protective packaging in an EME that does not exceed the levels defined as an RF-Free Environment. Such areas may be found in buildings designed with electromagnetic shielding.

(d) UXO is considered to be HERO UNSAFE ORDNANCE. The detection equipment used to locate UXO (that is, ground-penetrating radar, ground conductivity meters) may be capable of generating sufficient electromagnetic energy to cause inadvertent actuation of EIDs in UXO. Prior to commencing operations with UXO, contact USATCES or EOD to determine the safety of the detection equipment.

(3) Components of All-Up Rounds (AURs) that contain EIDs must be considered for HERO. Typically, HERO tests do not evaluate the individual components of an AUR separate from the AUR unless operational requirements dictate the need (for example, blasting caps, ejector cartridges, and some bomb fuzes). Individual components that contain EIDs and are not listed in the DA-approved E3 risk assessment database must be considered HERO UNSAFE ORDNANCE and require appropriate safety mitigations during all ordnance operations involving these components. This general guidance may be tailored if specific information is known about the individual component configuration and its projected use within DoD. The following provides additional guidance for tailoring safety mitigations during operations for individual components:

(a) For transportation and storage of components and subassemblies, components/subassemblies shipped in sealed, all-metal containers or sealed metal foil packages do not require additional HERO mitigations. The unopened container/packaging may be safely/reliably transported, handled, or stored in the typical operational or storage EME.

Note: The container/packaging must not be opened during this phase. Components/ subassemblies that are shipped in non-metal containers or packages require additional HERO mitigations.

(b) Removal of individual components/subassemblies from their containers or packaging and assembly/disassembly of the components must be performed in an area designated as an RF-Free Environment; otherwise, HERO safety mitigations must be implemented.

(c) Handling, removing, or installing components in subassemblies of AURs or assembly of AURs requires the implementation of HERO safety mitigations.

(d) Once all the components have been assembled or installed into the system, HERO guidance is based on the HERO classification of the resultant AUR. Refer to the DA-approved E3 risk assessment database for HERO classification of the AUR.

c. The following general HERO requirements must be implemented when conducting operations with any ordnance item that contains EIDs, regardless of the ordnance item's HERO classification:

(1) General HERO Requirements for Ordnance Operations.

(a) Comply strictly with authorized ordnance loading manuals and checklists.

(b) Plan ordnance operations so that the ordnance has minimal exposure to the EME.

(c) Do not alter ordnance systems (ordnance item, electrical cables) unless USATCES and the Ordnance materiel developer have been contacted to determine the HERO impact of such alterations.

(d) Do not allow electrical contacts, electrodes (primer buttons), or connector pins to touch any object capable of conducting EM energy during handling and loading operations. Objects capable of conducting EM energy include aircraft, vehicles, launchers, hoists, bomb carts, bomb racks, cartridge breeches and connectors, tools, personnel, other cartridges, and CADs. Contact with CAD primer buttons and connector pins that is not required to complete authorized handling and loading and/or unloading operations is prohibited.

(e) Do not handle umbilical cables and cable connectors unnecessarily.

(f) Do not make electrical connections to ordnance systems before the ordnance is loaded to the platform unless:

1. Procedures have been specifically authorized in the checklist or loading manual.
2. The appropriate HERO conditions for HERO UNSAFE ORDNANCE contained in the current HERO survey have been implemented.
3. The appropriate HERO UNSAFE ORDNANCE safe separation distances are required to ensure an RF-free environment is maintained between transmitting antennas and the ordnance operation. Electrical connections between aircraft and ordnance are the most likely entry paths for RF energy.

Note: Racking an ordnance item to the aircraft first and tightening the sway braces before making electrical connections reduces the amount of EM energy induced into the item's internal circuitry.

(g) Transport all HERO UNSAFE ORDNANCE in sealed, all-metal containers.

Note: By definition, a pallet is not a container. Therefore, metal pallets must not be considered all-metal containers.

(h) Cover all open electrical connectors on ordnance items with non-shorting caps to prevent accidental contact with the pins of these connectors. The caps should be removed just before connector mating and reinstalled promptly upon connector unmating.

(i) Do not expose the ordnance item’s internal wiring and firing circuits by assembling or disassembling the ordnance in an EME exceeding the levels for a HERO UNSAFE ORDNANCE RF-free environment.

(j) Test procedures that involve making electrical connections to the ordnance are permitted only if authorized by the loading manual or checklist.

(k) Flexible waveguides must not be routed through magazines. Rigid, continuous-run waveguides with no splices are authorized in magazines. However, do not store igniters, primers, detonators, and other items containing EIDs within 5 feet (1.5 meters) of rigid, continuous-run waveguides. Ordnance items stored in magazines must be stored in sealed, all-metal containers whenever possible.

(l) Only coaxial cables that are part of an installed (approved) transmitter system may be routed through magazines. “Lossy line” coaxial cable runs (for example, HYDRA) must not be installed, used, or terminated (that is, with an antenna) in magazines without the approval of USATCES. Do not store igniters, primers, detonators, and other items containing EIDs within 5 feet (1.5 meters) of approved coaxial cables. Ordnance items must be stored in sealed, all-metal containers whenever possible.

(m) No transmitter/antenna systems, including handheld transceivers, must be present, installed, or used in magazines or ordnance assembly areas without the approval of USATCES. Before aircraft/vehicle ordnance operations (loading/unloading), perform the following: silence all transmitters on the aircraft/vehicle being loaded/unloaded with ordnance; silence transmitters on all other aircraft and vehicles or maintain the safe separation distances using the equations of table 16–3 or emission control (EMCON) Analysis from the ordnance operation. Do not conduct maintenance or operational checks that could cause the aircraft transmitters to radiate; however, transmitters may operate into dummy loads.

(n) When in-flight aircraft are carrying HERO UNSAFE or HERO SUSCEPTIBLE ORDNANCE, maintain the safe separation distances (obtained using the HERO Safe Separation Distance Calculator or the current EMCOM Plan) for the transmitter/antenna systems, or silence the transmitter.

(o) Maintain a minimum safe separation distance of 10 feet (3 meters) between transmitting antennas and all ordnance items regardless of their HERO classification. The separation distance applies to the ordnance item itself or any metal structure or object attached to the ordnance item, such as a gun mount, aircraft, or launcher. For HERO SUSCEPTIBLE or HERO UNSAFE ORDNANCE, greater distances may apply based on transmitter/antenna parameters (that is, power, frequency, antenna gain). Refer to the calculated HERO Safe Separation distance or the EMCON Analysis. Table 16–3 provides exceptions to the minimum safe separation distance requirement of 10 feet (3 meters).

(p) During hoisting operations, EM energy can be induced on cranes and booms. These large metal structures act as parasitic antennas for RF energy emitted by nearby transmitting antennas. The high EM energy can produce voltages that may be discharged as arcs to personnel, ordnance, or other handling equipment. Nonconductive rope or other insulators that link the loading hook and the crane boom are required to prevent such EM energy discharge. Insulating links for installation between the cargo hook and the wire may be ordered using the following NSNs: 15-Ton rating NSN 4010–00–418–2118; 30-Ton rating NSN 5825–00–418–2119. HERO requirements for Transportation of Ordnance on Installations. When

transporting ordnance in a vehicle, consult the HERO portion of the facility's ESMP or maintain the calculated safe separation distance.

Note: An exception may be made to the requirement for insulating links if a HERO evaluation is available that provides specific HERO guidance. The general condition for HERO SUSCEPTIBLE ORDNANCE must be set when applying alternative requirements. Otherwise, maintain the safe separation distances (obtained using the HERO Safe Separation Distance Calculator) between the ordnance operation and affected antennas. HERO UNSAFE ORDNANCE and HERO SUSCEPTIBLE ORDNANCE may be protected from EMEs by enclosing the ordnance in sealed, all-metal containers.

d. In general, managing ordnance operations in the EME is done by maintaining safe separation distances, managing the EME (reducing the emitter's output power), or combining both. By using the ordnance's HERO classification and the measured or calculated RF environment from fixed (or permanently located) emitter systems, the best method can be determined.

(1) To determine the calculated HERO safe separation distance for an emitter, specific characteristics, such as average transmitter power, minimum operational frequency, and antenna gain, must be identified to maintain safe separation distances. Then the MAE, or the limits provided in the HERO curves for SUSCEPTIBLE and UNSAFE ORDNANCE, must be identified. The equations in figure 16–11 are used to determine the distance at which the EME should not create a hazard to the munition. After all the emitters have been evaluated, ensure that the ordnance area is farther away from the worst-case distance. Note that providing HERO safe separation distances based on HERO classification is purely analytical and is generally a more conservative approach for managing HERO, and the result typically has more restrictions and provides less operational flexibility.

(2) If the above method cannot be accomplished because of limited real estate, then one must manage the EME at the ordnance location. Consequently, measured data is used to characterize the EME better and identify which transmitter/antenna systems will be secured (or reduced in power) when HERO UNSAFE or HERO SUSCEPTIBLE ordnance is present. The administrative workaround is implemented using HERO EMCONs. For example, HERO EMCON Condition 1 might require silencing a high-frequency antenna while HERO UNSAFE ORDNANCE is present.

(3) There may be situations where you don't have the real estate to maintain the safe separation distance, and the offending emitter(s) cannot be reduced in power or silenced. Another approach (although not a simple one) can be employed. After determining the level of the EME at the ordnance location, comparisons of the MAEs for each ordnance item at the site (in each of its applicable S4 phases) are made to ensure the operation can be completed safely. HERO EMCONs can be tailored for each ordnance located at the location. The life cycle management command/material support command Safety Office should be consulted as necessary.

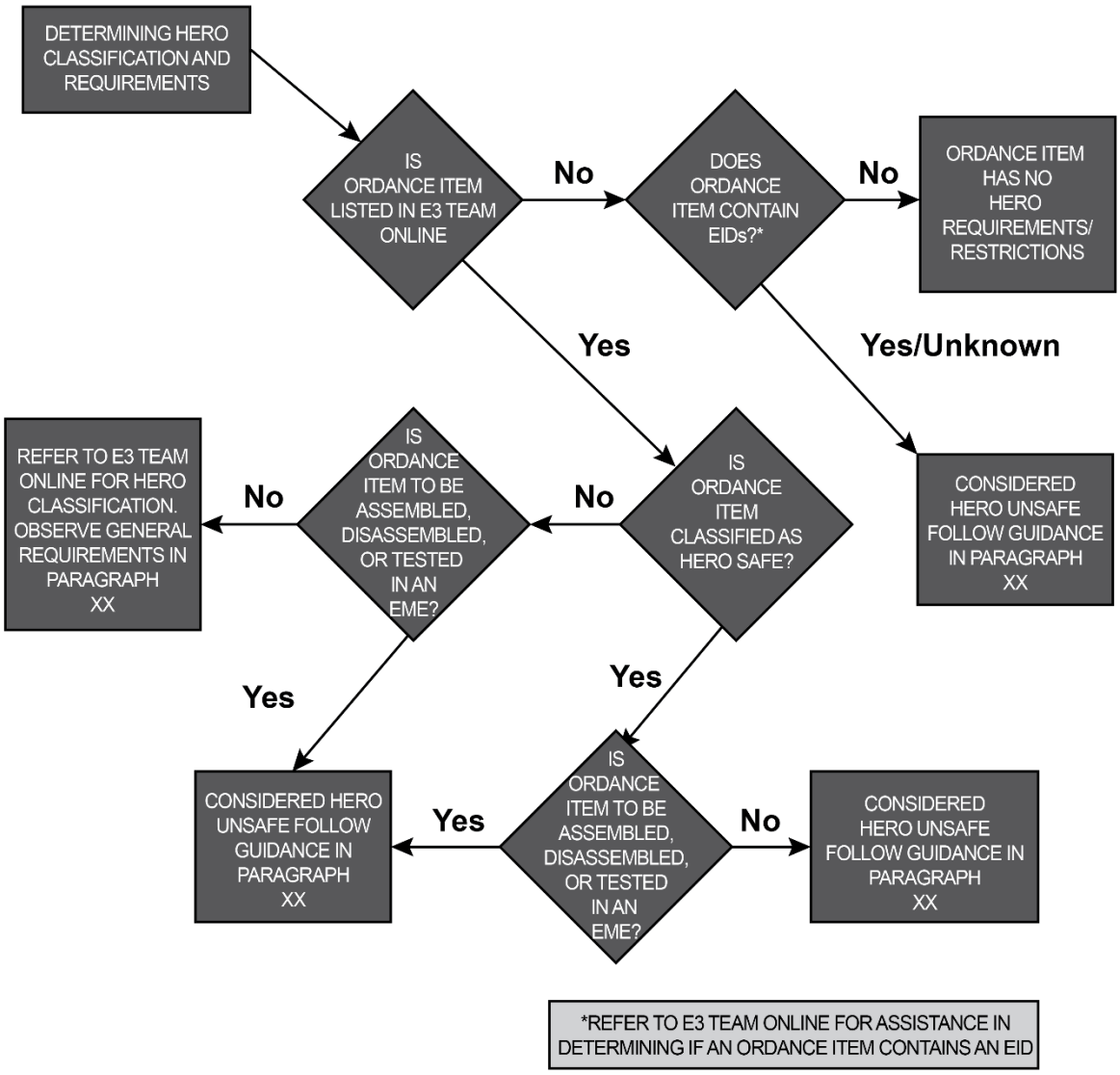


Figure 16–9. Process for determining hazards of electromagnetic radiation to ordnance classification

Table 16–3
Minimum safe separation distance exceptions—Co

MINIMUM SEPARATION DISTANCE (ft.)	HERO CLASSIFICATION		
	SAFE	SUSCEPTIBLE	UNSAFE OR UNRELIABLE
≥10	General HERO Requirements	Use Calculated Distance	Use Calculated Distance
5	0.5 < EIRP < 5 watts All Frequencies	EIRP < 0.5 watts Frequencies > 100 MHz	0.025 < EIRP < 0.1 watts 200 MHz < Freq < 1 GHz
1	0.1 < EIRP < 0.5 watts All Frequencies	0.025 < EIRP < 0.1 watts Frequencies > 200 MHz	0.025 < EIRP < 0.1 watts Frequencies > 1 GHz

Table 16–3
Minimum safe separation distance exceptions—Continued

0	EIRP < 0.1 watts All Frequencies	EIRP < 0.025 watts All Frequencies	EIRP < 0.025 watts Frequencies > 100 MHz

ALL ORDNANCE: Maintain 5 feet (1.5 meters) from rigid waveguide routed through magazines.

$EIRP = P_t \times G_t$

Where:

EIRP is the effective isotropic radiated power in watts.

P_t is the average power output of the transmitter in watts.

G_t is the numerical (far-field) gain ratio (not the dB value) of the transmitting antenna, derived as follows: $Gt = 1 \times 10^{G/10}$ where G = gain in dBi

Example: If the antenna far-field gain is 2.1 dBi, the far-field gain ratio is $1 \times 10^{2.1/10} = 1 \times 10^{0.21} = 1.62$

Graph for Computing Safe Field Strength

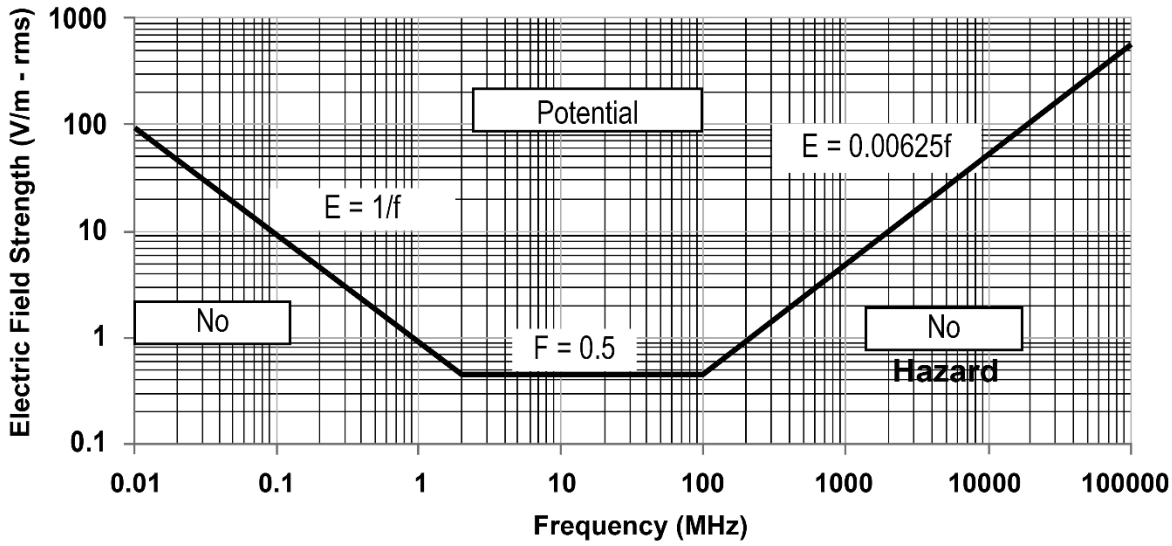


Figure 16–10. Radio frequency free environment

Safe Separation Distance Calculations

Frequency Ranges (MHz)	HERO SUSCEPTIBLE Distance Equations	HERO UNSAFE Distance Equations
0.01 £ *f* < 2.0	$D = 1.37 f \sqrt{P_t G_t}$ meters	$D = 5.5 f \sqrt{P_t G_t}$ meters
	$D = 4.5 f \sqrt{P_t G_t}$ feet	$D = 18 f \sqrt{P_t G_t}$ feet
2.0 £ *f* < 80.0	$D = 2.74 \sqrt{P_t G_t}$ meters	$D = 10.95 \sqrt{P_t G_t}$ meters
	$D = 9 \sqrt{P_t G_t}$ feet	$D = 36 \sqrt{P_t G_t}$ feet
80.0 £ *f* < 100, 000	$D = 219 f^{-1} \sqrt{P_t G_t}$ meters	$D = 876 f^{-1} \sqrt{P_t G_t}$ meters
	$D = 718 f^{-1} \sqrt{P_t G_t}$ feet	$D = 2873 f^{-1} \sqrt{P_t G_t}$ feet
Where: D is the distance in the units designated.		
f is the transmitting frequency in megahertz (MHz)		
P_t is the average power output of the transmitter in watts.		
G_t is the numerical (far-field) gain ratio (not the dB value) of the transmitting antenna, derived as follows: Gt = 1 x 10 G/10 where G = gain in dBi,		
Notes: 1. The information above represents “worst-case” conditions for safe distance required.		
2. Equations are provided with the proper numerical multipliers to yield distances in either meters or feet.		
3. In cases where the computed safe separation distance is less than 10 feet (3 meters), refer to table 16-3a for guidance.		

Figure 16–11. Safe separation distance calculations

16–18. Hazards of electromagnetic radiation to ordnance emission control plan

a. HERO EMCON plan is the management of electromagnetic emissions to prevent the inadvertent actuation or damage to EIDs contained in ordnance items. The HERO EMCON Plan is a set of procedures developed for managing HERO in areas where ordnance is present and is the main product of the HERO Survey and ordnance testing procedures. The purpose of the EMCON Plan is to prescribe, through advance planning, the easiest and most efficient method of managing the conflict between the EME created by transmitting equipment and electrically initiated ordnance.

b. HERO safety programs will comply with the following:

(1) Each activity and/or installation is required to establish and maintain an effective HERO Safety Program. Directions and procedures (for example, a set of local instructions) must be established to support the EMCON Plan that provides operational guidance for all operations, exercises, and activities involving ordnance. The process starts with an assessment of munition and transmitting equipment locations, including operations, storage, and on-post transportation routes. The assessment may require the completion of an instrumented HERO survey. The assessment must evaluate ordnance distance from transmitters and be used to support the subsequent development and the EMCON Plan's review/certification of the EMCON Plan by USATCES before implementation. The development and certification of the EMCON Plan ensures that all aspects of HERO have been considered and that the final EMCON Plan provides a near-zero risk-based solution for managing ordnance operations.

(2) It is important that the EMCON Plan is updated whenever changes have occurred to the ordnance operations or when the emitter system configuration has changed. Ordnance changes include the introduction of new ordnance items, weapons platforms, or ordnance operation areas. Emitter changes include the introduction of new/modified emitter systems or the relocation of existing emitter antennas.

c. EMCON plan development will include the following:

(1) The EMCON Plan development process is shown in figure 16–12. The three critical elements necessary for developing the EMCON Plan are the emitter list, ordnance inventory list, and drawings highlighting ordnance storage, operations, and transportation locations. The figure 16–12 flowchart shows how these critical elements cumulate into the HERO EMCOM Plan. The following paragraphs describe each flowchart block and its relation to the EMCON Plan development process.

(2) The emitter list contains an inventory of all fixed, mobile, and portable emitter systems installed or used on the installation or within the operating area. This listing provides the user with the location designation for each transmitting antenna and the calculated HERO SUSCEPTIBLE and HERO UNSAFE ORDNANCE safe separation distances. These calculated distances are considered worst-case in that they assume main-beam illumination and maximum efficiency of the transmitter/antenna system as it relates to the RF output power (that is, no system losses). Also, these calculated distances do not consider system losses and derive safe separation distances for a category of ordnance (that is, SUSCEPTIBLE, or UNSAFE) based on the worst-case susceptibility for that category and not on the specific susceptibility for an ordnance item. The EMCON Plan may be refined based on an instrumented survey (that is, measurements of the EME), considers all of the transmitter systems documented, and generally is not based on calculated safe separation distances but rather measured data. As such, the measurement-based EMCON Plan obtained from a HERO survey is more than a two-dimensional safe separation distance paper study in that it measures the true RF environment and considers system operation parameters (that is, elevation, and azimuth restrictions), off-axis radiation levels, and their proximity to ordnance locations and the surrounding structures or terrain. The instrumented survey provides a less restrictive means for managing HERO and minimizes the impact on operations. Consequently, the calculated safe separation distances are a general indicator of the potential for HERO for fixed emitter systems. Calculated distances apply more specifically to portable, mobile, and aircraft radios since these systems are not used at any fixed location. However, the safe separation distances for fixed emitter systems do apply to the main-beam illumination of in-flight aircraft.

(a) Each antenna normally correlates to a building or structure assigned a building/structure identification number to specify its location.

(b) The list also contains the emitter system specifications that were used to calculate the safe separation distances. The emitter system specifications necessary to calculate the separation distances are transmitter maximum average output power, frequency range, and antenna gain. Depending on how the equipment is used, the maximum average output power for each mode of operation may also be listed.

(c) The lowest frequency capability of the transmitter is used when calculating the safe separation distances. The exception to this rule is for frequencies below 2 MHz, where the highest frequency is used.

(d) The emitter listing should be updated whenever new emitter equipment is installed, or existing emitter equipment is relocated. Emitter equipment removed from service should also be annotated. The responsibility to maintain the emitter list normally resides with the facilities Spectrum Manager, reference AR 5–12, paragraph 2–3b.

(3) An ordnance list will be maintained to show each ordnance item’s respective HERO classification (for example, No HERO Requirement, HERO SAFE ORDNANCE, HERO SUSCEPTIBLE ORDNANCE, or HERO UNSAFE ORDNANCE). The DoDIC sorts the ordnance items. The HERO concern items

contain EIDs, indicated by a HERO classification of HERO SAFE ORDNANCE, HERO SUSCEPTIBLE ORDNANCE, or HERO UNSAFE ORDNANCE.

(a) Ordnance susceptibility can be found on the DA-approved E3 risk assessment database Platform Ordnance Application, which contains the HERO database and platform management tool. The ordnance application produces an output report that lists each item's DoDIC, description, and HERO classification. The application also enables the user to access the ordnance data sheets electronically. These data sheets provide information on each item, including overall HERO classification, MAEs for each applicable S4 phase, NSN, part numbers, packaging, and application on which the item has been tested or evaluated. It is important to note that an item's susceptibility can vary depending on its application and/or platform.

(b) Ordnance items that are listed as Unserviceable Condemned components of AURs or HERO untested ordnance items (that is, items that contain EIDs and are not listed in the DA-approved E3 risk assessment database) are to be treated as HERO UNSAFE ORDNANCE until a new HERO status is established.

(c) The ordnance list must be updated whenever new ordnance items are introduced, or changes have occurred to existing ordnance items' HERO classification. The responsibility to maintain the ordnance list normally resides with the installation/activity Safety Office in coordination with the ASP.

(4) Drawings will be maintained to show the locations of all the installed emitter equipment and identify ordnance operation areas. Ordnance locations include all locations represented in the S4 phases: transportation/storage, assembly/ disassembly, staged, handling/loading, and platform-loaded.

(a) The drawings must be updated whenever changes to the fixed emitter configuration or when new ordnance operation areas are established or relocated.

(b) The responsibility to update and maintain the drawings must reside with the Installation Master Planning Office in coordination with the installation/activity Safety Office.

(5) The next step in the EMCON Plan development is determining the emitter systems that require HERO EMCON. This is accomplished in a three-phased approach.

(a) Phase 1 is the safe separation distance comparison. A comparison of the emitter's calculated HERO UNSAFE, and HERO SUSCEPTIBLE ORDNANCE safe separation distance arcs with respect to ordnance operation areas is conducted to determine if the emitter equipment can potentially impact ordnance operation areas. These distances represent the worst-case condition for HERO UNSAFE and HERO SUSCEPTIBLE ORDNANCE. This comparison is accomplished by superimposing these safe separation distance arcs onto the drawings to determine if the arcs impinge upon ordnance operation areas. The emitter equipment that does not impinge upon ordnance operation areas will not require HERO EMCON, and no further action is required. However, emitter equipment whose separation distance arcs do impinge upon ordnance operation areas is identified for further study and possible HERO EMCON. Further analysis is necessary because these calculations are worst-case and do not consider antenna location, antenna orientation, antenna pattern, or system losses that can potentially reduce the system's efficiency, thus reducing the EME levels produced. This, in turn, reduces the actual distances where the ordnance MAEs are exceeded. The HERO safe separation distances must be maintained between the emitter equipment antenna and ordnance operation areas for portable and mobile transmitter systems.

(b) Phase 2 is the antenna radiation pattern analysis. An analysis of the antenna's vertical location (that is, height above ground), vertical beam width, and azimuth radiation pattern, including any installed radiation cutouts in relation to ordnance operation areas, is conducted to determine if the emitter equipment can potentially impact ordnance operation areas. Emitter equipment that is determined to not be capable of illuminating ordnance operation areas does not require HERO EMCON. Systems capable of directly illuminating ordnance areas are identified for measurement to quantify the EME levels. The measured EME levels are used to formulate the appropriate HERO EMCON procedures to manage the emitter equipment for HERO.

(c) Phase 3 is EME measurements. EME measurements may be taken during a HERO survey process and used to formulate system-specific HERO EMCON procedures. These HERO EMCON procedures may end up being as restrictive as the safe separation distance comparison but usually result in less restrictive procedures due to the reasons stated in paragraphs 16–18c(2) and 16–18c(5)(b).

(6) The next step in the process is to establish EMCON conditions based on the ordnance HERO classification and the proximity to transmitters. EMCON conditions are a set of mitigations that apply to specific ordnance locations. Mitigations could include restricting RF transmissions during certain operations and controlling antennae elevation and/or azimuth to minimize impact.

(7) The EMCON conditions, along with the emitter equipment and ordnance lists, make up the EMCON Plan. In addition to the specific guidance provided in the EMCON Plan, the general HERO requirements during ordnance operations are found in paragraph 16–17. The Safety Office must conduct a documented annual review of the EMCON Plan to ensure new emitters (portable or fixed) or new ordnance configurations have been appended properly to the EMCON Plan to reflect the current HERO posture.

(8) Each installation/activity must develop a written HERO Safety Program and is a two-part document consisting of procedures for managing HERO and setting HERO EMCON during ordnance operations (that is, EMCON Plan) and an administrative section that assigns responsibilities for establishing/maintaining a HERO Program, monitoring the HERO posture of the installation, and procedures for setting HERO EMCON. This information may be included in the installation/activity ESMP.

(9) To determine the appropriate HERO EMCON condition to set, identify the HERO classification of the ordnance item(s) involved in the operation (see the DA-approved E3 risk assessment database).

(a) For ordnance item(s) listed as HERO UNSAFE or HERO SUSCEPTIBLE: identify the location where the ordnance operation will occur; select the proper HERO condition associated with the location and HERO classification; apply the appropriate HERO EMCON procedures.

(b) For ordnance item(s) listed as HERO SAFE ORDNANCE, follow all HERO SAFE ORDNANCE requirements established in paragraph 16–17.

(c) Ordnance items listed as “No HERO Requirement” require no HERO EMCON.

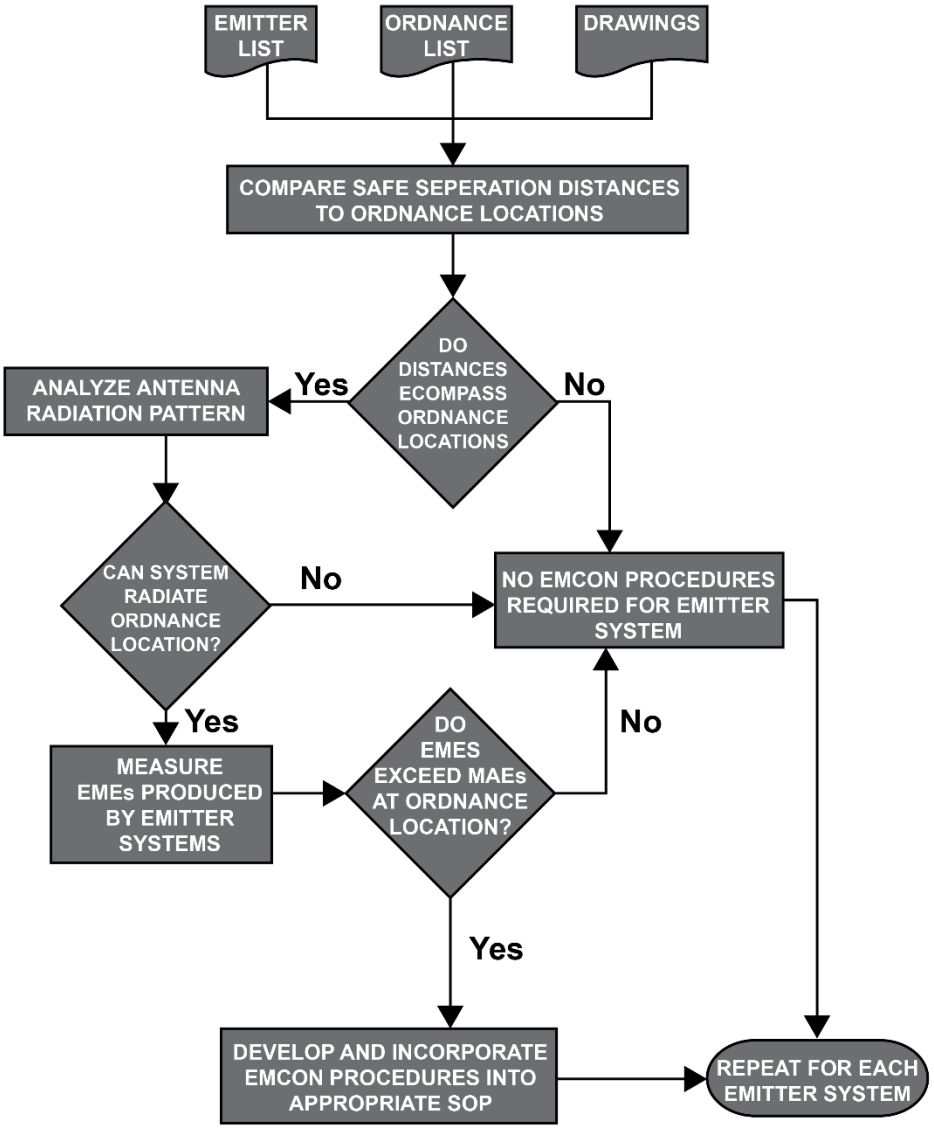


Figure 16–12. Emission control development process

Section V

Lightning Protection

16–19. Fundamental principles of lightning protection

a. NFPA 780 (current edition), “Standard for the Installation of Lightning Protection Systems,” will be the guidance for LPS employed to protect army AE facilities and sites.

b. The fundamental principle for protecting life and property against lightning is allowing a lightning discharge to enter or leave the earth without damage or loss. A low impedance path should be offered, which the discharge current will follow in preference to all alternative high impedance paths offered by building materials such as wood, brick, tile, stone, or concrete. When lightning follows the higher impedance paths, damage may be caused by the heat and mechanical forces generated during the discharge

passage. Most metals, being good electrical conductors, are virtually unaffected by either heat or mechanical forces if they are large enough to carry the current that can be expected. The metal path must be continuous from the earth electrode system to the air terminal. Care should be exercised in selecting metal conductors (see table 16–4) to ensure the integrity of the lightning conductor for an extended period. In most atmospheres, a nonferrous metal such as copper or aluminum will provide a lasting conductor free of the effects of rust or corrosion.

c. Parts of structures most likely to be struck by lightning are those that project above surrounding parts, such as chimneys, ventilators, flagpoles, towers, water tanks, spires, steeples, deck railings, antennas, shaft-houses, gables, skylights, dormers, ridges, and parapets. The roof edge is the part most likely to be struck on flat-roofed buildings.

d. An LPS consists of three basic parts that provide the low impedance metal path required:

(1) A system of air terminals or overhead wires on the roof and other elevated locations;

(2) A system of earth electrodes, and

(3) A conductor system (down conductor) connecting the air terminals to the earth electrode system.

e. Properly located and installed, these basic components described in paragraph 16–19.*d* improve the probability that lightning discharge will be conducted harmlessly between the air and ground terminals.

16–20. Locations requiring a lightning protection system

a. LPS will be installed on all facilities and/or locations used for development, manufacturing, testing, handling, storage, inspection, holding, or maintenance of AE.

b. An LPS will be required at a demilitarization or disposal site when:

(1) Personnel are required to work or remain at the site during the approach of or during a lightning storm.

(2) The respective commander can determine whether an LPS is necessary to protect personnel or equipment based on a thoroughly documented risk assessment. The documentation will be maintained in records at the appropriate safety office.

c. Underground storage with metal or structural parts that have less than 2 feet of earth cover will be protected as an AGS.

d. NFPA 780, Section 8.1.1, currently exempts AE structures that contain HD 1.4 AE or a structure containing an HC/D with a NEW of less than 25 pounds from LPS requirements. However, this is not authorized by current DoD and Army guidance.

16–21. Locations not requiring lightning protection

Under conditions specified in the following subparagraphs, lightning protection may be omitted from certain AE facilities. If lightning protection is not installed on a facility, the reasons for not protecting the facility must be documented and kept with DDESB/USATCES ESP documentation. Bonding and surge suppression requirements still apply.

a. An LPS may be omitted on facilities equipped with an adequate lightning warning system (see table 16–4) when all the following conditions can be met—

(1) Operations can be terminated before the storm strikes;

(2) All personnel can be evacuated to IBD; and

(3) The expected damage due to a lightning strike will not seriously affect the garrison or installation mission.

b. An LPS may be omitted on facilities without a lightning warning system where—

(1) Personnel are not expected to sustain injury; and

(2) The resulting economic loss of or to the facility, it contents, or surrounding facilities is minimal.

c. Lightning protection may be omitted on facilities that—

(1) Contain only AE that cannot be initiated by lightning;

(2) As determined by USATCES and approved by DDESB; and

(3) No fire hazard exists.

16–22. Requirements for lightning protection systems

a. Army installation SCs; Army activity Commanders, when storing AE on a DoD installation under the control of another Military Service; or an Army Commander’s designated representative who has the appropriate authority are required to ensure the adequacy of LPS for existing AE facilities or accept the risk

associated with a waiver or exemption of LPS requirements. To meet this condition, the following requirements must be met:

(1) A Facility Engineer (FE) has determined that the LPS is compliant with or equivalent to the criteria in DESR 6055.09, NFPA 780, and this pamphlet and, therefore, is adequately protective.

(a) The Army Commander or Army Commander's designated representative must have verified the FE to be a qualified person in compliance with AR 385–10 (a qualified FE). AR 385–10 and NFPA 70e indicate that a qualified person is "... one who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations, and has received safety training to identify and avoid the hazards involved."

(b) At a minimum, the qualified FE making the determination must have successfully completed at least one of the following DAC courses:

1. Ammo-28 Army Electrical Explosives Safety (4E–F32/645–F16 (MC));
2. Army Electrical Explosives Safety (CERT) (4E–F33/645–F17 (DL));
3. Navy Electrical Explosive Safety (CERT) (4E–F35/645–F19 (DL)); or
4. Air Force Electrical Explosive Safety (CERT) (4E–F38/645–F22 (DL)).

(2) The Army Commander or Army Commander’s designated representative must:

(a) Accept the risk associated with waiving or exempting LPS requirements for the AE facility and document in DA Form 7632; and

(b) Approve actions taken to mitigate the risk.

b. A qualified FE will review LPS test and inspection reports and ensure that necessary maintenance is being conducted and repairs made. The installation’s Safety Office or the Army activity storing munitions on a DoD installation under the control of another Military Service will maintain records that document tests, inspections, and repairs for at least six inspection cycles.

c. RESSs will include a statement that:

(1) The design and installation of LPS meet the criteria of DESR 6055.09, NFPA 780, and this pamphlet or provides equivalent protection as verified by a qualified FE; or

(2) The requirement for an LPS has been waived or exempted with the associated risk accepted by the Army Commander or Commander’s authorized representative.

d. USATCES approval of a RESS is the Army’s acceptance of the adequacy and protectiveness of the LPS. USATCES concurrence with the risk the Army Commander or Commander’s authorized representative provides is the Army’s concurrence with the risk being accepted.

16–23. Types of lightning protection systems

The following LPSs are listed in the NFPA and are the only ones currently approved for use:

a. An integral system consists of air terminals mounted directly on the structure to be protected, down conductors, and a grounding system. This system is used to protect structures. Air terminal spacing will meet the requirements of the 100-foot zone of protection (see appendix F). Metallic building components which are at least 3/16 inches thick may be used as down conductors.

b. A mast system consists of an air terminal (lightning rod) on a mast, down conductors, and an earth electrode subsystem. This system can be used to protect either structures or areas. Masts will be separated by a minimum of 6 feet from the building or stack of munitions being protected.

c. A catenary system consists of one or more overhead wires strung between masts and connected to a grounding system. This system is normally used to protect large open areas, such as a truck holding yard, but may also be used to protect structures.

(1) Masts of wood, used either separately or with ground wires, must have an air terminal extending at least two feet above the top of the pole, attached to the pole as in figure 16–13, and connected to the grounding system.

(2) In the case of an overhead ground wire system, the pole guy wire must be permitted to be used as the down conductor (see figure 16–14).

(3) The air terminal and the down conductor must not be required for grounded metallic masts.

d. A m*etallic (Faraday-like) cage system is a* structure of all metallic construction or has metallic structural members that form a cage-like design that keeps lightning currents on the exterior (thereby protecting the items in the interior). Structures considered metallic (Faraday-Like) structures must gain the approval of the USATCES and the DDESB.

16–24. General prohibitions

a. When aluminum is used, the following applies:

(1) Aluminum lightning protection equipment will not be installed on copper roofing materials or other copper surfaces or where exposed to runoff from copper surfaces.

(2) Aluminum materials will not be used where they come into direct contact with the earth. Fittings used to connect aluminum down conductors to copper, or copper-clad grounding equipment will be bimetallic. Bimetallic connectors will be installed at 18 inches or higher above the earth level.

(3) Connectors and fittings will be suitable for use with the conductor and the surfaces on which they are installed. Bimetallic connectors and fittings must be used for splicing or bonding dissimilar metals.

(4) An aluminum conductor will not be attached to a surface coated with alkaline-base paint, embedded in concrete or masonry, or installed in a location subject to excessive moisture.

b. Copper lightning protection materials will not be installed on aluminum roofing, siding, or other aluminum surfaces.

c. Galvanized steel will not be used in areas where atmospheric conditions are destructive to galvanized steel. Where galvanized steel conductors are used, the individual wires of the cable will have a protective coating of zinc (hot-dipped process). This treated cable must be capable of withstanding four 1-minute immersions in a standard copper sulfate solution without showing a fixed deposit of copper.

d. Where copper-clad steel is used, the copper covering will be permanently and effectively welded to the steel core. The portion of copper will be such that the conductance is not less than 30 percent of the conductance of an equivalent cross-section of solid copper.

e. Stainless steel is very susceptible to corrosion in many soil conditions. Extreme caution will be used, along with a proper soil analysis when this material is used. Records of the soil analysis will be kept as a permanent part of the lightning protection records.

f. Steel arch and reinforced concrete arch magazines with design discontinuities between the steel in the arch and the steel in the floor should not be used to store AE.

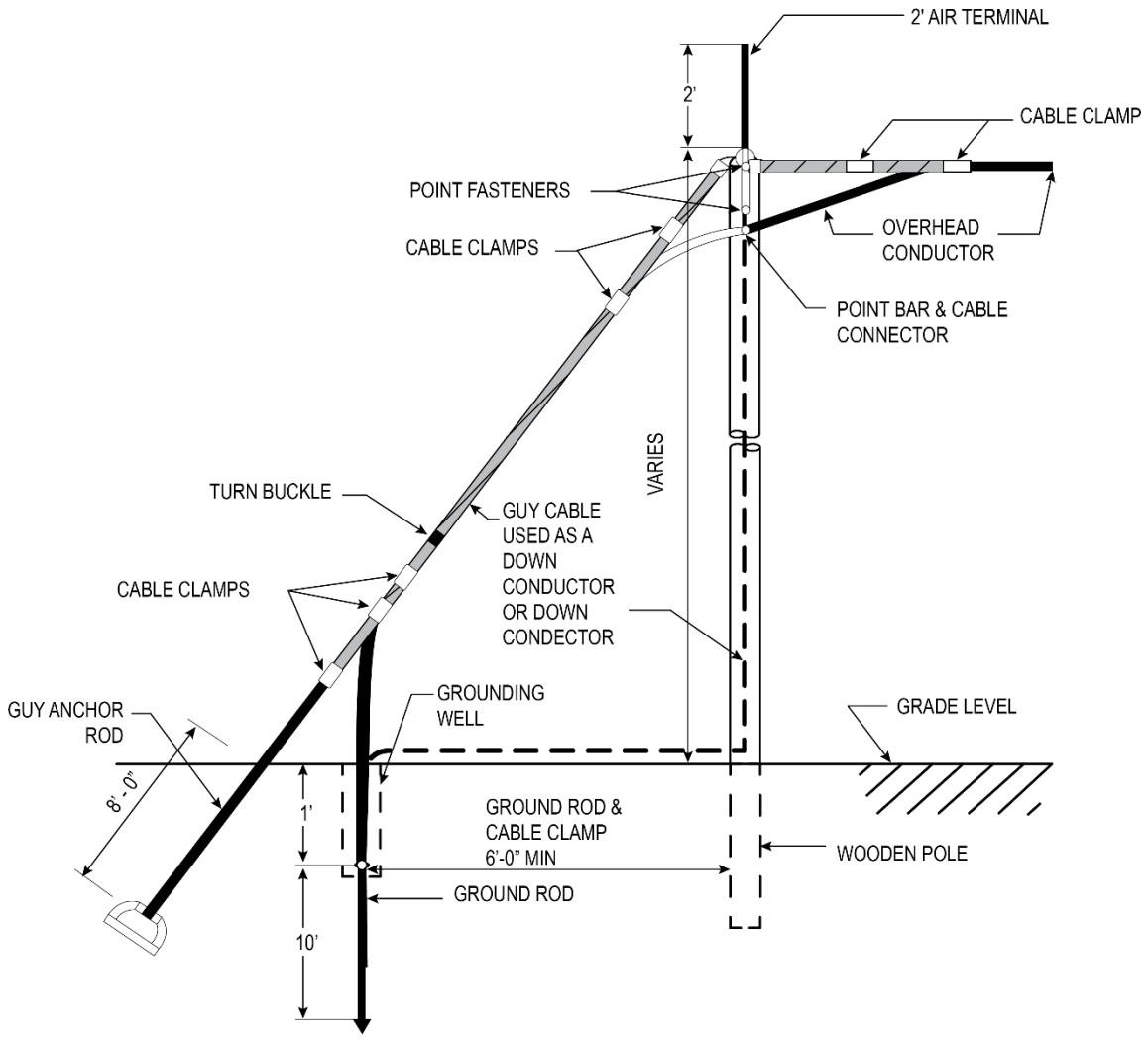


Figure 16–13. Overhead pole and cable details (catenary system)

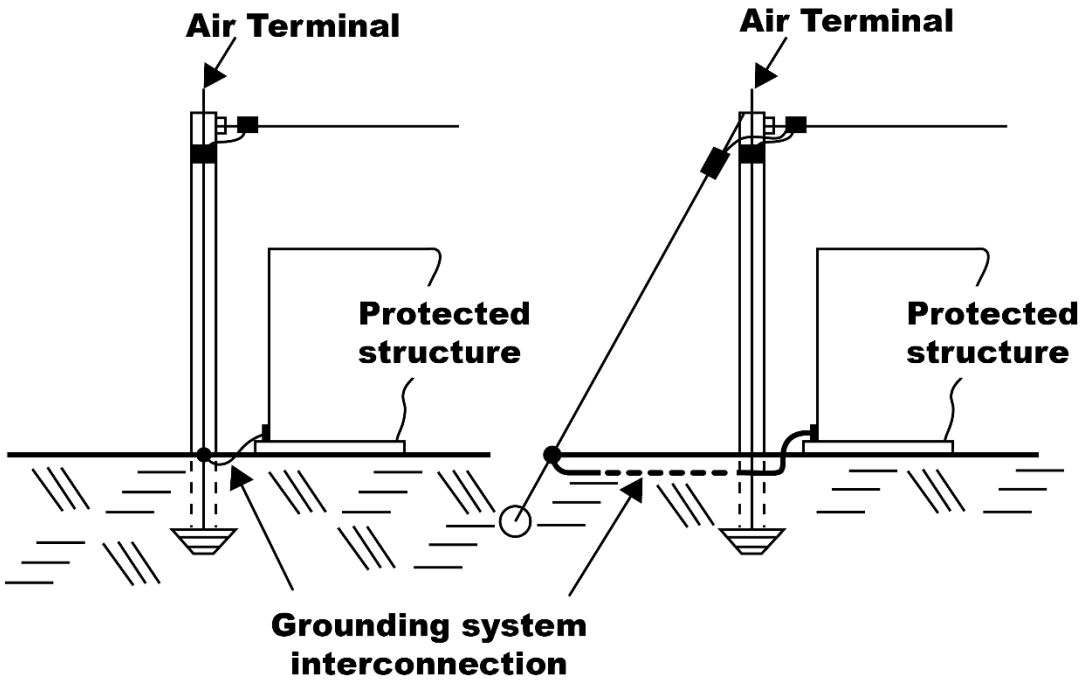


Figure 16–14. Alternate grounding methods for overhead ground wire protection

16–25. Bonding

a. Protection from side flash must be obtained by either separation distance or by bonding. The required separation distance must be determined by using the formula in NFPA 780. Bonding is used to reduce the possibility of a side flash and is used to ensure no electrical potential differences are produced by lightning current. Chapter 4 of NFPA 780 must be used to determine the minimum bonding requirements except as modified herein.

b. For buildings that are 36 feet in height or less:

(1) Bonding will be required for large masses of metal (400 inches square or larger surface area) located on the exterior or within facilities;

(2) Bonding is also required if the object is within 6 feet of an opening or within six feet of any part of the LPS. Examples include facility metal items such as radiators, tanks, permanent machinery, stair rails, ventilator, metal doors, air conditioning ducts, metal columns, and metal siding.

c. For buildings greater than 36 feet in height: Bonding will be required as specified in NFPA 780.

d. The material used to bond the LPS to the grounding loop conductor will meet the requirements of NFPA 780. The resistance of any object bonded to the LPS will not exceed one ohm.

e. Fences and gates which come within 6 feet of an AE structure's LPS will be bonded to the structure's LPS.

f. Railroad tracks that run within 6 feet of an AE structure's LPS will be bonded to the structure's LPS or its grounding system. If the tracks are used to carry electrical signals, they will have insulated joints immediately external to bond the LPS's ground loop conductor. If these tracks enter a facility, they will also be bonded to the structure's frame or equivalent.

g. Bonding distances can be reduced by application of the bonding distance formula in NFPA 780. The use of reduced bonding distances must be documented.

16–26. Lightning warning systems

a. Lightning warning systems provide a positive, reliable means of continuously monitoring and recording atmospheric voltage gradient. They can detect atmospheric conditions that may produce lightning in the vicinity. Lightning warning systems installed and properly maintained can detect thunderstorms up to 200 miles away and indicate the direction of approach.

b. Locations relying on a lightning warning system instead of LPS will establish specific procedures for terminating AE operations at the approach of a thunderstorm. These procedures will be based on the sensitivity of the operation involved and the time required to terminate operations safely. At the minimum, the lightning warning system must allow termination of AE operations and evacuation before the storm is 10 miles from the location.

c. Location without lightning warning systems will also be required to develop detailed procedures for evacuating AE facilities at the approach of a storm. These procedures will address at a minimum:

(1) The decision to terminate an operation and/or evacuate on a case-by-case basis pending an evaluation of the risks to operations and support personnel.

(2) Procedures must identify a responsible individual who has the authority to decide when an evacuation is necessary. Following are some examples of facilities that should be evacuated in the event of a probable electrical storm:

(a) All operations involving EIDs and exposed explosives or propellants.

(b) Buildings containing explosives, dusts, or vapors, whether, or not equipped with approved LPSs and locations within ILD of these facilities.

(c) Outdoor operations with unpackaged munitions or ammunition operations being conducted without lightning protection.

16–27. Structural grounds

On all new construction and extensive renovation, the structural steel in all AE facilities will be bonded to the facility grounding system. No greater than 1-ohm resistance will exist between the structural steel and the grounding system. Testing must be performed in accordance with appendix F.

16–28. Grounding

For details on grounding, use table 16–4 and Section III.

16–29. Surge protection

a. An LPS for AE structures will use surge protection for incoming conductors meeting the requirements of NFPA 780.

b. Power and communication lines will enter the facility in underground shielded cables or in metallic conduits which enter the ground at least 50 feet from the facility. In addition, intrusion detection systems and other metallic lines will run underground for at least the last 50 feet up to the structure. Surge suppression for incoming conductors must include suppression at the entrance to the building from each wire to ground. The use of low-pass filters will be considered for added protection on specific critical electronic loads as determined by the user.

c. Fiber optic cables do not need to run underground before entering the building.

d. Steam, water, and air conditioning lines may run above-ground as long as they are bonded to the structure's LPS before entering the structure. If these lines are not bonded to the LPS, they will run the last 50 feet to the building underground.

16–30. Visual inspection requirements

See table 16–1 and appendix F, paragraph F–2.

16–31. Electrical testing requirements

See table 16–1 and appendix F, paragraph F–3 for inspection and test criteria.

a. The resistance of any component of the LPS will not exceed the value specified in table 16–1.

b. The resistance of any metal object bonded to the LPS will not exceed the values specified in table 16–1.

c. Any standard ohm meter capable of reading 1 ohm with a manufacturer's certified accuracy of ± 0.1 ohm and measuring bond connections for large facilities can be used. Analog meters can continue to be

used, but all newly procured meters must have a resolution of 0.1 ohms and 1-ohm capability with an accuracy of ± 0.1 ohms.

d. All test equipment must be calibrated by TMDE in accordance with the manufacturer's specifications. DA Label 80 calibration label must be affixed to all test equipment.

e. Some garrisons or installations have LPSs unique to their particular location. Compliance with all testing details as stated in this chapter may not be practical or possible due to variations in building features, unavailability of as built drawings, or even terrain features (rock or concrete-covered ground near structures to be tested). When strict compliance for test and inspection of a facility cannot be accommodated, garrisons, or installations must make maximum use of expertise available; for example, electrical engineers must develop a reasonable and well-documented LPS test and inspection plan. This plan will be forwarded to the respective ACOM, ASCC, or DRU for coordination and approval. Once approval has been granted, the documentation must be retained with the garrison or installation's permanent LPS records.

f. ECMs designed and constructed to be compliant with the metallic cage criteria, as defined in NFPA 780, do not require earth resistance testing.

16–32. Records

The inspection and test reports and/or records will be maintained in the garrison or installation safety office; unless an alternate office is specifically designated by the garrison or SC. Records of tests and inspections will be kept on file for the last six inspection cycles. These records will be reviewed for deficiencies. Significant variances will be analyzed to determine causation.

16–33. Truck holding areas

For designated established truck holding areas, lightning protection must be applied. For undesignated truck holding sites used in support of field training exercises, lightning protection is not necessary if the following requirements are met:

a. AE QD limits and vehicle separations are strictly enforced.

b. Onsite security personnel are kept to a minimum.

c. The sites are located away from lightning conductors and attractors.

16–34. Lightning protection for empty facilities

Empty AE facilities that have been inspected, certified empty, and sealed (with numbered and recorded seals) will be considered no longer used for development, manufacturing, testing, handling, storage, maintenance, or demilitarization and/or disposal of AE. These facilities will no longer require either a visual inspection or an electrical test of the LPS, as described in this chapter. All visual inspections and electrical tests required by this chapter will be performed before reactivating the AE facilities. This requirement is applicable to empty facilities at active garrisons or installations as well as facilities at garrisons or installations on the Base Closure List.

16–35. Field expedient grounding techniques

a. The ground rod technique is as follows:

(1) Drive a 3-foot ground rod into moist earth to a depth of approximately 30 inches.

(2) Attach a length of cable (having a resistance value of less than 1 ohm) to the item being worked and the driven ground rod. (Example: When working on propelling charges in the field. Drive the ground rod. Attach one end of the lead to the charge container and the other to the driven ground rod.)

b. Equalization of the potential method. The equalization of the potential method equalizes the static electricity charge potential between the item and the operator. For this reason, equalizing the potential method will be used when no other method is available. This method consists of the operator touching a mass of bare metal before touching the item being worked.

Table 16–4
Lightning protection systems 6

Item	Material	Size requirements	Restrictions
Ground rod	-Copper -Copper-clad steel	0.75 inch in diameter or larger; not less than 10 ft long.	-The top of the rod must be at least 12 inches below the finished grade.

Table 16–4
Lightning protection systems 6—Continued

	-Stainless steel[2] -Hot-dipped galvanized steel[3]		-Must be free of paint or other nonconductive coatings.
Ground loop (counterpoise)	-Stranded copper -Copper-clad steel cable	Must be at least 1/0 AWG with no single strand less than 17 American Wire Gage (AWG) (0. 045 inch) in size.	-Must be at least 30 inches below the finished grade. -Must be located at least 3 ft, but not more than 8 ft from the building foundation or footing. -All bends in the cable must be not less than 90°.
Air terminal	-Solid copper -Copper-clad steel -Hot-dipped galvanized steel[3]	-Must be at least 24 inches high and extend at least 10 inches above the structure to be protected. -Must be 3/8 inch in diameter (Class I)[4] or 1/2 inch (Class II)[5] in diameter below the taper.	-Air terminals will be either tapered to a sharp or blunt point. -Separate points are not required on top of air terminals; but, if they are used, they must be substantial and securely attached by screw or slip joints.
Air terminal	-Solid aluminum[1]	-Must be at least 24 inches high and extend at least 10 inches above the structure to be protected. -Must be 1/2 inch in diameter (Class I)[4] or 5/8 inch (Class II)[5] in diameter below the taper.	-Air terminals will be either tapered to a sharp or blunt point. -Separate points are not required on top of air terminals; but, if they are used, they must be substantial and securely attached by screw or slip joints.
Catenary (overhead wire) system	-Copper -Copper-clad steel -Aluminum[1] -Stainless steel[2]	-A continuous run of wire. Wire size to be determined by an engineering analysis based on the environment, installation needs, and the requirements of NFPA 780. -When an analysis is not available, 1/0 AWG is the required wire size.	-Side flash separation distance and height of overhead wire above protected structure will be determined by using the requirements of NFPA 780. -Air terminals are required on nonmetal poles (see air terminal).
Air terminals	-Tubular aluminum[1] -Tubular copper	-Must be at least 24 inches high and extend at least 10 inches above the structure to be protected. -Must have an outer diameter of at least 5/8 inch below the taper. -Minimum wall thickness will be 0.033 inch for copper and 0. 064 inch for aluminum.	-Air terminals will be either tapered to a sharp or blunt point. -Separate points are not required on top of air terminals; but, if they are used, they must be substantial and securely attached by screw or slip joints.
Main conductor, stranded cable	Copper	-Minimum strand size is 17 AWG (0.045 inch) (Class I)[4] or 15 AWG (0.057 inch) (Class II)[5]. -The weight of the wire will be at least 187 lbs per 1,000 ft (0. 187 lbs per foot) (Class I)[4] and 375 lbs per 1,000 ft (0.375 lbs per foot) (Class II)[5].	-The down conductor will be as nearly vertical as possible. -Bends will not be less than 90° with minimum radius of 8 inches.
Main conductor, stranded cable	Aluminum1	-Minimum wire size is 14 AWG (0.064 inch) (Class I) 4 or 13 AWG (0.072 inch) (Class II) 5. -The weight of the wire will be at least 95 lbs per 1,000 feet (0. 095 lbs per foot) (Class I) 4 or 190 lbs per 1,000 feet (0.190 lbs per foot) (Class II) 5.	-The down conductor will be as nearly vertical as possible. -Bends will not be less than 90◦ with minimum radius of 8 inches.
Main conductor, solid strip	Copper	-The outside diameter will be at least 0.5 inch.	-The down conductor will be as nearly vertical as possible.

Table 16–4
Lightning protection systems 6—Continued

		-Minimum thickness will be 0. 051 inch. -Minimum width will be 1 inch.	-Bends will not be less than 90◦ with minimum radius of 8 inches.
Main conductor, solid strip	Aluminum1	-Minimum thickness will be 0. 064 inch. -Minimum width will be 1 inch.	-The down conductor will be as nearly vertical as possible. -Bends will not be less than 90◦ with minimum radius of 8 inches.
Bonding strap (solid or stranded)	Copper	-Minimum wire size is 17 AWG (0.045 inch). -The weight of the wire will be at least 80 pounds per 1000 feet (0.080 pounds per foot). -Solid wire must be a minimum of 6 AWG.	None
Bonding strap (solid or stranded)	Aluminum1	-Minimum wire size is 14 AWG (0.064 inch). -The weight of the wire will be at least 128 pounds per 1000 feet (0.128 pounds per foot). -Solid wire must be a minimum of 4 AWG.	None
Bonding strip	Copper	The strip will be at least 0.051 inch thick and 0.5 inch wide.	None
Bonding strip	Aluminum1	The strip will be at least 0.064 inch thick and 0.5 inch wide.	None

Notes:

[1] Where aluminum is used, care must be taken not to use it in contact with the ground or elsewhere where it will rapidly deteriorate. Conductors will be electrical grade aluminum.

[2] Research has been presented that warns that stainless steel is very susceptible to corrosion in many soil conditions. A proper soil analysis will be conducted before using this type of rod.

[3] Galvanized steel will not be used in atmospheric conditions which are destructive to it.

[4] Class I specifications apply to buildings or structures 75 feet or less in height.

[5] Class II specifications apply to buildings or structures which exceed 75 feet in height.

[6] In OCONUS applications, metric equivalent dimensions are considered acceptable (for example, 3 meters 10 feet).

[7] Unless otherwise noted, specifications in this chapter apply to Class I structures.

Chapter 17
Storage Requirements for Waste Military Munitions

17–1. Environmental Protection Agency munitions rule

a. EPA promulgated the Munitions Rule (MR) (40 CFR 266 Subpart M) to define when DoD military munitions AE become hazardous waste and to provide for the safe storage and transportation of such waste. DoD subsequently issued DoDM 4715.26, (referred to as the DoD Management Review and Improvement Program (MRIP)), to implement the MR.

b. The MRIP:

(1) Applies to Military munitions and WMM in the United States and under the control of a DoD Component.

(2) Does not apply to munition responses (cleanup).

c. Provides for:

(1) Conditional exemption (CE) from certain Resource Conservation and Recovery Act (RCRA) requirements; however, CE is not authorized for waste chemical munitions and agents.

(2) A RCRA storage unit standard (for example, 40 CFR Parts 264 and 265, Subpart EE).

17–2. Waiver and exemptions

The Assistant Secretary of the Army (Installation, Energy and Environment) ASA (IE&E) must approve waivers or exemptions to the criteria of DESR 6055.09 for AE being stored as WMM under RCRA.

17–3. Requirements for storage of waste military munitions under conditional exception

a. ACOMs or activities storing WMM under CE must comply with DoDM 4715.26 and applicable environmental laws and regulations. HQDA, DCS G–4 has oversight responsibilities for ensuring compliance with DoDM 4715.26; therefore, the MR. Commands or activities having questions regarding compliance may contact HQDA, G–4's Ammunition Division.

b. Among other requirements, compliance with DoDM 4715.26 requires commands and activities storing WMM to maintain inventory and inspection records for three years. These records will be made available to federal, State, interstate, and local regulatory authorities upon request. Standard Army AE inventory formats will be used for recording the inventory. The inventory record must include:

(1) The type of WMM stored by standard nomenclature, lot number, Federal Supply Class, NSN, Management Control Number or Manufacturer Part Number as appropriate, DoD Ammunition Code, and condition code.

(2) The quantity of each type of WMM stored.

(3) The date that each military munitions, by type, was identified as waste.

(4) The last storage date for each, by type, WMM.

(5) The storage location or locations (for example, building number or storage pad and grid coordinates) used.

(6) The disposition (for example, destroyed, demilitarized, shipped) and the waste munitions' date of action by type.

17–4. Other storage standards for waste military munitions

Some states regulate waste management activities, including the storage of WMM. If a State's regulation conflicts with DoD or Army explosives safety standards, HQDA G–4 will attempt to resolve the conflict. For those matters that the HQDA G–4 cannot resolve:

a. HQDA G–4 will notify Executive Director, DDESB, through the Army Voting Board Member, of the conflict.

b. The Executive Director, DDESB, will review the matter and its potential impact on explosives safety and assist the HQDA G–4, in coordination with the Army Voting Member, in attempting to resolve the conflict.

17–5. Reporting

a. Commands and activities will comply with the reporting requirements of DoDM 4715.26 and applicable environmental laws and regulations.

b. A non-permitted or uncontrolled detonation, release, discharge, migration (for example, fire), or loss (for example, by theft) of WMM poses a risk to human health, or the environment will be reported in accordance with AR 385–10, DA Pam 385–40, 40 CFR 266.205(a)(v). The affected command or activity will also notify:

(1) Chain of command;

(2) DAC, USATCES;

(3) The appropriate Federal or State environmental regulatory authority; and

c. Notifications:

(1) Telephonic notification or, when notifying the chain of command and USATCES, electronic notification (via email usarmy.mcalester.usamc.list.dac-est-siteplan@army.mil) or facsimile (DSN) 956–8503 Commercial (918) 420–8503 will be made within 24 hours.

(2) Written notification will be provided within five days if the initial report was telephonic. These reports will comply with the requirements of DA Pam 385–40.

d. Follow-up reports are only required when pertinent information, which was not previously reported, becomes known. Follow-up reports will comply with the requirements of DA Pam 385–40.

17–6. Closure of waste military munitions storage facilities

The closure of WMM storage facilities will comply with the applicable requirements of DoDM 4715.26, an RCRA permit, if applicable, and the requirements of paragraph 3–4 and DESR 6055.09.

Chapter 18
Real Property Known or Suspected to Contain Department of Defense Military Munitions

18–1. General

a. DoD is responsible for protecting people, including DoD personnel and contractors, and the environment from potential explosive or chemical agent hazards associated with DoD military munitions AE that may be encountered outside DoD's logistics management system. Such AE includes AE that are UXO or DMM, including that which, upon evaluation by uniformed DoD EOD personnel or similarly qualified personnel (that is, UXO qualified personnel), may be determined to be MEC. Uniformed DoD EOD personnel and UXO qualified personnel are herein referred to as technically qualified personnel (TQP) (see TP–18).

b. Although AE may be encountered anywhere, Army-related property on which AE may be encountered includes:

(1) Regular Army installations, particularly operational range impact areas and sites used for the OB/OD of AE;

(2) Army installations affected by BRAC decisions, particularly former ranges and sites used for the OB/OD of AE;

(3) Property the Army or DoD may have once used for munitions-related activities (for example, live-fire training or testing, production, demilitarization), but that has either transferred out of Army or DoD control or may never have been under Army or DoD control.

(4) Munitions operating facilities (for example, production, renovation, storage, and demilitarization), both active and closed, may present an explosive hazard.

c. This chapter and applicable DoD and Army policy addresses explosives safety and related criteria that pertains to AE outside DoD's logistics management system. This includes identifying; recording; managing (that is, controlling access to and using) property known or suspected to contain AE that may, upon evaluation by TQP, be determined to be MEC.

d. Army, as DoD's Lead Agent for the FUDS Program and DoD's Executive Agent for the Recovered Chemical Warfare Material Program, has additional responsibilities related to the conduct of range clearance activities, munitions responses (clean up), and other activities that may include the demolition, closure, or cleanup of munitions operating facilities.

18–2. Requirements

ACOMs and activities will in the management, control, use, or cleanup of real property known or suspected to contain AE that upon evaluation by TQP may be determined to be MEC will comply with this pamphlet and:

a. DESR 6055.09;

b. DoDM 4715.20, Defense Environmental Restoration Program (DERP) Management;

c. DoDI 4140.62;

d. AR 200–1;

e. AR 385–10;

f. AR 385–63; and

g. Other applicable environmental laws and regulations.

18–3. Identification of areas known or suspected to contain ammunition and explosives

a. Army installations will maintain an installation master plan or an equivalent document and associated maps and records (for example, archival search reports, investigation, decision documents for past cleanup) and, if applicable, adjacent off-installation property that includes areas known or suspected to contain AE that may be MEC. Such property includes:

(1) Operational ranges, including firing points, impact areas, and safety buffer zones; on Regular Army installations;

(2) Former operational ranges on Active installations, BRAC installations; and former military installations (for example, FUDS properties);

(3) Permitted OB/OD (treatment) units;

(4) Closed OB/OD (treatment) units, including areas once used for OB/OD;

(5) Known or suspected AE burial or disposal sites both on land or within watered areas; and

(6) Former AE operating facilities (for example, production, renovation, RDTE facilities).

b. Installation master plans and equivalent documents will:

(1) Be permanently retained;
(2) Indicate, for each area identified, the types of AE known or suspected to be present:
(a) Used during live-fire training or testing;
(b) Disposed of by OB/OD or burial;
(c) Addressed during an explosives or munitions emergency;
(d) Recovered during a munition response.

18–4. Control of areas known or suspected to contain ammunition and explosives

a. ACOMs and activities will:

(1) Develop and implement guidelines to control access to real property known or suspected to contain AE that may be MEC. At a minimum, such guidance will:

(a) Control and limit access to such areas, particularly operational range impact areas, to personnel who have an operational requirement (for example, range clearance and environmental monitoring) to enter such areas.

(b) Provide escorts, consistent with DESR 6055.09, for authorized personnel to enter such areas for operational reasons (for example, environmental or archeological monitoring) based on a risk assessment. Personnel authorized access for whom an escort is not provided will be informed of the potential hazards, briefed on the 3Rs, including being shown pictures of the types of AE that may be encountered, and informed of actions to take should they encounter or suspect they have encountered AE.

(c) Prohibit access to such areas, particularly operational range and former operational range impact areas, for recreational purposes (for example, hunting, fishing, and recreation associated with off-road vehicles).

(2) Ensure personnel authorized to enter such areas to perform routine maintenance (for example, grass cutting of cleared areas around buildings, phone, and computer cable repair to range buildings) are, based on a risk assessment, either:

(a) Provided an escort, if determined necessary; or

(b) Informed of the potential hazards and briefed on the 3Rs and about the boundaries between cleared areas and areas that may contain AE, and, if necessary, provided a map indicating these boundaries.

(3) Ensure non-range personnel who are authorized to enter such areas to conduct maintenance involving ground intrusive activities (for example, install environmental monitoring well, replace targets, install fencing) are provided escorts who can ensure munitions on the surface or anomalies in the subsurface are avoided.

b. Commands and activities will, consistent with the SC's ESMP, implement, and maintain a 3Rs Program (see 3Rs.mil) to advise military personnel and their families, DoD civilians, and those living working on, or visiting DoD installations and the public, particularly communities surrounding the installation, about the dangers associated with DoD military munitions AE and the actions to take should they know or suspect they have encountered AE. Special emphasis will be placed on the dangers associated with collecting or keeping souvenir munitions, with guidance provided on how such souvenirs would be either recovered by EOD or turned in under the amnesty program.

18–5. General explosives safety principles for the conduct of munitions responses (cleanup)

a. ACOMs and activities that design or execute munitions responses will conduct such responses in compliance with DESR 6055.09, DoDM 4715.20, and other applicable environmental laws and regulations.

b. Specific Army guidance follows:

(1) The best available and most appropriate technologies will be used during geophysical surveys.

(2) Analog technology will not be used in conducting geophysical surveys; the exception is when such technology is the only available technology that can be used safely within limited areas of the area being surveyed.

(3) An MRS Project Team will be formed to support the use of EPA's systematic planning process or USACE's Technical Planning Process.

(4) Environmental and safety officials responsible for munitions response (cleanup) will be provided opportunities to be involved throughout the cleanup process. It is important to work with these officials to identify a single regulatory framework, which should remain consistent throughout the cleanup, to guide the cleanup process.

(5) The local community (for example, stakeholders, property owners, and community members) should be provided opportunities to be involved in the cleanup process as early as possible and throughout the cleanup. Local stakeholders (for example) affected or potentially affected by the cleanup will be provided opportunities throughout the cleanup process to be involved and informed of action being taken.

(6) The known, determined, or reasonably suspected end use will provide the basis for each required munitions response (cleanup) design.

(7) RESS (for example, munitions response chemical safety submission, munitions response explosives safety submission (MRESS), ESP, or CSP) will be submitted through command channels to USATCES for Army review and approval and submission to the DDESB for Office of the Secretary of Defense's review and approval.

(8) AE encountered will be evaluated by TQP, with AE determined to pose an explosive or chemical agent hazard destroyed on-site and AE determined to be inertly deformed (for example, being cut into quarters) so that they cannot be mistaken for an AE.

18–6. Residual explosives hazards

Areas that the military has used for live-fire training or testing or demilitarization of AE may not be suitable, even after completion of a munitions response (cleanup) for specific uses (for example, recreation involving ground-disturbing activities, residential development). Such areas are normally best suited for uses such as a wildlife refuge or surface-only recreation that restricts or limits intrusive activities.

18–7. Special considerations

a. For construction*, t*he 3Rs Construction Guide should be provided or made available to Army personnel (for example, Facilities Engineers) and other entities (for example, utility crews, construction crews) conducting ground-disturbing or intrusive activities within active installations. In addition, construction support, if determined necessary based on a risk assessment:

(1) May, be provided or required by an SC for ground-disturbing or intrusive activities conducted within the installation.

(2) Will be provided when required by an approved Decision Document, provided the specific conditions (for example, period of advanced notification to allow for budgeting, type of support to be provided) under which construction support is to be provided are clearly defined.

b. The precautions outlined below do not apply to areas known to contain ICM that were used exclusively for live-fire training or testing with practice sub-munitions that lacked an HE fill.

(1) Access will generally be prohibited.

(2) When authorized, access and control measures to be taken will be based on a risk assessment and strictly controlled. The risk assessment will consider the hazard severity and hazard probability. For sub-munitions, the functioning of the most disruptive explosive component must always be a probability of one functioning. For sub-munitions, the hazard probability is based on these minimum factors:

(a) Fuzing.

(b) Density of sub-munitions in the area. The greater the density, the higher the probability of accidental contact and accidental initiation.

1. Areas with only one to two sub-munitions per acre may be considered low density;
2. Areas with 3 to 40 sub-munitions per acre may be considered medium density; and
3. Areas with 41 or more sub-munitions per acre are considered high-density.

(c) Type of activity to be conducted.

(d) Before the conduct of range clearance activities for such areas, the ground surface will be visible prior to conducting range clearance activities if an operational range or surface removals if a munitions response.

(e) Personnel authorized access will be briefed on the hazards present and escorted by EOD or other TQP.

c. It is essential that firefighting operations within or near areas that are known or suspected to contain AE (for example, UXO) be planned with consideration of explosives safety. The criteria outlined in DESR 6055.09 should be followed. DoD FES and civilian Fire Departments that support DoD installations with an AE-related mission and those that are located at or near an MRS at which a munitions response is being conducted should be provided with the 3Rs Wildland Firefighting Guide.

d. Controlled burns in areas known or suspected to contain AE must be carefully planned and executed to manage the potential explosive's safety risks and environmental effects. Weather conditions

under which the burn is to occur will be stipulated. The plans and measures to mitigate the effects on the public will be closely coordinated with local environmental and safety officials. During such burning operations, essential personnel will be at maximum fragmentation distance from burned area, based on the munition with the greatest maximum fragmentation distance, and will remain out of the area for at least 24 hours. Non-essential personnel should be upwind of the area, at least at IBD from the burn area.

e. Military Munitions Response Program Decision Documents will, upon request by the installation environmental office, be forwarded to the Command level safety staff for submission to USATCES for review in accordance with Army Decision Document policy and guidance.

18–8. Department of Defense required explosives safety submittal

a. RESS for munitions responses will be submitted through command channels to USATCES for Army review and approval and submission to the DDESB for review and approval. RESS for a munitions response that is a chemical warfare materiel response will be submitted to USATCES for review and subsequent submission to the USATCES.

b. Agencies, ACOM, ASCC, DRU, or installations conducting a munitions response will submit:

(1) The required RESS through command channels to reach USATCES 90 days before the planned start of response activities that involve intentional physical contact with AE, the conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain MEC or the placement of explosives on-site.

(2) RESS for which a command or activity is requesting an expedited review will be submitted to USATCES with justification for the expedited review.

(3) USATCES may provide interim Army approval of the RESS after its review and approval and subsequent submission to the DDESB. If USATCES provides interim approval, the submitter should be prepared to modify the munitions response action based on changes the DDESB's approval may require.

c. USATCE will only accept expedited or time-critical submissions electronically. Electronic submissions should be submitted to usarmy.mcalester.usamc.list.dac-est-siteplan@army.mil. Large RESS should be sent via the DoD SAFE file exchange at https://safe.apps.mil/ to usarmy.mcalester.usamc.list.dac-est-siteplan@army.mil.

d. Hard copies of RESS, if sent, should be submitted in two copies along with a copy on a compact disk to USATCES, 1 C Tree Road, ATCL–ACE (Risk), Building 35, McAlester, OK 74501.

e. Routing and approval.

(1) For Army installations closing or closed due to BRAC decisions or other reasons, the installation will submit the RESS to the BRAC office. The BRAC office will provide ACOM, ASCC, or DRU-level approval and forward it to USATCES. If the installation is not staffed, the supporting BRAC office will send the RESS to USATCES.

(2) For Regular Army installations, the SC's safety office will forward the RESS through the chain of command in accordance with the command's ESMP to USATCES.

(3) RESS that USACE has prepared for an Regular Army installation will be submitted to USACE's Military Munitions Center of Expertise, CEHNC–EMM, P.O. Box 1600, Huntsville, AL 35807–4301 for review and endorsement before review by the responsible installation for submission through command safety channels to USATCES.

(4) RESS for FUDS, the USACE Division, District, or Center will forward the submission to the USACE Military Munitions Center of Expertise. The Center will provide ACOM, ASCC, or DRU-level approval and forward it to USATCES.

18–9. Amendments and corrections to required explosives safety submittal

Amendments or corrections to an approved RESS do not require resubmission of the complete RESS. However, the information submitted must be sufficient detail to identify the specific RESS being amended or corrected, the affected portions, and the precise amendments or corrections being made. Amendments and corrections will be submitted through USATCES for review and, if appropriate, Army approval for submission to the DDESB for review and, if appropriate, approval.

18–10. After action reports

a. An after action report (AAR), which is intended to be a relatively simple submission, is required for munitions responses completed per a DDESB-approved MRESS. When a munitions response's final

report contains the information required in an AAR, a cover letter indicating the response was completed in accordance with the DDESB-approved RESS, an AAR is not required.

b. AAR will be submitted in accordance with DESR 6055.09. AAR will be submitted to USATCES for review and submission to the DDESB.

18–11. Change of use of real property

Before changing the use of Army real property known or suspected to contain AE to a use incompatible with the presence of AE, a munitions response per an Army and DDESB-approved RESS is required.

Chapter 19
Transportation of Ammunition and Explosives

Section I

General Requirements

19–1. General information

Shipments of Army AE are governed by AR 385–10, this pamphlet, and other referenced military publications. In the United States, shipments of military AE are governed by DOT regulations, DoDI 5100.76, and DTR 4500.9–R. Shipments outside of the United States are governed by host country regulations. In the absence of host country hazardous materials transportation regulations, AR 385–10, DTR 4500.9–R, and this pamphlet will apply to movements of AE.

19–2. On-post/off-post transportation

There are differing requirements for motor vehicle transportation of AE for movements that are exclusively "on-post" and those that are "off-post." These differences apply regardless of the mode of transportation (that is, commercial, government, or contractor vehicle). For this chapter, the definitions of and the distinction between "on-post" and "off-post" transportation will be as follows:

a. On-post transportation. Any vehicular transportation of AE within a military installation conducted exclusively on property controlled by the DoD and does not cross a PTR.

b. Off-post transportation. Includes not only vehicular transportation beyond the boundaries of a military installation but also any movements that occur within an installation and cross a PTR. This application is intended to meet the definition of roads that are uncontrolled by DoD as included in DTR 4500.9–R, chapter 204.

19–3. Certification of personnel involved with transportation of ammunition and explosives

All personnel involved with the classification, preparation of items and/or bills of lading, an inspection of vehicles and/or shipments, loading or unloading of carriers, driving, or other duties that directly involve the transportation of AE require training and certification in accordance with DTR 4500.9–R and DOT regulations.

19–4. Fires involving ammunition and explosives

Personnel assigned AE duties will not fight fires when AE is engulfed in flames. Firefighting equipment assigned to the immediate area or a vehicle will be used to contain combustible fires to prevent the propagation to AE items or materials. When AE items are engulfed in flames, all personnel will evacuate to a safe location (refer to DESR 6055.09, Table V1.E10.T10. for withdrawal distances) and follow the orders of the incident commander/fire chief. Over-the-road withdrawal distances will be as defined in the DOT Emergency Response Guidebook (ERG).

19–5. Commercial transportation (off-post)

All AE items require a final or IHC before shipment. See chapter 7 for specific guidance.

a. Once a requirement for a commercial AE shipment is identified, a person trained and certified in accordance with DTR 4500.9–R will verify the hazard classification of the AE item. This person then provides the following minimum information to the transportation officer:

(1) Proper shipping name.

(2) DOT hazard class.

(3) DOT labels required.
(4) DOT markings required.
(5) DoD hazard class and division.
(6) DoD storage CG.
(7) United Nations number.

b. TB 9–1300–385 and, if appropriate, other Service publications will be checked for AE suspensions or restrictions before offering AE for shipment to ensure that the AE is suitable for use and that there are no prohibitions on transporting the AE.

c. Transportation on off-post roads must comply with all packaging, marking, labeling, loading, placarding, and certification requirements of local, state, Federal (49 CFR), host country, and DoD publications regardless of means of conveyance.

19–6. Compatibility of ammunition and explosives in transportation

a. The Army storage CG authorized in DESR 6055.09, paragraph V1.E6.2.2, paragraphs V1.E6.2.2.1 through V1.E6.2.2.13 and Table V1.E6.T1 differs from compatibility authorized in a transportation mode. 49 CFR 177.848 and the International Maritime Dangerous Goods Code as applicable must be used when determining DOT Highway, Rail, and Sea compatibility.

b. When ammunition in either commercial or military conveyance is to be transported off-post, DOT compatibility rules must apply.

c. When ammunition is transported on-post, AE may be transported according to the storage compatibility chart (see DESR 6055.09, Table V1.E6.T1.). Blasting caps or detonators will not be transported with HEs unless they are packed in a Mark 663 MOD 0 container or equivalent. Additionally, DESR 6055.09, Table V1.E6.T1., note h. is not authorized for transportation.

d. When ammunition is transported in the training area on the installation by troops on a training exercise using tactical vehicles, the vehicles may transport a mix of ammunition similar to that the vehicles would carry in combat, provided the vehicles do not cross or move along a route accessible to the general public.

e. Incompatible loads may be transported on public roads during times of war, contingency operations (not contingency exercises), or declared national emergencies when DOT Exemption 3498 has been invoked, and the shipper complies with all provisions of that exemption (see Section II, Part Four, Motor Vehicles).

19–7. Ammunition and explosives transport vehicle general safety requirements

a. All lifting devices on vehicles used in AE operations will have a serviceable mechanism designed to prevent the sudden dropping of the load if power fails.

b. All Government trucks transporting any DOT class of AE (both on and off-post) will be equipped with two portable fire extinguishers rated class 10BC or greater. These two fire extinguishers are recommended to be rated 2A:10B: C. If chemical munitions are transported, one must be a CO2 or dry chemical. Commercial trucks transporting AE for the Army are required to have only one 10BC or greater rated fire extinguisher. Crews loading and unloading vehicles carrying or about to carry AE must have two 10BC or greater fire extinguishers available as required by chapter 6.

c. Before motor vehicles loaded with AE leave an installation, drivers will be given a briefing concerning emergency response information. Commercial drivers will have in their possession a DD Form 626 (Motor Vehicle Inspection), DD Form 2890 (DoD Multimodal Dangerous Goods Declaration), and the bill of lading annotated with the appropriate guide number from DOT ERG. Military drivers will use DD Form 626 and DD Form 2890 for hazardous materials information dissemination. When performing transportation of AE shipments in a foreign country, the DD Form 2890 will contain the host nation's language as well.

d. For “on-post” movement, the following provisions apply:

(1) The interior of the cargo body will have all exposed ferrous-metal covered with non-sparking material when transporting AE not packaged for shipment in accordance with DOT specifications.

(2) Open-body vehicles, other than flatbed trailer types used to transport large items such as rockets or missiles, must have strongly constructed and securely fastened sides to safely retain the items.

(3) When a top is required, it will be of noncombustible or flame-proof material. Tarpaulins used for covering AE will be secured by rope or tie-downs. Nails will not be used to fasten protective tarpaulins.

e. No repairs which use a flame or spark-producing device will be made to an AE-laden vehicle.

f. See AR 190–11 for instructions on the security of vehicles carrying AE.

19–8. Ammunition and explosives transport vehicle inspection requirements

a. Prior to loading or unloading vehicles, the vehicle's DD Form 626 will be reviewed for completion of required items, and the vehicle inspection will be spot-checked (for example, check for functioning lights and reflectors, wipers, horn; availability of fire extinguisher; and no visible tire defects) by a person trained in the DD Form 626 inspection process. Deficient equipment will not be used.

b. A thorough, documented inspection of all vehicles used to transport placarded quantities of hazardous material and any placarded or non-placarded AA&E shipments moving under Transportation Protective Service in accordance with 49 CFR and DoD safety regulations using DD Form 626, Motor Vehicle Inspection (Transporting Hazardous Materials) prior to loading is the responsibility of the transporting entity (for example commercial carrier).

c. Requirements for "on-post" inspection prior to loading AE follow:

(1) Motor vehicles used for on-post transport of AE must be inspected a minimum of every 30 days to see that mechanical conditions and safety devices are in good working order. The inspections of such vehicles will be documented using a DD Form 626. A copy of the completed form will be maintained on the vehicle and be available upon request.

(2) In addition to any inspections required by other daily or recurring interval inspection procedures, operators will inspect AE vehicles daily to determine that:

(a) Fire extinguishers are serviceable and of proper (10–BC or greater) rating. Extinguishers must have an intact inspection seal and a gauge to verify that the extinguisher is full.

(b) Electric wiring is in good condition and properly attached.

(c) Fuel tank and piping are secure and not leaking.

(d) Brakes, steering, and other equipment are in good condition.

(e) The exhaust system is not exposed to accumulations of grease, oil, gasoline, or other fuels and has ample clearance from fuel lines and other combustible materials.

d. Requirements for "off-post" inspection prior to loading AE follows:

(1) Motor vehicles used for off-post transport of AE must be inspected to see that mechanical conditions and safety devices are in good working order. This inspection should be conducted as soon as possible before the actual loading, with the "day of" inspections being ideal. If the power unit is disconnected from the trailer after an inspection is documented, a new DD Form 626 must be accomplished before the over-the-road transport. A copy of the completed form will be maintained on the vehicle and be available upon request.

(2) When a deficiency is noted during DD Form 626 of a commercial vehicle or if the form is not made available, procedures should be included in the local SOP for notification of the transportation officer.

e. Requirements for inspection prior to the release of AE-loaded vehicle follow:

(1) All AE-loaded on vehicles will be secure and stable before movement, except for transport necessary to consolidate or distribute a vehicle load (for example, between storage structures within an ASP or AHA or close proximity firing points within a training area). "Secure and stable" means that AE will be blocked and braced in accordance with approved AMC 19–48 series drawings except for non-standard ammunition. Non-standard ammunition will be blocked and braced using accepted procedures for similar types of packaged standard munitions, taking into account the number of pallets and/or packages. The packages will be placed in position without excessive or violent force.

(2) All vehicles hauling AE for the Army within the United States require proper DOT placards to inform emergency responders of the vehicle's contents. Host country requirements for placarding will be followed outside the United States.

(3) After loading has been completed and prior to any transport beyond that necessary to consolidate or distribute a vehicle load (for example, between storage structures within an ASP or AHA or close proximity firing points within a training area), Part III of DD Form 626 will be completed by a person trained in post-loading inspection requirements of DD Form 626.

f. The following are requirements for the inspection of inbound AE motor vehicle:

(1) The DD Form 626 for inbound motor vehicles loaded with AE will be reviewed for completion of required items, and the vehicle inspection will be spot-checked (for example, check for functioning lights and reflectors, wipers, horn; availability of fire extinguisher; and no visible tire defects) by a person trained in the DD Form 626 inspection process. The inspection station will be as far as practical from hazardous and populated areas.

(2) When inspection reveals that an incoming vehicle is in an unsatisfactory condition, the risk associated with the defect will be assessed.

(a) Under no circumstances will a vehicle be allowed into the ammunition area with a defect that could endanger the area or the load.

(b) In all cases, defective equipment on inbound vehicles will be noted on the DD Form 626. In the case of commercial shipments, a copy will be provided to the transportation officer. Local SOPs should address responsible personnel notification procedures for all other shipments.

(c) At no time will an inbound vehicle known to be defective be allowed to leave an Army installation laden with AE.

(d) When AE-laden vehicles cannot be dispatched to unloading points immediately, they must be moved to a holding yard or designated area. The holding yard or designated area must be sited in accordance with the provisions of table 8–3 of this pamphlet.

19–9. Secure holding area (secure hold lot) / safe haven for commercial ammunition and explosives shipments

a. A "secure holding area" is a location designated for the temporary parking of commercial carriers' motor vehicles transporting DoD-owned and other non-DoD AA&E in support of testing or NATO exercises; classified (Secret or Confidential) materials; and CCIs. There are two types of secure holding areas:

(1) *Secure Explosives Holding Area.* (Site as a holding yard per table 8);

(2) *Secure Non-explosives Holding Area.* No siting is required if located outside all ESQD arcs. If located within an ESQD arc, site as an administrative parking lot per table 8–1. The holding of HD 1.4S materials, without regard to ESQD, is permitted at this location.

b. A "safe haven" is on installation parking for emergency situations such as, but not limited to, vehicle breakdown, driver illness, terrorist or suspicious criminal activity, civil disturbance, or natural disaster.

c. DoD installations must accept AA&E shipments for safe haven or secure hold regardless of arrival time or final destination. If a safe haven or secure hold cannot be provided, the DoD activity will provide assistance and escort to a suitable location in coordination with civil law enforcement authorities. Protection of shipment will be commensurate with the sensitivity of the AA&E. Under safe haven conditions or secure hold, ESQD requirements must be considered, but these requirements will not eliminate the responsibility to provide a safe haven or secure hold to mitigate shipment vulnerability.

d. Refer to DTR 4500.9–R, Part II, Chapter 205 and DoDI 5100.76 for detailed requirements.

19–10. Passengers in or on Government vehicles transporting ammunition and explosives

a. Except as noted below, passengers must not ride in vehicles transporting AE.

b. In limited situations as approved in an SOP and in strict compliance with the conditions listed below, the minimum essential personnel and limited quantities of HDs 1.2.2, 1.3, and 1.4 AE may be transported together in the cargo portion of vehicles. Examples are vehicles used by the military police in providing security or by EOD personnel performing their mission. These conditions are as follows:

(1) AE are packed separately from other items and packed in closed, clearly identified metal or wooden containers properly secured or sandbagged in the vehicle body to prevent movement.

(2) Seats are provided for all passengers.

(3) Smoking is not allowed in the vehicle.

(4) The vehicle cannot be left unattended.

c. Troops and AE may be transported in the same vehicle during training exercises when the vehicle is the prime mover for a weapon system engaged in the tactical portion of the exercise, troops being transported are assigned to the weapon system being moved, the vehicle is organic to the unit, and the vehicles remain on the training range. The only exception will be for HD 1.4 ammunition when it is necessary to travel between training ranges (on or off post), and then conditions in paragraph e. below will apply.

d. Mission essential passengers may ride in the passenger compartments of vehicles transporting AE if they can be safely seated.

e. AE will not be transported in a vehicle's passenger compartment except in cases involving limited quantities (no more than two full outer packs of SAA with non-explosive bullets). SAA must be in closed containers which are properly secured in the vehicle, and seats must be available for all personnel. Using privately owned vehicles for such purposes is prohibited, except for the Reserve Officer Training Corps and Marksmanship Programs, when a government-owned vehicle is not available. It is permissible to

transport limited quantities of HD 1.4 SAA in the trunk of sedan-type government-owned vehicles or in cargo compartments of government-owned van-type vehicles.

Section II

Rail, Air, and Water Transport

19–11. Railroad transportation

a. Railcar inspections and certifications will be conducted and used in accordance with DTR 4500.9–R.

(1) Shipments of DOT Class 1.1 or 1.2 (Explosive) Materials; Car Selection, Preparation, Inspection, and Certification, each rail car used to transport Hazard Class/Divisions 1.1 and 1.2 must have a three-part car certificate (provided by the carrier) prior to loading, completed in triplicate by the rail carrier.

(2) DOT Class 1.2 and 1.3 AE Shipments must be loaded in a closed car or container car that is in good condition, and sparks cannot enter.

(3) Selections of cars for shipment of DOT classes 1.4, 1.5, or 1.6 will be done in accordance with 49 CFR and DTR 4500.9–R.

b. In addition to the requirements of other parts of this section, the following rules will be followed:

(1) When cars containing AE or other hazardous materials are received at the installation or held in yards, precautions must be taken to prevent accidents, particularly at night. These precautions must include provisions for quickly removing and isolating the cars in case of fire.

(2) Cars loaded with hazardous materials must be properly loaded and placarded before being offered for transportation. The carrying of hazardous materials on locomotives or other self-propelled rail vehicles is prohibited.

(3) Before a locomotive moves cars, the air brake hose will be coupled and tested to assure that the air brakes are in proper working condition and the car doors will be closed.

(4) Empty cars will not be removed from warehouses, magazines, buildings, or loading docks until all warning placards have been removed.

(5) Special care must be taken to avoid rough handling of cars. Cars must not be cut off while in motion and must be coupled carefully to avoid unnecessary shocks. Other cars must not be cut off and allowed to strike a car containing AE. Cars must be so placed in yards or on sidings that they will be subject to a minimum of handling and can be readily removed from danger of fire. Such cars must not be placed under bridges, in or alongside passenger sheds of a station, and, where avoidable, engines on parallel tracks will not be allowed to stand opposite or near them.

(6) “Dropping,” “humping,” “kicking,” or the use of the flying switch is prohibited.

(7) Adequate measures such as guarding, patrolling, and safety inspecting must be provided at all times. All such activities will be under positive administrative controls.

(8) DOT placards will be placed on each railroad car while containing/transporting AE to provide quick identification of the potential hazard by emergency response personnel.

c. Constant alertness must be maintained to detect hazardous materials leaking from faulty packages by sight or characteristic odors. Leaking packages will be removed from cases and repaired. If artificial light is necessary, only electric lights approved for the hazard involved will be used. All unnecessary movement of a leaking package discovered in transit must cease until the unsafe condition is remedied.

d. Loading methods prescribed by AMC 19–48 series drawings (AMC Drawing 19–48–75–5 contains a list of AMC drawings and ordering instructions.) will be followed for the loading, blocking, and bracing of railway car shipments of military AE. If no drawing is available or yet developed, Bureau of Explosives Pamphlets 6 and 6C will be used. The packages will be placed in position without excessive or violent force.

e. With reasonable care, steel tools may be used inside cars if AE likely to ignite are not exposed. When AE subject to initiation are exposed, spark-proof tools will be used.

f. In addition to any other seals that may be used, cars containing AE will be secured. A cable seal lock plus an upper rail lock will be used to secure car doors. Serial numbers of seals will be placed on the government bill of lading.

g. Requirements for i*nspection of cars before unloading follow:*

(1) A qualified person must inspect railcars containing AE entering an installation. This inspection includes examining the outside and underside of each car for damage, detecting unauthorized and suspicious items, and checking the correctness of individual car numbers and seal numbers against bills of lading. When the probability of sabotage is remote, such inspections may be accomplished from ground

level without using an inspection pit to discover the car's unsafe structural and mechanical deficiencies. During periods of emergency when sabotage may be attempted, and also to aid in the rapid inspection and movement of cars, an inspection pit will be provided.

(2) Cars of AE on which foreign and suspicious articles have been secreted or attached outside or underneath the car, or cars that show a defect that might affect the installation or contents of the car will be removed to a siding, as remote from other locations as possible, for additional inspection.

(3) Cars that satisfactorily pass the inspection outlined above may be considered reasonably safe, but care must be exercised in breaking car seals and opening car doors because of possible damage or shifting lading, leaking containers, and so forth. When the ESQD standards for classification yards are met, cars may be opened for inspection in the classification yard. Otherwise, interior inspection will be accomplished after the cars have been spotted at the unloading point.

h. Cars in which AE are received will be inspected after unloading to see that they are clean and free from loose explosives or other flammable materials and that the placards and car certificates are removed. Explosives sweepings must be collected and disposed of according to local SOP procedures.

i. Any shipment received in a damaged condition because of inadequate or improper blocking and bracing or failure to load in accordance with appropriate AMC 19–48 series drawings will be reported on DD Form 361 (Transportation Discrepancy Report) in accordance with DTR 4500.9–R–Part II, Cargo Movement. If the damage was due to improper P&P or packing, a supply discrepancy report will be prepared in accordance with AR 700–15.

j. Blue flags or signals will be placed at both ends of a car or group of cars when personnel are working in, on, or under the cars. Cars marked in this manner will not be coupled to or moved. The supervisor or foreman in charge of the personnel loading or unloading the cars will place and remove the blue flag or signal. Train crews will be informed of the use of blue flags or signals. Exceptions are as follows:

(1) Flags are not required when flat cars are involved, and the presence of a working party is clearly evident.

(2) Flags or signals may be omitted from the end of a car located against or toward a dead-end spur. This also applies to a loading ramp where no other railcars can approach from that direction.

k. Except for bunkers and spurs, railroad lines serving AE areas will be looped to give at least two ways to exit. Looping of railroad lines may not be required if a local HA indicates operations can be conducted safely.

l. Grass and brush along railroad right-of-way, which present a fire hazard, will be controlled.

19–12. Air transportation

a. Carrying AE and other hazardous materials on civil aircraft is regulated by the DOT. Criteria for preparing and carrying hazardous materials on military aircraft are contained in TM 38–250, DOT regulations, and AR 95–27.

b. Military aircraft operating requirements are as follows:

(1) If an aircraft carrying hazardous materials makes a landing, forced or otherwise, and only minor repairs or refueling are necessary, the cargo need not be unloaded. Repairs or refueling will be accomplished at a location separated from dissimilar AE and other aircraft by the appropriate IBD for the cargo aboard. For major repairs, the plane will be unloaded and the cargo stored in accordance with ESQD requirements. Appropriate protection will be afforded to the cargo during inclement weather.

(2) When an explosive-laden aircraft is parked in a designated, restricted, and posted AE parking or loading and unloading area, fire symbols will be posted at all normal approaches to the designated area. Otherwise, fire symbols will be placed at the nose, tail, and each side of the aircraft. Where the height of the aircraft does not readily permit attaching the fire symbols to the aircraft, the fire symbols may be mounted on stands approximately 1.5 meters (5 feet) in height, positioned adjacent to the aircraft where they are visible at long range. At other DoD installations and at non-DoD installations, placarding will be in accordance with the requirements of TM 38–250 and the requirements of the host installation.

c. AE that may be shipped by civil air are identified in 49 CFR. AE that may be shipped by military aircraft are identified in TM 38–250.

d. Loading and unloading aircraft will be in accordance with the following:

(1) Before an aircraft can be loaded or unloaded with AE, it must be electrically grounded so that the resistance to ground does not exceed 10,000 ohms.

(2) Work crews will display DOT placards as required when loading or unloading aircraft containing AE.

(3) Loading and unloading will be done in accordance with the applicable ESQD requirements.

(4) All ignition switches must be in the off position.

(5) The front and rear wheels will be chocked.

(6) The loadmaster will direct the loading of military aircraft. Non-military aircraft will be loaded to comply with civil air regulations.

(7) The host normally provides aircraft rescue and fire protection at non-military airfields used by U.S. Army flight activities. If this protection does not meet the standards established in AR 420–1, Army FES personnel and/or auxiliary firefighters will be used during Army flight activities, including loading and unloading of AE.

(8) As a minimum, four portable fire extinguishers will be available for firefighting during all loading and unloading of AE. Recommended extinguishers are as follows:

(a) Two each pressurized water-type extinguishers using AFFF liquid concentrate (note: MIL–PRF–24835 has been adopted for Armywide use; Army units may continue to use MIL–F–24385 for emergencies until replacement with MIL–PRF–24835 is complete); and

(b) Two each Potassium Bicarbonate Base Dry chemical extinguishers, 13.6 kgs (30 pounds) capacity.

e. Air shipments of AE received in a damaged condition or not loaded in accordance with applicable requirements will be reported in accordance with 41 CFR 101 or DTR 4500.9–R Part II Cargo Movement.

f. Containers of AE in aircraft will not be opened or repaired.

19–13. Water transportation

a. Transporting AE on waters under U.S. jurisdiction and in vessels engaged in commercial service is regulated by the U.S. Coast Guard (USCG). Shipments overseas will be made in accordance with the regulations of the carrier, the USCG, International Maritime Dangerous Goods -Code, or the Department of the Army (see TM 55–607). If the travel route requires passing under any bridges, obtain prior authorization from the responsible agency (this is not necessary if the U.S. Coast Guard is involved).

b. Damaged shipments or shipments not stowed in accordance with regulations when received will be reported in accordance with DTR 4500.9–R–Part II Cargo Movement. If the damage was due to improper P&P or packing, a supply discrepancy report will be prepared in accordance with AR 700–15.

c. Containers of AE will not be opened or repaired on board a vessel.

d. Vessels in which AE are received will be inspected after unloading to see that they are clean and free from loose explosives or other flammable materials and that signage/placards and so forth are removed. Explosives sweepings must be collected and disposed of according to local SOP procedures.

Appendix A

References

Section I

Required Publications

Unless otherwise indicated, DA publications are available on the Army Publishing Directorate website at https://armypubs.army.mil/. DoD publications are available on the Executive Services Directorate website at https://www.esd.whs.mil/dd/.

ANSI Safety Code A14.3
American National Standards for Ladders-Fixed-Safety Requirements (Cited in *para 15–9b*.) (Available at https://webstore.ansi.org.)

AR 75–1
Malfunctions Involving Ammunition and Explosives (RCS–CSGLD–1961 (M1)) (Cited in para 1–15.)

AR 75–15
Policy for Explosive Ordnance Disposal (Cited in *para 11–2c*.)

AR 190–11
Physical Security of Arms, Ammunition, and Explosives (Cited in para 11–1e(2).)

AR 190–12
Military Working Dog Program (Cited in para 11–7a(1).)

AR 190–45
Law Enforcement Reporting (Cited in para 11–10g(2).)

AR 200–1
Environmental Protection and Enhancement (Cited in *para 18–2d*.)

AR 385–10
Army Safety Program (Cited in para 1–1.)

AR 385–63
Range Safety (Cited in table 1–1.)

AR 420–1
Army Facilities Management (Cited in *para 3–10g*.)

AR 690–950
Career Program Management (Cited in *para 1–9b*.)

CJCSI 4360.01C
Explosives Safety and Munitions Risk Management for Joint Operations Planning, Training, and Execution (Cited in para 1–13k(1).) (Available at https://www.jcs.mil/.)

DA Pam 40–501
Army Hearing Program (Cited in para 14–5g(2).)

DA Pam 385–10
Army Safety Program (Cited in *para 1–13a*.)

DA Pam 700–107
Preparation of Standard Operating Procedures and Written Standards for Ammunition Operations (Cited in *para 13–2a*.)

DESR 6055.09
DoD Ammunition and Explosives Safety Standards (Cited in para 1–1.) (Available at https://denix.osd.mil/ddes/.)

DoDD S–3325.01
Foreign Material Program (FMP) (Cited in *para 11–2e*.)

DoDD 6055.09E
Explosives Safety Management (ESM) (Cited in para 1–1.)

DoDI 4140.62
Material Potentially Presenting an Explosive Hazard (MPPEH) (Cited in *para 13–15b*.)

DoDI 5100.76
Safeguarding Sensitive Conventional Arms, Ammunition, and Explosives (AA&E) (Cited in para 19–1.)

DoDI 6055.16
Explosives Safety Management Program (Cited in *para 4–4b*.)

DoDM 4160.21
Defense Materiel Disposition: Disposal Guidance and Procedures (Cited in *para 13–15b*.)

Joint Hazard Classification System (JHCS)
Official DoD database of final hazard classification data for the military services' ammunition and explosives maintained by USATCES (Cited in para 7–1.) (Available at https://www.quantico.marines.mil/portals/147/docs/safety/yellow%20book%20rev%2019%20dated%20february%202021.pdf#:~:text=joint%20hazard%20classification%20system%20%28jhcs%29%201.the%20jhcs%20database,database%20for%20final%20hazard%20classified%20ammunition%20and%20explosives.)

MIL–STD–398
Shields, Operational for Ammunition Operations, Criteria for Design, and Tests for Acceptance. (Cited in para 13–3a(2).) (Available at https://assist.dla.mil/online/start/.)

MIL–STD–882
Department of Defense Standard Practice for System Safety (Cited in *para 1–13j*.) (Available at https://assist.dla.mil/online/start/.)

NFPA Standard 30
Flammable and combustible Liquids Code (Cited in *para 6–8e*.) (This publication may be obtained from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269–9101.)

NFPA Standard 58
Liquefied Petroleum Gas Code (Cited in para 2–5d(2).) (This publication may be obtained from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269–9101.)

TB 9–1300–385
Munitions Restricted or Suspended (Cited in *para 19–5b*.)

TB 43–0142
Safety Inspection and Testing of Lifting Devices. (Cited in *para 16–10r*.)

TB 700–2
Department of Defense Ammunition and Explosives Hazard Classification Procedures. (Cited in para 7–1.)

TM 38–250
Preparing Hazardous Materials for Military Air Shipments (Cited in *para 19–12a*.)

TM 43–0001–47
Army Equipment Data Sheets: Ammunition Peculiar Equipment (Cited in *para 13–5b*.)

TP–10
Methodology for Chemical Hazard Prediction (Cited in para 8–29f(2)(a).) (Available at https://www.denix.osd.mil/ddes/ddes-technical-papers/.)

TP–15
Approved Protective Construction (Cited in *para 3–2a*.) (Available at https://www.denix.osd.mil/ddes/ddes-technical-papers/.)

TP–18
Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel (Cited in *para 18–1a*.) (Available at https://www.denix.osd.mil/ddes/ddes-technical-papers/.)

TP–27
Explosive Safety Training (Cited in para 1–9b(2).) (Available at https://www.denix.osd.mil/ddes/ddes-technical-papers/.)

UFC 3–340–02
Structures to Resist the Effects of Accidental Explosions. (Cited in para 8–4.) (Available at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3 – 340 – 02.)

UFC 3–601–02
Fire Protection Systems Inspection, Testing, and Maintenance (Cited in *para 6–17b*.) (Available at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3 – 601 – 02.)

10 USC 2692
Storage, treatment, and disposal of nondefense toxic and hazardous materials (Cited in para 10–1.) (Available at https://uscode.house.gov/.)

Section II

Prescribed Forms

Unless otherwise indicated, DA forms are available on the Army Publishing Directorate website (https://armypubs.army.mil).

DA Form 7632
Deviation Approval and Risk Acceptance Document (DARAD) (Prescribed in *para 1–5a*.)

Appendix B

DD Form 2977 and DA Form 7632 Instructions

B–1. DD Form 2977

DD Form 2977 is the Army's standard form for documenting risk assessment and approval and provides a tool for units to logically apply the five steps of risk management. It is available in both hard copy and electronic form and may be filled out electronically or free-hand. DD Form 2977 is designed to be used as a living document as changes occur or new information is gleaned during the mission and/or task being assessed.

B–2. Instructions for completing DD Form 2977

a. Page 1 provides areas for identifying the event or operation, preparer information, an area to capture information used in the five-step process, identification of the overall residual risk level, and approval authority information. Block 1 (Mission/Task Description) should include the date(s) of the mission; block 2 (Date) is to be completed with the date the DD Form 2977 was prepared.

b. Page 2 provides a standard risk assessment matrix, an area for review (used for ongoing operations), an area to capture feedback and lessons learned, and an area for additional comments or remarks.

c. Page 3 provides basic instructions for completing each block of the form.

B–3. DA Form 7632

a. DA Form 7632 is a three-page automated form for documenting risk management and acceptance. Use of this form is mandatory for deviations from AE or chemical agent safety standards.

b. Page 1 of the form contains the information necessary for the approval authority to decide whether to approve the deviation and accept the associated risk, including location information, violation information, and documentation of deviation approval and risk acceptance. Page 2 is a worksheet used to document the risk assessment and should be completed before page 1.

c. When used for deviations involving AE or chemical agent, the AE Worksheet, found on pages 3 and 4 of the DA Form 7632, must be completed. This worksheet provides documentation of information on the PES, ESs, and potential consequences from AE or chemical agent incidents and should be completed before page 1.

B–4. Completing the DA Form 7632

a. This section on page 1 identifies the site the DA Form 7632 covers. Dropdown menus are provided to help with standardization.

(1) Block 1a - Country. Enter the country where the site is located. The default is set to the United States.

(2) Block 1b - State. Enter the state where the site is located or select not applicable for sites outside the United States and its territories.

(3) Block 2 - Service. Select the Service responsible for submitting the deviation.

(4) Block 3a - Installation Type. Enter the type of installation on which the site is located (for example, Fort, Base, Forward Operating Base). Select "other" for sites, not on an installation.

(5) Block 3b - Installation Name. Enter the name of the installation, if applicable. For example, enter "Hood" if Fort Hood is the installation. There is no need to put "Fort Hood" in this block when "Fort" was entered in block 3a.

(6) Block 3c - Type of Site. Enter the type of site on which the deviation occurs. This block should convey the nature of the operation involved (for example, hospital, dining facility, AHA, ammunition turn-in, driver training, and so forth).

b. Deviation information. This section on page 1 provides all the violation information at a glance and allows the approval authority to see all the critical information on one page. A portion of the blocks on page 1 will auto-populate from page 2.

(1) Block 4 - Deviation number. This is the originator's unit identification code (UIC), the type of deviation (see block 7), followed by the 4–digit year, 2–digit month, 2–digit day (see block 10), and a sequential alpha character for each deviation of the type prepared that day. For example, for the second event waiver (EW) initiated by the activity with UIC W4QUAA on 10 April 2013, the individual preparing the DA

Form 7632 would enter “W4QUAA–EW–20130410–B.” The Deviation number will automatically be inserted on the top of each sequential page of the DA Form 7632 to ensure continuity of the document.

(2) Block 5a - Effective Date. No data entry is required. This block will auto-populate from block 16a (Date) and will also be automatically inserted on the top of each sequential page.

(3) Block 5b - Expiration Date. No data entry is required. This block will auto-populate from block 16b (Expiration Date) and will auto-populate the Expiration Date block on the top of each sequential page.

(4) Block 6 - Deviation From. Choose the appropriate type of standards from the dropdown list. Enter the type of standard from which the activity will deviate.

(5) Block 7 - Type of Deviation. Enter whether the deviation is an EW, waiver (W), exemption (E), or SecCert.

(6) Block 8a - Number/Title and Paragraph of Requirement. Enter the title, number, and paragraph of the requirement not being met. For example, “DA Pam 385–64, paragraph 17–2.” When the deviation involves a violation of the DoDM 6055.09, include the appropriate reference for that document as well (for instance, DESR 6055.09 paragraph V1.E8.2.1).

(7) Block 8b - What we need to do that deviates from 8a. Provide a synopsis of the risk being taken. This is a synopsis of block 24.

(8) Block 8c - Operational, Strategic or Compelling Reason for Violation. Explain the operational, strategic, or compelling reason to justify violating the safety standards identified in block 8a.

(9) Block 9 - Potential Consequences of Deviation from Approved Standards. These numbers quantify the potential consequences of the risk being accepted and are based on the residual risk after control measures on page 2 have been implemented. Enter the anticipated numbers for fatalities, additional injuries, and the dollar loss to equipment and facilities due to the deviation based on the worst-case scenario.

(10) Block 10 - Date Deviation Initiated. Enter the date the safety professional and/or analyst created this DA Form 7632.

(11) Block 11 - Residual Severity. Identify the residual severity after controls identified on page 2 have been implemented.

(12) Block 12 - Residual Probability. Identify the residual probability after controls identified on page 2 have been implemented.

(13) Block 13 - Residual Level of Risk. No data entry is required. The residual level of risk will be automatically calculated based on the severity and probability entered in locks 11 and 12.

(14) Block 14a - Safety Professional/Analyst (POC Info). Enter the name and POC information of the safety professional and/or analyst that conducted the risk assessment. This will allow the “Reviewed By” official to contact the safety professional and/or analyst if questions arise.

(15) Block 14b - Analyst Signature. Signature of the safety professional and/or analyst that conducted the risk assessment. Do not sign until the risk analysis has been completed.

(16) Block 14c - Submitter’s (POC Info) if different from 14a.

(17) Block 14d - Submitter Signature if different from 14a.

(18) Block 14e - Reviewed By. This section lists offices that have reviewed the risk assessment and have concurred or non-concurred. Routing for the DA Form 7632 should not be assumed to be through the garrison commander only. Routing for approval and proper awareness should include the garrison commander (for coordination with safety, master planning, Department of Public Works, security, FES, environmental, legal, and so forth), SC (overall responsible for the installation), the higher headquarters of the unit responsible for the mission or operation, and any exposed units (to include other Services and/or agencies and non-DoD entities). Enter the date, whether they concur with approving the deviation and accepting the associated risk, organization, printed name and title of the person reviewing, and their signature. Comments should be attached, as necessary, and the safety professional and/or analyst should consider changing the original risk assessment, if necessary, based on these comments. If a reviewer does not concur, they must select the attachment block to provide comments for their non-concurrence. If additional space is needed to document DA Form 7632 routing, create and attach additional (separate) page 1 documents. These “continuation pages” will have blocks 1 through 4 completed and “Continuation of block 14e” entered in block 8a.

c. The section on page 1 identifies the person approving the deviation and accepting the associated risk. The person signing must be authorized to accept the risk in accordance with table 1–1.

(1) Block 15 - Army HQ. From the dropdown, select the Army Headquarters (HQ) - Headquarters, Department of the Army (HQDA), ACOM, ASCC, or DRU (or combatant command if appropriate) - the acceptance authority falls under.

(2) Block 15b - Unit/Comm. Enter the specific unit and/or command the approval authority is assigned.

(3) Block 16a - Date. Date the approving authority signs the document accepting the risk. This date will automatically populate the “Effective” date in block 5a and at the top of each sequential page.

(4) Block 16b - Expiration Date. To be completed by the approval authority. Enter the date the deviation will expire. The expiration date is calculated by using block 16a, and the duration was chosen from blocks 21a through 21d. This date should be consistent with the “Duration of Deviation” selected in either blocks 21a, 21b, 21c, or 21d. The Expiration Date will auto-populate block 5b and the top of each sequential page once block 16b has been populated. For example, for effective date 20131202 (block 16a) and duration of one month to one year (block 21b), 12 was selected from the dropdown. The expiration date would be 12 months from the effective date. The deviation would expire on 20141201. If the deviation is greater than five years, enter “permanent” in the space provided for the expiration date.

(5) Block 17 - Rank/Title. Rank and title of the approving authority. For example, Major General, USA, 4th Infantry Division, Commanding.

(6) Block 17a - Printed Name. The printed name of the approving authority.

(7) Block 17b - Signature. Signature of the approving authority. Electronic signature capability is provided.

(8) Block 17c - Comment. Comments should be attached as necessary. If an approving authority comments and/or does not accept the assessed residual risk, then those developing the risk assessment should work together with the approving authority to mitigate and manage the risk to meet mission requirements. If more room is needed for comments, attach a continuation sheet and check the “attachment” block to indicate that something is attached.

d. The Deviation number is an installation-specific number for tracking purposes and will auto-populate from block 4. The effective and expiration dates (block 5a) will auto-populate from blocks 16a and 16b.

(1) Block 18 - Current Situation. Describe the situation that necessitates this deviation. For example, briefly describe the status of the planned operation, the ongoing activity that is unsustainable and needs to change, and/ or the current deviation, as applicable. Use a continuation sheet, if necessary, and check the “attachment” block indicating that something is attached.

(2) Block 19 - Hazard Category. From the dropdown, enter the broad category of the hazard created by the deviation (for example, fire, weather, explosion).

(3) Block 20 - Specific Hazard. Enter a brief description of the specific hazard being created by deviating from requirements (for example, fire due to linking extension cords).

(4) Block 21 - Duration of Deviation. Choose one block to document the period of the deviation and, except for block 21d, select a duration from the dropdown menu in the appropriate block (for example, block 21a, 21b, or 21c). If the deviation is permanent or greater than five years, enter “permanent” in the space provided or the specific number of years, if known. The expiration date (block 16b) will be calculated by the effective date (block 16a), and the specific duration entered in blocks 21a, 21b, 21c, or 21d.

(5) Block 22 - Deviation Approval Authority (or equivalent). Select the appropriate approval authority level in accordance with table 1–1. Military positions are listed in the drop-down with the Army Civilian equivalent. Army Civilian equivalent grades per table X–X of DA Pam 385–10 are authorized.

(6) Block 23 - Mission Impact of Not Accepting Risk. Describe the impact on the mission if the deviation and risk are not accepted (for example, the mission must be canceled, the mission must be postponed until the hazard can be corrected, or the mission violates Army requirements). Use a continuation sheet, if necessary, and check the “attachment” block indicating that something is attached.

(7) Block 24 - What we need to do that violates 8a. Provide a detailed description of the action that deviates from the safety standards identified in block 8a. A synopsis of this information will be provided in block 8b. If more room is needed for a detailed explanation, attach a continuation sheet and check the “attachment” block to indicate that something is attached.

(8) Block 25 - Control Measures. List the control measures that will be implemented to reduce the initial risk to residual risk. Include milestones of when controls will be implemented if not implemented before the DA Form 7632 is signed. If more room is needed for an explanation, attach a continuation sheet and check the “attachment” block to indicate that something is attached.

(9) Block 26 - Permanent Corrective Actions (with Milestones). Permanent measures may or may not be possible. Provide milestones for any permanent actions that will be taken. For military construction projects, provide the project number and estimated cost. If more room is needed for an explanation, attach a continuation sheet and check the “attachment” block to indicate that something is attached.

(10) Block 27 - Alternatives Considered. List the alternative solutions considered and the reason these were not used. Explain the reason if an appropriate one is not listed in the drop-down box. Explain if no alternative solution is available. (For example, the host nation directed which port or berth to use.) Use a continuation sheet, if necessary, and check the “attachment” block indicating that something is attached.

(11) Block 28 - Attach any Supporting Documents. Check this block if supporting documents (other than the continuation pages from the above sections) are attached, so the reviewers know to look for them (for example, photos, maps, and drawings).

B–5. Additional considerations when completing the DA Form 7632 when deviations involve ammunition or explosives, or chemical agents

When a deviation involves AE or chemical agent, complete the Risk Assessment Worksheet (page 2) and the AE Worksheet (page 3) of DA Form 7632 before completing page 1. Block 9 - Potential Consequences of Deviation from Approved Standards block 9a (Fatalities), block 9b (Injuries), and block 9c (Equip/Fac Loss) will auto-populate once blocks 39a through 39c have been populated if AE is the source of the risk. The AE Worksheet is required when a deviation involves AE or a chemical agent. Information needed to populate this worksheet can be found at various organizations, but not limited to: the safety office, Directorate of Public Works, master planner, FES, Director of Logistics, security and/or Military Police, property book office, and so forth. For technical assistance with this worksheet, contact USATCES, 1 C Tree Road, Building 35, McAlester, OK 74501 at DSN: 956–8737, Commercial: 918–420–8737, or at usarmy.mcalester.usamc.list.dac-est-siteplan@army.mil or via Ammo Help located under the “DAC” tab at https://mhp.redstone.army.mil/mhpmain.aspx.

Note. The deviation number, effective, and expiration dates will auto-populate on this page after completion of page 1 of the DA Form 7632.

a. Information on the PES.

(1) Block 29a - PES Name. Enter the name of the PES (for example, ASP #1, Joint Explosive Ordnance Disposal Rapid Response Vehicle Parking).

(2) Block 29b - PES Function. Describe the function of the PES (for example, unit storage, explosives-loaded vehicle parking area).

(3) Block 30 – Not Used.

(4) Block 31 – Not Used.

(5) Block 32 - Required Blast Distance. Enter the calculated blast distance based upon the NEW for the most hazardous HD and mixing rules. The amount of NEW is the highest expected during the requested timeframe.

(6) Block 33 - Required Fragment Distance. Enter the calculated fragment distance based upon the NEW for the most hazardous hazard division and mixing rules.

(7) Block 34a-f - Hazard Division. Enter the NEW by HD.

(8) Block 35a - QD arcs exceed the installation boundary? Are other Services affected? Was coordination made? Provide other coordination documentation, as necessary why coordination was not made. Is coordination paperwork attached? Check yes or no to indicate whether the arcs exceed the installation boundary, affect other Services, or if other coordination documents are available. State why coordination was or was not made. Check the “attachment” block to indicate that something is attached, if needed.

(9) Block 35b - Is this deviation associated with an HSS or RBSS? Indicate yes or no if a deviation is associated with an approved explosives safety site submission. The DA Form 7632 will be included in the explosives safety site submission as a supporting document.

(10) Block 35c - If yes, provide the site plan number. This is an installation-specific number for tracking purposes. For example, MCAAP–SP–2013–01. McAlester Army Ammunition Plant is MCAAP , SP indicates site plan, 2013 is the year, and 01 is the sequence number of site plans that installation has for that year or alpha and numeric format similar to block 4 above.

b. The “Information on exposed sites” section lists ESs to the PES and provides estimates of the expected loss in the event of an accident. Block 36 – Exposed Sites. List the ES facility number and description of all facilities within IBD of the PES. Enter the required and actual distances between the PES and ES. Next, enter the number of people at the ES and calculate the estimated dollar value of the ES facility and/or equipment at the ES. Then, enter the type of exposure (that is, QD) relationship required between the PES and ES (for example, IBD, PTRD, and so forth). Next, annotate whether the ES is on or off the installation. Then, calculate the expected number of fatalities, injuries, and loss to equipment and

facilities for the ES. Calculation of expected loss can be determined by using software, such as the DDESB-approved software Automated Safety Assessment Protocol–Explosives (ASAP–X) tool. The expected number of fatalities, injuries, and loss to equipment and facilities must be calculated twice: for each ES at the required distance and again for each ES as sited. The information entered in block 36 will be broken down into different categories in the following Expected Potential Consequences section. Use a continuation sheet, if necessary, and check the "attachment" block indicating that something is attached.

c. The "Expected potential consequences" section uses information from block 36 to calculate potential consequences. The different types of consequences have been calculated to reflect the impact of an incident assuming the total loss of the people, equipment, and facilities at the PES.

(1) Blocks 37a through c – Not Used.

(2) Blocks 38a through c – Not Used.

(3) Blocks 39a through c - Potential Loss Being Accepted for Deviating from Approved Standards. These numbers reflect the increased potential loss for ESs that are in violation of the required distance. These fields represent the additional consequences associated with the PES and the violations being accepted. These numbers come from the difference in the "as sited" and the "at required distance" fields of block 36 for ES sites listed that have the answer "Yes" violation in block 36. Blocks 39a through c should include the totals from any continuation sheet attachments if additional space for block 36 was needed. These blocks require manual input and will auto-populate blocks 9a through c.

(4) Blocks 40a through c – Not Used.

Appendix C

Safe Conveyor Separation for Ammunition and Explosives

C–1. Safe separation distances

Safe separation distances are meant for use on conveyor systems at maintenance lines. The distances and precautions given in figure C–1 are sufficient to prevent sympathetic detonation.

C–2. Items not listed in figure C–1

For information on items not listed in figure C–1, consult Commander, Joint Munitions Command.

Nomenclature	Model	Distance	Shield/barrier	Notes
40mm (TNT)		May be placed in contact	None	Projectile only or complete round
57mm (TNT)		6 inches between items	None	Projectile only or complete round
60mm (TNT)		4 inches between items	None	Projectile only or complete round
75mm (TNT)		5 inches between items	None	Projectile only or complete round
76mm (TNT)		5 inches between items	None	Projectile only or complete round
81mm (Comp B)	M374	8 inches between items, for pearlitic malleable iron (PMI) cartridges, 8 inches between items, oriented vertically, with intervening shield, for steel cartridges	For the steel cartridges, the intervening shields must be 2-inch diameter bars with minimum length equal to the length of the cartridges, and may be of steel or aluminum.	Projectile only or complete round
81mm (TNT)		7 inches between items	None	Projectile only or complete round
90mm (TNT)		7 inches between items	None	Projectile only or complete round
90mm, HEAT (Comp B)	M371A1	7 inches between items, oriented horizontally, 20 degrees oblique	None	Composition B loaded projectile with M530A1 PIBD fuze
90mm, HEAT (Comp B)	M371A1	7 inches between items, oriented horizontally, 20 degrees oblique	None	Composition B loaded projectile w/o fuze
90mm, HEAT (Comp B)	M371A1	7 inches between items, oriented horizontally, 20 degrees oblique	None	Composition B loaded complete cartridge
90mm, HEAT (Comp B)	M431A1	7 inches between items, oriented horizontally, 20 degrees oblique	None	Composition B loaded projectile with M530A1 PIBD fuze
90mm, HEAT (Comp B)	M431A1	7 inches between items, oriented horizontally, 20 degrees oblique	None	Composition B loaded projectile w/o fuze
90mm, HEAT (Comp B)	M431A1	7 inches between items, oriented horizontally, 20 degrees oblique	None	Composition B loaded complete cartridge
Burster for 4.2 inch M2A1 cartridge	M14	64 inches between items, oriented end-to-end	None	Bursters from chemical munitions projectiles
Burster for projectile, 105mm M360	M140A1	48 inches between items, oriented end-to-end	None	Bursters from chemical munitions projectiles
Burster for projectile, 105mm M60	M5	8 inches between items, oriented end-to-end	None	Bursters from chemical munitions projectiles
Burster for projectile, 105mm M104, M110	M6	8 inches between items, oriented end-to-end	None	Bursters from chemical munitions projectiles
Burster for projectile, 105mm M121A1	M71	16 feet between items, oriented end-to-end	None	Bursters from chemical munitions projectiles

Figure C–1. Safe conveyor spacing

Burster for projectile, 8 inch M426	M83	24 feet between items, oriented end-to-end	None	Bursters from chemical munitions projectiles
Cartridge, HEAT-T, 52mm	M409 series	15 feet between projectiles, center-to-center, in a nose down, vertical orientation	None	Complete round
Cartridge, 105mm, HEAT-T	M456	23 inches, center-to-center oriented vertically, w/aluminum bar placed halfway between cartridges; or 15 inches, center-to-center, oriented horizontally, side-to-side, w/aluminum bar placed halfway between cartridges	Barrier bars are aluminum, 6061-T6, 3 inch diameter, and of aluminum length equal to that of the cartridges	Complete round
Cartridge, 105mm, HEAT-T	M456	23 inches, center-to-center, oriented vertically, w/aluminum bar placed halfway between projectiles	Barrier bars are aluminum, 6061-T6, 3 inch diameter, and of aluminum length equal to that of the cartridges	Projectile only
Cartridge, 105mm, HEAT-T	M456	23 inches, center-to-center oriented vertically, w/aluminum bar placed halfway between cartridge cases, and with protective caps on cases or rapid response deluge protection over cartridge cases.	Barrier bars are aluminum, 6061-T6, 3 inch diameter, and of aluminum length equal to that of the cartridge case. Protective caps must be fire resistant, and must protect propellant charge from fire brands and radiant thermal effects.	Primed, loaded cartridge cases.
Cartridge, 105mm, HEAT-T	M456	Empty cases may be placed in contact.	None	Empty cartridge case w/M83 primers
Cartridge, 105mm, HE	M1	15 inches between items oriented nose-to-tail	None	Completed cartridge with primer protected
Cartridge, 105mm, HE	M1	15 inches between items oriented nose-to-tail	None	completed cartridge w/o fuze, primer protected
Cartridge, 105mm, HE	M1	15 inches nose-to-tail w/rounds oriented nose-to-tail	None	Fuzed or unfuzed rounds
Cartridge, 106mm HEAT	M344	6 inches between items	None	Complete (nose-to-base)
Cartridge, 20mm HEI-T-SD	M246	3/4 inch (edge-to-edge)	None	Horizontal and perpendicular
Cartridge, 25mm, HEI-T	M792	2.5 inches, center-to-center, oriented vertically	None	Loaded body assembly, w/o fuze

Figure C–1. Safe conveyor spacing - continued

Cartridge, 25mm, HEI-T	M792	2.5 inches, center-to-center, oriented vertically	None	Fuzed projectile only
Cartridge, 25mm, HEI-T	M792	2.5 inches, center-to-center, oriented vertically	None	Complete round
Cartridge, 25mm, HEI-T	M792	One half inch, center-to-center	None	HEI mix pellet, type II, containing 1.94 grams; 97/3 percent RDX/wax (64 percent), aluminum powder (35 percent), and graphite and/or calcium sterate (1 percent)
Cartridge, 25mm, HEI-T	M792	One inch, center-to-center, between stacks	None	Stack of 3 HEI mix pellets, type I, totaling 10.11 grams; 97/3 percent RDX/wax (64 percent), aluminum powder (35 percent), and graphite and/or calcium sterate (1 percent)
Cartridge, 30mm, TP	M788	Zero (in contact)	None	Horizontal and perpendicular to the conveyor travel
Cartridge, 4.2 inch illuminating	M335	No separation required in the horizontal coaxial orientation	None	
Cartridge 4.2 inch mortar, HE	M329	21 inches between items	None	Cartridge
Cartridge, 81mm	M821	No separation required in the nose-to-tail horizontal coaxial orientation	None	
Cartridge, 81mm	M889	No separation required in the nose-to-tail horizontal coaxial orientation	None	
Cartridge, 81mm illuminating	M301	No separation required in the horizontal coaxial orientation	None	
Cartridge, 81mm w/ alloy steel projectile	M374	6 inches between items oriented nose-to-tail	None	With or w/o fuze, and with or w/o propellant
Cartridge, 90mm AP-T	M318	No separation required mm the horizontal coaxial orientation. The point of the windscreen must not be in contact with the primer of the cartridge in front.	None	
Cartridge, 90mm APERS-T	M580	7 inches between items, oriented nose-to-tail	None	Complete round
Cartridge, 90mm Canister	M336	Zero (in contact)	None	Horizontal coaxial (nose-to-tail)
Charge, propelling, 155mm	M4	84 inches tail-to-tail	None	Horizontal oblique, 30 degree angle

Figure C–1. Safe conveyor spacing - continued

Cloud detonator for M130 SLUFAE rocket	M130	4 feet between oriented center-to-center oriented vertically	None	Steel outer body containing a detonator/delay element, safety and arming mechanism, and tow booster pellets loaded with PBXN-5.
Cluster tray for grenade, GP	M42/M46	Zero spacing between trays	Tray is a component for continuous feed conveyor systems used in the load, assembly, and pack of M483 and M509 projectiles	Tray configuration and material of construction must be identical to that depicted in the 4th Ind DRXOS-ESSP, 29 Sep 81, to letter, DRDARLCM-SP, 7 May 81, subject: Test Results Safe Separation Distance Testing of M42/M46 GP Cluster Tray
Composition B		20 feet, side-to-side; or 12 feet side-to-side, when effective means exist to prevent spread of a fire between buildings via the conveyor.	None	60-lb box
Explosive D		15 feet, side-to-side	None	50-pound box or fiber container
Fuze, point detonating	M48A3, M51A5, & M557	3 inches between cans	5/16-inch thick paper non-propagation tubes (NSN 8140-01082-9678; dwg #9328329) will replace the normal plastic bottom support for the fuzes	8 fuzes per M2A1 ammunition can with non-propagation tubes, w/o can covers, and w/o nose supports for the fuzes.
Fuze, point detonating	M48A3, M51A5, & M557	6 inches, edge-to-edge, in a nose up orientation	None	Fuze only
Grenade, 40mm, cartridge	M406	6 inches, edge-to-edge	None	Edge-to-edge in the horizontal perpendicular position
Grenade, hand, fragmentation	M26	3 inches between grenades	None	Fuzed grenade only
Grenade, hand, fragmentation, delay	M33	12 inches between grenades regardless of orientation	None	Grenade body is a 2.5 inch diameter steel sphere containing 5.5 oz. of Comp B high explosive, its M213 fuze is equipped with a steel safety pin, but not a safety clip
Grenade, hand, fragmentation, delay	M61	12 inches between grenades regardless of orientation	None	Grenade body is a 2.25 inch diameter consisting of 2 pieces of thin wall sheet steel containing a total of 5.5 oz. of Comp B & .3 oz. of tetyl pellets

Figure C–1. Safe conveyor spacing - continued

Grenade, hand, fragmentation, delay	M61	12 inches between grenades regardless of orientation	None	Grenade body is a 2.25 inch diameter consisting of 2 pieces of thin wall sheet steel containing a total of 5.5 oz. of Comp B & .3 oz. of tetyl pellets. Its M20A1/M204A2 incorporates a safety clip
Grenade, smoke	M18	6 inches between grenades	None	Horizontal, side-by-side w/o fuze
Grenade, smoke	M18	6 inches between grenades, fuze-to-base	None	8 grenade ring pack, Loading rings consist of grenades and metal parts constituting one layer in a projectile
Hand grenade, Fragmentation	M67	12 inches outside edge to outside edge w/o regard to orientation	None	15 grenade ring pack, Loading rings consist of grenades and metal parts constituting one layer in a projectile
Loading rings for grenade, GP (for M483 projectile)	M42/M46	12 inches outside edge to outside edge	None	Complete assembly with 1.3 lbs. of RDX, two conical shaped charge plates, two cover plates, and center loaded booster.
Loading rings for grenade, GP (for M509 projectile)	M42/M46	12 inches outside edge to outside edge	None	Horizontal, front of mine facing up, and side-by-side to each other
Mine, AP	M74	Zero spacing (edge-to-edge) between the mines and the shield	A rod with a minimum height of 2.6 inches (mine height), 3-inches thick, and a width equal to the conveyor belt.	Mine only
Mine, AP	M74	Zero spacing edge-to-edge w/shield described below loaded on the center line and between each mine, 3-inch diameter, 6061-T6 aluminum rod, height of the rod equal to the full height of the mine.	3-inch diameter, 6061-T6 aluminum rod, height of the rod equal to the full height of the mine.	Complete assembly with 1.3 lbs. of RDX, two conical shaped charge plates, two cover plates, and center loaded booster.
Mine, AP	M18A1	12 1/2 inches (edge-to-edge)	None	Horizontal, front of mine facing up, and side-by-side to each other
Mine, AT, HE, heavy	M15	25 feet between mines	None	Mine only
Mine, AT, HE, heavy	M15	25 feet between mines	None	Mine only, 4 mines per tray
Mine, AT-AV	M75	Zero spaced (edge-to-edge) between the mines and the shield	A rod with a minimum height of 2.6 inches (mine height), 3-inches thick, and a width equal to the conveyor belt.	Complete assembly with 1.3 lbs. of RDX, two conical shaped charge plates, two cover plates, and center loaded booster.
Mines, AP, (TNT)	M16	12 inches between mines	None	Mine only
Pentolite (bulk)		35 feet, side-to-side	None	50-pound box or fiber container

Figure C–1. Safe conveyor spacing - continued

Projectile for cartridge, 105mm	M1	15 inches between items, oriented nose-to-tail	None	Comp B loaded, w/o fuze, with lift plug
Projectile for cartridge, 105mm	M1	22 inches between items oriented horizontally, nose-to-tail	None	Comp B loaded w/o fuze or nose.
Projectile, 105mm (Comp B)	M1	20 feet between pallets, rounds in vertical orientation, 1-inch apart	Intervening shield of 21 inches by 24 inches by 0.75 SAE 1020 steel	Pallets of projectiles only, w/o funnels, 16 projectiles per pallet.
Projectile, 105mm (Comp B)	M1	30 feet between pallets, rounds in vertical orientation, 1-inch apart	None	Pallets of projectiles only, w/o funnels, 16 projectiles per pallet.
Projectile, 105mm, HE	M444	24 inches tail-to-tail	None	Horizontal oblique, w/o fuze, 45 degree angle
Projectile, 105mm, HE	M444	36 inches tail-to-tail	None	Horizontal oblique, w/o fuze, 45 degree angle
Projectile, 105mm, HE	M444	72 inches tail-to-tail	None	Vertical, w/o fuze, overhead monorail
Projectile, 105mm, illuminating	M314	No separation required between projectiles	None	Horizontal, 45 degrees oblique w/fuze
Projectile, 105mm, illuminating	M314	No separation required between projectiles	None	Horizontal, 45 degrees oblique w/o fuze
Projectile, 106mm, HEP-T	M346	9 feet between items	None	Projectile
Projectile, 155mm HERA	M549	3.5 inches, outside edge to outside edge	3-inch diameter aluminum bar with a minimum length equal to the height of the projectiles placed halfway between projectiles, oriented vertically	Loaded projectiles w/o fuze, w/o lifting plugs
Projectile, 155mm HERA	M549	5 feet, center-to-center, oriented vertically, side-to-side	None	Loaded projectiles w/o fuze, with lifting plugs
Projectile, 155mm	M107	18 inches, center-to-center	Intervening shield of 0.5 inches steel, 0r 1-inch aluminum	This does not apply to ICM projectiles or the M795
Projectile, 155mm, HE	M795	15 feet center-to-center, oriented side-to-side, vertically	None	Single projectiles with loading funnels, filled with cast explosives
Projectile, 155mm (Comp B or TNT)	M107	18 inches, center-to-center, placed horizontally with a shield located halfway between projectiles	Intervening shield of 0.5 inches thick steel, or 1 inch thick aluminum. A minimum of 9 inches by 25 inches in frontal diameter	Projectile only M107 type, This does not apply to ICM projectiles or the M795
Projectile, 155mm, HE	M449	42 inches positioned horizontally (nose-to-tail or side-by-side); 54 inches positioned vertically	None	Projectile with lifting plug and loaded with expulsion charge and M43 grenades

Figure C–1. Safe conveyor spacing - continued

Projectile 155mm, smoke	M116	No separation required between projectiles	None	Horizontal 30 degrees oblique
Projectile, 175mm (Comp B)		15 feet between items	None	Projectile only
Projectile 30mm, HEDP	M789	3 inches between projectiles (outside edge to outside edge) oriented side-to-side, vertically	None	Heated loaded body assembly with cone temperature of 205 degrees F
Projectile 30mm, HEDP	M789	3 inches between projectiles (outside edge to outside edge) oriented side-to-side, vertically	None	Fuzed projectile
Projectile 30mm, HEDP	M789	One inch between assemblies (outside edge to outside edge) oriented side-to-side, vertically	None	Shell body with 2 each, loose PBXN-5 pellets, 27 grams total explosive weight
Projectile, 30mm, HEDP	M789	One inch between assemblies (outside edge to outside edge) oriented side-to-side, vertically	None	Loaded body assembly with liner, 0.08 gram PBXN-5 relay charge and steel spacer, at ambient temperature
Projectile, 30mm, HEDP	M789	One inch side-to-side	None	Stacks of 2 each PBXN pellets, type 2, 13.5 grams
Projectile, 8 inch, HE	M106	8 feet, edge-to-edge, in the vertical in-line orientation	None	
Projectile, 8 inch, HE	M106	One foot between outside edges with aluminum bar placed halfway between projectiles, oriented vertically	None	Loaded projectile w/o fuze, lifting plug, supplementary charge and liner
Projectile, 8 inch, HE	M404	42 inches positioned horizontally (nose-to-tail or side-by-side); 48 inches positioned vertically	None	Projectile with lifting plug and loaded with expulsion change and M43 grenades
Projectile, 8 inch, HE	M509	5 feet center-to-center oriented vertically	V shield	Projectile w/o fuze or expulsion charge, at any stage of grenade loading
Rocket	M229	15 inches nose-to-tail	None	Complete round using M423 fuzed and MK40 mod 3 motors, Warhead loaded with 4.8 lbs. of Comp B-4.
Rocket 2.75 inch	M151	15 inches nose-to-tail	None	Complete round using M423 fuze and MK40 motor, Warhead loaded with 2.3 lbs. of Comp B-4.
Rocket, 3.5 inch HEAT	M28A2	14 inches between items, placed horizontally at a 20 degree angle to the direction of movement	None	All up round.

Figure C–1. Safe conveyor spacing - continued

Rocket, 3.5 inch HEAT	M28A2	14 inches between items, placed horizontally at a 20 degree angle to the direction of movement	None	Warhead only, fuzed or unfuzed.
Rocket, 66mm, HEAT	M72	10 inches between items, placed horizontally at a 20 degree angle to the direction of movement	None	Complete round.
Rocket, 66mm, HEAT	M72	10 inches between items, placed horizontally at a 20 degree angle to the direction of movement	None	Warhead only, fuzed or unfuzed.
Submunition	BLU-97/B	4 feet between pallets with barrier placed halfway between	Solid barrier, 0.5 inch thick by 8 inches high by 16 inches wide, 6061-T6 aluminum plate	Pallet of 16 submunitions with solid barrier
Submunition	BLU-97/B	5 feet between pallets with barrier placed halfway between	Airflow barrier	Pallet of 16 submunitions with airflow barrier
Submunition	BLU-97/B	9 inches, center-to-center line, with full height barrier placed between submunitions	Full barrier, 1.0 inch thick by 6 inches wide by 5.1 inches high, 6061-T6 aluminum plate	Single submunition
Submunition	BLU-97/B	9 inches, center-to-center line, with full height barrier placed between submunitions	Partial barrier, 1.0 inch thick by 6 inches wide by 3.75 inches high, 6061-T6 aluminum plate	Single submunition
Tetyl (bulk)		25 feet, side-to-side	None	50-pound box of fiber container
TNT		20 feet, side-to-side; or 12 feet side-to-side, when effective means exist to prevent spread of a fire between buildings via the conveyor.	None	55-pound box, carton, or fiber container.
Warhead	BLU 108/B	17.5 feet from nearest edge of munitions on tray to nearest edge of munition on the next tray with a shield between trays	Intervening shield of 1 inch thick aluminum (AL 6061-T6 plate). A minimum frontal dimension of 12 inches by 12 inches. Shield may be located as close as 2 feet, 8.5 inches from nearest tray	4 per tray, vertical, w/o fuze, with or w/o funnel
Warhead, rocket, 5 inch		36 inches tail-to-tail	None	Horizontal, 30 degree oblique, w/o fuze

Figure C–1. Safe conveyor spacing - continued

Appendix D

Earth Electrode Subsystem Test and Inspection

D–1. Introduction

This appendix provides criteria and procedures for conducting both visual inspection and electrical testing of earth electrode subsystems.

D–2. Visual inspection criteria

The earth electrode subsystem will be visually inspected only when or where the subsystem is visible. The earth cover will not be removed from the earth electrode subsystem for the sole purpose of inspection.

a. Components will be in good repair.

b. Components will be free of paint or other nonconductive coatings.

c. Components will be free of corrosion. Discoloration of materials is not considered corrosion.

d. Components will be free of breaks, cuts, and damage that will affect equipment integrity.

e. All permanent (welded) and semi-permanent (bolted) bonds are in good condition.

f. Components will be securely fastened to their mounting surfaces and protected against movement and damage.

g. There have not been additions or alterations to the protected facility that would require additional protection or testing.

h. Compression clamps are tight.

D–3. Earth resistance testing

The resistance of the earth surrounding the facility should be measured using a four-terminal fall of potential meter. The reading obtained indicates the soil's average resistance in the test area's immediate vicinity. A resistance profile of the site requires that the test be repeated at many sample locations over the region being mapped.

a. For small sites, up to 2,500 square feet (232 square meters), make at least one measurement at the center of the site and at each of the four corners of a 50-foot (15 meters) square, as shown in figures D–1 and D–2. Drive a stake or marker at the locations shown. Position the potential and current probes in a straight line with the stake or marker centered between the probes. Make a resistance measurement at each location and calculate the resistance. Record the resistance. Take the average of the five readings as the resistance for the soil at the site. If possible, soil measurements should be made during average or normal weather conditions. Measurements should never be made immediately after a rain or storm.

b. For larger sites, make measurements every 100 to 150 feet (31 to 46 meters) over the site area. Include in the site area the locations of support elements such as transformer banks, towers, engine-generator buildings, and so forth. Choose a sufficient number of test points to indicate the relative uniformity of the soil composition throughout the area. Be particularly alert for the presence of localized areas of very high or very low resistance soils.

c. A single soil resistance measurement is made using the four-probe method in the following manner:

(1) At a location near the center of the site, insert the four short probes supplied with the earth resistance test set into the soil in a straight line, as illustrated in figure D–2. A convenient probe spacing of 6 to 9 meters (20 to 30 feet) is recommended as a start. If probes are not supplied with the test set or if they have been lost or misplaced, four metal (steel, copper, or aluminum) rods, 1/4 to 3/8 inch in diameter and 12 to 18 inches in length, may be used. Drill and tap the rod for Nos. 6–32, 8–32, or 10–24 screws, according to the rod size, and securely fasten the test set leads to the rods. Clamps may also be used for connecting the leads to the probes.

(2) Following the manufacturer’s instruction, obtain a resistance reading, R, with the test set.

(3) Convert the probe spacing, A, to centimeters.

(4) Compute resistance from p=6.28RA (in ohm-cm). Example: Assume that resistance of 2 ohms is measured with probe spacings of 20 feet. Convert 20 feet to centimeters: 20 ft. x 30.5 cm/ft. =610 cm. Calculate resistance: p=6. 28 x 2 (ohm) x 610 (cm) = 7662 ohm-cm.

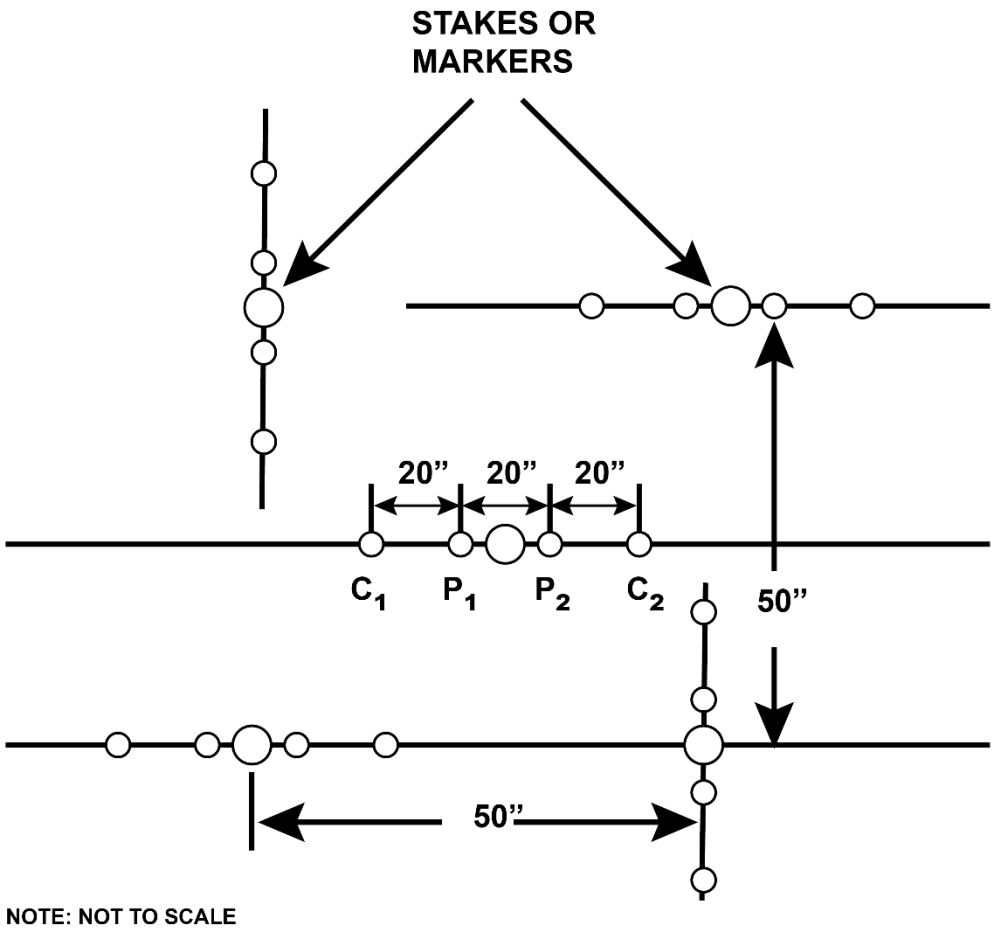


Figure D–1. Measurement of soil resistance

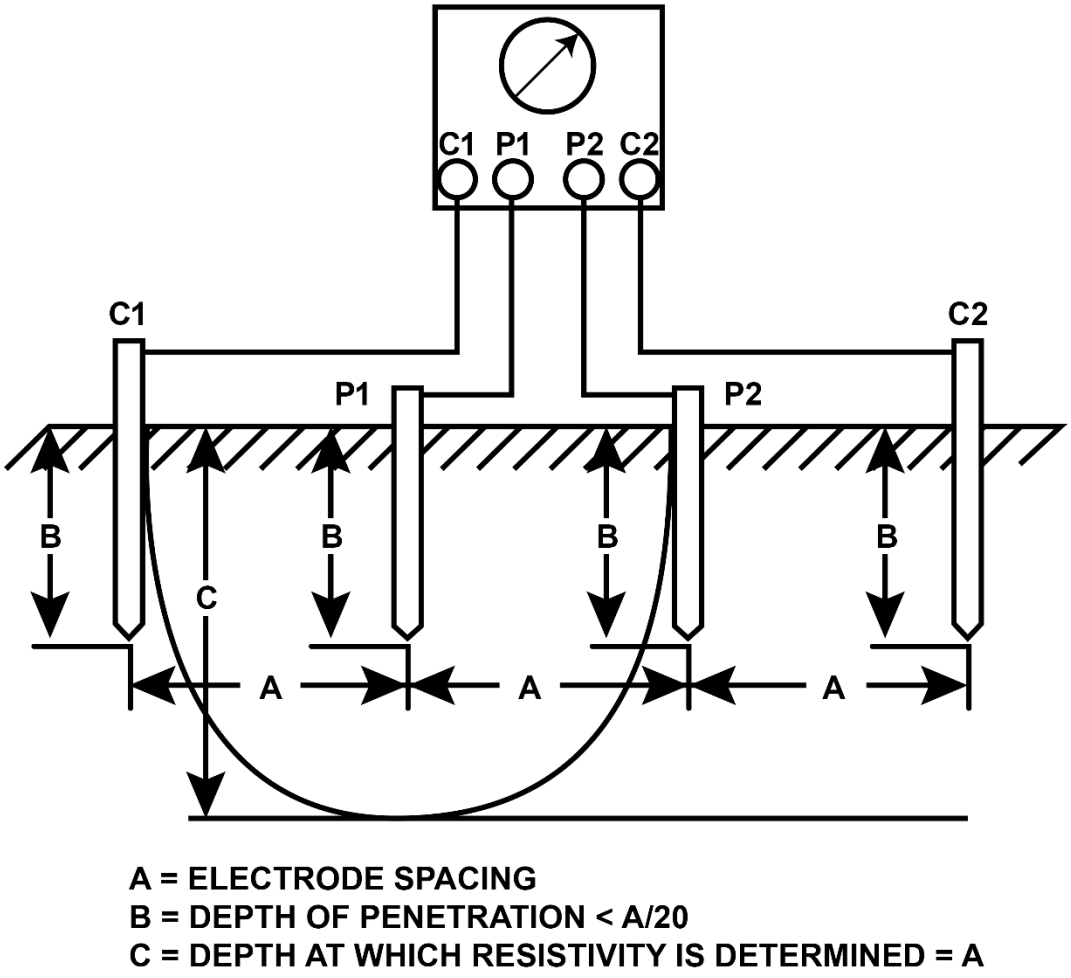


Figure D–2. Resistance determination of a small site

D–4. Resistance to earth testing

The calculated resistance of a given earth electrode subsystem is based on a variety of assumptions and approximations that may or may not be met in the final installation. Because of unexpected and uncontrolled conditions which may arise during construction or develop afterward, the resistance to earth of the installed earth electrode subsystem must be measured to see if the design criteria are met. In an existing facility, the resistance to earth of the earth electrode subsystem must be measured to see if modifications or upgrading are necessary. There is only one test method (the 3point fall of potential method) that the Army recognizes. The 3-point fall of potential method involves passing a known current between the electrode under test and a current probe, as shown in figure D–3. The drop in voltage between the earth electrode and the potential electrode located between the current electrodes is then measured. The ratio of the voltage drop to the known current gives a measure of resistance.

a. Current flow into the earth surrounding an electrode produces shells of equipotential around the electrode. A family of equipotential shells exists around both the electrode under test and the current reference probe. The sphere of influence of these shells is proportional to the size of each respective electrode. The potential probe in figure D–3 provides an indication of the net voltage developed at the earth's surface by the combined effect of these two families of shells. If the electrode under test and the current

reference probe are so close that their equipotential shells overlap, the surface voltage variation as measured by the potential probe will vary, as shown in figure D–4. Since the current flowing between the electrodes is constant for each voltage measurement, the resistance curve will have the same shape as the voltage curve. For close electrode spacings, the continuously varying resistance curve does not permit an accurate determination of resistance to be made. By locating the current reference probe far enough away from the electrode under test to ensure that the families of equipotential shells do not overlap, a voltage curve like that shown in figure D–4 will be obtained to produce the type of resistance curve shown in figure D–3. When the distance (D) between the electrode under test and the current reference probe is very large compared to the dimensions of the earth electrode subsystem under test, the latter can be approximated as a hemisphere, and interaction between the two electrodes is negligible. Thus the true value of resistance to earth corresponds to the ratio of the potential difference to the measured current when X is 62 percent of the distance (D) from the electrode under test to the current probe. It is important to remember that (D) is measured from the center of the electrode under test to the center of the current probe and that (D) is large relative to the radius of the electrode under test. Figure D–4 shows an example of data taken with the fall of potential method. The correct resistance of 13 ohms corresponds to the potential probe location of 27.4 meters (90 feet) which is 62 percent of the distance to the current probe. For a complete explanation of probe spacing, see Military Handbook 419.

b. Meters for this type of test are manufactured with either three or four terminals. With a four-terminal meter, the P1 and C1 terminals must be interconnected and connected to the earth electrode to be tested. With a three-terminal instrument, connect terminal X to the earth electrode being tested. The earth electrode subsystem will be disconnected when practical. If the earth electrode is directly accessible, connect the C1 P1 terminals or the X terminal of the test meter directly to the earth electrode or interconnecting cable. If the earth electrode is not directly accessible, connect the C1 P1 terminal or X terminal to the lowest portion of the LPS down conductor or a structural ground connection. The driven reference probe C should be driven at the distance (D) from the electrode under test as specified in table D–1. Potential reference probe P is then driven at a point between the earth electrode under test and probe C as specified in table D–1. The test leads should then be connected, as shown in figure D–4. Reference probes should be driven to a three-foot depth unless an acceptable reading can be achieved with the reference probes driven to a lesser depth. Operate the test meter in accordance with the manufacturer’s instructions to obtain the resistance to earth reading. Record the reading.

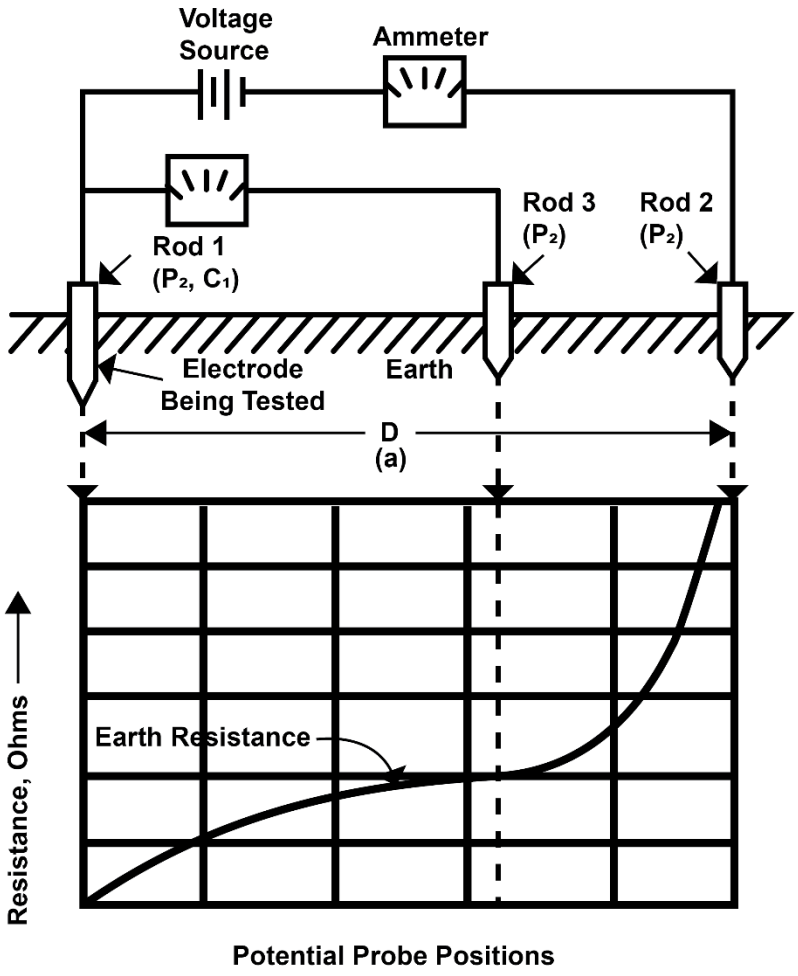


Figure D–3. Fall of potential method for measuring the resistance of earth electrodes

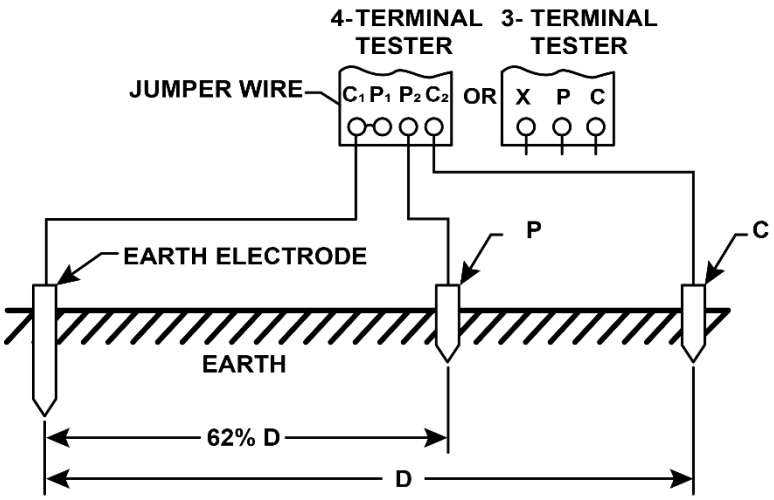


Figure D–4. Fall of potential resistance to earth test

Table D–1
Test probe C and P distances Continued

Earth Electrode System	Figure #	Probe C distance (D)	Probe P distance
Single Rod		40 meters/131 feet	25 m/82 ft
Multiple Rod	16–4	40 meters/131 feet	25 m/82 ft
Ground Loop/ counterpoise	16–5	40 meters/131 feet	25 m/82 ft
Grid		40 meters/131 feet	25 m/82 ft
Radial	16–7	40 meters/131 feet	25 m/82 ft
Plates	16–8	40 meters/131 feet	25 m/82 ft
Navy installed system	16–6	40 meters/131 feet	25 m/82 ft

Appendix E

Inspection and Test of Static Electricity Charge Dissipation Subsystems

E–1. Introduction

This appendix provides criteria and procedures for conducting both visual inspection and electrical testing of static electricity charge dissipation systems.

E–2. Visual inspection procedures and criteria

a. Visual inspection procedures and criteria for conductive floors, mats, and runners.

b. Floors mats and runners will be clean, dry, and free of paint or other nonconductive coatings.

(1) Related equipment (metal parts) will be corrosion-free. Discoloration of materials is not considered corrosion.

(2) Floors, mats, and runners will be free of breaks, cuts, and damage that will affect equipment integrity.

(3) Bonding straps will not have more than 50 percent of the wire strands broken.

(4) Components will be in good repair.

(5) Components will not be weakened by vibration.

(6) Components will be securely fastened to their mounting surfaces and protected against movement and damage.

(7) There have not been additions or alterations to the protected equipment which would require additional protection or testing.

c. Visual inspection procedures and criteria for conductive shoes.

(1) Conductive sock liners not separated or removed from the conductive plug.

(2) Conductive plugs not depressed below the insole surface.

(3) Conductive soles are clean and free of nonconductive materials.

(4) No additions or alterations to the footwear which would negate the protective properties of the footwear.

d. Visual inspection procedures and criteria for belt system.

(1) Belts and related equipment will be free of paint or other nonconductive coatings.

(2) Related equipment (metal parts) will be corrosion-free. Discoloration of materials is not considered corrosion.

(3) Belts and related equipment will be free of breaks, cuts, and damage that could affect equipment integrity.

(4) Bonding straps will not have more than 50 percent of the wire strands broken.

(5) Components will be in good repair.

(6) Components will not be weakened by vibration.

(7) Components will be securely fastened to their mounting surfaces and protected against movement and damage.

(8) There are no additions or alterations to the protected equipment which would require additional protection or testing.

e. Visual inspection procedures and criteria for legstats and wriststats.

(1) Legstats or wriststats will be free of paint or other nonconductive coatings.

(2) Legstats or wriststats will be free of corrosion. Discoloration of materials is not considered corrosion.

(3) Legstats or wriststats will be free of breaks, cuts, and damage that must affect their integrity.

(4) Wriststat bonding straps will not have more than 50 percent of the wire strands broken.

(5) Components of legstats or wriststats will be in good repair.

(6) There have been no additions or alterations to the protected equipment which would require additional protection or testing.

f. Visual inspection procedures and criteria for machinery and equipment.

(1) Mating surfaces of machinery and equipment will be free of paint or other nonconductive coatings.

(2) Machinery and equipment will be free of corrosion. Discoloration of materials is not considered corrosion.

(3) Bonding straps will not have more than 50 percent of the wire strands broken.

(4) Machinery and equipment will be in good repair.

(5) Machinery and equipment components will be securely fastened to their mounting surfaces and protected against movement and damage.

(6) No additions or alterations to the protected machinery or equipment that would require additional protection or testing.

E–3. Electrical testing of conductive floors and mats

a. Equipment requirements are as follows:

(1) Conductive surface resistance will be measured with a calibrated ohmmeter that operates on a nominal open circuit output voltage of 500 V dc with a short circuit current of 2.5 mA to 5 mA. Nominal internal resistance must not be less than 100,000 ohms.

(2) Accessories required for these tests must include two weighted electrodes. Each electrode must weigh 5 lbs. and have a flat circular contact area 2 1/2 inches in diameter. The contact surface must be comprised of aluminum or tin foil .0005 inches to .001 inches thick with a backing layer of rubber 1/4 inch thick. The rubber backing will have a hardness rating of between 40 and 60 based on measurement with a Shore Type A Durometer.

b. Testing procedures (two-electrode).

(1) Obtain resistance readings from five different locations on the conductive surface.

(2) When conducting this test, two electrodes are placed 3 feet apart at each of the 5 test points.

(3) Record the readings and compute the average of the five locations.

(4) The average resistance must be more than 25,000 ohms and less than 1,000,000 ohms.

(5) No individual reading must be less than 10,000 ohms or more than 5,000,000 ohms.

Note. When obtaining resistance measurements, it is recommended that approximately 5 seconds be allowed for meter stabilization before recording the reading.

c. Test procedures (one electrode to ground).

(1) Obtain five resistance readings to the ground. For this test, only one electrode is placed at each test location on the conductive surface. The meter leads are connected to the electrode and to the ground point.

(2) The average of the five values must be greater than 25,000 ohms, with no individual reading less than 10,000 ohms nor more than 1,000,000 ohms.

E–4. Electrical testing of conductive shoes

a. The testing instrument should consist of conductive plates arranged so that the employee stands with only one foot on each plate to complete the circuit. When tests are so made, the maximum allowable resistance is 1 million ohms. The test voltage will be no greater than 500 volts. The short circuit current across the electrodes (plates) will not exceed 2.5 milliamperes to 5 milliamperes (0.5 milliamperes is required when the instrument is used with personnel). Positive safeguards must be incorporated into the design of the instruments to eliminate the chance of electric shock to the subject undergoing the test. Tests must not be performed in rooms where exposed explosives are present.

b. Shoes will be tested first without cleaning the soles and heels, and if the resistance does not exceed the required limits, the shoes may be put into service. If resistance exceeds 450,000 ohms per shoe when testing, they will be cleaned and retested. The shoes may be returned to service if readings are sufficiently low. Those with excessive readings will be destroyed. Sandpaper, solvents, or other agents affecting the structure or conductivity of the sole materials will be avoided. Separation or removal of the conductive sock liners from the conductive plug or depression of the conductive plugs below the surface of the insole of the shoe may cause high resistance.

E–5. Electrical testing of conductive conveyor belts

a. The building will be clean and dry. The room will be free of flammable gas mixtures, explosive dust, and explosives.

b. Electrodes will comply with *paragraph E–3a*.

c. Resistance will be measured with a calibrated ohmmeter. The meter will operate on a nominal open circuit voltage of 500 volts DC or a short circuit current of 2.5 to 5 milliamperes and have an effective internal resistance of 100,000 ohms.

d. Both electrode-to-electrode and electrode-to-earth electrode subsystem measurements will be made at five or more locations on the belt, and the results will be averaged. The average will be below the value

specified in table 16–1. When the resistance to the earth electrode subsystem is measured, two measurements will be taken at each of the five test points. The test leads will be interchanged between each measurement, and the two readings must be averaged. Electrodes will not be placed closer than three feet from any down conductor or bonding strap (except when space is not available). All readings will be done after the voltage has been allowed to stabilize for 5 seconds. Record the readings.

E–6. Electrical testing of conductive V-belts

a. Requirements of *paragraph E–5a* apply.

b. Requirements of International Standards Organization (ISO) 1813 will be used to test conductive V-belts prior to installation.

c. Requirements of *paragraph E–5c* apply.

E–7. Electrical testing of legstats

a. Legstats will be tested using any meter capable of measuring resistance in the 0 to 1 megohm range.

b. Each legstat will be tested both off and on the wearer. Use paragraph E–4 for testing procedures.

E–8. Electrical testing of wriststats (see table 16–1)

Wriststats must be tested in accordance with the publication requiring the use of the wriststats.

E–9. Electrical testing of equipment and machinery

a. The requirements in *paragraph E–5a* apply.

b. The meter will be capable of reading 2 ohms.

c. Measurements will be made, as a minimum, at a location closest to the earth electrode subsystem, at a location farthest from the earth electrode subsystem, and at all locations requiring bonding straps. Test electrodes must not be placed closer than 3 feet from any LPS down conductor or bonding strap that is attached to down conductors (except when space is not available). Record the readings.

E–10. Electrical testing of airfield loading pads

Use appropriate procedures contained in appendix D.

Appendix F

Inspection and Test of Lightning Protection Subsystems

F–1. General requirements

LPS will be visually inspected and tested as specified in table 16–1 for electrical resistance and adequacy of grounding. Any system will be considered deficient if the required resistance value cannot be met. Any system found to be deficient will be repaired. If the deficiency cannot be corrected immediately, the LPS test/maintenance/ace personnel must record the deficiency on the test record and initiate the following actions:

a. Notify the installation safety office.

b. If the deficient system protects an AE storage structure, the custodian of the contents must be notified.

c. Interim control measures will be developed based on a risk assessment in accordance with AR 385–10. The risk assessment must consider ceasing operations in and around the building and rewarehousing the contents for storage facilities. A decision not to rewarehouse the contents of a storage magazine is justified only when the risk of rewarehousing exceeds the risk associated with the deficient LPS. When the use of the facility continues, maintenance to achieve the required resistance must be accomplished as soon as possible.

F–2. Visual inspection of lightning protection subsystem

Components of the subsystem will be inspected for the following:

a. Subsystem will meet the requirements specified in NFPA 780.

b. Components will not be broken.

c. Components will be in good repair.

d. Components will be free of corrosion. Discoloration of materials is not considered corrosion.

e. Components will be free of breaks, cuts, and damage that will affect equipment integrity.

f. Bonding straps will not have more than 50 percent of the wire strands broken, and the remaining portion of the strap will meet the minimum strap thickness and width/cross-section requirements of table 16–4.

g. Components will not be weakened by vibration.

h. Components will be securely fastened to their mounting surfaces and are protected against accidental mechanical displacement as required.

i. There have not been additions or alterations to the protected facility which would require additional protection or testing.

F–3. Electrical testing of lightning protection subsystems

a. Test instruments. Electrical tests consist of measuring the bonding resistance of the lightning protection subsystem components. The instrument must be capable of measuring resistance up to 1 ohm +10 percent. The manufacturer’s instruction manual will be followed to ensure proper use of the instrument.

b. Requirements for the bonding test are as follows:

(1) The bonding test (see figure F–1) consists of firmly attaching one lead of the ohmmeter to the down conductor where it enters the earth. The earth electrode system will be disconnected when practical. The other lead will then be firmly attached to:

(a) The other down conductor where it enters the earth (see figure F–1).

(b) Each component of the lightning protection subsystem.

(c) Each component of all other subsystems on the facility.

(d) All large metal bodies (a surface area equal to or greater than 400 square inches) that are bonded to the lightning protection subsystem.

(2) Read the meter. If the meter reading is one (1) ohm or less, the lightning protection subsystem is acceptable. Record the reading. If the meter reading exceeds one ohm, the lightning protection subsystem is not acceptable.

(3) If lightning protection down conductors are not accessible, the air terminal base may be used as an alternate reference test point for the meter test lead. The air terminal selected should be the same one used to do the 3-point fall of potential test, which validates the system’s resistance to earth.

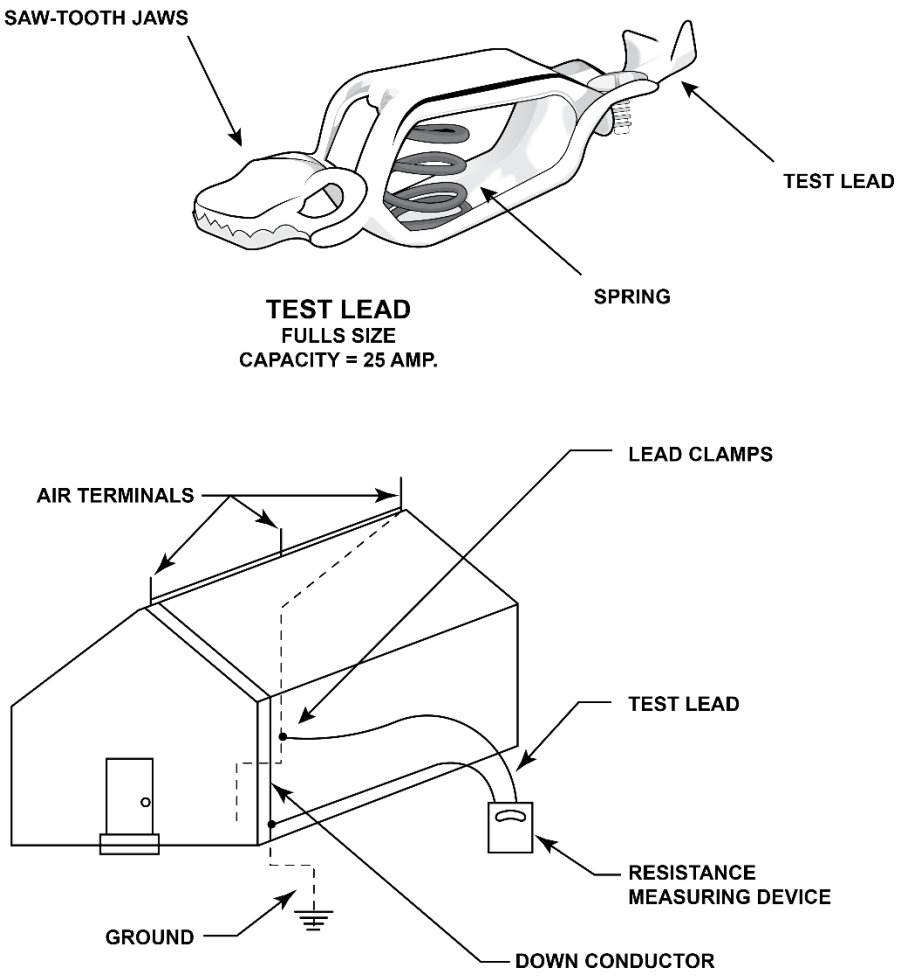


Figure F–1. Testing lightning protection systems

Glossary of Terms

Aboveground magazines
Any open area or any structure used for explosives storage that does not meet the requirements of an ECM.

Activity commander
The military or civilian responsible for the installation executing an assigned mission.

Administrative area
The area in which administrative buildings that function for the garrison or installation as a whole, excluding those offices located near and directly serving components of explosives storage and operating areas, are located.

Administrative controls
Policies and procedures used to limit access and/or to reduce chemical exposures.

Aerosol
Micron-size liquid droplets or solid particles dispersed in the air. When liquid droplets reach micron dimensions, their behavior becomes similar to solid particles of the same size. A suspension or dispersion of small particles (solids or liquids) in a gaseous medium (air).

Ammunition and explosives areas
An area specifically designated and set aside from other portions of a garrison or installation for the development, manufacture, testing, maintenance, storage, disposal, or handling of AE.

Ammunition storage units
All types of explosives storage magazines, including outdoor or indoor, open storage areas, sheds, bunkers, and earth-covered and above-ground magazines.

Annually
From the month of the current year to the same month of the following year. However, the time period will not exceed 13 months. This does not apply to items covered under the Army Maintenance Management System.

Barge piers
Piers and wharves are used exclusively for loading/unloading explosives on barges or utility craft.

Barricade
An intervening barrier, natural or artificial, of such type, size, and construction as to limit in a prescribed manner the effect of an explosion on nearby buildings or exposures.

Base realignment and closure
Program governing the scheduled realignment and/or closure of DoD sites via Congressional legislation.

Blast overpressure
The pressure, exceeding the ambient pressure, manifested in the shock wave of an explosion.

Boss lift
An event in which civilian employers of ARNG and Army Reserve Soldiers get to see and experience what their employees do during military training.

Captured enemy ammunition
All ammunition products and components produced for or used by a foreign force that is hostile to the United States (that is or was engaged in combat against the United States) in the custody of a U.S. military farce or under the control of a DoD Component. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, SAA, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components of the above. Captured enemy ammunition can also include NATO or U.S.-manufactured munitions that may not have been under U.S. custody or control.

Cell
Various small compartments or bounded areas forming part of a module.

Chemical munitions and agents
An agent or munitions that, through its chemical properties, produces lethal or other damaging effects to human beings, except that such term does not include riot control agents, chemical herbicides, smoke, and other obscuration materials.

Chemical warfare
All aspects of military operations involving the use of lethal munitions and agents and the warning and protective measures associated with such offensive operations.

Classification yard
A railroad yard used for receiving, dispatching, classifying, and switching of cars.

Clean up
Actions taken to deal with a release or threat of release of a hazardous substance that could affect humans and/or the environment. The term "cleanup" is sometimes used interchangeably with the terms remedial action, removal action, response action, or corrective action.

Clearance
See surface clearance.

Compatibility
AE are considered compatible if they may be stored or transported together without increasing either the probability of an accident significantly or, for a given quantity, the magnitude of the effects of such an accident.

Compatibility group
The compatibility group for ammunition, explosives, and/or other hazardous materials which can be stored and/or transported together without significantly increasing the probability of accident or, for a given quantity, the magnitude of the effects of such an accident. The compatibility groups are based on the system recommended for international use by the United Nations Organization and as adopted by NATO and the Department of Defense.

Competent authority
An individual of the armed forces designated in command responsible for the direction, coordination, and control of military forces. The commander alone is responsible for everything their unit does or fails to do. They cannot delegate their responsibility, or any part of it, although they may delegate portions of their authority to competent individuals. An individual designated by the commander to address areas of primary interest within that individual’s technical expertise.

Component
Any part of a complete item, whether loaded with explosives, inert (not containing explosives), or empty (not filled with explosives).

Comprehensive Environmental Response, Compensation, and Liability Act
CERCLA, commonly known as Superfund, is a Federal law that provides for the cleanup of releases from abandoned waste sites that contain hazardous substances, pollutants, and contaminants.

Conditional exemption
An exemption from the regulatory definition of hazardous waste (and therefore from compliance with specific environmental requirements pertaining to the storage of hazardous waste) conditioned on compliance with certain criteria requirements as set forth in 40 CFR 266.205.

Confirmation
The process of validating or invalidating a positive response.

Construction support
Support provided by qualified UXO personnel during construction activities at potential MEC sites to ensure the safety of construction personnel from the harmful effects of MEC. There are two types of support: standby support and active support. Standby construction support applies when a determination is made that the probability of encountering MEC is low (seldom or unlikely). UXO personnel will stand by and

identify any MEC items encountered. If an item is encountered, UXO personnel assume site control and destroy the item or move it to a safe location for later disposal. Active construction support applies when a determination is made that the probability of encountering MEC is moderate to high (occasional, likely, or frequent). UXO personnel conduct subsurface MEC clearance for the known construction footprint in conjunction with the construction contractor or prior to intrusive activities.

Conveyance
A truck, tractor-trailer, railcar, or commercial intermodal container used for transportation of ammunition, explosives, or hazardous material.

Corrective action
Any action taken to rectify adverse conditions and, where possible, to preclude their recurrence.

Debris
Any solid particle thrown by an explosion or other strong, energetic reaction. For aboveground detonations, debris usually refers to secondary fragments. For underground storage facilities, debris refers to both primary and secondary fragments, which are transported by a strong flow of detonation gases.

Defense sites
Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. (10 USC 2710(e)(1)).

Deflagration
A rapid chemical reaction in which the output of heat is enough to enable the reaction to proceed and be accelerated without input of heat from another source. Deflagration is a surface phenomenon with the reaction traveling along the surface at subsonic velocity.

Demilitarize
To mutilate, disarm, neutralize, and accomplish any other action required to render ammunition, explosives, and chemical agents innocuous or ineffectual for military use.

Detonation
A violent chemical reaction within a chemical compound or mechanical mixture involving heat and pressure. A detonation is a reaction that proceeds through the reacted material toward the non-reacted material at a supersonic velocity. A detonation, when the material is located on or near the surface of the ground, is normally characterized by a crater.

Deviation Approval and Risk Acceptance Document
Written authorization granted by the proper Army authority that permits a deviation from mandatory Army explosives safety requirements.

Disposal
End-of-life tasks or actions for residual materials resulting from demilitarization or disposition operations. The discharge, deposit, injection, dumping, spilling, leaking or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.

Disposition
The process of reusing, recycling, converting, redistributing, transferring, donating, selling, demilitarizing, treating, destroying, or fulfilling other life-cycle guidance, for Army property.

Distribution lines
Electrical lines supplying multiple garrison or installation locations.

Dividing wall
A wall designed to prevent, control, or delay propagation of an explosion between quantities of explosives on opposite sides of the wall.

Dud
Explosive munitions which have not armed as intended or which have failed to function after being armed. (See misfire.)

Dummy ammunition
Ammunition or ammunition components having the appearance of actual items and not having any explosives components, normally used in non-live fire training events.

Earth-covered magazine
Any earth-covered structure that meets the soil cover depth and slope requirements of chapter 8. ECMs have three possible structural strength designations (7-bar, 3-bar, or Undefined). The strength of an ECM's headwall and door(s) determines its designation.

Electrical lines
See transmission lines, distribution lines, or service lines.

Electrically initiated device
An EID is a single unit, device, or subassembly that uses electrical energy to produce an explosive, pyrotechnic, thermal, or mechanical output. Examples include: electro-explosive devices (such as hot bridge wire, semiconductor bridge, carbon bridge, and conductive composition), exploding foil initiators, laser initiators, burn wires, and fusible links (see MIL–HDBK–240).

Electro-explosive device
An explosive or pyrotechnic component that initiates an explosive, burning, electrical, or mechanical train and is activated by the application of electrical energy.

Energetic
See energetic compound

Energetic compound
A composition or mixtures of elemental ingredients capable of instantaneously releasing large amounts of energy and doing work of various kinds on objects and bodies surrounding them. Also, see Explosive.

Engineering controls
Regulation of facility operations through the use of prudent engineering principles, such as facility design, operation sequencing, equipment selection, and process limitations.

Exception
A determination approved by the Secretary of the Army or his or her designee, waiving for a limited time or purpose a policy or procedure contained in a DA publication.

Exemption
A written authorization granted by the proper Army authority for strategic or other compelling reasons that permits a long-term deviation from mandatory Army safety requirements.

Expansion chamber
A protective construction feature in an underground storage facility which is designed to reduce the blast shock and overpressure exiting the facility by increasing the total volume of the complex. It may also function as an operating area within the underground facility, as well as a debris trap.

Explosion
A chemical reaction of any chemical compound or mechanical mixture that, when initiated, undergoes a very rapid combustion or decomposition, releasing large volumes of highly heated gases that exert pressure on the surrounding medium. Also, a mechanical reaction in which failure of the container causes a sudden release of pressure from within a pressure vessel. Depending on the rate of energy release, an explosion can be categorized as a deflagration, detonation, or pressure rupture.

Explosive
A substance or mixture of substances which is capable, by chemical reaction, of producing gas at such a temperature, pressure, and rate as to be capable of causing damage to the surroundings.

Explosive hazard
A condition where danger exists because explosives are present that may react (for example, detonate, deflagrate) in a mishap with potential unacceptable effects (such as death, injury, damage) to people, property, operational capability, or the environment.

Explosive ordnance disposal
The detection, identification, field evaluation, rendering safe, recovery, and destruction of MEC. It may also include the rendering safe and/or disposal of explosive ordnance that have become hazardous by damage or deterioration when the disposal of such is beyond the capabilities of personnel normally assigned the responsibility for the routine disposal.

Explosives area
A restricted area specifically designated and set aside from other portions of a garrison or installation for the manufacturing, processing, storing, and handling of AE.

Explosives facility
Any structure or location containing AE, excluding combat aircraft parking areas or AE aircraft cargo areas.

Explosives or munitions emergency
A situation involving the suspected or detected presence of MEC, damaged or deteriorated explosives or munitions, an improvised explosive device, other potentially explosive material or device, or other potentially harmful military chemical munitions or device that creates an actual or potential imminent threat to human health, including safety, or the environment, including property, as determined by an explosives or munitions emergency response specialist.

Explosives or munitions emergency response
All immediate response activities by an explosives and munitions emergency response specialist to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. May include in place render safe procedures, treatment or destruction of the explosives or munitions, and/or transporting those items to another location to be rendered safe, treated, or destroyed. Any reasonable delay in the completion of an explosives or munitions emergency response caused by a necessary, unforeseen, or uncontrollable circumstance will not terminate the explosives or munitions emergency. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at RCRA facilities.

Explosives safety
A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of potential mishaps involving military munitions.

Explosives safety specialist
A U.S. Government civilian in a safety career field with specialized training and background in DoD and DoD Component explosives safety standards and procedures.

Exposed site
A location exposed to the potential hazardous effects (blast, fragments, debris, and heat flux) from an explosion at a PES.

Exposure
The amount of radiation or pollutant present in a given environment that represents a potential health threat to living organisms.

Field office
An office required by operational supervision, for example, foremen and line supervisors, in direct support of AE operations.

Field operations
Operations conducted outdoors or outside of fabricated enclosures or structures that contain built-in alarms or engineered chemical agent controls. Short-term operations in storage structures are also considered field operations.

Firebrand
A projected burning or hot fragment whose thermal energy is transferred to a receptor.

Fire-resistive
A term used to indicate the property of structures or materials to resist a fire to which they might be subjected without themselves becoming weakened to the point of failure.

Fire-retardant
A term used to designate generally combustible materials or structures that have been treated or have surface coverings designed to retard ignition or fire spread.

Firewall
A wall of fire-resistive construction designed to prevent the spread of fire from one side to the other. A firewall may also be termed a “fire division wall.”

Fixed ammunition
Ammunition, except small arms and rocket ammunition, consisting of a cartridge case loaded with propellant and a projectile which are loaded in one operation into the weapon, the cartridge case being firmly attached to the projectile.

Flammable
A material that has the characteristic of being easily ignited and burning readily.

Formerly used defense sites
Those properties previously owned, leased, or otherwise possessed by the United States and under the jurisdiction of the Secretary of Defense; or manufacturing facilities for which real property accountability rested with DoD but the operation was performed by contractors (Government owned - contractor operated), and later the facilities were legally disposed of.

Fragment
A piece of exploding or exploded munitions. Primary fragments may be complete items, subassemblies, pieces thereof, or pieces of equipment that are in immediate contact with explosives. Secondary fragments are from pieces of equipment or buildings containing the item(s).

Fragment distance
The limiting range based on a specific density of hazardous fragments expected from the type and quantity of explosives involved. Used in establishing certain QD criteria. A hazardous fragment is a fragment having an impact energy of 58 foot-pounds or greater. Hazardous fragment density is a density of hazardous fragments exceeding one per 600 square feet.

Fragmentation
The breaking up of the confining material of a chemical compound or mechanical mixture when an explosion occurs. Fragments may be complete items, subassemblies, or pieces thereof, or pieces of equipment or buildings containing the items.

Frequency
Rate of mishap occurrence. Frequency is sometimes substituted for probability as a component of risk (for example, loss events per 100 operating hours).

Fuze
a. A device with explosive components designed to initiate a train of fire or detonation in ordnance. b. A nonexplosive device designed to initiate an explosion in ordnance.

Garrison
A permanent military post for the stationing of Soldiers.

General public
Persons not associated with a DoD installation’s mission or operations, such as visitors, to include guests of personnel assigned to the garrison or installation or persons not employed or contracted by DoD or the garrison or installation.

Hazard
A condition with the potential to cause injury, illness, or death of personnel; damage to or loss of equipment or property; or mission degradation.

Hazard analysis
The logical, systematic examination of an item, process, condition, facility, or system to identify and analyze the probability, causes, and consequences of potential or real hazards.

Hazard class
The United Nations Organization hazardous classification system, which contains nine hazard classes, is used by the DoD for dangerous materials to identify the hazardous characteristics of AE. Hazard Class 1 AE is further divided into seven division designators that indicate the primary characteristics and associated hazards.

Hazardous fragment
A fragment having an impact energy of 58 ft-lb or greater and/or weight greater than 2,700 grains (6.17 ounces or 175.5 grams).

Hazardous fragment density
A density of hazardous fragments exceeding one hazardous fragment per 600 square feet.

Hazardous fragment distance
The distance to which a hazardous fragment density of one hazardous fragment per 600 feet is projected.

Hazardous material
The component of, or an item of, ammunition that is inherently designed to produce the necessary energy required for ignition, propulsion, detonation, fire, or smoke, thus enabling the item to function. Also, a material (corrosive, oxidizer, and so forth), which inherently is dangerous and capable of serious damage and which, therefore, requires regulated handling to avoid creating accidents in connection with its existence and use.

Hazardous waste
A solid waste, or combination of solid waste, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.6 Chemical agents and munitions become hazardous wastes if (a) they become a solid waste under 40 CFR 266.202, and (b) they are listed as a hazardous waste or exhibit a hazardous waste characteristic; chemical agents and munitions that are hazardous wastes must be managed in accordance with all applicable requirements of RCRA.

Holding area
A temporary location used to store AE until it can be safely moved to a permanent storage area.

Holding yard
A location for groups of railcars, trucks, or trailers used to hold ammunition, explosives, and dangerous materials for interim periods before storage or shipment.

Homemade explosive
An explosive compound or chemical mixture produced from precursor materials that is not designed for traditional military or commercial use. Precursor materials - commercially produced chemicals and explosives used to produce IE/HME - are not in and of themselves considered IE/HME. IE/HME includes (1) Primary explosives (includes but is not limited to triacetone triperoxide, hexamethylene triperoxide diamine, and methyl ethyl ketone peroxide); (2) Secondary explosives (includes but not limited to hydrogen peroxide and fuel explosives, potassium perchlorate, and fuel explosives); and Imminent danger. Imminent danger is defined as any conditions or practices in any place of employment which is such that a danger exists which could reasonably be expected to cause death or serious physical harm immediately or before the imminence of such danger can be eliminated. *a*. Requirements. The following conditions must be met before a hazard becomes an imminent danger: *b*. There must be a threat of death or serious physical harm. "Serious physical harm" means that a part of the body is damaged so severely that it cannot be used or cannot be used very well. *c*. For a health hazard, there must be a reasonable expectation that toxic substances or other health hazards are present and exposure to them will shorten life or cause a substantial reduction in physical or mental efficiency. The harm caused by the health hazard does not have to happen immediately. *d*. The threat must be immediate or imminent. This means that you must believe that death or serious physical harm could occur within a short time before an official could

investigate the problem. *e*. Section 13 of 29 USC 662, Public Law 91–596 84 STAT. 1590 91st Congress, S.2193, December 29, 1970, as amended through January 1, 2004.

Improvised explosive
See homemade explosive.

Industrial chemical
Chemicals developed or manufactured for use in industrial operations or research by industry, Government, or academia. These chemicals are not primarily manufactured for the specific purpose of producing human casualties or rendering equipment, facilities, or areas dangerous for use by man.

Inert ammunition
Ammunition containing no explosives or chemical agents.

Inert components
The parts of ammunition that do not contain explosives or chemical agents.

Inhabited building distance
The minimum distance permitted between an inhabited building and an AE location for the protection of administration, quarters, industrial, and other similar areas within a garrison or installation. At this distance, personnel are not expected to be killed or seriously injured. Vehicles and aircraft will be serviceable without damage from the blast but may be struck by fragments. Unstrengthened structures, tents, thin-skinned aluminum or sheet metal, and modular offices will sustain superficial damage. This distance is required for all inhabited structures and critical mission assets.

Inhabited buildings
Buildings or structures other than operating buildings occupied in whole or in part by human beings, both within and outside DoD installations. They include but are not limited to schools, churches, residences (quarters), Service clubs, aircraft passenger terminals, stores, shops, factories, hospitals, theaters, mess halls, post offices, and post exchanges.

Inspection station
A designated location at which trucks and railcars containing AE are inspected.

Installation
An aggregation of contiguous or near contiguous, common mission-supporting real property holdings under the jurisdiction of or possession controlled by the Department of the Army or by a State, commonwealth, territory, or the District of Columbia, and at which an Army unit or activity (Active, Army Reserve, or ARNG) is assigned.

Interchange yard
An area set aside for the exchange of railroad cars or vehicles between the common carrier and DoD activities.

Intraline distance
The distance to be maintained between any two operating buildings and sites within an operating line, of which at least one contains or is designed to contain explosives, except that the distance from a service magazine for the line to the nearest operating building may be not less than the ILD required for the quantity of explosives contained in the service magazine. At this distance, personnel will sustain serious injury or even death. Vehicles and aircraft will be extensively damaged or a total loss. Unstrengthened buildings will receive extensive damage. Ammunition supplies will survive but may be damaged beyond use.

Limited quantities
The minimum amount of ammunition required in support of operational missions (for example, for security guard forces, military police, and so forth) or the immediate training requirements of the unit owning the facility. For HD 1.2.2, this may not exceed 50 pounds NEW, and for HD 1.3, this may not exceed 100 pounds NEW.

Liquid propellants
Substances in fluid form (including cryogenics) used for propulsion or operating power for missiles, rockets, ammunition, and other related devices (See table 5–16). Hydrocarbon fuels used in the operation of ships, aircraft, and other vehicles are not considered liquid propellants for the purpose of this pamphlet. Those dual-purpose hydrocarbon fuels which are used in both missiles/rockets/ammunition and in

ships/aircraft/vehicles are considered liquid propellants only when the fuel is actually charged into the missile/rocket/ammunition.

Loading docks
Facilities, structures, or paved areas, designed and installed for transferring AE between any two modes of transportation.

Magazine
Any building or structure, except an operating building, is used for the storage of AE.

Magazine distance
The minimum distance permitted between any two magazines depending on the type of magazine and the class/division quantity of AE involved; the type and quantity of explosives requiring the greater distance will govern the magazine separation. Also called 'Intermagazine Separation.'

Material potentially presenting an explosive hazard
Material potentially containing explosives or munitions (such as munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris); or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (for example, equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations). Excluded from MPPEH are munitions within DoD's established munitions management system and other hazardous items that may present explosion hazards (such as gasoline cans and compressed gas cylinders) that are not munitions and are not intended for use as munitions.

Matrix
The component or substrate that contains the analyte of interest.

Maximum credible event
The most disastrous maximum credible loss identified for a given system or operation. In AE and chemical agent hazards evaluation, the MCE due to a hypothesized accidental explosion, fire, or toxic chemical agent release (with explosives contribution) is the worst single event that is likely to occur from a given quantity and disposition of AE. The event must be realistic with a reasonable likelihood of occurrence considering the means of initiation, explosion propagation, burning rate characteristics, and physical protection given to the items involved. The MCE evaluated on this basis may then be used as a basis for effects calculations and casualty predictions.

Method
A set of procedures and techniques for systematically performing an activity (for example, sampling, chemical analysis, quantification). A method will encompass certain parameters that, when changed significantly, may result in a new method. Methods will be placed under configuration control, and critical parameters will identify tolerances that, when exceeded, will result in a new method.

Military munitions
All ammunition products and components produced or used by or for the DoD or the U.S. Armed Services for national defense and security, including ammunition products or components under the control of the DoD, the U.S. Coast Guard, the DOE, and ARNG personnel. The term military munitions includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DoD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, SAA, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. Military munitions do not include wholly inert items, improvised explosive devices, nuclear weapons, nuclear devices, and nuclear components thereof. However, the term does include non-nuclear components of nuclear devices managed under DOE's nuclear weapons program; after all, required sanitizing operations under the Atomic Energy Act of 1954, as amended, have been completed.

Minimum separation distance
The distance at which personnel in the open must be from an intentional or unintentional detonation.

Misfire
Failure of a component to fire or explode following an intentional attempt to cause an item to do so. (See dud.)

Mishap
An unplanned event or series of events resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

Module
A barricaded area comprised of a series of connected cells with hard surface storage pads separated from each other by barricades

Munitions and explosives of concern
This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means a. UXO; b. DMM; or c. MC (for example, TNT, RDX) present in high enough concentrations to pose an explosive hazard. Formerly known as Ordnance and Explosives (OE).

Munitions constituents
Any materials originating from ordnance, UXO, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. Munitions constituents may be subject to other statutory authorities, including, but not limited to, CERCLA (42 USC 9601) and RCRA (42 USC 6901).

Munitions response
Response actions, including investigation, removal, and remedial actions to address the explosives safety, human health, or environmental risks presented by UXO, DMM, or MC.12 The term is consistent with the definitions of removal and remedial actions that are found in the NCP. The response could be as simple as administrative or legal controls that preserve a compatible land use (that is, institutional controls) or as complicated as a long-term response action involving sophisticated technology, specialized expertise, and significant resources.

Munitions response site
A discrete location within an MRA that is known to require a munitions response.

Net explosive quantity
Net explosive quantity (expressed in kilograms).

Net explosive weight
The actual weight in pounds of explosive mixtures or compounds, including the TNT equivalent of energetic material that is used in the determination of explosive limits and explosive quantity data arcs.

Noncombustible
Not burnable in the ordinary sense of the word.

Nonessential personnel
Nonessential personnel are personnel that perform support functions, which can be executed without exposure to AE hazards and risks (such as medical support personnel, administrative personnel, stock-records clerks, and so forth). See the definition of essential personnel above.

On-site
As applied to munitions response actions, the MRS containing MEC and all areas in proximity to the MEC that are necessary to implement the response action.

Operating building
Any structure, except a magazine, in which operations pertaining to manufacturing, processing, handling, loading, or assembling of AE are performed.

Operating line
A group of buildings, facilities, or related work stations so arranged as to permit the performance of the consecutive steps in the manufacture of an explosive or the loading, assembly, modification, and maintenance of ammunition.

Operational range
A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities (10 USC 101(e)(3)(a) and (b)). It also includes “military range,” “active range,” and “inactive range,” as those terms are defined in 40 CFR 266.201.

Operational shield
A barrier constructed at a particular location or around a particular machine or operating station to protect personnel, material, or equipment from the effects of a possible localized fire or explosion.

Operator
A person assigned to perform a specific, generally continuing function on production, maintenance, renovation, or disposal line or operation. Typically the functions are performed at workstations or areas defined in an SOP.

Ordnance and explosives
See MEC

Outdoor storage sites
Locations selected within the magazine area for the storage of ammunition and, in exceptional cases, inert items.

Personnel protection
Elimination or positive control of ignition and initiation stimuli. Sufficient distance or barricades to protect from blast or fragments. In those areas of facilities where exposed thermally energetic materials are handled that have a high probability of ignition and a large thermal output as indicated by hazard assessments, fire detection, and extinguishing system that is sufficiently quick-acting and of adequate capacity to extinguish potential flash fires in their incipient state will protect both personnel and property. The design and installation of the system must maximize the speed of detection and application of the extinguishing agent. In operational ammunition areas where it is essential for personnel to be present and the hazard assessment indicates that an in process thermal hazard exists, the use of thermal shielding between the thermal source and personnel is an acceptable means of protection. If shields are used, they must comply with MIL–STD–398. If shielding is not possible, or if that provided is inadequate for the protection of exposed personnel, including their respiratory and circulatory systems, augmentation with improved facility engineering design, personnel protective clothing, and equipment may be necessary. Thermal protective clothing must be capable of limiting bodily injury to first-degree burns (0.3 calories per square centimeter per second with personnel taking turning-evasive action) when the maximum quantity of combustible material used in the operation is ignited. Protective clothing selected must be capable of providing respiratory protection from the inhalation of hot vapors and toxicological effects when the hazard assessment indicates adverse effects would be encountered from the inhalation of combustion products. Personnel hazards from glass breakage can be minimized by means such as building orientation and/or keeping the number of exposed glass panels and panel size to a minimum. When window panels are necessary and risk assessment determines a glass hazard will be present, blast-resistant windows must be used. The framing and/or sash of such panels must be of sufficient strength to retain the panel in the structure.

Pier
A landing place or platform built into the water, perpendicular or oblique to the shore, for the berthing of vessels.

Plasticized white phosphorous
PWP is finely divided WP suspended in a gel of rubber and xylene. Like WP, PWP is spontaneously combustible when exposed to air.

Positive control
At a burning site, this is a means to prevent items, energetic material, or embers from being ejected to a place where they could cause injury or damage.

Potential explosion site
The location of a quantity of explosives that will create a blast, fragment, thermal, or debris hazard in the event of an accidental explosion of its contents.

Probability
In risk analysis, the likelihood that an event will occur. There are five categories (with associated codes) of probability: frequent (A), likely (B), occasional (C), seldom (D), and unlikely (E).

Process steam
Steam that is in direct contact with explosives or which, in case of equipment failure, would exhaust directly into contact with explosives or explosives vapors.

Public exclusion distance
The greater of the IBD (based on the fragment hazard distance or the NEW of the munitions) or the 1-percent lethality distance

Public traffic route
PTR is any public street, road, highway, navigable stream, or passenger railroad, including roads on a military reservation used routinely by the general public for through traffic.

Pyrotechnic material
The explosive or chemical ingredients, including powdered metals, used in the manufacture of military pyrotechnics.

Quality assurance specialist (ammunition surveillance)
Department of the Army Civilians that function in the ammunition surveillance program at DoD installations, activities, and commands that receive, store, maintain, issue, use, and dispose of ammunition.

Quantity-distance
The relationship between the quantity of explosive material and the distance separation between the explosive and people or structures. These relationships are based on levels of risk considered acceptable for protection from defined types of exposures. These are not absolute safe distances but are relatively protective or safe distances.

Range
A designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 USC 101(e) (1) (A) and (B)).

Range clearance
The destruction or removal and proper disposition of used military munitions (for example, UXO and munitions debris) and other range-related debris (for example, target debris, military munitions packaging, and crating material) to maintain or enhance operational range safety or prevent the accumulation of such material from impairing or preventing operational range use. This does not include removal, treatment, or remediation of chemical residues or munitions constituents from environmental media or actions to address DMM (for example, burial pits) on operational ranges.

Real property
Lands and improvements to land, buildings, and structures, including improvements and additions and utilities. It includes equipment affixed and built into the facility as an integral part of the facility (such as heating systems) but not movable equipment (such as plant equipment). In many instances, this term is synonymous with “real estate.”

Recurring missions
Recurring missions are operations that are cyclic in nature, are anticipated to occur again in the near future, and involve the same hazards, control measures, and risks during each occurrence, such as night training flights, rifle-range training, and so forth. For recurring missions, the duration should be based on the anticipated total time period to accomplish all recurring missions; for example, if the mission will be

conducted for one week every month for three years, then the duration used would be three years, not one week or one month.

Release
Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant).

Remote operation
An operation sufficiently hazardous such that special protection to personnel is required. Protection is provided by distance, protective construction (shielding, barricades, and so forth), or both.

Renovation
That work performed on ammunition, missiles, or rockets to restore them to a completely serviceable condition; usually involves the replacement of unserviceable or outmoded parts.

Residual risk
The risk associated with a hazard that remains after implementing all planned countermeasures or controls to eliminate or control the hazard. The residual risk can also be the initial risk.

Resource Conservation and Recovery Act
The Federal statute that governs the management of all hazardous waste from the cradle to the grave. RCRA covers requirements regarding identification, management, and cleanup of waste, including (1) identification of when a waste is solid or hazardous; (2) management of waste C transportation, storage, treatment, and disposal; and (3) corrective action, including investigation and cleanup, of old solid waste management units.

Response action
As defined in Section 101 of CERCLA, remove, removal, remedy, or remedial action, including enforcement activities related thereto. For MEC projects refers to the process of evaluating and, if appropriate, reducing the risk of exposure resulting from military MEC. An action that begins with a site characterization but ends with a no further action or No DoD Action Indicated is a response. If further action is warranted, risk reduction actions are taken. Risk reduction actions may include removal of MEC and treatment on-site to eliminate its explosives properties; transportation off-site to a storage or treatment facility; land use controls; engineering controls; public education; or other action necessary to protect the public. Explosives or munitions emergency responses, time-critical responses, non-time-critical responses, and remedial actions are all considered risk reduction measures.

Risk
The expected damage or consequences are expressed as the product of the consequence’s probability and severity.

Risk acceptance
The management process of having the proper authority to review and accept risks.

Risk assessment
The process of identifying and characterizing hazards, analyzing them for their potential mishap severity and probability (or frequency) of occurrence, and prioritizing them for risk mitigation actions. The first two steps of the risk management process.

Risk decision
The decision to accept or not accept the risk(s) associated with an action; made by the commander, leader, or individual responsible for performing that action and having the appropriate resources to control or eliminate the risk’s associated hazard.

Risk management
The process for managing risk; is continuously applied across the full spectrum of Army training and operations, individual and collective day-to-day activities and events, and base operations functions to identify and assess hazards, develop and implement controls, and evaluate outcomes. The process of identifying and providing recommendations on whether to resolve or accept accident-producing hazards associated with a mission; the design of a system, facility, equipment, or processes; and their operation.

Rocket
A motor which derives its thrust from ejection of hot gases generated from propellants carried within the motor casing.

Rocket motor
That portion of the complete rocket which is loaded with propellant.

Runway
Any surface on land designated for aircraft takeoff and landing operations or a designated lane of water for takeoff and landing operations of seaplanes.

Safety data sheet
For the purposes of this pamphlet, an SDS refers to a document used to relay safety and health information that meets the requirements of 29 CFR 1910.1200, or 29 CFR 1910.1450 Occupational Exposure to Hazardous Chemicals in Laboratories, whichever standard applies. It may include the known properties of the chemical; the physical, health, and environmental health hazards; protective measures; first aid measures; and safety precautions for handling, storing, and transporting the chemical. In cases where the chemical in question is a substance developed in a laboratory, an SDS may not be available, and other locally generated documents may be used to record like information.

Safety shoes
Specifically designed footwear to protect the feet from various hazards. All shoes certified under Z41 must meet the impact and compression requirements. Shoes may be designed to also meet requirements for metatarsal protection, protection from electrical hazards, puncture resistance, conductivity, and static dissipative. Conductive footwear is designed to dissipate static electricity from the body to the ground to reduce the possibility of ignition of explosive mixtures s or volatile chemicals

Sample
Physical evidence collected for environmental measuring and monitoring.

Sampling
The physical collection of a representative portion of the population, universe, or environment.

Secondary girdle
A ground loop (counterpoise) earth electrode subsystem which is connected to all grounding subsystems except the lightning protection subsystem at former U.S. Navy installations.

Secretarial Certification
A written authorization granted by the Assistant Secretary of the Army for Installations, Energy, and Environment for strategic or other compelling reasons that permits long-term noncompliance with mandatory Army safety requirements.

Secure explosives holding area
An area designated for the temporary parking of commercial carriers' motor vehicles transporting DoD AA&E. (See DTR 4500.9–R, part 205 and part II, Cargo.)

Secure non-explosives holding area
An area designated for the temporary parking of commercial carriers' motor vehicles transporting categorized DoD arms, classified (SECRET or CONFIDENTIAL) materials, and CCI. (See DTR 4500.9–R, part 205 and part II, Cargo.)

Service line
Electrical lines supplying individual or unique installation locations.

Service magazine
A building of an operating line used for the intermediate storage of explosives materials.

Severity
The expected consequence of a mishap in terms of the degree of injury, property damage, or other mission impairing factors (loss of combat power and so on). There are four categories (with associated codes) of severity: catastrophic (I), critical (II), moderate (III), or negligible (IV).

Similar risk
Similar risk, when applied to AE, represents a condition where the risk between AE operations is of the same magnitude. In order for the risk of AE operations to be considered of the same magnitude, the severities and probabilities of the operations being compared must produce the identical level of risk (such as risk assessment code) in accordance with DA Pam 385–10. The risk for each operation must be independently evaluated and then compared. During the determination of risks when developing the probability, the analysis will consider the reactivity, sensitivity, ignition stimuli, and likelihood of ignition. When determining the severity, the analysis will consider fragmentation distances, overpressures, thermal flux, effects of fire, survivability of the structure, and criticality of the structures to the mission, as well as political ramifications.

Simultaneous detonation
Detonation of separated quantities of explosives or ammunition occurs so nearly simultaneously that the effect on the surroundings is the same as if the several quantities were not separated and were detonated en-masse.

Small arms ammunition
Ammunition, without projectiles that contain explosives (other than tracers), that is, .50 caliber or smaller, or for shotguns.

Solid waste
Any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but not including solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act as amended, or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended.6 When a military munition is identified as solid waste is defined in 40 CFR 266.202.

Spall
Spall refers to pieces of a material (and the process by which they are formed) that are broken loose from the surface of a parent body by tensile forces that are created when a compression shock wave travels through the body and reflects from the surface. For underground storage, spall normally refers to the rock broken loose from the wall of an acceptor chamber by the shock wave transmitted through the rock from an explosion in a nearby donor chamber.

Stakeholders
In MEC response planning refers to Federal, state, and local officials, federally recognized tribes, community organizations, property owners, and others having an interest or involvement or a monetary or commercial involvement in the real property that is to undergo a MEC response action.

Standard
A known concentration of a known chemical that is used to perform quantitative analysis.

Standing operating procedure
A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.

Storage compatibility
A relationship between different items of ammunition, explosives, and other dangerous materials whose characteristics are such that a quantity of two or more of the items stored or transported together is no more hazardous than a comparable quantity of any one of the items stored alone.

Substantial dividing wall
An interior wall designed to prevent the simultaneous detonation of quantities of explosives on opposite sides of the wall.

Support facilities
AE storage or operations that support solely the functions of tactical or using units as distinguished from storage depots or manufacturing facilities.

Surveillance
The observation, inspection, investigation, test, study, and classification of ammunition, ammunition components, and explosives in movement, storage, and use with respect to the degree of serviceability and rate of deterioration.

Surveillance workshop
A special building equipped to permit all normal ammunition surveillance inspections.

Tactical facilities
Prepared locations with an assigned combat mission, such as missile launch facilities, alert aircraft parking areas, or fixed gun positions.

Thermite
TH, a mixture of iron oxide, aluminum, and other substances, is a dark gray granular mass that requires an igniter to start burning. TH burns with great rapidity at a temperature of 4,300 degrees F, with the iron oxide being reduced to molten iron. Thermate is a mixture of TH aluminum, barium nitrate, sulfur, and lubricating oil.

Transient
A person with official business on a production line or operation but who is not routinely assigned to a specific limited location.

Transmission lines
Electrical lines supplying locations outside the garrison or installation uniquely or in common with garrison or installation locations.

Treatment
When used in conjunction with hazardous waste, means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume. Such a term includes any activity or processing designed to change the physical form or chemical composition of hazardous waste so as to render it nonhazardous.

Triethylaluminum
TEA is a pyrophoric colorless liquid that burns with a bright flame reaching temperatures approaching 2,300 degrees F. The TEA reacts violently with water. TPA is a thickened version of TEA.

Unexploded ordnance
Military munitions that have been primed, fused, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, personnel, or material and remains unexploded either by malfunction, design, or any other cause.

Unrelated personnel
All personnel who are not directly involved with a chemical agent operation.

Waiver
A written authorization granted by the proper Army authority for strategic or other compelling reasons that permits a temporary deviation from mandatory Army safety requirements.

Warhead
That portion of a rocket or guided missile containing the high explosives charge or another destructive agent.

Waste military munitions
A military munitions is a ’waste’ if it is either a solid or hazardous waste under regulations implementing RCRA (42 USC Section 9601 et seq.) or defined as a waste under a DoD Component’s formal written policies and procedures.
a. An unused military munitions is a solid waste when any of the following occurs: (1) The munitions are abandoned by being disposed of, burned, detonated (except during intended use), incinerated, or treated prior to disposal; or (2) The munitions are removed from storage in a military magazine or another storage area for the purpose of being disposed of, burned, or incinerated, or treated prior to disposal, or (3) The munitions is deteriorated or damaged (for example, the integrity of the munitions is compromised by

cracks, leaks, or other damage) to the point that it cannot be put into serviceable condition, and cannot reasonably be recycled or used for other purposes; or (4) An authorized military official has declared the munitions a solid waste.
b. A used or fired military munitions are a solid waste: (1) When transported off range or from the site of use, where the site of use is not a range, for the purposes of storage, reclamation, treatment, disposal, or treatment prior to disposal; or (2) If recovered, collected, and then disposed of by burial or landfilling either on or off a range. (3) For purposes of RCRA section 1004(27), a used or fired military munitions is a solid waste and, therefore, is potentially subject to RCRA corrective action authorities under Section 3004(u) and (v), and Section 3008(h), or imminent and substantial endangerment authorities under Section 7003, if the munitions land off range and is not promptly rendered safe and/or retrieved. Any imminent and substantial threats associated with any remaining material must be addressed. If remedial action is not feasible, the operator of the range must maintain a record of the event for as long as any threat remains. The record must include the type of munitions and their location (to the extent the location is known). For further clarification, see 40 CFR 266.202 under Definition of Solid Waste.

Wharf
A landing place or platform built into the water or along the shore for the berthing of vessels.

White phosphorous
A yellowish, wax-like substance that melts at 110 degrees F. WP's most characteristic property is that it spontaneously ignites when exposed to air, burning with a yellow flame and giving off a large volume of white smoke, which in field concentrations is usually harmless. Dense concentrations, however, may cause irritation of the eyes, nose, and throat. WP is intensely poisonous when taken internally.

SUMMARY of CHANGE

DA PAM 385–64
Ammunition and Explosives Safety Standards

This major revision, dated 24 July 2023—

- Incorporates ammunition and explosives and chemical agent risk management standards from DA Pam 385–30 (para 1–11).
- Incorporates site planning guidance from DA Pam 385–65 (chap 4).
- Updates storage and handling of Department of Defense non-standard ammunition and explosives, other government agencies ammunition and explosives, non- Department of Defense ammunition and explosives, foreign-procured ammunition and explosives, commercial explosives, and other regulated material domestic (chap 10).
- Incorporates homemade explosives safety standards (para 11–10).
- Incorporates standards for process safety management for ammunition and explosives production-related processes (chap 12).
- Updates waste military munitions requirements (chaps 14, 17, and 18).
- Updates hazards of electromagnetic radiation to ordnance standards (para 16–16).
- Updates safety standards for real property known or suspected to contain munitions and explosives of concern (chap 18).