Department of the Air Force
HQ AEDC (AFMC)
Arnold AFB, TN 37389

Safety, Health, and Environmental Standard

Title: **EXPLOSIVES SAFETY**

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Releasability: There are no releasability restrictions on this publication.

The provisions and requirements of this standard are mandatory for use by all AEDC personnel engaged in work tasks necessary to fulfill the AEDC mission. Please contact your safety, industrial health and/or environmental representative for clarification or questions regarding this standard.

Approved:

Contractor/ATA Director
Safety, Health, and Environmental

Air Force Functional Chief

Record of Review/Revision

(Current revisions are highlighted in yellow and marked with a vertical line in the right margin.)

Date/POC	Description
01/08/2013 Roosa	Added paragraph 4.1.5.15 Load Stability to restate requirements from the AEDC Hoisting and Rigging Handbook. Moved information regarding "critical lifts" from paragraph 4.1.1.12 to 4.1.5.15.3; deleted paragraph 4.1.1.12. Added NFAC supplement.
12/07/2010 Roosa	Administrative/formatting changes. Removed requirements previously performed by HAZMAT regarding storage and inspection of explosives due to contract change; AF now controls explosive storage area. No changes resulted in increased workload to any operating contractor organization.
03/12/09 Roosa	Added new definitions, and new general requirements under section 4, and Annex C to align with the revised AFMAN 91-201 Explosives Safety Standard, dated 17 November 2008. Coordinated updates with affected AEDC personnel.
01/09/08 Roosa	As requested by AEDC/SE, revised definition of license; added criteria for operating location personnel limits, smoking areas, housekeeping, LPS, heat producing devices, vegetation control; subsequent re-ordering of annexes to reflect proper sequences; added an example to Annex B; updated Annex D rocket motor x-ray per new requirements; updated references.
03/01/07 Roosa	Annual review; no change required.
04/30/06 Roosa	Major revision and reformatting to bring standard into compliance with new requirements: Administrative update throughout to reflect use of PeopleSoft to maintain training records. Added/clarified pertinent definitions to section 3.0; updated requirements to section 4; updated section 5.0 references; deleted Guide for Explosives Use in Test Facilities (formerly Annex A); updated existing Annex A Standard Format For Personnel and Explosives Limit Signs; updated Annex C Explosives Facility License; updated text references to annexes.
01/12/04/ Jennings/Rollins	General revision
09/25/02 Jennings/Rollins	AEDC Safety, Health and Environmental Standard, E15 Explosives Safety, revised to meet current OSHA, Air Force and Contractor requirements.

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EXPLOSIVES SAFETY
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EXPLOSIVES SAFETY

1.0 INTRODUCTION/SCOPE/APPLICABILITY

1.1 Introduction – This standard outlines general safety criteria that apply to Air Force, Base Operating Contractor personnel and outside contractors/subcontactors, whose responsibilities and activities involve working with explosives at AEDC.

1.2 Scope – The scope of this standard is to limit the exposure to a minimum number of personnel, for a minimum time, to the minimum amount of explosives consistent with safe, reliable and efficient operations.

1.3 Application – This standard applies to employees who work with or support facility test activities, operations, systems, test cells, and/or transport explosives material.

2.0 BASIC HAZARDS/HUMAN FACTORS

2.1 Basic Hazards – An explosive material is capable of releasing mechanical, chemical, or nuclear energy in a sudden and often violent manner that results in the release of high pressures and temperatures.

2.2 Human Factors – Improper handling of explosive components may not only result in malfunctioning and loss of test data/time, but may cause mishaps that could result in injury, loss of life and/or damage to property. Explosive mishaps have occurred at AEDC resulting in loss of life and damage to property. Inattention to detail, failure to follow written instructions, improper work practices, complacency and poor housekeeping practices are just some of the human factors that contribute to a mishap. Explosives operations must be performed by trained and qualified employees under the supervision of an employee who is trained and qualified to understand the hazards of the operation. For this reason, a two-man rule is always in effect when working with explosives. Personnel must be trained to work with explosives and follow written work instructions. They must also know to question such instructions or other work practices that are or have the potential to become unsafe.

3.0 DEFINITIONS

Base Explosives Storage Area – Areas or facilities designated exclusively for the storage of base explosives stock. These locations include open pads, railheads or spurs, earth covered magazines, warehouses, and test facilities.

Base Operating Contractor Explosives Safety Officer (ESO) – The individual designated to oversee the explosives safety program. The AEDC Air Force Safety Office will have an individual designated AEDC Explosives Safety Manager with overall responsibility for direction and management of the AEDC explosives safety program. Base Operating Contractor Safety, Health, and Environmental will have an individual designated as the Base Operating Contractor ESO who will be responsible for the administration of the Base Operating Contractor's explosives safety program. The Base Operating Contractor ESO shall have completed the Air Force Weapons Safety Management Course, or equivalent.

Bonding – Electrically interconnecting metallic parts to ensure they are of the same electrical potential.

Buddy System (Two-Man Rule) – At least two persons are present while conducting explosives operations, so that one may assist the other if an emergency occurs.

Casual – Persons who are not normally part of the explosives operation but who have duties that require their presence i.e. Safety, QA, inspection personnel, medical etc.

Courtesy Storage – Storage of explosives in the Base Explosives Storage Area by authorized personnel. Courtesy storage is for the length of time necessary to meet mission requirements for a given test or operation and must meet the requirements listed in this standard.

Clear Zone – The area surrounding a potential explosion site which is determined by the required inhabited building separation. The inhabited building separation will be based on the sited, waivered, exempted, or actual explosives limits of the potential explosion site, whichever is greatest.

Compatibility – Ammunition or explosives are considered compatible if they may be stored or transported together without significantly increasing either the probability of a mishap or, for a given quantity, the magnitude of the effects of such a mishap.

Concurrent Operations – Two or more explosives operations within a single facility or location. Concurrent operations must be arranged to provide ILD QD protection. Example; preparation work being performed on two rockets motors simultaneously in the same building would be considered a concurrent operation. However, preparation work on a single motor that involved installing thermal couples and then installing the safe and arm device would not be considered concurrent operations.

Deviation – Written authorization that permits a specific departure from a mandatory requirement of AFMAN 91-201, Explosives Safety Standards, and which does not involve quantity-distance criteria.

DoD Explosives Safety Board (DDESB) – The DoD organization charged with promulgation of ammunition and explosives safety policy and standards, and with reporting on the effectiveness of the implementation of such policy and standards.

Energetic Liquids – Liquid and gaseous substances used for propulsion of missiles, rockets, and other related devices. For the purpose of this standard, hydrocarbon fuels are not considered energetic liquids unless used specifically for the propulsion of missiles or rockets.

Electro-Explosive Device (EED) – An explosive or pyrotechnic component that initiates an explosive, burning, electrical, or mechanical train and is activated by the application of electrical energy.

Essential Personnel – Employees who, by the nature of their work or position, are essential to the safety of other employees and/or the accomplishment of safe, reliable, and efficient explosives operations.

Exemption – A long-term departure from a mandatory requirement of AFMAN 91-201 quantity-distance standards which must be approved by the US Secretary of the Air Force.

Explosives – All ammunition, munitions fillers, demolition material, solid rocket motors, liquid propellants, cartridges, pyrotechnics, mines, bombs, grenades, warheads of all types, explosives elements of ejection and aircrew egress systems, air-launched missiles and those explosive components of missile systems and space systems, and assembled kits and devices containing explosives material.

The term *explosives*, also refers to the fillers of an explosive item. Fillers may be explosive mixtures, propellants, pyrotechnics, and other toxic substances. This term does not include liquid fuels and oxidizers that are not used with missiles, rockets, and other such weapons or explosive items. *Explosives weight*, *net weight*, and other like terms also include fillers.

Explosives Area or Location – Any area or location specifically designated and set aside from other areas and used for manufacturing, testing, maintenance, storage, demilitarization, shipping and receiving, and other similar type explosives operations.

Explosives Operating Area (Ready Storage Area) – An area designated to store explosives, for short periods of time, near the location of use.

Explosive Ordnance Disposal (EOD) – Personnel trained to safely handle and destroy hazardous explosives such as partially armed articles, improvised explosive devices, or unexploded ordnance.

Explosives Safety Quantity Distance (Quantity-Distance) – An expression of the quantity versus distance principle involved in determining acceptable separations between given explosives sources and given exposures to the hazard. For the purposes of this standard, the term "Quantity-Distance" or "Q-D" will be used (see "quantity-distance").

Explosives Site Plan (ESP) – Package consisting of all information necessary to assess compliance with explosives safety standards (especially quantity-distance) for an explosives storage or operating location. Once approved, this package identifies net explosives weight (NEW) storage and operational limitations, and provides a tool for management of risks associated with the storage or operating location.

Exposed Explosives – Explosives that (a) are actually visible (such as unpackaged bulk explosives, or disassembled or open components) and that are susceptible to initiation directly by static or mechanical spark, or by impact,

friction, etc; or (b) create (or accidentally create) explosive dust or give off vapors, fumes, or gases in explosive combinations.

Exposed Site (ES) – Any permanent structure, utility, POL (Petroleum, Oil, Lubricants), at risk from either blast or fire effects of a Potential Explosion Site (PES). An ES may or may not contain explosives. An ESP may be required to be prepared for an ES that is located within the explosive clear zone of a PES.

Grounding – Electrically connecting metallic parts to a grounding device to ensure that the parts are at earth electrical potential.

Hazard Classification – Identifies the hazardous characteristics of explosive items by their assignment to established hazard categories governing storage and transportation. These categories are: hazard class/division; storage compatibility group; Department of Transportation (DoT) class; and DoT marking.

Hazards of Electromagnetic Radiation to Ordnance (HERO) – Requirements to protect explosives from electromagnetic radiation to prevent inadvertent or unintentional detonation. There are three HERO classifications 1) HERO SAFE; EED is incapable of being initiated by EMR either by shielding or design 2) HERO SUSEPTIBLE; EED could potentially be initiated by EMR, and 3) HERO UNSAFE; EED is susceptible to being initiated by EMR.

Incident Commander (IC) – The person responsible for all aspects of an emergency response to include developing incident objectives, managing all incident operations, application of resources as well as responsibility for all persons involved. The Incident Commander sets priorities and defines the organization of the incident response teams and the overall Incident Action Plan. The role of Incident Commander may be assumed by Senior or higher Qualified Officers upon their arrival or as the situation dictates.

Inhabited Building Distance (IBD) – The required separation distance between any explosives source and structures or other places not directly related to the explosives operation where people usually assemble for work.

Inspection Station – A designated location for inspecting vehicles and railcars containing ammunition or explosives.

Intraline Distance (ILD) – The required separation distance between explosives source and structures or other places directly related to that explosives operation.

License – Formal permission to store explosives or munitions outside the sited explosives storage area.

Lightning Protection System (LPS) – An electrical grounding system used to help protect explosives facilities from lightning strikes.

Mishap – An accident or an unexpected event involving DoD ammunition and explosives.

Modern Mobile Emitters (MME) – Defines all RF emitters that can be placed in close proximity to EEDs. They include cellular phones, Personnel Digital Assistants (PDAs), barcode readers, wireless computers, network access points, and remote keyless entry systems (car door remote control entry and starting devices).

Air Force Munitions Accountable Systems Officer (MASO) – Person responsible for the accountability of all explosive materials assigned to AEDC.

Net Explosives Weight (NEW) – The total quantity, expressed in pounds, of explosives material or pyrotechnics in each item or round.

Non-essential Personnel – Those employees whose presence is not required to ensure the safety of others or to ensure safe reliable efficient explosive operations.

Operating Location – A building, facility, or site in which operations pertaining to the manufacturing, processing, handling, or assembling of ammunition and explosives are done.

Operational Risk Management (ORM) – Is a decision making tool used to evaluate a course of action, identify risks and benefits, and determine the best course of action at the appropriate level of authority.

Operations – The term “operations” in this standard encompasses handling, transport, and in some cases loading and testing of explosive materials.

Potential Explosion Site (PES) – A location or facility that contains or is expected to contain explosives. An ESP will always be prepared for a PES.

Public Traffic Route (PTR) – Any public highway, navigable stream, passenger railroad, or joint military-nonmilitary use taxiways. PTR is 60% of IBD.

Risk Assessment – A tool used to evaluate and document hazards which may be present and the controls, or countermeasures, for mitigating or eliminating those hazards.

Safe Standoff Distance (SSD) – Is a calculation to determine the distance from an emitter beyond which the radiated power density of the emitter has dissipated to a level below that which could initiate an EED.

Suspect Vehicle and Railcar Site – A designated location for placing vehicles or railcars containing explosives that are suspected of being in a hazardous condition. These sites also are used for vehicles that may be in a condition that is hazardous to their contents.

Waiver – Written authorization by US Secretary of the Air Force that allows a special departure from mandatory QD requirements of AFMAN 91-201 for a stated length of time.

4.0 REQUIREMENTS/RESPONSIBILITIES

4.1 REQUIREMENTS

4.1.1 General

4.1.1.1 The buddy system (2 employees minimum) shall be applied to all explosives operations. The Base Operating Contractor ESO and the area supervisor may approve, on a case-by-case basis (single operation or task), single person entry. Exceptions to the buddy system shall be documented using the Job Safety Analysis.

4.1.1.2 At least two, externally mounted fire extinguisher shall be provided within 15 feet of the facility. Extinguishers shall be mounted on a suitable post or attached to the side of the facility not higher than 5 feet (extinguisher < 40 pounds), 3 ½ feet (extinguishers weighing > 40 pounds), to the top of the extinguisher. Extinguishers shall be protected from the elements within a cabinet, cover, or other suitable protective enclosure. Where fire extinguishers are installed in closed cabinets or exposed to elevated temperatures, the cabinets shall be provided with screened openings and drains. Extinguisher type and size shall be suitable for the hazard being protected. Coordination with the AEDC Fire Department shall be required prior to selection, placement, or mounting of extinguishers.

4.1.1.3 Matches, open lighters, and other devices producing heat, spark, or flame (to include welding, cutting, or brazing) shall not be carried into an explosives area unless prior special permission is obtained from the Base Operating Contractor ESO and the Fire Department. Flame or heat producing devices shall not be allowed when explosive devices/materials are present.

4.1.1.4 Heat Producing Devices

4.1.1.4.1 Use of heat producing devices that produce temperatures higher than 280°F must be limited to mission essential temporary use.

4.1.1.4.2 Written work instructions must include location of device, purpose, duration of use, and safety precautions.

4.1.1.4.2 Written work instructions must be coordinated through the Base Operating Contractor Safety Office and AEDC Fire Department and AF/SE for approval.

4.1.1.4.3 Heat-producing devices are not be used while exposed explosives are present.

4.1.1.5 Designated Smoking Areas

4.1.1.5.1 Smoking is not allowed in explosives areas except for areas approved by the AEDC/TSDC. Requests for designated smoking areas must be coordinated through the Base Operating Contractor ESO and Fire Department. Requests will be forwarded to AEDC/SE for coordination and final approval with the AEDC/TSDC. The designated smoking area approval letter will be posted at each designated smoking area. The following minimum requirements must also be met:

4.1.1.5.2 Post authorized smoking area sign.

4.1.1.5.3 Use a designated properly marked receptacle.

4.1.1.5.4 Provide a fire extinguisher.

4.1.1.5.5 Smoking is prohibited within 50 ft of vehicles loaded with explosives.

4.1.1.5.6 Personnel must not smoke or use flame-producing devices after working with exposed explosives. Personnel must first clean all exposed areas of the body and change into clean clothing.

4.1.1.5.7 A "No Smoking Except in Designated Areas" or "No Smoking" signs shall be posted at the entrances to the explosives storage area and all explosives operating locations.

4.1.1.6 Hand tools used for work in locations containing exposed explosives or hazardous concentrations of flammable dusts, gases, or vapors shall be constructed of wood or non-sparking metals such as bronze.

4.1.1.7 Construction requirements for explosives facilities (building exteriors, interior walls, roofs, floors, exits and doors emergency egress, ventilation, etc.) shall be in accordance with 32 CFR Part 184 and AFMAN 91-201.

4.1.1.8 Structures and facilities that contain explosives shall be kept clean and orderly. Trash and used or dirty rags will be removed from the area each shift. Excess wood, boxes, cardboard, excess packing, unused pallets etc. will not be stored in explosives operating or storage locations.

4.1.1.9 Controlled Access/Evacuation procedures for explosives testing in facilities shall comply with Annex A of this safety standard.

4.1.1.10 A Job Safety Analysis (JSA) shall be prepared for each contractor operation involving explosives.

4.1.1.11 Cranes used in explosives areas and used for explosives lifting shall be inspected annually by a certified crane inspector.

4.1.1.12 ORM shall be a part of every operation involving explosives. To the greatest extent possible, every effort shall be made to mitigate or eliminate explosives risks/hazards to personnel and resources. ORM tools consist of the following:

4.1.1.12.1 Indentify the hazards. Hazard identification is the first step in defining real or potential conditions which could cause a mishap.

4.1.1.12.2 Assess the risk. Using quantitative and qualitative measures, determine the probability and severity of the hazard.

4.1.1.12.3 Analyze risk controls. Evaluate measures that reduce probability, severity, and/or exposure.

4.1.1.12.4 Make control decisions. Make decisions at the appropriate levels of authority.

4.1.1.12.5 Implement risk controls. Once the decision has been made at the appropriate level, implement risk controls.

4.1.1.12.6 Supervise and review. ORM is a continuous process throughout the life cycle of a system, mission, or activity. Once controls are in place the process must be monitored to ensure it is operating properly. If changes occur, they must be re-evaluated, starting at the beginning of the ORM process.

4.1.1.12.7 The e-Matrix System™ Safety Hazard Analysis process incorporates similar risk management techniques and is an accepted ORM tool used at AEDC.

4.1.1.14 Motor Vehicle Parking

4.1.1.14.1 Government leased/owned and personal vehicle parking areas shall be a minimum of 100 feet from explosives locations.

4.1.1.14.2 Government leased/owned vehicles may temporarily park within 25 feet of an explosives operating or storage facility if being used to transport equipment or explosives that must be loaded or unloaded. *Temporary* is defined as the length of time required to complete unloading or loading equipment or explosives. Upon completion of the task, the vehicle shall be moved to a designated parking area or 100 feet from the facility.

4.1.1.14.3 Personal vehicles shall never be allowed to park closer than 100 ft from a facility housing explosives. Personal vehicles shall never be used to transport explosives materials.

4.1.2 Explosives Locations

4.1.2.1 Fire Symbols

4.1.2.1.1 Posted fire and chemical hazard symbols must reflect the highest hazard stored in the facility.

4.1.2.1.2 Fire and hazard symbols must be visible from all roads that approach the facility.

4.1.2.1.3 Post fire symbols on the interior and exterior of facilities that are authorized for explosives. For example, post fire symbols on doors leading to rooms that contain explosives materials.

4.1.2.1.4 Affix the proper fire symbol to lockers and containers.

4.1.2.1.5 Remove fire symbols immediately when explosives materials are no longer present. Place "Empty" signs on containers when explosives are no longer present.

4.1.2.1.6 The lead/supervisor or designated representative is responsible for changing the fire and chemical hazard signs.

4.1.2.1.7 Notify the Fire Department each time a fire or chemical hazard symbol is posted or changed.

4.1.2.2 Explosives Material Storage

4.1.2.2.1 Explosives received at AEDC without an assigned DoD classification shall be considered DoD Hazard Class Division and Compatibility Group 1.1L and placed in segregated storage. These items shall not be issued until an approved DoD hazard classification has been obtained by the project manager.

4.1.2.2.2 All damaged, unpackaged, or unserviceable explosive items shall be kept separated from other explosives, either in a separate facility or physically separated within the same facility. The Air Force MASO, Base Operating Contractor ESO, and/or AF Safety office shall be contacted immediately for further guidance.

4.1.2.3 Operating Locations

4.1.2.3.1 Personnel limits shall be posted and prominently displayed near the facility entrance. (See Annex B).

4.1.2.3.2 Personnel limits signs shall indicate the number of supervisors, workers, and casuals present. Personnel limits are established at the discretion of the supervisor commensurate with safe reliable efficient operations. Personnel limits may be adjusted throughout the course of operations as conditions changed.

4.1.2.3.3 NEW limits shall be posted and prominently displayed near the entrance to the facility.

4.1.2.3.4 The NEW shall be the quantity of explosives at the facility.

4.1.2.3.5 Concurrent operations shall not be performed in operating facilities.

NOTE: Written work instructions that contain personnel limits for supervisors, workers and casuals, and NEW limits may be used in lieu of posting signage at the facility. Fire symbols signs must still be posted at the facility.

4.1.2.4 Air Force Explosives Storage Magazines

4.1.2.4.1 NEW limits for the authorized quantities of explosives shall be posted at the entrance to a facility, room, or pad where explosives materials are stored.

4.1.2.4.2 Annual depth check inspections must be performed to ensure that a minimum of 24 inches of earth covering is maintained.

4.1.2.4.3 Check ventilators annually (more frequently if needed) to ensure they function properly.

4.1.2.4.4 Where installed, fusible links must be in serviceable condition and must not be painted.

4.1.2.5 Non-explosives Storage Locations

4.1.2.5.1 Unoccupied non-explosives storage facilities that directly support other storage and/or test operations may be located at 100 feet (combustible structures) and 50 feet (non-combustible structures) from explosives-sited facilities. Directly related means that the items/materials stored in the facility support the mission/tests conducted at the facility to which the storage location supports. For example, a storage building housing test support equipment for a test facility would be related to that facility.

4.1.2.5.2 Unoccupied non-explosives storage facilities that do not directly support test operations involving explosives shall be sited at PTR (750 feet minimum) when located in the open. Consideration shall be given to the importance of the material, its relationship to the explosives facility, and available space.

4.1.2.5.3 Unoccupied non-explosives storage facilities not directly supporting explosives storage or test operations shall be sited at a minimum of IBD (1,250 feet minimum). Materials in this category of storage have no association or connection to test operations or other hazardous materials maintained in the facility or facilities in the surrounding area.

4.1.2.6 Licensed Facilities

4.1.2.6.1 An AF Form 2047 Explosives Facility License shall be obtained from the Air Force Explosive Safety Manager. (See Annex C)

4.1.2.6.3 When necessary, limited quantities, not to exceed 200 grams in a location, of HCD 1.1 material may be licensed for research. The license shall only be authorized for the length of the project. The Center Commander must approve locally written procedures for the explosives test operation.

4.1.2.7 Lightning Protection and Grounding and Bonding

4.1.2.7.1 Utility Systems Engineering will ensure LPS (with some exceptions – see AFMAN 91-201) is properly maintained for explosives facilities.

4.1.2.7.2 LPS must feature air terminals, low impedance paths to ground, side flash protection, surge suppression of all conductive penetrations into the protected area, and earth electrode systems. LPS must be designed to intercept lightning at a 100-foot or less striking arc.

4.1.2.7.3 Grounding equipment reduces the hazard of static electricity and provides a continuous path to ground.

4.1.2.7.4 Grounds should consist of one continuous wire, cable, or strap connected between a facility ground and an explosive item.

4.1.2.7.5 Do not connect wires, cables, or straps together to make a longer ground.

4.1.2.7.6 Do not use telephone grounds, electrical conduit systems, gas, steam, hot water, air lines, sprinkler systems, LPS air terminals.

4.1.2.7.7 Wire used for static grounding must be a minimum of American Wire Gauge (AWG) #6. Wire used for portable or moveable equipment must not be less than AWG #12.

4.1.2.7.8 Static bonding of equipment will be accomplished as follows:

4.1.2.7.8.1 A ground wire, cable, or strap between the item to be grounded and an approved serviceable facility ground and/or;

4.1.2.7.8.2 Conductive tabletops, or conductive material coverings on the tabletop, if the conductive surfaces are properly grounded.

4.1.2.7.9 When making a ground connection, attach the ground to the items requiring grounding first and then attach the other end to the facility ground system. This ensures that if a spark occurs it will occur at the building and not the item.

4.1.2.7.10 When a new or different ground is needed, the new ground must be attached before disconnecting the existing ground.

4.1.3 Research, Development, and Testing of Explosives

4.1.3.1 Compatibility criteria shall not apply to explosives components when those components are transferred to a test cell or preparation area for assembly into a system for testing (e.g., igniter, rocket motor, etc.).

4.1.3.2 HC/D 1.1 explosives articles shall not be delivered to test cells, operating areas, or ready storage areas until these facilities are prepared for immediate use or installation of the test article. Additional controls shall be implemented to limit personnel exposure when tests require the ignition of Class 1.1 explosives (e.g., off-shift testing and clear zone evacuation of nonessential personnel).

4.1.3.3 During explosives test operations (loading, arming, and/or firing of explosives), all personnel, except those required to conduct the operation, shall be evacuated to safe distances. All evacuation procedures shall be reviewed and approved by the Base Operating Contractor ESO and AEDC/SE Explosives Safety Manager.

4.1.3.4 Rocket motor/engine tests involving Hazard Class/Division 1.1 or propellants with potential hazards greater than Hazard Class/Division 1.3 shall be restricted to the second/third shift or any shift on weekends, except at J6. Rocket motor/engine operations shall not be scheduled during shift changes due to the high volume of personnel traveling on the base (e.g., 0600-0800 and 1430-1630 hours). Pretest work instructions shall be in accordance with Annex D.

4.1.4 Electrical Hazards

4.1.4.1 HERO Devices and Grounding and Bonding

4.1.4.1.1 The SSD for Mobile Modern Emitters is 10 feet from EEDs. Exception; remote keyless entry devices are not allowed within 6 inches of EEDs.

4.1.4.1.2 EEDs shall be short-circuited (shunted) during handling, storage, and at all times except when continuity checks are made or firing is intended. EEDs and rocket motors shall be bonded together before installation to ensure they are at the same potential.

4.1.4.1.3 All EEDs or exposed explosives shall be provided with bonding and/or grounding systems to minimize the potential of creating a spark hazard.

4.1.4.1.4 Solid propellant rockets, metallic containers, materials sensitive to electrostatic discharge shall be grounded whenever practical.

4.1.4.1.5 Conductive surfaces shall be provided in all areas involved in the use of exposed explosives and shall be bonded to all other metallic parts in the area to minimize the potential of a spark hazard. The ground cable/bonding reel shall be attached to the item i.e. EED, container, or test article requiring grounding first and an approved facility ground system second.

4.1.4.1.6 Igniter resistance checks or firing circuit continuity checks through igniters shall be performed using an approved Igniter Circuit Tester that limits the current flow to an amount less than the no-fire current of the electro-explosive device and is specifically designed for testing igniters.

WARNING: General-purpose ohmmeters shall not be used for this purpose.

4.1.4.1.7 Igniter testers shall be battery-powered and shall include a fail-safe circuit to limit output current to less than 15 percent of the no-fire current of the electro-explosive device under test.

4.1.4.1.8 Only igniter circuit testers, recommended by the manufacturer, test customer, and/or specified in item technical data shall be used to inspect or test electrically primed igniters and ignition circuits. Igniter circuit testers shall be calibrated prior to use through PMEL and a label shall be affixed to the circuit tester indicating the current inspection and calibration date. Igniter circuit testers that have been dropped, damaged, or are pass-due PMEL inspection and calibration shall not be used to inspect or test electrically primed explosive devices.

4.1.4.1.9 Leg-stats, wrist-stats, and bonding and grounding methods shall be used when working with EEDs. Leg- and wrist-stat straps shall be affixed to the body in such a way as to make contact with the skin in order to work properly.

4.1.4.2 Procedures in the Event of Electrical Storms

4.1.4.2.1 When the Lightning Detection System (LDS) detects an electrical storm within 30 miles of AEDC, the contractor at the Operations Center notifies appropriate personnel. When lightning is detected within 10 miles of AEDC, the Operations Center will again notify appropriate personnel. Notifications are accomplished via Net Send (to all computers on base), area pages, radios and phone notification and Giant Voice. Explosives operations must stop when lightning is within 10 miles of AEDC. Personnel will evacuate to a safe location (minimum of IBD) from explosives.

NOTE: Attempts should be made to properly store and/or secure explosives unless danger of lightning direct strikes poses imminent threat to personnel safety.

4.1.4.2.2 Supervisors should consider evacuating areas with an approved LPS depending on the severity of the storm and the sensitivity of the explosives.

4.1.4.2.3 Personnel will evacuate to approved shelters located at a safe distance from explosives. If shelters are not available, personnel shall withdraw to safe places at inhabited building distances (minimum 1,250 ft) from the hazardous locations.

4.1.4.2.4 If operations cannot be shutdown they should be manned by the minimum number of personnel until it is safe to leave.

4.1.4.2.5 Transportation of explosives containing EEDs installed shall be prohibited during an electrical storm.

4.1.4.2.6 If the LDS is out of service, the contractors shall revert to the observation method for the 10-mile radius or when the time between the lightning flash and the thunder report is 25 seconds or less.

4.1.5 Transportation and Handling

4.1.5.1 DoT placards as outlined in Subpart F, Title 49, CFR, Part 172 shall be posted on all sides of a vehicle or trailer transporting explosives.

4.1.5.2 No explosives or ammunition shall be loaded or unloaded from a motor vehicle while its motor is running unless the motor is required to power vehicle accessories such as mechanical handling equipment.

4.1.5.3 Each vehicle that transports explosives shall be equipped with at least two extinguishers.

4.1.5.4 Explosives loaded vehicles will be chocked at all times. This includes during loading, while parked and no driver in position, or while off loading.

4.1.5.5 Personnel shall not ride in or on the cargo compartment of motor vehicle transporting ammunition or explosives.

4.1.5.6 Operators of vehicles and equipment used to transport and handle explosives shall be adequately trained and in possession of a valid vehicle/equipment operator's permit.

4.1.5.7 Unless loading or unloading, gasoline or diesel-powered vehicles shall not be parked within 100 feet of a building containing explosives.

4.1.5.8 Gasoline or diesel-powered vehicles shall not be used inside a building that has flammable vapors or "Exposed Explosives" present.

4.1.5.6 Gasoline or diesel-powered vehicles used within 25 feet of a building that has flammable vapors or "Exposed Explosives" present shall be equipped with a spark arrestor on the exhaust system.

4.1.5.10 Gasoline or diesel-powered vehicles used for handling materials within an explosives storage area shall have backfire deflectors (standard air cleaners) securely attached to the carburetor throat.

4.1.5.11 All vehicles transporting rocket motors to and from test cells shall have a sign on the front and rear of the vehicle that states radio or cellular phone transmission prohibited within 10 feet. These vehicles shall be escorted by security and support vehicles with flashing lights.

4.1.5.12 Transportation of rocket motors from the explosives storage area to the test cell shall not be scheduled during peak shift times (e.g., 0630-0800 and 1430-1630 hours) unless approved by the Base Operating Contractor ESO and the AEDC/SE Explosives Safety Manager. Transportation shall comply with published transportation routes on AEDC.

4.1.5.13 Vehicles and handling equipment shall not be refueled inside of explosives facilities or within 100 feet of an explosives location.

4.1.5.14 Exposed explosives and EEDs shall be transported in suitable containers, painted red with white letters indicating EXPLOSIVES, after removal from the original shipping container.

4.1.5.14.1 All vehicles delivering explosives to AEDC shall report to the vehicle inspection station for inspection prior to entering the RPA or explosive storage area.

4.1.5.14.2 Suspect vehicles shall not be moved to the vehicle inspection station until declared safe and secure by the munitions inspector.

4.1.5.15 Load stability.

4.1.5.15.1 Ensure explosives loaded on to vehicles and/or handling equipment e.g. forklifts, trailers are stable and secure before moving the vehicle. All loads must be secured by an effective and serviceable restraining system e.g. load binders, tie-down straps, blocking or bracing, locking pins or other manufacturer recommended systems.

4.1.5.15.2 All hardware and equipment shall be inspected to ensure serviceability before being used to secure explosive materials.

4.1.5.15.3 Lifting explosives with a crane shall be considered a "critical lift." Appropriate procedures shall be followed per AEDC Safety, Health, and Environmental (SHE) Standard D5, Hoisting Devices.

4.1.6 Explosives Site Plans

4.1.6.1 Explosives Site Plans shall be prepared in accordance with the instructions in AFMAN 91-201, the DoD 6055.9 Std, and 32 CFR 184.

4.1.6.2 All new construction projects will be evaluated to determine if they encroach into the explosives safety clear zone. An explosives site plan is required if new construction falls within the explosives clear zone.

4.1.6.3 Any modification or change in use to a facility used for explosives operational or storage purposes shall be sited or re-sited as necessary. These facilities may include, but are not limited to, storage areas, handling, and inspection; handling, shipping, receiving, testing, and/or disposal of explosives. Facilities or locations proposed for siting within an existing explosives safety clear zone shall also require siting in accordance with AFMAN 91-201.

4.1.6.4 Any organization designing, developing, or using a facility or area requiring an explosives site plan (or modification to an existing facility) shall coordinate with the Base Operating Contractor ESO.

NOTE: The Base Operating Contractor ESO and AEDC/SE Explosives Safety Manager shall be notified as soon as a need is identified to build, modify, expand, or change the use of any facility or utility (PES or ES) in the explosives safety clear zone. Development of explosives site plan packages is labor-intensive and can take up to a month to develop, depending on the complexity of the operation; therefore, coordination with the Base Operating Contractor ESO should be made as soon as possible to prevent delays. Once completed the ESP must be submitted for review and approval to AEDC/SE; HQ AFMC/SEW, Wright Patterson AFB, OH; Air Force Safety Center, Kirkland AFB, NM; and finally to the Department of Defense Explosives Safety Board (DDESB) for final review and approval. This review process can take as long as one year or longer to complete depending on workload and priorities.

4.1.7 Waivers, Exemptions, and Deviations

4.1.7.1 When it is impractical to comply with the mandatory requirements of this standard or AFMAN 91-201, a request for an exception shall be prepared. Depending on the situation, a waiver, exemption, or deviation shall be prepared and submitted for any situation where explosives materials are involved and there is a departure from the explosives safety standard.

4.1.7.1.1 Waivers apply to short-term violations of quantity-distance requirements.

4.1.7.1.2 Exemptions apply to long-term violations of quantity-distance requirements.

4.1.7.1.3 Deviations apply to any other departure from the mandatory requirements of AFMAN 91-201.

4.1.7.2 Requests for waivers, exemptions, or deviations shall be coordinated with all affected agencies and sent to the Base Operating Contractor ESO for coordination and staffing.

4.1.8 Disposition of Explosives, Expended Explosive Items, Empty Containers, and Scrap Material Generated from Items Containing Explosives

4.1.8.1 Explosive items considered unserviceable, serviceable excess, suspended, or obsolete shall be reported to the MASO for disposition instructions.

4.1.8.2 Expended explosives test articles or rocket motors that will be returned to the manufacturer must be properly packaged, marked, and shipped in accordance with the manufacturer's instructions.

4.1.8.3 The appointed Munitions Inspector shall ensure all empty containers that have held explosives material (except rocket motors, cartridge cases, fuses, primers, boosters, etc.) be inspected before disposal to determine if any explosives contaminant remains. The containers must be marked to show their status in accordance with 11A-1-60.

4.1.8.4 If any item is considered an immediate danger to life or property, AEDC/SE will be called immediately.

4.1.9 Identification of EMPTY and INERT Explosive Items

4.1.9.1 All explosive items and components that were procured empty or loaded with inert material and all explosive items that were rendered safe for training, display, or research and development purposes shall be identified in the following manner:

4.1.9.1.1 All explosive items and components that were procured empty or rendered safe by removal of all explosives material shall be identified by the word EMPTY impressed and stenciled in letters of an appropriate size on the item.

4.1.9.1.2 Explosive items and components that have had the explosives material replaced by an inert material shall be identified by the word INERT impressed and stenciled in letters of an appropriate size on the item.

4.1.9.1.3 Empty and inert explosive items that are mounted on wall plaques or display boards shall be identified by the word EMPTY or INERT permanently affixed to the plaque or display board. Items mounted on wall plaques or display boards shall not require tagging.

4.1.9.2 Only the appointed Munitions Inspector shall be authorized to verify and certify that an explosive items is free of explosives material and safe for training, display, or research and development purposes in accordance with 11A-1-60.

4.1.10 Contractor Explosives Work Instructions

Base Operating Contractor and outside contractor explosives work instructions shall include the following:

4.1.10.1 Explosives limits, including the DoD hazard classification and division of the explosives involved.

4.1.10.2 Personnel limits.

4.1.10.3 The location where operations will be performed.

4.1.10.4 Safety requirements, to include special requirements for personal protective clothing and equipment.

4.1.10.5 Actions to be taken during an emergency.

4.1.10.6 Step-by-step instructions in proper sequence for accomplishing the task.

NOTE: Air Force personnel will use applicable Technical Orders and directives.

4.1.11 Emergency Actions

4.1.11.1 Firefighting Procedures

4.1.11.1.1 Fires shall be reported immediately and may be fought without specific authorization. Personnel shall evacuate and seek safety if fires involve explosives materials or cannot be controlled by equipment at hand. Personnel shall not attempt to fight fires involving Hazard Class/Division (HC/D) explosives 1.1, 1.2, or 1.3.

NOTE: If a fire is in a building containing a HC/D 1.1, 1.2, or 1.3 explosives and involves non-explosives material, and is small or in a segregated container, an attempt may be made to extinguish the fire.

4.1.11.1.2 Firefighters shall be thoroughly briefed of specific reactions of the explosives exposed to heat or fire.

4.1.11.1.3 Firefighters shall be briefed on conditions at the scene before proceeding.

4.1.11.1.4 Personnel in the immediate vicinity of HC/D 1.3 explosives shall activate deluge systems and alarms as appropriate. Unless the fire is minor, involves no explosive, and appears controllable, the Fire Department shall confine its efforts to preventing the fire from spreading to other buildings. Fire in H/C 1.3 materials creates a wide area of intense radiant heat, dangerous to personnel and equipment. Fires involving pyrotechnics shall not be fought unless personnel have had adequate training and equipment provided.

4.1.11.1.5 HC/D 1.4 explosives present a moderate fire hazard. Fires involving them may be fought until extinguished.

4.1.11.1.6 Firefighters shall know the characteristics and specific hazards of liquid propellants. Burning liquid propellant fumes are generally toxic. Firefighters shall remain upwind of fires involving liquid propellants. Protective clothing shall include an approved, self-contained breathing apparatus.

4.1.11.1.7 Personnel shall be trained and briefed on Emergency Response Procedures, which include the required response to a fire in the facility or operational explosives area. See AEDC SHE Standard A2, Mishap Investigation.

4.1.11.2 Fire Withdrawal Distances

4.1.11.2.1 Initial withdrawal distance for non-essential personnel will be IBD from the PES.

4.1.11.2.2 The Incident Commander (IC) will establish SSD's as necessary depending on the situation. The IC will also decide which personnel are essential and non-essential.

4.1.11.2.3 Withdrawal distances from IED's shall be

4.1.11.2.3.1 500 feet for small items such as boxes up to 2 cubic feet

4.1.11.2.3.2 1,000 feet for barrel or car up to 15 cubic feet

4.1.11.2.3.3 1,500 feet for vans or trucks

4.1.11.2.3.4 2,000 feet and beyond for larger vehicles.

4.1.11.2.4 Command authorities and EOD will adjust distances as the situations dictate.

4.1.11.2.5 Withdrawal Distance for Explosives not involved in Fire

4.1.11.4.5.1 Initial withdrawal distance is 300 feet.

4.1.11.4.5.2 Simulators and smoke producing devices, 125 feet.

4.1.11.4.5.3 The IC will evaluate the situation and determine withdrawal distances for non-essential personnel.

4.1.12 Dispersed Propellant Procedure and Emergency Planning

4.1.12.1 Actions to be taken by AEDC in the event of a rocket motor failure resulting in dispersed or damaged propellant shall follow AEDC OI 91-2 *Dispersed Propellant Procedure*.

4.1.12.2 Action shall be initiated immediately after the event to minimize AEDC facility damage and to maximize personnel safety.

4.1.12.3 The user/sponsor will provide the identification by name, organization, address, and phone number of the consultant to be contacted by AEDC in the event of a rocket motor failure resulting in dispersed or damaged propellant. This consultant shall be knowledgeable of failed motor propellant characteristics and be available, if needed, to support an AEDC.

4.1.13 Withdrawal Distances

4.1.13.1 If fires involve explosives materials, personnel must evacuate a minimum of 4,000 feet from the facility.

4.1.13.2 If an explosive article is dropped or partially armed, evacuate a minimum of 300 feet.

4.1.13.3 Evacuation locations will be pre-determined, documented in operating procedures, and briefed to all personnel involved in the operation.

4.1.13.4 Emergency response actions in the Base Civil Engineer Contingency Response Guide (BCE CRP 10-211) may apply and will be followed when necessary.

4.1.14 Courtesy Storage

Courtesy storage agreements shall be coordinated through the MASO. Courtesy storage requires that the personnel responsible for the explosives materials maintain stewardship of that material from the time the materials are procured until disposition and adhere to the requirements listed below. Information below shall be provided to the MASO prior to storage:

4.1.14.1 NSN (National Stock Number) or Noun for the material

4.1.14.2 Joint Hazard Classification System Data, or an Interim Hazard Classification of the material, to include compatibility group.

4.1.14.3 Specific/Special storage requirements "Shelf Life/Service Life."

4.1.14.4 Inspection criteria, to include results of last inspection and when the next surveillance inspection is due.

4.1.14.5 Name of the person responsible for the material and who will perform the surveillance inspection.

4.1.14.6 Approval for storage signed by the appropriate director annually.

4.1.14.7 Technical Data Package on the material, or applicable references.

4.1.14.8 Coordination with MASO for munitions allocations and procurements.

4.1.14.9 Coordination with MASO, Transportation Management Officer, and Inspector prior to shipping any Munitions asset into Arnold AFB.

4.1.15 Vegetation Control

Vegetation must be controlled around facilities that house explosives.

4.1.15.1 Maintain vegetation to a height of 8 inches or less.

4.1.15.2 Do not allow dead or cut vegetation to accumulate.

4.1.15.3 Maintain 50-foot firebreaks around operating and storage locations.

4.1.15.4 Maintain a 5-foot firebreak around earth-covered magazine vents.

4.1.15.5 Do not conduct controlled burning within 200 feet of any explosives facility. Doors and vents must be closed at facilities within 600 feet of burn operations.

4.1.15.6 Do not conduct burn operations if winds are expected to exceed 5 miles per hour.

4.1.16 Flammable Liquids for Cleaning

4.1.16.1 Flammable liquids used for cleaning purposes shall be prohibited for use in the within the explosives areas except when specifically authorized by approved technical data or procedures.

4.1.16.2 Flammable liquids shall be confined to designated areas and only a one-day supply shall be kept on hand. This supply shall be stored in approved storage cabinets.

4.1.16.3 Flammable liquids must be stored in an approved cabinet a minimum of 50 feet away from explosives locations.

4.1.16.4 Combustible materials that will add fuel i.e. wood, paper, rags, etc. shall not be stored with flammables.

4.1.16.5 Flammables shall be stored in a waterproof storage cabinet if stored outdoors.

4.1.16.6 Flammable storage lockers are not required to be bonded to the facility ground system. However, flammable containers shall be bonded to each other and to an approved facility grounding system whenever transferring product from one container to another.

4.1.16.7 At least one portable fire extinguisher no less than 40-B shall be located at least 10 feet from the operation. One portable 40-B fire extinguisher suitable for fighting fires involving class I or II materials shall be located at no less than 30 feet from the operation.

4.1.16.8 Water-reactive material shall not be stored in the same room with flammable or combustible liquids.

4.1.17 Hunting

Wild game hunting is prohibited in close proximity to explosives storage and/or operating locations. Hunting activities must be separated by no less than PTR from explosives operating and storage facilities. Consult the Base Operating Contractor ESO for details and information about hunting in these areas.

4.2 Responsibilities

4.2.1 The Base Operating Contractor shall

4.2.1.1 Implement and maintain a comprehensive explosives safety program.

4.2.1.2 Comply with explosive safety requirements.

4.2.1.3 Designate in writing a qualified, responsible individual to function as the Base Operating Contractor ESO to administer the Base Operating Contractor Explosives Safety Program.

4.2.1.4 Coordinate explosives activities with all affected base agencies, through the Operations Center, to ensure that each organization understands the nature of the support it is expected to provide.

4.2.1.5 Ensure that all personnel whose duties involve contact with explosives are trained and qualified to perform their designated tasks.

NOTE: These personnel shall receive initial, and area/specific explosives safety training before participating in explosives operations, and will receive annual refresher training. All training will be documented.

4.2.2 Base Operating Contractor Explosives Safety Officer shall

4.2.2.1 Administer the Base Operating Contractor's explosives safety program.

4.2.2.2 Assist in development and implementation of required explosives safety procedures and advise Base Operating Contractor personnel on all matters involving explosives.

4.2.2.3 Review and approve explosives-related procedures and instructions before transmittal to AEDC/SE for approval.

4.2.2.4 Provide technical assistance in the preparation of explosives work instructions, facility licenses, waivers, deviations, exemptions, and site plans.

4.2.2.5 Monitor explosives operations to ensure compliance with explosives safety criteria, placing special emphasis on operations not previously performed at AEDC.

4.2.2.6 Inspect each explosives operation or location at least monthly, perform spot inspections as necessary, document inspection findings, assign Risk Assessment Codes as required, and ensure that satisfactory corrective actions are implemented. Provide a copy of inspection reports and subsequent corrective actions to AEDC/SE.

4.2.2.7 Monitor personnel who handle, inspect, transport, or maintain explosives material to help ensure they receive required explosives safety training.

4.2.2.8 Maintain a copy of approved licenses, explosives site plans, waivers, deviations, and exemptions. This file may be electronic.

4.2.2.9 Maintain the base D8 explosives safety zone map showing the following:

4.2.2.9.1 The location of each explosives storage/operational site.

4.2.2.9.2 The hazard class and division.

4.2.2.9.3 The maximum explosives limits authorized at each site.

4.2.2.9.4 The explosives safety clear zone (based on quantity-distance criteria) required around each site.

4.2.2.9.5 Primary and alternate explosives movement routes.

4.2.2.9.6 Potential electromagnetic radiation hazard zones.

4.2.2.10 Actively participate in the investigation and reporting of mishaps involving explosives when required.

4.2.2.11 Act as the Base Operating Contractor Safety office point of contact for AEDC/SE on matters involving explosives safety.

4.2.2.12 Accompany the Air Force Explosives Safety Manager on annual explosives safety inspections of all explosives areas and activities.

4.2.2.13 Conduct initial and annual refresher explosives safety training.

NOTE: The Base Operating Contractor ESO shall provide basic explosives training. The functional area manager, project engineer, test engineer or supervisor shall provide area and operational specific training. Area specific training may be supplemented with computer based training courses.

4.2.2.14 Satisfactorily complete all Air Force Weapons Safety Management Courses, and Assessment Systems for Hazardous Surveys (ASHS II) explosives site planning course.

4.2.2.15 Maintain the ASHS II database and site planning tool and provide backup copies to the AEDC/SE.

4.2.2.16 Be competent in explosives site planning and be able to utilize the current Air Force accepted procedures and software to produce explosives site plans; should also be competent in AutoCAD in order to maintain base D8 explosives safety maps.

4.2.3 Base Operating Contractor Organizational Manager and/or Project Engineer shall

4.2.3.1 Designate, either by name or by title, an individual responsible for the safe handling of explosives in each location or operation.

4.2.3.2 Ensure that explosives safety requirements incorporated into all projects, test plans, or operations involving explosives including required explosives training for personnel.

4.2.3.3 Plan all explosives operations to limit exposure to explosives materials to the smallest number of people, for the shortest duration of time, consistent with safe efficient operations.

4.2.3.4 Ensure that system safety hazard analyses are performed, in accordance with AEDC SHE Standard A4, for all test projects involving explosives. These analyses must identify hazards, associated risks, and the specific controls or countermeasures to eliminate or reduce those risks. Once the risk priority code is established, approval from the appropriate level of authority shall be obtained before proceeding with operations.

4.2.3.5 Develop written work instructions for explosives operations not covered by standard Air Force publications.

4.2.3.6 Ensure required licenses, non-explosives site plans, waivers, exemptions and deviations are initiated and submitted to the Base Operating Contractor ESO for evaluation and processing.

4.2.3.7 Coordinate with the user, sponsor, or USAF project officer to ensure, all incoming shipments of explosives material are assigned an approved Department of Defense (DoD) explosives hazard classification (interim or joint) and forwarded to the MASO before shipment to AEDC.

4.2.3.8 Notify Supply of expected shipment or receipt of explosives material by completing Form GC-1654 Test Material Shipment and Receiving Report.

4.2.3.9 Complete Form GC-1228 AEDC Fire Department Hazardous Material Tracking Record for expected shipment or receipt of explosives material and forward, with a copy of the GC-1654, to the Fire Department. Call the Fire Department (454-5648) to request a Fire Department tracking number; enter the tracking number on both the GC-1654 and GC-1228 forms.

4.2.3.10 Ensure that all expended explosive items and empty shipping containers are turned in to the MASO or Munitions Inspector for disposition.

4.2.3.11 Obtain instructions from the user or sponsor for the safe shipment or disposition of expended, damaged, or excess explosives material.

4.2.3.13 Ensure that explosives-related work instructions and procedures are coordinated with all affected agencies and reviewed and approved for safety considerations by the Base Operating Contractor ESO before transmittal to AEDC/SE for coordination.

4.2.3.14 Ensure that all personnel who handle, inspect, transport, or maintain explosives material receive required explosives safety training prior to handling/working with explosives. Training shall include Basic Explosives Training provided by the Base Operating Contractor ESO and operational specific explosives training provided by the organization/department.

4.2.3.15 Ensure that only those sponsors, users, and other personnel involved with explosives operations are allowed in areas where explosives are present. Advise all other personnel who need access to areas where explosives are present to contact the munitions personnel, Base Operating Contractor ESO, or AEDC/SE Explosives Safety Manager, as appropriate.

4.2.3.16 Establish a courtesy storage agreement with the MASO to facilitate proper storage requirements listed in Paragraph 4.1.14.

4.2.4 Base Operating Contractor Supervisors shall

4.2.4.1 Be knowledgeable of all hazards involved in the operation, convey emergency procedures to workers and visitors, and know steps required when abnormal conditions arise.

4.2.4.2 Ensure that tasks involving explosives are performed by qualified personnel in the manner prescribed by item technical orders, approved work instructions, AFMAN 91-201, this standard, and other applicable safety directives.

4.2.4.3 Brief all personnel on standards they are expected to follow and hazards of each explosives operation.

4.2.4.4 Ensure that approved work instructions are posted or readily available for each explosives operation.

4.2.4.5 Maintain strict housekeeping practices within explosives areas.

4.2.4.6 Ensure hazardous waste materials and empty explosives containers are removed from explosives operating areas to prevent clutter. Turn these materials in to the Munitions Inspector.

4.2.4.7 Ensure the Fire Department is notified whenever a fire or chemical hazard symbol is displayed, removed, changed, or covered.

4.2.4.8 Notify the Fire Department when explosives items have been received.

4.2.4.9 Ensure smoking locations are designated, as needed, in operating areas approved by the Fire Department.

4.2.4.10 Ensure that all non-permanent bonding devices used in explosives locations, such as leg-stats, wrist-stats, and bonding straps, are tested for electrical continuity according to the manufacturer's specifications and recommendations. The electrical continuity tests may be accomplished by the using organization or by Facilities Operations and Maintenance.

4.2.4.11 Ensure that all permanently installed grounding, bonding, conductive surfaces, and LPSs in explosives areas are inspected and tested according to the schedule listed in Section 4.2.7.

4.2.4.12 Request copies of grounding, bonding, and/or LPS records from Utilities System Engineering if needed.

4.2.4.13 Ensure personnel have received initial, area/operational, and annual refresher explosives Safety training and are briefed on specific hazards prior to working with explosives.

4.2.4.14 Review PeopleSoft training records of personnel who handle and/or work with explosives, munitions, weapons, weapons systems or other specified required training.

4.2.4.15 Be responsible for the controls and requirements identified on the AF Form 2047 or DDESB-approved explosives site plan.

4.2.5 AEDC Fire Protection shall

4.2.5.1 Maintain a ready fire fighting capability to fight fires involving explosives.

4.2.5.2 Provide information on the fire characteristics of explosives, as requested.

4.2.5.3 Maintain a current list of fire or chemical hazard symbol for each location housing explosives.

4.2.5.4 Review and coordinate all requests for explosives facility licenses to ensure that Fire protection requirements are satisfied.

4.2.5.5 Exercise approval authority for all requests for smoking locations in and around explosives areas.

4.2.5.6 Conduct fire drills in the base explosives storage area at least every six months.

4.2.5.7 Approve and provide oversight of controlled burns involving vegetation control around explosives locations.

4.2.6 Arnold Police shall

4.2.6.1 Ensure that adequate security is provided for explosives resources as required by AFI 31-101, the Air Force Installation Security Program.

4.2.6.2 Review and coordinate all requests for explosives facility licenses to ensure that explosives are adequately protected and security requirements are satisfied.

4.2.6.3 Provide escort vehicles when explosives materials and rocket motors are transported.

4.2.7 Base Operating Contractor Mission Support (Civil Engineering) shall

4.2.7.1 Assist the Base Operating Contractor ESO in the preparation of explosives site plans in accordance with AFMAN 91-201.

4.2.7.2 Prepare facility drawings and LPS Survey results as needed.

4.2.8 Resource Provisioning HAZMAT Section shall

4.2.8.1 Receive, store, handle, transport, and ship explosive items as required to support the AEDC mission.

4.2.8.2 Notify the Operations Center of an item having a Fire Department tracking number at the beginning of the move (giving the travel route it will take) and at the end of the move.

4.2.9 Operations Center shall

Notify the AEDC Fire Department that an item having a Fire Department tracking number is being moved and specify the travel route it will take.

5.0 BASE OPERATING CONTRACTOR TRAINING

5.1 Only trained and qualified personnel shall be allowed to work inside the explosives safety clear zone.

5.2 All employees who work with explosives shall be trained in accordance with this safety standard and AFMAN 91-201. Personnel will be qualified in the tasks to be performed and understand all safety standards, requirements, and procedures that apply to explosives operations.

5.3 Initial, basic Explosives Training shall be provided by the Base Operating Contractor ESO; specific Explosives Training for the operations/procedures being conducted at a specific facility will be provided by the organization having responsibility and control of the activities at the facility.

5.4 Training of personnel assigned to a specific organization that works with explosives shall include but not be limited to; the characteristics of explosives materials, reactions to heat and fire, what to do in case of fire, misfire or other emergency, appropriate wear of PPE, emergency procedures, work instructions, and system safety hazard analysis hazards and countermeasures.

5.5 Training will be completed before any explosives-related duties are assigned, when there is a change in assigned duties, or when there is a change in operations that presents a hazard for which an employee has not been trained.

5.6 Re-training shall be provided whenever there are deviations from the explosives procedures/instructions, or when there are inadequacies in the employee's knowledge or use of those procedures/instructions.

5.7 The supervisor shall maintain awareness of explosives training for all employees under his/her jurisdiction and ensure that only qualified personnel are designated to work with explosives.

5.8 This training shall be documented as follows:

5.8.1 For members of the AEDC workforce, the Base Operating Contractor shall maintain a database and records of employees who have completed the initial, basic explosives training.

5.8.2 The record of training for non- Base Operating Contractor personnel may be a letter or other documentation from their employer(s) stating that they have had the required explosives training and are qualified.

6.0 INSPECTIONS/AUDITS

6.1 Inspection

6.1.1 Base Operating Contractor Utilities System Engineering shall inspect and test electrical protection systems (grounding, bonding and lightning protection systems) in explosives areas in accordance with AFMAN 91-201, AFI 32-1065 Grounding Systems, and this standard.

6.1.2 Utilities System Engineering shall ensure that all permanently installed grounding, bonding, conductive surfaces, and LPS in explosives areas are inspected and tested according to the following schedule:

SYSTEM	CONTINUITY AND RESISTANCE	VISUAL
Grounding/Bonding	Semiannually	Quarterly
Conductive Surfaces	Semiannually	NA
Lightning Protection Systems	Annually	Semiannually

6.1.3 Utilities System Engineering shall maintain copies of the grounding/bonding/lightning protection test reports for a minimum of six inspection cycles. Copies of the test reports may be made available from Utilities System Engineering to the using organization and Base Operating Contractor ESO if requested. Grounding/ bonding, conductive surfaces and LPS checks shall not be required for those explosives facilities that have been approved by the Air Force for temporary (2 years) re-designation (as inactive) of the explosives clear zone. Prior to reactivating the systems and conducting operations, they shall be tested according to the above schedule.

6.1.4 The Base Operating Contractor ESO shall inspect each explosives operation or location at least monthly. The inspection findings shall be documented and Risk Assessment Codes assigned as appropriate. Subsequent monthly and spot inspections shall ensure that satisfactory corrective actions have been implemented. A copy of each inspection report and subsequent corrective actions shall be forwarded to AEDC/SE.

6.1.5 The Base Operating Contractor ESO shall conduct annual explosives inspections. A copy of each inspection report and subsequent corrective actions shall be provided to AEDC/SE.

6.1.6 AEDC/SE Explosives Safety Manager shall inspect explosives operating areas/storage locations prior to initial operations/storage. Base Operating Contractor may be requested to assist in these inspections. A copy of the inspection report shall be provided by AEDC/SE.

6.1.7 The person responsible for items in Courtesy Storage shall determine the Inspection Criteria for those items, the name of the person to conduct the inspection, and the frequency of inspection. A copy of the results of the inspection shall be forwarded to the Resource Provisioning HAZMAT Section Manager.

7.0 References

7.1 AEDC

AEDC Operating Instruction 91-2 Dispersed Propellant Procedure
Safety, Health and Environmental Standard A2, Mishap Investigation
Safety, Health and Environmental Standard A4, System Safety
Safety, Health and Environmental Standard D4, Compressed Gas Cylinders
Safety, Health and Environmental Standard D5, Hoisting Devices

7.2 Air Force

AFMAN 91-201; Explosives Safety Standards
AFI 31-101 Air Force Installation Security Program
AFI 32-1065, Civil Engineering Grounding Systems
AFI 90-901; Operational Risk Management
AFI 91-202; The US Air Force Mishap Prevention Program
AFI 301-101, The Air Force Physical Security Program
AF TO 11A-1-60, Section III, Inspection of Reusable Munitions Containers and Scrap Material Generated from Items Exposed to, or Containing, Explosives

7.3 Department of Defense

DoD 6055.9-Standard, DoD Ammunition and Explosives Safety Standards

MIL-HDBK-1512 (USAF) DoD Handbook, Electroexplosive Subsystems, Electrically Initiated, Design Requirements and Test Methods

7.4 OSHA

32 CFR Part 184; DoD Contractors' Safety Manual For Ammunitions and Explosives Proposed Rule

7.5 **NFPA-30** Flammable and Combustible Liquids Code

7.6 **BCE CRP 10-211** Base Civil Engineer Contingency Response Guide

8.0 ANNEXS

Annex A Controlled Access/Evacuation Procedure Criteria

Annex B Standard Format for Personnel and Explosives Limits Signs at AEDC

Annex C Explosives Facility License

Annex D Pretest Safety and Reliability Certification Procedure for Solid-Propellant Rocket Motors

9.0 SUPPLEMENT

NFAC A321-0801-XSP E15 Explosives Safety

Annex A
Controlled Access/Evacuation Procedure Criteria

This Annex provides instructions to guide the preparation and implementation of Controlled Access/Evacuation procedures for certain areas/zones associated with Explosives Testing. These procedures are used to restrict the number of personnel exposed to explosives hazards. These hazards generally result from solid or liquid rocket testing, associated operations such as motor loading/unloading, propellant transfers, pressure checking, etc., and ballistic range testing.

Definitions

Authorized Personnel - Persons required and/or permitted to enter and remain within a controlled access zone.

Boundary Map – A drawing or sketch, included with the Controlled Access/Evacuation procedure, showing the boundary of a controlled access/evacuation zone. It includes the location of signal lights and controlled entry points.

Boundary Signal Light – A permanently installed or portable flashing red or yellow light, usually with an audible alarm, used to mark the boundary of a controlled access/evacuation area. The lights are located at or near the approach to the boundary in high traffic areas.

- Flashing Yellow – Controlled access condition and/or explosives present.
- Flashing Red –Evacuation condition exists.

Controlled Access – A condition which involves a hazardous operation, such as loading or unloading live rocket motors, that restricts all non-essential personnel from the "Controlled Access" zone (based on Intraline (IL) distance). Badge exchange is required under Controlled Access conditions.

Control Entrance Point – A location in or immediately outside a "Controlled Access" boundary where Security Police make badge exchange for authorized personnel entry into the zone.

Evacuation – The action of removing/restricting all personnel from the "Controlled Access" zone encompassing the potential hazards. All badges exchanged must be accounted for.

Exchange Badge – A special badge, exchanged for the AEDC identification badge, and worn by authorized personnel while inside the "Controlled Access" zone. The exchange provides an accounting for all personnel within the zone.

Evacuation Rope – A red and white rope or ribbon used to define the Evacuation/"Controlled Access" boundary.

Requirements/Responsibilities

(1) **Test engineering personnel** will prepare the controlled access/evacuation procedures in conjunction with other procedures for operations required during explosives testing. For all other applications requiring controlled access/evacuation procedures, the cognizant engineer will prepare the procedure or ensure that it is done by others.

(2) The **Area Supervisor** is responsible for the controls and requirements identified on the area explosives license during all times that explosives are present.

(3) The **Explosives Safety Officer** provides consulting services for explosives operations.

(4) The **controlled access zone** is based on the intraline distance (IL) for the quantity (lb) of the particular hazard class/divisions of explosives to be tested. Prior to establishment of the main evacuation, controlled access with badge exchange is established to keep nonessential operations and/or personnel from the test area.

(5) The **main evacuation** is based on;
   (a) The inhabited building distance (IB) for Class/Div. 1.3 explosives and,
   (b) The distance corresponding to the 1.0 psi distance or 1250 feet. whichever is greater for the quantity of Class/Div. 1.1 or explosives with detonation potential.
   (c) The main evacuation is established when the ignition system has been made active and the explosives system is in a condition to be fired.
   (d) Non-essential personnel will remain at Main Evacuation distance.

(6) **Location of mission-essential personnel** between the IL and IB radii will be known, and people will remain clear of outside windows and doors at the time of firing. Using the appropriate evacuation distance as a radius, interconnecting arcs should be drawn on an area map using the outer extremities of the location housing the hazard, i.e., building corners, centerlines of outside walls, test cell walls, etc.

(7) A **buffer zone** will be established for testing Class/Div. 1.1 or propellants with detonation potential from the 1.0 psi (1250 ft) out to 0.5 psi. Security guards will be stationed on streets at the 0.5 psi distance to control access. All personnel assigned to test support work or maintenance must remain indoors and away from windows and doors and stay out from under fluorescent light fixtures. All other personnel must evacuate outside the Buffer Zone.

(8) The **actual boundaries** should be 'squared off' to take advantage of existing building lines and other natural barriers. This will facilitate setting up the actual barrier line. The map should also show the locations of boundary signal lights and controlled entrance points. The boundary signal lights are permanently located at strategic locations and supplemented by portable signal lights to identify the evacuation zone at high traffic locations.

Annex B
Standard Format for Personnel and Explosives Limits Signs at AEDC

NOTICE

PERSONNEL LIMITS

Supervisors: 1

Workers: 6

Casuals: 2

Example

J-6 FACILITY

Note: This is an example sign. The elements presented above should be listed on the sign and posted at the explosive operating location.

NOTICE

EXPLOSIVE LIMITS

HC/D	N.E.W.
1.1	100,000
1.2.1	0
1.2.2	0
1.2.3	0
1.3	130,000
1.4	0

Example

NOTE: List each Hazard Class Division and authorized net explosive weight.

NOTE: This is an example sign. The elements presented above should be listed on the sign and posted at the explosives operating location.

NOTICE

EXPLOSIVE N.E.W. PRESENT

HC/D	N.E.W.
1.1	_____
1.2.1	_____
1.2.2	_____
1.2.3	_____
1.3	_7,281_
1.4	_____

Example

NOTE: List each Hazard Class Division and authorized net explosive weight.

NOTE: This is an example sign. Annotate the N.E.W. in the space provided for the explosives material currently present in the facility.

Annex C
AF Form 2047 Explosives Facility License

The purpose of this Annex is to provide the information necessary to determine when an explosives facility license is required and to provide steps necessary to obtain a license.

Requirements

1. A license is required for all areas where explosives are located except for the base explosives storage area and operating locations that have approved explosives site plans. This includes liquid propellants as well as solid explosives.

2. Only the smallest quantity of explosives will be licensed to support the mission. No license is required for hydrocarbon or pyrophoric fuels unless they are used as a rocket propellant in a missile or rocket system.

NOTE: The maximum amount of explosive that can be licensed for any location is 50 lbs of HC/D 1.2.2, 100 lbs of HC/D 1.3, and a mission essential quantity of HC/D 1.4. Where 1.2.2 and 1.3 are stored together, the NEW limit will not exceed 100 pounds total weight between the two HC/Ds. In this situation, the maximum NEW. for 1.2.2 is still 50 pounds i.e. if I have 50 pounds of 1.2.2, I can only store 50 pounds of 1.3 with the 1.2.2. Exception, HC/D 1.1, 1.2.1, 1.2.3 and compatibility group A, K, and L will not be licensed.

3. The structure or room used to store explosives must be capable of being secured to prevent pilferage.

4. The license will be issued for a maximum of one year and may be reissued, as needed, on the anniversary date.

5. The license must be clearly displayed at the explosives location.

6. When the requirement no longer exists, the license is to be revoked, removed from display, and the Base Operating Contractor ESO notified.

7. Under extraordinary circumstances, temporary revisions to licenses for specific operating areas will be by memo to record, with the AEDC Explosives Safety Manager (AEDC/SE) concurrence, identifying the circumstance, name, NEW and hazard class/division with accompanying compatibility group for the explosives in question.

8. The license will include the personnel limits.

9. The license will include the title of the individual responsible for the use of the explosives for that location.

10. Air Force Form 2047 must be used for the license.

11. The following is provided for assistance in the preparation of the license AF Form 2047:

    Item 1: Base – Insert Arnold Air Force Base or AAFB

    Item 2: Organization – Insert AEDC.

    Item 3: License No. – leave blank. This number will be assigned by the Base Operating Contractor ESO.

    Item 4: Facility Identification – insert name and building number. For an unnumbered facility, insert narrative description.

    Item 5: Primary Use – Insert, for example, rocket testing, rocket preparation, storage, propellant operation, operation of launcher, small arms storage, liquid rocket testing, exercise evaluation team, etc.

Item 6: Written Work Instructions (WI) Applicable – include the WI numbers that are used in the explosives operation. If additional space is needed, use the 'Remarks" box.

Item 7: Room No. – Insert room number (if applicable).

Item 8: Room Use – Applicable only when Item 7, above, is filled in.

Item 9: Construction – Enter a brief description of the facility (e.g., concrete, concrete block, earth barricaded, metal construction).

Section II. EXPLOSIVES LIMITS Explosives Limits Requested
Column A: Class/Division - insert DoD Class/Division (1.2.x, 1.3, 1.4) for each explosive items ;
If Energetic Liquids (i.e. Liquid Propellants) are used, designate by hazard group designation below: (see DoD 6055.9 Std for Compatibility Group designation.)

Class 1 (explosives),
Class 2 (compressed or liquefied gases,
Class 3 (flammable liquids),
Class 4 (flammable solids, self-reactive materials),
Class 5 (Oxidizers),
Class 6 (toxic/infectious substances),
Class 8 (corrosive), or
Class 9 (miscellaneous).

NOTE: HC/D 1.1 explosives will not be licensed. This HC/D requires the submission of an explosives site plan. Contact the Base Operating Contractor ESO for clarification. See exception in paragraph 4.1.2.6.3. Items in Class 2 – 9 will only require an explosives facility license if a Class 1 explosive is affixed to or part of an overall assembly that couples class 1 and class 2-9 together.

Column B: Compatibility Group(s) – insert compatibility group(s) for each explosive items. If Energetic Liquids, see DoD 6055.9 Std which designates Compatibility Groups as LA, LB, LC, LD and LE. For example, Liquid Hydrogen's Class / Division/ Compatibility Group designation is 2.1 (LB). Liquid Oxygen is 2.2 (LA). JP 10 is 3J (LB). Compatibility group "L" items will not be stored together with other compatibility groups.

Column C: Nomenclature - insert stock listed nomenclature and national stock number or, Federal Supply Class and Department of Defense Identification Code (DODIC).

Column D: Quantity – insert number of items authorized, both serviceable and unserviceable.

Column E: Explosives Weight – insert the total N.E.W., based on the number of items authorized. This does not apply to HC/D 1.4 items.

Column F: Fire Symbol – insert fire symbol number, as required for each explosive items listed.

Section III – CERTIFICATION. Only the AEDC Operation, Maintenance, Information Management, and/or Contract Deputy General Manager may act as the certifying official.

Section IV ACTION OF RESPONSIBLE OFFICIAL. Type in the Name, Rank of the AEDC Air Force Explosives Safety Manager who will sign in the signature block.

Remarks column – insert the personnel limits, renewal date, license number it replaces and the name or title of the individual responsible for the use of explosives for that location. This section may include additional work instruction numbers, any conditions of approval, or other comments of the requesting organization. The Fire Prevention will enter specific type, quantity, and physical placement of fire extinguishers for the location, as well as any additional fire safety requirements.

Section V – COORDINATION. Each block shall contain the organization, printed name, date, and signature.

The following applies to handling and storage of explosives materials at licensed locations:

1. Comply with OSHA Class II construction for up to 50 pounds of explosives.
2. Must have EMPTY signs when no explosives are present.
3. Must be of wood construction and covered with 20 gauge steel plate.
4. Metal construction must be lined with 3/8 inch-plywood.
5. Covers must be substantial and constructed so it can be locked.
6. Must be painted red and marked in white, "EXPLOSIVES - KEEP FIRE AWAY."
7. Designed to prevent leakage.
8. Marked with the Hazard Class/Division or type of explosives or hazard stored inside.
9. Portable storage magazines must be kept locked except when materials are added to or removed from storage or when other approved and adequately supervised operations are in progress.
10. Only the minimum amount of explosives required for the current operation may be kept in an explosives operating area.
11. Only the minimum amount of explosives required to accomplish the mission may be kept in a licensed location.

Annex D
Pretest Safety and Reliability Certification Procedure for Solid-Propellant Rocket Motors

Policy

Prior to the firing of solid propellant rocket motors in the altitude test cells of the Engine Test Facility, certification of the safety and reliability of the motors is required. This certification will be based on documentary evidence presented in the AEDC System Safety Hazard Analysis and Risk Assessment (Ref. AEDC Safety Standard A4) and summarized in the Project Safety Review.

User/Sponsor Safety and Reliability Documentation

Documentary evidence of the safety and reliability for each individual test article will be obtained from the User/Sponsor, through the USAF the Project Manager prior to testing at AEDC. The information should be furnished as soon as it is available, but no later than two working (business) days after delivery of the test article to AEDC. Notice of any out-of-specification motor manufacturing defects or x-ray results should be provided by telephone no later than two working days before shipment to AEDC. The required documentation is defined as follows:

a. Statement of Acceptance

A formal statement of acceptance of the delivered unit and final inspection by the by the User's Quality Control Department identifying by serial number the article to be tested will be provided. Manufacturing or processing defects or deviations from specifications or effects of motor aging that may have an impact on motor safety or reliability will be described, including official disposition by material review board and rationale for acceptance. This will include all defects reported in the manufacturer and AEDC x-ray reports.

b. Previous Firing History

A summary of the system firing history will be provided. The history will include information on all previous sea level, simulated altitude and flight tests with emphasis on any failures of this type motor. Information from failures will include failure mode, initial failure location, and the probable cause of failure. The information will also include a plot of predicted and actual chamber pressure versus time from previous tests. For new motors with no firing history, information will be provided for any similar or closely comparable motors.

c. Design Analysis and Predicted Performance

Design analysis and predicted performance information for each motor type will be provided. This information will include margins of safety for the motor and subcomponents, such as case, insulation, nozzle, etc. and results of subcomponent tests. Predicted performance information will include force, pressure, and mass flow versus time and Maximum Expected Operating Pressure (MEOP). The equation and the test data used to calculate MEOP will be included. The results of hydrostatic tests will be provided, including the internal pressure at ultimate case failure, motor elongation, and the location of the initial failure.

d. Inspection.

(1) All rocket motor data will be evaluated by the project team prior to test.

(2) Factors to be evaluated include:

a. Review of x-ray or CT-Scans and recommendations from test customer
b. G-load accelerometer sensor data recorded from motor transport
c. Temperature history to include temperature data recorded during transportation
d. Date of previous x-ray or CT-Scan
e. Age of motor
f. Propellant information
g. Propellant weight
h. Motor size
i. History of motor integrity
j. Firing temperature
k. User recommendations

(3) X-ray or CT-Scan results will be evaluated.

a. All defects will be reported, compared to the specific criteria for the motor, and reviewed/analyzed by the User/Sponsor.

b. A summary report, including an analysis of all defects, of all previous x-ray or CT-scan inspections of the motor will be provided. This report will include the equipment and type of shots taken and the temperature of the motor at the time of x-ray.

c. The User/Sponsor will also supply AEDC with the propellant cure temperature and pressure, and the propellant stress-free temperature.

d. The motor temperature at which case-to-insulation of insulation-to-propellant becomes un-bonded.

e. Identification of Electro-Explosives Devices

(1) Identification of electro-explosives devices which will be attached to or will be part of the test unit is required. A certification that they comply with provisions of Paragraphs 5.6 and 5.14 (excluding Paragraph 7.1 option) of MIL-HDBK-1512 "Electroexplosive Subsystems, Electrically Initiated, Design Requirements and Test Methods" is required. If the devices do not comply, a description of all deviations is required.

(2) Description of radioactive initiating devices (i.e., SR120 Stage II, Stage III, and Stage IV), by isotope and strength will be provided.

f. Propellant Description

A description of the motor, igniter, and any subsystem propellant will be provided as follows:

(1) Propellant formulation, including names of ingredients (i.e., aluminum, ammonium perchlorate, HTPB, etc.), function (i.e., fuel, oxidizer, binder, etc.), and percent by weight.
(2) Elemental chemical analysis and heat of formation.
(3) Test article individual propellant weights (include main grain, igniter, and other subsystems, if any).
(4) Exhaust products species and mole fraction of each.
(5) DoT and DoD explosives classification for motor and all explosive subsystems (igniter, initiators, gas generators, etc.).
(6) Combustion chamber temperature at design operating pressure.
(7) Specific electrical resistivity of propellant as function of temperature.
(8) Electrical discharge time constant of motor (also include method for determination of them constant).
(9) Propellant incompatible materials (e.g., adhesives or anything contacting the grain).

NOTE: If User test plans require that AEDC personnel affix an object (s) to the propellant grain (i.e., attach a thermocouple), then the User must specify the type and brand of adhesive(s) to be used. No such operation will be performed unless this information is provided by the User.

g. Propellant Mechanical Tests

The results of all tests conducted to determine the DoT and DoD explosive classification and compatibility group for the propellant will be provided.

Also, the results and method of testing will be provided for any other propellant tests that may have been conducted such as:

Friction test, lbg/in^2 at ft/sec
Electrostatic discharge test, joules
Minimum priming charge test
French test
XDT

h. Chemical Reaction

In the event of a motor failure that results in dispersed propellant, the following will be provided by the User/Sponsor in accordance with the Dispersed Propellant Procedure.

(1) Measured temperature, pH, and gas generation quantity and composition will be determined for a mixture of water, granulated propellant (ratios and particle size to be determined), and quantities of materials commonly found in the AEDC/ETF test area, such as iron oxide, hydraulic fluid, wood chips, dried paint, concrete chips/dust, Kevlar fibers, and carbon dust (from nozzle materials).
(2) These measurements are to be made for a period of several days for the mixture in closed, insulated, inert, constant pressure containers.
(3) Dehydrate (at temperatures below 130°C; 266°F) the samples and determine results of the mechanical tests specified in Section G of this annex.
(4) Other motor failure influences such as heat, pressure, vacuum, impact, friction, AC/DC electrical, LN_2, etc., should be considered.

i. Motor Failure Recommended Actions

Recommended actions to be taken by AEDC in the event of a motor failure resulting in dispersed or damaged propellant:

(1) Actions to be initiated immediately after the event to minimize AEDC facility damage and to maximize personnel safety.
(2) Actions to be taken to initially stabilize the motor components including explosive devices, pressure devices, propellant, radioactive devices, etc. These actions are intended to secure/ stabilize the area during the immediate 24 hours following the event, during which time initial event-peculiar assessments are made and directions are developed.
(3) Actions to be taken to remove the motor components from the test facility and relocate to a more remote, segregated AEDC location. These actions must include necessary continuing actions to maintain component stability during the course of the cleanup and relocation.
(4) Actions to be taken to dispose of all motor components, including propellant.

j. Motor Manufacturer Explosives Consultant

The User/Sponsor will provide the identification by name, organization, address, and phone number of the consultant to be contacted by AEDC in the event of a motor failure resulting in dispersed or damaged propellant will be provided. This consultant must be knowledgeable of failed motor propellant characteristics and be available, if needed, to support an AEDC propellant disposal team.

NOTE: All explosive items must be packaged with inherently non-static generating materials.

k. Responsibility

Project Manager

(1) Informs the User/Sponsor of the documentation (a through j above) required before solid rocket motors may be fired at AEDC. The above requirements will be transmitted to the User/Sponsor in writing during the planning for a solid rocket motor test program.
(2) Receives and reviews documentation and AEDC radiographic inspection reports for each motor to be fired at AEDC.
(3) Transmits copies of documentation to system safety assignee to support preparation of system safety analyses as required by AEDC Safety Standard A4.
(4) Prepares the Pretest Safety and Reliability Certification using the format of a through j, above. A Pretest Safety and Reliability Certification will be prepared for each motor of the test series and will summarize the motor configuration, test conditions, and any motor anomalies. The certification will also identify the designated Action Coordinator in the event of motor failure/dispersed propellant.

A321-0801-XSP E15 Explosives Safety Supplement

This supplement has been approved for the NFAC Site.

Review: This supplement will be reviewed and updated using the same cycle as the AEDC Safety Standard E15 "Explosive Safety".

References: AEDC Safety Standard E15 – Explosive Safety at the AEDC NFAC Site.

NASA Ames Procedural Requirements APR 1700.1 Chapter 12 "Explosive Safety".

Scope:
This supplement outlines general safety criteria that apply to NFAC operating personnel, customers, and subcontractors, whose responsibilities and activities involve working with explosives at NFAC.

The scope of this supplement is to limit the exposure to a minimum number of personnel, for a minimum time, to the minimum amount of explosives consistent with safe, reliable and efficient operations.

This supplement applies to all NFAC personnel, customers and vendors.

NFAC Worksite Application:

NFAC will follow the local NASA Ames Procedural Requirements APR 1700.1 Chapter 12 "Explosive Safety".

I. NFAC Site Management shall:

1. Ensure that the supplement is followed.

II. NFAC Supervisors and Test Directors shall:

1. Ensure supplement is followed
2. Ensure that the customer and staff follow all explosive safety rules

III. NFAC Safety Engineer/Management Designee shall:
1. Assess and monitor all activities involving explosives
2. Maintain training requirements for explosive provided by NASA Ames

IV. NFAC Staff

1. Will follow all explosive safety rules
2. Will be trained by NASA Ames to the level of their required duties

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