(5) Erect required barricades, and signage (for example, Danger, Warning, Detour) before closing any roads.

(6) When roads are temporarily closed to public access, use barricades or gates that are highly visible in day or night conditions according to the MUTCD and other applicable requirements.

(7) Post appropriate warning signs on affected roads at least 100 feet (30.5 m) before the barrier according to the MUTCD or USACE Sign Standards Manual (that is, EP 310-1-6a and EP 310-1-6b). Size and placement of signs depend on viewing distance and speed limit of roadway.

f. Signal and Flagging Systems, Personnel, and Procedures. (8-8.f)

(1) For marine signals, see chapter 19.

(2) For LHE and helicopter hand signals, see chapter 16 of this manual.

(3) Protect signal systems against unauthorized use, breakage, weather, or interference. Stop all work if the system malfunctions.

8-9. Figures and Tables.
Not Applicable.

8-10. Checklists and Forms.
Not Applicable.

Chapter 9
Fire Prevention and Protection

9-1. References.

a. EP 1130-2-540, Environmental Stewardship and Maintenance Guidance and Procedures (https://www.publications.usace.army.mil/USACE-Publications/Engineer-Pamphlets/) (9-1.a)

b. International Code Council, International Building Code (IBC) (https://www.iccsafe.org/) (9-1.b)

c. National Interagency Fire Center, Interagency Standards for Fire and Fire Aviation Operations, 'Redbook' (https://www.nifc.gov/policies/pol_ref_redbook.html) (9-1.c)

d. NFPA 10, Standard for Portable Fire Extinguishers (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=10) (9-1.d)

e. NFPA 30, Flammable and Combustible Liquids Code (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=30) (9-1.e)

f. NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=30A) (9-1.f)

g. NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=51B) (9-1.g)

h. NFPA 58, Liquefied Petroleum Gas Code (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=58) (9-1.h)

i. NFPA 70, National Electrical Code (NEC) (2020) (https://www.nfpa.org/Codes-and-Standards) (9-1.i)

j. NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=241) (9-1.j)

k. NFPA 386, Standard for Portable Shipping Tanks for Flammable and Combustible Liquids (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=386) (9-1.k)

l. NFPA 600, Standard on Facility Fire Brigades (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=600) (9-1.l)

m. NFPA 1051, Standard for Wildland Firefighting Personnel Professional Qualifications (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1051) (9-1.m)

n. NFPA 1142, Standard on Water Supplies for Suburban and Rural Firefighting (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1142) (9-1.n)

o. NFPA 1143, Standard for Wildland Fire Management (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1143) (9-1.o)

p. NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1710) (9-1.p)

q. NFPA 1720, Standard for the Organization and Deployment of Fire Suppression Operations, emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1720) (9-1.q)

r. NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting and Urban Interface Fire Fighting (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1977) (9-1.r)

s. NFPA 2010, Standard for Fixed Aerosol Fire-Extinguishing Systems (https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=2010) (9-1.s)

t. OSHA's Nationally Recognized Testing Laboratory (NRTL) Program (https://www.osha.gov/nationally-recognized-testing-laboratory-program) (9-1.t)

u. UFC 3-600-01, Fire Protection Engineering for Facilities https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc) (9-1.u)

v. UFC 3-601-02, Fire Protection Systems Inspection, Testing, and Maintenance (https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc) (9-1.v)

w. 29 CFR 1910.110, Storage and Handling of Liquefied Petroleum Gases (https://www.govinfo.gov/content/pkg/CFR-2019-title29-vol5/pdf/CFR-2019-title29-vol5-sec1910-110.pdf) (9-1.w)

x. 29 CFR 1910.156, Fire Brigades (https://www.govinfo.gov/content/pkg/CFR-2022-title29-vol5/pdf/CFR-2022-title29-vol5-sec1910-156.pdf) (9-1.x)

9-2. Definitions.

a. Extinguisher Classification. The letter classification given to an extinguisher to designate the classes of fire on which it will be effective. (9-2.a)

b. Extinguisher Rating. The numerical rating given to an extinguisher that indicates the extinguishing potential of the unit. (9-2.b)

c. Fire Cut-Offs. Building features (for example, fire walls, automatic fire doors) designed to retard or restrict the spread of a fire within the building. (9-2.c)

d. Fixed Extinguishing System. A permanently installed system that either extinguishes or controls a fire. (9-2.d)

e. Flammable Liquid. Any liquid having a flashpoint at or below 199.4°F (93°C). Flammable liquids are divided into four categories as follows: (9-2.e)

(1) Category 1 includes liquids having flashpoints below 73.4°F (23°C) and having a boiling point at or below 95°F (35°C).

(2) Category 2 includes liquids having flashpoints below 73.4°F (23°C) and having a boiling point above 95°F (35°C).

(3) Category 3 includes liquids having flashpoints at or above 73.4°F (23°C) and at or below 140°F (60°C).

(4) Category 4 includes liquids having flashpoints above 140°F (60°C) and at or below 199.4°F (93°C).

f. Fume. Very small suspended solid particles created by condensation from the gaseous state. (9-2.f)

g. Hot Work. Hot work is considered any activity that generates or has the potential to generate, heat, sparks, open flame, or explosion (for example, hot riveting, welding, burning, abrasive blasting, brazing, cutting, grinding, powder-actuated tools, soldering). Grinding, drilling, abrasive blasting, or similar spark-producing operations are also considered hot work except when such operations are isolated physically from any atmosphere containing more than 10% of the lower explosive limit (LEL) of a flammable or combustible substance. (9-2.g)

h. Hot Work Permit. Written authorization to perform hot work operations. (9-2.h)

i. Incipient Stage Fire. A fire that is in the initial or beginning stage and that can be controlled or extinguished by portable fire extinguisher, Class II standpipe, or small hose systems without the need for protective clothing or breathing apparatus. (9-2.i)

j. Prescribed Fire. Any fire ignited to meet specific management objectives. (9-2.j)

k. Qualified Person (QP), Fire Protection Systems, Inspection, Testing and Maintenance. An individual who meets the criteria of a QP as defined in UFC 3-601-02. (9-2.k)

l. Sprinkler System. A system of piping designed according to fire protection engineering standards and installed to control or extinguish fires. The system includes an adequate and reliable water supply, a network of specialty sized piping and

sprinklers that are interconnected, a control valve, and device for actuating an alarm when the system is in operation. (9-2.l)

m. Wildland Fire. A planned or unplanned fire involving wildland fuels. (9-2.m)

9-3. Personnel Required Qualification/Training.

a. Fueling Heaters. Train personnel involved in fueling heaters so that they are thoroughly familiar with the manufacturer's instructions for safe fueling procedures. (9-3.a)

b. Kettle Operators. Train kettle operators in the proper operation of the kettle so that they have knowledge of the material being heated therefore not to allow the material to be heated beyond the allowable temperature. (9-3.b)

c. Portable Fire Extinguishers. When portable fire extinguishers are provided for employee use in the workplace, the employer must provide training upon initial employment and at least annually thereafter to employees who are responsible for their use in the general principles of fire extinguisher use and the hazards involved with incipient stage firefighting. (9-3.c)

d. Wildland Firefighting. (9-3.d)

(1) Employees that may encounter incipient stage wildland fires must be trained upon initial employment and at least annually thereafter in approved firefighting techniques commonly used to extinguish incipient stage wildland fires and the hazards associated with such firefighting activities.

(2) Wildland Fire Management Teams. All wildland fire management team personnel must be trained and qualified according to NFPA 1051 and 1143, to include training in fire line safety, basic wildland fire behavior, basic wildland fire suppression tactics, communications procedures, first aid and use, and limitations and care of protective and firefighting equipment.

(3) Employees engaged in fire management activities must be examined by a physician and obtain certification that they are physically able to perform assigned fire management duties.

e. Firefighting Organizations. Firefighting organizations must be trained according to NFPA 1710 and 1720. (9-3.e)

(1) Fire brigade drills must be held according to 29 CFR 1910.156 to assure a well-trained and efficient operating force. Maintain record of drills.

(2) Conduct demonstrations and training in first aid according to chapter 3 and firefighting at intervals to ensure that project personnel are familiar with and capable of operating firefighting equipment.

f. Fire Prevention Plan. All employees must be trained on the contents of their site-specific Fire Prevention Plan to include the following: (9-3.f)

(1) The fire hazards and the materials and processes to which they are exposed.

(2) Emergency evacuation procedures.

(3) The preferred means of reporting emergencies, such as manual pull box alarms, public address systems, or telephones.

9-4. Roles and Responsibilities.
A Qualified Person (QP) for Fire Protection Systems, Inspection, Testing and Maintenance will:

a. Conduct surveys, including an annual survey, of the suitability and effectiveness of fire prevention and protection measures and facilities at each project or installation according to UFC 3-601-02. Retain records of the survey findings and recommendations on file at the project or installation. (9-4.a)

b. Service, test, maintain, or repair fire detection alarm, and mass notification systems. (9-4.b)

9-5. Inspection Requirements.

a. Portable Fire Extinguishers. Inspect and maintain fire extinguishers according to NFPA 10. Inspect fire extinguishers at least monthly. Keep records on a tag or label attached to the extinguisher on an inspection check list maintained on file, or by an electronic method that provides a permanent record. The record/tag must include date inspection was performed and initials of the person performing the inspection. (9-5.a)

Note. For any extinguishers that do not require an annual internal examination, designate a person/s to perform annual maintenance check of fire extinguishers. If deficiencies are found that would require the emptying of extinguishing agent or the release of pressure to correct, the extinguisher deficiency must be corrected by a certified fire extinguisher technician per NFPA 10.

b. Fixed Fire Suppression Systems. Inspect and maintain fixed fire suppression systems according to UFC 3-601-02. Fixed fire suppression systems that are not addressed in the UFC should be inspected and maintained according to the applicable NFPA standards. Record inspection and maintenance dates on the container, on a tag attached to the container, or in a central location. (9-5.b)

c. Standpipe and Hose Systems. (9-5.c)

(1) Inspect and maintain standpipe systems according to UFC 3-601-02.

(2) Inspect hose systems after each use and at least annually to assure that all equipment is in place, available for use, and in operable condition.

(3) Un-rack hemp and linen hoses and physically inspect them for deterioration at least annually, and re-rack them using a different fold pattern.

(4) When the system or any portion of the system is found not to be serviceable, remove it for repair and replace it with equivalent protection (for example, fire watch, extinguisher) until the repairs are complete.

9-6. Activity Hazard Analysis (AHA) Requirements.
Develop AHAs according to paragraphs 1-6 or 2-6, as applicable.

a. AHAs are required when conducting wildland fire prescribed burns (see paras 9-7.b and 9-8.l). (9-6.a)

b. Employer will determine how long a fire watch is required to stay in place, but it must be a minimum of thirty (30) minutes after the exposure has ended and documented in the AHA (see para 9-8.g). (9-6.b)

9-7. Minimum Plan Requirements.

a. Fire Prevention Plan. A Fire Prevention Plan is required at all USACE facilities and project sites. For construction operations, develop according to NFPA 241, and for marine operations, develop according to chapter 19. All plans must include the following: (9-7.a)

(1) Detailed description of activities performed where fire hazards are present or generated during the course of such activities.

(2) Description of anticipated hazards, to include the following:

(a) A list of the major workplace fire hazards.

(b) Potential ignition sources.

(c) Control measures that will be implemented to control to an acceptable level, to include housekeeping procedures (for example, removal of waste materials) and the types of fire suppression equipment or systems appropriate to control a fire.

(3) Assignments of personnel and their roles and responsibilities, to include responsibilities for maintaining fire suppression equipment or systems and controlling

fuel source hazards. Include necessary information/documentation to support qualifications/training of such persons. (See para 9-3)

(4) Inspection and oversight methods to ensure adherence to the plan.

b. Wildland Fire Management Plan. A Wildland Fire Management Plan is required at all USACE facilities and project sites with potential exposure to wildland fire, whether prescribed or planned. Plans must be reviewed and updated at least annually. Plans must address prescribed fire and wildfire prevention and suppression to include the following: (9-7.b)

Note. USACE only. Develop plans according to EP 1130-2-540.

(1) Detailed description of activity being performed, to include individual prescribed fire burn plan procedure and AHA.

(2) Description of anticipated hazards or concerns and the control measures that will be implemented to control to an acceptable level, to include the following:

(a) An analysis of wildland fire causes and special wildland fire hazards and risks.

(b) Proposed measures to reduce wildfire occurrence and decrease fire damage.

(c) Procedures for public education and notification and wildfire prevention sign posting, including procedures for keeping the public informed of the current fire danger rating.

(d) Provisions for cooperative efforts with all other neighboring wildland fire management protection agencies.

(e) A listing of cooperating agencies (including any mutual aid agreements with adjacent fire departments and agencies) and notification procedures for both them and the in-house wildland fire management or control team.

(f) A listing of additional available resources for work force, equipment, supplies, and facilities, and contracting or procurement information.

(g) An up-to-date map(s) of the managed and/or protected area(s) that shows boundaries, roads, and other means of access, heliports, airports, water sources, special hazards, and special fire risks.

(h) A listing of weather information sources.

(i) A pre-attack fire suppression plan.

(j) Conduction of onsite safety meetings to discuss predicted weather patterns, escape route(s), and safety zone(s).

(3) Assignment of personnel and their roles and responsibilities, to include the in-house wildland fire management or control team organization and personnel roster, training, and equipment requirements. Include necessary information/documentation to support qualification/training of such persons. (See para 9-3)

(4) Inspection and oversight methods to ensure adherence to the plan.

9-8. General Requirements.
Follow applicable NFPA recommendations in situations not covered in this chapter. When unusual fire hazards exist or fire emergencies develop, provide additional protection as required by the USACE supervisor/KO or COR.

a. Fire Prevention. (9-8.a)

(1) Fire Prevention Plan. A Fire Prevention Plan must be developed for all USACE facilities and project sites according to paragraph 9-7.a. All employees must be trained on the plan according to paragraph 9-3.f. Use the plan to brief emergency first responders on the fire hazards, the materials and processes, and the emergency evacuation procedures.

(2) Do not leave fires and open flame devices unattended.

(3) Separate all sources of ignition, including smoking, at least 50 feet (15.2 m) from any operations with a potential fire hazard or areas where flammable, combustible, or oxidizing materials are stored. Conspicuously post with legible signs stating, “NO SMOKING, MATCHES, or OPEN FLAME.”

(4) Segregate DOT-identified noncompatible materials that may create a fire hazard with a barrier having a fire resistance rating equivalent to a listing of at least one hour. See chapter 20 for compressed gas cylinders.

(5) Do not install low-density fiberboard, combustible insulation, or vapor barriers with a flame spread greater than 25 inches in permanent buildings.

(6) Space temporary buildings according to the IBC.

(7) Shield all combustibles from all types of hot work activities.

(8) Take precautions to protect formwork and scaffolding from exposure to and spread of fire.

(9) Control the growth of tall grass, brush, and weeds adjacent to facilities. Maintain a break of at least 3 feet (0.9 m) around all facilities.

(10) Maintain sufficient clearance around lights and heating units to prevent ignition of combustible materials.

(11) Housekeeping.

(a) Promptly remove and dispose of accumulations of combustible scrap and debris.

(b) Use self-closing containers to collect waste saturated with flammable liquids.

(c) Use non-combustible or Underwriters Laboratories (UL)-labeled nonmetallic containers to dispose of waste and rubbish.

b. Fire Protection. (9-8.b)

(1) When outside help is relied upon for fire protection, prepare a written agreement or a memorandum of record stating the terms of the arrangement and the details for fire protection services and provide it to the USACE supervisor/KO or COR.

(2) Provide and maintain water supply and distribution facilities for firefighting according to NFPA 1142.

(3) Establish and maintain fire lines that are free of obstructions and provide access to all areas.

(4) Do not permit vehicles, equipment, materials, and supplies to obstruct access to fire hydrants and other firefighting equipment.

(5) Portable Fire Extinguishers. Provide portable fire extinguishers according to table 9-2.

(a) All portable fire extinguishers must be approved by a NRTL and labeled to identify the listing and labeling organization and the fire test and performance standard that the fire extinguisher meets or exceeds.

(b) All portable fire extinguishers must be marked with their extinguisher classification and rating.

(c) Fire extinguishers must be suitably placed, distinctly marked, and readily accessible. All fire extinguishers must be fully charged and in operable condition.

(d) Inspect fire extinguishers according to paragraph 9-5.a.

(e) When fire extinguishers are provided in the workplace, employees must be trained according to paragraph 9-3.c.

(f) Do not use fire extinguishers with carbon tetrachloride or bromochloromethane extinguishing agents.

(g) Do not use soldered or riveted shell self-generating foam or gas cartridge water-type portable extinguishers that are operated by inverting the extinguisher to rupture or initiate an uncontrollable pressure generating chemical reaction to expel the agent.

(6) Standpipe and Hose System Equipment.

(a) The design and construction of standpipes must be according to UFC 3-600-01.

(b) Locate standpipes or otherwise protect them against damage. Promptly repair damaged standpipes.

(c) Design and maintain reels and cabinets used to contain fire hose to ensure easy access to the hose valve, hose, and other equipment. Conspicuously identify reels and cabinets and only use them for fire equipment.

(d) Locate hose outlets and connections high enough above the floor to avoid their obstruction and to be accessible to employees. To ensure hose connections are compatible with support fire equipment, standardize the screw threads or provide adapters throughout the system.

(e) Equip standpipe systems with vinyl type or lined hoses of such length that friction loss resulting from water flowing through the hose will not decrease the pressure at the nozzle below 30 psi (206.8 kilopascal (kPa)) gauge. The dynamic pressure at the nozzle will be within 30 psi (206.8 kPa) gauge and 125 psi (861.8 kPa) gauge.

(f) Equip standpipe hoses with basic spray nozzles with a straight stream to wide stream spray pattern. Nozzles must have a water discharge control capable of functions ranging from full discharge to complete shutoff.

(g) Perform the following tests on standpipe and hose systems before placing them in service:

(g-1) Hydrostatically test piping (including yard piping) for at least two hours at not less than 200 psi (1379 kPa), or at least 50 psi (344.7 kPa) more than normal pressure when the normal pressure is greater than 150 psi (1034.2 kPa).

(g-2) Hydrostatically test hose with couplings in place at a pressure of not less than 200 psi (1379 kPa). Maintain this pressure for at least 15 seconds, but not more than one minute, during which time the hose must not leak or the jacket thread break.

(h) Keep water supply tanks filled to the proper level except during repairs. When pressure tanks are used, always maintain proper pressure except during repairs.

(i) Always keep valves in the main piping connections to the automatic sources of water supply fully open, except during repairs.

(j) Inspect the system according to paragraph 9-5.c.

(k) The minimum water supply for standpipe and hose systems provided for the use of employees must provide at least 100 gal (0.38 m^3) per minute for at least 30 minutes.

(l) For all structures in which standpipes are required, or where standpipes exist in structures being altered, install the standpipes as soon as practical and maintain them as construction progresses so that they are always ready for fire protection use. There must be at least one standard hose outlet at each floor.

(7) Fixed Fire Suppression Systems.

(a) Design, install, and acceptance test fixed fire suppression systems according to the requirements of the UFC 3-600-01.

(b) Inspect the system according to paragraph 9-5.b.

(c) Protect automatic sprinkler systems from damage.

(d) Maintain a vertical clearance of at least 18 inches (45.7 cm) between the top of stored material and sprinkler deflectors.

(e) If a fixed extinguishing system becomes inoperable, the employer must notify the employees and take necessary precautions to assure their safety until the system is restored to operating order.

(f) Provide effective safeguards to warn employees against entry into fixed extinguishing system discharge areas where the atmosphere remains hazardous to employee safety and health. Identify manual operating devices as to the hazard against which they will provide protection.

(g) Post warning or caution signs at the entrance and inside the areas protected by fixed extinguishing systems that use agents in concentrations known to be hazardous to employee safety and health.

(8) Dry Chemical Fixed Extinguishing Systems.

(a) Dry chemical extinguishing agents must be compatible with any foams or wetting agents with which they are used.

(b) Do not mix dry chemical extinguishing agents of different compositions.

(c) Refill dry chemical extinguishing systems with the chemical stated on the approval nameplate or an equivalent compatible material.

(9) Gaseous Agent Fixed Extinguishing Systems.

(a) Agents used for initial supply and replenishment must be of a type approved for the system's application.

(b) Do not expose employees to toxic levels of the gaseous agent or its decomposition products.

(10) When water and spray foam fixed extinguishing systems are used, drain the water away from work areas and emergency egress routes.

(11) When fire blankets are provided, keep them in a conspicuous and accessible location.

c. Fire Fighting. (9-8.c)

(1) Do not attempt to fight a fire that is in imminent danger of contact with explosives. Relocate all employees to a safe area and guard the fire against intruders.

(2) Firefighting Equipment.

(a) Provide and install firefighting equipment according to applicable NFPA and OSHA regulations (see para 9-1).

(b) Do not make any fire protection equipment or device inoperative or use them for other purposes, unless specifically approved by the USACE supervisor or accepted by the KO or COR.

(c) If fire hose connections are not compatible with local firefighting equipment, adapters must be made available.

d. Fire Alarm and Mass Notification Systems. The employer must establish an alarm system so that employees onsite and the local fire department can be alerted of an emergency. (9-8.d)

(1) Design, install, and maintain fire alarm and mass notification systems according to UFC 3-600-01 and UFC 3-601-02.

(2) Restore fire detection systems and components to normal operating condition as soon as possible after each test or alarm. Maintain spare devices and components in sufficient quantities for prompt system restoration.

(3) Maintain fire detection systems in operable condition, except during maintenance or repairs. Only a QP, will service, test, maintain, or repair fire detection, alarm, and mass notification systems. (See para 9-4)

(a) Test and adjust fire detectors and detector systems as often as necessary to maintain operability and reliability. Factory calibrated detectors do not need to be adjusted after installation.

(b) Clean fire detectors of dirt, dust, or other particulate matter at regular intervals according to the manufacturer's instructions to be fully functional.

(4) Equip pneumatic and hydraulic operated detection systems installed after January 1, 1981, with supervised systems.

(5) Protect fire detection systems and devices from weather, corrosion, and mechanical and physical damage.

(6) Do not support fire detectors from their control wiring or conduit.

(7) Manually operated alarm actuation devices must be conspicuous, accessible, and inspected and maintained in operable condition.

(8) The alarm must be distinctive and recognizable as a signal to evacuate the work area or to perform actions designated in the Emergency Plan according to paragraphs 1-7.d or 2-8.d, as applicable. The alarm must be capable of being perceived above ambient noise and light levels by all employees in the affected area. Tactile devices must be used to alert those employees who would not otherwise be able to recognize the audible or visual alarm.

(9) Instruct employees in the preferred means of reporting emergencies, such as manual pull box alarms, public address systems, or telephones (see para 9-3.f).

(a) Post the alarm code and reporting instructions in conspicuous locations such as at phones and at employee entrances.

(b) Post evacuation instructions in a conspicuous location.

(10) For work at installations that are equipped with radio wave fire alarm systems, a compatible fire alarm transmitter should be used at the construction site.

(11) Install and maintain smoke detectors where personnel are quartered.

e. Hot Work. Prior to performing any hot work, survey the work area to ensure they are free from fire hazards. (9-8.e)

(1) Hot Work Permits. The USACE supervisor/KO or COR must survey all activities and determine which require a hot work permit. Hot work permits are required when performing hot work. Hot work permits must include the date(s) authorized for hot work and identify the objects on which the hot work is to be performed. Permits must be kept on file until the completion of the hot work.

Note. See NFPA 51B for a sample hot work permit.

(2) All hot work and hot work permits must conform to local policy when present.

(3) Fire Watches. Where combustible materials have been exposed to fire hazards, employer will determine how long a fire watch is required to stay in place, but it must be a minimum of thirty (30) minutes after the exposure has ended and documented in the AHA. Where fire watch personnel or guards are provided, they must make frequent rounds through buildings and storage areas when work is suspended.

(4) A fully charged fire extinguisher, minimum 10 lbs. (4.5 kg), must be readily available in the immediate area of the hot work.

(5) Install and maintain smoke detectors where personnel are quartered.

(6) Hot work is prohibited in the following areas:

(a) In areas not authorized by USACE supervisor/KO or COR.

(b) In sprinklered buildings while such protection is impaired unless equivalent protection is provided for the hot work and approved by the USACE supervisor or accepted by the KO or COR.

(c) In the presence of explosive atmospheres, areas where an explosive atmosphere may develop, or where there is an accumulation of combustible dust.

(d) In areas near the storage of large quantities of exposed, readily ignitable materials such as bulk sulfur, baled paper, or cotton.

f. Burning Operations. (9-8.f)

(1) Establish burning areas in coordination with the USACE supervisor/KO or COR and with the agency responsible for monitoring fire potential at the location of the proposed burning area.

(2) All burning operations must comply with this manual, applicable federal, state, and local requirements.

(3) Maintain a sufficient force to control and patrol the burning operations until the last embers have been extinguished.

(4) Provide bump blocks where trucks back-up to a fire or burning pit.

(5) Conduct prescribed burning activities for natural resource management according to paragraph 9-8.l.

g. Hazardous Locations. (9-8.g)

(1) Only use electrical lighting as a means of artificial illumination in areas where flammable liquids, vapors, fumes, dust, or gases are present.

(2) All electrical equipment and installations in hazardous locations must comply with the NEC for hazardous locations.

(3) Do not remove or replace globe(s) lamp(s) or make repairs on the electrical circuit until it has been de-energized (see chapter 12).

(4) All miners' lights and flashlights used around explosives or in atmospheres likely to contain explosive vapors, dusts, or gases must be approved by a private sector organization recognized by OSHA's NRTL Program.

h. Fire Protection in the Construction Process. (9-8.h)

(1) Retain fire cut-offs in buildings undergoing alterations or demolition until operations require their removal.

(2) Where a water distribution system is required for the protection of buildings or other structures, install water mains and hydrants before or concurrent with the construction of facilities. Until the permanent system is in operation, an equivalent temporary system must be provided.

(3) Install permanent (fixed) and functioning extinguishing equipment and water supply for fire protection as soon as possible. The scheduling of sprinkler installation must closely follow the building construction and, following completion of each story, must be placed in service as soon as possible.

(4) During demolition or alterations, retain service to the existing automatic sprinkler systems if reasonable. Expedite the modification of sprinkler systems to allow alterations or additional demolition of the system to return service as quickly as possible. Check sprinkler control valves daily at close of work to find out if the protection is still in service. The operation of sprinkler control valves is allowed only when approved by the USACE supervisor or accepted by the KO or COR.

(5) During the construction process, prioritize the construction of fire walls and exit stairways required for completed buildings. Install fire doors, with automatic closing devices, in openings as soon as practical.

i. Temporary Heating Devices. (9-8.i)

(1) The USACE supervisor/KO or COR must approve all temporary heating devices.

(2) Each heater must have a safety data plate permanently affixed by the manufacturer. The plate must show requirements or recommendations for:

(a) Clearance from combustible materials.

(b) Ventilation (minimum air requirements for fuel combustion).

(c) Fuel type and input pressure.

(d) Lighting, extinguishing, and relighting.

(e) Electrical power supply characteristics.

(f) Location, moving, and handling.

(g) Name and address of the manufacturer.

Note. If this information is not available on a data plate, provide it in writing at the jobsite.

(3) Establish a standard operating procedure to assure the following:

(a) Proper placement and servicing.

(b) Safe clearance from combustible material.

(c) Close surveillance.

(d) Safe fuel storage and refueling.

(e) Proper maintenance.

(f) Ventilation and determination of gaseous contamination or oxygen deficiency.

(4) Install and maintain heaters according to the manufacturer's instructions.

(5) Do not use open-flame heating devices having exposed fuel below the flame.

(6) Operate heaters in a horizontally level position, unless otherwise permitted by the manufacturer's specifications.

(7) Mark heaters that are unsuitable for use on wood floors. When such heaters are used, place them on suitable heat insulating material, such as 1 inch (2.5 cm) minimum thick concrete. The insulating material must extend at least 2 feet (0.6 m) in all directions from the edges of the heater.

(8) Locate heaters used near combustible tarpaulins, canvas, or similar coverings at least 10 feet (3 m) from such coverings. Securely fasten the coverings to prevent them from igniting or upsetting the heater due to the wind.

(9) Protect heaters from damage.

(10) Separate temporary heating devices from combustible materials by the minimum clearances shown in table 9-1.

(11) Train personnel involved in fueling heaters according to paragraph 9-3.a.

(12) Vent fuel combustion space heating devices used in any enclosed building, room, or structure with a flue pipe to the exterior of the structure.

(a) Supply fresh air by natural or mechanical means in sufficient quantities to ensure the health and safety of workers. Give particular attention to areas where heat and fumes may accumulate.

(b) When heaters are used in confined spaces, take precautions to ensure proper combustion, maintenance of a safe and healthful atmosphere for workers, and limitation of temperature rise in the area. Address these concerns on the confined space entry permit. (See chapter 34)

(c) Locate vent pipes at least 18 inches (45.7 cm) from flammables and combustibles. Where vent pipes pass through combustible walls or roofs, properly insulate, and securely fasten and support them to prevent accidental displacement or separation.

(13) When a heater is placed in operation, perform initial and periodic checks to make sure it is functioning properly.

(14) When heaters are used in enclosed or partially enclosed structures, monitor for carbon CO continuously. If not feasible, state in the AHA and perform tests to monitor for the presence of CO within one hour of the start of each shift and at least every 4 hours thereafter. If CO concentrations exceed 25 parts per million (ppm) (TLV) of air volume at worker breathing levels, extinguish the heater or provide additional ventilation to reduce the CO content to acceptable levels.

(15) Heaters must be equipped with an approved automatic device to shut off the flow of fuel if the flame is extinguished. On liquid fuel heaters, barometric or gravity oil feed is not considered a primary safety control.

(16) Spark arresters must be provided on all smokestacks or burning devices having forced drafts or short stacks permitting live sparks or hot materials to escape.

(17) Do not use solid fuel heaters in buildings or on scaffolds.

(18) Gas Heaters.

(a) Leak test all piping, tubing, and hoses using soap suds or other noncombustible detection means after assembly to prove free of leaks at normal operating pressure.

(b) Protect hose and fittings from damage and deterioration.

(c) Check all hoses and fittings to ensure that the type, capacity, and pressure ratings are as specified by the heater manufacturer. Hoses must have a minimum working pressure of 250 psi (1723.7 kPa) gauge and a minimum bursting pressure of 1,250 psi (8618.4 kPa) gauge.

(d) All hose connectors must withstand, without leakage, a test pressure of 125 psi (861.8 kPa) gauge for natural gas, and 500 psi (3,447 kPa) gauge for Liquefied Petroleum (LP)-Gas and withstand a pull test of 400 lbs. (181.4 kg) (see 29 CFR 1910.110).

(e) Securely connect hose connectors to the heater by mechanical means. Do not use "slip-end" connectors (that is, connections that allow the hose end to be held only by the friction of the hose material against the metal fitting of the unit) nor ring keepers (that is, tightened over the hose to provide an increased force holding the hose to the metal fitting).

(19) Natural Gas Heaters. When using flexible gas supply lines, the length must be as short as practical and must not exceed 25 feet (7.6 m).

(20) Portable LP-Gas Heaters (see chapter 14).

(a) If LP-Gas is supplied to a heater by hose, the hose must not be less than 10 feet (3 m), or more than 25 feet (7.6 m), in length.

(b) Equip heaters with an approved regulator in the supply line between the fuel cylinder and the heater unit. Provide cylinder connectors with an excess flow valve to minimize the flow of gas in the event the fuel line ruptures.

(c) Equip LP-Gas heaters having inputs above 50,000 British Thermal Unit (BTU)/hour with either a pilot, which will be lighted and proved before the main burner can be turned on, or an electronic ignition. These provisions do not apply to portable heaters under 7,500 BTU/ hour when used with containers having a maximum water capacity of 2.5 lbs. (1.1 kg).

(d) Do not use container valves, connectors, regulators, manifolds, piping, or tubing as structural support for LP-Gas heaters.

(e) Locate heaters, other than integral heater-container units, at least 6 feet (1.8 m) from any LP-Gas container. This requirement does not prohibit the use of heaters designed specifically for attachment to the LP-Gas container or to a supporting standard, provided they are designed and installed to prevent direct or radiant heat application from the heater into the containers. Do not direct blower or radiant type heaters toward any LP-Gas container located within 20 feet (6.1 m).

(f) If two or more heater-container units (of either the integral or non-integral type) are in the same area of an unpartitioned floor, separate the container or containers of each unit from the container or containers of any other unit by at least 20 feet (6.1 m).

(g) When heaters are connected to containers for use in an unpartitioned area on the same floor, the total water capacity of containers, manifolded together for connection to a heater(s), must not be greater than 735 lbs. (333.4 kg), nominal 300 lbs. (136.1 kg) LP-Gas capacity. Separate such manifolds by at least 20 feet (6.1 m).

(21) Installation of Heating Equipment in Service or Lubrication Areas.

(a) Install heating equipment in lubrication or service areas where there is no dispensing or transferring of flammable liquids so that the bottom of the heating unit is at least 18 inches (45.7 cm) above the floor ad is protected from damage.

(b) Where flammable liquids are dispensed, install heating equipment of an approved type for garages at least 8 feet (2.4 m) above the floor.

(22) Do not modify temporary heating devices, use proper purpose only, and follow manufacturer's instruction to use.

j. USACE Wildland Fire Control and Recovery. (9-8.j)

(1) A Wildland Fire Management Plan must be developed according to paragraph 9-7.b at all USACE facilities and project sites with potential exposure to wildland fire, whether prescribed or planned.

(2) Organize and conduct wildland fire management teams and operations according to NFPA 1143.

(a) Wildland fire management team personnel must be trained according to paragraph 9-3.d.

(b) Wildland fire management teams must include at least two qualified individuals (see para 9-3.d).

(3) Maintain firefighting equipment in working and ready condition.

(4) Provide and maintain in working and ready condition PPE according to NFPA 1143 and NFPA 1977, to include fire-resistant clothing, safety hard hats, protective footwear (safety toe required for chainsaw operators and/or crush hazard), leather boots, goggles, and fire-resistant gloves. (See chapter 5)

(5) A physician must examine employees engaged in fire management activities as part of their medical surveillance. The physician must certify that they are physically able to perform assigned fire management duties. (See para 9-3.d)

(6) Provide communication equipment to personnel as necessary for coordination, control, and emergency needs.

(7) Prior to conducting a prescribed burn, a hazard evaluation and exposure assessment must be completed and recorded on the AHA to determine if adequate controls are in place. It is recommended that medical surveillance and exposure monitoring is conducted for volatile organic compounds, nitrogen dioxide, CO, and particulate matter 2.5 microns or less in diameter (PM2.5). (See para 9-6)

k. Heating Devices and Melting Kettles. (9-8.k)

(1) All kettle operators must be trained according to paragraph 9-3.b.

(2) Place heating devices and melting kettles on firm, level, non-combustible foundations, and whenever possible, place downwind from employees or occupied buildings. Protect against traffic, accidental tipping, or similar hazards.

(3) Establish procedures to contain uncontrol spills of heated material which may be on fire. Place a fire-retardant tarp, or other effective means, under the kettle.

(4) Maintain a minimum of two fire extinguishers rated not less than 2A:20B:C within 25 feet (7.6 m) of the working kettles.

(5) Hot work permits are required on government installation unless otherwise indicated by the USACE supervisor/KO or COR (see para 9-8.g).

(6) Provide and ensure use of a working thermometer.

(7) Do not leave heating devices and melting kettles unattended when in use. When the kettle is heating material to the working temperature, the operator must be located on the same level as the kettle and be within eyesight, but no more than 25 feet (7.6 m) from the kettle.

(8) Provide bituminous-material melting kettles with an effective tight-fitting lid or hood and a calibrated thermometer in operating condition.

(a) The temperature must be maintained 25° below the flash point of the bituminous material.

(b) All melting kettles must be appropriately sized for the job.

(c) Do not locate asphalt or tar kettles on roofs.

(9) Do not use or operate bituminous-material melting kettles inside or within 25 feet (7.6 m) of combustible materials, including propane tanks being stored or in use. The lid for the kettle must open away from the building.

(10) Keep liquid propane container(s) used as a heat source at least 10 feet (3 m) away from the kettle. Place in an upright and secured position to prevent tip over.

(11) Locate kettles so that means of egress is not restricted. Kettles must not be placed closer than 10 feet (3 m) of an egress path.

(12) Ventilate enclosed areas where hot substances are heated or applied.

(13) All ladles, equipment, and material must be moisture-free before being used or placed in heated material.

(14) Do not use flammable liquids with a flashpoint below 100°F (37.8°C) to thin the mixture or to clean equipment.

(15) Include in the Fire Prevention Plan (see paras 9-7.a and 9-3.f).

9-9. Figures and Tables.

Table 9-1
Temporary Heating Device Clearances

Heater Type	Sides	Rear	Chimney Connector
Room heater - circulating	12 inches (30.5 cm)	12 inches (30.5 cm)	18 inches (45.7 cm)
Room heater - radiant	36 inches (91.4 cm)	36 inches (91.4 cm)	18 inches (45.7 cm)

Table 9-2
Fire Extinguisher Distribution

	Occupancy Low Hazard Class A	Occupancy Low Hazard Class B	Occupancy Medium Hazard Class A	Occupancy Medium Hazard Class B	Occupancy High Hazard Class A	Occupancy High Hazard Class B
Minimum rating for single fire extinguisher	2-A	5-B or 10-B[1]	2-A	10-B or 20-B	4A	40-B or 80-B[2]
Maximum coverage (floor area) per unit of A-rating	3,000 ft^2 (278.7 m^2)	Not Applicable	1,500 ft^2 (139.4 m^2)	Not Applicable	1,000 ft^2 (93 m^2)	Not Applicable
Maximum floor area for extinguisher	11,250 ft^2 (1045.2 m^2)	Not Applicable	11,250 ft^2 (1045.2 m^2)	Not Applicable	11,250 ft^2 (1045.2 m^2)	Not Applicable
Maximum travel for distance to extinguisher	75 feet (22.9 m)	30 feet for 5-B or 50 feet for 10-B	75 feet (22.9 m)	30 feet for 10-B or 50 feet for 20-B	75 feet (22.9 m)	30 feet for 40-B or 50 feet for 80-B

Note:

[1] Up to three foam extinguishers of at least 2 1/2 gal (9.5 L) capacities will be used to fulfill low hazard requirements.

[2] Up to three aqueous film forming foam (AFFF) extinguishers of at least 2 1/2 gal (9.5 L) capacities may be used to fulfill high hazard requirements.

[3] Derived from NFPA 10: In multiple-story facilities, at least 1 fire extinguisher will be adjacent to stairways.

[4] On construction and demolition projects, a one-half (½) inch (1.2 cm) diameter garden hose, not to exceed 100 feet (30.5 m) in length and equipped with a nozzle, will be substituted for a 2-A rated fire extinguisher provided it its capable of discharging a minimum of 5 gal (18.9 L) per minute with minimum hose stream range of 30 feet (9.1 m) horizontally. The garden hose lines will be mounted on conventional racks or reels. The number and location of hose racks or reels will be such that at least one hose stream can be applied to all points in the area.

9-10. Checklists and Forms.

Not Applicable.