

CHAPTER 7

FIRE FIGHTING AND SUPPRESSION SYSTEMS

7-1. Description of wet pipe sprinkler systems and fire detection systems

Fire protection in a facility includes architectural, mechanical, and electrical considerations. Provisions for egress by locating exit doors within limited walking distances, fire walls, fire doors, the location of fire extinguishers, and mechanical fire suppression systems which may or may not be interlocked with electrical fire detection and alarm systems are some of the ways personnel, facilities, and equipment can be protected from fire. An early warning fire detection system is designed to detect fire, warn personnel through alarms, and release extinguishing agents. There are various types of fire fighting suppression systems and detection systems. Some of these are discussed in paragraph 7-3, General fire fighting and suppression systems.

a. *Wet pipe sprinkler system.* This manual addresses the wet pipe system shown in figure 7-1, Typical wet pipe sprinkler system. The typical wet pipe sprinkler system includes city water supply, drain lines, fire riser consisting of shutoff valves, check valves, an alarm check valve, fire department connection, water motor driven alarm, branch lines, fusible link sprinkler heads, vent, and low point drain.

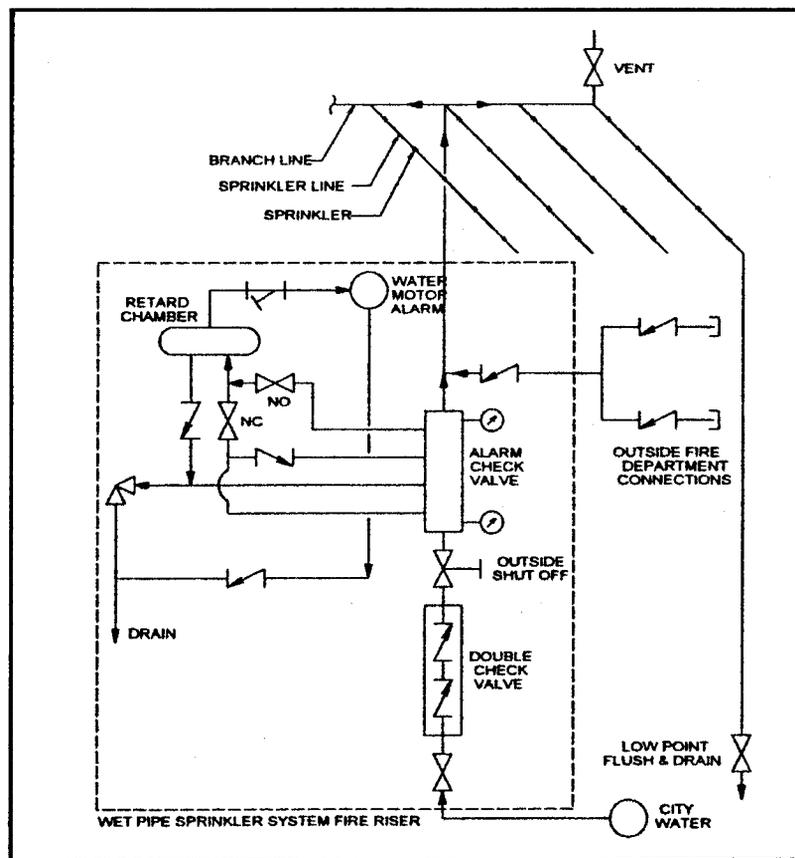


Figure 7-1. Typical wet pipe sprinkler system

b. Fire detection system. Discussed in this manual is a typical fire detection system. The fire detection system consists of smoke detectors, heat detectors, pull stations, alarm/strobe lights, tamper switches, flow switch, control panel, and backup power supply.

c. Wet pipe sprinkler system and fire detection system. More information on design, maintenance, and testing of fire fighting and suppression systems is found in the National Fire Protection Association (NFPA) Standard 12, Carbon dioxide extinguishing systems, Standard 13, Installation of sprinkler systems, and Standard 72, National fire alarm code. Also Department of the Army: TM 5-692-1 Maintenance of Mechanical and Electrical Equipment at Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, Recommended Maintenance Practices, chapter 33, and TM 5-692-2 Maintenance of Mechanical and Electrical Equipment at C4ISR Facilities, System Design Features, chapter 33.

7-2. Operation of wet pipe sprinkler systems and fire detection systems

Operation of the typical wet pipe sprinkler system and a fire detection system are discussed in the following paragraphs.

a. Wet pipe sprinkler system operation. From figure 7-1 it can be seen that city potable water serves as the source for fire water. A shutoff valve is provided in the fire riser just inside and above the building floor. Above the shutoff valve is a double check valve installed to prevent back flow into the city water system. This valve is followed by a shutoff valve with outside access having an indicator to indicate whether it is open or closed. The valve is normally open with a chain and padlock applied to prevent tampering. A tamper switch is also installed to sound an alarm should the valve be tampered with by unauthorized personnel. Above this valve is an alarm check valve which permits flow to the sprinkler system and has connections for a drain, pressure gages, and the retard chamber which operates the water flow motor driven alarm placed outside of the building. Test connections, shutoff valves, check valves, vents, and drains are located as required to flush and test various components of the system on a schedule established by the local fire department, authority having jurisdiction, and the insurance company. Above the alarm check valve is a tee. One leg of the tee allows fire water to be provided by a set of fire department connections located outside of the building. A check valve is incorporated to prevent backflow through the fire department connection. The fire department connections are redundant to the city water supply and provide another source of water for the wet pipe sprinkler system. The riser then connects to branch lines which serve sprinkler lines. In the sprinkler lines are fusible link sprinkler heads located as required by the National Fire Protection Association (NFPA), local codes, and the insurance company. The fuse is usually chosen to melt at 135°F, however other temperatures are available. The number, type, and location of sprinkler heads is determined by the fire occupancy rating. This rating considers the type of structure, the materials present in the area, the number of personnel, and the liability resulting from a fire. In the wet pipe system, heat from a fire will melt the fuse in the sprinkler allowing water to flow from that head. The purpose of the water is to slow the fire until professional fire fighting assistance can arrive. Also provided in the sprinkler lines are a high point vent and a drain at the far end of the system. The vent allows the system to relieve air to assist with draining the sloped sprinkler and branch lines and to assist in filling the system with water. The drain at the far end of the system permits verification of water flow and flushing of the system.

b. Fire detection system operation. The fire detection system uses smoke detectors and heat detectors to detect fire in a facility. Heat detectors are fuse type, usually set for 195°F and must be replaced after activation by a fire. An electrical signal interruption from these detectors, pull stations, tamper switches on fire riser valves, and/or flow switch on the fire riser is interpreted by the control panel and processed.

The panel will activate local alarm/strobe lights mounted inside and outside of the facility, and an alarm at the fire department. The panel face displays the location and type of sensor which sent off the alarm. The backup power supply includes a solid-state automatic switch, battery, and charger.

7-3. General fire fighting and suppression system equipment description and operation

A description and operation of different types of fire suppression components and systems, and fire detection components is presented in the following paragraphs.

- a. *Dry pipe sprinkler system.* Dry pipe sprinkler systems have heat operated fusible sprinkler heads similar to a wet pipe system, however, the piping system contains air under pressure. When a sprinkler head fusible link melts, the air pressure is reduced, a "dry pipe" valve in the riser is opened by water pressure, and water flows to any opened sprinkler heads. A small air compressor is required for this system.
- b. *Deluge sprinkler system* A deluge type of fire suppression system consists of open-type sprinkler heads attached to a network of dry (not water-filled) piping which is automatically controlled by a fully supervised fire detection system which also serves as a fire alarm system. When a fire is detected, an automatic deluge valve is tripped open, admitting water to the system for discharge through all sprinkler heads.
- c. *Pre-action sprinkler system.* The pre-action type of sprinkler system is similar to the above water spray deluge system, except that it contains fusible link sprinkler heads. When the supervisory system opens the valve, water will flow through those sprinklers whose fixed temperature elements and fuses have been opened by the heat from a fire.
- d. *Carbon dioxide (CO₂) fire suppression system.* A CO₂ fire suppression system usually consists of a trailer mounted low pressure refrigerated liquid CO₂ storage tank with temperature sensing controls to permit the automatic injection of piped CO₂ into areas to be protected. The system usually includes warning alarms to alert personnel whenever CO₂ is being injected into an actuated area. CO₂ will displace all oxygen in the area and suffocation can occur.
- e. *Sprinkler system pipe.* There are several different types of pipe, valves, and couplings from schedule 40 to light gage schedule 10 galvanized that are permissible for use in sprinkler systems. All must be NFPA approved.
- f. *Post indicator valves (PIVs)* . PIVs are located in the supply line between the city water supply and the sprinkler system riser. The post is located above ground, includes a handle to operate the valve, includes an indicator of the open or shut valve position, and includes a padlock for controlled access to operation of the valve.
- g. *Hose stations.* Hose stations in wet pipe sprinkler systems are provided inside of buildings. They include a valve, festooned hose, and nozzle and are housed in a cabinet with a glass door.
- h. *Ionization smoke detectors.* Ionization smoke detectors contain a small amount of radioactive material which ionizes air in the sensing chamber, rendering it conductive and permitting a current flow. When smoke particles enter the ionization area, the detector circuit responds with an alarm.

i. *Photoelectric smoke detectors.* Photoelectric spot type detectors contain a chamber that has either overlapping or porous covers of light that allow the entry of smoke. The unit contains a light source and a special photosensitive cell in the darkened chamber. As light is blocked with the admission of smoke particles, light striking the particles is scattered and reflected into the photosensitive cell and a circuit response is initiated.

j. *Spot heat detectors.* Spot type heat detectors sense heat. Above a predetermined level the detector trips and signals an alarm.

k. *Portable CO₂ fire extinguishers.* Portable hand held CO₂ fire extinguishers should be provided and located throughout the facility in accordance with the NFPA. The use of dry chemical fire extinguishers is not recommended, primarily due to cleanup problems.

7-4. Pre-functional test plan and functional performance test plan for wet pipe sprinkler systems and fire detection systems

This manual assumes that individual components and packaged equipment have been tested by the manufacturer. As part of the commissioning effort each component should be checked for damage, deterioration, and failures by a procedure using inspections and tests as defined by the specific equipment manufacturers. Equipment manuals from manufacturers identify the minimum required receipt inspections, handling and installation procedures, drawing and wiring verification, field inspection and installation checks, verification of removal of shipping braces, inspection of installation against drawings and nameplates, inspection of components for damage and cleanliness, inspection of insulators and grounding, inspection of anchorage and alignment, adjustment checks, mechanical operation and interlock checks, lubrication application, and verification that local safety equipment is in place.

a. *Fire suppression system tests.* Tests, as required by the NFPA, fire department, insuring agency, and authority having jurisdiction are done by licensed and bonded fire sprinkler companies and fire detection companies. Test reports are provided to the facility manager and others as requested. These tests should form the basis of commissioning as required by the commissioning plan. Some pre-functional tests may be conducted to provide general knowledge of the system. These are outlined in figure 7-2, Example of a completed DA Form 7483-R, wet pipe sprinkler system and fire detection system inspection checklist.

b. *Fire codes.* It is imperative that the NFPA Fire Code standards and manufacturer's recommendations relative to each suppression, detection, and alarm system be consulted before any operation is performed on any of these systems.

c. *Safety, fire suppression systems.* Many tests involve the use of high voltages, high currents, and pressurized water. These can be dangerous to personnel and damaging to equipment. A procedure should be followed to insure adequate safety rules are instituted and practiced to prevent injury to personnel performing the tests and other personnel who might be in the local area.

d. *Test equipment, fire suppression systems.* It is important that in any test program the proper equipment is used. The equipment should be calibrated, in good condition, and used by qualified operators as required by a procedure. Any test equipment used for calibration shall have twice the accuracy of the system to be tested. All equipment should be operated in accordance with its instruction manual. A procedure defining installation inspection and a system test needs to be provided.

WET PIPE SPRINKLER SYSTEM AND FIRE DETECTION SYSTEM INSPECTION CHECKLIST

For use of this form, see TM 5-697; the proponent agency is COE

SECTION A - CUSTOMER DATA

1. PLANT East Building	2. LOCATION Washington, DC	3. JOB NUMBER EB03-103
4. EQUIPMENT Fire Protection	5. SYSTEM DESIGNATION FP 1022	6. DATE (YYYYMMDD) 20030119
7. TEST EQUIPMENT Pressure gauge, Alarm system manual, Fire system schematic		8. TESTED BY Roger Swanson

SECTION B - EQUIPMENT DATA

9. FIRE DETECTION CONTROL PANEL AND SYSTEM MANUFACTURER ADT Focus	10. MODEL NO ADT 23	11. SERIAL NO BD 23E465	12. LOCATION Front entrance
13. FIRE RISER		14. LOCATION Northeast corner	

SECTION C - VISUAL AND MECHANICAL INSPECTION

15. CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES
EXTERIOR OF EQUIPMENT	A		EQUIPMENT IDENTIFICATION	A	
COMPLETENESS OF ASSEMBLY	A		FREEZE PROTECT, VENTS AND DRAINS	A	
CONTROL SYSTEM DISPLAY	A		LABELING AND TAGGING	A	
ELECTRICAL/MECHANICAL INTERLOCKS	A		WALLS AND OBJECTS NEAR SPRINKLER HEADS	A	
SAFETY INTERLOCKS	A		MATERIALS BEING STORED	A	
INSTRUMENTS AND ALARMS	A		OCCUPANCY	A	
PROPER GROUNDING	R	C	PAD LOCKS	A	
PROPER INSULATION	A		ACCESS NEAR RISER, PANEL AND FDC	A	
LOCATION OF SPRINKLER HEADS	R	1	ANCHORAGE AND PIPE HANGERS	A	
CONDITION OF SPRINKLER HEADS	R	2	COMPARISON TO DRAWINGS	R	3

SECTION D - CALIBRATION AND SET POINT

16.	DESCRIPTION	NOTES
GAUGES	Check to assure they are within pressure specifications	
BATTERY AND CHARGER	Check for charge condition, corrosion, and battery specific gravity	

SECTION E - SYSTEM TESTS

17.	OPERATING MODES	TEMPERATURES	PRESSURES	FLOWS	LEVELS	NOTES
HYDROSTATIC TEST	Standby	NA	45 - 95	NA	NA	
ALARM/STROBES	Alert	NA	NA	NA	NA	4
FLOW AND TAMPER SWITCHES	System test	NA	45 - 95	Rated	NA	
PULL STATIONS	Alert	NA	NA	by	NA	5
FLOW TEST	System test	Rated	45 - 95	size	NA	6
SYSTEM TEST	Alert	Rated	45 - 95	"	NA	6

18. NOTES

1. Need additional heads over new equipment along West wall.
2. Need taller ladder for closer inspection.
3. Update drawings to include new sprinklers along West wall.
4. Verify all points. Operate properly.
5. Verify all stations operate and are accessible.
6. Test system during cold and hot ambient conditions.

* CONDITION: A= ACCEPTABLE, R= NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C= CORRECTED; NA= NOT APPLICABLE

Figure 7-2: Example: DA Form 7483-R

7-5. Possible failures and corrective measures for wet pipe sprinkler systems and fire detection systems

Table 7-1 shown below lists general problems that may arise during the testing of equipment and systems along with possible troubleshooting techniques. For all problems, consult equipment and component manuals for troubleshooting directions. Check fuses/lights/breakers/etc., for continuity, check equipment calibration and settings, check for clogged strainers, check for closed manual shutoff valves, check for improperly adjusted valves and equipment, and look for faulty equipment and connections.

a. Repair of wet pipe sprinkler system and fire detection system. It is recommended that adjustments and corrections to wet pipe sprinkler and fire detection systems be done by licensed and bonded fire sprinkler companies and fire detection companies.

b. Fire code compliance. It is imperative that the NFPA Fire Code standards and manufacturer's recommendations relative to each suppression, detection, and alarm system be consulted before any operation is performed on any of these systems.

Table 7-1 Possible failures and corrective actions for wet pipe sprinkler system and fire detection system

	Areas to Check
Fire detection system	
Devices will not close/trip	Check mechanical alignment of tamper switches Check flow switches Check interlocks and safeties Check for mis-wired circuits Check control panel program Check power supply Check battery back-up power supply Check grounds
Devices trip inadvertently	Check protective device settings and operation Check for mis-wired circuits Check control panel program Check for system overload or short Check grounds Check local environmental conditions
Wet pipe sprinkler system	
Does not flow, flows at a reduced rate	Check shut off valves Check strainers and check valves Check city water supply Check pressures Check safeties and interlocks to fire protection systems Check for open drain valves
Water motor driven alarm does not sound	Check retard chamber Check for closed shut off valves Check strainers and drain Check for clogged water motor