SPECIAL PROTECTION SYSTEMS

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1.0 SCOPE

This data sheet provides general guidelines for the selection, plan submittal, design and installation, testing and maintenance of special protection systems. It does not cover explosion suppression systems, which are covered in Data Sheet 7-17, *Explosion Protection Systems.* For more specific guidance for each type of special protection system, refer to the appropriate protection system data sheet, as follows:

Data Sheet 4-1N, *Fixed Water Spray Systems for Fire Protection.*

Data Sheet 4-2, *Water Mist Systems*.

Data Sheet 4-3N, *Medium and High Expansion Foam Systems.*

Data Sheet 4-7N, *Low Expansion Foam Systems.*

Data Sheet 4-8N, *Halon 1301 Extinguishing Systems.*

Data Sheet 4-9, *Clean Agent Fire Extinguishing Systems*.

Data Sheet 4-10, *Dry Chemical Systems.*

Data Sheet 4-11N, *Carbon Dioxide Extinguishing Systems.*

Data Sheet 4-12, *Foam-Water Sprinkler Systems.*

Application guidance as to the specific type of special protection system and further design guidance may also be found in the appropriate hazard or occupancy data sheet. A list of data sheets in which special protection systems are recommended is included in the Appendix (Section C.4).

Note: Spark extinguishing systems are covered in Data Sheet 7-73, *Dust Collectors and Collection Systems,* and the *Approval Guide*, an online resource of FM Approvals, under the heading *Water-Spray Extinguishing Systems for Pneumatic Materials Handling Systems.*

1.1 Changes

April 2012. Terminology related to ignitable liquids has been revised to provide increased clarity and consistency with regard to FM Global's loss prevention recommendations for ignitable liquid hazards.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Equipment and Processes

2.1.1 Plans and Specifications

2.1.1.1 Contracts for new installations or changes in existing systems should be subject to FM Global's acceptance of plans, materials, and the completed installation.

2.1.1.2 Submit final plans and calculations of new or modified systems to FM Global for review and acceptance before installation is started.

Final plans should be to scale or fully dimensioned, with sufficient detail to define clearly both the hazard and the proposed system. Clearly indicate the location and sizes of piping and nozzles together with the location of the extinguishing agent supply, fire-detecting units and all auxiliary equipment. Show dampers, conveyor equipment, doors and other features in any way related to the protection of the hazard. Submit a wiring diagram if fire-detection or system operations are electric. All components should be FM Approved for the particular application and identified by part or model number.

2.1.2 Approval of Installations (Acceptance Testing)

2.1.2.1 The installer or manufacturer's representative should make turnover tests of the completed installation and provide appropriate documentation of the test results to the purchaser (e.g., test certificate or form). These tests should be witnessed by the purchaser and can be used to train selected plant personnel.

2.1.2.2 Turnover tests should determine that the system has been properly installed and will operate as intended. Specifically, the tests should check tightness of piping, flow from nozzles or discharge devices, and the operation of all components.

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2.1.2.3 Where possible, the system should be discharged, but where such action would cause damage, alternate means are acceptable.

For further guidance, refer to the specific protection system data sheet and appropriate hazard or occupancy data sheet, as applicable.

Note: Do not discharge test Halon 1301 extinguishing systems due to the ozone layer concern.

2.1.2.4 Properly identify all controls as to function, area controlled, and operating instructions.

2.1.3 Installation and Design

2.1.3.1 Detection and Actuation

2.1.3.1.1 Use FM Approved automatic detection devices actuated by heat, smoke, flames, or flammable vapors, as needed for the particular hazard.

2.1.3.1.2 The power supply for electrical detection and release devices should be independent of the supply for the hazard area. Where this is not practical, use pneumatic or mechanical devices or provide an emergency minimum 24-hour standby capacity, battery-powered supply with automatic switchover if the primary supply fails.

Where a special protection system is the sole or recommended protection for valuable and important occupancies, provide an alternative power supply for any electrically operated detection and actuation system. An emergency battery-powered supply, with automatic switchover if the primary supply fails, as required for an FM Approved control panel is an acceptable alternate power supply. The electric power supply should not be exposed by the protected area.

2.1.3.1.3 Locate and protect wiring, cables, and tubing to avoid mechanical damage. Wires and cables should be in conduit. Tubing in vulnerable locations should also be in conduit or equivalent. Conduit is not needed for short lengths of cables or tubing near detectors and controls. Wiring or tubing used as detectors should not be in conduit.

2.1.3.1.4 Heat detectors may be used for most installations. Locate heat detectors for room-flooding systems at the ceiling and not more than 15 ft (4.5 m) above the hazard, with at least one detector directly overhead. Shield detectors installed below sprinklers from sprinkler discharge by a piece of sheet metal or equivalent. Locate outdoor heat detectors above and about the hazard to ensure detection regardless of wind conditions.

2.1.3.1.5 Smoke detectors are recommended for vaults, ducts, electronic computer systems, or other enclosures where a smoldering smoke type fire might not be detected quickly by other automatic means.

2.1.3.1.6 Flame detectors may be used in locations having ignitable liquid hazards where very rapid system actuation is desired and considered unlikely to be achieved using heat detectors. Establish compatibility of flame detectors with the operating environment of the protected hazard before arranging them to actuate the special protection system. Flame detectors are recommended for foam systems used as supplementary protection for aircraft hangars.

2.1.3.1.7 For further guidance on selection and arrangement of detectors, refer to Data Sheet 5-48, *Automatic Fire Detection,* and the specific occupancy data sheet, as applicable.

2.1.3.1.8 Where manual bypass switches are provided to prevent accidental discharge of special protection systems especially during testing or servicing of the system; ‘‘keyed lock-out’’ devices should be located at the control panel. These devices should not disable the alarm circuit. Establish and follow written system impairment procedures. Preferably, the key(s) should not be left in place but rather under the control of a responsible management or fire protection person.

2.1.3.2 Operating Devices

2.1.3.2.1 Use FM Approved operating devices to control the flow of extinguishing agent and to operate related equipment. They include cylinder, master, selector and deluge valves, cylinder release devices, manual discharge controls, predischarge and discharge timers, and pressure trips and switches. Selector valves are installed in single-supply systems protecting multiple hazards to direct the extinguishing agent to the hazard involved. Operation of these devices is by mechanical, pneumatic or electrical means. Time delays are either pneumatic or electrical in operation.

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2.1.3.2.2 Actuation of operating devices is either automatic by a detector unit or manual through remote or local control stations.

Automatic actuation is generally recommended. Manual actuation is classified as either normal or emergency. All systems should have an emergency manual control for discharging the system if other controls fail.

2.1.3.2.3 Normal manual controls should perform all the functions of automatic controls beyond that of detection.

2.1.3.2.4 Emergency manual controls are usually independent of the normal means and may not perform all of the same functions. They are usually mechanical in operation and mounted on the device to be operated. Multiple-hazard systems using selector valves should have multiple emergency manual controls, preferably installed at one location or at least within 50 ft (15 m) of each other and on the same floor.

2.1.3.2.5 Both normal and emergency manual-control stations should be readily accessible during a fire. Normal controls usually present no problem of location. Where emergency controls are mounted on operating devices exposed to the hazard, provide a remote means of manual operation.

2.1.3.2.6 Label each manual control, identifying the system and the hazard protected.

2.1.3.2.7 Locate or protect operating devices so as to avoid mechanical damage or damage by corrosion, unfavorable weather or other conditions. Guards, enclosures or canopies may be needed. Enclose devices having external moving parts with substantial wire mesh or expanded metal to prevent tampering or damage.

2.1.3.3 Alarms and Supervisory Devices

2.1.3.3.1 Provide an audible alarm that will sound when the system operates and continue until reset manually.

2.1.3.3.2 When a special protection system is the sole or recommended protection for valuable and important structures, equipment or contents such as chemical processing equipment, a fur vault, or a record storage room, the detection devices and circuits should be supervised by an Approved proprietary system or central station. Provide trouble alarms and discharge alarms, distinctive from each other, to sound at a constantly attended location.

2.1.3.4 Supply of Extinguishing Agent

2.1.3.4.1 The location of extinguishing agent supplies, both in-service and reserve, should be such as to avoid mechanical, chemical, weather, or other types of damage. Guards or enclosures may be needed.

2.1.3.4.2 Locate control valves for water spray systems and storage containers of carbon dioxide, foam concentrate, halogenated hydrocarbons, or dry chemical near the protected hazard but where they will always be accessible during a fire. In addition, they should be readily accessible for inspection, testing or recharging, and maintenance with minimum interruption of service.

2.1.3.4.3 The in-service supply of extinguishing agent should be adequate for at least the largest single hazard or group of hazards to be protected simultaneously.

2.1.3.4.4 Where hand hose lines may be operated simultaneously with a fixed system, provide a separate supply or a sufficient additional quantity for this use.

2.1.3.4.5 Reserve supplies are necessary to permit prompt restoration of the system after a discharge, to minimize interruption of the process and the interval of impaired protection. The reserve should at least equal the minimum requirement for the in-service supply, unless available from an outside source within 24 hours.

2.1.3.4.6 Where two or more hazards are protected by a single supply through selector valves, connect the reserve supply to the piping. Provide a switchover arrangement, if needed, to permit actuation by the normal means. A manually actuated main/reserve switch is normally provided at the control panel for this purpose.

2.1.3.4.7 Provide a connected reserve where a special protection system is the sole protection for valuable and important occupancies unless protection can be fully restored within 24 hours, occupancies are constantly attended and written impairment procedures have been established.

2.1.3.4.8 Recharging materials should be those FM Approved for the specific type of system.

2.1.3.5 Piping

2.1.3.5.1 Lay out the piping to produce the desired rate of flow at the nozzles or discharge devices.

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2.1.3.5.2 For all systems, piping should be noncombustible and able to withstand expected temperatures without deformation except where flexible piping or hose is part of an FM Approved system.

2.1.3.5.3 In corrosive atmospheres, use a corrosion-resistive material or protective coating.

2.1.3.5.4 Secure piping with supports such as hangers, brackets and U bolts. Where explosion may occur, hang piping from structural supports that are least likely to be displaced and where damage from flying fragments can be avoided.

2.1.3.5.5 Avoid obstructions in the piping from foreign materials or faulty fabrication. Ream and clean piping before assembly. After assembly, blow out the entire system before nozzles or discharge devices are installed.

2.1.3.6 Nozzles

2.1.3.6.1 Use and arrange FM Approved nozzles or discharge devices suitable for the specific application to provide the flow rate and pattern coverage required for the hazard. Support them securely so as to remain in adjustment during a fire or system discharge.

Note: Effective nozzle areas of coverage are provided in the respective system manufacturer's approval report.

2.1.3.6.2 Prevent process deposits of such materials as paint, dust or oil on nozzle orifices or on the fusible element of automatic nozzles. Special sealed nozzles are available having a frangible disk that is blown out by the system discharge. Nozzle blowoff caps are also available; they are held in place by friction and blown off by the discharge.

2.1.3.6.3 Inspect and clean these special nozzles periodically. Check blowoff caps for ease of release and evidence of deformation or mechanical damage.

2.1.4 Inspection, Maintenance and Instruction

2.1.4.1 Maintain systems in operating condition at all times and restore to service promptly after any impairment or operation. Report any impairments to the local FM Global office so that appropriate precautionary guidance may be obtained. Follow procedures based on the use of the FM Global *Red Tag Permit System.*

2.1.4.2 Establish and follow a program of scheduled inspections, tests and maintenance that includes the following:

a) Weekly inspections to see that nozzles or discharge devices are clear and in proper position, that all operating controls are properly set, and that components have not been damaged.

b) Annual inspections and tests of all actuating and operating devices. Test pressure-operated devices, preferably by a complete or partial discharge where practical. Regular service contracts with the manufacturer, authorized representative, or FM Approved recharge agency are advised.

c) Periodic training of plant personnel who may be called on to inspect, test, maintain, operate, or restore the system.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 General

Satisfactory performance of a special protection system can best be ensured by following the loss prevention recommendations within this document.

4.0 REFERENCES

4.1 FM Global

Data Sheet 4-1N, *Fixed Water Spray Systems for Fire Protection*
Data Sheet 4-3N, *Medium and High Expansion Foam Systems*
Data Sheet 4-7N, *Low Expansion Foam Systems*
Data Sheet 4-8N, *Halon 1301 Extinguishing Systems*

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Data Sheet 4-10, *Dry Chemical Systems*
Data Sheet 4-11N, *Carbon Dioxide Extinguishing Systems (NFPA)*
Data Sheet 5-48, *Automatic Fire Detection*
Data Sheet 7-17, *Explosion Protection Systems*
Data Sheet 7-73, *Dust Collectors and Collection Systems*
FM Global *Red Tag Permit System*
Approval Guide, an online resource of FM Approvals

Note: See Section C.4 for a list of data sheets where special protection systems are recommended.

APPENDIX A GLOSSARY OF TERMS

Approval Guide: An online resource of FM Approvals that provides a guide to equipment, materials, and services that have been FM Approved for property conservation.

AFFF: aqueous film forming foam.

APPENDIX B DOCUMENT REVISION HISTORY

April 2012. Terminology related to ignitable liquids has been revised to provide increased clarity and consistency with regard to FM Global's loss prevention recommendations for ignitable liquid hazards.

May 2010. Replaced all references to Data Sheet 2-8N, *Installation of Sprinkler Systems (NFPA)*, with references to Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*. References to other data sheets were updated.

September 2002. Minor editorial changes were made for this edition.

January 2000. This revision of the document has been reorganized to provide a consistent format.

APPENDIX C SUPPLEMENTARY INFORMATION

C.1 General

Special protection systems are used to extinguish or control fire in easily ignitable, fast-burning substances such as ignitable liquids, some gases and chemicals. They are also used to protect ordinary combustibles in certain high-value occupancies especially susceptible to damage and in certain high-piled storage occupancies. Their quick action can keep production downtime at a minimum.

Typically, special protection systems are recommended where the potential property damage and business interruption from fire for a particular process or occupancy is considered unacceptably high. This protection rationale applies whether automatic sprinklers are provided as backup protection or not. Occasionally, a special protection system may be acceptable as sole protection without backup sprinkler protection to achieve an acceptable loss potential.

Typical applications include the protection of dip tanks, drainboards, flow coaters, engine test rooms, foil mills, electronic computer installations, storage tanks of ignitable liquid or liquefied gas, fur vaults, oil-filled transformers, rotating electrical equipment, aircraft hangars, rubber tire storage, and chemical processing equipment. A list of data sheets where special protection systems are recommended is given in Section C.4.

Special protection systems generally supplement automatic sprinklers and are not a substitute for them unless an exception is made within the appropriate occupancy data sheet. Sprinklers can function much longer than most special protection systems and can be restored more quickly to service. Their effectiveness is much less affected by physical changes in a hazard. Most important, the reliability of conventional sprinkler systems is unequaled. Special protection systems are more complex than conventional sprinkler systems and consequently subject to more electrical and mechanical failure modes as well as possible accidental discharges. Reflash or reignition potential is also a concern, especially for transitory extinguishing agents such as carbon dioxide, dry chemical and halons.

In spite of the above concerns, a special protection system is expected to perform reliably provided the following conditions are met:

1. System is specifically recommended or recognized as suitable for the protected hazard or occupancy.
2. System is designed and installed in accordance with accepted plans.
3. System acceptance tests are satisfactorily performed.
4. System impairment procedures are established and followed.

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5. System and the protected hazard or occupancy is maintained in accordance with the guidelines in this data sheet, the specific data sheet as applicable, and any additional guidelines provided within the appropriate occupancy data sheet.

The last condition is intended to recognize that conditions within or around the protected hazard or occupancy also strongly influence the reliability of the special protection system. Such special protection systems may, under certain conditions, suffice as sole protection. As previously noted, such exceptions and conditions should normally be covered within the appropriate occupancy data sheet.

C.2 Types of Systems

Special protection systems include 1) carbon dioxide systems, 2) dry and wet chemical systems, 3) foam including high-expansion foam systems and foam-water systems, 4) halogenated hydrocarbon (halon) systems, 5) clean agent (halon alternative) systems, 6) water-spray systems, and 7) steam extinguishing systems.

Foam-water sprinkler systems, including closed-head AFFF (aqueous film forming foam) sprinkler systems, although technically sprinkler systems, may also be considered special protection systems since they are primarily used for special hazards protection, particularly ignitable liquid hazards. Foam-water sprinkler systems also have a limited amount of foam concentrate which is characteristic of special protection systems (i.e., limited amount of agent).

Wet chemical systems use a potassium carbonate or potassium acetate solution and are specifically FM Approved for kitchen protection.

Steam extinguishing systems have limited application as special protection systems. They are primarily used for the protection of normally heated and insulated equipment in plants having large quantities of steam continually available. Examples include protection of direct contact evaporators and associated equipment for black liquor recovery boilers at pulp and paper mills, and also airborne pulp dryers at modern kraft pulp mills.

Special protection systems are further classified by their arrangement and method of application. In fixed systems, the extinguishing agent is piped to nozzles or discharge devices within or about the hazard.

In hose-line systems, the extinguishing agent is supplied through hose or piping and hose to portable nozzles or discharge devices.

Standpipe systems with a mobile supply consist of fixed nozzles or discharge devices, or hose lines to which a portable extinguishing-agent supply can be connected. These systems are not considered equivalent to fixed systems because of the inherent delay in transporting, coupling and actuation.

C.3 Selection of Systems

Each type of system has its advantages and limitations. Two main factors govern the selection of a particular type:

1. The ability to provide the desired protection, whether for extinguishment or control. In most situations this is the major consideration.

2. The damage likely to be caused by the extinguishing agent, including the problems of cleanup, salvage and interruption of production. This is an important consideration in high-value damage-susceptible occupancies, such as fur storage and certain electrical or electronic equipment.

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C.4 Recommended Applications

FM Global data sheets that recommend special protection systems include the following:

Data Sheet	*Subject*	*Protection*
1-6	Cooling Towers	Water Spray
1-53	Anechoic Chambers	Halon
1-56	Cleanrooms	Halon
5-3/13-2	Hydroelectric Power Plants	Halon/Carbon Dioxide
5-4	Transformers	Halon/Carbon Dioxide/Water Spray
5-14	Telecommunications	Halon
5-15/13-14	Electric Generating Stations	Halon/Carbon Dioxide/Water Spray
5-16	Arc Furnace Transformer Installations	Carbon Dioxide
5-17	Motors and Adjustable Speed Drives	Carbon Dioxide
5-24	Miscellaneous Electrical Equipment	Halon/Carbon Dioxide/Water Spray
5-31	Cables and Bus Bars	Halon/Carbon Dioxide/Hi-Ex Foam
5-32	Electronic Data Processing Systems	Halon/Carbon Dioxide
6-8	Combustion Air Heaters	Water Spray
6-21	Chemical Recovery Boilers	Water Spray/Steam
6-24	Coal Pulverizers and Pulverizing Systems	Carbon Dioxide
7-1	Fire Protection for Textile Mills	Halon/Carbon Dioxide/Dry Chemical
7-2	Waste Solvent Recovery	Water Spray
7-3	Flight Simulator System Protection	Halon
7-4	Paper Machines and Pulp Dryers	Steam
7-7/17-12	Semiconductor Fabrication Facilities	Halon
7-9	Dip Tanks, Flow Coaters and Roll Coaters	Carbon Dioxide/Water Spray
7-10	Wood Processing and Woodworking Facilities	Water Spray/Steam
7-11	Conveyors	Water Spray
7-14	Fire and Explosion Protection for Ignitable Liquid, Flammable Gas, and Liquefied Flammable Gas Processing Equipment and Supporting Structures	Water Spray/Foam
7-18	Asphalt Saturators	Water Spray/Dry Chemical
7-26	Glass Plants	Water Spray
7-27	Spray Application of Flammable and Combustible Materials	Halon/Carbon Dioxide/Dry Chemical
7-29	Ignitable Liquid Storage in Portable Containers	Halon/Carbon Dioxide/Dry Chemical/Hi-Ex Foam
7-32	Ignitable Liquid Operations	Water Spray/Carbon Dioxide/Dry Chemical
7-37	Cutting Oils	Carbon Dioxide
7-40	Heavy Duty Mobile Equipment	Dry Chemical
7-41	Heat Treating of Material Using Oil Quenching and Molten Salt Baths	Carbon Dioxide/Water Spray
7-45	Instrumentation and Control in Safety Applications	Halon/Carbon Dioxide
7-48	Disposal of Waste Materials	Water Spray
7-55	Liquefied Petroleum Gas (LPG) in Stationary Installations	Water Spray
7-73	Dust Collectors and Collection Systems	Carbon Dioxide/Water Spray/Steam
7-74	Distilleries	Water Spray
7-77	Testing Internal Combustion Engines and Accessories	Halon/Carbon Dioxide/Water Spray
7-79	Fire Protection for Gas Turbine Installations	Halon/Carbon Dioxide/Water Spray
7-87	Protection of Aircraft	Halon
7-88	Storage Tanks for Ignitable Liquids	Foam
7-93	Aircraft Hangars, Aircraft Manufacturing and Assembly Facilities, and Protection of Aircraft Interiors During Assembly	Foam/Hi-Ex Foam
7-95	Compressors	Water Spray

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Data Sheet	*Subject*	*Protection*
7-96	Printing Plants	Carbon Dioxide
7-99	Heat Transfer by Organic and Synthetic Fluids	Steam
7-101	Fire Protection for Steam Turbines and Electric Generators	Water Spray/Carbon Dioxide
8-3	Rubber Tire Storage	Hi-Ex Foam
8-33	Carousel Storage and Retrieval Systems	Halon

Note: As many of these data sheets are revised, halon systems will no longer be recommended because of the ozone layer concern.

Note: The NFPA has no general standard for special protection systems. Recommendations are covered in each specific special protection system standard. Where these standards have been adapted for FM Global use, any conflicts with the above have been indicated in each specific standard.

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