

Approval Standard

Dry Chemical Extinguishing Systems

Class Number 5320
December 2013

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Member of the FM Global Group

Approval Standard for Dry Chemical Extinguishing Systems

Class Number 5320

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1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard describes requirements for fixed fire extinguishing systems which use dry chemical as the primary means of extinguishment.
- 1.1.2 FM Approvals criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing and filling facilities, audit of quality assurance procedures, and a surveillance audit program.

1.2 Scope

- 1.2.1 Pre-engineered dry chemical fire extinguishing systems are classified into one of two general categories according to protection type: total flooding or local application. Total flooding systems are designed to uniformly discharge dry chemical throughout the entire protected volume, and are intended to be used for the protection of Class A hazards, Class B hazards, or both. Local application systems are designed to discharge dry chemical directly onto a specific area of protection, and are intended to be used for the protection of Class B hazards only. Either type shall be designed for automatic and manual control to protect single or multiple hazard areas.
- 1.2.2 A basic dry chemical extinguishing system typically comprises one or more agent storage containers, discharge valves arranged for automatic or manual/automatic control, lock-out valves (when required), piping, and discharge nozzles. Alternate design features may also be acceptable, provided they exhibit equivalent durability and effectiveness that can be determined employing the subject standard, at the discretion of FM Approvals. Compatible FM Approved detectors and detection and release controls are required for automatic electrical operation of these systems, but are not included in the scope of this standard. If a system uses an integral detection and actuation system, it may be evaluated as a part of that system, using criteria derived from those used for standalone detection and control systems.
- 1.2.3 This standard requires the examination of complete systems. Complete systems shall be submitted along with design, installation, operation, and maintenance instructions for Approval. However, the manufacturer may, at any time, submit additional components or auxiliary equipment for use on the Approved system. Purchased devices such as thermostats, releases, and timers must also be submitted by the system manufacturer for evaluation as a part of the system, even though such devices may already be FM Approved and listed by FM Approvals. At minimum, a system shall consist of those components and auxiliary equipment considered necessary by FM Approvals for the system to operate properly when connected to an Approved detection and control system. Incomplete systems shall not be FM Approved.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions, and/or loss control specialists has also been considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of dry chemical fire extinguishing systems (hereinafter referred to as “systems”) for the purpose of obtaining FM Approval. Systems having characteristics not anticipated by this standard may be FM Approved if performance equal or superior to that required by this standard is demonstrated, or if the intent of the standard is met.

Alternatively, systems which meet all of the requirements identified in this standard may not be FM Approved if other conditions which adversely affect performance exist, or if the intent of this standard is not met.

1.4 Basis for FM Approval

FM Approval is based on satisfactory evaluation of the product and the manufacturer in the following areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:
- The suitability of the product
 - The performance of the product as specified by the manufacturer and required by FM Approvals
 - The durability and reliability of the product
- 1.4.2 Surveillance audits of the manufacturing and filling facilities and quality control procedures shall be made to evaluate the manufacturer's ability to produce the product which was examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of FM Approvals' surveillance audit program.

1.5 Basis for Continued Approval

Continued Approval is based on:

- Production or availability of the product as currently FM Approved
- Continued use of acceptable quality assurance procedures
- Satisfactory field experience
- Compliance with the terms stipulated in the Approval Agreement
- Satisfactory re-examination of production samples for continued conformity to requirements.
- Satisfactory audits conducted as part of FM Approvals' Surveillance Audit program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after that date shall satisfy the requirements of the standard. Products FM Approved under a previous edition shall comply with the new version by the effective date or forfeit Approval.

The effective date of this standard is **One Year from date of Issue** for full compliance with all requirements.

1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement; the converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-2002, *American National Standard for Use of the International System of Units (SI): The Modern Metric System*. Two units of measurement (liter and bar), outside of but recognized by SI, are commonly used in international fire protection and are used in this standard.

1.8 Applicable Documents

The following standards, test methods, and practices are referenced in this standard:

American Society of Mechanical Engineers (ASME)

American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990

BPVC-CC-N – 2004, Boiler and Pressure Vessel Code 04

American Society for Testing and Materials (ASTM)

American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

ASTM B 117 - 05, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

ASTM D 412 - 98a(2002)e1, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers*

ASTM E – 1 - 05, *Standard Specification for ASTM Thermometers*

ASTM E1354-04a, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*

ASTM G 36 – 94(2000), *Standard Practice for Evaluating Stress-Corrosion-Cracking Resistance of Metals and Alloys in a Boiling Magnesium Chloride Solution*

ASTM G 155 – 05a, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*

Compressed Gas Association (CGA)

Compressed Gas Association, 4221 Walney Road, Fifth Floor, Chantilly, VA 20151-2923

CGA G10.1, *Commodity Specification for Nitrogen*,

CGA S-1.1, *Pressure Relief Standards Part 1 - Cylinders for Compressed Gases*,

FM Approvals

1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood MA 02062

<http://www.fmglobal.com/approvals/resources/standards.asp>

FM Approvals requirements for Class Number 3010, *Fire Alarm Control Equipment*

FM Approvals Standard Class Number 3600, *Electric Equipment for Use in Hazardous (Classified) Locations General Requirements*.

FM Approvals Standard Class Number 3610, *Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, and Class I, Zone 0 and 1 Hazardous (Classified) Locations*.

FM Approvals Standard Class Number 3611, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2, Hazardous (Classified) Locations*.

FM Approvals Approval Standard Class Number 3615, *Explosionproof Electrical Equipment General Requirements*.

FM Approvals Approval Standard Class Number 3620, *Purged and Pressurized Electrical Equipment for Hazardous (Classified) Locations*.

FM Approvals Approval Standard Class Number 3810, *Electrical and Electronic test, Measuring, and Process Control Equipment*.

FM Approvals *Quality Assurance Guidelines for Manufacturers of FM Approved and Specification Tested Products*.

FM Global

FM Global, 75 Remittance Drive, Suite 6182, Chicago, IL 60675-6182

<http://www.fmglobal.com/fmglobalregistration>

FM Global Property Loss Prevention Data Sheet 4-0, *Special Protection Systems*.

FM Global Property Loss Prevention Data Sheet 4-10, *Dry Chemical Systems*.

Institute of Electrical and Electronics Engineers (IEEE)

IEEE Standards Activities, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331

IEEE/ASTM SI 10-2002, *American National Standard for Use of the International System of Units (SI): The Modern Metric System*.

International Organization for Standardization (ISO)

International Organization for Standardization, 1 rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland

ISO 7202: 2012, *Fire Extinguishing Media – Powder*

NFPA Publications

National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101

NFPA 17, *Standard on Dry Chemical Extinguishing Systems*

NFPA 72 - *National Fire Alarm Code*

U.S. Department of Transportation (DOT)

Bureau of Explosives, 55500 DOT Road, Pueblo, CO 81001

Title 49, Code of Federal Regulations (CFR), *Hazardous Materials Regulations of the Department of Transportation*

1.9 Definitions

For the purposes of this standard, the following terms shall apply:

Accepted

Installations acceptable to the authority having jurisdiction and enforcing the applicable installation rules. When the authority is FM Global, such installations are termed “FM Global Accepted.” Acceptance is based on an overall evaluation of the installation by the particular FM Global Operations office. Factors other than the use of FM Approved equipment impact on the decision to “accept” the equipment. Acceptance is not a characteristic of a product; acceptance is installation specific for that one location/occupancy. A product “Accepted” for one installation may not be suitable at another location/occupancy (contrast with the definition of FM Approval).

Actuation Device

A means of initiating the dry chemical fire extinguishing system discharge.

Agent Storage Container

The assembly holding the dry chemical supply for a fire extinguishing system. This includes the pressure vessel and various accessories necessary for management of the supply, such as valves, dip tubes, pressure gauges, and pressure relief devices.

Agent Storage Cylinder

See “Agent Storage Container”

Amplitude

The maximum displacement of sinusoidal motion from position of rest, or one-half the total table displacement, during a vibration test.

Area of Coverage

The maximum area that can be protected by a dry chemical discharge nozzle or automatic extinguisher unit.

Authority Having Jurisdiction

The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

Automatic Control

An operating device, or arrangement of devices, which does not require human intervention. The automatic control includes a control panel that monitors fire detection devices and releases the agent when pre-established conditions have been met.

Automatic Extinguisher Unit

A total flooding dry chemical extinguishing storage container that discharges following the operation of a heat responsive element. Automatic extinguisher units may also include optional mechanical manual controls. A single automatic extinguisher unit shall be used to protect each hazard volume, unless it is possible to configure multiple units such that operation of any one will operate all others simultaneously.

Class A Fires

Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

Class B Fires

Fires in ignitable liquids (also known as flammable liquids), combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

Class C Fire

Fires that involve energized electrical equipment and during which the electric power is maintained, thereby continuously adding electrical energy.

Discharge Nozzle

A device with one or more orifices that is connected to a termination of a pipe network for the purpose of controlling the discharge rate and uniformly distributing the extinguishing agent.

Discharge Time

The time interval between the first appearance of extinguishing agent at the discharge nozzle or unit and the time at which the discharge becomes predominantly gaseous.

Dry Chemical

A powder composed of very small particles, typically sodium bicarbonate-, potassium bicarbonate-, or ammonium phosphate-based with added particulate material. These powders are also generally supplemented to provide resistance to packing and moisture absorption and maintain proper flow capabilities.

Element Operating Temperature

The nominal temperature in degrees Fahrenheit (°F) or Celsius (°C) at which a heat responsive element operates when subjected to the influence of heat.

Expellant Gas

The medium used to facilitate the discharge of the extinguishing agent from the agent storage container.

Flow Rate

The quantity of extinguishing agent passing through a nozzle or other device in a unit time. When a minimum discharge rate is indicated, reference is made to the minimum quantity of agent discharged per unit time, measured within ± 1 second.

FM Approvals Certification Marks

The FM Approvals Certification Marks are detailed in Appendix C, and their use is mandatory on all FM Approved systems. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to a specific product. For dry chemical extinguishing systems, the FM Approvals Certification Marks shall be placed on the system placard and not on individual components, unless those components have undergone a separate evaluation to the applicable standards.

FM Approved

Products certified by FM Approvals to the applicable FM Approval Standard(s). Such products are listed in the Approval Guide, an online resource of FM Approvals. All products listed in the Approval Guide have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. This contract obligates the manufacturer to allow re-examination of the product and surveillance audits at FM Approvals' discretion. It further requires the manufacturer not to deviate from the FM Approved configuration of the product without review by and agreement of FM Approvals. Approval is product specific.

Gas Cartridge

The container used to store the expellant gas in a gas cartridge operated extinguishing system.

Gas Cartridge Operated

A type of dry chemical extinguishing system that utilizes expellant gas stored in a separate container from the dry chemical agent storage container.

Heat Responsive Element

An operating device that does not require human intervention. This device includes an operating element that, when subjected to the influence of heat, ruptures, bursts, or otherwise functions, to cause the release of dry chemical agent.

Local Application System

An extinguishing system with a supply of dry chemical permanently connected to fixed piping with nozzles arranged to discharge directly onto a specific hazard area.

Lock-Out Valve

A supervised, lockable, manually operated valve located in the discharge line between the agent supply and the nozzle(s), which can be used to isolate the agent supply from all or part of the system during maintenance and service.

Maintenance

Any work performed to ensure that the equipment operates as intended.

Manual Control

An operating device, or arrangement of devices that requires action by a human operator. The manual control may be initiated either mechanically or electrically.

Maximum Working Pressure

The pressure in an agent storage container associated with the maximum installation temperature.



Minimum Bending Radius

The smallest radius (expressed in inches [mm]) specified by the manufacturer to which a flexible hose is safely allowed to bend without damage.

Minimum Working Pressure

The pressure in an agent storage container associated with the minimum installation temperature.

Operable Pressure Range

The minimum and maximum pressures of the agent storage container over which the system is intended to be functional. These pressures result from the minimum and maximum storage temperatures and the physical characteristics of the agent and expellant gas.

Operating Device

See “Actuation Device”

Operating Pressure

See “Working Pressure”

Pilot Container

One or more pressurized containers in a dry chemical extinguishing system that are directly actuated by an operating device, and that supply pressure to initiate full system discharge.

Pilot Cylinder

See “Pilot Container”

Pilot Line

Pneumatic piping or tubing used to connect pilot containers with agent containers.

Pipe

Circular conduit used to transport the extinguishing agent from the agent storage container to the discharge nozzles. Wherever *pipe* or *piping* is used in this standard, it is also understood to refer to any tubing, flexible piping, or hose used for the same purpose.

Pre-Engineered System

A fire extinguishing system with predetermined flow rates, nozzle pressures, and quantities of extinguishing agent, using specific piping specifications and number and types of nozzles.

Proof Test Pressure

The factory test pressure used to verify the structural integrity of the agent storage container.

Resonance

The maximum magnification of applied vibration during a vibration test.

Secondary Cylinder

One or more cylinders in a dry chemical fire extinguishing system that are operated by pressure supplied from a pilot cylinder, rather than directly by an operating device.

Specified

The value of a design parameter set by the manufacturer that shall be equal to, or more conservative than, the limiting values of this standard.

Stored Pressure

A type of dry chemical extinguishing system that utilizes expellant gas stored in the dry chemical agent storage container.

Supervised

A type of device, such as a valve, which is equipped with switches, or is otherwise electrically monitored, to allow its state to be displayed or to initiate an alarm via a control panel.

Total Flooding System

An extinguishing system with a supply of dry chemical permanently connected to fixed piping with nozzles designed to uniformly discharge agent throughout the enclosed volume surrounding the hazard.

Working Pressure

The pressure in a fully charged agent storage container or gas cartridge, as applicable, at 70° F (21° C).

2. GENERAL INFORMATION

2.1 Approval Application Requirements

To apply for an Approval examination, the manufacturer, or its authorized representative, should submit a request to:

Fire Protection Group Manager
FM Approvals
Hydraulics Laboratory
743A Reynolds Road
West Glocester, Rhode Island 02814 U.S.A.

2.1.1 The manufacturer shall provide the following preliminary information, as applicable, with any request for Approval consideration:

- A complete list of all models, types, sizes, and options for the products being submitted for Approval consideration
- Assembly drawings, component drawings, materials list, anticipated marking format, nameplate format, brochures, sales literature, specification sheets, and design, installation, operation and maintenance instructions
- The number and location of manufacturing facilities for the product under examination

2.1.2 All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level.

2.1.3 All documents shall be provided with English translation.

2.1.4 The manufacturer may also be asked to complete an Application for FM Approval Services.

2.2 Requirements for Samples for Examination

- 2.2.1 Following authorization of an Approval examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by FM Approvals following review of the preliminary information.
- 2.2.2 Sample requirements may vary depending on design features, results of prior testing, and results of any foregoing tests.
- 2.2.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototype components or systems shall be at the sole discretion of FM Approvals.
- 2.2.4 The manufacturer shall be responsible for providing any necessary test fixtures that may be required to evaluate the system.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

During the initial investigation and prior to physical testing, the manufacturer's specifications, technical datasheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The system and its components shall be suitable for use within the defined limits of the Approval investigation.

3.2 Physical or Structural Construction Features

3.2.1 Operating Range

All system components shall operate within the temperature ranges of Table 3.2.1. System and component evaluations will be based on the specified minimum and maximum operating temperatures. Operating temperatures outside these limits shall be specified at discrete 10°F (5.6°C) increments.

Table 3.2.1 *Required Operation Temperature Range*

<i>Allowable Minimum Operating Temperature</i> <i>°F (°C)</i>	<i>Allowable Maximum Operating Temperature*</i> <i>°F (°C)</i>
32°F (0°C), or lower	120°F (49°C), or higher

3.2.2 Materials

3.2.2.1 All components shall be made of materials suitably corrosion resistant for their intended use.

3.2.2.2 Any seals used in the system shall be compatible with the dry chemical agent and expellant gas. Compatibility shall be determined by successful performance when subjected to the requirements listed in Sections 4.5.2 (Long Term Leakage Test), 4.5.3 (30-Day Maximum Temperature Leakage Test), 4.5.4 (30-Day Minimum Temperature Leakage Test), and 4.16 (Elastomeric Materials Tests).

3.2.3 Controls

3.2.3.1 For normal operation, a system shall be either automatically controlled or operable from a manual control, easily accessible to the hazard, or both. If the normal manual means of actuation incorporates electric power, the source of that power shall be completely independent of any electric power source used for automatic operation. A power source used for both normal manual and automatic operation shall be provided with an independent backup, such as a battery.

3.2.3.3 Control panels shall comply with NFPA 72 and FM Approvals' Approval Standards Class Number 3010 and 3810. Control panels are not required to be submitted as a part of a system. However, system design shall be such that the system is operable by a minimum of one FM Approved detection and release panel that is compatible for use with the dry chemical extinguishing system.

3.2.4 Pressure Vessels

3.2.4.1 Storage containers shall conform to the appropriate regulations for the installation location. In the U.S.A., DOT Title 49, CFR, Parts 171 through 180 are applicable for dry chemical storage and expellant gas containers that are shipped under pressure.

3.2.4.2 The following documents shall be submitted for each storage container design, to demonstrate compliance with the relevant design standard:

- Calculation of wall thicknesses per the method specified in the applicable standard, with appropriate supporting references as necessary
- Certificate of chemical analysis of materials
- Certificate of physical properties of materials

3.2.4.3 The pressurization level shall be specified by the manufacturer.

3.2.5 Valves

3.2.5.1 Discharge valves shall incorporate varying sizes or connection designs for all ports to minimize the likelihood of improper connection during installation. Other types of valves not designed for mounting directly on an agent storage container may use inlet and outlet connections of the same size and design, but shall be marked to indicate correct direction of flow.

- 3.2.5.2 For pressure operated valves, the manufacturer shall provide data for the minimum available force or torque for each actuator and the maximum required operating force or torque for the corresponding valve. Proper operation of the most adverse combinations shall be verified by test.

3.2.6 Gauges and Indicators

A pressure gauge shall be included with all extinguishing systems to indicate the pressure in the agent storage container and/or pilot container, and shall comply with the following requirements:

- The face of the gauge shall indicate the appropriate units of pressure
- The range of the gauge shall be based on the system's operable pressure range
- The minimum indicated gauge pressure shall be marked on the left side of the gauge's range
- A 70°F (21°C) value shall be marked at the system's working pressure
- The maximum gauge pressure shall be between 150 and 250 percent of the system working pressure at 70°F (21°C), and shall be marked on the right side of the gauge's range
- The gauge shall be provided with a means of pressure relief to allow venting in the event of an internal leak
- The face of the gauge shall identify the agent with which it is intended to be used

For gas cartridge operated systems where the gas cartridge can be removed and weighed to determine the amount of expellant gas, a pressure gauge is not required.

3.2.7 Siphon Tubes

- 3.2.7.1 Systems containing a siphon tube to discharge the dry chemical agent from the storage container shall be configured so that the discharge end of the siphon tube is mechanically locked and sealed to remain in place during all conditions of use.
- 3.2.7.2 Siphon tubes shall be designed to prevent gas discharge until the dry chemical level drops below the opening on the free end of the siphon tube.
- 3.2.7.3 The free end of the siphon tube shall be configured to prevent restriction of flow by contact with the cylinder wall. The minimum clearance between the end of the siphon tube and the cylinder wall shall be at least 0.25 times the tube's inside diameter. Compliance with this requirement shall be demonstrated by drawings showing the calculated assembly clearance, based on worst case dimensional tolerance stack-ups. Alternatively, the manufacturer's assembly process may contain controlled procedures for verifying the minimum required clearance.

3.2.8 Pressure Relief Devices

Calculations shall be submitted to verify that pressure relief devices used on agent storage containers are designed to comply with the flow capacity and operating pressure requirements specified in CGA S-1.1, or equivalent regulations acceptable to the authority having jurisdiction. The construction and size of the pressure

relief device shall, at a minimum, be appropriate for the system pressure at the maximum specified operating temperature.

3.2.9 Anti-Recoil Devices

The discharge valve outlet of an agent storage container shall be provided with an anti-recoil device for the purpose of shipping, handling, and storage. The device shall be an integral part of or attached to the container via a chain, or otherwise designed to minimize the likelihood of removal from the container.

3.2.10 Pilot Line Connections

When a pilot line must be disconnected from a container during maintenance operations, a plug or cap shall be provided to seal the disconnected end of the line. Appropriate warnings shall be displayed on these devices to caution the user with regard to the high pressure discharge hazard and the proper procedure for mitigating this hazard.

3.2.11 Agent Distribution Connectors and Piping

3.2.11.1 Agent distribution connectors of proprietary designs used in place of standard pipe and fittings shall have minimum internal diameters greater than or equal to that of the corresponding pipe sizes.

3.2.11.2 Flexible hose used for distribution of dry chemical agent shall be of one of the following types:

- Corrosion-resistant metallic hose
- Polymeric hose with metallic reinforcement
- Polytetrafluoroethylene hose with metallic or non-metallic reinforcement

Polymeric flexible hose assemblies that are 5 ft (1.52 m) or less in length do not require metallic reinforcement if they are used only for connecting the discharge valve to the agent distribution piping.

3.2.12 Cylinder Supports

Equipment which supports multiple cylinder installations shall be designed to facilitate the removal of individual cylinders for inspection and servicing.

3.2.13 Protective Covering

All valves and control devices with exterior movable parts that are vulnerable to obstruction or physical damage shall be protected by paneled enclosures or cages. Operating, levers, handles, or buttons requiring manual access for operation shall be exempt from this requirement to the extent necessary to allow for their unimpeded operation. Conduit shall be used for electrical cables and wires, or pressurized tubes outside the enclosures. Tubing used for heat detection may be exposed in the areas being monitored, but shall be enclosed where not performing this function and vulnerable to mechanical damage. Mechanical cables shall be sheathed or otherwise protected to minimize the likelihood of damage or mechanical interference with operation.