



Examination Standard for Explosion Suppression Systems

Class Number 5700

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for explosion suppression systems. An explosion suppression system is designed to detect an incipient deflagration and suppress it in order to prevent the full impact of the deflagration from developing. Typically these systems consist of four basic components: the detector(s), a control unit, suppressant storage container(s), and suppressant dispersers.
- 1.1.2 An explosion is detected in the incipient stage, either by a rise in pressure or the presence of flame within the protected enclosure. The control unit then actuates the suppressant dispersers to envelop and arrest the explosion.
- 1.1.3 Certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 This standard applies to the design, construction, operation, maintenance, and testing of a system for the suppression of a deflagration by introductions of a suppression medium.
- 1.2.2 This standard does not apply to devices or systems designed to protect against over-pressure due to phenomena other than internal explosions.
- 1.2.3 This standard only applies to systems designed to limit the pressure developed in the protected enclosure to a level that does not exceed the design strength of the enclosure.
- 1.2.4 This standard does not apply to systems for explosion isolation or suppression of detonations.

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 was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of explosion suppression systems for the purpose of obtaining certification. Systems having characteristics not anticipated by this standard may be certified if performance equal or superior to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification is contingent upon satisfactory results of analysis of the product (compliance with this standard) and the manufacture of the product in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:
 - the suitability of the product,
 - the proper operation and performance of the product as specified by the manufacturer and required by the certification agency and, as far as practical,
 - the durability and reliability of the product.

- 1.4.2** An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product, which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

Continued certification is based upon:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agencies product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this Standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Where units of measurement are expressed in U.S. customary units, they are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. Conversions are in accordance with ANSI/IEEE/ASTM SI-10. Where units of measurement are expressed in SI units, no US customary units are provided.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/IEEE/ASTM SI-10, *American National Standard for Metric Practice*

ANSI/IEC 60529 *Degrees of Protection provided by Enclosures (IP Code)*

ASME BPVC, *Boiler and Pressure Vessel Code*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers*

ASTM E1226-19, *Standard Test Method for Explosibility of Dust Clouds*

ASTM G36 – 94, *Standard Practice for Evaluating Stress-Corrosion-Cracking Resistance of Metals and Alloys in a Boiling Magnesium Chloride Solution*

ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic*

Materials

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

FM 3010, *Approval Standard for Fire Alarm Signaling Systems*

NEMA 250, *Enclosures for Electrical Equipment*

NFPA 68, *Guide for Venting of Deflagrations*

NFPA 69, *Standard on Explosion Prevention Systems*

NFPA 72, *The National Fire Alarm and Signaling Code*

NFPA 70, *The National Electrical Code*

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

1.9 Definitions

For purposes of this standard, the following terms apply:

Acknowledge — To confirm that a message or signal has been received, such as by the pressing of a button on the control unit or the selection of a software command.

Actuation Device — a means of initiating the explosion suppression system discharge that is installed on the suppressant storage releasing device or actuation cartridge and is capable of operation by electrical means.

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

Authority Having Jurisdiction — The organization, office, or individual responsible for certifying equipment, materials, an installation, or a procedure.

Combustion — a chemical process of oxidation that occurs at a rate fast enough to produce heat and usually light, either as glow or flames.

Combustible Dust — a fine combustible particulate solid that presents a fire or explosion hazard when suspended in air.

Corrosion Resistant — a material that can withstand damage caused by oxidation or other chemical reactions.

Deflagration — Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium.

Design Strength of Enclosure — The design pressure sufficient to withstand p_{red} . See NFPA 69 for further information.

Detonation — Propagation of a combustion zone at a velocity that is greater than the speed of sound in the unreacted medium.

Deflagration Parameters — Deflagration parameters are numerical terms, determined in accordance with the test methods specified in this standard that characterize the contained deflagration of a specified concentration of reactants in a vessel having a volume of 1 m³.

- Maximum Pressure, P_{max} (bar(g))

The parameter $P_{\max}$ is the maximum pressure developed by a deflagration as determined by tests over a wide range of concentrations and under unvented conditions.

- Reduced Explosion Pressure, P_{red} (bar(g))

The peak pressure reached in an explosion test vessel during a suppressed explosion test.

- Deflagration Index, K (bar-m/s)

The deflagration index K is a constant of direct proportionality which defines the maximum rate of pressure rise with time $(dp/dt)_{\max}$ of a deflagration in a volume V , according to the equation:

$$K = \left(\frac{dp}{dt} \right)_{\max} \times \sqrt[3]{V}$$

K_g is used for gases, K_{st} for dusts.

Deflagration indices measured in large-scale explosion test are identified as effective deflagration indices K_{eff} , since the conditions of large-scale tests differ from those present in standard test equipment commonly used for dust explosibility testing.

Note: While used widely for engineering purposes, there are limits to the significance of the parameter K as a measure of mixture reactivity.

In general, K cannot always be considered a finite property of the explosive mixture as its value depends on the volume and geometry of the test vessel, and on the presence or absence of turbulence.

- Fundamental Burning Velocity, S_u (cm/sec)

The burning velocity of a laminar flame under stated conditions of composition, temperature, and pressure of the unburned mixture.

- Effective Burning Velocity, S_{eff} (cm/sec)

The burning velocity of a reactive mixture that may be affected by turbulence, obstacles, or other factors. These factors produce a faster rate of flame propagation into the unburned mixture than that associated with a laminar flame for the same mixture. The effective burning velocity can be determined from the initial portion of the pressure trace in a full-volume, unsuppressed, unvented explosion.

Expellant Gas — The medium used to facilitate the discharge of the suppressant from the suppressant storage container.

Explosion — The bursting or rupture of an enclosure or a container due to the development of internal pressure from a deflagration.

Fire Alarm Signal — A signal following a detected explosion event requiring that a general alarm signal be sent to the local protective signaling system at the protected property, if so equipped.

Half Power Field of View — The half power field of view (HPFV) is defined as the off-axis angle where a radiant energy detector responds to a flame source at no less than ½ the distance it is capable of detecting on-axis.

Initiating Device — A system component that originates transmission of a change-of-state condition, such as in an explosion detector.

Maximum Working Pressure — The pressure in a suppressant storage container associated with the maximum operating 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 a suppressant storage container associated with the minimum operating temperature.

Operable Pressure Range — The minimum and maximum pressures of the suppressant storage container over which the system is intended to be functional. These pressures result from the minimum and maximum operating temperature range and the physical characteristics of the suppressant and expellant gas.

Proof Test Pressure — The factory test pressure used to verify the structural integrity of the suppressant storage container.

Resonance — The maximum magnification of applied vibration during a vibration test.

Supervisory Signal — A signal that results from the detection of a supervisory condition that impairs the proper operation of the explosion suppression System, such as a reduction in suppressant pressure.

Suppressant — The suppression agent used by the explosion suppression system to suppress the deflagration.

Suppressant Container — The assembly holding the suppressant supply for the explosion protection system. This includes the pressure vessel and various accessories necessary to discharge the suppressant, such as valves, pressure gauges, and pressure relief devices.

Suppressant Container Capacity — Nomenclature specified by the manufacturer of either the volume of suppressant or volume of the suppressant storage container.

Suppressor Configuration — A unique combination of suppressant container capacity, suppressant container working pressure, suppressant releasing device, suppressant type, suppressant disperser, etc.

Trouble Signal — A signal that results from the detection of a trouble condition within the explosion suppression System or its supervised components, such as faulty wiring or other equipment problems.

Working Pressure — The pressure in a fully charged suppressant storage container or gas cartridge, as applicable, at 70°F (21°C) or other temperature appropriate for the local jurisdiction.

2 GENERAL INFORMATION

2.1 Application

2.1.1 The technique of explosion suppression may be considered for any enclosure in which flammable gases, vapors, mists, or combustible dusts are subject to deflagration in a gas phase oxidant.

2.1.2 Typical equipment that may be protected by an explosion suppression system includes:

- processing equipment, such as mixers, blenders, pulverizers, mills, driers, ovens, filters, screens, and dust collectors;
- storage equipment, such as atmospheric or low pressure tanks and bins;
- material handling equipment, such as pneumatic and screw conveyors, and bucket elevators; and
- laboratory and pilot plant equipment, including hoods, glove boxes, test cells, and other equipment.

2.2 Certification Categories

2.2.1 Systems can be certified for suppression of flammable dust, gas, and vapor explosions.

2.2.2 Dusts are categorized in hazard classes from ST 0 to ST 3, based on K_{st} values in bar-m/sec:

ST 0 = K_{st} 0

ST 1 = K_{st} 1 to 200

ST 2 = K_{st} 201 to 300

ST 3 = K_{st} > 300

Certification listings will indicate the hazard class, by specific test(s), and system limitations for which an explosion suppression system has been certified.

Note: A typical representative dust for Class ST 1 would be cornstarch.

2.2.3 In general, certification of explosion suppression systems for gas and vapor explosion hazards shall be granted for either quiescent or turbulent mixture conditions; certification granted for turbulent conditions shall be deemed to also apply for quiescent conditions. The required turbulence shall be such that the measured effective burning velocity under turbulent conditions be at least four (4) times the value of the burning velocity of the same mixture under quiescent conditions. The actual multiplying value, determined by tests, shall be stated in the certification agent's listing. Certification shall apply only to the tested mixture and may be expanded to include other materials/mixtures if a review of data indicates that the following conditions are met:

1. The fundamental burning velocity of the material(s)/mixture(s) is less than or equal to the material/mixture tested; and
2. The material(s) are in the same chemical family such as alcohols, aliphatic hydrocarbons, aldehydes, ketones, etc., or it has been demonstrated that the material(s)/mixture(s) can be suppressed with equal or greater efficiency compared to the material/mixture tested, using a given suppressant.

2.3 Limitations

- 2.3.1 Performance of a suppression system can be adversely affected by obstructions within the protected enclosure.
- 2.3.2 The effectiveness of an explosion suppression system is limited by the physical and chemical properties of the reactants in the system.
- 2.3.3 Explosion suppression is applicable only to systems involving deflagrations that take place in a gaseous oxidant.
- 2.3.4 This standard does not apply to explosion suppression involving deflagrations in hybrid (dust/vapor) systems due to the variability in constituents and/or constituent concentrations.

2.4 Certification Application Requirements

To apply for a certification examination the manufacturer, or its authorized representative, should submit a request to the certification agency.

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration.
- Assembly drawings, component drawings, materials list, anticipated marking format, nameplate format, brochures, sales literature, specification sheets, and installation, operation and maintenance instructions.
- The number and location of manufacturing facilities.
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.5 Requirements for Samples for Examination

- 2.5.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by the certification agency following review of the preliminary information provided.
- 2.5.2 Requirements for samples may vary depending on design features, results of prior testing, and results of any foregoing tests.
- 2.5.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.
- 2.5.4 It is the manufacturer's responsibility to provide 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 certification investigation.

3.2 Operational, Physical, or Structural Features

3.2.1 Control Units (Panels)

- 3.2.1.1 Controls shall be powered by commonly available AC line voltage and shall be equipped with a battery backup system of sufficient capacity to power all detectors, suppressant actuation devices, and alarms for a period of 4 hours. The control shall have a means of maintaining the backup battery at full charge (typically a “trickle charger”) during normal operation.
- 3.2.1.2 They shall be equipped with audible and visual alarms and a means for automatic shutdown of a process, blower, conveyor, etc.
- 3.2.1.3 Controls shall be provided with some means of detecting faults in the actuation and detection circuits.
- 3.2.1.4 Fault detection or discharge of the explosion suppression system shall result in the activation of audible and visual alarms and activation of the shutdown circuit.
- 3.2.1.5 The control panel shall be equipped with a switch to activate or deactivate the suppression system. Switch operation shall require a key or other suitable means of preventing unauthorized operation. Deactivation of the suppression system shall activate the shutdown circuit and a visual alarm.
- 3.2.1.6 The control must be capable of operating properly between 85 and 110 percent of its nominal input power voltage.
- 3.2.1.7 Activation of the system control circuitry shall result in power-up of detectors and actuators, to ensure that the system is armed and providing active protection.
- 3.2.1.8 The control unit shall be capable of operating over a temperature range shown in Table 3.1 Required Operation Temperature Range.
- 3.2.1.9 The controls shall be enclosed by an appropriately rated housing capable of protecting components from normally expected adverse environmental conditions such as corrosive atmospheres, dust, and rain, see Section 4.17.1 (Electronics Enclosures).
- 3.2.1.10 Means shall be provided to mount control panel equipment securely and independently of the wiring.
- 3.2.1.11 The control panel equipment shall be capable of withstanding normal handling and installation.
- 3.2.1.12 Equipment intended for use in hazardous (classified) locations shall comply with the certification agency's requirements for hazardous (classified) location electrical equipment in addition to this standard.

- 3.2.1.13 The control panel equipment and enclosure shall be suitable for the intended environmental exposures as determined by testing in accordance with acceptable national, regional, or international codes and standards.
- 3.2.1.14 The control panel equipment shall accommodate secure wiring methods in accordance with NFPA 70, National Electrical Code and NFPA 72, National Fire Alarm Code, or the governing codes and standards/authority for the installed jurisdiction.
- 3.2.1.15 Although not mandatory, the control panel may be connected to a certified fire alarm control unit. In such cases, the requirement of 3.2.1.16 shall apply, and the system output circuits shall be compatible with a certified fire alarm control unit that will produce distinctive alarm, supervisory and trouble fire alarm signals.
- 3.2.1.16 When the explosion suppression control unit is interfaced with a Fire Alarm Signaling System, the combination shall have response times in accordance with NFPA 72 The National Fire Alarm Code and within those defined in the manufacturer's specifications and installation and operational manual. The maximum response values as found in NFPA 72 are as follows:
- Alarm - 10 seconds (10.11.1) (applies when connected to a local alarm system)
 - Supervisory – 90 seconds (10.13.1)
 - Trouble – 200 seconds (10.14.1)
- Note:** Typical detection occurs in milliseconds When the explosion suppression control unit is interfaced with a Fire Alarm Signaling System, the Alarm Response cannot exceed 10 seconds.
- 3.2.1.17 Equipment rated at or above 30 V ac and 60 V dc requires a proper (protective) ground terminal to be provided.
- 3.2.1.18 For products intended for use in unsecured (public) areas, the controls for signal acknowledgement, reset, optional program initiation, manual override of any control sequence, or altering of system parameters, shall be of restricted access requiring software security code or other equivalent protection. For installations in secured, non-public areas (for example, within a manufacturing plant), this requirement shall not apply.
- Note:** If the manual controls are accessed via the opening of the key-locked enclosure, the equipment shall be arranged so that access does not result in the exposure of live electrical parts. A permanent warning / caution label with legible wording to avoid high voltage live parts can satisfy this requirement.
- 3.2.1.19 At a minimum, all control equipment and their displays shall use the following basic indicators:
- GREEN (Normal) - This green indicator shall illuminate when all power is applied to the system and no off-normal situations exist.
 - RED (Explosion Alarm) - This red indicator shall illuminate when an explosion has been detected, flashing or steady state until the condition is resolved and cleared.
 - YELLOW (Supervisory Alarm) - This yellow indicator shall illuminate when any supervisory condition exists, flashing or steady state until the condition is resolved and cleared.

- YELLOW (Trouble Alarm) - This yellow indicator shall illuminate when any trouble condition exists, flashing or steady state until the condition is resolved and cleared.

If an acknowledge feature is provided, the above indications shall be flashing until acknowledged, and steady state following acknowledgement.

3.2.2 Detectors

3.2.2.1 Explosion suppression systems shall be supplied with a minimum of two detectors. If a single detector has redundant means of detection, only one detector shall be required. The detectors shall be “cross-zoned” (i.e. both detectors must be activated) to minimize false actuation of the suppression system.

3.2.2.2 An incipient explosion shall be detected by pressure or radiant energy sensors. Pressure sensors may respond to a rate of pressure rise or at a preset pressure level. Radiant energy may be detected by infrared (IR), ultraviolet (UV), UV/IR combination or optical flame sensors.

3.2.2.3 Pressure detectors shall be capable of withstanding 150 percent of their rated operating pressure without permanent deformation or change in their system actuation settings.

3.2.2.4 Radiant energy sensors shall be equipped with a means of detecting sensitivity changes due to viewing lens obscuration, or a method of preventing obscuration. Detection of obscuration shall result in a visual and audible alarm.

3.2.2.5 Radiant energy sensors shall be of the rapid response type. Delayed reaction is allowable only for applications where there is a possibility for false discharge. The delay shall not be field adjustable, unless performed by a manufacturer’s service technician with approval from the AHJ.

3.2.2.6 The detectors shall be capable of operating over a temperature range shown in Table 3.1 Required Operation Temperature Range.

3.2.2.7 Detectors and mounting hardware shall be capable of operating in, or be protected from, the normally expected adverse atmosphere or vibration in the protected enclosure.

3.2.2.8 For installations where radiant energy detectors can be exposed to direct or reflected sunlight or artificial light, they shall not react (alarm) to these sources, nor shall these sources prevent or delay the response to an explosive event.

3.2.3 Software Requirements

For equipment, including initiating devices that are dependent on software/firmware programs for normal operation:

- All software and firmware shall be identified by release level which shall be clearly marked on, or which can be displayed by, the product for ease of identification;
- All changes to the software shall result in a revision to the release level;
- The software/firmware shall not be accessible for and changes or modifications beyond what it has been certified for; and
- Any software failure that renders the detector inoperable shall result in a trouble condition at the detector and be appropriately transmitted to the fire alarm control (e.g. watchdog timer).

3.2.4 Actuation Devices

- 3.2.4.1 Actuators shall consist of an electrically fired pyrotechnic or propellant driven device (initiator), and a high speed suppressant releasing mechanism. Activation of the device shall cut, fracture, or otherwise open the suppressant releasing mechanism, thereby releasing the suppressant into the protected enclosure. Other types of actuators will be considered on an individual basis.
- 3.2.4.2 The actuation device and suppressant releasing mechanism shall be protected from adverse environments that could hinder or cause inappropriate operation.
- 3.2.4.3 The actuators shall be capable of operating over a temperature range shown in Table 3.1 Required Operation Temperature Range.
- 3.2.4.4 Galvanic action between the actuator and suppressant container shall be prevented by use of suitable materials, isolation from direct contact, or protective coatings.
- 3.2.4.5 The device which actuates the explosion suppressor shall either be an independent actuation device attached to the unit, or an internal component of the explosion suppression assembly itself.
- 3.2.4.6 Actuation devices shall be actuated automatically by a compatible certified detection and control system.
- 3.2.4.7 Where puncturing mechanisms are used, all exposed parts shall be made of corrosion resistant material.

3.2.5 Operating Range

All system components shall operate within the temperature ranges of Table 3.1. System and component evaluations will be based on the specified minimum and maximum operating temperatures. Operating temperatures outside of these limits shall be specified at discrete 5°F (3°C) increments.

Table 3.1 *Required Operation Temperature Range*

System Component	Highest Allowable Minimum Operating Temperature		Lowest Allowable Maximum Operating Temperature	
	°F	(°C)	°F	(°C)
Electronic Equipment	32	(0)	120	(49)
All other components	32	(0)	140	(60)

3.2.6 Materials

- 3.2.6.1 All components shall be made of materials suitably corrosion resistant for their intended use.
- 3.2.6.2 Any elastomers/seals used in the system shall be compatible with the suppressant and expellant gas. Compatibility shall be determined by successful performance when subjected to the requirements listed in Sections 4.3.2 (Long Term Leakage Test), 4.3.4 (30-Day Maximum Temperature Leakage Test), 4.3.3 (30-Day Minimum Temperature Leakage Test), and 4.14 (Elastomeric Materials Tests).

3.2.7 Gauges and Indicators

- 3.2.7.1 A pressure gauge shall be included with all suppression systems to indicate the

pressure in the suppressant storage container and/or expellant storage containers/cartridges, as applicable, and shall comply with the following requirements:

- The face of the gauge shall indicate the appropriate units of pressure for which it is calibrated;
- 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; and
- The face of the gauge shall identify the suppressant/expellant with which it is intended to be used.

3.2.7.2 Pressure gauges are not required when pressures are monitored constantly by pressure transducers, provided that the presence of suitable pressure for the system is displayed locally, or at the control panel. Alternate methods of pressure indication shall be evaluated at the discretion of the certification agency.

3.2.7.3 Suppressant storage containers that need to be pressurized in order to expel suppressants shall be equipped with a pressure gauge marked to indicate an acceptable pressure range for effective dispersion of the suppressant. Pressure gauges, similar to those found on fire extinguishers, that use a green band to indicate an acceptable range are considered suitable.

3.2.7.4 Suppressant storage containers for high vapor pressure suppressants, that do not require auxiliary pressurization, shall be easily weighable or equipped with some means of determining suppressant quantity, at regular required maintenance intervals, after installation.

3.2.8 Pressure Relief Devices

Calculations shall be submitted to verify that pressure relief devices used on suppressant 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 Maintenance Lockout Devices

3.2.9.1 The explosion suppressant releasing device shall be provided with a maintenance lockout device for the purpose of shipping, handling, maintenance, and storage. For maintenance purposes, 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 suppressor.

3.2.9.2 Systems that are equipped with lockout device for maintenance shall provide supervision to indicate that the suppression system is impaired.

3.2.10 Protective Covering

All explosion suppression systems 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. Appropriate NEC cabling methods shall be used for electrical cables and wires, or pressurized tubes outside the enclosures. The manufacturer's installation and maintenance instructions shall include this requirement.

3.2.11 Suppressant Dispersers (Nozzles)

3.2.11.1 Suppressant dispersers and associated mounting hardware shall be capable of withstanding the effects of any corrosive atmosphere created by the gases or dusts within the protected enclosure. This may be accomplished by use of corrosion resistant materials, protective coatings, or any other suitable method.

3.2.11.2 Nozzle design and required maintenance intervals shall be such as to minimize the possibility of clogging by the material in the protected area.

3.2.12 Suppressant Containers (Cylinders)

3.2.12.1 Suppressant containers shall comply with ASME boiler and pressure vessel code, DOT, UN/ISO, or other national or international requirements as applicable. certification of other types of containers shall require a special investigation.

3.2.12.2 The container shall be capable of operating over a temperature range shown in Table 3.1 Required Operation Temperature Range.

3.2.12.3 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

3.2.13 Suppressant

3.2.13.1 Generally, suppressants shall be of the dry chemical type, one of the clean agents listed in NFPA 2001, or water. Other types of suppressants will be considered on an individual basis.

3.2.13.2 The suppressant shall be effective at the specified extremes of temperature for the explosion suppression system.

3.2.13.3 Expellant Gases

Nitrogen used in an explosion suppression system shall have a dew point of no greater than -60°F (-51.1°C) and shall have a purity greater than or equal to 99.99 % (mole/mole). The use of any other expellant gas shall be evaluated at the discretion of the certification agency.

3.2.14 System Operation – General

A visual indication that the explosion suppression system is in normal operating condition is

required. This is permitted to be at the control unit.

3.2.15 Electrical Wiring

3.2.15.1 All wiring to the explosion suppression system and between components of the system shall be grounded and shall be isolated and shielded from all other wiring to prevent induced currents that could affect operation of the system.

3.2.15.2 When environmental conditions warrant, wiring shall be sealed in accordance with NFPA 70, or equivalent to prevent entrance of moisture and other contaminants.

3.2.15.3 When conduit is used for wiring multiple installations, the wiring for each suppression system shall be run in separate conduits. Alternatively, each system may be wired with shielded cables run in common conduits.

3.3 Drawings, Plans, and Specifications

The manufacturer shall provide the following items:

- Drawings and/or specifications for all the major components of the suppression system. This includes the control panel and its major components, suppressant actuators and suppressant storage containers, detectors, and suppressant dispersing nozzles;
- Schematics, final assembly layout, and bills of material (BOM) pertaining to electronic circuit boards. Information concerning common electronic components and circuit board artwork is not needed;
- Safety data sheets (SDS) for the explosion suppressant;
- Drawings and/or samples of all labels attached to the system and an indication of their location;
- A copy of the installation, operation, and maintenance manual for the system;
- The Deflagration Index K, burning velocity, and chemical family for all combustibles for which the system is designed; and
- Information relating to the calculations and/or formulas for determining type and quantity of suppressant; dispersing nozzle location, quantity, and size; and detector location, quantity, and type.

3.4 Markings

3.4.1 Easily visible nameplates shall be affixed to the suppressant storage container assembly of the explosion suppression system and shall display the following markings at a minimum. Any additional markings required by the authority having jurisdiction shall also be provided:

- Manufacturer's name and address;
- System type and model number;
- Serial number;
- Applicable electrical ratings;
- The certification agency's mark of conformity;
- Suppressant identification;
- Quantity of suppressant;
- System working pressure;
- Operating and storage temperature limitations;
- Factory test pressure of the storage container;

- Year of manufacture of the storage container (if not directly stamped on the container);
- Reference to the relevant NFPA standard and/or any other relevant local standards; and
- Reference to the manufacturer's installation, operation, recharge, and maintenance instructions.

3.4.2 When hazard warnings are needed, the markings should be universally recognizable.

3.4.3 Explosion suppression systems shall be labeled with a model number, part number, or by some other type of identification that will allow an observer to determine that the correct system components have been supplied.

3.4.4 Labeling shall be capable of withstanding prolonged exposure to normally expected environmental conditions without loss of legibility or detachment from its mounting surface, as verified by Section 4.12 (Corrosion – Salt Spray).

3.4.5 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the product as certified. The manufacturer shall not place this model or type identification on any other product unless covered by a separate agreement.

3.4.6 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the mark of conformity guidelines. The manufacturer shall not use this Mark on any other product unless such product is covered by a separate report.

3.4.7 Detection and control system components shall be marked at minimum with the following information:

- The manufacturer's name and address, or equivalent;
- The model or type designation, which shall uniquely identify the product and correspond to the manufacturer's catalog designation;
- The serial number or an equivalent means to identify date of manufacture, a code traceable to date of manufacture or lot identification;
- Identification of controls and indicators;
- Operational and environmental suitability ratings (if not possible due to size, this information must be provided in other included installation and use materials);
- The certification agency's mark of conformity; and
- Inter-equipment wiring diagrams (if not possible due to size, this information must be provided in other included installation and use materials).

3.4.8 All markings shall be legible and durable.

3.5 Manufacturer's Installation and Operation Instructions

3.5.1 The manufacturer shall provide information required to properly install, operate, and maintain the system. These instructions shall be submitted to the certification agency prior to the examination of a system.

3.5.2 Section 5.6 (Installation, Operation, and Maintenance Manual) provides further guidance on the requirements for the installation, operation, and maintenance manuals.

3.6 Calibration

- 3.6.1** Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required for the certification agency's records. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified as traceable to the National Institute of Standards and Technology (NIST) or traceable to other acceptable reference standards and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory is required for the certification agency's records
- 3.6.2** The calibration of new equipment is also required. Documentation indicating either the date of purchase or date of shipment, equipment description, model and serial number is required for identification. The new test equipment shall be clearly identified by label or sticker showing the date of initial calibration and the next due date.
- 3.6.3** When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of this equipment.

3.7 Tolerances

Tolerances on units of measure shall be as described in APPENDIX B: TOLERANCES, unless otherwise specified.