Aerosol Fire Extinguishing Systems

Design, Installation, Operation, and Maintenance Manual

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1.0 FORWARD

This manual is written for those who design, install, and maintain Stat-X® aerosol fire extinguishing systems. It contains design, installation, operation, and maintenance information for these fire extinguishing systems.

IMPORTANT

Fireaway assumes no responsibility for application of any systems other than those addressed in this manual. The technical data in this manual is limited strictly for information purposes only. Fireaway believes this data to be accurate, but it is published and presented without any guarantee or warranty whatsoever, Fireaway disclaims any liability for any use that may be made of the data and information contained herein by any and all other parties.

The Stat-X aerosol fire extinguishing systems are to be designed, installed, inspected, maintained, and tested by qualified and trained personnel in accordance with the following:

- NFPA 2010 and any other applicable NFPA Standards.
- All instructions, limitations, etc. contained in this manual.
- Storage, handling, and transportation shall be performed by qualified and trained personnel in accordance with DOT requirements.

Questions concerning the information presented in this manual should be addressed to:

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2.0 INTRODUCTION

The Stat-X aerosol fire extinguishing systems are designed for total flooding applications in accordance with established design criteria. Application methods, design criteria, and limitations are contained within this manual. In any situation not specifically covered by this manual, the application, and installation of the system must be in accordance with the appropriate and/or applicable standards. All installations must meet the requirements of the local authority having jurisdiction.

Stat-X fire extinguishing systems produce a highly effective, technologically advanced fire extinguishing agent with unique operational and flow characteristics. Since these systems are designed and installed in a manner different than other extinguishing systems with which the system designer may be familiar, the system designer must become thoroughly familiar with the design criteria contained in this manual to properly input design data and parameters. There are several limitations, which must be observed in entering parameters if accurate results are to be obtained.

Stat-X fire extinguishing systems combine an environmentally safe fire extinguishing agent, specially developed components, and highly effective detection devices for rapid agent application. The resulting extinguishing of fire may reduce property, equipment, and facility damage and products of combustion to the lower levels. These systems are electrically activated, are extremely compact, and may eliminate the expensive pressure vessels, nozzles, and distribution piping associated with other fire extinguishing systems. Stat-X fire extinguishing systems offer significant weight and space savings. Generators are strategically placed throughout the hazard area and are designed to discharge in seven to thirty-six seconds, depending on the size of the generator.

The agent produced is a Potassium based aerosol with particle sizes primarily in the ≤ 2 micron size. The aerosol has the flow characteristics of a gas and has been determined to be non-toxic to humans when exposed for short periods at recommended design concentrations. (See Appendix A).

3.0 SYSTEM DESCRIPTION

3.1 General

Stat-X systems are used to suppress fires in specific hazards or equipment located in enclosed areas and confined spaces and where low weight/space to extinguishing capacity is a factor. The fire-extinguishing agent is an ultra-fine aerosol which will hang in suspension for an extended period (up to one hour) providing protection against re-flash and may minimize clean-up. Stat-X systems are suitable for use as total flooding fire extinguishing systems in normally-occupied and unoccupied areas. In areas where personnel may be present the system must employ a pre-discharge alarm, with a 30 second time delay, and provision for a supervised disconnect switch to avoid unwanted discharge during maintenance.

The following areas may benefit from an aerosol-based fire extinguishing system:

- Telecommunications Facilities
- Power Plants
- Turbine Enclosures
- Electrical Rooms
- CNC and other High Value Machines
- Flammable Liquid Storage Areas
- Marine Engine Rooms*
- High Value Mobile Equipment*
- Storage Vaults

*These applications are not part of the UL Listing under UL Standard 2775 but are covered under other applicable listings (American Bureau of Shipping, Marine and Coast Guard Agency, ECB, and others)

Stat-X generators are currently listed for the following classes of fire:

- Class A - Surface Fires
- Class B - Flammable Liquids
- Class C - Energized Electrical Equipment with A or B involvement

For the above areas or additional hazard areas, the designer must invest significant time in proper design, which may include consulting with Fireaway or other suitably experienced professionals and consultation of applicable standards on the suitability of the system for the protection of the hazard, the necessary design concentration, equipment, facility, and personnel exposure effects from that concentration.

Stat-X systems are **not suitable** for the following hazards; or, where the following materials may be present:

- Class A materials that burn with deep-seated characteristics (wood fiber, cotton, etc.)
- Electrical equipment operating at over 40,000 V
- Metal Hydrides, Pyrophoric substances, and chemical substances that smolder and burn without air
- Metal powders (magnesium, titanium, etc.)
- Environments rated hazardous (explosive atmospheres).

3.2 Extinguishing Agent

The aerosol produced upon activation of the Stat-X system is composed of ultra-fine particles of Potassium salts with secondary inert gases. Potassium salts have long been recognized as one of the most effective fire extinguishing agents available. It suppresses fire by a combination of chemical and physical mechanisms similar to the Halons without any negative effect on the environment. Because of the aerosol's ultra-fine particle size (≤ 2 micron) there is a dramatic increase in the surface area interaction between the agent and the fire. Potassium based aerosol has been shown in numerous tests to be a highly effective alternative to other extinguishing agents.

Unlike gaseous agents the aerosol does not decompose in the presence of fire nor does it extinguish by oxygen deprivation. Stat-X is listed under the United States Environmental Agency (EPA) Significant New Alternatives Program (SNAP) for use as a total flooding agent in normally-occupied and unoccupied areas. The aerosol is considered non-toxic to humans when applied in normal design concentrations necessary to extinguish most fires; however, there is a high obscuration factor and certain safety restrictions should be observed when applying and handling the generators. Exposure to the aerosol should be limited and unnecessary exposure to the particulate should be avoided. Exposure to the aerosol is generally of less concern than is exposure to the decomposition products of a fire.

Toxicity: Under the SNAP Program the US EPA conducted a risk screen process on the human health and environmental risks of the agent based on laboratory test data submitted by the manufacturer. The US EPA has ruled that the Stat-X agent is suitable for use in normally-occupied spaces. **See Table 3.2.1: Stat-X Aerosol Physical Properties.**

While the components of the aerosol are not considered toxic at normal concentration levels, ingestion of the ultra-fine particulate may cause short-term discomfort and unnecessary exposure should be avoided. Tests have shown no long-term negative effects from exposure to the aerosol. In addition, the aerosol has a high obscuration factor as noted above. **In normally-occupied and unoccupied spaces where personnel may be present Stat-X systems shall only be applied in conjunction with a 30 second time delay.** In occupied areas, a system maintenance isolate switch and manual only activation ensures egress of personnel during maintenance of the system detection and control equipment.

Residue & Cleaning: The ultra-fine aerosol discharge remains in suspension for an extended period and can be vented by a fan or air handling system. Residual amounts of aerosol, which may have settled on the floor or other surfaces, can be vacuumed, blown out or wiped clean with a water and vinegar solution.

Other Safety Considerations: The aerosol discharged into the hazard area upon activation of the generator is relatively "cool." However, the aerosol stream as it leaves the generator is above 100°C for a short distance from the outlet of the generator. Maximum temperatures are realized only in the last seconds of discharge.

Each model has a required installation clearance distance specified as its clearance “C-Zone.” Steps must be taken to ensure generator placement so that it complies with this

installation requirement. The generator housing is approximately 90°C immediately after discharge and care should be taken if handling the post-discharge generator prior to its cooling to ambient temperature. Generators must never be installed to discharge directly on walls or equipment being protected, as this will cause agglomeration.

Storage: The Stat-X aerosol generator is a disposable device and is sealed with a non-permeable membrane and has been evaluated for temperature cycling (- 40°C to + 54°C) and humidity (up to 95% relative humidity). Accelerated aging tests have shown the generator's charge maintains its viability for ten (10) years.

Table 3.2.1: Stat-X Aerosol Physical Properties

Average Values @ 100 gram/m^3 Concentration

Gas Products: (ppm)	**Stat-X 15 minute *TWA**	**Automobile-Airbag Emission Standard 20 minutes *TWA**	**NIOSH IDLH**
NO_2	1.08	9.90	20.00
NO	0.97	50.10	100.00
$NO_X = NO + NO_2$	2.05	60.00	120.00
CO	84.20	445.00	1,200.00
CO_2	756.00	40,000.00	40,000.00
NH_3	58.30	151.50	300.00
Solid Particulate:			**Percent**
K_2CO_3			55.2%
$KHCO_3$			8.2%
KNO_2			7.9%
K_2O			
Other Potassium Compounds			5.5%
NH_4HCO_3			23.2%
Average pH in solution =			
Particle Size Distribution:			**Percent**
< 1μm			3%
< 2μm			76%
< 5μm			97%
> 5μm			3%
Operating and Storage Conditions:			
Humidity			Up to 95% @ +54°C
Temperature			- 40°C to + 54°C
Useful Life			10 years

*TWA – Time Weighted Average

3.3 Component Descriptions

3.3.1 Stat-X Aerosol Generator Assemblies

Each Stat-X aerosol generator is comprised of an insulated stainless-steel housing containing the aerosol forming compound, initiator, insulating medium, and internal elements for oxidation and cooling of the aerosol stream prior to its discharge from the unit. The initiator utilizes a secure two-wire connector for electrical activation and a proprietary thermal detector for thermal activation. Each generator is sealed and utilizes a non-permeable membrane to maintain the internal integrity of the unit even in humid and high temperature environments. The Stat-X generators are protected under the following patents: In the USA - 6089326, 5865257, 6116348, 6264772, 5831209, 6042664: In Germany - 19634006, 19636725, 19638626, and 19638628.

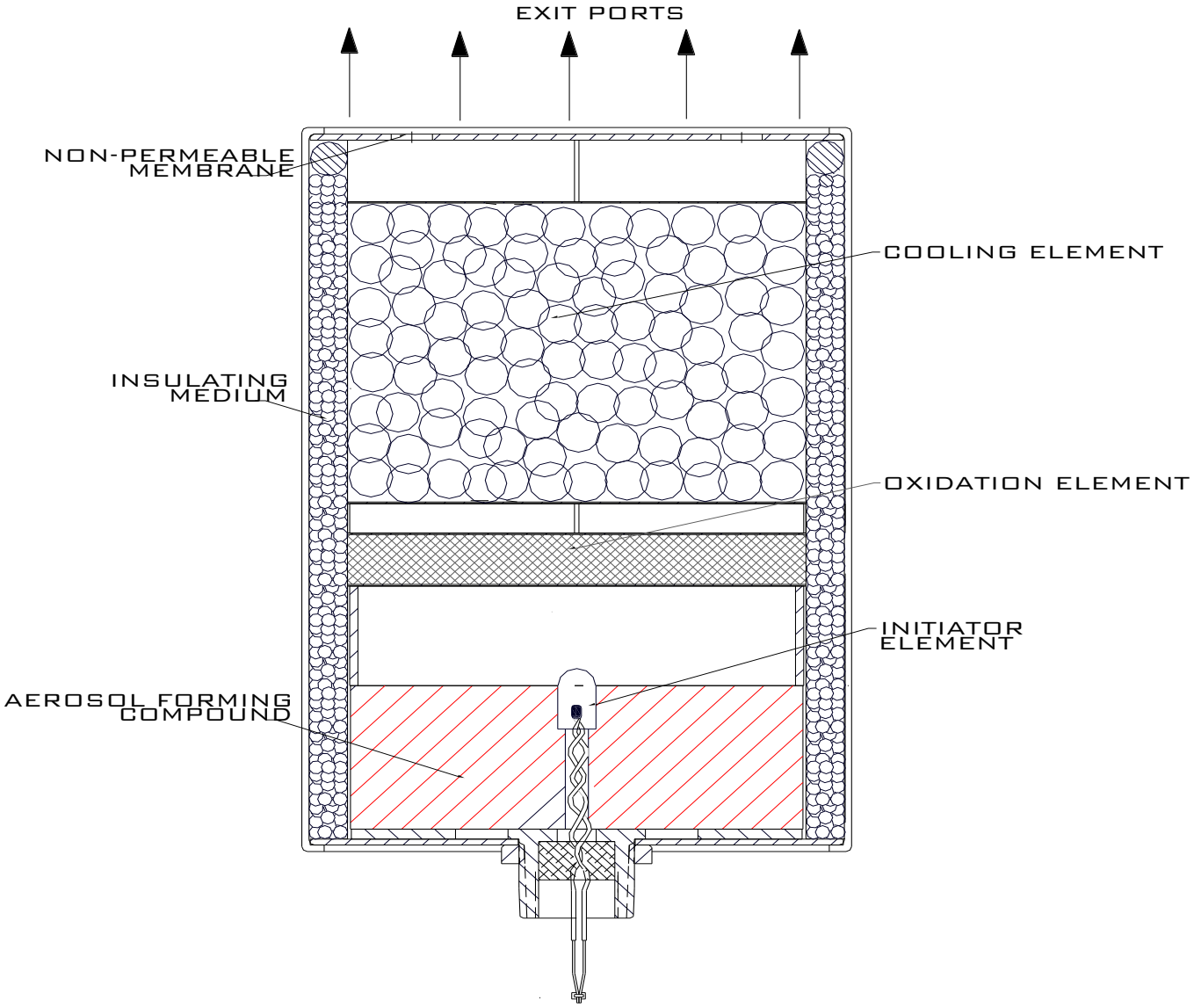


Illustration: Typical Stat-X Aerosol Generator Overview

Part Number	Capacity	Diameter	Length	Weight
15100	30 grams	51 mm	109 mm	0.26 kg
15110	60 grams	51 mm	130 mm	0.35 kg
15111	60 grams	51 mm	155 mm	0.55 kg
15120	100 grams	76 mm	121 mm	0.9 kg
15130	250 grams	127 mm	150 mm	2.2 kg
15140	500 grams	127 mm	180 mm	2.9 kg
15150	1000 grams	203 mm	170 mm	5.4 kg
15160	1500 grams	203 mm	203 mm	6.8 kg
15170	2500 grams	203 mm	267 mm	9.0 kg

Table 3.3.1.2 Stat-X Aerosol Generators

3.3.2 Initiation

Electrical. The initiator for the Stat-X aerosol generator consists of a two-wire connector for electrical actuation. The two-wire connector and initiation mechanism are secure and highly reliable initiating devices. Activation parameters of the initiator are:

- Resistance: 1.4 – 2.0 Ohms
- Minimum Parallel Circuit Firing Current: 0.5A each, for 0.050 Seconds.
- Minimum Series Circuit Firing Current: 1.0A for 0.050 Seconds.
- Specified Maximum Test Current: $\leq$ 0.025A.
- Specified Maximum Supervisory Current: $\leq$.005A.
- Operating Voltage: 12 – 24 V DC*.
- See Appendix E for further information on compatible fire alarm control panels.

*The rated operating voltage under the UL Listing is 24 V DC.

3.3.3 Control Panels and Accessories

Fire alarm control panels must be UL/ULC Listed as compatible with the aerosol generators under the UL Listing.

3.3.4 Mounting Hardware and Ancillary Equipment

3.3.4.1 Generator Mounting Bracket

Stainless steel straps and brackets are used to mount the aerosol generator. Mounting Brackets (PNs 18001, 18005, 18010, 18015) are available for the 30 grams through 2500 gram generators, depending on the method of attachment.

3.3.4.2 Electric Remote Pull Box

An electric manual pull station listed by UL/ULC as compatible with the control panel and acceptable to the authority having jurisdiction may be used to operate the Stat-X aerosol generator system.

3.3.4.3 Time Delay. A minimum 30-second time delay shall be utilized in areas where personnel may be present to allow occupants of the area to egress prior to system activation. While the agent itself poses no significant health hazard to the occupants, occupants should leave the area before activation of the system to avoid any potential problems associated with obscuration or minor irritation from inhalation of the ultra-fine particulate.

3.3.4.4 System Isolate Switch. A system isolate switch Listed by UL/ULC as compatible with the Control Panel (located outside the protected area) is recommended (unless prohibited by local authority having jurisdiction [AHJ]) in areas where personnel may be present. **The operation of the system shall be manual only when personnel are present** (unless prohibited by local AHJ)**.** While the system isolate switch is active, the automatic activation of the system is inhibited; but the fire detection and alarm system shall continue to function. The system returns to full automatic control when the switch is reactivated. The operation of the system isolate switch shall electrically isolate and earth each conductor of the wiring to the generators and initiate a visual indicator of status at the control station.

3.3.4.5 Horn/Strobe Alarm. A horn/strobe alarm shall be UL/ULC Listed as compatible with the control panel and used in conjunction with the time delay to provide an audio and visual alert to personnel in the area that a system discharge is imminent and that the protected area must be evacuated.

4.0 SYSTEM DESIGN AND LIMITATIONS (Total Flooding)

4.1 General

System design is based on the applicable requirements of the National Fire Protection Association (NFPA) Standard 2010, the Russian Federation Fire Protection Authority Standard NBC 88-2001 (formerly NPB 21-98), manufacturer's design data, and the authority having jurisdiction.

4.2 Application

The following steps must be taken to design and calculate a Stat-X system:

- Determine how the area is used and if floor, ceiling, and walls are fire-proof.
- Determine the hazard's fire classification.
- Determine the appropriate design density based on fire classification.
- Determine the leakage potential of the hazard enclosure.
- Determine the geometrical dimensions of protected area (volume, total area, height). (Protected equipment volume is not deducted from the total volume).

- Determine if any large obstructions exist in the hazard.
- Determine if additional agent will be required to compensate for leakage, or obstructions.

4.2.1 Calculate the total mass of aerosol required to protect the hazard

The following describes the method for calculating required concentration by hand. It is intended to educate the user on the methodology to determine and enter required system parameters. Actual calculations can be more readily done using the system design calculator supplied with this manual. ***For Manual Calculation See Appendix D.***

The required mass of aerosol required for a specific volume is calculated according to the following formula:

$$\mathbf{M = K_1 \bullet K_2 \bullet K_3 \bullet V \bullet q}$$

Where:

M – is the total mass of aerosol required to protect the hazard.
K_1- is a ratio based on the non-uniformity of aerosol distribution according to the height of the protected enclosure.
K_2 – is the ratio based on the calculated leakage rate and leakage distribution for the protected volume.
K_3 – is the ratio based on specific parameters for cable tunnels.
V - is the total volume of the protected area in cubic meters.
q - is the design density of aerosol required to extinguish the hazard class.

Note: Calculated Final Application Density rates must be ≥ those shown in Table 4.2.1. For normally occupied spaces with K factors = 1, the US EPA lists the maximum application density q as 100 g/m3.

For hand calculation of M use as value of q*:

a) Class A hazard: 97 g/m3
b) Class B hazard: 55 g/m3
c) Class C hazard involving Class B material: 62 g/m3
d) Class C hazard involving Class A material: 97 g/m3

Note*: Total quantity of M, adjusted by K factors, must equal or exceed the quantity required to meet density levels listed in Table 4.2.1. Select number of devices to supply or exceed the calculated quantity of M.

4.2.2 Calculation of Facility Leakage Rate

Leakage rate is calculated according to the formula:

$$LR = \frac{\sum : A_{open}}{A_{total}}$$

Where:

LR – leakage rate %, $\sum : A_{open}$ – sum of the area of unclosed openings, (windows, doors, etc.)
A_{total} – total surface area of the bounding structure, including floor and ceiling.

4.2.3 Determination of Formula Value K_1

Formula Value K_1 is determined according to the height of the protected enclosure as follows:

4.2.3.1 Determination of Formula Value K_1 when, LR ≤ 1%

K_1 = 1.00 when the height of the enclosure ≤ 3.5 meters.
K_1 = up to 1.16 when the height of the enclosure 3.51 – 5.0 meters.
K_1 = up to 1.26 when the height of the enclosure 5.1 – 8.0 meters.

Limiting Factors:

- LP not more than 0.04.
- **Consult manufacturer for height of enclosure > 8.0m.**

4.2.3.2 Determination of Formula Value K_1 when LR is 1% - 2%

K_1 = 1.00 when the height of the enclosure ≤ 3.0 meters.
K_1 = up to 1.16 when the height of the enclosure 3.1 – 4.5 meters.
K_1 = up to 1.26 when the height of the enclosure 4.51 – 6.0 meters.

Limiting Factors:

- **LP** not more than 0.2.
- **Consult manufacturer for LR > 2.0%.**
- **Consult manufacturer for height of enclosure > 6.0m**

4.2.4 Calculation of Formula Value K_2

Formula Value **K_2** is determined by the relationship between the leaking parameter (**LP**) and the distribution of leakage in the protected enclosure (**LH**) as outlined below. Entry of location and dimensions of unclosed openings into the ***SYSTEM CALCULATOR*** included with this manual will automatically generate the correct **K_2** value into the formula. ***For Manual Calculation See Appendix E.***

4.2.4.1 Calculation of Facility Leakage Parameter

Leakage parameter is calculated according to the formula:

$$LP = \frac{\sum : A_{open}}{V} \ m^{-1}$$

Where:

LP is a value, which characterizes the leakage of the protected enclosure as a ratio of the sum of the area of unclosed openings to the volume of the enclosure.

4.2.4.2 Calculation of Facility Leakage Distribution

Leakage distribution is calculated according to the formula:

$$LH = \frac{A_{upper}}{\sum A_{open}} \times 100\%$$

Where:
LH is a value expressed as a ratio of the area of constantly unclosed openings in the upper half of the protected enclosure (**A_{upper}**) to the sum of the area of constantly unclosed openings.

4.2.5 Calculation of Formula Value K_3

K_3 = 1.5 for cable structures.
K_3 = 1.7 for cable structures where the longitudinal axis of the cable structure is situated at an angle > 45 degrees to the horizon (vertical, inclined cable collectors, tunnels, passages, and cable wells).
K_3 = 1.0 for all other structures.

Protection of cable structures should be limited to volumes ≤ 3000 m^3 with a height restriction of ≤ 12 m. **LP** (leaking parameter) of the structure is not to exceed 0.01^{m-1}. **LP** is a value, which characterizes the leakage of the protected enclosure as a ratio of the sum of the area of unclosed openings to the volume of the enclosure and is determined as follows:

$$LP = \frac{\sum : A_{open}}{V}, \ m^{-1}$$

There may not be any automatic re-closing switches in the circuits of the cable structure being protected.

4.2.6 Calculate the number of aerosol generators required

The following formula is used to calculate the number of aerosol generators required for the extinguishing system:

N = M/m

(When using generators of one size only)

Where:

N – the number of generators required. If the value of N is fractional, it is rounded up to a whole number.
M – the total mass of aerosol required.
M – the mass charge of the individual aerosol generator

4.2.6.1 Area Coverage Review

Each Stat-X generator has been tested and listed with a unique "footprint" for area coverage **(See Table 4.2.4 Aerosol Discharge Stream Characteristics)**. Once the number of generators required to provide the necessary mass of aerosol has been determined, the area coverage of each unit selected must be evaluated to ensure the system falls within listed parameters. If not, additional units shall be provided to ensure the final system configuration conforms to the Stat-X listing.

4.2.6.2 Excess Pressure, ΔP Review

In general, very few enclosures are completely tight and excess pressure is not an issue at normal design concentrations. However, in extremely "tight" enclosures (LP=0) an evaluation of the structure should be made, and it is recommended that louvered pressure venting be installed if deemed necessary. Venting should be sized to provide an effective open area during discharge that calculates to an LP=0.001. If venting is added, the design calculation must be recalculated including the vent open area to ensure proper design density is maintained for the protected volume.

The chart below gives excess pressure ΔP information for each size of aerosol generator at LP =0.001 values. For reference a ΔP of 3kPa is the threshold for damage to glass area.

Maximum excess pressure values ΔP (kPa) in conditionally sealed enclosure (LP=0.001) at different design densities.

Design Density g/m³	**100 250 ΔP, (kPa)**	**1000 ΔP, (kPa)**	**500 1500 ΔP, (kPa)**	**2500 ΔP, (kPa)**
50	0.66	0.53	0.21	0.12
75	0.93	0.89	0.32	0.20
100	1.62	1.43	0.66	0.31
125	2.40	2.12	0.85	0.52

4.2.1 Minimum Application Density

Fire Class	Stat-X® minimum application density grams/m³
Class A	97.15
Class B	66.95
Class C - Energized Electrical	Determined by A or B involvement

4.2.7 Other Facility/System Considerations

4.2.7.1 Significant Obstructions/Agent Distribution

In cases where there is a large ratio of fixed equipment to total volume, or where the protected equipment is located in such a way as to present a barrier to the free flow and distribution of aerosol throughout the hazard area, the use of a larger number of smaller aerosol generators is preferred. This will allow for strategic placement of the aerosol generators and improved distribution characteristics throughout the area. **See Illustration 4.2.3 Installation with Significant Obstruction Present.**

4.2.7.2 Total flooding in normally occupied and unoccupied areas where personnel may be present: Note: In total flooding installations in normally unoccupied spaces where personnel may be present, a 30 second time delay shall be installed to ensure egress time prior to system discharge. In normally occupied and unoccupied areas, a system isolate switch shall be installed outside the hazard area to ensure that activation of the system is "manual only" when personnel are present.

4.2.7.3 Shutdown of Air Handling and Power Supply

Upon pre-discharge detection of a fire, the ventilation system for the protected volume must be shut-down to ensure the required application density is delivered and that the fire is not exacerbated by excessive air-flow. In addition, electrical power to protected equipment must be shut down. This will minimize the potential of re-ignition from a continuous short circuit.

4.2.8 Placement of Stat-X aerosol generators in the hazard area

4.2.8.1 Mounting

Stat-X aerosol generators are listed for both sidewall and center locations and may be mounted on walls, beams, constructions, and columns as long as the unit is securely fastened and is mounted in a position where it has an unobstructed discharge path and where its "C-zone" (required clearance zone) will not impact on personnel, equipment, and combustible materials located within the protected area. **See Table 4.2.4 Aerosol Stream Characteristics.** The generators must also be located with adequate clearance between structural materials and the generator housing. **See Table 4.2.5 Generator Housing Clearance.**

The information below is a general guide for tightening fasteners used in the Stat-X

mounting brackets. Many variables can affect the torque tension relationship when securing fasteners, including position of the generators along with the general condition of the fastener threads.

All torque recommendations are given in inch-pounds and are minimum torque values for UL/ULC Listing.

Bracket PN	Clamp Nut Torque	Bracket Pivot Bolt Torque
18001	20	N/A
18005	20	40
18010	30	80
18015	50	100

4.2.8.2 Mounting Height

In general, the aerosol generators should be mounted in rooms at or near ceiling height and angled to discharge down toward the floor at an angle to insure three-dimensional distribution of aerosol. Normal orientation from vertical is 15° - 30° for sidewall mounting and vertical for center mounting. In larger volumes (≥100m^3) utilizing a 1500E unit and a 2500E unit the rotational angles should ensure an unobstructed discharge path as long as possible. **The aerosol generators must be mounted in such a way as to have a clear discharge path and must not discharge onto walls or equipment as this will result in agglomeration and decreased effectiveness.** In order to ensure maximum distribution of aerosol throughout the hazard area, the maximum height of generator placement must be limited as indicated in **Table 4.2.4**. In facilities with walls higher than the heights given in **Table 4.2.4** aerosol generator systems for total flooding must be designed to place generators on multiple levels. When multiple generators are installed in the same enclosure, they shall be installed on multiple levels (tiers) along the enclosure elevation; with each level (tier) maintaining compliance with the installation height limitations and the maximum area coverage limitations. This will ensure complete and even distribution of aerosol throughout the hazard area. **See Illustration 4.2.5 Installation in High Walled Facilities for an example of a 2-tier installation.**

Generators used in underfloor applications should be mounted to discharge horizontally due to the limited height of the volume. For the same reason, underfloor applications should generally utilize smaller units (500g or less).

4.2.8.3 Flow

Placement of the aerosol generators to insure proper aerosol flow and distribution is extremely important. Generators should be spaced as evenly as possible around the hazard area and directionally positioned to promote a circular, three-dimensional flow pattern. **Aerosol generators must never be positioned to discharge directly at each other! This will cause agglomeration of the aerosol particulate; reducing the aerosol's extinguishing effectiveness. For the same reason, aerosol generators in total flood applications should also be positioned to ensure that the aerosol stream does not impinge directly on walls or the sides of equipment being protected**. **See Illustration 4.2.6 Typical Aerosol Generator Placement.**

Table 4.2.4 Aerosol Discharge Stream Characteristics Installation Limitations

Model	Length of C – Zone (momentary peak temp >75°C)**	Installation Height Limitations † (meters)	Maximum Area Coverage Limitation (square)	Maximum Area Coverage Limitation (rectangle)	Discharge Time (seconds)
30 gram	0.25 meter	0.5 to 1.22	1.200m x 1.200m		7
60 gram	0.35 meter	0.5 to 2.00	1.700m x 1.700m		10
60 gram	0.30 meter	0.5 to 2.00	1.700m x 1.700m		10
100 gram	0.46 meter	0.5 to 2.50	2.184m x 2.184m		12
250 gram	0.75 meter	0.5 to 2.75	3.454m x 3.454m	2.450m x 4.880m	12
500 gram	1.27 meter	0.5 to 3.50	4.880m x 4.880m		23
1000 gram	2.30 meter	0.5 to 4.88	4.880m x 4.880m		16
1500 gram	2.00 meter	0.5 to 4.88	4.880m x 4.880m		23
2500 gram	2.70 meter	0.5 to 4.88	4.880m x 4.880m		36

**** The "C-Zone" is a distance where the momentary peak temperature of the discharge will not exceed 75°C. Generators must also be installed with as long a clear discharge path as possible to reduce possibility of agglomeration.**

† 2500 gram generators should not generally be installed in volumes with a height < 3m. When multiple generators are installed in the same enclosure, they shall be installed on multiple levels (tiers) along the enclosure elevation with each level (tier) maintaining compliance with the installation height limitations and the maximum area coverage limitations.

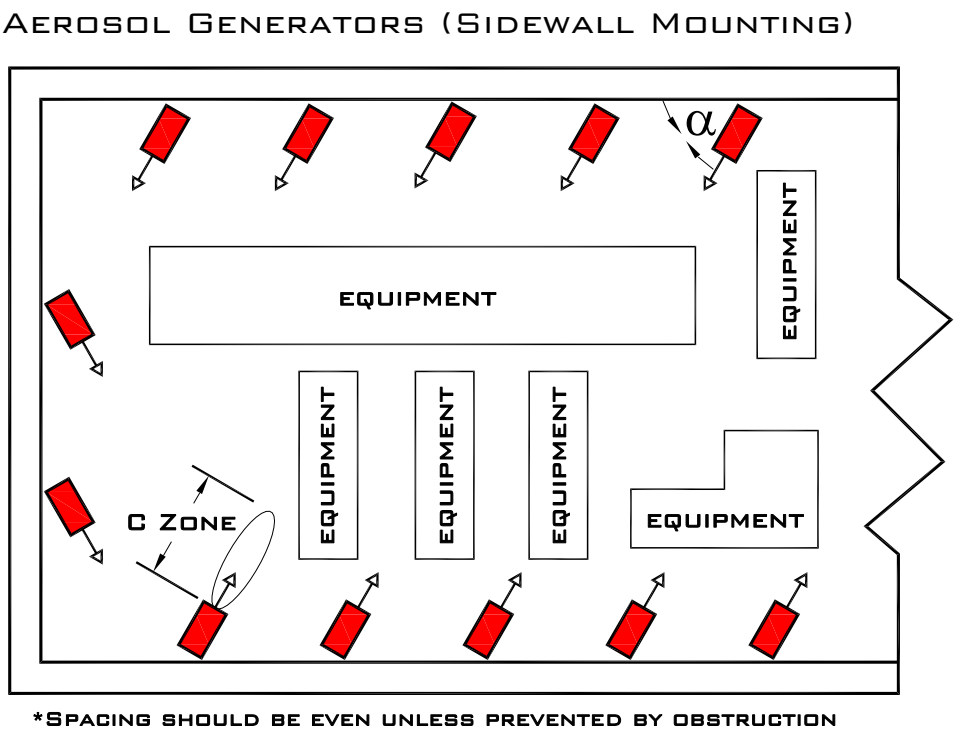
Table 4.2.5 Generator Housing Clearance

Model	Required Clearance from Combustible and Structural Materials	
	mm	inch
30 gram	7	0.25
60 gram	7	0.25
100 gram	13	0.50
250 gram	13	0.50
500 gram	13	0.50
1000 gram	13	0.50
1500 gram	30	1.00
2500 gram	30	1.00

Note: Fittings (junction box, conduit) directly connected to the generator must be metallic only.

4.2.9 Operating/Temperature Range

Stat-X electrical aerosol generators are listed to operate within a temperature range of - 40 °C to +54 °C. The generators are sealed with a non-permeable membrane and have been evaluated for exposure to humidity (up to 95%) and cycled temperature (- 40°C to + 54°C).



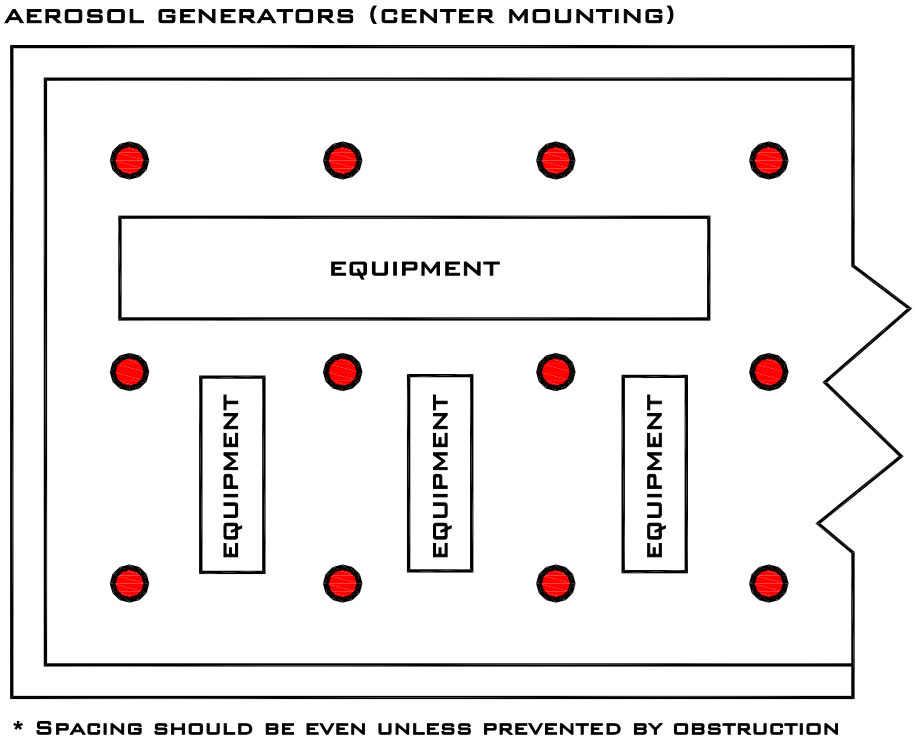
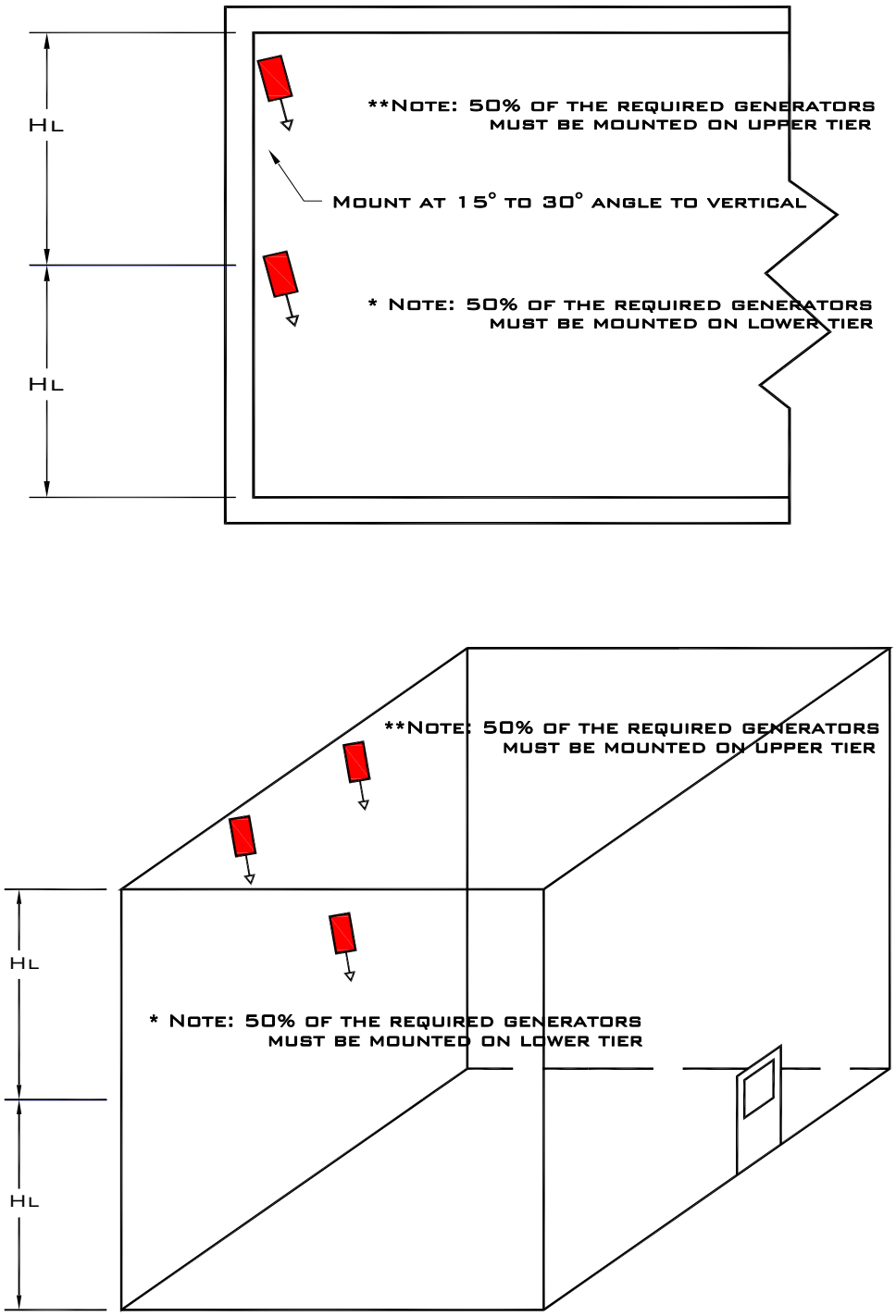
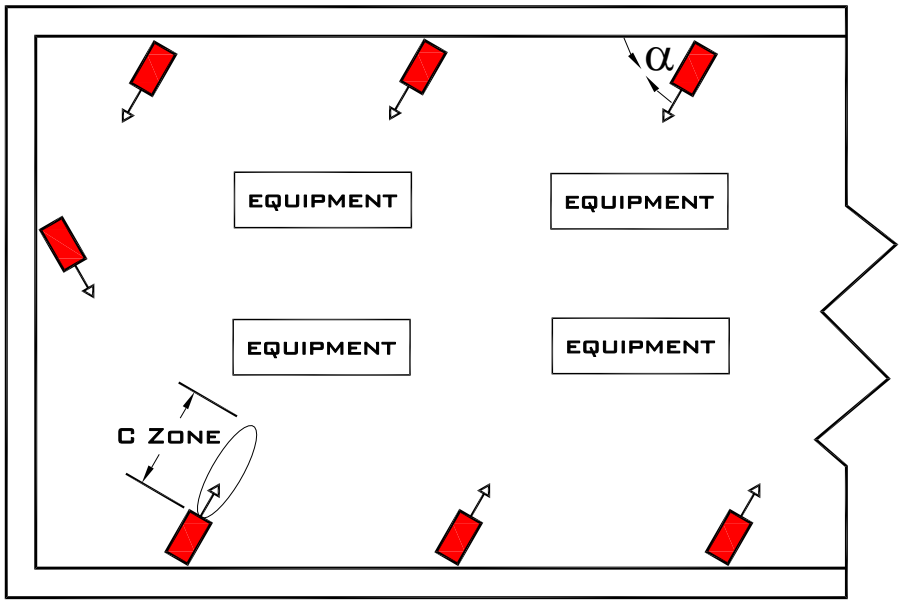


Illustration 4.2.3 Installation with Significant Obstruction Present



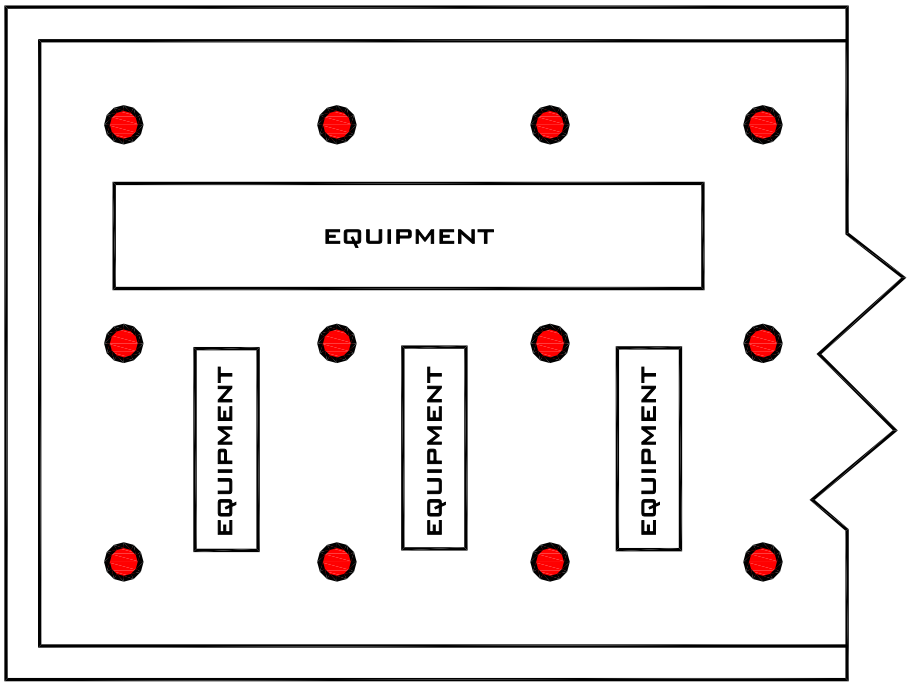
4.2.5 Installation in a High Walled Facility
Example of a 2 Tier Installation

AEROSOL GENERATORS (SIDEWALL MOUNTING)



*SPACING SHOULD BE EVEN UNLESS PREVENTED BY OBSTRUCTION

AEROSOL GENERATORS (CENTER MOUNTING)



* SPACING SHOULD BE EVEN UNLESS PREVENTED BY OBSTRUCTION

4.2.6 Typical Aerosol Generator Placement

5.0 EQUIPMENT INSTALLATION

5.1 General

All Stat-X equipment must be installed to facilitate proper operation, inspection, testing, and any other maintenance as may be necessary. Equipment must not be subject to mechanical, chemical, or other damage, which could render the equipment inoperative. Equipment must be installed in accordance with all applicable standards and the contents of this section of the manual.

WARNING

STAT-X AEROSOL GENERATORS CONTAIN A FLAMMABLE SOLID CHARGE AND MUST ONLY BE HANDLED, INSTALLED, AND SERVICED WITH THE INSTRUCTIONS CONTAINED IN THIS SECTION. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD CAUSE A PREMATURE DISCHARGE RESULTING IN POTENTIAL INJURY.

5.2 Aerosol Generator Installation

The Stat-X aerosol generators should be located within the protected hazard area. The following installation instructions must be followed in the exact sequence outlined below to prevent accidental discharge, bodily injury, or property damage.

WARNING

TO PREVENT PERSONNEL INJURY, DE-ENERGIZE ALL ELECTRICAL CONNECTIONS PRIOR TO GENERATOR INSTALLATION.

5.2.1 Single Generator System

1. Position mounting bracket and securely fasten to wall, ceiling, or other support in a location and manner, which ensures the generator will not be subjected to accidental damage or movement.

2. Remove generator from shipping container and inspect integrity of the non-permeable membrane. Do not install if the membrane is ruptured in any way or if circuit is broken. Verify igniter integrity with Ohmmeter. Do not install if reading is outside range of 1.4 to 2.0 ohms.

3. Securely attach generator to the mounting bracket with generator clamp taking care to ensure clamp is free of the initiator mechanism and that all bolts are securely tightened.

4. Position generator, via the bracket-mounting swivel, to allow for an unimpeded discharge upon activation. Care must be taken so that the generator does not directly discharge at close range at the wall, ceiling, horizontal, or vertical surfaces of the equipment within the hazard area.

5. Taking care to ensure power is off, connect electrical lines to the initiator fitting at the top of the generator.

WARNING

DE-ENERGIZE ALL ELECTRICAL CONNECTIONS PRIOR TO GENERATOR INSTALLATION. BE CAREFUL TO NOT PLACE ANY BODY PART DIRECTLY IN FRONT OF THE GENERATOR EXIT PORTS DURING INSTALLATION.

5.2.3 Multiple Generator System

1. Position mounting brackets and securely fasten to wall, ceiling, or other support in a location and manner which ensures the generators will not be subjected to accidental damage or movement.

2. Make sure mounting brackets are located in a manner to ensure a circular flow pattern and maximum mixing of aerosol during discharge.

3. Remove generators from shipping container and inspect integrity of the non-permeable membrane. Do not install if the membrane is ruptured in any way or if circuit is broken. Verify igniter integrity with Ohmmeter. Do not install if reading is outside range of 1.4 to 2.0 ohms.

4. Securely attach generators to the mounting brackets with generator clamps taking care to ensure clamps are free of the initiator mechanism and that all bolts are securely tightened.

5. Position generators, via the bracket-mounting swivel, to allow for unimpeded discharge upon activation. Care must be taken so that the generator does not directly discharge at close range on the wall, ceiling, or vertical surfaces of the equipment within the hazard area. Generators must be positioned to promote circular flow and mixing of aerosol from multiple generators. Aerosol generators must never be positioned to discharge directly at each other! This will cause agglomeration of the aerosol particulate, reducing the aerosol's extinguishing effectiveness.

6. Generators may be wired individually back to a control device or connected in series on a loop. Activation current must be supplied to each generator as follows:

   Activation parameters of the initiator are:

   - Resistance: 1.4 – 2.0 Ohms
   - Minimum Parallel Circuit Firing Current: 0.5A each, for 0.050 Seconds.
   - Minimum Series Circuit Firing Current: 1.0 A for 0.050 Seconds.
   - Specified Maximum Test Current: $\leq$ 0.025A.
   - Specified Maximum Supervisory Current: $\leq$ 0.005A.
   - Operating Voltage: 12 – 24 V DC*.
   - Refer to Appendix E for further information on compatible UL/ULC Listed control panels.

* The rated operating voltage for UL Listing is 24 V DC

7. After verifying power is off, connect electrical lines to the initiator fitting at the top of

the generator.

5.3 Post Installation Checkout

After the Stat-X generators have been installed and connected to the appropriate detection and/or control system; perform the following inspection and tests.

1. Verify generators of the correct size are installed per the installation drawings.

2. Verify generator mounting brackets and clamps are properly installed and that all fittings are tight.

3. Verify all electrical connections have been made and test for electrical continuity using an Ohmmeter (electrical only).

4. Verify generators are positioned properly. Check for obstructions in the path of the aerosol discharge stream. **Generators must be installed such that they cannot cause personnel injury upon activation. The aerosol discharge stream must not impinge at close range on walls, ceiling, or vertical surfaces of equipment!**

5. Manually operated electrical pull stations must be properly installed, readily accessible, and clearly identified.

6. Verify time delay functionality and integrity.

7. All acceptance testing shall be in accordance with this manual, any applicable standards, and the authority having jurisdiction.

6.0 OPERATION

6.1 General

A solid charge of the aerosol composition is contained within the sealed generator. Upon activation of the initiator, the charge begins a controlled burn producing an ultra-fine aerosol. The aerosol passes through an oxidation filter, where CO is converted to minor amounts of CO_2, and then through a cooling bed where the temperature of the aerosol is rapidly reduced before it escapes through the discharge ports of the generator at low pressure. Generator placement within the hazard area provides proper flow and distribution of the aerosol within the protected area.

6.2 Operating Procedures

6.2.1 Electrical Automatic Operation

Electrical automatic operation occurs upon activation of the detection circuit, initiating a voltage source from the Fire Alarm Panel to the generators. **In normally unoccupied areas where personnel may be present, a 30 second time delay shall be installed to ensure egress time prior to system discharge. In normally occupied and unoccupied areas, a system isolate switch shall be installed outside the hazard area to ensure activation of the system is "manual only" during maintenance operations.** Personnel must evacuate the hazard area promptly upon hearing the pre-discharge alarm. Ensure no one enters the hazard area after discharge and call the fire department promptly.

6.2.2 Remote Electrical Manual Operation

Manual electrical operation is performed by manual release from a releasing device located outside the protected enclosure. Operate as follows:

1. Upon fire notification, leave the hazard area quickly.
2. Proceed to the appropriate remote manual/electrical pull station for the hazard.
3. Ensure all personnel have exited the protected enclosure
4. Operate manual pull station.
5. Allow no one to enter the hazard area. Call the fire department promptly.

6.2.3 System Isolate Switch

The automatic operation of the system shall be prevented by means of a system maintenance isolate switch (located outside the protected area) when personnel are present in the hazard area. The operation of the system shall be manual only during system maintenance and control system testing. While the system isolate switch is active the automatic activation of the system is inhibited but the fire detection and alarm system shall continue to function. The system shall return to full automatic control when the switch is reactivated.

The operation of the system isolate switch shall electrically isolate and earth each conductor of the wiring to the generators and initiate a visual indicator of status at the Control Station.

NOTE

THE ABOVE INSTRUCTION MUST BE POSTED ON DISPLAY IN THE PROTECTED AREA.

6.3 Post Fire Operation

After discharge of a Stat-X fire extinguishing system, qualified fire extinguishing system maintenance personnel must perform post fire maintenance and system installation procedures outlined in this manual. Observe all warnings, especially those pertaining to the length of elapsed time before entering the hazard area.

WARNING

DO NOT ENTER A HAZARD AREA WITH AN OPEN FLAME OR LIGHTED CIGARETTE. THE POSSIBLE PRESENCE OF FLAMMABLE VAPORS MAY CAUSE RE-IGNITION OR EXPLOSION.

WARNING

ENSURE FIRE IS COMPLETELY EXTINGUISHED BEFORE VENTILATING AREA. BEFORE PERMITTING ANYONE TO ENTER THE HAZARD AREA, VENTILATE AREA THOROUGHLY OR USE SELF-CONTAINED BREATHING APPARATUS

6.4 Post Fire Maintenance

The following procedures must be followed in the exact sequence to maintain and re-commission a Stat-X extinguishing system:

1. After discharge, allow a minimum holding time of 10 minutes.
2. Always be sure to have backup portable extinguishers at hand for use in the unlikely event of re-ignition.
3. Vent the area thoroughly by operating the ventilation system, by fan extraction, or by opening doors and windows. To avoid unwanted inhalation of fire by-products and aerosol, a protective breathing apparatus or mask should be worn if it is necessary to enter prior to complete ventilation of the hazard volume.
4. Inspect the area to ensure the fire is completely extinguished and that there are no localized hot spots or other sources of re-ignition present.
5. Clean any minor amounts of residue, which have not been removed during ventilation, by thoroughly vacuuming, blowing, brushing, or washing away (with a water vinegar mixture) as appropriate. Check to make sure that there is no agglomeration due to discharge too close to equipment, walls etc. If any agglomeration exists it must be wiped or washed clean.
6. Any residue which is not cleaned up following discharge can absorb moisture. A change in room temperature during a fire event or discharge can affect humidity and it is important to reduce the enclosure humidity as soon as possible following a discharge.
7. Remove spent generators, being sure to wear gloves or other hand protection. The generators will remain quite warm to the touch for a time after actuation.
8. Dispose of spent generators according to applicable federal, state, and local regulations.
9. Contact your Stat-X distributor immediately for replacement generators.

WARNING

BEFORE PERFORMING POST FIRE MAINTENANCE PROCEDURES, REFER TO THE SAFETY DATA SHEETS AND SAFETY BULLETINS IN THE APPENDIX AT THE BACK OF THIS MANUAL. ALWAYS DETERMINE THE CAUSE OF THE DISCHARGE PRIOR TO RETURNING THE STAT-X AEROSOL EXTINGUISHING SYSTEM TO OPERATION.

NOTE

Due to the ultra-fine particle size and the method of generation, the particulate is quite buoyant and suspends in the gas/air mixture within the protected enclosure. Because of this “buoyant” effect the aerosol does not begin to “settle” for an extended period (up to an hour) and therefore is extremely easy to vent from the protected area. Minor amounts of particulate may be deposited on or in equipment and, generally, there is little need to do anything beyond extraction of the air within the protected volume through a fan or air handling system – followed by a blow down with compressed air. Any particulate deposited on horizontal surfaces will be ≤ 5µm and will not form a continuous layer. Large gaps will exist between particles.

As a precautionary measure, however, it is always important to inspect and clean the site thoroughly following a discharge. While the aerosol itself is quite “clean”, environmental factors are also a consideration. The unknown, and potentially harmful, by-

products of an actual fire pose the biggest risk to sensitive equipment. Because unknown products from the fire itself may be present or because of unwanted environmental conditions, it is always recommended that the area be thoroughly cleaned to ensure no unwanted particulates or by-products are present. For example, on-site maintenance and housekeeping may have been lax allowing accumulation of dirt in the enclosure. During discharge, any dirt within the enclosure will be blown around and then deposited as unwanted residue throughout the area. Also, in rare cases, unit orientation may have been altered improperly or equipment may have been re-oriented within the protected enclosure resulting in an improper discharge directly onto a wall or equipment surface. This could result in the deposit of small, localized areas of highly concentrated agglomerated particulate on that surface. If left untended, an agglomerated mass may take on moisture and may cause non-progressive surface discoloration (copper, bronze) of unprotected metal surfaces. It is therefore, very important that any agglomerated particulate be cleaned up with a water/vinegar solution within 24 hours following a discharge.

7.0 MAINTENANCE

WARNING

Before performing maintenance procedures, refer to the material safety data sheets and safety bulletins in the appendix at the back of this manual.

7.1 General

While Stat-X extinguishing systems require significantly less maintenance than other fire extinguishing systems which operate at pressure, a regular program of systematic maintenance must be established to insure continuous, proper operation of any fire extinguishing system. A periodic maintenance schedule must be followed, and an inspection log maintained for ready reference. At a minimum, the log must record: (1) inspection interval, (2) inspection procedure performed, (3) maintenance performed, if any, because of inspection, and (4) the name of the responsible person performing the operation.

7.2 Preventive Maintenance

Perform preventive maintenance per **Table 7.2 Preventive Maintenance/Replacement Schedule.**

Schedule	Requirement	Paragraph
Weekly	Check all electrical connections	7.3.1
	Visual inspection of components	
Semi-annual	Inspect/test all system components	7.3.2
	Test electrical continuity	7.3.2.3
	Inspect bracketing & position of generators	7.3.2.4
10 - Year	Replace generators from service	7.3.3

Table 7.2 - Preventive Maintenance/Replacement Schedule

MAINTENANCE PLAN

Stat-X fire suppression systems require significantly less maintenance than other fire suppression systems; a regular program of systematic maintenance must be established to ensure continuous, proper operation of any fire suppression system.

Stat-X systems maintenance schedule requires weekly, bi-annual and ten (10) year maintenance, where weekly maintenance involves only visual inspection of the components and electrical connections. All Stat-X generators must be replaced with a new device after reaching ten (10) years from the manufacture date. The manufacture date code is located on the label of each device. Stat-X devices must be installed as per this manual or owner's manual, and follow the bi-annual inspection steps described in the table below.

Type of Survey: Weekly/Six Month/On 10th year	**Date:**		
Inspection Steps	**Yes**	**No**	**N.A.**
Perform a general visual inspection of all aerosol generators for damaged or missing parts. Examine each device for a puncture in the aluminum foil seal at orifice plate. Replace generator if foil is punctured or ripped.			
Verify at the control panel for any fault or trouble indication with regards to the panel output releasing circuit(s). If there is an indicated releasing circuit fault, verify electrical signal connection from panel to each aerosol generator electrical initiator. Test using a multi-meter, the line resistance of the releasing circuit signal line. Replace aerosol generator if each electrical initiator resistance exceeds operational range of 1.4Ω to 2.0Ω.			
Inspect aerosol generators for physical damage that is not superficial, such as cracks, dents, distortion, or corrosion. If damage is found, replace generator as instructed in the owner's manual.			
Verify mounting brackets and straps, tightness of mounting hardware, and generator alignment are properly secured. Tighten all loose hardware or replace damaged parts.			
Ensure paths of emergency egress from protected area is not impeded by an aerosol discharge as well as unobstructed access to manual pull stations and abort devices (where installed). Ensure there are no obstacles inhibiting the proper operation of the aerosol generators or distribution of aerosol in the event of fire.			
Ensure automatic dampers (where fitted) are functional. Verify leakage areas identified during the original system design have not been modified.			
Follow specific recommended manufacturer maintenance and test procedure for the fire detection/control system and fire detection devices, and per local codes.			
The aerosol generators have an installed service life of ten (10) years. Replace each generator ten (10) years from the marked date code in the lower right corner of the product label.			

N.A.: Not Applicable

7.3 Inspection Procedures

7.3.1 Weekly

1. Check all electrical connections to insure operation of the Stat-X extinguishing system in the event of a fire.

2. Make a general visual inspection of all aerosol generators for damaged or missing parts.

3. Make sure that the generators are not obstructed and that the required clearances have been met.

7.3.2 Semi-Annual

1. Make a general visual inspection of all aerosol generators for damaged or missing parts.

2. Ensure access to hazard areas, lines of egress, and manual pull stations are unobstructed and that there are no obstacles inhibiting the proper operation of the aerosol generators or distribution of the aerosol in the event of a fire.

3. Inspect Stat-X aerosol generators for physical damage, such as cracks, dents, distortion, or corrosion. If damage is found, replace generator as instructed in Section 6 of this manual.

4. Inspect mounting brackets, straps, and associated hardware for loose, damaged, or broken parts. Replace damaged parts and tighten all loose hardware.

5. Inspect all manual pull stations for cracks, broken or cracked glass plate, dirt or distortion. Inspect station for signs of physical damage, replacing if necessary.

6. Inspect all electrical connections and run electrical continuity tests using an Ohmmeter. Repair and replace as necessary.

7. Make sure that the generators are not obstructed and that the required clearances have been met.

Replacement/Removal from Service

The aerosol generators have an installed service life of ten years. They are to be replaced ten years from the date code in the lower right corner of the product label. The Date Code appears as follows, where the 2-digit numeric character represents the year and the single digit numeric the month of shipment from the factory:

18	**19**	**20**	**21**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**

18 = 2018, 19 = 2019, 20 = 2020, etc. A unit marked 18 12, for example, would have shipped in December 2018

8.0 SYSTEM COMPONENTS

Aerosol Generator Assemblies

Model	Capacity	P/N
30E	30 grams	15100
60E	60 grams	15110
60ME	60 grams	15111
100E	100 grams	15120
250E	250 grams	15130
500E	500 grams	15140
1000E	1000 grams	15150
1500E	1500 grams	15160
2500E	2500 grams	15170

Mounting Brackets

Model	P/N
30 gram, 60 gram SS	18001
100 gram SS	18005
250 gram, 500 gram SS	18010
1000 gram, 1500 gram, 2500 gram SS	18015

9.0 WARRANTY

LIMITED WARRANTY STATEMENT

Fireaway represents that this product is free from defects in material and workmanship, and it will repair or replace any product or part thereof which proves to be defective in workmanship or material for a period of eighteen (18) months from the date of first shipment from our factory. Defective units should be returned shipment prepaid to the factory:

Fireaway Inc.
5852 Baker Road
Minnetonka, Minnesota USA 55345
www.statx.com

Fireaway will repair or replace and return shipping prepaid. Return or repair shall be the purchaser's sole remedy for defect.

Limitations of Liability

This warranty does not cover equipment damaged during shipment or by misuse, accident, or negligence, or which has been repaired or altered by others. Fireaway shall not under any circumstances be liable for special or consequential damages such as, but not limited to, damage or loss of property or equipment, loss of profits or revenue, cost of capital, cost of purchased or replacement goods, or claims by customers of the original purchaser. Remedies set forth herein to the original purchaser and all others shall not exceed the price of the equipment supplied.

This warranty is exclusively and expressly in lieu of all other warranties, whether expressed or implied, including warranty of merchantability or fitness.

APPENDIX A: SAFETY/INFORMATION BULLETINS

Stat-X fire extinguishing systems use flammable solid devices. Personnel responsible for fire extinguishing systems must be aware of the potential dangers associated with the improper handling, installation, or maintenance of this equipment.

Fire extinguishing system service personnel must be thoroughly trained in the proper handling, installation, and service of the Stat-X hardware and follow the instructions in this manual and in the Safety Bulletins contained in this Appendix. Fireaway has provided appropriate warnings and cautions throughout the text of this manual. These warnings and cautions are to be adhered to always. Failure to do so may result in potential injury to personnel.

Safety Bulletin #1

Environmental and Health Issues for STAT-X aerosol generators

Environmental Issues

There are no known environmental issues associated with the use of Stat-X aerosol generators. Both the Ozone Depletion Potential (ODP) and Global Warming Potential (GWP) are zero.

Toxicity and Health Issues

Aerosol generators do not present a known health hazard in their benign state - as the constituent chemicals are pressed into a solid form that is stable - even at elevated operating temperatures. There are no environmental or health hazards from the chemical in storage.

Unlike gaseous agents, the aerosol does not decompose in the presence of fire nor does it extinguish by oxygen deprivation. Stat-X suppresses fire (primarily) by chemical interference with the "Fire Propagation" radicals (OH, H, and O) that are essential elements in the expansion of the fire. Stat-X interacts rapidly with these free radicals within the fire zone – thus interrupting the on-going fire reaction.
The aerosol, itself, consists of solid and gas combustion products. The solid phase is composed of highly dispersed particles of salts and oxides of alkaline metals that present insignificant health hazards for humans at normal design concentrations. The gas phase may contain small amounts of carbon monoxide CO, carbon dioxide CO_2, nitrogen oxides NO_x, and ammonia NH_3. Production of these gases is minimal in the case of Stat-X due to its patented construction, chemical formulation, and its manufacture in the United States using only technical and reagent grade chemicals. In tests conducted by a certified, accredited testing facility in the United States, Stat-X generators were shown to produce gas levels several orders of magnitude less than the standard allowed for automobile airbag systems for passenger vehicles (See Figure 1).

Tests have shown no long-term negative effects from exposure to the aerosol. While the components of the aerosol are not considered toxic at normal concentration levels, ingestion of the ultra-fine particulate may cause short-term discomfort and unnecessary exposure should be avoided. Studies conducted to date, indicate that any potential toxicological issues with the aerosols in general are related to possible elevated levels of potentially harmful products that may be produced in the gas phase – such as, CO, NO_x, etc. - and not due to the influence of the solid particulate.[1,2] In the case of Stat-X, in particular, the effect is negligible due to the extremely low level of gas production (See Figure 1).

[1] E.A. Smith, E.C. Kimmel, et al, "Toxological Evaluation of Exposure to Two Formulations of a Pyrotechnically-Generated Aerosol: Range Finding and Multiple Dose", HOTWC.96

[2] "Search of Halon Alternatives in Fire Extinguishing" Safety Problems During Emergency Situations, Issue 1-M, 1992, pages 73-79.

In tests conducted by VNIIPO (Russian State Fire Protection Institute), the aerosol was considered to have the same acute toxicity as Halon 1301[3]. The Toxicology Institute of the Public Health and Medical Department of the Russian Federation and tests conducted by the Institute of Biophysics (Department of Public Health and Medicine Russian Federation), as well as others, have shown that the aerosol does not present a health hazard due to limited accidental exposure at normal design concentrations. Exposure to aerosol is generally of less concern than exposure to the decomposition products of a fire. Accidental exposures under five minutes are normally considered safe. Certain safety restrictions, however, should always be observed. Exposure to the aerosol should be avoided as ingestion of the ultra-fine particulate may cause short-term discomfort. The discharge of the aerosol also has a relatively high obscuration factor. Thus, the following system installation requirements must be observed.

System Installation Requirements

Total flood systems may be applied in normally occupied and unoccupied areas in conjunction with a 30 second time delay and system isolate switch to ensure egress of personnel prior to system discharge and manual only activation whenever personnel may be present in the protected volume.

[3] *Andreev V.A., et al, “Replacement of Halon in Fire Extinguishing Systems”, Proceedings of the Halon Alternatives Technical Working Conference, 1993.

Stat-X Aerosol Physical Properties
Average Values @ 100 gram/m^3 Concentration

Gas Products: (ppm)	Stat-X 15 minutes TWA*	Automobile-Airbag Emission Standard 20 minutes TWA*	NIOSH IDLH
NO_2	1.08	9.90	20.00
NO	0.97	50.10	100.00
NO_X = NO + NO_2	2.05	60.00	120.00
CO	84.20	445.00	1,200.00
CO_2	756.00	40,000.00	40,000.00
NH_3	58.30	151.50	300.00
Solid Particulate:			**Percent**
K_2CO_3			55.2%
$KHCO_3$			8.2%
KNO_2			7.9%
Other Potassium Compounds			5.5%
NH_4HCO_3			23.2%
pH in solution = 8.6			
Particle Size Distribution:			**Percent**
< 1μm			3%
< 2μm			76%
< 5μm			97%
> 5μm			3%
Operating and Storage Conditions:			
Humidity			Up to 95% @+54°C
Temperature			- 40°C to + 54°C
Shelf Life			10 years

* TWA = Time Weighted Average

Figure 1.0

SAFETY BULLETIN #2, FEBRUARY 18, 1999
SUBJECT: SAFE HANDLING PROCEDURES FOR AEROSOL GENERATORS

Before handling Stat-X aerosol generators, all personnel must be thoroughly trained in the safe handling of the generators, as well as, in the proper procedures for installation, removal, shipping, and disposal.

READ, UNDERSTAND, and ALWAYS FOLLOW the operation and maintenance manuals, owner's manuals, service manuals, etc., that are provided with the individual systems.

The following safety procedures must be observed always:

Moving Generators
Generators should be shipped compactly in an upright position in the packaging provided. They must be properly secured in place and not allowed to roll around or be dropped from the tailgates of vehicles. **Dropped generators are not to be installed.**

Rough Handling
Generators must not be dropped or permitted to strike violently against each other or other surfaces. **Dropped generators are not to be installed.**

Storage
Containers must be stored standing upright where they are not exposed to extreme environmental conditions or are subject to being knocked over.

SAFETY BULLETIN #3, FEBRUARY 18, 1999
SUBJECT: POST FIRE DISPOSAL OF AEROSOL GENERATORS

RECYCLING OF AEROSOL GENERATORS AFTER DISCHARGE:

In most cases the discharged generator can be disposed of in any landfill that handles industrial waste. However, local regulations must be researched and observed. Each discharged aerosol generator will contain the following material:

1. Stainless steel outer shell – all.
2. Mild steel cross members (100, 250, 500), spacer ring – all.
3. Stainless steel inner shell (30 – 2500), top and bottom plates, screens (all sizes), and cross members (1000, 1500, 2500)
4. Activated Alumina: CAS 1333-84-2 (Aluminum Oxide non-fibrous)

30E	60E	100E	250E	500E	1000E	1500E	2500E
30g	60g	100g	550g	970g	1670g	2350g	3600g

5. Fiberglass rope (ø1cm x 50cm).- 250 - 2500
6. Ceramic Paper < 15g (30, 60, 100).
7. Wire – 24gauge, PVC coated (< 1g)
8. Trace Chemicals: K_2CO_3 (water-soluble particulate “trapped” in unit during discharge).

Contact Fireaway if there are any questions relative to the above.

General Bulletin # 4:

EQUIPMENT EXPOSURE ISSUES FOR STAT-X AEROSOL GENERATORS

Stat-X aerosol has been tested on a wide range of materials including structural, aviation composites, and materials commonly used in electronics, and circuit boards. In all cases it has been shown that Stat-X has no deleterious effect on the operating capability of equipment.[4][5][6]

EXTINGUISHING MECHANISM

"Fire propagation" radicals (OH, H, and O) are essential elements in the propagation of the fire. Stat-X suppresses the fire (primarily) by chemical interference with these free radicals within the fire zone – thus interrupting the on-going fire reaction.

Potassium radicals (K) are the main active component of Stat-X aerosol. They are very active and react with these "propagation radicals" – much like the bromine radicals in Halons. The chemical reaction may be represented as follows, for example:

$K + OH = KOH$
$KOH + H = K + H_2O$
K + OH, etc…

In addition, the flame propagation radicals recombine on the surface area of the ultra-fine aerosol particulate to further interfere with flame propagation:

$O + H = OH$
$H + OH = H_2O$

AEROSOL CHARACTERISTICS

Due to the ultra-fine particle size and the method of generation, the particulate is quite buoyant and suspends in the gas/air mixture within the protected enclosure. Because of this "buoyant" effect the aerosol does not begin to "settle" for an extended period and, therefore, is extremely easy to vent from the protected area. Minor amounts of particulate may be deposited on equipment and, can be cleaned with a water and vinegar solution after venting extraction of the air within the protected volume through a fan or air handling system – followed by a blow down with compressed air. Any particulate deposited on horizontal surfaces will be ≤ 2µm.

As a precautionary measure, however, it is always good practice to inspect and clean the site thoroughly following a discharge. While the aerosol itself is quite "clean", environmental factors are also a consideration. The unknown, and potentially harmful, by-

[4] Findings, Study of Gas Aerosol Fire Extinguishing Compounds on Structural Materials, Maximov, Babkin, Samokhvalova, Report of Metall Company 1991.

[5] Findings, Corrosive Effect of Gas Aerosol Fire Extinguishing Compounds on Structural Materials in Aviation Technology, Leonova G.P., Usankova L.A., Report of All Union Scientific Research Institute for Aviation Materials 1991

[6] Findings, Effect of Gas Aerosol Fire Extinguishing Compounds on Electronic Equipment, Karelin V.G., Antonov, B.I., Scientific Industrial Organization Energia, 1991

products of an actual fire pose the biggest risk to sensitive electronic equipment. Because unknown products from the fire itself may be present, it is always recommended that equipment be blown down with air or vacuumed following a discharge to ensure no unwanted by-products from the fire itself are present.

Unlike HFC's, which can break down and produce deleterious compounds such as hydrofluoric acid when exposed to the high heat of a fire, Stat-X does not break down when exposed to a fire and quickly extinguishes by means of chemical interference with the flame's free radicals. Stat-X has been approved by the United States Environmental Agency (EPA) and approved for use under the EPA's Significant New Alternatives Program (SNAP).[7]

Stat-X aerosol composition[8]

Stat-X aerosol consists of a gas (30%) and solid particulate (70%) mixture. Mean dimensions of aerosol particulate are in the range of 1-2 µm. The aerosol consists of the following, primarily, potassium compounds (% mass 90 seconds after discharge) and carrier gases:

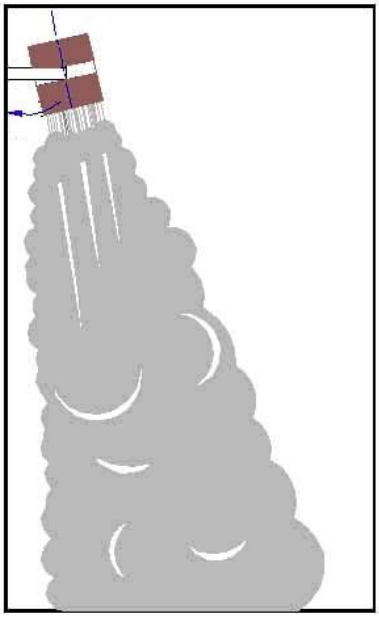
Compound: (particulate)	**% Original Mass**
Particulate captured within generator housing during discharge/cooling	30.00
K_2CO_3	22.08
$KHCO_3$	3.280
KNO_2	3.160
Other potassium compounds	2.200
NH_4HCO_3	9.280
Compound: (gas carrier)	
N_2	21.93
H_2O	6.550
CO_2	1.361
CO	0.097
NH_3	0.041
NO	0.001
NO_2	0.002
HCN	0.006
Other	Trace
Total	100.00

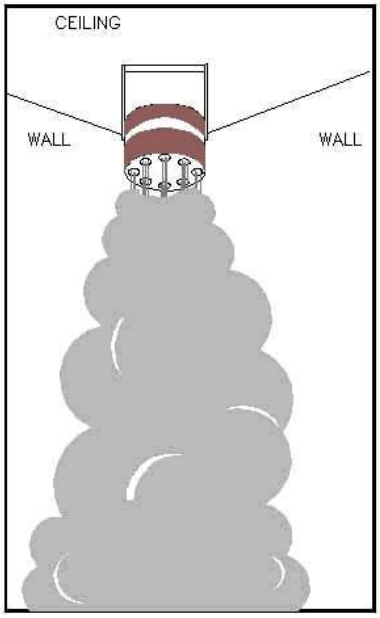
[7] Authorization letter from US EPA, 2004

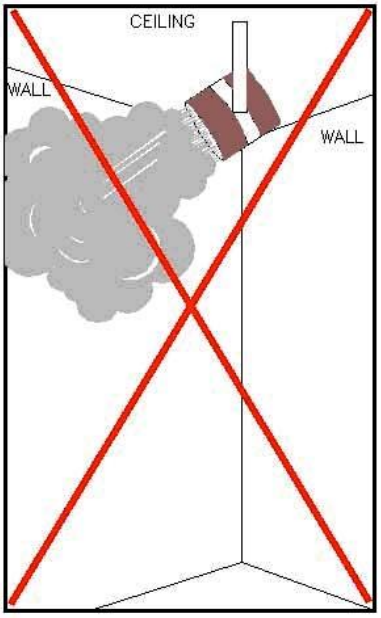
[8] 100 ft^3 tank testing of Stat-X Fire Suppressant Units, Talley Defense Systems, 1999

General Bulletin # 5: Stat-X Installation Guidelines

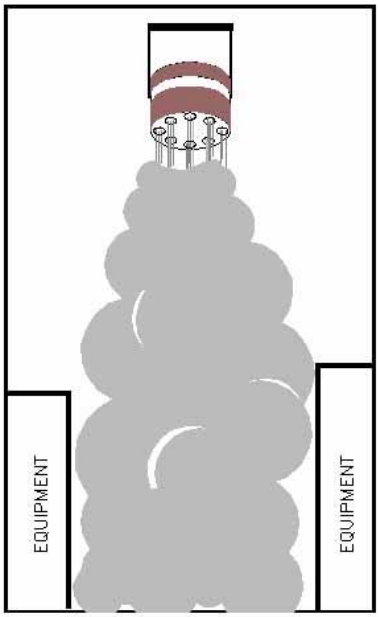
Aerosol generators should normally be mounted near ceiling height and angled to discharge down (under floor excepted) toward the floor at an angle to insure three - dimensional distribution of aerosol. Normal orientation from vertical is 15° - 30°.

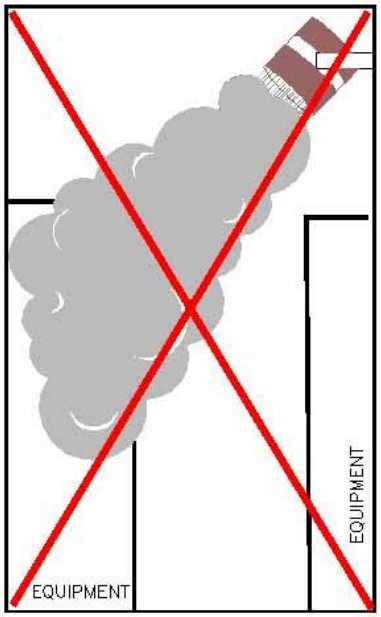


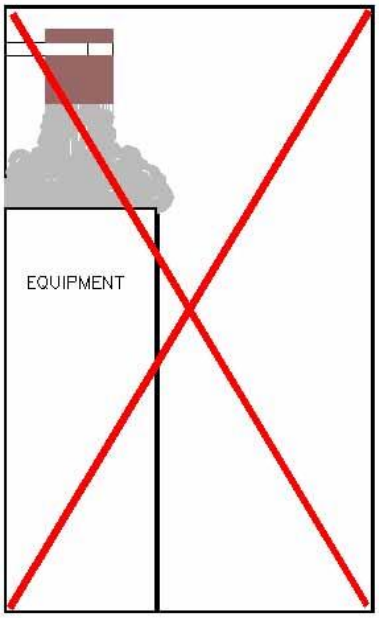




Aerosol generators must never be positioned to discharge directly at each other and must be mounted in such a way as to have an unobstructed discharge path, nor discharge at close range onto walls, ceiling, or equipment. Always check for obstructions in the path of the aerosol discharge stream. Generators must be installed such that they cannot cause personnel injury upon activation.







APPENDIX B: SHIPPING CLASSIFICATION

Stat-X generators have received the following shipping classification from the United States Department of Transportation:

1. For shipment by motor vehicle, rail, or cargo vessel: UN3268, Class 9, Proper Shipping Name: Safety Devices (check latest factory SDS if US DOT Special Permit is applicable)
2. For shipment by air (Cargo or Passenger): UN0432, Class 1.4S, Proper Shipping Name: Article, Pyrotechnic for Technical Purposes

Generators must be shipped as originally packaged by the manufacturer.

Generators packaged and shipped as Class 1.4S by aircraft shall have the following storage limitations:

Maximum weight/ single packaging on Passenger Aircraft	25 kgs
Maximum weight/ single packaging on Cargo Aircraft	100 kgs

Stat-X generators have been ruled by the United States BATF to be exempt from the reporting requirements of 18 U,S.C. Chapter 40 sections 842 and 843 and the implementing regulations.

APPENDIX C: MATERIAL SAFETY DATA SHEET

Stat-X® Aerosol Fire Suppression

Fireaway

Safety Data Sheet according to Regulation (EC) No. 1907/2006 (REACH) & HazCom 2012

SDSR# FU009B
DATE: 6/18

5852 Baker Road
Minnetonka, MN
55345
USA

SECTION 1: Identification of the Substance/Mixture and of the Company/undertaking Product Identifier

Stat-X® Condensed Aerosol Generators - Models 30 to 2500.



Safety Device

Details of the supplier of the safety data sheet:
Fireaway Inc., 5852 Baker Road, Minnetonka, MN, 55345, USA
Telephone +1 (952) 935-9745, Fax +1 (952) 935-9757
Email address of the competent person: info@statx.com

For information only, call 1-952-935-9745.
For emergencies, call
INFOTRAC
USA & CANADA: +1-800-535-5053
INTERNATIONAL: +1-352-323-3500 (collect)

Only Representative Contact:
Blue Frog Scientific Limited, Quantum House,
91 George Street, Edinburgh, EH2 3ES
+44 (0) 131 523 1412

SECTION 2: Hazards Identification

Possible exposure to aerosol suppression agent if generator is activated. May cause temporary, mild irritation of mucous membranes if inhaled. US EPA listed under US EPA SNAP List for use as a total flooding fire suppression agent in normally occupied spaces.

SECTION 3: Composition/Information on Ingredients

Hazardous components: Does not contain dangerous materials as defined by ordinance on hazardous materials.

Components – Chemical (Hazardous Components ≥ 1%)	CAS#	Weight %	COMMENTS:
Potassium Nitrate ECHA Registration no. 01-2119488224-35-0066	7757-79-1	75.0	Components are blended and pressed into a highly stable, molded form. Molded composition is contained within a sealed double-walled stainless steel housing – no environmental exposure. Upon generator unit activation these chemical elements are not discharged from the unit but are fully consumed by an internal chemical reaction.
DCDA	461-58-5	16.5	
Organic Resin	9003-35-4	8.5	
Appearance & Odor:			Beige to white in color. No odor.
Auto-Ignition Temperature:			300° C
Solubility in Water:			Slightly Soluble

SECTION 4: First aid measures

Contact Method:	Procedure:
Inhalation	Remove to fresh air
Eye Contact	Flush with water
Skin Contact	Wash with soap and water.
Ingestion	Not a likely route of exposure.
Seek medical attention for further treatment, observation, and support if necessary.	

SECTION 5: Firefighting Measures

In the event of a fire, evacuate the area and inform emergency services. Ignition of Stat-X produces a fire-suppression aerosol. Water may be used as an additional suppression agent.

SECTION 6: Accidental Release Measures

If these devices are spilled they can be safely recovered by hand and should be inspected for damage prior to repacking. Suspect or damaged articles should be labeled and consigned for correct destruction.

SECTION 7: Handling and Storage

Store in temperate conditions. Avoid shock, electric currents, static discharge, excessive heat and extended periods of storage at temperatures greater than 65°C.

SECTION 8: Exposure Controls/Personal Protection

Respiratory Protection	Ventilate area completely after discharge. Do not enter area prior to complete venting of enclosure. Use filter mask as necessary during clean-up.
Hand Protection	Wear gloves if handling generators prior to cooling.
Eye Protection	Safety glasses are advisable.
Skin Protection	N/A

SECTION 9: Physical and Chemical Properties

Appearance:	Stainless Steel Cylinder up to 270 mm in length

SECTION 10: Stability and Reactivity

These devices are extremely stable below 125°C. They are packaged to protect the articles from electrical power and shock. As with any stored products, stored packaging should be protected from fire and high temperatures.

SECTION 11: Toxicological Information

Toxic by-products of combustion are extremely low. Main by-products are listed below with 15-minute TWA values for a maximum 100g/m^3 concentration in a hermetically sealed volume.

Gas	15 minute Time Weighted Average in parts per million
NO_2	1.08
NO	0.97
CO	84.20

SECTION 12: Ecological Information

These devices are sealed and present no ecological hazards. The aerosol produced upon ignition has very low global warming potential and an ozone depletion potential = 0.

SECTION 13: Disposal Considerations

Comply with all local, state, and federal/international regulations.

SECTION 14: Transport Information

UN Number: 3268	Shipping Limitations:	
UN Classification: Class 9, Safety Devices US DOT PHMSA Special Permit DOT-SP 20600, dated Feb. 5, 2018	Cargo Air	Not permitted per Special Permit DOT-SP 20600. US DOT permits shipping by air when shipped as Class 1.4S UN0432, Max single packaging – 100 kg.
	Passenger Air	Not permitted per Special Permit DOT-SP 20600. US DOT permits shipping by air when shipped as Class 1.4S UN0432. Max single packaging – 25 kg.

SECTION 15: Regulatory Information

S15	Keep away from heat
S33	Take precautionary measures against risk of static discharge
S35	This material and its container must be disposed of in a safe way
S38	In case of insufficient ventilation wear suitable respiratory equipment
S39	Wear eye/face protection

SECTION 16: Other Information

Comply with manufacturer's installation and maintenance procedures.

Disclaimer: The information contained herein is accurate to the best knowledge and belief of Fireaway Inc., and is intended to describe the product for health, safety, and environmental requirements only. It is not intended and should not be construed as a warranty. Consult Fireaway for further information.

APPENDIX D: TABLE TO CALCULATE K_2

Leakage Parameter LP^{m-1}	K_2 value at parameter of leakage distribution according to the height of the protected enclosure LH%											
	0	5	10	20	30	40	50	60	70	80	90	100
0.000	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025
0.001	1.028	1.031	1.037	1.049	1.062	1.075	1.087	1.089	1.089	1.074	1.057	1.046
0.002	1.032	1.037	1.048	1.073	1.098	1.122	1.146	1.150	1.150	1.122	1.088	1.066
0.003	1.035	1.042	1.060	1.097	1.133	1.169	1.203	1.208	1.208	1.168	1.119	1.086
0.004	1.038	1.048	1.071	1.120	1.167	1.214	1.258	1.265	1.265	1.213	1.149	1.106
0.005	1.033	1.053	1.082	1.143	1.201	1.258	1.312	1.320	1.320	1.257	1.178	1.125
0.006	1.045	1.059	1.094	1.166	1.234	1.301	1.363	1.373	1.373	1.299	1.207	1.144
0.007	1.048	1.064	1.105	1.188	1.266	1.343	1.413	1.424	1.424	1.340	1.235	1.163
0.008	1.051	1.070	1.116	1.210	1.298	1.384	1.462	1.473	1.473	1.380	1.262	1.181
0.009	1.054	1.075	1.127	1.232	1.329	1.423	1.508	1.521	1.521	1.419	1.289	1.200
0.010	1.057	1.080	1.136	1.253	1.359	1.462	1.554	1.568	1.568	1.457	1.315	1.217
0.011	1.060	1.086	1.149	1.275	1.390	1.500	1.598	1.612	1.612	1.493	1.341	1.235
0.012	1.064	1.092	1.160	1.296	1.419	1.536	1.641	1.656	1.656	1.529	1.366	1.252
0.013	1.067	1.097	1.170	1.316	1.448	1.572	1.682	1.698	1.698	1.563	1.391	1.269
0.014	1.070	1.103	1.181	1.337	1.476	1.607	1.722	1.739	1.739	1.597	1.415	1.280
0.015	1.075	1.108	1.192	1.357	1.504	1.641	1.761	1.778	1.778	1.630	1.439	1.303
0.016	1.076	1.134	1.202	1.377	1.531	1.675	1.799	1.817	1.817	1.662	1.462	1.319
0.017	1.079	1.119	1.213	1.396	1.558	1.707	1.836	1.855	1.855	1.693	1.485	1.335
0.018	1.083	1.124	1.223	1.416	1.585	1.739	1.872	1.891	1.891	1.724	1.508	1.351
0.019	1.086	1.130	1.234	1.435	1.610	1.770	1.907	1.926	1.926	1.754	1.530	1.366
0.020	1.089	1.135	1.244	1.454	1.636	1.800	1.941	1.961	1.961	1.783	1.552	1.382
0.021	1.092	1.140	1.254	1.473	1.661	1.830	1.974	1.994	1.994	1.811	1.573	1.399
0.022	1.095	1.146	1.264	1.491	1.685	1.859	2.006	2.027	2.027	1.839	1.594	1.412
0.023	1.098	1.151	1.275	1.510	1.709	1.888	2.038	2.058	2.058	1.866	1.614	1.427
0.024	1.101	1.156	1.285	1.528	1.733	1.915	2.068	2.089	2.089	1.892	1.634	1.442
0.025	1.104	1.161	1.295	1.546	1.756	1.993	2.098	2.119	2.119	1.918	1.654	1.456
0.026	1.107	1.167	1.305	1.563	1.779	1.969	2.127	2.149	2.149	1.943	1.674	1.470
0.027	1.111	1.172	1.315	1.581	1.802	1.995	2.156	2.177	2.177	1.968	1.693	1.484
0.028	1.114	1.177	1.324	1.598	1.824	2.021	2.183	2.205	2.205	1.992	1.712	1.498
0.029	1.117	1.182	1.334	1.615	1.846	2.046	2.210	2.232	2.232	2.016	1.730	1.511
0.030	1.120	1.188	1.344	1.632	1.867	2.071	2.237	2.258	2.258	2.039	1.748	1.524
0.031	1.123	1.193	1.354	1.648	1.888	2.095	2.263	2.285	2.285	2.061	1.766	1.538
0.032	1.126	1.198	1.363	1.665	1.909	2.118	2.288	2.310	2.310	2.083	1.784	1.551
0.033	1.129	1.203	1.373	1.681	1.929	2.141	2.313	2.335	2.335	2.105	1.801	1.564
0.034	1.132	1.208	1.382	1.679	1.990	2.164	2.337	2.359	2.359	2.126	1.818	1.577
0.035	1.135	1.213	1.392	1.713	1.969	2.186	2.360	2.382	2.382	2.147	1.834	1.589
0.036	1.138	1.218	1.401	1.729	1.989	2.208	2.383	2.405	2.405	2.167	1.851	1.602
0.037	1.141	1.223	1.410	1.745	2.008	2.229	2.406	2.428	2.428	2.187	1.867	1.614
0.038	1.144	1.229	1.420	1.760	2.027	2.250	2.428	2.450	2.450	2.207	1.883	1.625
0.039	1.147	1.234	1.429	1.775	2.045	2.271	2.449	2.472	2.472	2.226	1.899	1.638
0.040	1.150	1.239	1.438	1.790	2.064	2.291	2.470	2.493	2.493	2.245	1.914	1.649
0.050	1.185	1.261	1.497	1.883	2.217	2.459	2.638	2.672	2.672	2.417	2.050	1.742
0.060	1.208	1.294	1.550	1.983	2.327	2.600	2.792	2.833	2.833	2.544	2.167	1.817
0.070	1.226	1.318	1.617	2.075	2.458	2.733	2.942	2.992	2.992	2.698	2.268	1.878
0.080	1.263	1.356	1.667	2.175	2.577	2.892	3.100	3.159	3.159	2.843	2.391	1.975
0.090	1.294	1.393	1.733	2.292	2.708	3.058	3.294	3.358	3.358	3.000	2.525	2.066
0.100	1.319	1.438	1.781	2.358	2.808	3.168	3.418	3.462	3.462	3.107	2.614	2.138
0.110	1.351	1.468	1.854	2.454	2.932	3.300	3.556	3.597	3.597	3.225	2.713	2.228
0.120	1.382	1.504	1.923	2.556	3.049	3.423	3.683	3.721	3.721	3.334	2.804	2.298
0.130	1.413	1.540	1.988	2.653	3.160	3.535	3.798	3.834	3.834	3.435	2.888	2.363
0.140	1.444	1.577	2.048	2.745	3.265	3.638	3.901	3.937	3.937	3.526	2.963	2.423

Table to Calculate K_2
(continued)

Leakage Parameter LP^{m-1}	K_2 value at parameter of leakage distribution according to the height of the protected enclosure LH%											
	0	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
0.150	1.476	1.612	2.103	2.833	3.363	3.732	3.992	4.028	4.028	3.608	3.031	2.475
0.160	1.507	1.648	2.153	2.915	3.453	3.817	4.071	4.109	4.109	3.681	3.091	2.521
0.170	1.538	1.683	2.199	2.993	3.538	3.892	4.138	4.180	4.180	3.745	3.143	2.561
0.180	1.569	1.718	2.240	3.067	3.617	3.957	4.194	4.239	4.239	3.801	3.225	2.595
0.190	1.600	1.752	2.276	3.135	3.688	4.013	4.238	4,288	4.288	3.847	3.267	2.622
0.200	1.632	1.786	2.308	3.199	3.753	4.059	4.269	4.326	4.326	3.884	3.333	2.643

APPENDIX E: COMPATIBLE FIRE ALARM CONTROL PANELS

Manufacturer	Model
Potter Electric	PFC-4410RC
Potter Electric	PFC-6075R
Potter Electric	P-400R
Potter Electric	ARC-100
Notifier	RP-2002 / RP-2002E
Notifier	NFS-320 / NFS-320E
Notifier	NFS2-640 / NFS2-640E
Gamewell-FCI	GF506R
FireLite	MRP-2002 / MRP-2002E