Victaulic Vortex™

Hybrid Fire Extinguishing System

ABSORB HEAT AND STARVE THE FIRE

Victaulic®

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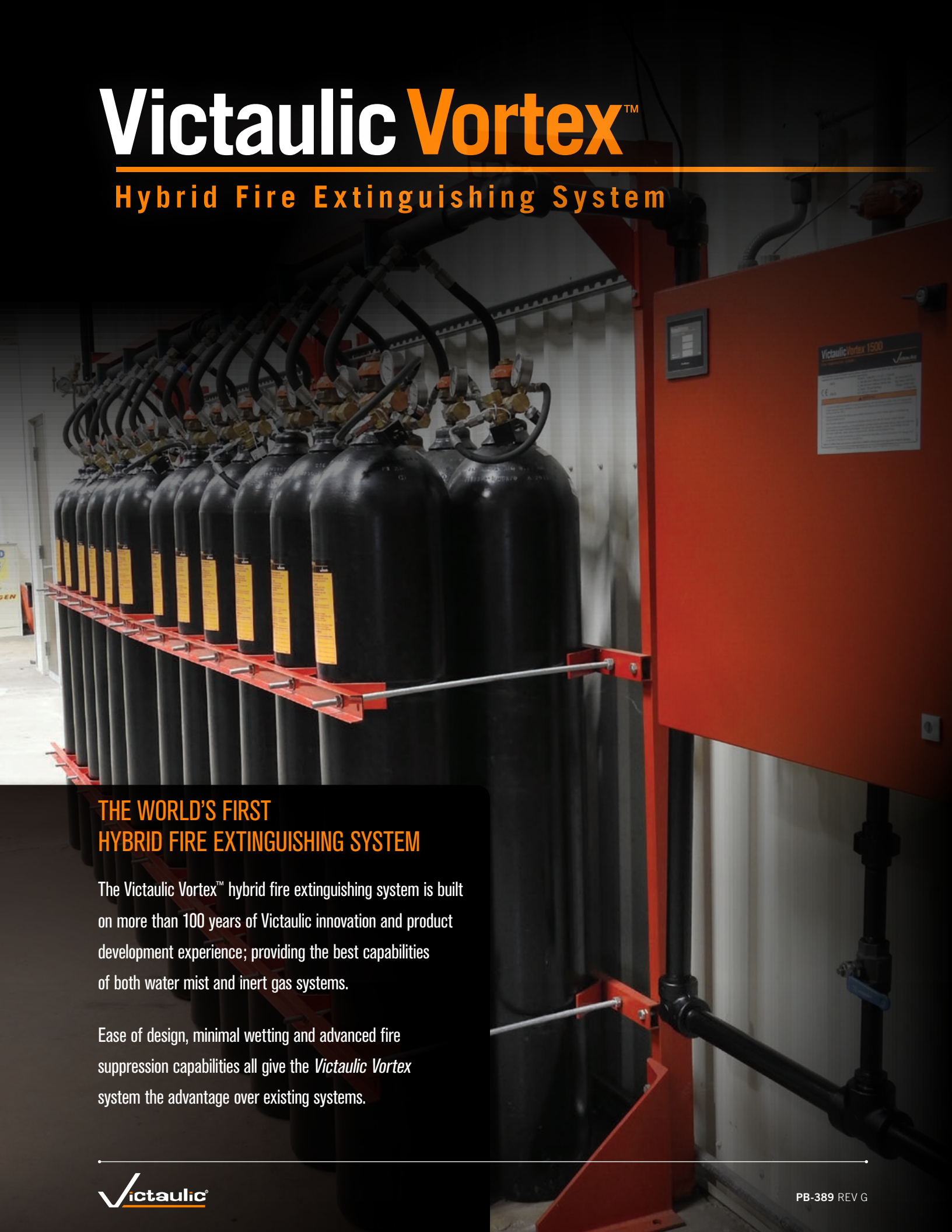


THE WORLD'S FIRST HYBRID FIRE EXTINGUISHING SYSTEM

The Victaulic Vortex™ hybrid fire extinguishing system is built on more than 100 years of Victaulic innovation and product development experience; providing the best capabilities of both water mist and inert gas systems.

Ease of design, minimal wetting and advanced fire suppression capabilities all give the *Victaulic Vortex* system the advantage over existing systems.

HOW IT WORKS

ABSORBING HEAT AND STARVING THE FIRE

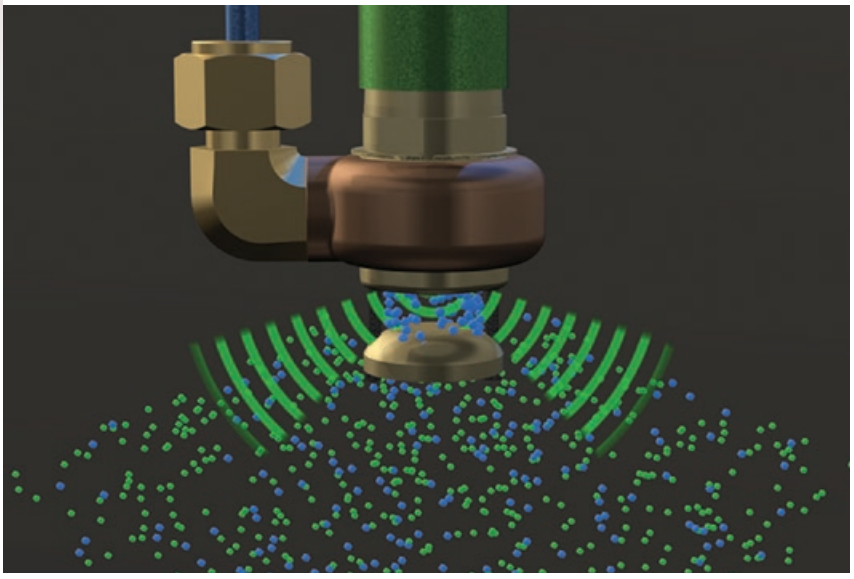
The Victaulic Vortex™ hybrid fire extinguishing system mixes nitrogen with atomized water particles, attacking the oxygen and heat legs of the basic fire triangle to suppress and extinguish.

ENGINEERED DESIGN

The emitter shape is based on supersonic aircraft wing design. The nitrogen flow drops rapidly to subsonic velocity, producing shock waves that atomize the water injected through the emitter.

EMITTER DISCHARGE

High velocity and low pressure creates a uniform blend of water and nitrogen; water is introduced to a jet stream of nitrogen at supersonic speed, then delivered with the nitrogen into the protected space.



SAFE ENVIRONMENT

Nitrogen is the primary extinguishing agent in smaller fires, reducing the oxygen level in the space within safe breathing tolerances, where combustion cannot be sustained.

Exclusive Features

IMMEDIATE ACTIVATION

No delay in system activation

Controlled discharge rates and greater life safety reduce the need for pre-discharge alarms

SUSTAINABLE DESIGN

Non-toxic agents that keep personnel safe during activation

BACK ONLINE IN NO TIME

Rapid system recharge that reduces downtime

EASY CLEANUP

EASE OF INTEGRATION

Compatible with fire protection systems within the facility to provide greater design flexibility in retrofit and new construction

ROOM INTEGRITY

Nitrogen and water reduces the need to fan test and completely seal rooms to maintain protection

WATER SPARSE PRESENCE

The system delivers as little as one gallon of water per emitter per minute. Each emitter can protect up to 2,500 sq. ft^3 | 71 m^3

INDEPENDENT ZONE CONTROL

Multiple zones may share a common water and nitrogen source

Did You Know?

ABSORB AND COOL

In larger fires, homogeneous mixtures are more effective, cooling the fire by absorbing the heat and reducing the available oxygen. The heat-absorbing water droplet surface area is 90× greater than that of any standard sprinkler system, providing maximum heat absorption efficiency.

BUILT FOR PERFORMANCE

Agency Testing and Evaluations

FM has Approved the Victaulic Vortex™ 1000 system for the protection of combustion turbines, machinery spaces, and special hazard machinery spaces in enclosures with volumes not exceeding 127,525 ft³ | 3611 m³ and a maximum height of 24.6 ft | 7.5 m.

The *Victaulic Vortex* system has been witnessed by Underwriter's Laboratory and found to extinguish Class A polymeric and wood crib materials and Class B flammable liquid fires effectively.

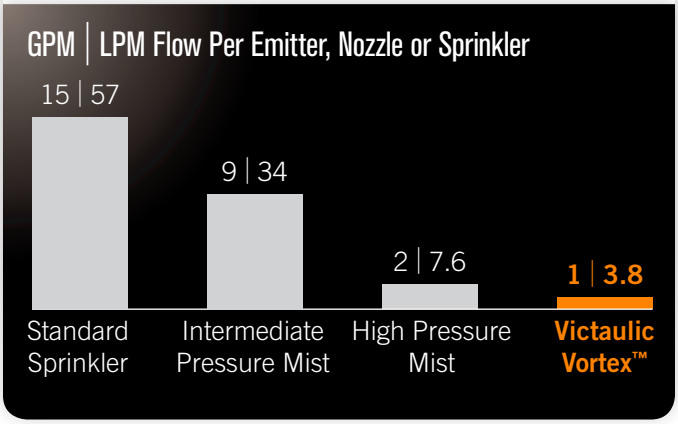
The EPA has provided a Significant New Alternatives Policy (SNAP) Approval for the *Victaulic Vortex* system, listing the system as a hybrid inert gas, water-based system and an acceptable replacement for Halon 1301 in total flooding applications.

The *Victaulic Vortex* system has been tested by both Victaulic and independent laboratories and shown to be effective using fire test protocols contained in water mist and clean agent approval standards.

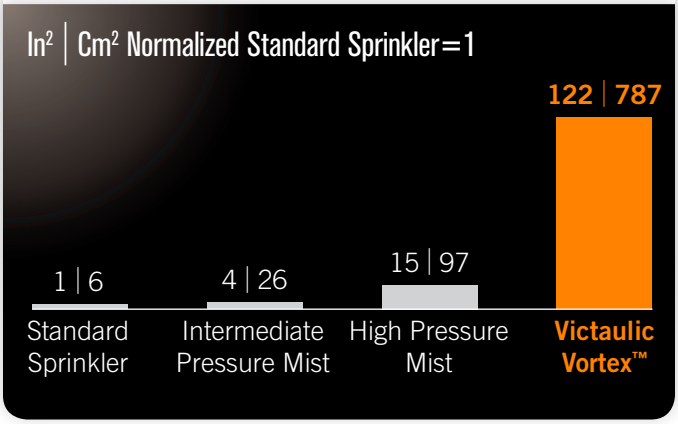
By only using the natural materials of water and nitrogen, the *Victaulic Vortex* system:

- is not subject to specific government regulations such as certificates of approval due to Ozone Depletion Potential (ODP).
- does not require special processes for the replacement of proprietary agents since the materials required for system recharging are readily available.

RELATIVE AMOUNT OF WATER REQUIRED



RELATIVE SURFACE AREA OF HEAT EXPOSURE



Environment Impact Comparison

VICTAULIC VORTEX™ HYBRID FIRE EXTINGUISHING SYSTEM	**The <10 µm sized water droplets remove the heat in large fires and aid in the radiative and convective heat blocking. The nitrogen extinguishes small fires in large rooms in naturally ventilated environments.**
Halocarbons	Rely on flame temperature reduction due to the thermal characteristics of the agent or disruption of the combustion process. No reduction in radiative or convective heat transfer and the fuel is generally not cooled leading to possible re-ignition. Halogenated Agents may be broken down into acids and other hazardous substances by exposure to high temperatures that may be present in a fire or at heated equipment.
Inert Gases	Rely primarily on oxygen reduction. Limited thermal cooling and no reduction of radiative or convective heat transfer. Fuel is not cooled and re-ignition from hot objects is possible.
High Pressure Water Mist	Water extracts heat from the fire. Steam generated from the fire aids in the radiative and convective heat blocking. Momentum is generally lost within a short distance of the nozzle. More efficient for large fire extinguishment.
Intermediate Pressure Water Mist and Standard Sprinkler Systems	Larger size water droplets are used to soak the fuel source. Steam generated from the fire aids in the radiative and convective heat blocking. Large droplet size and momentum generally make these less efficient for shielded fires.

Water Characteristics Comparison

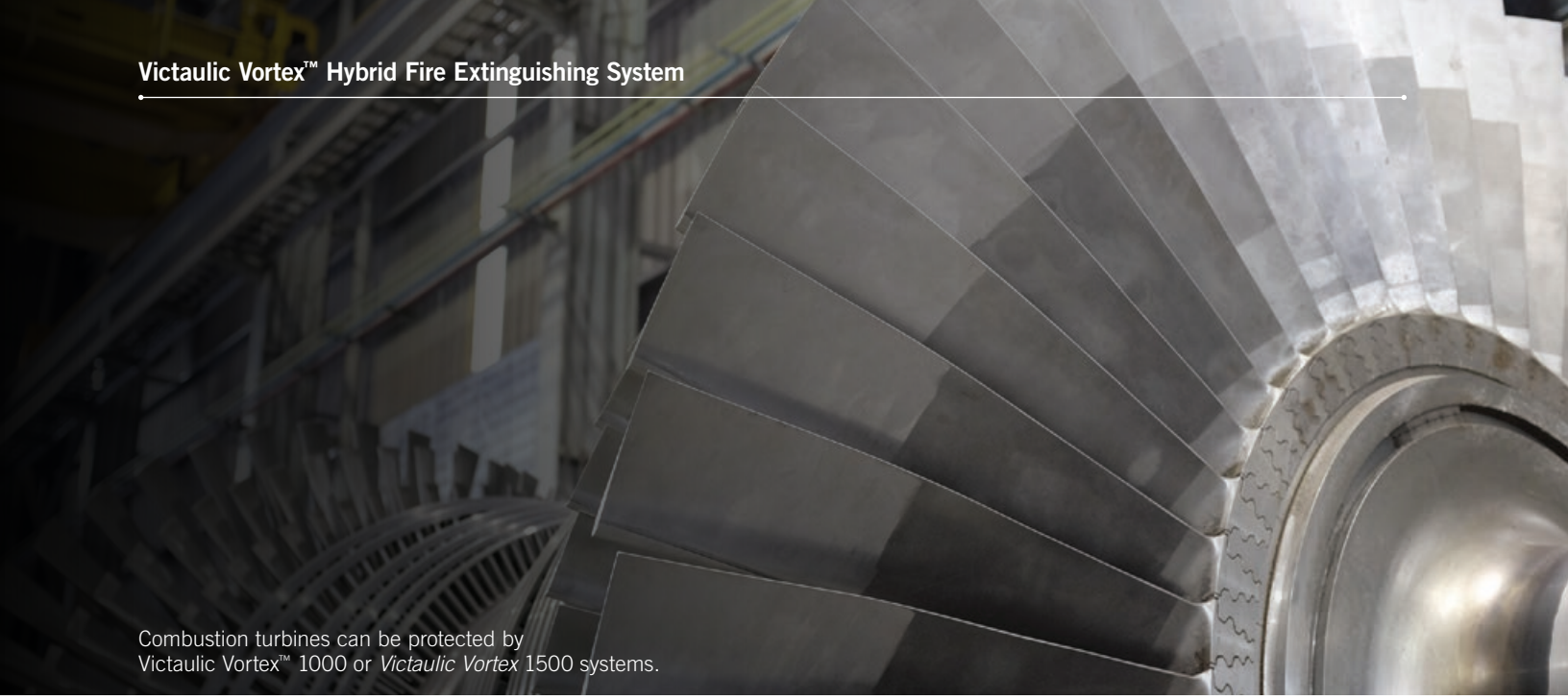
	FLOW, GPM PER EMITTER, NOZZLE OR SPRINKLER	DROP SIZE, µm	OPERATING PRESSURE, PSIG
VICTAULIC VORTEX HYBRID FIRE EXTINGUISHING SYSTEM	**<=1**	**<10**	**25**
CO_2	Very High Flow	N/A	>600
Halocarbons	Very High Flow	N/A	360–500
Inert Gases	High Flow	N/A	>600
High Pressure Water Mist	2	50 – 100	>500
Intermediate Pressure Water Mist	9	300	175–500
Low Pressure Water Mist	6	<1000	<175
Standard Sprinkler Systems	15	>1000	<175

*Dependent upon system design

SYSTEM OVERVIEW

	Victaulic Vortex™ 500 Hybrid Fire Extinguishing System	Victaulic Vortex™ 1000 Hybrid Fire Extinguishing System
System Type	Pre-Engineered	Engineered
Approvals	Performance based design EPA SNAP	FM 5580 machinery spaces and combustion turbines EPA SNAP
Typical Applications	Small data center, MCC rooms, and other Class A hazards	Combustion turbines and machinery spaces
Maximum Coverage	Approximately 4,500 ft^3 | 1372 m^3	127,525 ft^3 | 38,870 m^3
Maximum Ceiling Height	24.6 ft | 7.5 m	24.6 ft | 7.5 m
Emitter	⅝" Series 954	½" Series 953
Emitter Coverage	N/A	2,500 ft^3 | 762 m^3
Zoned System Option	No	Yes

* Self-contained/pre-engineered unit



Combustion turbines can be protected by Victaulic Vortex™ 1000 or *Victaulic Vortex* 1500 systems.

Victaulic Vortex™ 1500 Hybrid Fire Extinguishing System	Victaulic Vortex™ 2000 Hybrid Fire Extinguishing System
Engineered	Engineered
Performance based design EPA SNAP	FM 5560 wet benches and similar equipment EPA SNAP
Combustion turbines, machinery spaces, data centers, and manufacturing equipment	Wet benches and similar processing equipment
No maximum	No maximum
24.6 ft | 7.5 m Second row of emitters allowed for higher ceilings	53" | 1.3 m
¼", ⅜", ½", ⅝" Series 953 and 954 in brass, stainless, and PVDF	¼" Series 953 PVDF
1,700–2,100 ft^3 | 518–640 m^3 at 500 ft | 152 m ASL	Approximately 5 ft^2 | 1.5 m^2
Yes	Yes

TESTING AND RESEARCH ON HYBRID FIRE EXTINGUISHING SYSTEMS

In addition to NFPA and FM standards, there is a substantial amount of research and testing available on Hybrid Fire Extinguishing Systems. Variables recently identified as requiring more research are the effects of altitude, enclosure integrity and fire size on extinguishing time and hybrid media requirements. In 2016, the NFPA Fire Protection Research Foundation established a Project Technical Panel (PTP) to provide oversight for Hybrid Fire Extinguishing System testing. Upon commissioning of this testing, limited data was available regarding fire extinguishing testing at high elevations.

In order to eliminate external variables in relation to room geometry and size, a mobile fire laboratory was constructed using a 40 ft | 12.2 m cargo container as the enclosure. (Figure 1). A Victaulic Vortex™ fire extinguishing system was installed in the container, and the laboratory included allowances for adjusting nozzle placement and the quantity of openings in the enclosure. Tests were conducted by Victaulic at locations with elevations of 500 ft | 152 m Above Sea Level (ASL), 6500 ft | 1981 m ASL and 10,000 ft | 3048 m ASL. Fire tests were conducted using similar test protocol as Underwriters Laboratories UL 2127, Inert Gas Clean Agent Extinguishing System Units, with fuels including heptane and polymers, polypropylene (PP), acryonitril butadiene styrene (ABS) and polymethyl methacrylate (PMMA). Additional tests were performed at a lower elevation, including extinguishment of wood crib fires, variations to opening size and fire size, and the ability to prevent re-ignition.

Data collected from the mobile laboratory demonstrated that the required amount of hybrid media for extinguishment decreases with elevation. The new data provided a basis for using the Atmospheric Correction Factors (ACF) determined in NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems to adjust the required amount of hybrid media based on the local atmospheric pressure.

Testing has also demonstrated that designing a total flooding Hybrid Fire Extinguishing System for a smaller 68kW heptane fire (Figure 2) resulted in a conservative design when larger fires are considered. In total flooding applications, as fire size increased (utilizing a larger fuel source), extinguishment occurred sooner, based on increased oxygen consumption from the fire and increased oxygen dilution from conversion of water to steam.

The project included tests to evaluate the extinguishment and protection times for Hybrid Fire Extinguishing Systems using different sized openings in the enclosure. Testing of the *Victaulic Vortex* Hybrid system, in an enclosure with varied opening sizes, demonstrated that a total flooding Hybrid Fire Extinguishing System will provide protection from re-ignition after the fire has been extinguished and the discharge has stopped.

To test protection time of a hybrid system, re-ignition of the fuel was attempted after extinguishment. The ignition source was a spark provided by an oil burner ignition transformer that was used for ignition and re-ignition of the fuel. For the Victaulic Vortex System used for this test series, the maximum recommended opening size of 1.25 ft^2 | 0.12 m^2 per nozzle provided 10 minutes of protection time. Smaller opening sizes were capable of providing substantially longer protection times, in some cases exceeding 1 hour of protection.

Outside of this work with the NFPA Fire Protection Research Foundation, research has been conducted on combustion turbines used for power generation. FM 5580, Approval Standard for Hybrid Fire Extinguishing Systems, allows for the approval of Hybrid Fire Protection Systems for the protection of combustion turbines. Combustion turbines operate at very close internal clearances and there is concern that discharging water onto the case can cause rapid cooling and failure. Victaulic, manufacturer of the *Victaulic Vortex* Hybrid Fire Extinguishing System, has worked with owners and operators of Frame 7 combustion turbine and FT4 Aero-derivative turbines to conduct discharge testing on operating units deployed at power generation facilities. Testing included bringing the unit up to temperature by connecting to the grid and generating electricity, followed by a shutdown and discharge of the *Victaulic Vortex* Hybrid Fire Extinguishing System. Testing demonstrated that the minimal water discharge of a Hybrid Fire Extinguishing system allowed these systems to be discharged on combustion turbines without damage.

Figure 1

Figure 2

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PB-389 5309 REV G 12/2019