MARINE

FIRE PROTECTION SYSTEM

YG Yangın Güvenliği
San. ve Dış Tic. Ltd. Şti.

0437/25

0086/2025

HAFEX®

HYBRID AEROSOL FIRE EXTINGUISHING SYSTEMS

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HISTORY

YG YANGIN GUVENLIGI SANAYI VE DIS TICARET LIMITED SIRKETI was established in 2010 with experience of more than 25 years, focuses on fire safety projects for public and private institutions, including military and national security agencies. To ensure reliability, YG has started to manufacture their own products, such as HAFEX®, the world's cleanest and most advanced hybrid aerosol fire extinguishing system with dual-compound technology.

COMPANY STORY

Now YG YANGIN is one of the World's leading aerosol fire extinguisher manufacturer with its brand HAFEX® Hybrid Aerosol Fire Extinguishing Systems. Listed manufacturer and supplier for Turkish Navy (As NATO member) and International GSM providing companies while being a member of "SAHA ISTANBUL DEFENSE AVIATION AND SPACE CLUSTER".

YG YANGIN operates in 43 countries through 21 trusted distributors and 22 representative offices, managed from 5 regional headquarters in Turkey. Our team is highly experienced in providing specialized service in the field of fire suppression systems and offers a high-tech customer support and installation services to many countries around the World.

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"NEWEST AND THE CLEANEST AEROSOL EVER MADE"

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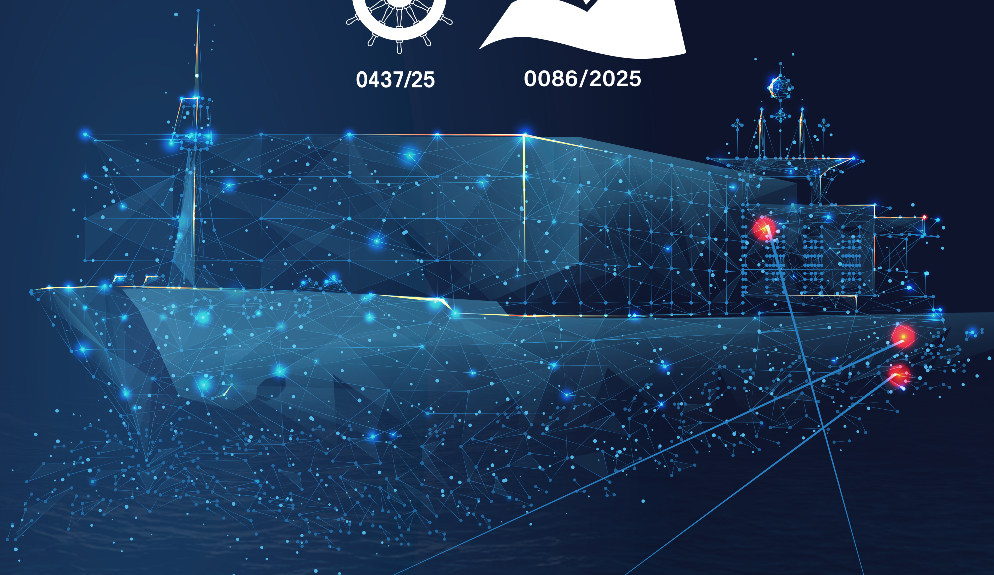


ELECTRICAL ROOM

ENGINE ROOM

CAPTAIN DECK

TS ISO 15779 · CE 2806 · UK CA 2806 · ISO 14001 · ATEX · bsi Aerosol Fire Extinguishers KITEMARK™ · 0437/24 · 0086/2025 · UKAS · UNECE-R107 · TNO · TS EN 15276

www.hafex.com.tr

For the North European market: **www.brannvernservice.com**

HAFEX CONDENSED AEROSOL

FIRE EXTINGUISHING SYSTEM

Aerosol fire-extinguishing technology offers a modern, efficient solution for protecting enclosed spaces against fire. By generating and dispersing fine solid particles suspended in gas, these systems interrupt the combustion process quickly and effectively. From the structure of aerosol fire-extinguishing systems to the role of generators, solid aerosol-generating compounds, and key performance measures such as effective mass, efficiency coefficient, design application density, and net volume, each element works together to ensure reliable fire suppression. The following sections outline these core components and definitions, providing a clear understanding of how the system operates and is designed for optimal fire protection.

DESIGN OF THE CONDENSED AEROSOL FIRE EXTINGUISHING SYSTEM

The required amount of solid aerosol-generating compound for the protected space should be calculated at the minimum expected ambient temperature using the design application density based on the net volume of the protected space,
including the casing.

Installation, Operation and Maintenance Manual for Marine Applications

$$W = \frac{V \times qe}{f}$$

W: Total mass of the solid a erosol-generating compound required for the protected volume (g),
V: Net volume of the protected space (m3),
qe: Design a pplication d ensity a s effective mass (g/m3),
f: Efficiency coefficient of the aerosol generator (%)

Table 3.1. Effective mass and efficiency coefficient of the HAFEX condensed aerosol generators.

GENERATOR MODEL	Compound Mass (g)	Effective Mass (g)	Efficiency Coefficient (%)
HFX-20	20	14	70
HFX-50	50	34	68
HFX-100	100	63	63
HFX-200	200	124	62
HFX-500	500	305	61
HFX-1100	1100	687	62.4
HFX-2200	2200	1353	61.5
HFX-3400	3400	2074	61
HFX-4500	4500	2790	62
HFX-6000	6000	3720	62
HFX-7600	7600	4560	60

DESIGN OF AEROSOL

Alternative Design Calculation Method Without Effective Mass Concept

Aerosol fire extinguishers, according to the way the extinguishing agent is applied to the protected volume; They are divided into condensed and dispersed aerosol extinguishers (IMO MSC.1/Circ.1270, Page 3, General).By using pyrotechnic methods in condensed aerosols, aersol mist (alkaline metal carbonate and bicarbonate in the form of particles smaller than 10 microns, a mixture of nitrogen, water vapor, carbon dioxide) is produced from solid aerosol-generating compound stored in the aerosol generator via redox reaction and discharged to the protected volume. In other words, in condensed aerosols, aerosol mist components with fire extinguishing effect are not stored in the metal body of the aerosol generator but are produced chemically during discharge as a result of the redox reaction created by pyrotechnic methods. No valves, pipes, nozzles, or pressurization are required to discharge condensed aerosol extinguishing units into the protected volume.

Due to the fact that international standards on aerosol fire extinguishing systems have been prepared in general to cover both condensed and dispersed aerosols until recent years, and these two types of aerosol extinguishers show fundamental design differences with each other, there are some conceptual confusions. At the beginning of these complexities is the misuse of the concept of effective mass or efficiency coefficient. In dispersed aerosol extinguishers, the extinguishing chemical is stored in a pressurized metal body, mixed with an inert propellant. Since the extinguishing chemical is stored in the aerosol unit body, the amount of the extinguishing agent remaining in the unit body (due to insufficient amount of propellant inert gaor insufficient siphon length) after the extinguishing agent in the aerosol unit is discharged to the protected volume is important. The amount of extinguishant discharged from the dispersed aerosol extinguisher to the protected volume is called the effective mass, and the amount of extinguishant remaining in the unit body without discharge is called the residual mass. As for each type of fire extinguisher in which the chemical substance with fire extinguishing action is stored in a pressurized body, the design application intensity in dispersed aerosol is determined by the ratio of the minimum amount of extinguishing agent to the total volume, which is sufficient to extinguish the fire by being discharged into the protected volume. Therefore, the determination of the effective mass is necessary to determine the design application density of dispersed aerosol extinguishers.

In condensed aerosol extinguishers, on the other hand, the chemical substance that has an extinguishing effect, namely the aerosol mist consisting of a mixture of alkali metal carbonate and bicarbonate microparticles, nitrogen, water vapor and carbon dioxide, is not stored in the aerosol generator body, unlike dispersed aerosols. Inside the non-pressurized metal body of the condensed aerosol generator, there is solid aerosol-generating compound that pyrotechnically creates fire extinguishing aerosol mist when the generator is operated. Since the aerosol mist, which has fire extinguishing effect in condensed aerosols, is not stored in the generator body, the concept of effective mass ceases to be a valid and meaningful concept for condensed aerosols. As a result of the redox reaction occurring in the aerosol-generating compound solid blocks inside the condensed aerosol generator, besides the chemically produced aerosol mist, redox reaction residues and by-products, which do not have fire extinguishing properties and can pollute or damage the protected volume if they go out of the generator body, also produce. These reaction residues, which do not have a fire extinguishing effect, are retained by the filtration layers used in the aerosol generator body and remain in the body. These reaction by-products, which are specially filtered and retained within the aerosol generator body and do not contribute to the extinguishing efficiency of the aerosol generator, should not be confused with the concept of the residual mass in dispersed aerosol extinguishers that store the extinguishing agent within the unit body.

Aerosol-generating compound mass (g) = Effective mass (g) / Efficiency coefficient

Effective mass (g) = Aerosol-generating compound mass (g) x Efficiency coefficients

Since the international standards on aerosol fire extinguishing systems have generally been arranged to cover all condensed and dispersed aerosols in the past years, the effective mass calculation has been used for both dispersed and condensed aerosols within the scope of the relevant standards. However, in the 2020 version of the NFPA 2010 standard on condensed aerosol fire extinguishers, all sections related to dispersed aerosols and all concepts unrelated to condensed aerosol extinguishers have been removed in order to prevent conceptual confusion in aerosol fire extinguishing systems, which are divided into two different types as dispersed and condensed aerosol fire extinguishers. The new version of the standard is designed to define condensed aerosols only (NFPA 2010:2020 – Stan dard for Fixed Aerosol Fire-Extinguishing Systems, page 4, Origin and Development of NFPA 2010). Therefore, the concept of effective mass (or efficiency coefficient) is not included in the NFPA 2010 standard, as of the 2020 version, as it is not related to condensed aerosol extinguishers.

In the IMO MSC.1/Circ.1270, the approach in which both dispersed and condensed aerosol extinguishing systems are evaluated together is used, and the ratio of the difference between the mass of the aerosol generator before discharge and after discharge to the mass of the solid aerosol generating compound in the aerosol generator is called the efficiency coefficient.

In the IMO MSC.1/Circ.1270 standard, the design application density is requested to be specified as the effective mass (due to the efficiency coefficient). However, since this method does not apply to the concept of effective mass for condensed aerosol extinguishing systems, and because it unnecessarily complicates and prolongs the aerosol extinguishing system design, the design application density in the installation and user manuals of the manufacturers can be specified as mass of the solid aerosol-generating compound in the aerosol generators instead of the effective mass.

The calculation formula for required amount of the solid aerosol-generating compound is as follows:

$$W = V \times qc$$

where:
W: Total mass of the solid aerosol-generating compound required for the protected volume (g),
V: Net volume of the protected space (m3),
qc: Design application density as aerosol-generating compound mass (g/m3),

qc = 201 g/m3

The total number of the aerosol generators required for the protected volume:

N =

where:
N: Total number of the aerosol generators required for the protected volume. It must be rounded up
as an integer if it is not an integer,
W: Total mass of the solid aerosol-generating compound required for the protected volume (g),
m: Mass of the solid aerosol-generating compound contained in an aerosol generator model intended to be used in the protected volume (g) – Table 3.1.

If different generator models should be selected, the total mass of the solid aerosol-generating compound shall not be less than the required total compound mass (W)

When designing the aerosol extinguishing system in environments where human beings exist, the discharge distances and minimum thermal clearance values of the aerosol generators should be considered, and the mounting heights and aerosol generator models, of which aerosol discharge temperature does not exceed the 75°C limit and which the human beings in the environment are not exposed to high aerosol discharge temperature, should be selected. In the environment where combustible and flammable materials exist, the maximum discharge temperature limit of 200°C should be considered when determining the aerosol discharge distance, suitable aerosol generator models and mounting heights of the aerosol generators. The discharge characteristics of HAFEX aerosol generators models determined within the scope of IMO MSC.1/Circ.1270 are given in Table 3.2.

Table 3.2. Discharge characteristics of the HAFEX condensed aerosol generators.

GENERATOR MODEL	75°C DISTANCE (m)	200°C DISTANCE (m)	400°C DISTANCE (m)	DISCHARGE LENGTH (m)	DISCHARGE TIME (sec)
HFX-20	-	-	-	1.8	3-5
HFX-50	-	-	-	2.0	3-5
HFX-100	0.05	-	-	2.5	4-6
HFX-200	0.05	-	-	3.0	4-6
HFX-500	0.45	0.15	-	4.0	5-7
HFX-1100	1.20	0.30	-	5.0	13-16
HFX-2200	1.50	0.30	-	5.5	14-17
HFX-3400	1.50	0.30	-	6.0	14-17
HFX-4500	2.00	1.00	0.10	7.0	15-18
HFX-6000	2.00	1.10	0.20	8.0	16-19
HFX-7600	2.50	1.50	0.40	12.0	20-23

IMO REGULATION CHAPTER FOR AEROSOL FIRE-EXTINGUISHING SYSTEMS

Where agent containers are stored within a protected space, the containers should be evenly distributed throughout the space and meet the following provisions:

1. A manually initiated power release, located outside the protected space, should be provided. Duplicate sources of power should be provided for this release and should be located outside the protected space and be immediately available;

2. Electric power circuits connecting the generators should be monitored for fault conditions and loss of power. Visual and audible alarms should be provided to indicate this;

3. Pneumatic, electric or hydraulic power circuits connecting the generators should be duplicated and widely separated. The sources of pneumatic or hydraulic pressure should be monitored for loss of pressure. Visual and audible alarmsshould be provided to indicate this;

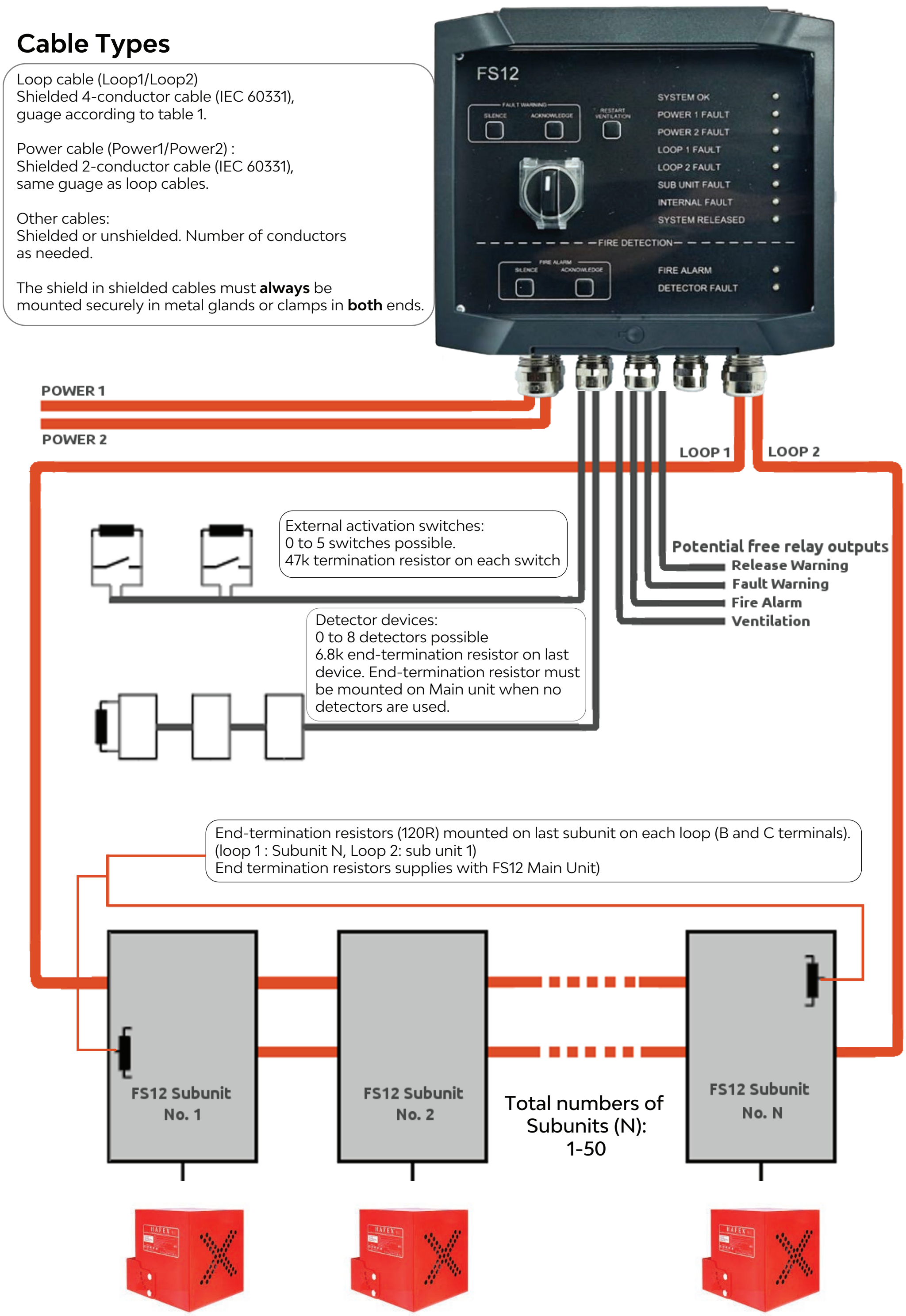
4. Within the protected space, electrical circuits essential for the release of the system should be fire resistant according to standard IEC 60331 or equivalent standards. Piping systems essential for the release of systems designed to be operated hydraulically or pneumatically should be of steel or other equivalent heat-resisting material to the satisfaction of the Administration;

5. Each dispersed aerosol pressure container should be fitted with an automatic overpressure release device which, in the event of the container being exposed to the effects of fire and the system not being operated, will safely vent the contents of the container into the protected space;

6. The arrangement of generators and the electrical circuits and piping essential for the release of any system should be such that in the event of damage to any one power release line or generator through mechanical damage, fire or explosion in a protected space, i.e., a single fault concept, at least the amount of agent needed to achieve the test density can still be discharged having regard to the requirement for uniform distribution of medium throughout the space;

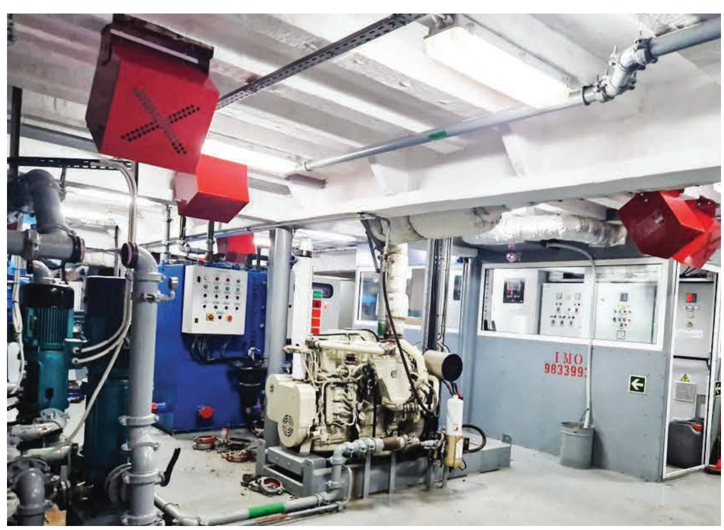
7. Dispersed aerosol containers should be monitored for decrease in pressure due to leakage and discharge. Visual and audible alarms in the protected area and on the navigation bridge, in the onboard safety centre or in the space where the fire control equipment is centralized should be provided to indicate this condition

MARINE FIRE CONTROL PANEL SETUP FOR HAFEX® GENERATORS



Each aerosol generator and subunit should be positioned as close to one another as possible.

HAFEX® AEROSOL MARINE FIRE PROTECTION PHOTO GALLERY



HAFEX®

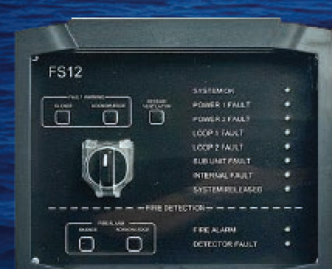
HYBRID AEROSOL FIRE EXTINGUISHING SYSTEMS

Eco-Friendly Aerosol Fire Suppression Systems. Safety, reliability, and smart protection for maritime and technical environments

Who We Are
We specialize in designing and supplying complete Hafex aerosol-based fire suppression systems for maritime vessels—and much more.

Our tailored solutions also cover:
- Electrical switchboards and sub-distribution panels
- Server rooms and data centers
- Control cabinets and automation systems
- Battery banks and UPS installations
- Solar power systems and energy containers

Our systems are compact, non-pressurized, and ideal for installations where space is limited and reliability is critical.



What's Included in Every Delivery
- Control panel with all required components
- Wheel-marked aerosol generators
- Certified cable
- IP64-rated siren with sound and light
- Safety signage and complete documentation

Why Choose Hafex Aerosol Suppression
- Lifespan of up to 15 years
- Quick and cost-effective installation
- Delivered in non-pressurized containers
- No pressure testing required after 10 years
- Minimal space requirements
- Extremely low maintenance cost.

Ready to protect your vessel or facility?
Contact us today or scan the QR code for more information. Let's build safety into into your operations—efficiently and sustainably.

Florø Brannvernservice

TS ISO 15779 | CE 2806 | UK CA 2806 | ISO 14001 | ATEX | 0437/24 | 0086/2025 | UNECE-R107 | TNO | TS EN 15276

SOME OF HAFEX REFERENCES

ADDITIONAL MARINE REFERENCES

TURKEY

Application: Electrical Cabinet Protection for All G-Class Frigate Type Turkish Navy Ships

- TCG Gaziantep (F-490) – ex USS Clifton Sprague (FFG-16)
- TCG Giresun (F-491) – ex USS Antrim (FFG-20)
- TCG Gemlik (F-492) – ex USS Flatley (FFG-21)
- TCG Gelibolu (F-493) – ex USS Reid (FFG-30)
- TCG Gökçeada (F-494) – ex USS Mahlon S. Tisdale (FFG-27)
- TCG Gediz (F-495) – ex USS John A. Moore (FFG-19)
- TCG Gökova (F-496) – ex USS Samuel Eliot Morison (FFG-13)
- TCG Göksu (F-497) – ex USS Estocin (FFG-15)

NORWAY

Application: Engine & Generator Rooms – Workboats, Rescue Boats, and Yards

- Skarsvaag Boats (210, 212, PGS)
- Grovfjord Mekaniske (185)
- Fosen Yards (Steinkjerringa, Åsenvåg)
- Maritime Partner (2321, 2326)
- Marø Safety (600)
- Promek (243, 244, 245, 246, 247)
- Lextor (Hermes VI)

ITALY

Application: Engine & Gen. Rooms Yachts and Shipyards

- Silent Italia Srl
- Tankoa Yachts
- SanLorenzo
- Baglietto
- AzimutBenetti
- Alpha Yachts
- Wider
- Arcadia Yachts
- Overmarine
- The Italian Sea Group)

NATIONAL COAST SHIPS OF TURKEY:

- Uzmar Yachts
- Sunmar Yachts
- ISTANBUL General Coast Guard Boats

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LIMITED COMPANY

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