Trusted above all.

ICAF

Integrated Compressed Air Foam System

ICAF Systems

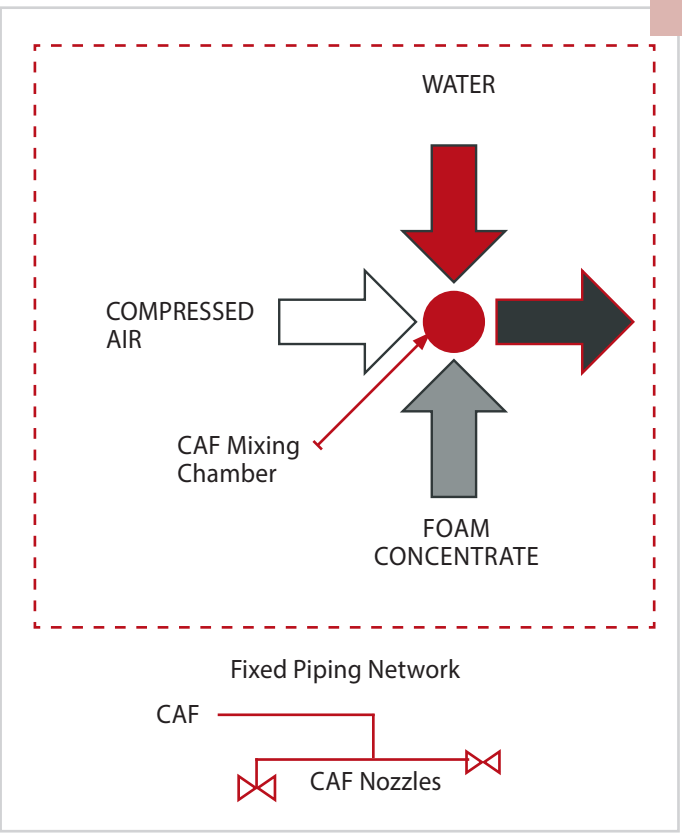
Description and design

Compressed air foam (CAF) is generated by the combination of compressed air, water and foam concentrate in the right proportions, to create a homogeneous foam solution similar to shaving cream. CAF is delivered with high momentum through a fixed piping system, and distributed over the hazard via an approved discharge device. The ICAF compressed air foam system is FM approved as a local application extinguishing system for Class B pool fires, spill fires and cascading fires. Full-scale fire tests have demonstrated ICAF to be an extremely effective extinguishing mechanism for flammable and combustible liquids, both miscible and non-miscible. The unique physical properties and texture of CAF allow it to form a stable and uniform foam blanket over the liquid surface. The robust foam blanket developed during a discharge works at the fuel surface, creating an effective vapour seal to establish a physical separation between the fuel and the burning vapours. Because CAF is generated through aeration in a mixing chamber versus agitation at the nozzle, it has higher expansion ratios and longer drain times than conventional low-expansion foam systems. This translates directly into enhanced extinguishing and burnback performance.

The FIREFLEX® ICAF System is a deluge-type system that uses a balanced piping network and can be activated by electric, pneumatic or manual release. The system can be configured with multiple mixing chambers and can have multiple zones. Each system is designed and installed as per the current NFPA 11 standard. FIREFLEX® provides design assistance with respect to piping and nozzle layout, including hydro-pneumatic calculations as well as offers system start-up service including onsite discharge testing and commissioning. The system water supply can be provided by a water pressure vessel or can be connected to a city fire main or fire pump system. The air supply is provided by high-pressure air cylinders that are factory assembled onto cylinder banks and include a high-pressure manifold and pressure regulator(s). The foam concentrate is stored in a stainless steel pressure vessel. The foam concentrate tank and water supply tank, if applicable, are pressurized with compressed air upon system actuation.

Water, compressed air and foam concentrate are then injected into the mixing chamber(s) mounted in the cabinet. CAF is generated in the mixing chamber and then flows through the system's piping network towards the distribution nozzles.

CAF is discharged in or on the hazard using special discharge devices which effectively distribute the foam evenly over the nozzle's area of coverage. In addition to coverage, the TAR and FPO nozzles (see page 6) are specifically designed to maintain CAF quality preventing degradation of the CAF generated in the mixing chamber.



ICAF systems are factory assembled, tested in cabinets and include all hydraulic, pneumatic and electrical devices required for proper operation.

System characteristics

Integrated releasing control panel options

The ICAF system is available with 2 control panel options. One of the releasing control panels is the Notifier® NFS-320 model. This panel includes two Class A or B, programmable detection zones; four Class B supervisory zones and four Class A or B, programmable output circuits. Programming of the control panel is done by FIREFLEX® Systems and is password protected. The panel is compatible with many types of fire alarm & supervisory devices such as linear heat detectors, spot-type heat and smoke detectors, water flow and release indicators, low and high air pressure switches, manual pull stations and abort switches. The control panel also includes an alphanumeric display with two lines of 40 characters describing all the system conditions, as well as a set of red and yellow LED lamps individually indicating the alarm and trouble conditions of the system. Easy to operate control buttons are also provided to activate and operate the system's various functions.

Twin control cabinet

For applications where there is a risk of electromagnetic field interference, the FIREFLEX® ARC-1 releasing control panel, designed and tested to meet stringent EMI shielding requirements, can be used. The FIREFLEX® ARC-1 panel is c-FM-us, MEA and CSFM approved, and provided with a menu-driven programming including a specific program assigned at the factory. This panel is compatible with many types of fire alarm and supervisory devices such as: linear heat detectors, spot type heat and smoke detectors, waterflow and release indicators, low and high air pressure switches and manual pull stations. The panel also includes an alphanumeric display with up to 16 lines of 40 characters describing all the system conditions, and a set of red and yellow LED lamps individually indicating each of the alarm and trouble conditions of the system. Easy to operate control buttons are also provided to activate and operate the system's various functions.

Chemical storage application

System characteristics

Water supply

- CAF technology offers an important reduction in the water supply requirements compared to standard sprinkler or foam systems; the system can operate with a water pressure in the range of 50 to 175 psi
- When fire pumps are required for system operation, they shall be designed and installed in accordance with NFPA 20, Standard for the Installation of Centrifugal Fire Pumps
- The water supply shall be designed and installed in accordance with NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- Water pressure vessels also available from FIREFLEX® Systems

In all cases the water supply shall be capable of providing the required flow and pressure for the required duration as determined by FIREFLEX®'s hydro-pneumatic calculation program.

Air supply

- Air is provided by DOT and TC certified compressed air cylinders pressurized to 2,400 psi (16,536 kPa); each cylinder is supplied with a cylinder valve equipped with a safety relief disc which provides relief at 3,600-4,000 psi
- Air pressure regulators are used to reduce the air supply pressure to 100 psi (689 kPa) for the system operation
- The cylinder bank pressure is supervised by a pressure transducer sending a low pressure supervisory signal when the pressure drops below the minimum pressure required to provide air supply for the specified discharge time
- A safety valve is also used at the outlet of the air pressure regulator to protect the system from high pressure in case of malfunction, the maximum air operating pressure on the system side (downstream of the air regulator) is adjusted to 160 psi (1,103 kPa)
- The cylinder bank is factory assembled on a painted steel skid and includes high pressure tubing, manifold and hardware
- The skid-mounted cylinder bank is available with single or twin pressure regulator assemblies and is available with up to 10 cylinders per bank

The number of cylinders and regulators established at the design stage is based on both the maximum system flow and discharge time required for the largest single hazard protected or group of hazards that are protected simultaneously. FIREFLEX®'s program will take that information into account when calculating the system's capacity.

Air supply cylinder bank

Foam supply

- Approved with standard foam concentrates
- Foam concentrate is stored inside a normally non-pressurized stainless steel pressure vessel type tank stamped according to ASME Section VIII Div. 1
- Foam storage tanks are built to order and come in various sizes from 5 to 500 US gallons
- Storage tank maximum working pressure is 150 psi (1,033 kPa)
- The tank is supplied with a safety relief valve set at 135 psi (930 kPa) for protection against over-pressurization

The foam storage tank is factory assembled and includes valves, trim and hardware. Manual valves are provided to fill the tank with foam concentrate and to release the air pressure after a CAF discharge. A sight gauge assembly is also provided to allow visual verification of the normal foam concentrate level.

Piping & fittings

- Standard piping materials and standard fittings as defined in current NFPA 11
- Balanced piping network - hydro-pneumatic calculation software by FIREFLEX® Systems

Transformer station

Generator room

Particle board production

CAF FM approved discharge devices

CEILING NOZZLE CONFIGURATION – The TAR-225C is an open-type ceiling nozzle used for area protection of flammable or combustible liquids spill or pool fire hazards and is specifically designed to effectively distribute CAF over a remote area.

TAR-225C Nozzles

Located at the ceiling level the ICAF Nozzle is designed to discharge CAF in a 360° radius over a maximum area of 150 ft^2 (13.9 m^2) when used on hydrocarbon liquids and 100 ft^2 (9.29 m^2) when used on polar solvents.

SPECIFIC HAZARD CONFIGURATION – The TAR-225L (not shown in table) is an open-type directional nozzle which is specifically designed to discharge CAF over exposed horizontal or vertical surfaces of specific equipment, and is effective on cascading fires.

The TAR 225L nozzle spacing shall be based on the spray pattern design principle. Nozzles shall be spaced and aimed so that their spray patterns will cover all surfaces adequately.

FOAM-POWERED OSCILLATOR – The FPO is an open-type oscillating nozzle that is specifically designed to project CAF horizontally over a wide area. It is an effective discharge device for low-level protection. The CAF can be delivered via a 90° or 180° arc of oscillation with discharge range up to 92 ft. The FPO nozzle is self-propelled by the CAF discharge and does not require any electrical or hydraulic connection, considerably simplifying installation.

FPO - Foam powered oscillator

Significant reduction in foam and water required

ICAF uses four times less water and up to six times less foam concentrate compared to foam-water systems.

Flammable & Combustible Liquid Type	Minimum Density (gpm/ft^2) TAR-225C		Minimum Density (gpm/ft^2) FPO	
	FOAM-WATER	CAF	FOAM-WATER	CAF
Hydrocarbons	0.16 at 3%	0.04 at 2%	0.10 at 3%	0.025 at 3%
Polar solvents: Alcohol	0.24 at 3%	0.06 at 6%	0.15 at 3%	0.06 at 6%
Ketone	0.26 at 3%	0.06 at 6%	0.15 at 3%	0.06 at 6%

Reduced infrastructure requirements for fire protection

WATER SUPPLY – ICAF can eliminate or reduce the size of water supply tanks & fire pumps

DRAINAGE & CONTAINMENT – ICAF can elimiate or reduce the size of drainage and containment systems including spill tanks and oil separators

DISPOSAL COSTS – The significant reduction in foam and water required for ICAF reduces the costs associated to clean-up and disposal of foam during discharge testing or after a fire.

Enhanced system performance

Full-scale fire tests have demonstrated that ICAF is a very effective extinguishing mechanism for class B fires. The unique physical properties of ICAF foam with a 10:1 expansion ratio combined with long drain times provide improved extinguishing and burnback performance. Furthermore, its ability to stick to vertical surfaces enabled the ICAF to be Listed for cascading fires. System performance can be a deciding factor in critical applications where it is desirable that system performance exceeds the minimum requirements set out in published codes or standards.

Improved visibility in the hazard

In comparison to water-based systems, ICAF's unique physical properties significantly reduce steam production and thereby improve visibility during and after a fire. The CAF blankets the fuel surface and therefore does not cause visual impairment often associated to high-expansion, total flooding foam systems.

ICAF supply system
(Air Cylinders, foam storage tank)

Viking 3% (C6) AFFF
foam concentrate

ICAF Systems

Features and applications

Typical applications

ICAF systems are a critical part of fixed foam fire suppression systems which are found in the most demanding applications such as:

- **Information technologies**: emergency generators and diesel storage areas
- **Pharmaceutical**: process areas, chemical storage, laboratories, loading and unloading gantries
- **Transportation**: urban transit fueling bays, maintenance garages, aircraft hangars, ethanol transfer stations and heliports
- **Power generation and distribution**: power transformers, turbine generators and nuclear facilities
- **Oil and gas**: oil pumping stations, refineries, off-shore drilling platforms, pump rooms and lube oil skids
- **Industrial**: wood processing machines, solvent storage, process areas
- **Mining**: hoistways, combustible and flammable liquids storage

Key features

- Significant reduction in foam and water requirements
- Reduced infrastructure requirements for fire protection
- Enhanced system performance
- Improved visibility in the hazard
- Engineered system

Industry recognition

Since its inception, ICAF has gained important industry recognition and acceptance. In addition to enhanced Listings with FM Approvals to incorporate designs involving simultaneous sprinkler discharge, the ICAF system can be used in certain storage applications, with reference to Data Sheets FM 7-29 - Ignitable Liquid Storage in Portable Containers and FM 7-32 - Ignitable Liquid Operations. Also, Compressed Air Foam Systems (CAFS) are an integral part of the NFPA 11 - Standard for Low-, Medium-, and High-Expansion Foam and NFPA 850 – Fire Protection for Electric Generating Plants and High-Voltage Direct Current Converter Stations.

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For further information, please contact your local Viking sales office or refer to the technical documentation.
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