



Foam Concentrates

The selection criteria

CFPA-E Guideline No 43:2024 F





The CFPA Europe develops and publishes common guidelines about fire safety, security, and natural hazards with the aim to achieve similar interpretation and to give examples of acceptable solutions, concepts, and models. The aim is to facilitate and support fire protection, security, and protection against natural hazards across Europe, and the whole world.

Today fire safety, security and protection against natural hazards form an integral part of a modern strategy for survival, sustainability, and competitiveness. Therefore, the market imposes new demands for quality.

These Guidelines are intended for all interested parties and the public. Interested parties includes plant owners, insurers, rescue services, consultants, safety companies and the like so that, in the course of their work, they may be able to help manage risk in society.

The Guidelines reflect best practice developed by the national members of CFPA Europe. Where these Guidelines and national requirements conflict, national requirements shall apply.

This Guideline has been compiled by the Fire Safety Commission and is adopted by the members of CFPA Europe.

More information: www.cfpa-e.eu



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Key words:

1 Introduction

Many industrial activities require the use and therefore the storage of flammable liquids, sometimes in large quantities. Fires involving this type of product (class B fires) are very often fought, whether by in-house teams or firefighters from the fire and rescue service, with the use of foam concentrates.

Foam concentrates are thus one of the key factors in the fire protection strategy.

However, other important factors must be taken into account in their use in order not to compromise the safety of people and property.

This means that when a new fire-extinguishing system is to be installed, the selection of a foam concentrate will be directly correlated to the nature of the risk. On the other hand, if the equipment is already in place, in addition to the nature of the risk and the notion of product performance, the compatibility between the foam concentrate and the fire-extinguishing equipment available on the site will be one of the main factors to take into account.

2 Scope

The purpose of this guideline is to provide the involved parties with relevant criteria for choosing an appropriate foam concentrate. It is intended for operators, safety teams (first responders and safety managers) of sites storing or using flammable liquids.

3 Definitions

Foam concentrate: A foam concentrate is a liquid which is diluted with water to produce foam solution (EN 1568:2018).

4 General information on foam concentrates

4.1 Their rankings

Each foam concentrate can be classified according to:

- Its physic-chemical nature,
- the type of solvent on which it is effective,
- the foam expansion ratio retained for its use.

A distinction is made between the following:

- **Synthetic-based foam concentrates:** its foaming base consists of hydrocarbon surfactants comparable to the active ingredients contained in that of liquid soaps and detergents.
- **Protein-based foam concentrates:** as their name suggests, this base contains protein hydrolysates, generally of animal origin (horns, hoof, blood, etc.).

Note: In Europe, mainly synthetic bases are used.

Over and above their physic-chemical characteristics, foam concentrates are also classified according to the nature of the risk (solvent miscible with water or not).

Synthetic or protein foam concentrates that can be used on apolar solvent fires (hydrocarbon type):

- Synthetic foam concentrates (S): their extinguishing performance and their resistance to re-ignition are very limited.
- Fluoroprotein foam concentrates (FP): they are obtained by adding a fluorinated telomere.
- Film-forming foam concentrates (AFFF: aqueous film-forming foams and FFFP: Film forming Fluoroprotein foams): they are obtained by adding to synthetic or protein foaming bases, one or more film-forming fluorinated surfactant(s)). The floating film therefore isolates the flammable liquid from the air and spreads quickly, thus extinguishing the fire. They are particularly suitable for pool fires.
- Fluorine-free foams (F3): these foam concentrates are dedicated to performance ratings and are targeting applications similar to AFFF and/or AR-foams with fluoroorganic compounds (EN 1568:2018).

Synthetic or protein alcohol-resistant (AR) foam concentrates that can be used on fires with polar solvents (i.e. miscible with water, example: alcohol, ketone, etc.):

- S-AR, FP-AR, fluorine-free AR, AFFF-AR or FFFP-AR foam concentrates: they contain fluorinated or non-fluorinated polymers which form a "gel" film on the surface of the polar liquid.

Note: All foam concentrates for polar liquid fires are versatile, but their effectiveness is often less on hydrocarbon fires.

Given their toxicity, some fluorinated foam concentrates have been banned and others are regulated:

- Foam concentrates containing PFOS (Perfluorooctanesulfonic acids): prohibited from manufacture and use since June 2011 (because they are bio accumulative and bio persistent), according to European regulations (directive 2006-122). They must be properly destroyed.
- Foam concentrates containing PFOA (Perfluorooctanoic acids) and related substances: the directive of June 2017 (2017-1000) requires that products put on the market from 2020 have a PFOA level of less than 25 ppb and less than 1 ppm for assimilated substances. There is no obligation to destroy existing stocks among users but there are restrictions of use for instruction and/or training.
- Foam concentrates containing perfluorocarboxylic acids containing (PFCA) with C9 to C14 carbon atoms in the chain and their salts and C9-C14 PFCA-related substances shall not be manufactured, or placed on the market with the mixture >25 ppb from 25 February 2023 according to the directive (2021/1297). Firefighting foams are allowed until 4 July 2025 with restrictions for testing and training and all releases must be contained from 1 January 2023.
- There is also a proposal from ECHA for restriction of all firefighting foams with PFAS greater than 1mg/L. The proposal covers firefighting foams used in hand extinguisher or to protect industrial companies with major accident hazards.

Caution: Check that your foam concentrates are not affected by these regulations.

Note: Multi-purpose foam concentrates are mainly used by the fire and rescue service. They are effective to varying degrees on polar and non-polar liquid fires.

4.2 General characteristics

	Protein foam concentrate	Synthetic foam concentrate	AFFF foam concentrate	Non-fluorinated foam concentrates	Versatile foam concentrate
Efficiency and lifespan	Very effective on "hot" hydrocarbon type fires Poorly withstands thermal amplitude (variations in heat) during storage	Less effective on very hot fires as it offers little resistance to re-ignition	Rapid extinction, good resistance to re-ignition. Good lifespan	Efficiency similar to a fluorinated foam concentrate. Wide variety of formulations Shorter lifespan than fluorinated foam concentrates	Effective on polar solvent fires Higher risk of bacterial contamination of the product due to the polymers
Toxicity and nuisance	Rinse the equipment after use Biodegradable, gives off a strong odor	Variable biodegradability	Persists in the environment (low biodegradability) To be used with a retention tank to recover waste (especially if the site is classified as an ICPE (Classified Installation for Environmental Protection)) Rinse the equipment after use	Can be presented as a response to environmental issues	More or less high viscosity May require appropriate equipment
<i>Under normal conditions of use, foam concentrates present no danger to human beings. However, the following precautions should be observed: do not ingest any such concentrate, avoid contact with eyes or skin and rinse immediately after accidental splashing. The use of foam concentrates requires at least personal protective equipment (gloves, safety shoes, helmet) for first and second responders.</i>					
Cost	Cost remains of course a criterion of choice. It depends on the type of foam concentrate and the quantity to be stored, itself determined by the protection policy (intervention of external emergency services or self-sufficient in-house teams).				
Storage conditions	Store at a T° < 50°C and protected from air, in suitable containers*, to avoid oxidation and evaporation				
(*) Caution: some foam concentrates are sensitive to freezing, refer to the MSDS.					

Table 1: Characteristics

4.3 The foaming base and froth expansion ratio

Diluted in water at a concentration defined by the manufacturer, the foam concentrate turns into a foaming solution.

With the help of appropriate equipment (fire-hose, nozzle, generator, etc.), an air supply makes it possible to generate foam, with different expansion ratios: low, medium or high.

It can be used:

- Manually, by a second responder (or a firefighter), using foam nozzles or water additive extinguishers.
- From a fixed installation, such as an additive sprinkler or foam pourers (generally used with high expansion foam).

Note: High expansion foam cannot be used outdoors, it is too light, there is a serious risk of it being blown away in the wind.

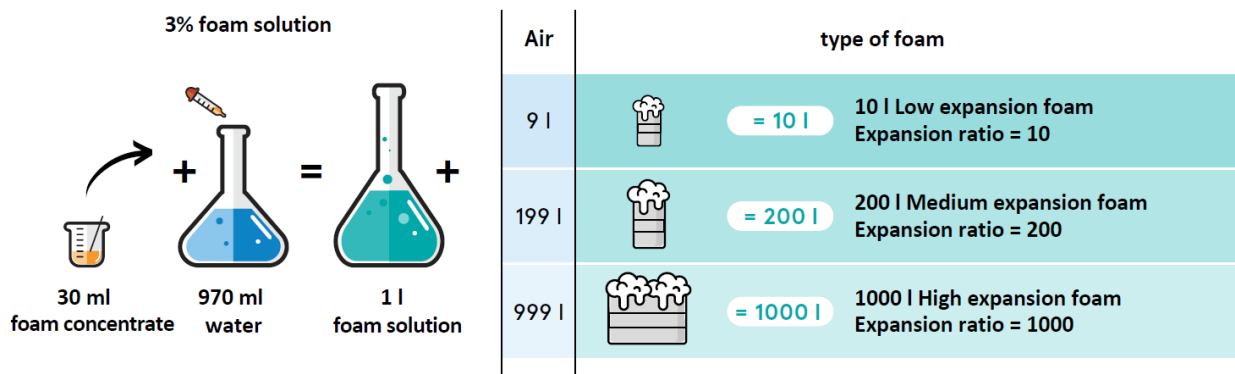


Figure 1: Foam formation

Each foam concentrate is approved for use with a low and/or medium and/or high expansion ratio.

The certification of foam concentrates is based on various reference documents:

- European standards,
- international (ISO 7203) and American (NFPA11) standards,
- specific reference documents: GESIP, ICAO, Last Fire Test, APSAD R12.

In Europe, standards EN1568-1 to 4: 2008 are in force and standards EN1568-1 to 4: 2018 are currently applied (handover period until 2019).

These standards make it possible to compare the different foam concentrates with each other so that the users can make an informed choice about the one that will best suit the protection of their site.

The standards define typical tests to be carried out by an independent and accredited test laboratory, in accordance with EN ISO 17025.

Four laboratories are accredited in Europe, see: MPA in Germany, RISE in Sweden, ANPI in Belgium and CNPP in France.

The low expansion foam concentrate standards EN 1568-3 and EN 1568-4 give a classification of the foam concentrate according to its performance in fire-extinguishing and in reignition (I, I+, II or III in fire-extinguishing, A, B, C or D in reignition).

The update of the 2018 standards is designed in particular to harmonise the results from one laboratory to another (harmonisation of the water quality, specification whether the tests take place indoors or outdoors) and to give more information to end-users (detailed informative technical data sheet, measurement of the freezing point, toxicological data, reinforced stability test, measurement of the resistance of the film, etc.).

Note: Any approval issued is invalidated when a modification occurs in the composition of the approved foam concentrate.

5 Factors to be taken into account when designing an installation

5.1 Risk analysis

The risk analysis, listing the products present on the site, is an important criterion making it possible to guide the choice of foam concentrate(s). It must be correlated with the equipment in place (compliance with attack distances in particular), with the regulatory and environmental requirements linked to your site and your activity. In the case of choosing non-fluorinated foam concentrate, its compliance with the installation must be checked.

As we said above, it is necessary to characterise the products present on the site: polar or not.

Caution: petrol, which contains a lot of additives, can behave as a polar flammable liquid (dissolution of standard foam concentrates).

Versatile foam concentrates exist; they are often found in petrochemical complexes, refineries, etc. However, on apolar solvents (hydrocarbon), they are sometimes less efficient than standard foam concentrates.

It is therefore relevant to question the operating conditions of the site.

A few important factors to take into account:

The foam concentrate storage mode (outdoors or indoors) will influence your choice:

- Does the foam concentrate have to resist freezing?
- Will it undergo large variations in temperature?

Water quality:

- Can the foam concentrate be used with brackish water?
- With sea water?

Site operating conditions:

- Are your polar and non-polar solvents stored on the same retention basins?
- Are the stocks distant, how and where are your foam concentrate reserves stored?

The organisation of your responders:

- What organisation has been set up for your responders?

5.2 Environmental considerations

The risk analysis must of course be completed by taking into account the configuration of the site and the immediate proximity of the neighbourhood to the potential risks of propagation. Faced with this, a foam concentrate should be chosen not only according to the use that will be made of it (in relation to the solvent to be protected), but also according to its performance criteria (speed of fire-extinguishing, resistance to re-ignition), determined by certification tests.

Note: Read the foam concentrate approval sheet, given on purchase, which characterises its performance: fire-extinguishing speed, resistance to re-ignition, etc.

5.3 Who takes charge of the response to an emergency? Are the teams self-sufficient or not?

One of the key points among all the criteria to be selected is undoubtedly self-sufficiency in emergency management. Are your second responder teams tasked with providing protection before help arrives? Are your human and material resources sized to intervene independently? Do you simply make your reserves of foam concentrate available to outside emergency services?

The answer to these questions will influence the quantity of foam concentrate products to be stocked and the budget.

If external emergency services intervene, it is necessary to establish a dialogue with the departmental fire and rescue service (SDIS) which may have requirements on the type of foam concentrate, its concentration of use, the quantity and the packaging of foam concentrate that you must have in stock with regard to the material that their services use. This particular issue may fall under regulatory requirements.

5.4 Regulatory requirements

Depending on your line of business, regulatory requirements can also guide the choice of foam concentrate. This is particularly the case for the storage of flammable liquids.

These sites must establish a fire defence plan, which will specify:

- If they choose to be self-sufficient with regard to the fire protection of their stocks of flammable liquids or if they use the departmental fire and rescue service (with the provision of foam concentrates).
- The characteristics of the fire-fighting systems (fixed, mobile, type of expansion, flow rates, duration of operation of the fire-fighting systems and volumes of water and foam concentrates sized accordingly, etc.).

5.5 Fire-fighting equipment

If you have fire-fighting equipment or an existing fire-fighting system, this will be a very important factor in your selection criteria.

The equipment is generally sized in relation to the risk to be protected. It will be necessary to check that the risk and the environment have not changed and that your equipment is still appropriate.

The choice of foam concentrate must take into account the characteristics of your equipment: the characteristics of the proportioners (viscosity, concentration), the risks of corrosion, the types of fire-extinguishers, etc.

Advice: Check and calibrate your proportioner to the nominal concentration of foam concentrate given by the manufacturer.

If your site has a fixed installation for discharging high expansion foam, it is obvious that the foam concentrate must be usable at a high expansion ratio and that the compatibility of the generator / foam concentrate pair will have been checked.

The EN 13565-1 standard also indicates that the materials used must be evaluated and tested.

Note: Remember to check the compatibility between the foam concentrate and the equipment available on site.

6 Tests and controls

6.1 Lifespan of a foam concentrate:

A foam concentrate is a complex formulation made up of different ingredients. It is a "living" product that changes over time.

Its lifespan depends on:

- Its nature (its constituents, etc.).
- Its storage environment (freeze-thaw, thermal amplitude, risk of contamination, backflow, etc.).
- Its container (material, tightness, etc.).

Typically, manufacturers guarantee that their products will retain their effectiveness for between five and ten years in their original packaging. It is your responsibility to ensure that these storage conditions adequately protect the product.

A canister of foam concentrate (for example for a PIA application), must not remain open with the rod immersed in the foam concentrate. The presence of air and the risk of contamination will very quickly render the foam concentrate unusable.

6.2 Check the effectiveness of the foam concentrate

Like any means of protection, a foam concentrate must be able to fulfil its role on the day it is needed... It is therefore up to the site operator to have an annual sample taken from the foam concentrate storage in order to check whether the product is still effective.

In general, at the time of purchase, your foam concentrate supplier will give you certain standard documents:

- A global technical data sheet, a kind of identity card for the product, describing its family of foam concentrates, its characteristics and its performance.

- A safety data sheet (SDS) which will indicate all the information necessary for the transport, loading, unloading of the product and will define its treatment within the framework of waste management.
- Also try to obtain the specification sheet for your batch of foam concentrate, which will give the specific characteristics of your batch.
- There is nothing regulatory about providing a specification sheet, but if you want to do things correctly, it is important to determine an initial reference value for the foam concentrate on which subsequent checks will be based.

Note: There is a good example of precise technical data sheets in 1568:2018. It is possible to request this model from the manufacturer, without obligation.

In practice:

- The foam concentrate supplier offers a "maintenance" contract and takes care of the initial sampling and the annual check.
- You can have a sample of foam concentrate sent to an independent laboratory at the time of purchase (to know the precise technical specifications), then one year later.

In both cases, the purpose is to verify that the values taken at time T are always equal to the initial reference value (in terms of concentration and effectiveness of the product) and comply with the specifications.

6.3 Checkpoints

These allow you to check that your foam concentrate is still effective. Ideally, the values of the analyses obtained are compared with the initial values found when purchasing the foam concentrate, then with the results obtained annually. It is not always the numerical values that are important, but how they change over time.

Several steps are possible depending on:

- The foam concentrate family: the properties of the foam concentrate are compared with data from the manufacturer and foam concentrates of the same family as well as with the values measured during tests for compliance with standard EN 1568. Ideally, the properties are compared with the initial values found when purchasing the foam concentrate.
- The age of the foam concentrate.
- The type of expansion ratio.
- Type of installation
- The risk to be covered.

For this reason, each year a sample of the foam concentrate is taken for a physico-chemical analysis and an expansion test and/or a fire test. We also take this sample as soon as we have a doubt or notice a fault (backflow, frost, etc.) without waiting for the annual inspection.

For annual checks, refer to national regulations.

Good practice for taking a sample:

- The ideal is to be able to homogenise the tank but this is not always possible.
- For tanks of more than 1m³, a sample will be taken from the top of the tank and a sample from the bottom of the tank
- The can for the sample (if possible made of plastic and not glass) must be clean and dry and perfectly sealed to avoid any leaks during transport. The cans will be identified (name of the foam concentrate, concentration of use, place and date of sampling, etc.).
- It is better to write this information on labels and not with a marker directly on the container.
- To check the concentration of foam concentrate in your foaming solutions, take water from the site, the foam concentrate and a sample of the foaming solution.
- Complete physico-chemical analyses by real fire tests (a small fire test or fire rating test). The fire rating or fire certification corresponds to the normative fire of the EN 1568 standards. It is used to check the rating of the product compared with the initial values.
- The fire test is informative in the EN 1568 standards. This is a good indicator of foam concentrate performance at a lower cost.

6.4 Incompatibility

Caution: Ideally, we strongly advise against supplementing one foam concentrate with another, even if it is an identical product purchased from the same supplier. In fact, this often leads to accelerated aging of the mixture, thus compromising the effectiveness of the product.

This practice of "addition" is regularly observed because contact with air degrades the product, hence the interest in limiting the volume of the top of the tank. If you top up your tanks, check beforehand that the "bottom of the tank" foam concentrate is still effective and then pay particular attention to the aging of the mixture.

Note: An overpressure/depression vent on the storage tanks makes it possible to limit the deterioration of the product linked to a significant flow of air.

As for protein and synthetic foam concentrates, they are totally incompatible with each other. Your product would no longer be able to play its role at all.

6.5 And with other extinguishing agents?

It is not uncommon to seek the greatest extinguishing efficiency by using dry chemical extinguishers and foam concentrates together.

It is therefore essential to ensure the compatibility between these two extinguishing agents by checking the technical data sheets of the products, issued by the suppliers.

In the EN 615 Standard (extinguishing agent: powder), there is a test to check the compatibility of a powder with a foam concentrate.

It is also necessary to beware of the risk of re-ignition following the use of a powder extinguisher, the "blast" of which could break the formation of the film or the foam carpet.

7 Conclusion

A foam concentrate constitutes a specific type of liquid fire-extinguishing agent which should not be chosen without a complete study.

It should be selected according to its use (equipment available, nature of the risk to be protected), the performance criteria sought (speed of fire-extinguishing, resistance to the risk of re-ignition), the self-sufficiency of the teams of responders in protecting a site (intervention by external services or not) and the environment in which it is used.

However, vigilance should not stop at the acquisition of the product. A foam concentrate is a living product. Its effectiveness must therefore be verified throughout its life cycle, from purchase to use.

European guidelines

Fire (<https://cfpa-e.eu/category-guidelines/fire-prevention-and-protection/>)

- Guideline No 1 F - Internal fire protection control
- Guideline No 2 F - Panic & emergency exit devices
- Guideline No 3 F - Certification of thermographers
- Guideline No 4 F - Introduction to qualitative fire risk assessment
- Guideline No 5 F - Guidance signs, emergency lighting and general lighting
- Guideline No 6 F - Fire safety in care homes
- Guideline No 7 F - Safety distance between waste containers and buildings
- Guideline No 8 F - withdrawn*
- Guideline No 9 F - Fire safety in restaurants
- Guideline No 10 F - Smoke alarms in the home
- Guideline No 11 F - Recommended numbers of fire protection trained staff
- Guideline No 12 F - Fire safety basics for hot work operatives
- Guideline No 13 F - Fire protection documentation
- Guideline No 14 F - Fire protection in information technology facilities
- Guideline No 15 F - Fire safety in guest harbours and marinas
- Guideline No 16 F - Fire protection in offices
- Guideline No 17 F - Fire safety in farm buildings
- Guideline No 18 F - Fire protection on chemical manufacturing sites
- Guideline No 19 F - Fire safety engineering concerning evacuation from buildings
- Guideline No 20 F - Fire safety in camping sites
- Guideline No 21 F - Fire prevention on construction sites
- Guideline No 22 F - Wind turbines – Fire protection guideline
- Guideline No 23 F - Securing the operational readiness of fire control system
- Guideline No 24 F - Fire safe homes
- Guideline No 25 F - Emergency plan
- Guideline No 26 F - withdrawn*
- Guideline No 27 F - Fire safety in apartment buildings
- Guideline No 28 F - Fire safety in laboratories
- Guideline No 29 F - Protection of paintings: transports, exhibition and storage
- Guideline No 30 F - Managing fire safety in historic buildings
- Guideline No 31 F - Protection against self-ignition and explosions in handling and storage of silage and fodder in farms
- Guideline No 32 F - Treatment and storage of waste and combustible secondary raw materials
- Guideline No 33 F - Evacuation of people with disabilities
- Guideline No 34 F - Fire safety measures with emergency power supply
- Guideline No 35 F - Fire safety in warehouses
- Guideline No 36 F - Fire prevention in large tents
- Guideline No 37 F - Photovoltaic systems: recommendations on loss prevention
- Guideline No 38 F - Fire safety recommendations for short-term rental accommodations
- Guideline No 37 F - Fire protection in schools
- Guideline No 38 F - Fire safety recommendations for short-term rental accommodations
- Guideline No 39 F - Fire protection in schools
- Guideline No 40 F - Procedure to certify CFPA-E Fire Safety Specialists in Building Design
- Guideline No 41 F - Safety instructions for the use and charging of small and medium size lithium ion powered devices
- Guideline No 42 F - Guidance document for Selection of Fire Protection Systems

Natural hazards (<https://cfpa-e.eu/category-guidelines/natural-hazards/>)

- Guideline No 1 N - Protection against flood
- Guideline No 2 N - Business resilience – An introduction to protecting your business
- Guideline No 3 N - Protection of buildings against wind damage
- Guideline No 4 N - Lighting protection
- Guideline No 5 N - Managing heavy snow loads on roofs
- Guideline No 6 N - Forest fires
- Guideline No 7 N - Demountable / Mobile flood protection systems
- Guideline No 8 N - Ensuring supplies of firefighting water in extreme weather conditions
- Guideline No 9 N - Protection against hail damage
- Guideline No 10 N - Heavy rain and flash flood; Recommendations on flood prevention and protection

Security (<https://cfpa-e.eu/category-guidelines/security/>)

- Guideline No 1 S - Arson document
- Guideline No 2 S - Protection of empty buildings
- Guideline No 3 S - Security systems for empty buildings
- Guideline No 4 S - Guidance on keyholder selections and duties
- Guideline No 5 S - Security guidelines for museums and showrooms
- Guideline No 6 S - Security guidelines emergency exit doors in non-residential premises
- Guideline No 7 S - Developing evacuation and salvage plans for works of art and heritage buildings
- Guideline No 8 S - Security in schools
- Guideline No 9 S - Recommendation for the control of metal theft
- Guideline No 10 S - Protection of business intelligence
- Guideline No 11 S - Cyber security for small and medium-sized enterprises
- Guideline No 12 S - Security Guidelines for Businesses
- Guideline No 13 S - Cybersecurity Basic level – Basic IT security



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