BS EN 16327:2014

BSI Standards Publication

Fire-fighting — Positive-pressure proportioning systems (PPPS) and compressed-air foam systems (CAFS)

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee FSH/17, Fire brigade equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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ISBN 978 0 580 76195 9

ICS 13.220.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2014.

Amendments issued since publication

Date	Text affected

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16327

February 2014

ICS 13.220.10

English Version

Fire-fighting - Positive-pressure proportioning systems (PPPS) and compressed-air foam systems (CAFS)

Lutte contre l'incendie - Systèmes proportionneurs à pression positive (SPPP) et systèmes de mousse à air comprimé (CAFS)

Feuerwehrwesen - Druckzumischanlagen (DZA) und Druckluftschaumanlagen (DLS)

This European Standard was approved by CEN on 27 December 2013.

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Ref. No. EN 16327:2014 E

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Foreword

This document (EN 16327:2014) has been prepared by Technical Committee CEN/TC 192 “Fire and rescue service equipment”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2014, and conflicting national standards shall be withdrawn at the latest by August 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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Introduction

This standard is a type C standard as defined in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

The present document describes systems installed in a fire-fighting vehicle in order to improve the efficiency of fire-extinguishing processes. This is achieved by adding chemical solutions or foam concentrates (hereinafter collectively called foam concentrates) under pressure to the water being delivered by the fire-fighting centrifugal pump. Compressed-air may be injected in some cases to create the finished foam.

In addition to Class B fire-fighting operation, the described systems are used in Class A fire-fighting operation, with the aim to improve the adhesion, penetration and retention time of the fire-extinguishing agent on the burning material, thereby transferring more energy, and improving the cooling effect of the applied media. The object of using foams with fire extinguishing agents is to increase the effective contact area of the foam solution and to improve the adhesion to non-horizontal surfaces of the burning material, thereby increasing the time period in which heat is effectively transferred.

Another aim of the systems described is to improve, ease, and speed-up the use of foam concentrates during regular use in municipal or similar fire-fighting operations.

The following principles can be considered for mixing foam concentrates to water for fire-fighting purpose, where a) and b) is not part of this standard:

a) Venturi type inductors which create a vacuum to draw foam concentrate into the water stream. These inductors may be used as loose equipment, coupled into the hose line or permanently installed with a fire pump. A “Round the Pump” (RTP) system takes water from the pump discharge through a venturi device to draw foam concentrate into the pump- suction

NOTE These mobile systems are subject of a standard currently in preparation by CEN/TC 192/WG 8.

An RTP system may be used in conjunction with a PPPS if the full flow capacity of a fire pump is delivered as solution, and the full flow pump capacity exceeds the performance of the PPPS. All discharges on a fire pump will provide solution once an RTP is in operation. A RTP system will contaminate the fire pump and related installations with foam concentrate.

b) Premix (also known as batch mix) is a concept used in certain applications, where a measured amount of foam concentrate is added to the water in the vehicle tank, each time the water tank is filled. There is no special mixing technology used, the foam concentrate is simply poured into the water tank.

This principle is typically used for seasonal fire- fighting operation (forest and wildland) where the equipment is flushed, serviced and stored away once the season is over.

c) Positive-pressure proportioning systems (PPPS) use a foam concentrate pump to inject the foam agent into the water stream at a pressure higher than the water pressure. A PPPS typically provides solution to designated discharges on a fire pump.

The systems considered in this standard were originally designed as “Class A foam proportioners” to handle low injection rates and variable flows. However, they can be used with any other suitable foam concentrate. Recent developments on foam concentrates allow low injection rates for Class B fire- fighting as well.

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PPPS do not contaminate the fire pump and water installations with foam concentrate.

Once a water concentrate solution is produced, the finished foam will be created by inducting air at the fire-fighting nozzle as a “Nozzle Aspirated Foam System” (NAFS) or as

d) Injecting compressed-air as a “Compressed-air Foam System” (CAFS).

The system designations mentioned in this standard refer to typical fire-fighting nozzle flow rates or to a combination of such nozzles used at one time.

Water foam solution produced by the PPPS can also be delivered through common non aspirating branch pipe in order to use water with reduced surface tension.

This European Standard considers PPPS and CAFS to be installed in conjunction with a fire-fighting centrifugal pump according to EN 1028 (all parts) or EN 14710 (all parts).

PPPS and CAFS may be operated simultaneously whilst delivering plain water from a fire pump.

Information on environmental impact of fluorine-containing foam extinguishing agent:

Poly-and perfluorinated chemicals (Perfluorochemicals PFC) can be detected by living organisms, in water and sediments. In nature they are very difficult or impossible to degrade. Therefore, the EU has banned the marketing and use of Perfluoroctansulfonate (PFOS) $C_8F_{17}SO_2X$ since 2008-06-27 by EU-Directive 2006/122/EC. See also EU-REACH-Regulation ECV 1907/2006. For fire extinguishing agent based on PFOS, a use period has expired on June 2011 (provided that they were already on the market before December 2006).

Only PFOS containing fire-fighting foaming agents are affected by the EU ban. However, other poly-and perfluorinated chemicals (PFCs) may have a long term influence on living organisms and the environment, as well. It is therefore necessary to carefully evaluate if PFC-containing foaming agents are required for the particular fire-fighting operation in question. Training with PFCs should be avoided or reduced to the absolute minimum. General procedures of foam application may be developed with “Training Foam” agents, thereby causing less impact on the environment.

The use of PFCs for fire-fighting and training operation may require the containment and proper disposal of any run-off, depending on local regulations.

While the use of the aforementioned foam agents (PFCs) may be required for Class B fire-fighting operations, the use of Class A, biodegradable foam agents should be considered for Class A fire-fighting operations, as it will reduce the environmental impact of the fire-fighting operation significantly.

Any tests producing finished foam, as described in this standard, should be kept to the minimum required and use an environmentally friendly foam agent whenever possible.

Testing and training should use appropriate sites, where run-off can be controlled in accordance with local regulations and will not contaminate any open water-sources or the water-table.

The Material-Safety Data Sheet (MSDS) for each foam agent being used should be considered for decisions in relation to the environmental impact. Consultations with local authorities, organizations and agencies may be required to ensure use and disposal.

The objective of using foam for any fire-fighting operation is to reduce knock-down time and the amount of combustion-products released while the fire is burning. Using foam to improve the efficiency of the fire-fighting operation will consume less water and reduce the amount of contaminated run-off. These factors should be balanced against any potential impact from the foam-agent being used.

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1 Scope

This European Standard applies to systems which add a foam concentrate to the water discharged from a fire-fighting centrifugal pump either:

a) by a positive-pressure proportioning system (PPPS) alone, or

b) together with compressed-air by means of a compressed-air foam system (CAFS).

In both cases pressure is applied to the foam concentrate in order to permit continuous operation. Such systems are permanently installed in fire-fighting vehicles. Permanently installed or fixed systems in buildings or structures are not covered by this European Standard.

NOTE 1 This European Standard is intended to be used in conjunction with EN 1846–2 and EN 1846–3.

This European Standard applies to the design, manufacture and operation of such systems. This European Standard deals with all significant hazards, hazardous situations and events relevant to PPPS and CAFS when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacture (see Clause 4).

NOTE 2 Performance requirements are also given (see Clause 7).

This European Standard applies to systems which are used at ambient temperatures ranging from −15 °C to +35 °C as stated in EN 1846-3.

For systems to be used at temperature outside this temperature range, the particular temperature range should be specified by the user and the manufacturer should determine by a risk assessment any need for additional precautions.

This European Standard does not apply to the technical safety requirements concerning the design and manufacturing of drives, auxiliary equipment, sources of energy or pumps. Furthermore, this European Standard does not deal with special hazards arising from the particular conditions under which these systems are used, for example:

a) handling of any equipment, devices etc. which are connected to the system or are joined to it (e.g. handling of branch pipes/nozzles and pressure hoses);

b) events specific to the location where the system is set up (e.g. on public roads);

c) decommissioning and disposal;

d) operation without supervision;

e) immunity against electromagnetic fields and electrostatic discharge.

Hazards relating to any kind of mechanical, electrical, hydraulic, pneumatic and other equipment dealt with by the respective standards for such equipment are not covered by the present standard. References to the relevant standards are made wherever such standards exist and whenever necessary.

This European Standard does not deal with the hazards arising from noise.

NOTE 3 EN 1846–2 covers hazards arising from noise for the complete vehicle.

This European Standard does not deal with hazards related to handling foam concentrates or contact with.

NOTE 4 Additive installation is dealt with in EN 1846–3.

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This European Standard is not applicable to systems which are manufactured before the date of publication of this European Standard by CEN.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 349, *Safety of machinery - Minimum gaps to avoid crushing of parts of the human body*

EN 547-2, *Safety of machinery - Human body measurements - Part 2: Principles for determining the dimensions required for access openings*

EN 547-3, *Safety of machinery - Human body measurements - Part 3: Anthropometric data*

EN 659, *Protective gloves for firefighters*

EN 894-1, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators - Part 1: General principles for human interactions with displays and control actuators*

EN 894-2, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators - Part 2: Displays*

EN 894-3, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

EN 894-4, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators - Part 4: Location and arrangement of displays and control actuators*

EN 953, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards*

EN 1005-3, *Safety of machinery - Human physical performance - Part 3: Recommended force limits for machinery operation*

EN 1028-1, *Fire-fighting pumps - Fire-fighting centrifugal pumps with primer - Part 1: Classification — General and safety requirements*

EN 1028-2, *Fire-fighting pumps - Fire-fighting centrifugal pumps with primer - Part 2: Verification of general and safety requirements*

EN 1568-1, *Fire extinguishing media - Foam concentrates - Part 1: Specification for medium expansion foam concentrates for surface application to water-immiscible liquids*

EN 1568-3:2008, *Fire extinguishing media - Foam concentrates - Part 3: Specification for low expansion foam concentrates for surface application to water-immiscible liquids*

EN 1846-2, *Firefighting and rescue service vehicles - Part 2: Common requirements - Safety and performance*

EN 1846-3:2013, *Firefighting and rescue service vehicles - Part 3: Permanently installed equipment - Safety and performance*

EN 14466:2005+A1:2008, *Fire-fighting pumps - Portable pumps - Safety and performance requirements, tests*

CEN/TS 15989, *Firefighting vehicles and equipment - Symbols for operator controls and other displays*

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EN 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1)*

EN 60529, *Degrees of protection provided by enclosures (IP code) (IEC 60529)*

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1)*

EN 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2)*

EN 61310-3, *Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators (IEC 61310-3)*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13732-1, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces (ISO 13732-1)*

EN ISO 13732-3, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 3: Cold surfaces (ISO 13732-3)*

EN ISO 13857, *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857)*

ISO 7000, *Graphical symbols for use on equipment - Registered symbols*

3 Terms and definitions

For the purpose of this document, the terms and definitions in EN 1028-1 and EN 1028-2 and the following apply.

3.1
positive-pressure proportioning systems
PPPS
system in which a foam concentrate under pressure, at a dosage rate proportional to the flow rate of the water, is continuously added to the water being discharged from a fire-fighting centrifugal pump

3.2
compressed-air foam system
CAFS
system in which a foam concentrate and air are continuously added, under pressure, to the water being discharged from a fire-fighting centrifugal pump

Note 1 to entry: It is assumed that in a compressed-air foam system a positive-pressure proportioning system adds the foam concentrate continuously to the water being discharged from a fire-fighting centrifugal pump at a dosage rate proportional to the flow rate of the water.

3.3
foam solution
mixture of water and foam concentrate

Note 1 to entry: PPPS has no influence on the aspiration. Therefore, test procedures in this standard only consider the accuracy of dosage. Finished foam may be tested as described in EN 1568 (all parts) if necessary.

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3.4
wet foam
operation defined by a nominal solution/air ratio between 1:3 and 1:10, being mixed in the system, with finished foam delivered from the system with an expansion ratio between 4 and 11

3.5
dry foam
operation defined by a nominal solution/air ratio greater than 1:10, being mixed in the system, with finished foam delivered from the system with an expansion ratio greater than 11

Note 1 to entry: CAFS has an influence on the production of the finished foam. Finished foam from CAFS is tested as described in Annex D, which is based on EN 1568–3 principles.

Note 2 to entry: Typically all finished foam produced by CAFS falls under “Low Expansion Foams” as described in EN 1568–3.

3.6
operating range
range (of conditions) specified by the manufacturer of a system and within which the system can be operated without limitations while achieving the designated performance characteristics

3.7
Delivery rates
NOTE Delivery rates are stated in litres per minute [l/min].

3.7.1
foam solution delivery rate
$Q_{\mathbf{w}}$
volume (of water plus foam concentrate) delivered per unit of time by a system

Note 1 to entry At proportioning ratios of up to 1 % the difference between water delivery rate and foam solution delivery rate can be neglected.

3.7.2
nominal foam solution delivery rate
foam solution delivery rate at the nominal delivery pressure of the fire-fighting centrifugal pump

3.7.3
air delivery rate
volume of air, in ambient condition, that is fed into a compressed-air foam system per unit of time

Note 1 to entry: For determination of flow-rate characteristics see ISO 6358.

Note 2 to entry: While inside the system the air-volume is compressed according to the pressure applied. Once leaving the system from the nozzle to atmosphere the air expands to its normal volume again.

3.8
proportioning ratio
amount of foam agent added to water given as a percentage

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3.9
Volume definitions

3.9.1
air/foam solution volume ratio
relationship between parts of liquid (solution) and parts of air (at atmospheric pressure) being mixed together in a CAFS mixing device

Note 1 to entry: The measurement units are l/min.

3.9.2
flushing procedure
procedure described by the manufacturer to ensure that the foam proportioning system and associated pipework on the fire-fighting centrifugal pump to the discharge connection is adequately flushed of foam concentrate and solution to avoid any damage

EXAMPLE Corrosion.

3.10
operating pressure of the compressed-air foam system
p
pressure, specified by the compressed-air foam system manufacturer, at the system input connection at which all performance and safety requirements are met

4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this European Standard, identified by risk assessment as significant for this type of machinery and which necessitates action to eliminate or reduce the risk.

The significant hazards are given in Table 1, which is based on the principles of EN ISO 12100:2010, Annex B. Also shown are the subclause references to the safety requirements and/or protective measures in this document, if applicable.

When the present standard was compiled, it was assumed that:

a) the systems are operated by properly trained personnel only;

b) components not subject to particular requirements are:

   1) designed according to standard engineering practice and calculation methods, including due consideration to all modes of failure;

   2) designed to be mechanically robust;

   3) made of materials with strength and quality meeting the requirements of this European Standard;

   4) manufactured of flawless materials.

c) no hazardous materials (e.g. asbestos) are used;

d) components are kept in good condition in order to maintain the required characteristics;

e) the structural dimensions of load-bearing elements ensure safe operation and remain fully operational even after testing;

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