## SBF 128:3

# Guidelines for permanently mounted fire suppression system on buses





The Swedish Fire Protection Association (SFPA) is a public-interest, non-profit association that works for greater fire safety in Sweden and is borne by an idea of good fire protection for all. Through information, training and expert advice, we help people take responsibility for their own fire protection. The SFPA stands for well-tried and up-to-date knowledge. Our networks are home to expertise and competence that make us a given collaborative partner for businesses, public-sector actors and the rescue services. Through collaboration with others, we reach farther and become better.

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## Foreword

Increasingly stringent environmental standards are being placed on today's buses in terms of noise and emissions. This means that engine spaces are increasingly enclosed and the installed equipment such as silencers and particulate filters have worse cooling, increasing the risk of fire.

These guidelines, SBF 128:3, regulating permanently mounted automatic fire suppression systems on buses, and the regulations adopted by the EU, ECE R 107-6, which require automatic fire suppression systems on all buses as of 2021, do not agree with each other, but do not conflict, which means that fire suppression systems on buses need to be designed according to both SBF 128:3 and ECE R 107-6. Depending on the bus category, the requirements according to ECE R 107-6 begin to apply as of June 2018.

The Swedish Fire Protection Association's (SFPA) work for greater fire safety in Sweden consists of issuing regulations and normative guidelines in the area of fire safety. The SFPA has a clear role as a standardisation organisation in the area.

The intention of the regulations and standards is to set quality and safety levels that can be generally applied by the parties concerned. Application is voluntary, however. A regulation is not intended to include all necessary reservations or provisions that may occur in an agreement or contract. An agreement with a regulation does not inherently entail automatic fulfilment of requirements or obligations by law, ordinance or public regulation.

As far as possible, these regulations are based on standards or other applicable documents. The regulations are therefore presented as supplements to these standards or documents. The regulations state the documents to which they relate and contain references to the same.

Any exceptions to these regulations can be made by the concerned specifier.

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Secretary-General The Swedish Fire Protection Association

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## 1 Introduction

According to the Road Traffic Definition Act (SFS 2001:559), buses are defined as follows.

A motor vehicle that is mainly equipped for passenger transport and is outfitted with more than eight seats in addition to the driver's seat. Buses are divided into light and heavy buses.

According to these regulations SBF 128, buses with a total weight of 10 tonnes or more, registered after 31 December 2003, shall be equipped with permanently mounted automatic fire suppression systems.

The rules constitute minimum requirements for a fire suppression system and requirements on companies (installation firms) that provide and install such systems.

In addition to requirements in SBF 128:3, there are requirements according to ECE R107-06 that state that the new bus models in Class III shall have a fire suppression system in the engine compartment that meets the requirements in ECE R107-06 as of 10 June 2018. New bus models in Class I and II that are voluntarily equipped with fire suppression systems shall meet the requirements according to ECE R107-06.

#### Significant changes in SBF 128:3

In this edition of the regulations, the following major changes have been made:

- 1. Editorial language adjustment
- 2. Maximum time to empty the fire suppression systems has been removed.
- 3. Requirements for pipe and line system and nozzles that were under the respective extinguishing agent have been compiled into one section.
- 4. No requirement of ABC dry chemicals.
- 5. The amount of necessary extinguishing agent has been reduced.
- 6. Requirements on the minimum amount of aerosol have been introduced.
- 7. Fire tests according to SP Method 4912 replace the earlier full-scale test.

## 2 References

ECE R107 Regulation no. 107 from the United Nations Economic Commission for Europe (FN/ECE) – Uniform provisions concerning the approval of category M2 or M3 vehicles with regard to their general construction.

#### Test norm

SP Technical Research Institute of Sweden (SP) method, SP method 4912. For more information, please refer to www.sp.se.

#### Detector, Detector cable/tube

The detectors, detector connections and cable splices shall be tested as a unit according to standard SS-IEC 60529, IP 65 and SS-IEC 60068-2-36.

They shall also comply with Commission Directive 95/54/EC and any subsequently published editions with respect to EMC requirements or UN-ECE R10.

#### Supply lines and hoses

In accordance with SAE J 517 of February 1998 (can be ordered from SIS). Fuel and air supply lines according to SS-EN ISO 7840 annex A1 (can be ordered from SIS).

#### Control unit

The control unit shall be tested with as complete a system as possible. The test consists of the following function and climate testing based on the SS-IEC 60068 standard.

Low temperature	SS-IEC 60068-2-1	-40 °C
High temperature	SS-IEC 60068-2-2	+85 °C
Temperature change	SS-IEC 60068-2-14	-40 °C, +85 °C
Moisture	SS-IEC 60068-2-30	-20 °C, +55 °C
Vibration	SS-IEC 60068-2-36	
Electrical specification	Test voltage Operating voltage	28 V 20 – 30 V

## 3 Definitions

This section explains common words in this publication which are not defined or explained elsewhere.

Activation device	a device that manually activates the fire suppression system by elec- trical or mechanical means.	
Detector, detector cable/ tube	a heat sensitive detector or similar device that responds to excessive rise of temperature in the protected area.	
Cartridge	a device to pressurise and discharge a normally non pressurised agent tank.	
Specifier	insurer, finance company, client/principal.	
Alarm device	a device that generates acoustic and optical signals in case of a fire.	
Circuits	cables that interconnect the electrical components of the system, for example detectors, control unit, alarm devices, activation and shut down devices and so on.	
Selector valve	a valve that selects between the ordinary and spare agent tank.	
Distribution system	a pipe system that distributes the agent.	
Agent tank	pressurised or non pressurised containers for the fire suppression agent.	

## 4 Fire suppression system requirements

## 4.1 General

A permanently mounted automatic fire suppression system refers to a fire suppression system that emits an alarm and activates an extinguishing agent in case of a farm.

The main purpose of the fire suppression system is to detect the fire, warn the surroundings and put out the fire in the bus' engine compartment.

The fire suppression system shall be unambiguously specified in its construction and certified by the SFPA after approved testing in accordance with the SP Technical Research Institute of Sweden SP method 4912.

The test shall be done by an independent testing laboratory.

## 4.2 Fire suppression system approval

For approval in accordance with SBF 128, the following is required in accordance with Sections 4.2.1–4.2.3:

### 4.2.1 Fire tests according to SP Method 4912

For approved results, the following must be fulfilled when the extinguishing method is tested according to SP method 4912

- Achieve a minimum of 6 points in the implementation of the tests 1-10 in SP Method 4912 and fulfil the following requirements:
  - Approved tests must include test 1 and test 6.
  - Approved tests must include test 5 and test 7.
  - A minimum of 45 second reignition protection in test 11 is required.
  - The most difficult test with a low fire load shall be carried out with a reduced amount of extinguishing agent.
  - Pass fire tests with extinguishing agent and propellant cooled to the minimum operating temperature.
  - According to ECE R107, approved results must be achieved in tests 1, 5, 6 and 11.

Tests according to SP 4912							
Test	Air (volume flow rate)	Test category	Requirements as per SBF 128	Requirements as per R107			
1	0 m³/s	High fire load	×	×			
2	0 m <sup>3</sup> /s	Low fire load					
3	0 m <sup>3</sup> /s	Hidden fire					
4	0.5 m <sup>3</sup> /s	Class A fire					
5	1.5 m³/s	High fire load	Z	X			
6	1.5 m³/s	Low fire load	X	×			
7	1.5 m³/s	Hidden fire	Z				
8	3 m³/s	High fire load					
9	3 m³/s	Low fire load					
10	3 m³/s	Hidden fire					
11	0 m <sup>3</sup> /s	Reignition test	×	×			
X test is required Z one (1) of the tests is required							

## 4.2.2 Extinguishing agent amount

- For liquid-based fire suppression systems, the amount may not be less than 3 litres/m<sup>3</sup> protected volume.
- For dry chemical-based fire suppression systems, the amount may not be less than 4 kg/m<sup>3</sup> protected volume.
- For aerosol-based fire suppression systems, the amount may not be less than 1.0 kg/m<sup>3</sup> protected volume.

## 4.2.3 Installation firm

In order to become an installation firm authorised according to SBF 1017, the company must be established in Sweden, possess necessary knowledge in the field and have the capability to perform planning, installation and maintenance of the fire suppression systems.

Additionally, the company must be able to provide components that comply with the relevant standards and, if necessary, have agreements with its suppliers on continuous technical information.

Planning and installation is to be done in cooperation with the authorised installation firm and manufacturer. This shall provide necessary documentation that confirms the fire suppression system's agreement with these regulations.

## 4.2.4 Application

An application for approval is to be sent to the Swedish Fire Protection Association (SFPA). The SFPA then issues a type certificate.

## 4.3 Level of protection

The fire suppression system shall protect the engine compartment. The generator and starter motor as well as hot components, such as the manifold, turbo and particulate filter, shall be protected in particular.

If the fuel-powered supplemental heater is installed in a separate space, it must also be covered.

#### 4.3.1 Volume measurement of engine compartment in bus

The volume of the engine compartment must be calculated as a gross volume. No deduction for engine volume, etc. is allowed.

- Height: Measured from the ceiling of the engine compartment (upper boundary towards the floor of the passenger area/baggage compartment) to the engine compartment floor. If the engine compartment has no floor, it is measured to the lower edge of the frame beams.
- *Width:* Measured internally in the engine compartment from bus side to bus side. In potential fully covering sheet metal boundaries between engine compartment and bus side, it is measured up to them.
- *Length:* Measured in engine compartment from engine hood/rear frame to the front part of the firewall.

## 4.4 General

Common requirements for all types of agent.

### 4.4.1 Detector

The protected areas shall be equipped with an adequate number of detectors or sufficiently long detector cable/tube in order to achieve fast detection of the fire.

When placing the detectors or detector cable/tube and choosing the activation system, the risk of false alarms due to radiated heat from nearby objects must be taken into account.

When placing the detectors, a high degree of serviceability is desired.

Detectors, detector connections and cable junctions shall be waterproof at least according to SS-IEC 529, IP 65 and vibration proof according to SS-IEC 68-2-36.

The detector cable/tube shall be equipped with a protective casing intended for the purpose.

Detectors and detector cable/tube shall be clearly and permanently marked.

### 4.4.2 Alarm device

The fire suppression system shall be equipped with one or more optical alarm devices with flashing light. The alarm device shall be placed so that it can be observed by the driver while driving.

The fire suppression system shall also be equipped with an acoustic alarm device with an intermittent sound signal. The signal shall be clearly perceptible from the driver area and its vicinity.

#### 4.4.3 Fire suppression system's electrical systems

Electric cables that interconnect important parts of the fire suppression system shall be protected from mechanical damage and be resistant to variations in temperature and environment.

### 4.4.4 Activation device

Activation of the agent shall take place automatically.

### 4.4.5 Distribution system

The distribution system for the agent shall be made of steel or steel reinforced hose at least complying with SAE J 517.

Dimensioning of steel pipes, hoses and connections shall be done in accordance with the manufacturer's specifications in order to obtain the necessary flow rate and pressure needed to achieve the correct spraying pattern.

Hoses/pipes shall be located so that they are not dislocated or damaged during normal operation and service of the bus.

If hoses/pipes are equipped with a blow-down valve, it shall be placed close to the container and before the first nozzle.

Hoses shall be red or permanently coloured red at least 1 decimetre from each coupling. Steel pipe shall be permanently marked where there is a risk of mix-up with other installations.

Pipe and hose connections exposed to internal pressure must comply with, and be handled in accordance with applicable official standards and instructions.

### 4.4.6 Nozzles

Nozzles shall be tested with respect to agent, spray pattern, length of throw and flow. The nozzle shall be unambiguously and permanently labelled so that it can be identified.

The nozzle shall be equipped with a filter and a protective cap to prevent it from clogging up with particles of dirt. The filter is to be located before the nozzle.

The fire suppression system must have a sufficient number of nozzles in order to cover all areas where a fire can occur.

The maximum number of nozzles for the fire suppression system is calculated according to the installation firm's instructions so that the available flow and pressure provide the projected spray pattern.

The nozzle shall be designed and placed so that fire suppression does *not spread the fire outside the protected area*.

### 4.4.7 Components

System components in both type approved and stand alone fire suppression systems that are crucial to a safe and correct system performance must comply with the standards in Chapter 2 *References*.

## 4.5 Type of fire suppression system

Special requirements depending on the type of agent.

#### 4.5.1 Fire suppression system, liquid

Any component exposed to internal overpressure, for example agent tank, cartridges, pipe system and hoses must comply with, and be handled in accordance with, applicable official standards and instructions.

#### 4.5.1.1 Type of agent

In general, the agent shall be certified by SFPA following an approved test according to SP Technical Research Institute of Sweden SP method 4912.

Refilling may only be done with same agent that the system is certified with.

#### 4.5.1.2 Calculating the amount of agent

The amount of agent shall be calculated according to the design criteria of the actual agent with respect to flow rate, spraying pattern and coverage for the used nozzles, and with respect to the flow rate in agent tanks and piping system. The agent shall be evenly distributed over the protected surface.

The fire suppression protected engine compartment volume shall be calculated as a gross volume as per Section 4.3.1 *Volume measurement of engine compartment in bus*.

The amount of agent shall however never be less than 3 litres/m<sup>3</sup> protected volume.

#### 4.5.1.3 Discharge time

The system shall release 85% of its contents within the stipulated discharge time. This shall also be applicable down to -30 °C.

If the system contains more than the minimum amount of agent, the discharge time can be prolonged correspondingly.

#### 4.5.1.4 Agent tank

If the agent tank is equipped with a siphon tube, this should be flexible. The valve and pipe system shall be dimensioned in accordance with the design criteria so that necessary flow rate and pressure are maintained.

Pressurised containers shall be equipped with easily readable manometers.

The agent tank shall be easily accessible and normally mounted in an upright position, firmly clamped and protected against mechanical damage and heat according to the manufacturer's specifications.

If the agent tank is mounted at an angle, the valves shall be orientated in opposite directions.

Minimum angle is 15° from the bus' maximum permissible inclination and only applies to tanks equipped with siphon tube.

#### 4.5.2 Fire suppression system, dry chemicals

Any component exposed to internal overpressure, for example agent tank, cartridges, pipe system and hoses must comply with, and be handled in accordance with, applicable official standards and instructions.

#### 4.5.2.1 Type of agent

In general, the agent shall be certified by SFPA following an approved test according to SP Technical Research Institute of Sweden SP method 4912.

Approved agents are dry chemicals of the specified type. Refilling may only be done with same type of dry chemicals that the container is marked with.

#### 4.5.2.2 Calculating the amount of agent

The fire suppression protected engine compartment volume shall be calculated as per Section 4.3.1 *Volume measurement of engine compartment in bus*.

The necessary amount of agent is at least 4 kg/m<sup>3</sup> protected volume.

#### 4.5.2.3 Discharge time

For dry chemical systems, the system shall release 95% of its contents within the prescribed projected discharge time. This shall also be applicable down to -30 °C.

#### 4.5.2.4 Agent tank

The dry chemical can be stored in one or more agent tanks. The agent tank shall be easily accessible and mounted in an upright position, firmly clamped and protected against mechanical damage and heat according to the manufacturer's specifications.

The agent tank is not allowed to have a siphon tube. The design of the tank shall ensure that the dry chemical is agitated upon release. Full working pressure shall be obtained before the distribution system opens.

The outlet of the tank must be at least 200 mm<sup>2</sup>, and be equipped with a seal or a membrane in order to prevent moisture from entering.

The agent tank shall be permanently marked with the type and amount of agent and handling and maintenance instructions. Handling and maintenance instructions can be displayed on a separate sign mounted by the agent tank or another suitable location. Spare tanks are not required.

#### 4.5.3 Fire suppression system, liquid high-pressure fire suppression system

A liquid high pressure system is a fire suppression system where the agent is mainly water and where the agent tank is charged with a fill pressure of 100 bar or more.

Any component exposed to internal overpressure, for example agent tank, pipe system and hoses must comply with, and be handled in accordance with applicable official standards and instructions, as well as the Pressure Equipment Directive (PED).

#### 4.5.3.1 Type of agent

In general, the agent shall be certified by SFPA following an approved test according to SP Technical Research Institute of Sweden SP method 4912.

Refilling may only be done with same agent that the system is certified with.

#### 4.5.3.2 Calculating the amount of agent

The amount of agent shall be calculated according to the design criteria of the actual agent with respect to flow rate, spraying pattern and coverage for the used nozzles, and with respect to the flow rate in agent tanks and piping system. The agent shall be evenly distributed over the surface.

The volume of the protected engine compartment must be calculated as a gross volume. No deduction for engine volume, etc. is allowed.

#### The amount of agent shall however never be less than 3 litres/m<sup>3</sup> protected volume.

Also see 4.3.1 Volume measurement of engine compartment in bus.

#### 4.5.3.3 Discharge time

The system shall release 85% of its contents within the stipulated discharge time. This shall also be applicable down to -30 °C.

#### 4.5.3.4 Agent tank

If the agent tank is equipped with a siphon tube, this should be flexible.

The valve and pipe system shall be dimensioned in order to uphold the stipulated flow rate and pressure.

Pressurised containers shall be equipped with easily readable manometers. The agent tank shall be easily accessible and normally mounted in an upright position, firmly clamped and protected against mechanical damage and heat according to the manufacturer's specifications.

If the agent tank is mounted at an angle, the valves shall be orientated in opposite directions. Minimum angle is  $15^{\circ}$  from the bus' maximum permissible inclination and only applies to tanks equipped with siphon tube.

### 4.5.4 Fire suppression system, aerosol

Aerosol is a solid material that is under pressure in containers. No hoses or pipes are necessary for distribution of the agent as nozzle(s) are built into the container.

#### 4.5.4.1 Type of agent

In general, the agent shall be certified by SFPA following an approved test according to SP Technical Research Institute of Sweden SP method 4912.

In recharging/replacement, the same make and size shall be used as the system is certified with.

#### 4.5.4.2 Calculating the amount of agent

The volume of the protected engine compartment must be calculated as a gross volume. No deduction for engine volume, etc. is allowed.

The necessary amount of agent is at least 1 kg/m<sup>3</sup> protected volume.

#### 4.5.4.3 Discharge time

The container shall be emptied in accordance with the current make's certification from SFPA even at temperatures of -30 °C.

#### 4.5.4.4 Agent tank

The tank's placement and discharge path shall be in accordance with the manufacturer's design criteria.

Tanks shall be easily accessible and may be placed both upright and horizontally. They shall be firmly mounted and protected from mechanical damage.

## 4.6 Manuals for installation and assembly

## 4.6.1 Drawings and manuals for installation

Drawings and manuals for installation and assembly shall be produced by installation firm in consultation with the bus manufacturer.

Drawings and manuals shall include location of agent tanks, activation devices, nozzles, detectors, alarm devices, schematic detector cable and pipe placement, and an electrical schematic.

## 4.6.2 Length of pipes and hoses

The length of pipes and hoses shall be specified in the installation instructions.

The angles and flow direction of the nozzles shall be specified in the installation drawings and the instructions.

## 5 Care and maintenance

## 5.1 General

The functionality and efficiency of the fire suppression system is to be upheld constantly and any fault is to be repaired without delay. Permanent or temporary actions or installations that may affect the system may not be carried out.

The care and maintenance directions prepared by the installation firm must be observed. Daily, weekly and periodical inspection of the fire suppression system is to be included in the bus' service procedures.

The driver of the vehicle shall be well trained on the fire suppression system and well acquainted with its operation.

## 5.2 Verification of system – authorisation

Verification of the fire suppression system is to be performed at least once every 12-month period according to the instructions from the manufacturer or specifier, resulting in a test protocol. The inspections shall be done by certified trained personnel or by an authorised service provider. The test protocol shall be presented by the vehicle owner upon request of the concerned specifier.

## 5.3 Care and maintenance

Like the bus, the fire suppression system with associated devices shall be cared for and maintained so that the fire suppression effectiveness and fire safety as per 4 *Fire suppression system requirements* is maintained. Also see FTR 128.

Repair and maintenance of the fire suppression system should only be carried out by authorised personnel approved by the manufacturer.