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**Fire safety engineering — Active fire  
protection systems —**

Part 1:  
**General principles**

*Ingénierie de la sécurité incendie — Systèmes de protection active  
contre l'incendie —*

*Partie 1: Principes généraux*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 4, *Fire safety engineering*.

A list of all parts in the ISO 20710 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

Predicting fire behaviour is important for preventing and reducing losses due to fire. Evaluation of the performance of active fire protection systems based on the prediction of fire phenomena plays a direct part in reaching the goal of fire safety. Therefore, evaluating fire protection system performance, including system operating time and effectiveness, is important for an engineer, peer reviewer, Authority Having Jurisdiction (AHJ), fire officials and other stakeholders. It can also be useful for fire investigators to reconstruct and analyse actual fires.

The ISO 20710 series provides guidance on estimating the activation time and effectiveness of active fire protection systems when carrying out fire hazard assessments and performance-based fire safety designs for all of the abovementioned stakeholders.

This document includes information on methods for estimation, theories and data required. It also provides information on the purpose, configuration, activation procedure and functioning principles of active fire protection systems.

The methods of evaluation are hand calculation, computer fire modelling and performance testing. The objective of the ISO 20710 series is to provide guidance for performance estimation methods for analysing whether a selected system can achieve the desired performance in various environments.

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# Fire safety engineering — Active fire protection systems —

## Part 1: General principles

### 1 Scope

This document provides information on the goal, scope, structure, contents and background of the different parts of the ISO 20710 series. The purpose of the ISO 20710 series is to provide information on active fire protection systems according to the design, implementation and maintenance described in ISO 23932-1. The ISO 20710 series is linked to the steps of the performance-based fire safety engineering design process described in ISO 23932-1.

This document is not intended as a detailed technical design guide but is intended to provide the guidance necessary for use of the ISO 20710 series by professionals who consider the active fire protection systems at each step presented in ISO 23932-1.

### 2 Normative references

There are no normative references in this document.

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

#### 3.1

##### **activation time**

time interval from response by a sensing device until the suppression system, smoke control system, alarm system or other fire safety system is fully operational

[SOURCE: ISO 13943:2017, 3.15]

#### 3.2

##### **active fire protection system**

##### **AFPS**

system or group of systems that require some amount of action to work in the event of a fire

Note 1 to entry: Actions may be manually operated, like a fire extinguisher or automatic, like a sprinkler.

#### 3.3

##### **ASET**

##### **available safe escape time**

for an individual occupant, the calculated time interval between the time of ignition and the time at which conditions become such that the occupant is estimated to be incapacitated, i.e. unable to take effective action to escape to a safe refuge or place of safety

[SOURCE: ISO/TS 29761:2015, 3.1, modified — notes to entry removed.]

3.4

**aspirating smoke detector**

smoke detector, in which air and aerosols are drawn through a sampling device and carried to one or more smoke-sensing elements by an integral aspirator

[SOURCE: ISO 7240-1:2014, 2.1.13, modified — Note 1 to entry and example removed.]

3.5

**authority having jurisdiction**

**AHJ**

organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure

[SOURCE: NFPA 11, 3.2.2]

3.6

**automatic closing device**

device that causes the fire door, fire shutter, fire and smoke damper, and fire window to close when activated by a fusible link or detector

[SOURCE: NFPA 80, 3.3.6]

3.7

**dry chemical fire extinguishing system**

**dry chemical system**

system that discharges dry chemical from fixed nozzles or hand hose line by means of expellant gas

[SOURCE: NFPA 17, 1.1]

3.8

**effectiveness**

extent to which planned activities are realized and planned results achieved

[SOURCE: ISO 18788:2015, 3.17]

3.9

**fire alarm control unit**

component of the fire alarm system, provided with primary and secondary power sources, which receives signals from initiating devices or other fire alarm control units, and processes these signals to determine part or all of the required fire alarm system output functions

[SOURCE: NFPA 72, 3.3.108]

3.10

**fire/smoke barrier**

barrier to restrict the spread of flame and/or heat and/or smoke

3.11

**fire and smoke damper**

device installed in an air distribution system to control the movement of smoke and restrict the passage of flame

[SOURCE: NFPA 80, 3.3.48 and 3.3.118]

3.12

**fire door**

door assembly capable of maintaining for a specified period some, or all of the fire resistance criteria defined in [ISO 3008](#), as appropriate for the door in use

[SOURCE: ISO/TR 5925-2:2006, 2.3, modified — reference to "or shutter" removed.]

**3.13****fire model**

calculation method that describes a system or process related to fire development, including fire dynamics and the effects of fire

[SOURCE: ISO 13943:2017, 3.136, modified — admitted term and Note 1 to entry removed.]

**3.14****fire shutter**

fire door assembly used for the protection of an opening

[SOURCE: NFPA 80, 3.3.63]

**3.15****fire suppression system**

technical system to fight a fire and to reduce the damaging effects of flames and heat

[SOURCE: ISO 19353:2019, 3.7, modified — Note 1 to entry removed.]

**3.16****fire window**

window or glass block assembly having a fire resistance rating

[SOURCE: NFPA 80, 3.3.64]

**3.17****flame detector**

fire detector which responds to the radiation emitted by flames from a fire

[SOURCE: ISO 7240-1:2014, 2.1.63]

**3.18****foam fire extinguishing system**

system that uses a foam made by an aqueous solution of a mixture of water and foam-generating agent that extinguishes a fire by covering the surface of the fuel with the generated foam preventing oxygen from reaching the surface of the fuel

**3.19****manual call point**

component for the manual initiation of an alarm

[SOURCE: ISO 7240-1:2014, 2.1.85]

**3.20****performance test for AFPS**

test conducted to evaluate the extent to which the active fire protection system design meets the performance criteria for achieving the fire safety objectives

Note 1 to entry: The test uses physical modelling considering the fire and environment to simulate the expected situation. The purpose, scenario, method, procedure and performance criteria of the test should be set by the AHJ and related professionals. The test should be conducted by professionals in a suitable environment using appropriate equipment. Professionals should analyse test results and conduct the evaluation in conjunction with AHJ and professionals.

Note 2 to entry: See [Clause 4](#).

**3.21****gaseous fire extinguishing system**

system that uses inert gas and chemical agents to extinguish the fire

**3.22**

**hybrid fire extinguishing system**  
**hybrid system**

system that uses a combination of atomized water and inert gas to extinguish fires

[SOURCE: NFPA 770]

**3.23**

**passive fire protection system**

system that does not require any external power but relies instead on specific construction features and the use of materials, products, and building elements that meet well-defined fire performance requirements

[SOURCE: Fire Protection Handbook 20<sup>th</sup> edition, Section 2, Chapter 5 – NFPA - modified]

**3.24**

**RSET**

**required safe escape time**

calculated time period required for an individual occupant to travel from their location at the time of ignition to a safe refuge or place of safety

[SOURCE: ISO 13943:2017, 3.330, modified — admitted term and Note 1 to entry removed.]

**3.25**

**smoke alarm**

device containing within one housing all the components, except possibly the power source, necessary for detecting smoke and generating an alarm condition

[SOURCE: ISO 12239:2010, 3.15]

**3.26**

**smoke control systems**

engineered system that uses mechanical fans or natural ventilation to produce pressure difference across smoke barriers to inhibit smoke movement

[SOURCE: NFPA 92A]

**3.27**

**video fire detector**

fire detector which analyses video images to detect the presence of smoke and/or flame

[SOURCE: ISO 7240-1:2014, 2.1.134, modified — Note 1 to entry removed.]

## **4 Goal and scope of active fire protection system documents**

The purpose of the ISO 20710 series is to provide technical information in fire safety engineering on the design, implementation and maintenance of active fire protection systems to reach the fire safety objectives described in ISO 23932-1. The ISO 20710 series is connected to the phases of the performance-based fire safety engineering design process as described in ISO 23932-1.

ISO 23932-1 requires that appropriate engineering methods be selected to predict the fire consequences of specific scenarios and scenario elements (ISO 23932-1:2018, Clause 12).

Maintenance and reliability of active fire protection systems are also included in the documentation, final report, and fire safety management (ISO 23932-1:2018, Clause 14, Clause 16).

This step in the fire safety engineering process is shown as a highlighted box in [Figure 1](#) and described in ISO 23932-1.

In accordance with the requirements of ISO 23932-1, the ISO 20710 series provides the methods, procedures and information for predicting and demonstrating the performance of the active fire

protection system considered. In addition, information on the maintenance and reliability of the active fire protection systems is also included.

The evaluation methods of AFPS design included in the ISO 20710 series are hand calculations, fire models and performance tests for AFPS. They provide information related to the theories, equations, algorithms, test methods, procedures and data in order to carry out the evaluation.

The ISO 20710 series includes content on predicting fire phenomena, which is required for estimating activation time and effectiveness of active fire protection system designs from other ISO/TC 92 documents for users' convenience. However, detailed theories and explanations about formulae are excluded and referenced instead in other ISO documents.

The predicted or measured values of the fire phenomena required as an input for the ISO 20710 series documents are taken from existing documents prepared by ISO/TC 92.

Information on specific items provided by a company or commercial agency can be referenced in a Part of the ISO 20710 series without any information about the manufacturer. The information and data contained in the ISO 20710 series relate to specific test conditions and environments, or specific commercial products. Therefore, special care should be taken when using data and information published in the literature on active fire protection systems, because of the possibility of significant errors occurring due to differences in application conditions.

The ISO 20170 series does not consider the influence of the operation of an active fire protection system on the evacuation or human behaviour in fire situations.

The automatic closing device is included in the ISO 20710 series. Most automatic closing devices, such as fire shutters and fire screens can operate by the signal from the control panel and fire detector. The ISO 20710 series does not deal with any passive fire protection elements, but only includes elements that are operated by electrical or mechanical elements, such as fire door, fire shutter, etc.

The scope of the ISO 20710 series includes the maintenance and reliability of AFPS. It will consider maintenance at the phase of design and use. It also includes the impact of factors on AFPS like earthquakes, and maintenance by the person in charge can be included.

The reliability of AFPS is not related to fire risk assessment and applies only to the maintenance.

The guidelines and procedures for AFPS performance testing in the ISO 20710 series do not supersede or act as substitutes for those in documents prepared by ISO/TC 21. This document includes the goal, scope, structure, contents and background of different parts of the ISO 20710 series. However, each document can change depending on the purpose and scope.

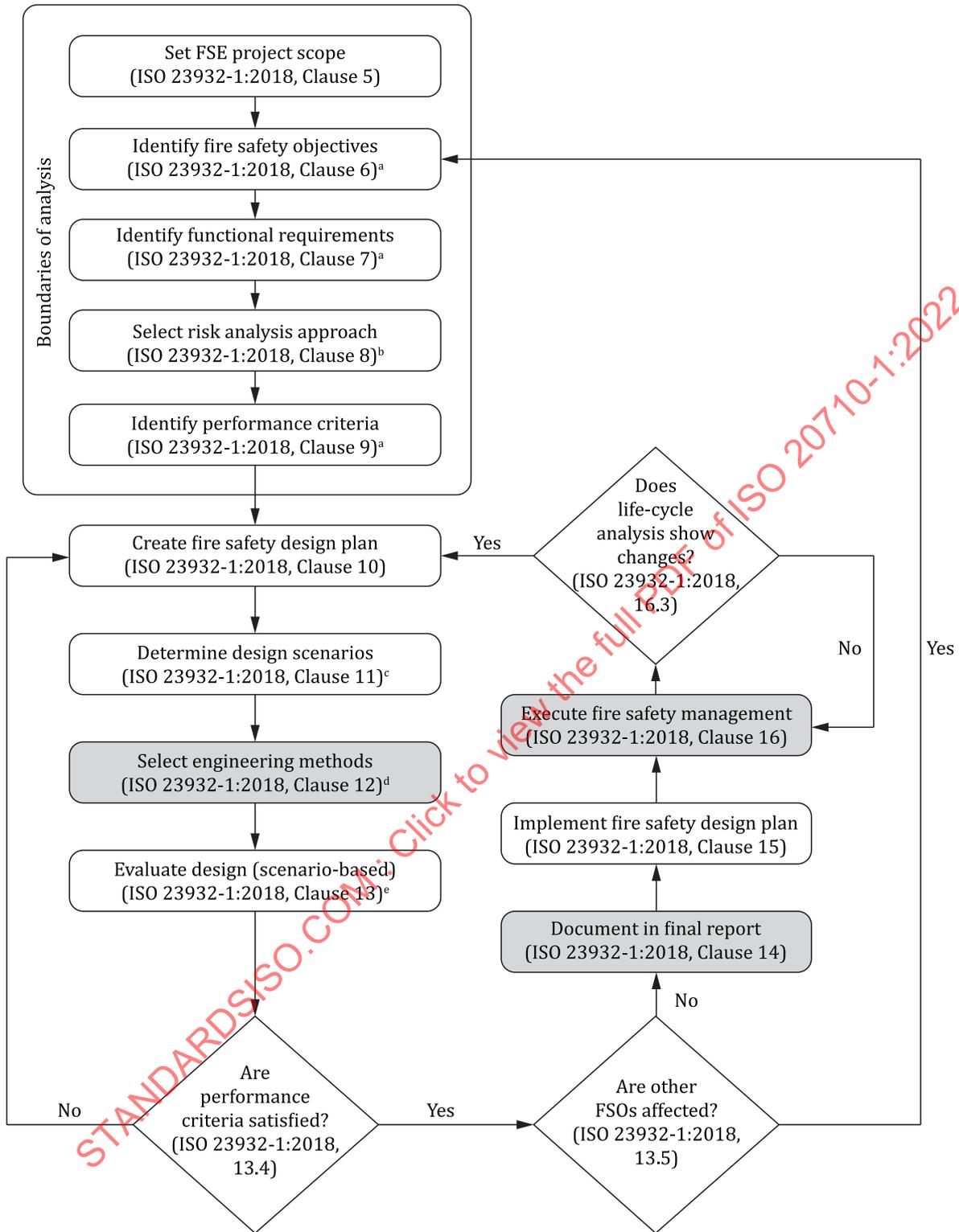


Figure 1 — Flow chart illustrating the fire safety engineering design process (from ISO 23932-1:2018)

## 5 Structure of the ISO 20710 series

### 5.1 Background

After fire occurrence, active and passive fire protection systems are important means of achieving the goal of fire safety. Active fire protection systems require manual, mechanical or electrical power and are designed to activate and operate upon fire occurrence to suppress or control fire and/or smoke spread. Passive fire protection systems do not require any external power but instead rely on specific construction features and the use of materials, products and building elements for minimizing fire damage by preventing the spread of fire.

[Table 1](#) shows the items of AFPS applied at each phase of the fire. In this table, the phase of the fire is divided into three categories: the incipient phase, the growth phase and the steady burning phase.

In the incipient phase, a fire is recognized by heat, smoke and light detectors. In addition, devices such as detectors using sensors for special gas species, aspirating smoke detectors, etc. can be used. When these devices are activated, a signal is sent to a fire alarm control unit.

In the growth phase, a fusible link or glass bulb in a sprinkler head is activated by heat from the fire. This makes water flow into the sprinkler pipe and operates the flow switch or sensor, and then a signal transmits to a fire alarm control unit.

People can recognize fire via the human sensory organs and use the manual call point for sending a signal to a fire alarm control unit.

**Table 1 — Items of AFPS applied at each phase of fire**

The phase of fire	Incipient	Growth	Steady burning
Detection	Heat detector Smoke detector Gas species detector Aspirating detector Flame detector Beam detector Video detector Multi-sensing detector Manual switch (Human)		
Alarm	Sound alarm Voice alarm Visual alarm		
Suppression system		Water-based system Gaseous system Wet chemical system Dry chemical system Foam system Aerosol system Hybrid system	
Smoke control		Smoke exhaust system Fire window (Natural ventilation)	

Table 1 (continued)

The phase of fire	Incipient	Growth	Steady burning
Fire/smoke barrier			Fire door Fire shutter Fire damper Automated smoke curtains
Fire stop			Drencher

The fire alarm control unit recognizes a fire occurrence through the signal from a detector or a sensor and transmits the signal to other fire protection systems like alarm devices, suppression systems, smoke control systems, and the devices for fire/smoke barrier in order to operate it.

Fire doors, fire shutters and fire dampers are sometimes included in passive fire protection systems. However, some of these items are initiated by the signal from the fire alarm control unit or the fire detector and operated by electrical power.

Figure 2 shows the relationship between each factor and the process. Factors for estimating active fire protection systems are divided into three parts: detection time, operation time and effectiveness of activation.

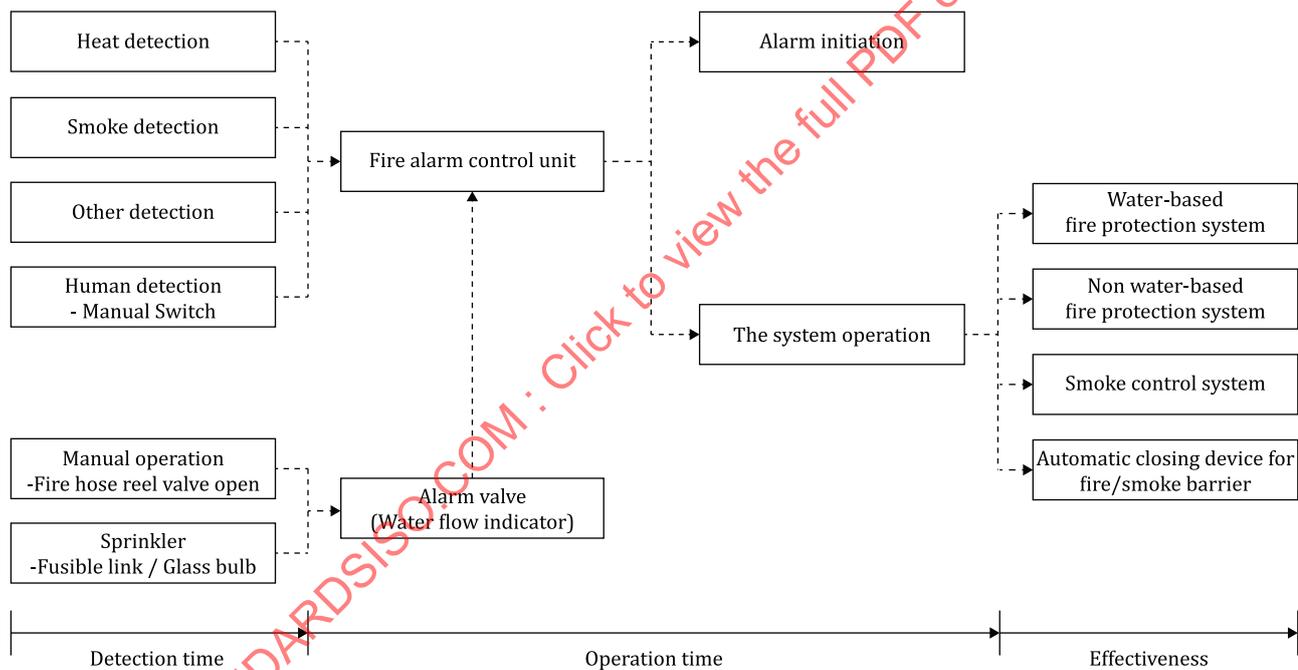


Figure 2 — Relationship between factors of AFPS

The specific aim of the ISO 20710 series is to provide guidance for estimating the time element for constructing ASET and RSET for fire hazard analyses and performance-based fire safety designs. It also provides guidance for estimating the effectiveness of active fire protection systems to evaluate fire protection designs.

Detection time refers to the time from the fire occurrence to the activation of devices such as heat detectors, smoke detectors, and other detectors. The time of human detection is defined as the time when the occupants recognize fire using their senses and operate active fire protection systems. Occupants press the button, and the signal is transmitted to a control panel after detection. The water flow indicator becomes operational through sprinkler activation or the opening of a fire hydrant valve. The water flow indicator transmits the signal to a control panel.

Operation time refers to the time between when a control panel receives the signal to when the alarm system becomes operational or the actuation of the fire protection system. The systems actuated by the control panel include water-based fire protection systems, non-water-based systems, smoke control systems, and the automatic closing device for fire/smoke barrier.

The effectiveness of an active fire protection system is the result of AFPS operation such as fire suppression or smoke control.

## 5.2 Description of the ISO 20710 series

To provide guidance for the evaluation of AFPS in detail, there are eight parts in the ISO 20710 series. These parts are divided considering the characteristics of each system.

Part 1 (this document), explains the background, characteristics and structure of the ISO 20710 series. Parts 2 to 5 are distinguished by the type of fire detection system. Part 6 includes the contents of the fire suppression system and its consequences. Part 7 includes the contents of smoke control system and compartmentation using automatic closing devices. Part 8 covers the maintenance and reliability of AFPS. It also includes the impact of outside factors on the active fire protection systems.

Furthermore, Parts 2 to 4 are concerned with the estimation of the time for fire detection devices to activate. The scope of these parts is limited to the phase where a single detector is activated by fire effluents and transmits a signal. The smoke alarm sends an alarm signal through a built-in device such as a speaker as soon as it detects smoke.

Although the fire signal from the fire detector is generated as an on/off signal, some detectors include various types of sensors inside. These detectors analyse signals generated from their sensors using an embedded algorithm to determine whether a fire has occurred and send the fire signal to the fire alarm control unit.

The fire signal from other detectors are transmitted as analogue signals to the fire alarm control unit. The fire alarm control unit analyses the analogue signals coming from the detectors using a simple algorithm or artificial intelligence to determine whether a fire has occurred. This document excludes the decision-making algorithm or process, which is included in a different part of the ISO 20710 series.

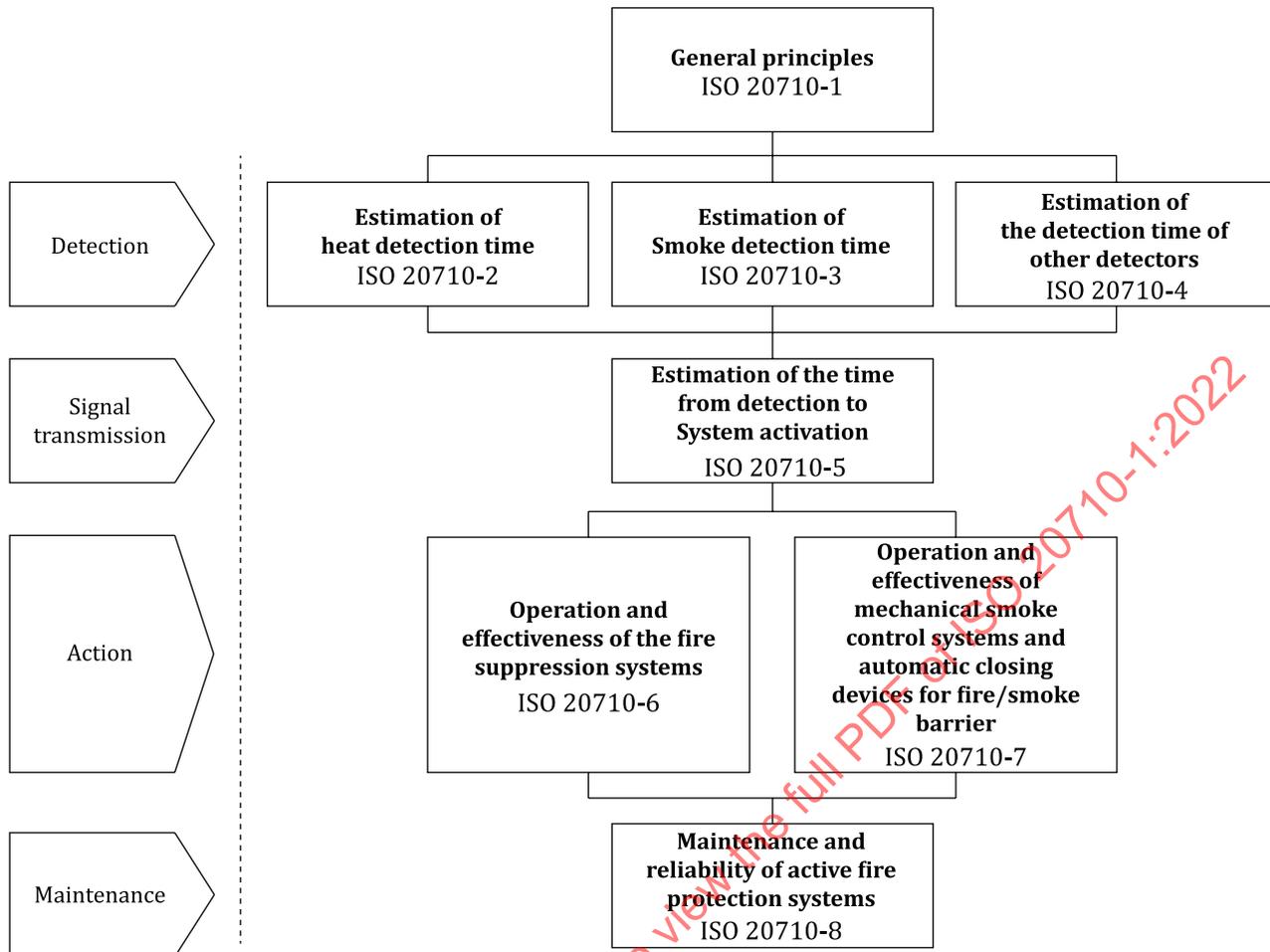
ISO 20710-5 is concerned with the system for transmitting the signal from the detection system to other AFPS. ISO 20710-5 deals with the time delay. The AFPS operation can be performed in a few seconds by a detection signal transmitted through an electric or network cable.

However, time delays can occur due to an incorrect system setting. Time delays can also occur to prevent false alarms or an issue in the operation of the system being caused due to the malfunction of a detector. A time delay intended to prevent the malfunction of a system is set in the process of the fire alarm control unit, but it is also intentionally caused by the system administrator. ISO 20710-5 provides information and data on the issues surrounding time delays and covers conservative evaluation methods.

ISO 20710-6 and ISO 20710-7 are concerned with the action of AFPS for fire suppression, smoke control, and fire stop by auto-closing devices. These deal with the time required for the activation of AFPS, the effect caused by the operation of AFPS, and the time required for the expected effect to occur.

ISO 20710-8 concerns the maintenance and reliability of AFPS. This includes various pieces of information required for maintenance during the period of use. ISO 20710-8 also includes information about the seismic design for AFPS.

[Figure 3](#) shows the five categories into which the ISO 20710 series is divided.



NOTE At the time of publication, Parts 2-8 of the ISO 20710 series have not yet been published.

Figure 3 — Structure of ISO 20710 documents

## 6 Contents of the ISO 20170 series

### 6.1 Model contents of Parts of the ISO 20170 series

Documents in the ISO 20710 series can include the items of model contents, if possible. The items of model contents are as follows:

- 1) The definition of the system:
  - Definition and basic theory of the system
  - Type of system (e.g. heat detector)
  - Description of the entire system (e.g. fire alarm system including heat detector)
- 2) Methods for the estimation of the activation time and/or effectiveness:
  - Formulae, processes and test methods for AFPS
  - Guidelines for selecting the estimation method
- 3) Evaluation report:
  - The items which should be included and how to describe them

- Validation report
- 4) Case studies:
- If possible

## 6.2 Contents of each Part of the ISO 20170 series

### 1) General principles

This section provides information about the ISO 20710 series, including its background, structure and contents. It also includes the description of each Part in the series.

### 2) Estimation of heat detection time

This section provides guidance for evaluating the performance of detector and fuse activated by heat. It also includes theories and methods for the estimation of activation time.

The types of heat detectors are:

- a) Maximum temperature detector
- b) Rate of temperature rise detector

This section includes the activation of sprinkler fuse by heat.

### 3) Estimation of smoke detection time

This section provides guidance for evaluating the performance of fire detection by smoke. It also includes theories and methods for the estimation of activation time.

The types of smoke detectors are:

- a) Smoke detector
- b) Beam detector
- c) Aspirating smoke detector

### 4) Estimation of the detection time of other detectors

This section provides guidance for evaluating the systems that are operated by various other sources. It also includes theories and methods for the estimation of activation time.

The types of systems are:

- a) Flame detector
- b) Multi-sensor fire detector
- c) Video fire detector
- d) CO/CO<sub>2</sub> detector