INTERNATIONAL STANDARD

ISO 26367-1

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Guidelines for assessing the adverse environmental impact of fire effluents —

Part 1: General

Lignes directrices pour déterminer l'impact environnemental des effluents du feu —

Partie 1: Généralités

Reference number
ISO 26367-1:2011(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 26367-1 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 3, *Fire threat to people and environment*.

ISO 26367 consists of the following parts, under the general title *Guidelines for assessing the adverse environmental impact of fire effluents*:

— *Part 1: General*

Components from fires in the built environment, open storage and transport is to form the subject of a future Part 2.

Introduction

In view of the fact that relevant quantitative data on environmentally hazardous components of fire effluents cannot routinely be obtained from accidental fires, appropriate data may also have to be obtained from real scale fire tests and simulations involving physical fire models.

General awareness of the fact that large fires present dramatic and persistent adverse effects on the environment has been accentuated by a number of high-impact incidents over the past half-century. Annex A contains a list of major fire incidents in recent years.

The serious consequences of such events have confirmed that the environmental impact of fires is a pressing international issue that urgently needs to be dealt with globally and systematically. This part of ISO 26367 provides a framework for a common treatment of the environmental impact of fires in answer to this pressing need.

It is principally intended for use by the following parties:

— fire-fighters and investigators;

— building owners and managers;

— storage facility operators;

— materials and product manufacturers;

— insurance providers;

— environmental regulatory authorities;

— civil defence organizations;

— public health authorities.

Guidelines for assessing the adverse environmental impact of fire effluents —

Part 1: **General**

1 Scope

This part of ISO 26367 gives guidelines whose primary focus is the assessment of the adverse environmental impact of fire effluents, including those from fires occurring in commercial and domestic premises, unenclosed commercial sites, industrial and agricultural sites, as well as those involving road, rail and maritime transport systems. Its scope does not extend to direct acute toxicity issues, which are covered by other existing International Standards.

It is intended to serve as a tool for the development of standard protocols for

a) the assessment of local and remote adverse environmental impacts of fires, and the definition of appropriate preventive measures,

b) post-fire analyses to identify the nature and extent of the adverse environmental impacts of fires, and

c) the collection of relevant data for use in environmental fire hazard assessments.

This part of ISO 26367 is intended as an umbrella document to set the scene concerning *what* should be considered when determining the environmental impact of fires. It is not a comprehensive catalogue of methods and models defining *how* to determine the environmental impact of fires, intended to be addressed by other parts of ISO 26367.

2 Normative references

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

ISO 13943, *Fire safety — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

3.1
environment
surroundings within which a fire occurs, including air, water, land, natural resources, flora, fauna and humans, and their interrelation

NOTE 1 Adapted from ISO 14001[2].

NOTE 2 For the purposes of this part of ISO 26367, "the environment" includes the following:

— *local*: within the perimeter of a burning enclosure (this part of ISO 26367 is not applicable to burning enclosures);

— *immediate*: vicinity within a short distance of, e.g. 1 km from the fire and excluding the local area of an enclosure fire.

— *external*: area outside the immediate vicinity of a fire; the extent of this depends on weather conditions and types of emission, i.e. to air, water or land, with short-term or long-term consequences.

3.2
environmental impact
any change to the environment, whether adverse or beneficial, wholly or partially resulting from a fire

NOTE 1 Adapted from ISO 14001[2].

NOTE 2 In this part of ISO 26367 it is used to signify an *adverse* change to the environment.

3.3
major accident
significant emission, fire or explosion resulting from uncontrolled developments in the course of the operation of any establishment, and leading to serious danger to human health and/or the environment, immediate or delayed, inside or outside the establishment, and involving environmentally hazardous materials

3.4
fire effluent
all gases and aerosols, including suspended particles, created by combustion or pyrolysis

NOTE It also refers to run-off water generated during fire-fighting activities.

3.5
primary fire effluent
effluent released directly from the fire source

3.6
receptors
segments of the environment on which fire effluents can have an impact, including air, water, and soil environments, plus flora and fauna associated with these environments, including humans

3.7
secondary fire effluent
effluent created through interaction between a primary fire effluent and the environment

3.8
run-off
fluid effluent created through the interaction between a fire and a liquid extinguishing agent and hazardous materials stored or generated on site

3.9
enclosed fires
fires which have been ignited and which take place inside an enclosure

NOTE This term is particularly important when defining the ventilation conditions in the fire.

3.10
fires in ruptured enclosures
fires in enclosures that have been breached and that allow unrestricted emission of the fire smoke plume for environmental distribution

NOTE Fire-fighting tactics in this type of fire are, in some cases, similar to those for an enclosure fire, even though emissions and environmental effects are similar to those for a fire in the open.

3.11
unenclosed fires
fires which initiate and propagate in the open air and those which initiate and propagate within an enclosure that subsequently ruptures and transforms the fire in terms of ventilation conditions and effluent transport mechanisms

4 Fire effluents

4.1 Overview

The interaction between a fire and its surroundings or environment is illustrated in Figure 1, which shows how fires cause harm to the environment through

— direct gaseous and particulate emissions to the atmosphere,

— spread of atmospheric emissions,

— deposition of atmospheric emissions,

— soil contamination, and

— ground and surface water contamination.

NOTE The contamination can be due to emissions from the fire itself or those associated with the fire-fighting activities, which was the cause of the greatest environmental impact at the fire in the chemical facility in Basel, Switzerland in 1986 (see Annex A).

Interaction through thermal radiation is not included in Figure 1. In the case of sensitive environments, this effect should also be taken into account.

The effect of these various emissions depends in part on the transfer mechanism — for example, the emission of gaseous species and the effect of weather or the emission of contaminated fire-fighting water and its interaction with the drainage system — and on the specific species, i.e. small gaseous compounds, large particles and the range of species in between. It should also be noted that emissions can undergo chemical changes after emission, e.g. chemical modification of nitrogen oxides (NO_x) in the atmosphere due to ultraviolet (UV) light.

A wide variety of toxic effluents (both primary and secondary) are emitted in fires. These effluents can follow a number of pathways to impact on human, animal or plant receptors. Even for industrial sites, risk assessments cannot take into account all potential impacts, but contingency planning should take account of appropriate "worst-case" scenarios.

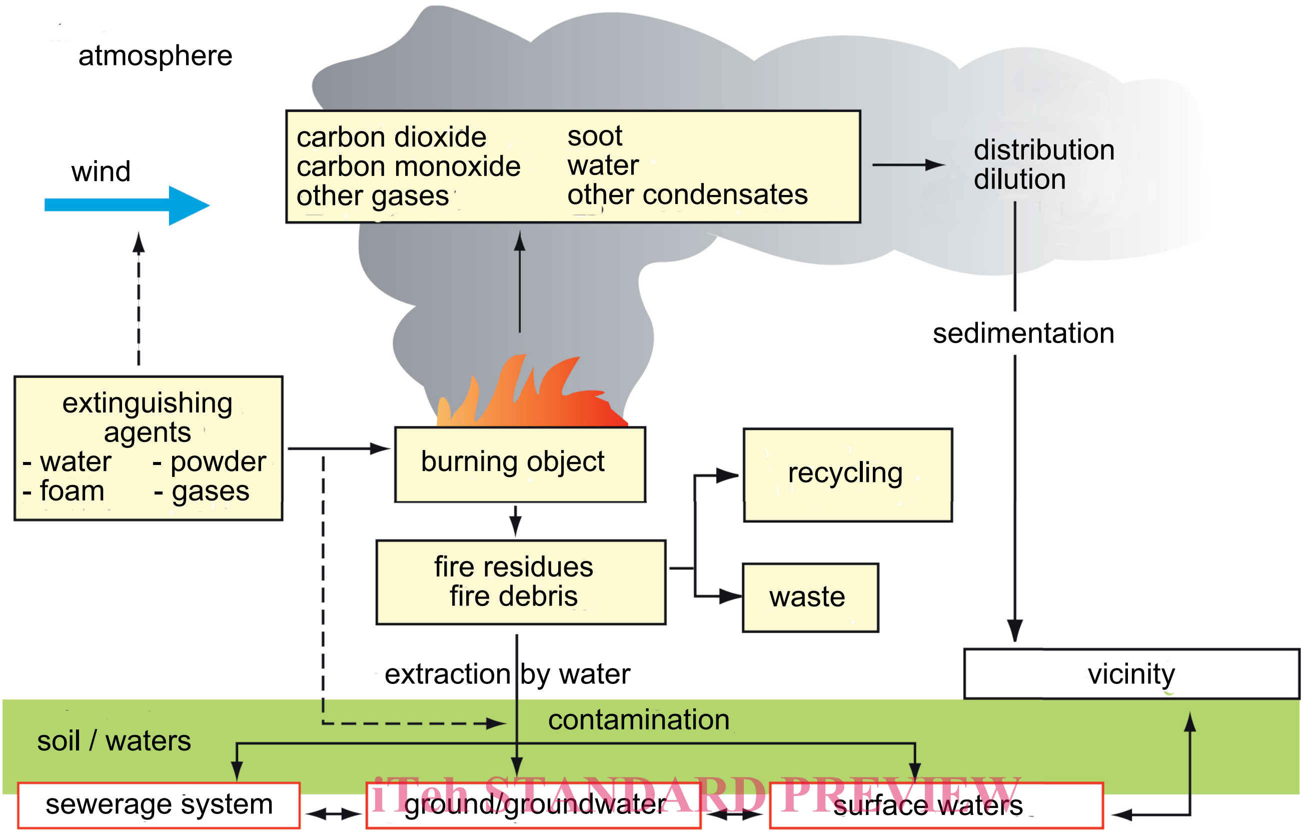


Figure 1 — Emission pathways from fires

4.2 Effluent generation

Initial decomposition is generally through pyrolysis, by which materials are broken down by heat to yield a range of organic by-products that provide the volatile fuel for combustion.

The elemental composition of materials provides guidance when predicting the combustion or decomposition products that can be generated during a fire. The molecular composition or structure of a polymer can affect combustion efficiency and the mix of organic and inorganic combustion products generated in a fire.

NOTE 1 BS 7982[8] gives guidance on the environmental impact of large fires with polymers.

The relative yields of the various combustion and pyrolysis compounds depend mainly upon the combustion conditions. Smouldering fires involve slow thermal decomposition under oxidative non-flaming conditions. These conditions give rise to fire emissions that are rich in organic compounds. Well-ventilated flaming fires, having a high air/fuel ratio, provide more efficient combustion conditions than vitiated fires. In the context of potential impacts to the environment, large, ventilation-controlled flaming fires are potentially the most environmentally harmful. In an event it is important to consider what is being produced at any given stage in the fire and how this can be emitted to the environment. For example, species produced under low-temperature conditions in the later stages of a fire combined with a reduced plume height can represent a greater local hazard than those produced under high temperature conditions during the early stages, despite the fact that the yield of species could be higher during those early stages. A possible response to this could therefore be to allow a fire to initially burn and commence fire-fighting once the fire begins to die down. The advantage of such an approach is that it would allow less fire-fighting water to be used, thereby making containment easier.

NOTE 2 Guidance on these issues is intended to be provided in subsequent parts of ISO 26367.

Recent investigations of emissions from fires indicate that, whereas gases such as CO, CO_2, HCN, NO_x and other irritants are most important from an acute toxicological point of view, organic species of high molecular weight and aerosols, e.g. particulate matter, polycyclic aromatic hydrocarbons (PAHs) and dioxins, are most significant from an environmental point of view.

NOTE 3 The absolute and relative concentrations of species will depend on the ventilation conditions and chemical make-up of the fuel.

NOTE 4 Molecules adsorbed on particles can be environmentally significant even when distant from the fire. Examples include HCl or dioxins adsorbed on particles.

NOTE 5 Water containment issues are to be dealt with in a document under preparation.

The products of combustion interact with the environment through direct emission to the air or through contamination of surface or groundwater and soil. These three emission pathways are discussed in more detail in 4.4 to 4.6.

It needs to be noted that the contamination of the surface or groundwater and soil is potentially compounded by the presence of physical fire debris, unburned products, and fire-fighting agents.

4.3 Fire stages

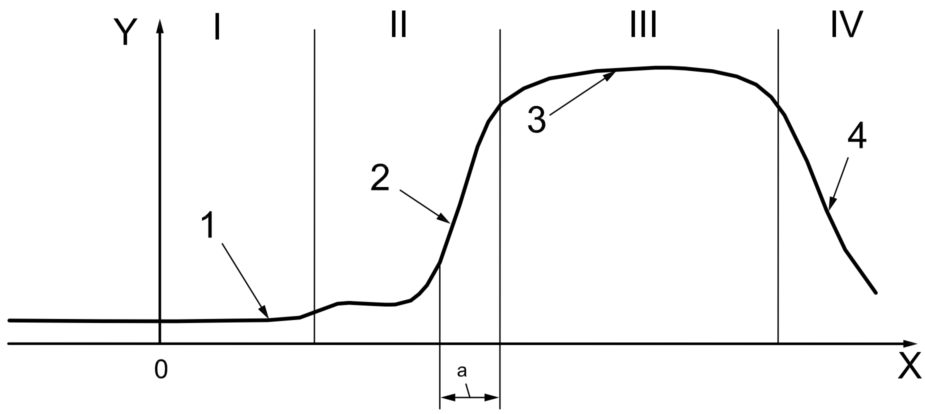
4.3.1 Background

Large-scale fires are complex events whose behaviour depends on many parameters, including the level of ventilation, fire load, the presence or absence of an enclosure and the burning properties of the combustible materials.

Emissions to the environment are generally more restricted in an enclosure fire than in the case of a fire in the open, owing to the potential for natural containment of fire effluents and fire fighting agent within the structure.

4.3.2 Enclosed fire

There are four main stages of fire development within an enclosure, as shown in Figure 2 which represents a fire development that assumes no intervention by fire-fighters or active fire protection systems such as sprinklers. *Flashover* (see Figure 2) refers to the stage in the fire when rapid growth occurs from a small, well-ventilated fire to a fully developed fire. Flashover in an enclosure can be described based on the temperature of the hot gases, the heat release rate relative to the size of the room or some other parameter.



Key

X time

Y temperature

1 initiation

2 growth

3 fully developped fire

4 decay

[a] Flashover.

Figure 2 — Potential fire development in an enclosure

