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Earth-moving machinery — Fire prevention guidance

*Engins de terrassement — Lignes directrices pour la prévention
des incendies*

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety, ergonomics and general requirements*.

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.

Earth-moving machinery — Fire prevention guidance

1 Scope

This document provides guidance on protective measures for consideration in fire risk reduction through machine design and operation and maintenance instructions for earth-moving machinery, as defined in ISO 6165, during their intended use.

NOTE The information in this document presumes that fire hazards for the normal applications anticipated for the machine family by the machine manufacturer have been analysed. This analysis can be done as part of the ISO 12100 machine risk assessment or as a separate fire hazard risk assessment conducted in accordance with ISO 12100 or ISO 19353:2019, 5.1, 5.2, 5.3 and 5.4.

This document also provides the basic concept of fire hazards and examples of typical fuel sources and ignition sources found in earth-moving machinery and earth-moving machinery applications.

This document does not cover all specific aspects of fire prevention for battery electric powertrains (e.g. fire prevention for batteries, battery management systems) due to the evolving development of such technology. However, the guidance in this document can still be beneficial. Additional guidance can also be found in the ISO 14990 series and ISO/DIS 23285.¹⁾

This document does not cover the additional risks for machines operating in potentially explosive atmospheres.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100, and the following 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

explosive atmosphere

atmospheres containing substances or gases at concentrations that will burn or explode if ignited

[SOURCE: ISO/TR 19591:2018, 3.112]

3.2

fire prevention

measures to prevent the outbreak of a fire and/or to limit its effects

[SOURCE: ISO 8421-1:1987, 1.21]

1) Under preparation. Stage at the time of publication: ISO/DIS 23285:2024

3.3

ignition energy

energy necessary to initiate combustion

[SOURCE: ISO 19353:2019, 3.8]

3.4

ignition source

source of energy that initiates combustion

[SOURCE: ISO 13943:2023, 3.244]

3.5

combustible

capable of burning

[SOURCE: ISO 8421-1:1987, 1.9]

3.6

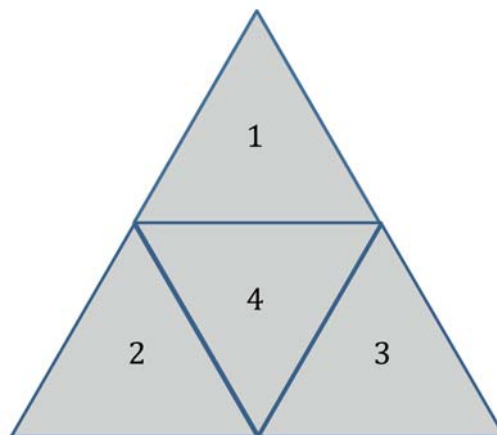
firewall

wall or partition designed to inhibit or prevent the spread of fire

4 Fire hazards

4.1 General

A fire hazard exists if combustible materials (fuel), oxidizer (oxygen) and ignition energy (heat) are available in sufficient quantities at the same place and at the same time. A fire is an interaction of these three components in the form of an uninhibited chemical chain reaction. See [Figure 1](#).



Key

- 1 heat (see [4.3](#))
- 2 oxygen
- 3 fuel (see [4.2](#))
- 4 uninhibited chemical chain reaction

Figure 1 — Fire tetrahedron

A fire can be prevented or suppressed by controlling or removing one or more of the components of the fire tetrahedron.

4.2 Fuel sources

4.2.1 General

Fuel is any substance that can undergo combustion. Fuel sources can occur as solids, liquids or gases. Fuel sources can arise from the material processed, used or released by the machinery, from materials in the vicinity of the machinery, or from materials used in the construction of the machinery.

The ease of combustion of fuel sources is affected by the size, shape and deposition of the materials. For example, small pieces of a material loosely collected together can be more easily ignited than a large piece of that material. Also, the combination of materials can have an influence on the ignitability and the burning behaviour. Where relevant properties of fuel sources are not well understood, appropriate testing or analysis should be conducted.

4.2.2 Machine components

Materials used in the construction of machine components can be fuel sources. See [Annex A](#) for examples of machine components that can be fuel sources for earth-moving machinery.

4.2.3 Machine fluids, gases and other onboard substances

Fluids, gases and other onboard substances required for operation of the machine can be a fuel source. Leaks, spills and overflows of these fluids or gases can become the fuel source for a fire. See [Annex A](#) for examples of machine fluids, gases and other onboard substances that can be fuel sources for earth-moving machinery.

4.2.4 Environmental debris

Combustible materials from the working environment which accumulate on or in the machine can be a fuel source. The amount of accumulation can be affected by weather conditions, type of debris, machine design, missing machine components, operational and maintenance practices, and other factors. The ease of combustion of these materials is affected by the size, shape, and deposition of the materials. See [Annex A](#) for examples of environmental debris that can be fuel sources for earth-moving machinery.

4.3 Oxidizers

An oxidizing agent is a chemical substance that, while not necessarily combustible by itself, can rapidly increase the rate of burning of other substances, or result in spontaneous combustion when combined with other substances. The most common oxidizer is oxygen in the atmosphere. But there are other oxidizers that support combustion, e.g. ammonium nitrate (NH_4NO_3) and potassium nitrate (KNO_3).

4.4 Ignition sources

4.4.1 General

Ignition sources for an onboard fire typically fall into three categories:

- thermal energy;
- electrical energy;
- mechanical energy.

These ignition sources can come from the machine itself and from sources external to the machine.