



**International  
Standard**

**ISO 13649**

**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](http://www.iso.org/directives)).

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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 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](http://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.<sup>1)</sup>

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**

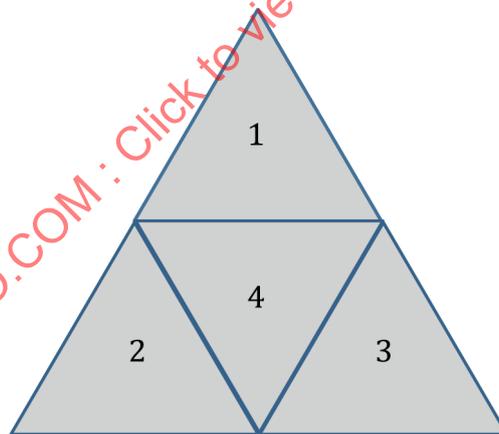
**firewall**

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 ( $\text{NH}_4\text{NO}_3$ ) and potassium nitrate ( $\text{KNO}_3$ ).

## 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.

#### 4.4.2 Thermal energy ignition sources

Thermal energy is the energy contained within a system that is responsible for its temperature. The transfer of heat from these systems can be a thermal energy ignition source. See [Annex B](#) for examples of thermal energy ignition sources for earth-moving machinery.

#### 4.4.3 Electrical energy ignition sources

Electrical energy is the movement of electrons from one point to another. Heat created by unconstrained movement of electrons can be an electrical energy ignition source. See [Annex B](#) for examples of electrical energy ignition sources for earth-moving machinery.

#### 4.4.4 Mechanical energy ignition sources

Mechanical energy is the energy created by friction of one component moving over another. The heat created by this friction can be a mechanical energy ignition source. See [Annex B](#) for examples of mechanical energy ignition sources for earth-moving machinery.

### 5 Strategy for risk assessment and risk reduction

The risk assessment and risk reduction process for fire prevention comprises a series of logical steps that allow systematic examination of fire hazards according to the procedures outlined in ISO 12100. This process includes the following sequential phases:

- a) fire risk analysis, comprising:
  - 1) determination of the limits of the machinery;
  - 2) identification of fire hazards;  
NOTE Machine and application incident history can be used as sources of information to help identify fire hazards.
  - 3) risk estimation;
- b) risk evaluation;
- c) risk reduction, if deemed necessary.

If risk reduction is required, then appropriate protective measures should be selected and applied. [Clause 6](#) provides design guidance for fire risk reduction specific to earth-moving machinery.

The risk assessment and risk reduction process for machinery should consider the entire lifecycle of the machine, including the following:

- 1) design, including but not limited to, the following:
  - operator egress;
  - considerations for fire suppression system;
  - access ports for firefighting to fire risk areas on the machine (e.g. engine compartment).
- 2) installation, assembly, and commissioning;
- 3) operation;
- 4) maintenance;
- 5) decommissioning and dismantling.

The fire risk assessment and risk reduction is repeated as an iterative process until the risk of a fire occurrence has been adequately reduced.

Care should be taken to ensure that the protective measures applied do not create or increase other risks.

See ISO 12100 or ISO 19353 for guidance on the risk assessment and risk reduction process.

Special use or severe applications (e.g. transporting hot materials) can require a separate risk assessment by the site management specific to that machine application.

## 6 Design guidance for fire risk reduction

### 6.1 General

Design measures for eliminating or reducing the potential risk of fire should include consideration for ignition sources, fuel sources, segregation of fuel and ignition sources, and minimizing the effects of fire.

### 6.2 Ignition sources

#### 6.2.1 Mechanical and thermal ignition sources

Design considerations for mechanical or thermal ignition sources should include, but not be limited to, the following:

- a) Eliminate or minimize, as practical, exposed hot surfaces, for example:
  - reduce surface temperatures with airflow;
  - insulate or double-wall exhaust components;
  - liquid cool components.
- b) Eliminate or minimize, as practical, the risk of overheating of machine components and systems (e.g. engines, transmissions, brakes, hydraulic systems, retarding grids, electrical motors). Where the potential exists for overheating in the presence of a fuel source; either monitoring or controls, or both, should be considered.

Simulation or surface temperature measurement can be carried out to understand machine surface temperatures.

NOTE Surfaces above 250 °C are generally considered to support a higher likelihood of combustion with typical fuel sources (e.g. diesel fuel, hydraulic oil) on board earth-moving machinery.

#### 6.2.2 Electrical ignition sources

Design considerations for electrical ignition sources should include, but not be limited to, the following:

- a) Eliminate or minimize, as practical, the risk of incorrect electrical connections. Electrical wires and cables used to connect components in electric circuits should be marked and identified. ISO 9247, ISO 23285 or ISO 14990-1 can be used as guidance.
- b) Ensure electrical wires and cables, including wire and cable covering, are applicable for the intended application. Considerations should include voltage, load, temperature, chemical resistance, contaminant ingress (e.g. moisture, dust) and flammability rating.
- c) Eliminate or minimize, as practical, the risk of overloading electrical circuits. Electrical circuits should be protected by fuses, circuit breakers, or current limiting devices unless specifically designed to be unprotected (e.g. starter motor, pre-heater). The circuit protection for the electrical equipment should be as close as practical to the source. Protection devices should be sized to protect the conductors. If a harness is split (separated into multiple wires), then the protection device should also be placed

immediately after the point of the split, unless protection device amperage rating prior to the split is sufficiently low to protect the wire sizes after the split.

- d) Eliminate or minimize, as practical, the risk of electrical shorting. Electrical wiring and cables should:
- 1) be routed and supported or clamped in a manner to prevent chafing, crushing or rubbing on sharp edges or rough surfaces and to minimize damage from vibration. Reusable or permanent clamps are preferred to assure proper support and routing are followed and repeatable after repairs. If cable ties are used, consideration should be given to:
    - i) the appropriate numbers and placement along the length of the wiring harness to prevent relative movement or rubbing;
    - ii) provision of adequate instructions and clear identification of the tie off positions to which cable ties are to be secured, so that they are tensioned and oriented correctly, including if replaced in the field;
    - iii) whether the specific cable ties used are suitable for the operating environment (e.g. temperature, vibration, chemical exposure, UV exposure);
    - iv) appropriate methods and tooling for cutting the excess length (i.e. length after the pawl) on the cable tie, to prevent sharp edges along the cut face from damaging adjacent components.
  - 2) use cable glands or bulkhead fittings where wiring enters an enclosure;
  - 3) accommodate the relative motion between machine components (e.g. lift arm to loader frame, frame articulation joint), if applicable;
  - 4) be routed to prevent contact with hot surfaces;
  - 5) use insulated cable connections where not connected to the frame (e.g. positive SLI battery cable).
- e) Eliminate or minimize, as practical, the risk of batteries shorting to ground. Secure batteries to protect against damage.
- f) Eliminate or minimize, as practical, the risk of shorting due to damage from external elements during operation (e.g. debris falling from bucket, rocks thrown from tyres during travel). External electrical components should be protected.
- g) See ISO 23285, ISO 14990-1, ISO 6469-1, and ISO 6469-3 for additional guidance when using lithium-ion and other batteries of similar technology, either as part of the machine or added accessories. Lithium-ion batteries have ignition, burning temperature, and burning environment characteristics that are unique from other potential electrical fire hazards. See IEC 62619 for guidance on requirements and tests for the safe operation of lithium-ion batteries.

### 6.3 Fuel sources

Design considerations for eliminating or minimizing, as practical, fuel sources should include, but not be limited to, the following:

- a) Eliminate or minimize, as practical, combustible and flammable materials in the construction of the machine or use materials with reduced combustibility and flammability.
- 1) Use cab and canopy components (e.g. upholstery, insulation, plastic coverings) and insulation materials used on other parts of the machine with a burning rate in accordance with ISO 20474-1:2017, 4.19.1.

## ISO 13649:2024(en)

- 2) Use fire resistant materials for components (e.g. hose material, hose covering, fuel tanks, fuel and water separators) that can be subjected to ignition sources. (See ISO 21507 for fire resistance requirements for non-metallic fuel tanks.)
- b) Use hose and pipe assemblies:
    - 1) rated for their application (pressure, flow, temperature, and vibration);
    - 2) routed and supported or clamped in a manner to prevent chafing, crushing or rubbing on sharp edges or rough surfaces and to minimize damage from vibration. Reusable or permanent clamps are preferred to assure proper support and routing are followed and repeatable after repairs. Do not use cable ties for securing hydraulic hoses.
    - 3) routed in such a manner to reduce the possibility of being used as a step or hand hold.
  - c) Use pipe assemblies in hot areas as practical. If hose assemblies are used, consider additional protection (e.g. shield, metal braiding).
  - d) Use fire-resistant hydraulic fluids for applications involving handling or transporting hot material (e.g. metal slag, molten steel).
  - e) Reduce or eliminate, as practical, the potential for combustible material (e.g. woodchips) accumulation near potential ignition sources including mechanical friction sources (e.g. rotating shafts) and hot surfaces (e.g. exhaust system).
  - f) Ventilate fluid tanks to prevent over pressurization. Locate ventilation means (e.g. vents, relief valves, and breathers) away from hot surfaces or provide a means to prevent a spill from contacting a hot surface, considering the maximum operating slopes of the machine and the direction in which spilt fluid will travel due to gravity.
  - g) Ventilate battery enclosures appropriately for the battery chemistry.

### 6.4 Segregation of fuel and ignition sources

Design considerations for segregation of fuel and ignition sources should include, but not be limited to, the following, as practical:

- a) When exposed hot surfaces cannot be eliminated:
  - separate the fuel source from the exposed hot surface; or
  - use shielding to reduce contact from the fuel source to the exposed hot surface; or
  - direct airflow to either keep fuel sources off hot surfaces or reduce the temperature of the hot surface, or both.
- b) Route hoses away from hot surfaces.
- c) Route hydraulic lines (e.g. pipes, hoses, fittings) outside of the engine compartment. If not practical, route hydraulic lines (e.g. pipes, hoses, fittings) on the side of the engine that is the coolest, e.g. opposite the exhaust manifold.
- d) Locate or shield fluid line fittings to prevent direct spray from the fitting to a hot surface in the event of a leak.
- e) Locate accumulators away from hot surfaces.
- f) Do not directly attach (e.g. cable tie) electrical wiring and cables to hose and pipe assemblies to prevent chafing or rubbing.
- g) Route electrical wiring and cables that utilize braided loom coverings above fluid lines.
- h) Do not position electrical connectors and components near hydraulic fittings and fill points.

- i) Locate and design fluid fill systems to accommodate easy fill to prevent spills.
  - 1) Locate fill locations, including overflow and vents if fitted, away from hot surfaces or provide a means to prevent a spill from contacting a hot surface.
  - 2) Provide drainage so that the fluid does not pool on the machine in the event of a spill.
- j) Use firewalls or insulating materials or both appropriate to the potential fire, which can delay or hold back propagation of a fire from one area to another.

## 6.5 Fire extinguishers and fire suppression

Design considerations for fire extinguishers or fire suppression systems should include, but not be limited to, the following, as practical:

- a) Machines should have space for the installation of an appropriately sized and type of fire extinguisher or extinguishers, easily accessible to the operator, or a fire suppression system, or both, to permit the operator to safely exit the machine. See ISO 20474-1:2017, 4.19.2.
- b) Where the potential fire source is within an inaccessible area on the machine, consideration should be given to means to allow a fire suppression agent to be discharged towards the fire source (e.g. port in enclosed panels). If port(s) are provided, the port(s) should be identified and information regarding their location and use should be provided in the operator's manual.

## 7 Information for use

### 7.1 General

The operator's manual provided with the machine should include information on fire prevention, including:

- a recommendation to keep the machinery in proper condition and ready for operation as well as the actions to be carried out in the event of a fire incident;
- information related to fire prevention (see 7.2);
- information related to fire safety (see 7.3).

NOTE It is not possible to list every fire-related hazard that can be encountered in every possible application.

### 7.2 Fire prevention

#### 7.2.1 Operation

Instructions for operation include the following:

- a) Prior to operating the machine, understand the use of the primary exit and the alternative exit.
- b) Prior to operating the machine, know where fire extinguishers are located and how to use them, including being trained on how to operate the fire suppression system, if installed. Ensure that the fire extinguishers are in place.
- c) Do not operate the machine near any flame or burn pile or where exhaust, arcs, sparks, or hot components can contact flammable material, explosive dust, or gases.
- d) Confirm that the underground utilities on the work site have been located and marked. Take care when operating near underground gas or electrical lines.
- e) Know the location of overhead electrical power lines. Maintain a safe distance from power lines.
- f) Do not operate a machine with a fluid leak. Repair leaks and clean up fluids prior to machine operation. Fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire.

## 7.2.2 Fuelling

Instructions for fuelling the machine include the following:

- a) Use caution when fuelling a machine. Fill the fuel tank outdoors. Stop the engine and let it cool before fuelling. Do not smoke or use cell phones or other electronic devices while fuelling a machine. Do not fuel a machine near open flames or sparks. Properly clean areas of spillage.
- b) Avoid static electricity when fuelling. Static charges can build up in ultra-low-sulfur diesel (ULSD) fuel while it is flowing through fuel delivery systems. Ensure that the entire delivery system (e.g. fuel supply tank, transfer pump, transfer hose and nozzle) used to refuel the machine is properly bonded and grounded. Contact the fuel or fuel refilling suppliers for more information.

## 7.2.3 Starting

Instructions for starting the machine include the following:

- a) Follow the instructions for the proper starting procedures. Do not use ether or starting fluids on any engine that has glow plugs or an air intake heater. These starting aids can cause an explosion and injure the operator or bystanders.
- b) Follow the instructions for the proper jump-starting procedure. Improper cable connections can cause an explosion.

## 7.2.4 Maintenance and inspection

### 7.2.4.1 General

Instructions for maintenance include the following:

- a) Inspect for and clean all accumulations of flammable debris (e.g. leaves, twigs, straw, trash) and combustible liquids (e.g. fuel, oil) from the engine compartment, around fuel lines, hydraulic lines, exhaust components, and electrical wiring. Flammable debris or combustible liquids coming in contact with hot surfaces or electrical components can result in a fire. Some applications and operating conditions can require multiple inspections and cleanings during operation.
- b) Inspect for signs of wear on moving and rotating parts. Investigate grinding or squeaking noises, noted during operation. Inspect bearings for excessive play and excessive heat. Inspect for material wrapped around shafts and bearings.
- c) Ensure the fire extinguisher, if equipped, is in place. Inspect and service the fire extinguisher regularly. Follow the recommendations on the fire extinguisher instructions.
- d) Ensure the fire suppression system, if equipped, is configured correctly (e.g. nozzles in correct configuration, detection and actuation systems ready). Inspect and service the fire suppression system regularly. Follow the recommendations on the fire suppression system instructions.
- e) Ensure shields are in place and installed correctly. Exhaust shields, if equipped, protect hot exhaust components from oil spray or fuel spray from a break in a line, hose, or seal.
- f) Ensure access covers or doors to service compartments are in place and in working condition prior to machine operation.
- g) Store fuels and lubricants in properly marked containers away from unauthorized personnel. Store oily rags and flammable materials in protective containers. Do not store in the operator compartment of the machine or near heat sources on the machine (e.g. engine compartment). Do not smoke in areas that are used for storing flammable materials.

#### 7.2.4.2 Electrical system

Instructions related to the electrical system include the following:

- a) Inspect all electrical wiring and connections for damage. If any of the following conditions exist, replace parts before operating the machine:
  - fraying;
  - abrasion or wear;
  - cracking;
  - discoloration;
  - cuts on insulation;
  - other damage.
- b) Ensure that all clamps, guards, clips, and straps are installed correctly to prevent vibration, rubbing against other parts, and excessive heat during machine operation. Ensure electrical wiring and cables are not directly attached to hose and pipe assemblies.
- c) Keep the SLI battery terminal connections clean and tight. Ensure SLI batteries are clamped to prevent movement in the event of a rollover.
- d) Battery gas can explode and cause serious injury. Follow the procedure in the operator's manual for connecting the SLI battery and for jump-starting. Do not jump-start or charge a frozen or damaged SLI battery. Keep any open flames or sparks away from SLI batteries. Do not smoke in SLI battery charging area.

#### 7.2.4.3 Hydraulic system

Instructions related to the hydraulic system include the following:

- a) Inspect hydraulic lines (e.g. pipes, hoses, fittings) for damage and leakage. Follow the instructions for checking for leaks. Where appropriate, specify an inspection and replacement interval.
- b) Replace any hydraulic hose if structural reinforced braiding is exposed. Follow the manufacturer's recommendations if damage to the outer cover is present.
- c) Tighten or replace any parts that show leakage.
- d) Clean fluid spills. Do not use gasoline or diesel fuel for cleaning. Use commercial non-flammable solvents.
- e) Make sure hydraulic lines (e.g. pipes, hoses) are properly routed and supported or clamped in a manner to prevent chaffing, crushing or rubbing on sharp edges or rough surfaces and to minimize damage from vibration. Make sure that all clamps, guards, clips, and straps are installed.

NOTE Where appropriate, a hose inspection or replacement interval should be specified in the operator's manual.

#### 7.2.4.4 Spark arrester exhaust system (if equipped)

A spark arrester exhaust system is intended to control the emission of hot particles from the engine and exhaust system, but the muffler and the exhaust gases can still be ignition sources.

For machines fitted with a spark arrester exhaust system, instructions include checking the spark arrester exhaust system regularly to make sure it is maintained and working properly. Follow the procedure in the operator's manual for cleaning the spark arrester muffler.

NOTE Spark arrestors can be required in certain earth-moving machinery applications. Where a spark arrester is required, a spark arrester can be a dedicated device, or a secondary function of a wall flow DPF or non-wastegated turbocharger system.

#### 7.2.4.5 Diesel particulate filter system (if equipped)

A diesel particulate filter (DPF) system is intended to control the emissions of particulate matter from the engine exhaust. The high exhaust gas temperatures reached during regeneration (DPF cleaning) can be an ignition source.

For machines with diesel engines equipped with a DPF, instructions include the following:

- a) Inspect the DPF system regularly to ensure it is functioning properly. This can include checking the engine diagnostic codes.
- b) Follow the procedure in the operator's manual for regenerating the DPF or use the disable regeneration function (if equipped) when appropriate.

#### 7.2.5 Service and repair

Instructions related to servicing and repairing the machine include:

- a) Before welding on the machine, clean the machine, disconnect the SLI battery, and disconnect the wiring from any electronic control modules. Cover rubber hoses, batteries and any other flammable parts. Keep a fire extinguisher near the machine when welding.
- b) Dust generated from repairing non-metallic parts such as hoods, fenders or covers can be flammable or explosive. Repair such components in a well-ventilated area away from open flames or sparks.
- c) Do not weld or flame cut on tanks or lines that contain flammable fluids or flammable material. Empty and purge the lines and tanks. Then clean the lines and tanks with a non-flammable solvent prior to welding or flame cutting. Ensure that the components are properly grounded to avoid unwanted arcs.
- d) If repairable damage occurs, check all impacted components and replace as necessary to prevent other damaged components from creating an additional fire risk.

### 7.3 Fire safety

Information should be provided to instruct the operator on actions to perform in the event of the machine being involved in a fire.

Instructions related to fire safety include:

- a) A recommendation to only carry out an action if this does not lead to a dangerous situation for persons in the area, including the operator.
- b) Warnings regarding the following risks in the event of a fire:
  - Tyres on wheeled machines pose a risk of explosion as the tyres burn. Hot shrapnel and debris can be thrown great distances in an explosion.
  - Tanks, accumulators, gas springs, struts, hoses, and fittings can burst or rupture in a fire, spraying fuels and shrapnel over a large area.
  - Nearly all fluids on the machine are flammable, including coolant and oils. Additionally, plastics, rubbers, fabrics, and resins in fiberglass panels are also flammable.
- c) If the machine is equipped with a fire suppression system, activate the system according to the system manufacturer's procedure.
- d) If the machine is equipped with ports in enclosed panels to allow fire suppression agent to be discharged towards the fire source [see 6.5 b)], information should be provided.
- e) If possible, move the machine away from nearby combustible material such as fuel or oil stations, structures, trash, mulch, and timber.

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- f) If possible, lower any equipment and attachment and turn off the engine. If the engine is left running, the engine will continue to feed a fire. The fire will be fed from any damaged hoses that are attached to the engine or pumps.
- g) If possible, turn the SLI battery disconnect switch to the off position. Disconnecting the SLI battery will remove the ignition source in the event of an electrical short. Disconnecting the SLI battery will eliminate a second ignition source if electrical wiring is damaged by the fire, resulting in a short circuit.
- h) Notify emergency personnel of the fire and location.
- i) Move a safe distance away from the machine and remain clear of the smoke.

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**Annex A**  
(informative)

**Examples of fuel sources**

See [Table A.1](#) for examples of fuel sources for earth-moving machinery.

**Table A.1 — Example of fuel sources**

Fuel source	General material	Application
Machine components <sup>a</sup>	Cloth/fabric	Seat coverings
		Headliners
	Foam	Sound insulation
		Thermal insulation
		Seat cushions
		Duct work
	Plastic/composites	Electrical cable insulation
		Tanks
		Shrouds
		Panels
		Trim pieces
	Rubber	Floor mats
		Hoses
		Belts
		Boots
		Tyres
Tracks		
Machine fluids, gases and other onboard substances <sup>b</sup>	Engine fuel	Diesel
		Gasoline
		Liquefied petroleum gas
		Liquefied natural gas
	Lubricants	Engine oil
		Gear case oil
		Grease
	Machine fluids	Hydraulic fluid
		Power steering fluid
		Brake fluid
		Coolant
		Battery electrolyte

<sup>a</sup> See [4.2.2](#).

<sup>b</sup> See [4.2.3](#).

<sup>c</sup> See [4.2.4](#).