

Guide to application of the Machinery Regulation (EU) 2023/1230

Annex III, 3.5.4- overhead powerlines

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General note:

Following creation of new EHSR 3.5.4 in Machinery Regulation, new § of comment have to be created.

It is also necessary to modify §182 commenting EHSR 1.1.7 as it is dealing with the topics of risks with overhead powerlines.

Note that references to other paragraphs (§xx) are references to the paragraph numbers in the current guide for the Machinery Directive Edition 2.3 – April 2024.

3.5.4. Risk of contact with live overhead power lines

Depending on their height, mobile machinery or related products shall, where relevant, be designed, constructed and equipped, so as to prevent the risk of contact with an energised overhead power line or the risk of creating an electric arc between any part of the machinery or an operator driving the machinery and an energised overhead power line.

When the risk to the persons operating machinery incurred by the contact with an energised overhead power line cannot be fully avoided, mobile machinery or related products shall be designed, constructed and equipped so as to prevent any electrical hazards.

§ XXX Risk of contact with live overhead power lines

The requirement set out in section 3.5.4 concerns mobile machinery operating in an environment where live overhead power lines can be present. This primarily applies to machinery operating outdoors but may also apply to certain activities inside a building (for example, machinery operating near a catenary located in a hangar or a train station). It covers only hazards due to the mobility of the machinery itself. See §292 comment on the requirement set out in section 3.1.1 (a). This requirement is complementary to the general requirement set out in section 1.1.7 Operating positions, which deals with the risks associated with the use of machinery or related products in a hazardous environment.

Remote-controlled and autonomous mobile machinery are also concerned.

Overhead power lines are free hanging cables strung between poles and pylons for power transmission and distribution, including catenary systems (e.g. for trains, trams, buses). There is a variation among countries regarding the minimum heights above ground level of overhead power lines.

Section 3.5.4 deals with the risks of contact or electric arcing of a machine with live overhead power lines that may cause:

- electric shock which can lead to burns or electrocution;
- fire, for example for machinery operating or equipped with particularly flammable materials or substances;
- tyre explosion.

These risks result from the hazardous situations identified in the risk assessment of the manufacturer.

‘Contact’ refers to an electric contact of persons or domestic animals with live parts, i.e. physical contact with uninsulated live parts, for example when a person comes into contact with a live overhead power line while working at height on a machinery. ‘Contact’ can also include a person touching a part of a machine that has become energised by a contact of the machine with a live overhead power line. Risk of contact concerns mainly uninsulated live overhead power lines. Nevertheless, it can also occur with machinery with cutting tools performing their specific application near insulated overhead power lines, e.g. cutting a line with a self-propelled tree-trimmer.

‘Electric arc’ results from a condition where electric energy flows across a gap between two physical objects, and at least one of them is uninsulated live part, e.g. a cable, but the other one can be also e.g. a human or a conductive object. Depending on power line voltage, minimum clearance distances must be maintained to prevent the risk of an electric arc.

Risks of fire and explosion are addressed by the essential health and safety requirements 1.5.6, 3.5.2 and 1.5.7, see §227 comments on EHSR 1.5.6, §321 comments on EHSR 3.5.2 and §288 comments on EHSR 1.5.7 of Annex III.

Only machinery or related product whose height is likely to lead to an electrical contact or an electric arc with a live overhead power line during intended use or reasonably foreseeable misuse are concerned by this requirement. The height refers to the highest point reachable by a part of the machine, including interchangeable equipment, tools or accessories attached to the machine as well to any objects or loads handled or carried by the machine in accordance with the recommendations in its instruction for use, and during every phase of its outdoor use.

Interchangeable equipment placed on the market independently and capable of increasing the maximum height of the basic machine to which they are attached are also concerned. Manufacturers of such equipment are therefore subject to the requirements of section 3.5.4. See §41 and §326 on interchangeable equipment.

Without prejudice to the national regulations applicable to users and risk assessment done by the manufacturer, it is recommended to apply the requirement set out in section 3.5.4 when the maximum height of the machine exceeds 4 metres above ground level. This value is not relevant for machinery used on electrified railways.

If, due to the specific application of the machinery, an operator is working on it without being protected by an adequate cab, the maximum height will correspond to the maximum height that the operators and any tools or materials they may be using or handling can reach (for example, mobile elevating working platform).

The first paragraph of EHSR 3.5.4 applies to machinery and related products where there is a risk of contact or electric arc due to their height or their deployment at height. This risk is fully avoided in accordance with the principles of safety integration in the order given in EHSR 1.1.2 of Annex III by inherent safe design or protective measure.

Example of possible solution: limitation of machinery height by inherent design or protective device.

The second paragraph of EHSR 3.5.4 states that machinery or related product shall be designed, constructed and equipped to prevent any electrical hazards where the

state of the art does not allow to fully avoid the risk of contact or arcing by design or protective measure.

It means that:

- the risk of contact shall be reduced as far as possible;
- in case of contact, persons operating the machinery shall be protected against electrical hazards thereby generated to which they may be exposed during normal use or reasonably foreseeable misuse of the machinery or related product. For example, a dump truck moving under a live overhead power line with a raised dump bed.

Persons operating machinery includes the driver or any other person, either on the ground or on the machinery, that operate at least one function of the machinery using a control.

To prevent any electrical hazard, design, construction and equipment of machinery mentioned above in paragraph 5 shall be conducted following the principles of safety integration in the order given in EHSR 1.1.2 of Annex III.

According to the manufacturer's risk assessment and the process of safety integration, preventing the risk usually includes a set of technical measures and information.

A non-exhaustive list of possible inherent safe design or protective measures is provided below:

- Suitable and sufficient insulation of parts of a machine which may come into contact with a live overhead power line or a part of a machine between the part that may come into contact and the rest of the machine;
- Equipment of machinery with a cab designed to prevent any hazardous potential differences inside the cab (equipotentiality), thereby preventing any possibility of any contact by the operator. Cab also protects the driver in the event that a power line becomes damaged and falls onto the machinery;
- Reduction of the risk for the operator associated with fault current flowing to earth following machine's contact with a live overhead power line, in particular by providing sufficient insulation from ground under the intended conditions of use;
- Equipment of machinery with one or several automatic control system(s) allowing the uploading of the position of live overhead power lines, which would allow to limit certain machine's travel movement to avoid contact with mapped power lines e.g. geofences;
- Restriction of movements or speed of part(s) of machinery that may contact a live overhead power line by programming, setting or adjustment of a device or loading of a software;
- Hold-to-run control device to operate the movement of the machine or part(s) of the machine that may contact a live overhead power line;
- Mandatory validation by a specific control device in cases where an operator raises a part of the machine that may come into contact with a live overhead power line and when a certain height has been reached;
- Adequate visibility from the operator's position;
- Location of the operator within an insulated environment;
- Wireless remote control allowing to remove the operator from the hazard zone.

Information for users for machinery mentioned above in paragraph 5 include, where appropriate, the following elements:

- i. Information on the height of machinery or related product according to section 1.7.4.2 (d), (k), (n).
- ii. Information on the remaining residual risks.

According to section 1.7.2, where risks remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted, warnings, including warning devices, shall be provided.

A non-exhaustive list of possible warning devices is provided below:

- warning device alerting the driver that a certain height has been reached that may present a risk of a contact of a part of the machine with a live overhead power line or the risk of creating an electric arc with the machine or part of the machine;
 - warning device alerting that an energised overhead power line has been detected in the hazard zone of the machine, e.g. live overhead power line detection device.
- iii. Moreover, instructions for use shall inform about residual risks according to section 1.7.4. Protective measures to be taken by the user and information in case of accident and for the rescue of persons according 1.7.4.2 (h), (m), (q) and (v).

For example, instruction on how to react in case of an accident or contact of a part of a machine with a live overhead power line shall be given.

- iv. Information on required training.

According to section 1.1.2 b) (iii) and section 1.7.4.2 (k), instructions for the training of operators shall be given if required.

1.1.7. Operating positions

The operating position shall be designed and constructed in such a way as to avoid any risk due to exhaust gases or lack of oxygen.

If the machinery or related product is intended to be used in a hazardous environment presenting risks to the health and safety of the operator or if the machinery or related product itself gives rise to a hazardous environment, adequate means shall be provided to ensure that the operator has good working conditions and is protected against any foreseeable hazards.

Where appropriate, the operating position shall be fitted with an adequate cabin designed, constructed or equipped to fulfil the above requirements. The exit shall allow rapid evacuation. Moreover, when applicable, an emergency exit shall be provided in a direction which is different from the usual exit.

§182 Operating positions in hazardous environments

Operating positions are the places on or at the machinery where operators, as defined in section 1.1.1 (d), carry out their tasks. The manufacturer's instructions must describe the workstation(s) likely to be occupied by operators – see §262: comments on section 1.7.4.2 (f).

The requirement set out in the first paragraph of section 1.1.7 applies mainly to machinery with internal combustion engines. This requirement implies, firstly, that the emission of hazardous exhaust gases must be reduced as far as possible. For example, in the case of machinery designed to be used in enclosed spaces, appropriate systems for the extraction or filtering of exhaust gases must be fitted. Secondly, where there remains a risk of exposure to hazardous exhaust gases, means must be provided to ensure that operators do not inhale such gases and are provided with an adequate supply of breathable air.

The second paragraph of section 1.1.7 is more general and requires operators to be protected against any risks due to the foreseeable use of the machinery in a hazardous environment. Such risks may include, for example, exposure to hot and cold atmospheres, to risks due to noise, radiation, humidity, adverse weather conditions or atmospheres polluted by hazardous substances. This section also covers the risk of electric shock due to overhead power lines in the operating area. In addition, EHSR 3.5.4 applies specifically to machines covered by Part 3 of Annex III dedicated to risks related to mobility manufacturer must therefore take account of the intended and foreseeable conditions of use of the machinery. For example, if the machinery is placed on the market in a country with a mild climate, it might not be necessary to provide protection against extremely cold weather, whereas protection against dust or heat might be needed. Special consideration needs to be given to machinery that generates hazardous substances, such as dust, fume or toxic aerosols, by its very operation; examples are machinery for rock crushing and screening, machinery for grain handling, agricultural spray machinery and paint spray booths.

The third paragraph of section 1.1.7 refers to one of the means that can be used to ensure that operating positions are protected. 'Cabin' in this paragraph is a generic term for an enclosed operating position such as, for example, a cab on mobile machinery or an enclosed control panel on fixed industrial machinery. In order to fulfil the requirements set out in the first two paragraphs of section 1.1.7, the cabin or enclosure must be provided with the necessary means of purifying and conditioning the air entering the enclosure and preventing inward leaks, for example, by maintaining

a positive pressure differential with the outside atmosphere. As well as ensuring protection against hazardous environments, such enclosures can also be designed and constructed to protect operators against exposure to noise emissions – see §229: comments on section 1.5.8. On some mobile machinery, the cab may include a structure to protect against the risk of rolling or tipping over or the risk due to falling objects or both – see §315 and §316: comments on sections 3.4.3 and 3.4.4.

It should be noted that operator's cabins which are an integrated part of a building (e.g. for concrete batching plant or asphalt mixing plant) are not covered by the Machinery Regulation, being subject to national regulations, unless they are provided by the manufacturer as part of machinery when placed on the market. However, the control panels provided by the manufacturer shall comply with the Machinery Regulation.