INTERNATIONAL STANDARD

ISO 14990-3

First edition
2016-11-01

Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems —

Part 3: Particular requirements for self-powered machines

Engins de terrassement — Sécurité électrique des machines utilisant des moteurs électriques et composants et systèmes connexes —

Partie 3: Exigences particulières pour les machines auto-alimentées

Reference number
ISO 14990-3:2016(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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).

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).

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

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html

The committee responsible for this document is ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 3, *Machine characteristics, electrical and electronic systems, operation and maintenance*.

This document is intended to be used in conjunction with ISO 14990-1.

Introduction

This document is a type-C standard as defined in ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations, or hazardous events are covered are indicated in ISO 14990-1:2016, Annex A.

When requirements of this type-C standard are different from those stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Electrification is an enabling technology providing increased flexibility in machine form packaging. Because in the past earth-moving machinery (EMM) electrical systems have predominately been in the 12–24 V DC range, two safety aspects require particular attention:

— significantly higher voltages, such as are utilized in industrial or structural applications and in other transportation sectors;

— greater available electrical energy.

Portions of this document appear to govern electrical design practices (e.g. Clauses 9, 11, 12, and 17). Their requirements are necessary because certain aspects of design cannot be separated from electrical safety.

Some of the content of this document is based on IEC 60204-1 and IEC 60204-11, adapted to the needs of earth-moving machinery. Non-electrical hazards are addressed in the ISO 20474 series.

Figure 1 is provided as an aid to the understanding of the interrelationship of the various elements of a machine and its associated equipment. Figure 1 is a block diagram of a typical machine and associated equipment showing the various elements of the electrical equipment addressed in this document.

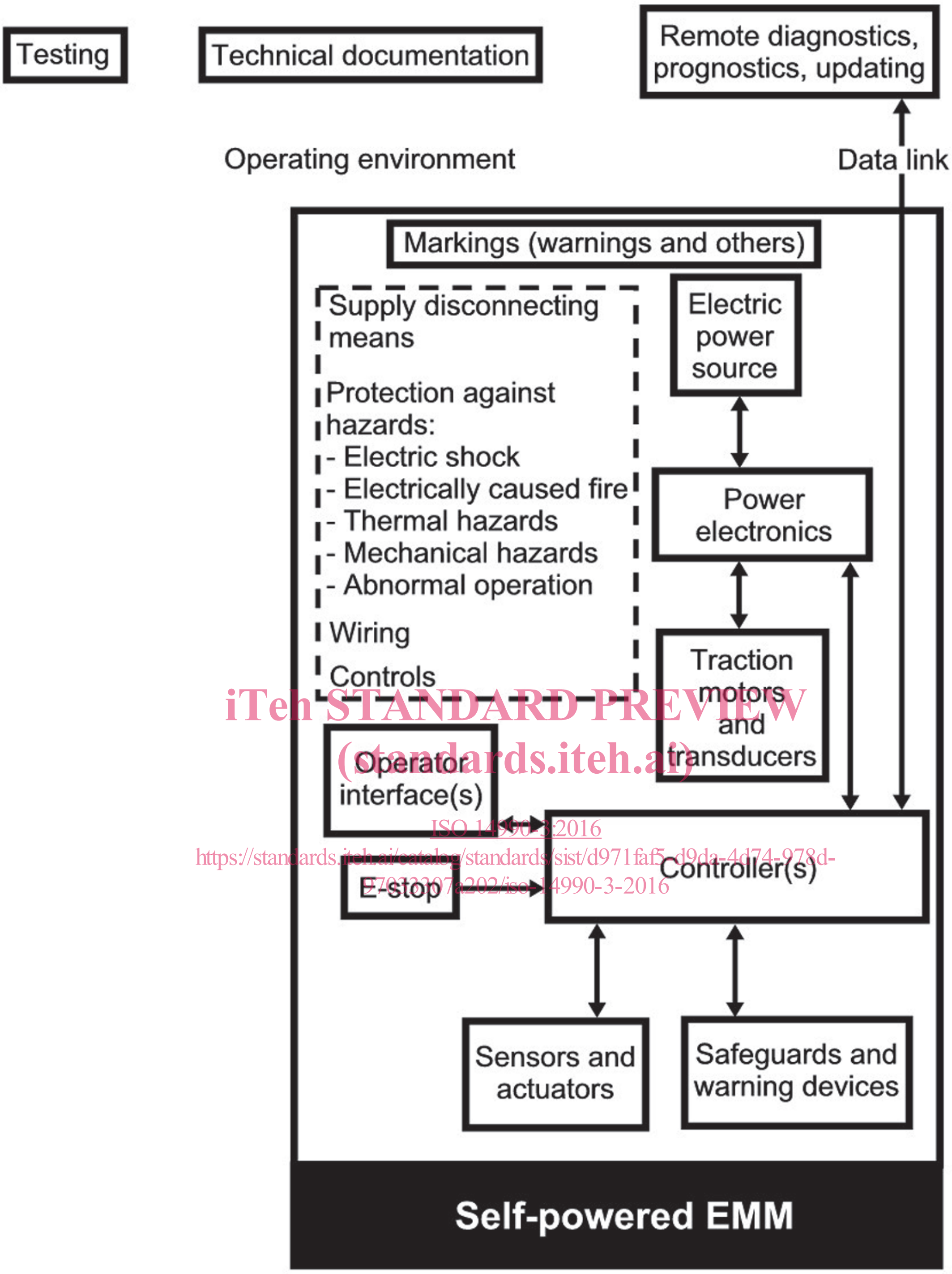

Figure 1 — Block diagram of a typical machine

Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems —

Part 3:
Particular requirements for self-powered machines

1 Scope

This document specifies the particular safety requirements for the electrical equipment and its components incorporated in self-powered (utilizing on-board electric power sources) electrically-driven earth-moving machines (EMMs).

It is applicable to those machines using on-board voltages in the range of 50 V–36 kV AC r.m.s. at any frequency, and 75 V–36 kV DC — including any repetition rate of pulsating DC— intended for outdoor use.

Voltages occurring within devices are not considered to be on-board voltages and are thus not within its scope.

It is intended to be used in conjunction with ISO 14990-1, which gives general requirements for EMMs regardless of how they are powered. Requirements specific to externally-powered machines are given in ISO 14990-2. It is possible to have an EMM that is both self-powered *and* externally powered (e.g. a battery powered machine having a built-in charger with power supply function), in which case ISO 14990-2 is also applicable.

NOTE For machines intended to be operated on-road, automotive standard ISO 6469 and/or UN ECE R100 may provide useful guidance. See Annex B for a comparison of requirements.

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 14990-1:2016, *Earth-moving machinery — Electrical safety of machines utilizing electric drives or related components and systems — Part 1: General requirements*

ISO 14990-2, *Earth-moving machinery — Electrical safety of machines utilizing electric drives or related components and systems — Part 2: Particular requirements for externally-powered machines*

3 Terms and definitions

For the purposes of this document, the terms, definitions and abbreviated terms given in ISO 14990-1 apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

4 General requirements

4.1 General

The requirements of ISO 14990-1:2016, Clause 4 shall apply except as modified by this clause.

4.2 Special conditions

The enquiry form given in Annex A can be used as the basis for an agreement between user and supplier to address special conditions, or where certain provisions of this document might not be applicable. The waiver of any requirement shall be limited to situations not covered by this document.

4.3 Supplies

For supply systems such as onboard generators, supply voltage limits are not applicable, provided that the equipment is designed to operate correctly from the supply voltage source.

5 Protection against electric shock hazards

The requirements of ISO 14990-1:2016, Clause 5 shall apply except as modified by this clause.

5.1 See Figure 2 for an example of equipotential bonding for electrical equipment of a self-powered EMM.

5.2 Each protective conductor connecting point on a machine shall be marked or labelled as such using the symbol IEC 60417-5019[1)] or with the letters "PE", or by use of the bicolour combination GREEN-AND-YELLOW, or by any combination of these. The graphical symbol is preferred.

Alternatively, each protective conductor connecting point on a self-powered machine may be marked or labelled as such using the symbol IEC 60417-5020[2)].

5.3 On self-powered machines, the protective conductors, the conductive structural parts of the electrical equipment, and those extraneous conductive parts which form the structure of the machine shall all be connected to a protective bonding terminal to provide protection against electric shock. Where a self-powered machine is also capable of being connected to an external incoming power supply, this protective bonding terminal shall be the connection point for the external protective conductor.

When the supply of electrical energy is self-contained within mobile equipment, and when there is no external supply connected (for example when an on-board battery charger is not connected), there is no need to connect such equipment to an external protective conductor.

6 Protection against electrical fire hazards

The requirements of ISO 14990-1:2016, Clause 6 shall apply.

1) Online database: available at http://www.graphical-symbols.info/

2) Online database: available at http://www.graphical-symbols.info/

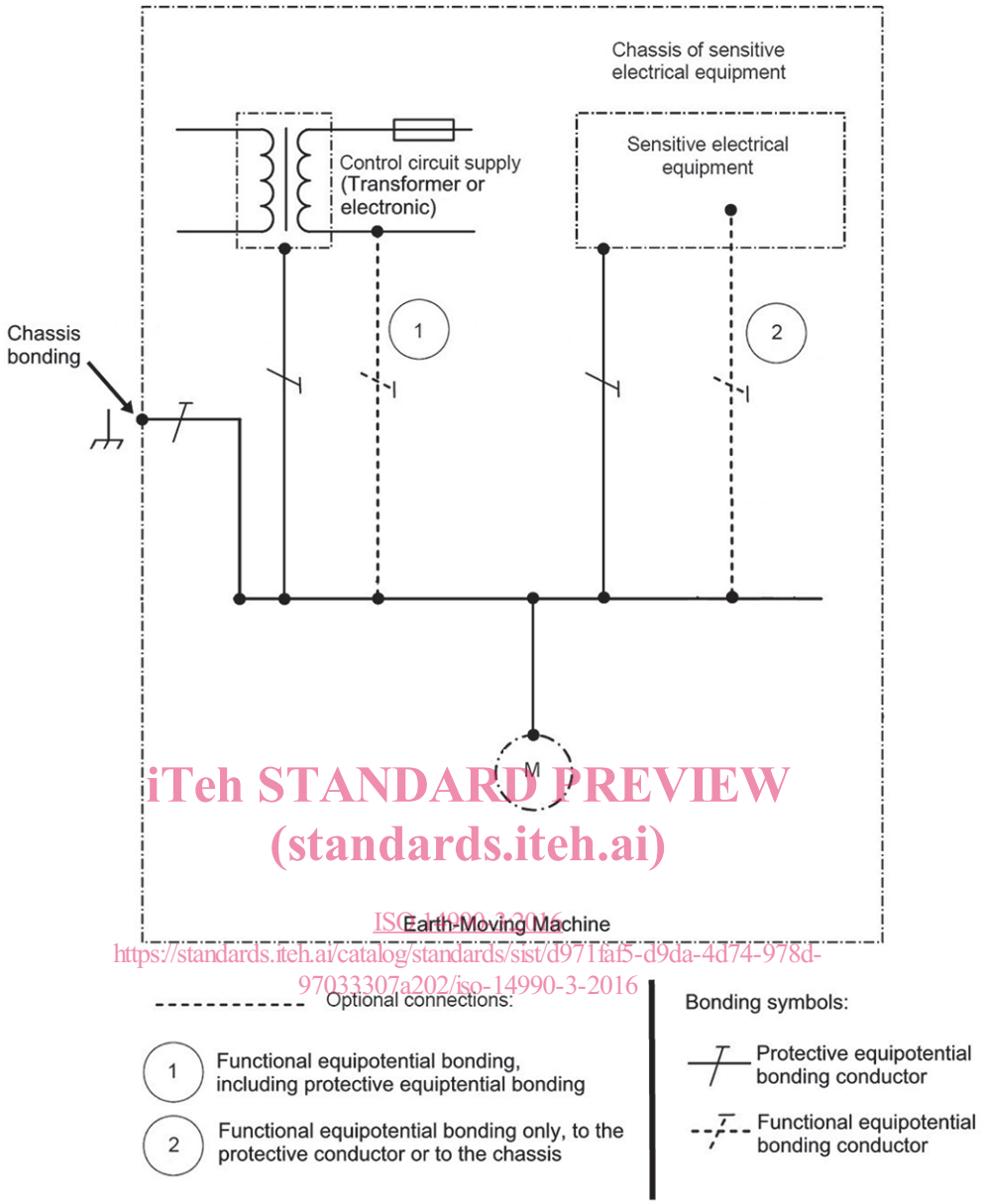

Figure 2 — Example of equipotential bonding for self-powered EMMs

7 Protection against thermal hazards

The requirements of ISO 14990-1:2016, Clause 7 shall apply.

8 Protection against mechanical hazards

The requirements of ISO 14990-1:2016, Clause 8 shall apply.

9 Protection against abnormal operation hazards

9.1 General

The requirements of ISO 14990-1:2016, Clause 9 shall apply except as modified by this clause.

9.2 Overcurrent protection (OCP)

Overcurrent protection by means of automatic engine shutoff is permitted if the I^2t ratings of conductors and components are not exceeded.

10 Electric power source

The requirements of ISO 14990-1:2016, Clause 10 shall apply except as modified in this clause.

There shall be a means of disconnecting or removing the power source from the rest of the low voltage system.

— An engine key switch or engine stop feature together with a lockable battery disconnect is sufficient for removing a generator power source.

— For low-voltage batteries, a switch, relay, plug, connector, or equivalent shall be provided. The device shall be located as close to the source as is practical. It shall be possible to remove power without exposing a service person to live low voltage parts.

11 Wiring

The requirements of ISO 14990-1:2016, Clause 11 shall apply.

12 Electric motors

The requirements of ISO 14990-1:2016, Clause 12 shall apply.

13 Non-motor loads

The requirements of ISO 14990-1:2016, Clause 13 shall apply.

14 Controls

The requirements of ISO 14990-1:2016, Clause 14 shall apply.

15 Manuals and documentation

15.1 General

The requirements of ISO 14990-1:2016, Clause 15 shall apply except as modified by this clause.

15.2 Information to be provided

Manufacturers shall provide adequate instructions to ensure power supply compatibility for external charging systems. External charging systems are outside the scope of this standard.

16 Marking

16.1 General

The requirements of ISO 14990-1:2016, Clause 16 shall apply except as modified by this clause.

16.2 Marking of equipment

For equipment having chassis leakage currents greater than 10 mA AC or DC, a warning marking shall be provided adjacent to the PE terminal, and where necessary on the nameplate of the electrical equipment. The warning shall include information about the leakage current and the minimum cross-sectional area of the external protective conductor.

17 Tests

The requirements of ISO 14990-1:2016, Clause 17 shall apply.