
**Earth-moving machinery — Operator's
controls**

Engins de terrassement — Commandes de l'opérateur

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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 10968 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety requirements and human factors*.

This second edition cancels and replaces the first edition (ISO 10968:1995), which has been technically revised.

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Earth-moving machinery — Operator's controls

1 Scope

This International Standard specifies requirements and guidelines for the operator's primary controls on earth-moving machinery (as defined in ISO 6165) in as far as those controls relate to the ride-on operator (for remote operator-controlled machines, see ISO 15817). Its provisions for finger-, hand- and foot-operated controls are not intended to prevent usage of other types of controls, control locations or control movements. Nevertheless, it does recommend that the general requirements and principles of arrangement be followed for those others, taking into account operator safety and ergonomics.

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 3411, *Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope*

ISO 3450, *Earth-moving machinery — Braking systems of rubber-tyred machines — Systems and performance requirements and test procedures*

ISO 5010, *Earth-moving machinery — Rubber-tyred machines — Steering requirements*

ISO 6165, *Earth-moving machinery — Basic types — Vocabulary*

ISO 6405-1, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 6405-2, *Earth-moving machinery — Symbols for operator controls and other displays — Part 2: Specific symbols for machines, equipment and accessories*

ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls*

ISO 10264, *Earth-moving machinery — Key-locked starting systems*

ISO 10265, *Earth-moving machinery — Crawler machines — Performance requirements and test procedures for braking systems*

ISO 13766, *Earth-moving machinery — Electromagnetic compatibility*

ISO 15817, *Earth-moving machinery — Safety requirements for remote operator control¹⁾*

ISO 15998, *Earth-moving machinery — Machine-control systems (MCS) using electronic components — Performance criteria and tests¹⁾*

1) To be published.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

primary control

control that is used frequently or continuously by the operator (see ISO 6682)

NOTE The primary controls are the following.

a) For the base machine:

- 1) steering;
- 2) clutch or inch pedal;
- 3) gear selection;
- 4) speed;
- 5) travel direction;
- 6) brakes;
- 7) rotary/slewing motion.

b) For equipment:

- 1) raising/lowering operations (e.g. loader arm, dozer equipment, excavator boom, side boom winch, rope excavator winch);
- 2) boom extending, retracting or articulating operations;
- 3) backward-/forward motion (e.g. backhoe-arm);
- 4) attachment operations (e.g. bucket, attachment bracket shovel, clamshell, forges, dump body);
- 5) rotary/slewing operations.

3.2

secondary control

control that is infrequently used by the operator but is needed for the proper functioning of the machine (e.g. control for parking brake, for lighting)

3.3

machine response

movement of base machine or equipment or attachment in response to activation of a control

EXAMPLE Raising of the bucket when the bucket lift control is moved to the raise position, closing of a clamshell when the clamshell close control is moved to the close position.

3.4

control actuating force

force exerted at the centre of the control contact surface, in the direction of movement of the surface, in order to achieve a control function

NOTE This force does not necessarily represent the force typically applied by the operator.

3.5**remote operator control**

operation of an earth-moving machine by an operator at a distance from the machine by means of wired control or wireless control, including the control of an autonomous machine when operating in remote-control mode

4 Control location**4.1 Control locations**

The location of controls shall be in accordance with ISO 3411 and should also take into account the guidelines given in ISO 6682.

4.2 Distance between primary controls

4.2.1 The distance between adjacent controls and between controls and other machine parts shall be sufficient to allow operation without unintentional activation of adjacent controls. The overlapping of controls is permissible to provide independent and simultaneous control application.

4.2.2 The distance between finger, hand- and foot-operated controls, or between those types of controls and any adjacent parts, shall be as follows.

NOTE The distance between two adjacent finger-operated controls is related to the width of the controls. Therefore, a distance between the centre lines of two adjacent controls is specified, depending on whether a device is located between two controls.

— For finger-operated controls, the distance between the centre lines of two adjacent controls (excluding key or touch pads intended for fingertip activation):

1) 25 mm, without divider;

2) 18 mm, with divider.

— For hand-operated (with fingers around the control): 40 mm.

— For foot-operated controls: 50 mm.

4.2.3 If two adjacent finger-, hand- or foot-operated controls are intended to be used simultaneously, a smaller distance is acceptable.

The location of secondary controls should follow the same principle.

4.3 Measures against movement or damage by external forces

Controls, control linkage and their power supply shall be arranged such that they cannot be damaged or moved into an undesirable position by foreseeable external forces, e.g. hand or foot force or shaking (vibration) of the machine.

4.4 Non-slip pedals

The surface of pedals shall be slip-resistant.

5 Movement of controls

5.1 General

5.1.1 The movement of the controls in relation to their neutral position shall be in the same general direction as the machine response, unless the combining of controls or customary usage dictates otherwise (e.g. driving control of machines where the operator's position is located on a slewable part of the machine, such as the upper structure of an excavator).

5.1.2 If a machine is equipped with an alternative operator's position, with duplicated control arrangements, both sets of controls shall operate in the same manner. When one set of controls is active, the other set shall be inactive. The active set shall be clearly identified with a visual indicator.

Machines shall maintain the same correspondence between action on steering controls and direction of travel, whatever the position of the reversible drive.

5.1.3 All controls shall return to their neutral position when the operator releases the control, unless the control has a detent or hold position or continuously activated position.

5.1.4 There shall be no hazardous movement during or following start-up or stoppage of the power supply or engine.

Starting systems shall be in accordance with ISO 10264.

5.1.5 If control signals are electrically transmitted, the control system shall be in accordance with ISO 13766 and ISO 15998.

5.1.6 The controls shall be so arranged or deactivated or guarded that they cannot be activated unintentionally — in particular when the operator is getting into or out of the operator's station according to the manufacturer's instructions.

5.1.7 The type, location and method of operation of typical primary controls are specified in Annex A for the base machine and in Annex B for equipment. Controls for equipment not otherwise specified (e.g. on the backhoe portion of a backhoe loader) should follow the same principles as given by Annex B.

5.1.8 The identification symbols shall be on the controls or next to them. If space limitations dictate, a diagram showing the primary controls is acceptable: it shall be easily visible to the operator.

Graphical symbols shall be in accordance with ISO 6405-1 and ISO 6405-2.

5.2 Multifunctional controls

5.2.1 General

In the case of a multifunctional control used to control the operations of the base machine and/or equipment or attachments, the following applies *in addition* to 5.1.

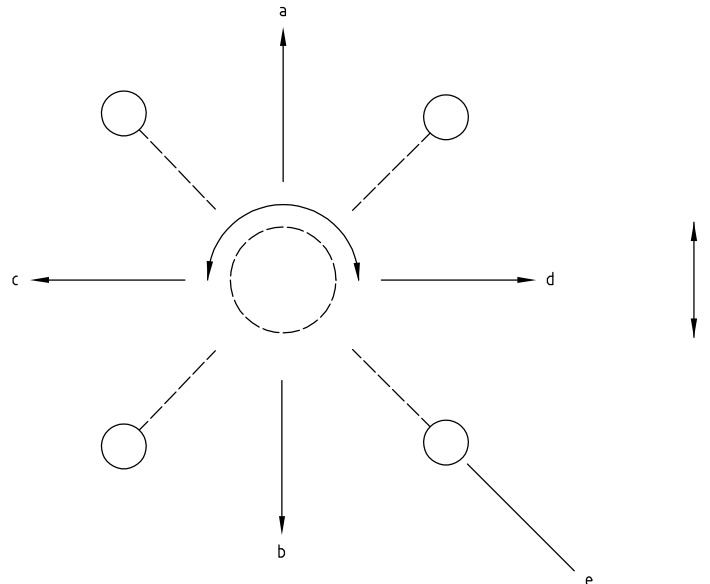
5.2.2 Basic movement of multifunctional controls

The basic movements of multifunctional controls consist of the following control movements (or combination of them):

- to the front/rear;
- to the left/right;
- slewing/rotation(e.g. gear selection up and down);
- upward/downward (lifting/lowering).

The combined movement of operational functions (e.g. to front left or to front right, to rear left or to rear right) is permitted.

See Figure 1.



- a Front.
- b Rear.
- c Left.
- d Right.
- e Combined control.
- f Upward and downward (lifting/lowering).

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Figure 1 — Basic functions of a multifunctional control

5.2.3 Machine responses to control change-over

Changing the machine response to a multifunctional control movement to another primary function (see Annexes A and B) is permissible if a control mechanism label or visual indicator is provided to inform the operator of the control movements and the machine responses in the basic and change-over positions.

5.2.4 Additional controls located at a multifunctional control

Additional control mechanisms, such as knobs or switches, may be located on a multifunctional control to actuate either primary or secondary controls. However, no more than four additional control mechanisms should be located on the control (e.g. grab turned right/hold/left, driving forward/neutral/rearward, oscillation axle lock/unlock, stabilizer up/hold/down).

The control device for the additional control mechanisms and the response shall be indicated by a control mechanism label or visual indicator.

Fingertip-activated controls such as key or touch pads are excluded from these requirements.

6 Control-actuating forces

6.1 The maximum control actuating forces given in Table 1 shall not be exceeded for normal operation, but may be exceeded on a control for an emergency.