



BSI Standards Publication

Tractors and self-propelled machinery for agriculture — Operator controls — Actuating forces, displacement, location and method of operation

National foreword

This British Standard is the UK implementation of ISO 15077:2020. It supersedes BS ISO 15077:2008, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AGE/6, Agricultural tractors and forestry machinery.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2020
Published by BSI Standards Limited 2020

ISBN 978 0 580 98360 3

ICS 65.060.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2020.

Amendments/corrigenda issued since publication

Date	Text affected
<hr/>	

INTERNATIONAL STANDARD

ISO
15077

Second edition
2020-03

Tractors and self-propelled machinery for agriculture — Operator controls — Actuating forces, displacement, location and method of operation

*Tracteurs et machines agricoles automotrices — Commandes de
l'opérateur — Forces de manoeuvre, déplacements, emplacements et
modes de fonctionnement*



Reference number
ISO 15077:2020(E)

© ISO 2020



COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Requirements	3
4.1 General	3
4.2 Identification	3
4.3 Foot-operated controls	3
4.4 Control actuating forces and torques, direction of motion, and location	3
4.5 Control operation	4
Annex A (informative) Control actuating forces and torques, direction of motion and control location	9
Annex B (normative) Operator controls associated with virtual terminals	14
Annex C (informative) Identification of hand controls by colour coding	16
Bibliography	18

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 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.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 3, *Safety and comfort*.

This second edition cancels and replaces the first edition (ISO 15077:2008), which has been technically revised.

The main changes compared to the previous edition are as follows.

- In [Clause 3](#):
 - the definition for hybrid power source has been added;
 - the definition for critical VT operator control has been revised.
- In [Clause 4](#):
 - multiple new general requirements have been added;
 - a new subclause ([4.2](#)) specifically for identification has been added;
 - additional requirements for stopping and starting has been added in [Table 1](#);
 - provisions for new technologies have been introduced into [Table 1](#);
 - requirements for speed selection pattern in [Table 1](#) related to manual/nonlinear transmission shifting patterns have been clarified;
 - new requirements for remote engine starting have been added in [Table 1](#).
- In [Annex A](#):
 - the annex has been reorganized for clarity and flow;
 - torque values have been added to [Table A.1](#) for rotational controls;

- a new [Figure A.1](#) has been added for clarity;
- [Figure A.2](#) (former Figure A.1) has been revised to correct the operator's position.
- In [Annex B](#):
 - reference to AEF 006 has been added.
- In [Annex C](#):
 - colour identification numbers have been added to [Table C.1](#).

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.

Introduction

This document has been developed to provide guidance on methods of operation and requirements for operator controls. These provisions were derived from experience, current practice, human factors literature and existing standards. Specific operating requirements are given for controls common to many tractors and self-propelled agricultural machinery.

Tractors and self-propelled machinery for agriculture — Operator controls — Actuating forces, displacement, location and method of operation

1 Scope

This document specifies methods of operation and requirements related to manual (for example, hand-, finger-, foot-operated) controls as well as controls associated with virtual terminals intended for a seated operator.

It applies to controls installed on agricultural tractors and self-propelled agricultural machinery.

It also gives recommendations for the control actuating forces and torques, direction of motion and location of these manual controls.

This document also specifies the minimum information relevant to manual controls to be provided in the operator's manual, for use as intended by the manufacturer.

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 3767-1, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 3767-2, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 2: Symbols for agricultural tractors and machinery*

ISO 11783-6, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 6: Virtual terminal*

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

control

device actuated by an operator to effect a response from the machine, its attachments or its implements

3.2

control actuating force

force exerted at the centre of the control contact surface and in the direction of its movement to effect a control function

3.3
forward

direction the operator faces while seated in the operator's seat with the machine and the operator's seat in the position for forward travel as defined by the manufacturer

3.4
decelerator pedal

control used on certain machines which, when actuated, reduces the engine speed

3.5
hand-operated control

device manipulated by the operator's hand

3.5.1
hand-operated control with finger/wrist activation

hand control manipulated by the movement of one or more fingers or the wrist, with little or no shoulder/elbow motion

3.5.2
hand-operated control with arm activation

hand control gripped by the hand and moved primarily by shoulder/elbow movement

3.6
auxiliary input unit

electronic control unit (ECU) containing one or more *virtual terminal (VT) operator controls* ([3.9](#)) for common use and facilitating the machine operation

Note 1 to entry: See ISO 11783-6.

3.7
non-critical function

machine function which, when actuated, presents a minimal risk to the machine operator or bystanders

3.8
critical function

machine function which, when actuated, can cause an action that could be hazardous to the machine operator or bystanders

3.9
virtual terminal operator control

VT operator control

element of an *auxiliary input unit* ([3.6](#)) or of a remote key pad, or virtual terminal soft key or touch screen control or reconfigurable proprietary control meeting the requirements of ISO 11783-6 and those specified in [Annex B](#)

3.9.1
non-critical VT operator control

VT operator control ([3.9](#)) that is suitable only for the control of *non-critical functions* ([3.7](#))

3.9.2
critical VT operator control

VT operator control ([3.9](#)) input suitable for the control of *critical functions* ([3.8](#)) with a means of preventing inadvertent operation

3.10
pointing unit control

means of activating and releasing of a function displayed by *virtual terminal operator control* ([3.9](#))

3.11
foot-operated control

device manipulated by the operator's foot

3.12

hybrid power source

use of two or more distinct types of power, such as an internal combustion engine to drive an electric generator that powers an electric traction drive motor

4 Requirements

4.1 General

4.1.1 Controls shall be arranged so that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles.

4.1.2 The unintentional actuation of controls shall be avoided, for example, by suitable design or position.

4.1.3 The incorrect actuation of controls shall be avoided, for example, by suitable design, arrangement, marking or lighting.

4.2 Identification

4.2.1 Control functions and movements shall be identified by symbols conforming to ISO 3767-1 or ISO 3767-2 so that the operator can determine the proper control function and movement. In cases where the ISO 3767 series of standards do not include a suitable symbol that addresses a machine's function (for example, as a result of new technology), it is acceptable for the manufacturer to develop and use an appropriate symbol. The explanation of all symbols shall be included in the operator manual. Identification is not required for controls that have universal recognition by virtue of their shape, colour, location, arrangements or method of actuation, such as a steering wheel, foot-operated clutch pedal, service brake or accelerator pedal.

NOTE The symbols given in the ISO 3767 series are also registered in ISO 7000.

4.2.2 When a control device is designed and constructed to perform several different actions, the actions shall be clearly identified or displayed and subject to confirmation, when necessary.

4.2.3 For identification of manual controls by colour coding, see [Annex C](#).

4.3 Foot-operated controls

Foot-operated controls shall be designed to minimize the risk of the foot slipping off the pedal.

4.4 Control actuating forces and torques, direction of motion, and location

Guidelines for control actuating forces and torques, and generic direction of motion for controls are given in [Annex A](#). Minimum control actuating forces shall be sufficient to avoid inadvertent actuation by the force of a hand or foot resting on the control during anticipated operating conditions.

NOTE ISO 5697 and ISO 10998 specify maximum actuating forces not to be exceeded to meet the braking and steering performance requirements. Actuating forces to be applied for normal operation referred to in this document are usually lower.

4.5 Control operation

Control operations shall be in accordance with [Table 1](#) if provided on the machine.

NOTE The control motion indicated in [Table 1](#) represents the motion of several control types such as levers, rocker switches, pairs of push buttons, or sliders. For example, if a pair of buttons or a rocker switch are used to raise and lower the three-point hitch, the interpretation of [Table 1](#), No. 8.1, would be to use the button in the upper or rearward position to raise the hitch and the button in the lower or forward position to lower the hitch.

Table 1 — Control operation

No.	Control	Control operation and requirements
1	Engine	
1.1	Starting/stopping engine	Provisions shall be made to prevent the engine start unless: <ul style="list-style-type: none"> a) in case of self-propelled machinery designed for a ride-on operator only, the driver is in the driver station; b) the traction transmissions are in neutral or parked position or the traction clutch is disengaged; c) the master implement clutch and, if separate, the power take-off (PTO) clutch are disengaged; d) hybrid power sources are excluded from the above requirements.
1.1.1	Starting engine (rotational switch)	The control shall be rotated clockwise to operate engine starter.
1.1.2	Engine preheater circuit (rotational switch)	If an engine preheater circuit is provided, this control shall occur before or at the starting position. It may be activated by rotating the control clockwise, anticlockwise (counter-clockwise) or pushing inwards on the control.
1.1.3	Stopping engine (rotational switch)	The control shall be rotated anticlockwise (counter-clockwise) to the stop position.
1.1.4	Stopping engine (mechanical control)	When the stop control is actuated, controls shall automatically remain in the stop position without the application of sustained manual effort. Direction of motion shall be pulled to stop. The control shall be located within 150 mm of the engine start control. If the stop control is combined with the speed control, it shall be in the direction of and beyond the low idle position.
1.1.5	Starting/stopping engine (finger operated push button switch)	The button shall be actuated to start or stop the engine.
1.1.6	Remote engine starting	Provision shall be made to prevent remote engine starting unless: <ul style="list-style-type: none"> a) the traction transmissions are in the neutral or parked position or the traction clutch is disengaged; b) the master implement clutch and, if separate, the PTO clutch are disengaged; c) hazards associated with engine motion are mitigated.
1.2	Engine speed	
1.2.1	Foot-operated	The control shall be readily accessible to the operator's right foot. The pedal shall be pushed forward, downward, or both forward and downward to increase engine speed.

Table 1 (continued)

No.	Control	Control operation and requirements
1.2.2	Hand-operated variable speed	The control shall be positioned in front of, or to the right of, the operator. Direction of motion shall be in a plane generally parallel to the longitudinal axis of the vehicle. The control shall be moved away from the operator (generally forward) to increase engine speed.
1.2.3	Hand-operated discrete settings	The control shall be positioned in front of, or to the right of, the operator. The actuation of the part of the control which is generally away from the operator shall select higher speed settings.
1.2.4	Decelerator pedal	If provided, the control shall be positioned in front of, or to the right of, the operator and be readily accessible to the operator's right foot. The direction of motion shall be forward, downward, or both forward and downward to decrease engine speed. A foot-operated engine speed control as described in 1.2.1 shall not be provided.
2	Steering (when travelling in a forward direction)	
2.1	Steering wheel	When a steering wheel control is provided, a clockwise rotation shall effect a right turn, and an anticlockwise (counter-clockwise) rotation shall effect a left turn.
2.2	Two levers	When two levers are provided for steering: <ul style="list-style-type: none"> — a right turn shall be effected by moving the right-hand lever rearward, the left-hand lever forward, or both; — a left turn shall be effected by moving the left-hand lever rearward, the right-hand lever forward, or both.
2.3	One lever	When one lever is provided for steering, a lateral motion of the lever to the right shall effect a right turn and a lateral motion to the left shall effect a left turn.
3	Brakes	
3.1	Service brake	
3.1.1	Foot-operated	Pedals shall be readily accessible to the operator's right foot, except as noted in Table 1 , No. 3.1.2. The direction of motion for engagement shall be forward, downward, or both. Where separate brake pedals are provided for the independent righthand and left-hand brake control, it shall be possible to obtain combined control with one foot.
3.1.2	Foot operated brake used in combination with Table 1 , No. 4.2.1 and Table 1 , No. 4.2.2	Pedal(s) may be installed to be activated by the left-hand foot in case that a sustained activation of the right-hand pedal(s) is required to keep the vehicle in motion (for example, with hydrostat transmission with one pedal for forward and one for reverse (Table 1 , No. 4.2.2) or a toe and heel pedal for respectively forward and reverse motion (Table 1 , No. 4.2.1).
3.2	Park brake	
3.2.1	Hand-operated with finger/wrist activation (for example, electrical switch, button)	The park brake shall remain applied without manual effort. Provision shall be made to prevent unintentional release.
3.2.2	Hand-operated with arm activation	The control shall be pulled to apply the brake. A device shall be provided to retain the brake control in the applied position. Provision shall be made to prevent unintentional release.
3.2.3	Foot-operated	The direction of motion shall be forward, downward, or both for engagement. A device shall be provided to retain the brake control in the applied position. Provision shall be made to prevent unintentional release.

Table 1 (continued)

No.	Control	Control operation and requirements
3.2.4	Combined control for parking and transmission	Provision shall be made to prevent unintentional disengagement.
3.3	Secondary braking system	
3.3.1	Hand-operated with finger/wrist activation (for example, electrical switch)	The control shall be actuated as instructed by the manufacturer. The actuation can include being moved forward or moved away.
3.3.2	Hand-operated with arm activation	The control shall be pulled to apply the brake.
3.3.3	Foot-operated	The direction of motion shall be forward, downward, or both to apply the brake.
4	Transmission	
4.1	Clutch (includes combined transmission and PTO) See also PTO control, Section 7.	
4.1.1	Foot-operated	The control shall be readily accessible to operator's left foot. The pedal shall be pushed forward, downward, or both for disengagement.
4.1.2	Hand-operated with arm activation	The control shall be moved rearward or towards the operator for disengagement. Positive means shall be provided for holding the clutch control in the disengaged position so that it is incapable of being reengaged unless manually operated. It is recommended that the clutch be operable only from the operator's seat.
4.2	Combination ground speed and forward/reverse direction (continuously variable combined control)	Provision shall be made to prevent unintentional movement of the control from a) neutral to forward or reverse, b) forward to reverse, c) reverse to forward, or, alternatively: the machine motion due to unintentional movement of this control shall be prevented. The neutral position shall be clearly identified and easy to select.
4.2.1	Foot-operated — one pedal, or two pedals longitudinally related to simulate one pedal	The control shall be readily accessible to the operator's right foot. Forward motion and increasing forward speed shall be caused by moving the front of the pedal forward, downward, or both. Rearward motion and increasing rearward speed shall be caused by moving the rear of the pedal downward. The requirement of 3.1.1 does not apply in this case.
4.2.2	Foot-operated — two pedals (side by side)	The control shall be readily accessible to the operator's right foot. Rearward motion and increasing rearward speed shall be caused by moving the outer pedal forward, downward, or both. Forward motion and increasing forward speed shall be caused by moving the inner pedal forward, downward, or both. The requirement of 3.1.1 does not apply in this case.
4.2.3	Hand-operated	Forward motion and increasing forward speed shall be caused by moving the control from the neutral position forward, upward, or both. Rearward motion and increasing rearward speed shall be caused by moving the control from the neutral position rearward, downward, or both.

Table 1 (continued)

No.	Control	Control operation and requirements
4.3	Speed selection	
4.3.1	Hand operated	Speed selection pattern shall be clearly marked.
4.3.2	Foot-operated	The control shall be pushed forward or down for higher speed.
4.3.3	Finger operated memory setting (for example, push button)	A push button control shall be pressed to select a set speed.
4.4	Direction control (forward-reverse non-variable speed)	Provision shall be made to prevent unintentional movement of the control from a) neutral to forward or reverse, b) forward to reverse, c) reverse to forward, or, alternatively: the machine motion due to unintentional movement of this control shall be prevented. The neutral position shall be clearly identified and easy to select.
4.4.1	Hand or finger operated	The control shall be moved forward, upward, or both to effect forward motion. The control shall be moved rearward, downward, or both to effect rearward motion.
4.4.2	Forward-Reverse momentary switch	Finger operated push button - The push button shall be pressed momentarily to change the current direction. Neutral position shall be obtained by other transmission controls.
5	Master implement control, header or gathering unit clutch	
5.1	Hand-operated	The control shall be moved rearward or downward for disengagement. Provision shall be made to prevent unintentional engagement of the clutch. The control shall be operable only from the operator's seat.
5.2	Finger-operated	Finger operated push button - The push button shall be pressed momentarily to engage and disengage. Provision shall be made to prevent unintentional engagement.
6	Differential lock	
6.1	Foot or hand-operated	The control shall be moved forward or downward for engagement. If the differential lock remains on after release of the actuation mechanism, a means to indicate the differential lock engagement status to the operator shall be provided.
6.2	Finger-operated	Finger operated push button — The push button shall be pressed momentarily to engage and disengage differential lock. Provision shall be made to prevent unintentional engagement of the differential lock or to limit the speed when the differential lock can be engaged while turning.
7	PTO (power take-off)	
7.1	Clutch	
7.1.1	Foot-operated	The control shall be readily accessible to the operator's left foot. The pedal shall be pushed forward, downward, or both for disengagement. In the case of a combined traction-drive/PTO clutch, the PTO disengagement shall be the second stage.

Table 1 (continued)

No.	Control	Control operation and requirements
7.1.2	Hand-operated	The control shall be moved upward, forward, or both to engage. The control shall be moved downward or rearward to disengage. Provision shall be made to prevent unintentional engagement of the PTO clutch.
7.1.3	Finger-operated	Finger operated push button — The push button shall be pressed momentarily to engage and disengage PTO clutch. Provision shall be made to prevent unintentional engagement of the PTO clutch.
8	Implements and auxiliaries	
8.1	Lift mechanism (three-point hitch)	
8.1.1	Hand-operated	The control shall be readily accessible to the operator's right hand and moved upward, rearward or both to raise and downward, forward or both to lower. It shall be possible to lock the control levers or mechanism in the upper position.
8.2	Front loader	
8.2.1	Two levers — lift arm, bucket/attachment	The bucket/attachment control shall be located to the right of the lift arm control. The direction of control motion shall be forward, downward, or away from the operator to lower the lift arm, and in opposite directions to raise the lift arm. The direction of control motion shall be forward, downward, or away from the operator to dump the bucket/attachment, and in opposite directions to roll back the bucket/attachment.
8.2.2	One lever — lift arm, bucket/attachment	The direction of control motion shall be forward, downward, or away from the operator to lower the lift arm, and in opposite directions to raise the lift arm. Movement of the control away from the operator shall dump the bucket/attachment and movement of the control toward the operator shall roll back the bucket/attachment.
8.3	Selective hydraulic function	The direction of control motion for a remote hydraulic function shall be forward, downward, or away from the operator to lower or move forward the function; and rearward, upward, or toward the operator to raise or move rearward the function. Additional selective hydraulic functions shall be defined in the corresponding implement's operator's manual.
9	VT Operator controls	VT operator controls shall comply with the requirements of Annex B .

Annex A (informative)

Control actuating forces and torques, direction of motion and control location

A.1 Control actuating forces and torques

A.1.1 The control actuating forces and torques given in [Table A.1](#) should not be exceeded for normal operation. However, emergency situations may require higher forces.

Table A.1 — Control actuating forces and torques

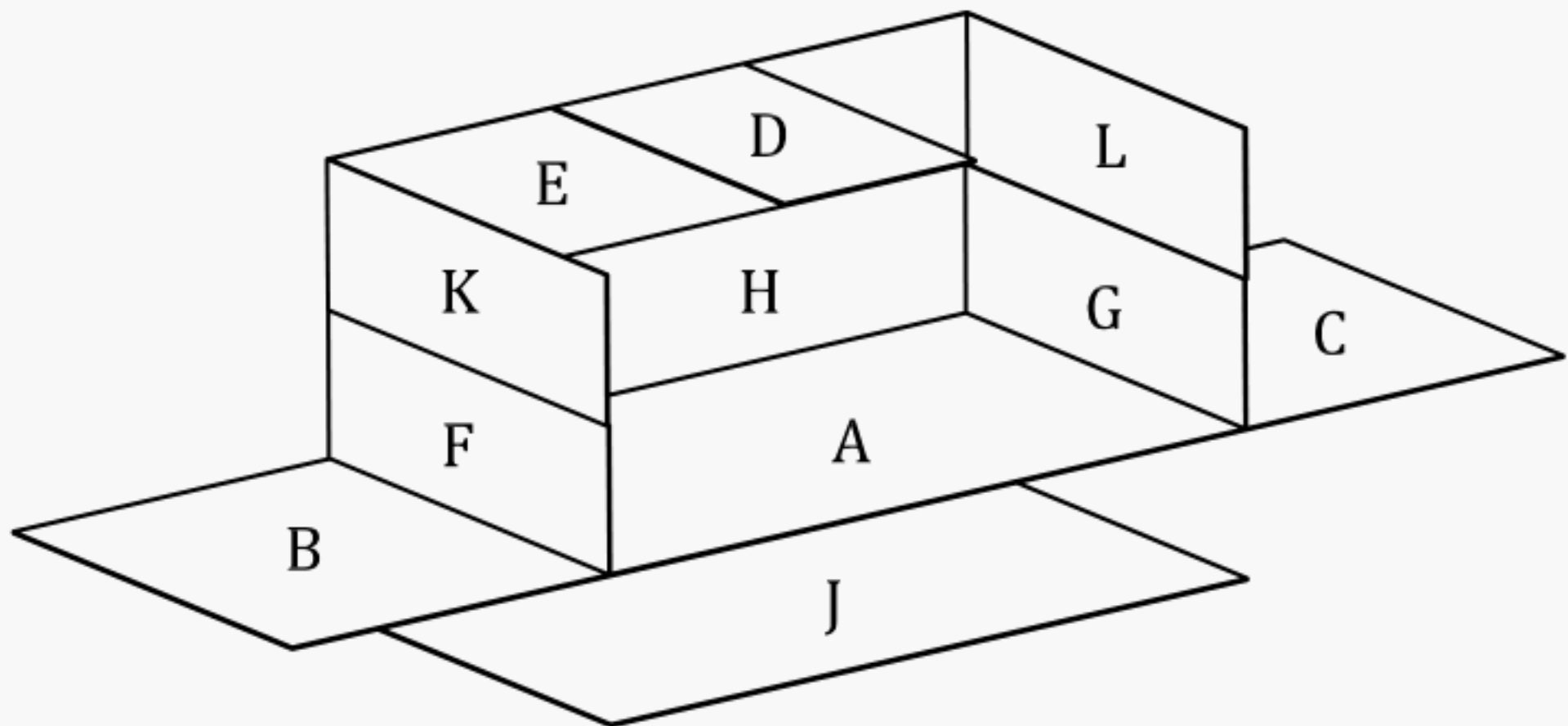
Type of control	Normal force (frequent operation) (N)	Maximum force (N)
Lever (fore/aft)	80	230
Lever (lateral)	60	100
Lever (vertical upwards)	60	400
Pedal (leg/foot operation)	120 ^a	450
Pedal (ankle rotation)	50	90
Finger/wrist operation (push/ pull/press)	10	20
Type of control	Torque (maximum) (N mm)	
Finger operation (rotational)	42	
Wrist operation (rotational)	680	
NOTE These forces do not apply to steering and braking systems. Maximum input forces for these systems are specified in ISO 10998 and ISO 5697. See also the NOTE to 4.4 .		
^a With back support, 150 N.		

A.1.2 Minimum control forces are dependent on the control system and are not stated.

A.2 Control arrangement

A.2.1 Panels

For the purposes of this document, panels are shown in [Figure A.1](#).



Key

panel A	horizontal transverse centre	panel G	vertical transverse right
panel B	horizontal transverse left	panel H	vertical transverse front
panel C	horizontal transverse right	panel J	horizontal lower centre
panel D	horizontal top centre	panel K	vertical upper left
panel E	vertical upper front	panel L	vertical upper right
panel F	vertical transverse left		

NOTE Panels H, C, B and J constitute the prime work areas.

Figure A.1 — Panels

A.2.2 Panels orientation allowance

A.2.2.1 The recommended maximum angles for panels are given in [Figure A.2](#).

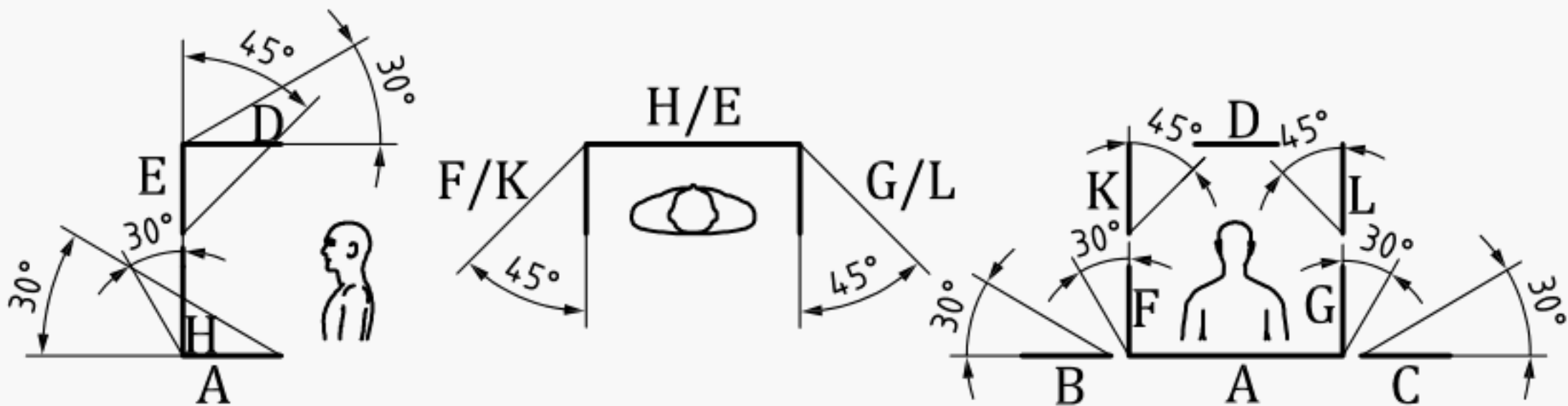


Figure A.2 — Recommended maximum angles for panels

A.2.2.2 Overhead panel D should be horizontal or up to 30° above horizontal.

A.2.2.3 High panel E should be angled 45° or less from vertical.

A.2.2.4 Vertical panels F and G should be angled less than 30°.

A.2.2.5 Horizontal control panels A, B, and C may be tilted up to 30°.

A.2.3 Control location/layout

A.2.3.1 If controls are designed with operator rotation in mind, panels B and C should be identical to panel A.

A.2.3.2 If the operator can turn to face side panels F and G, all controls should be similar to H.

A.2.3.3 It is recommended that a control should not be located on a surface which causes ambiguity in the relationship between control movement and function movement.

For example, a lever control for a raise-lower function should not be located on a 30° to 60° upward sloping surface, since the recommended direction of the motion changes when it is moved from a vertical to a horizontal plane.

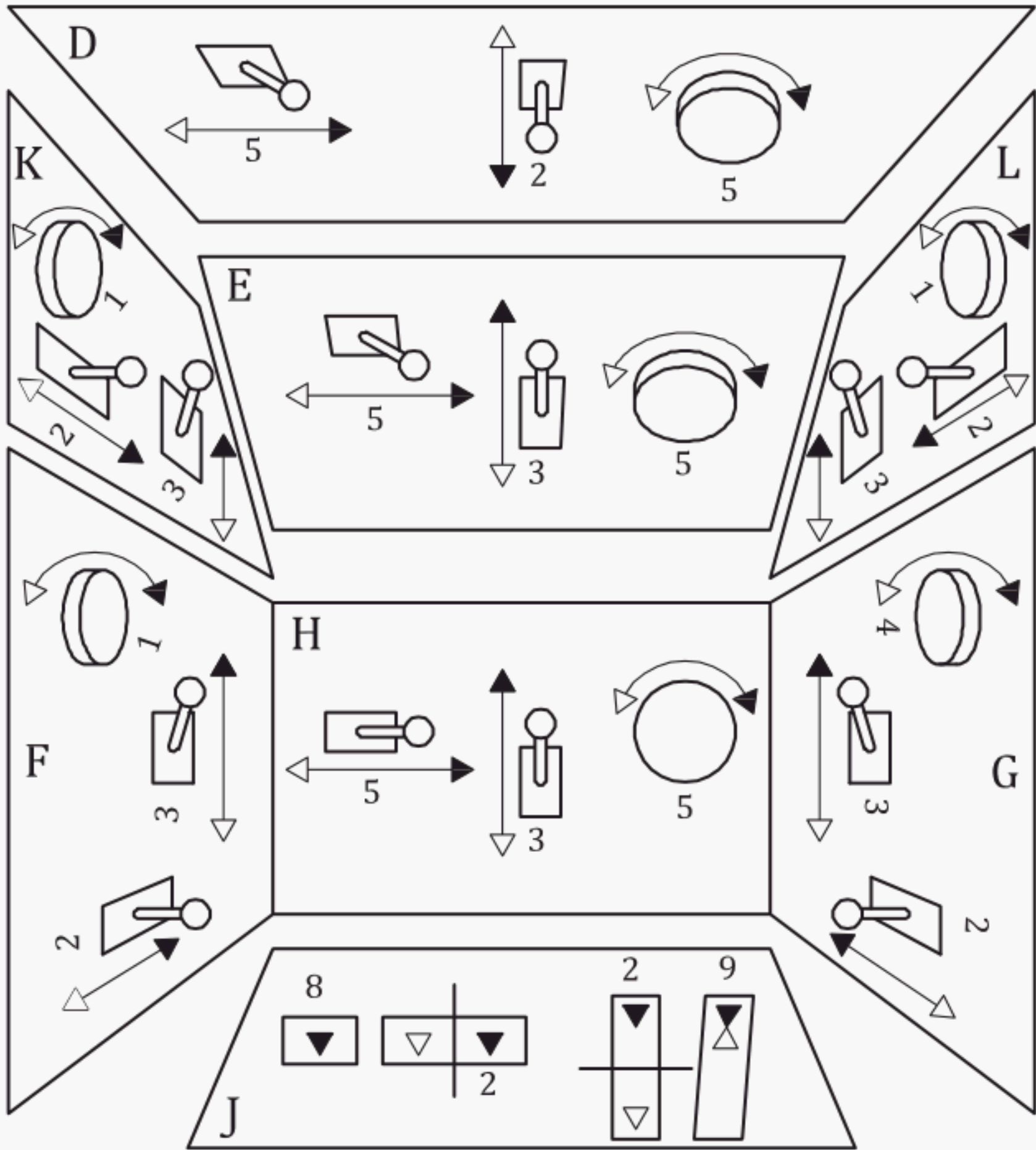
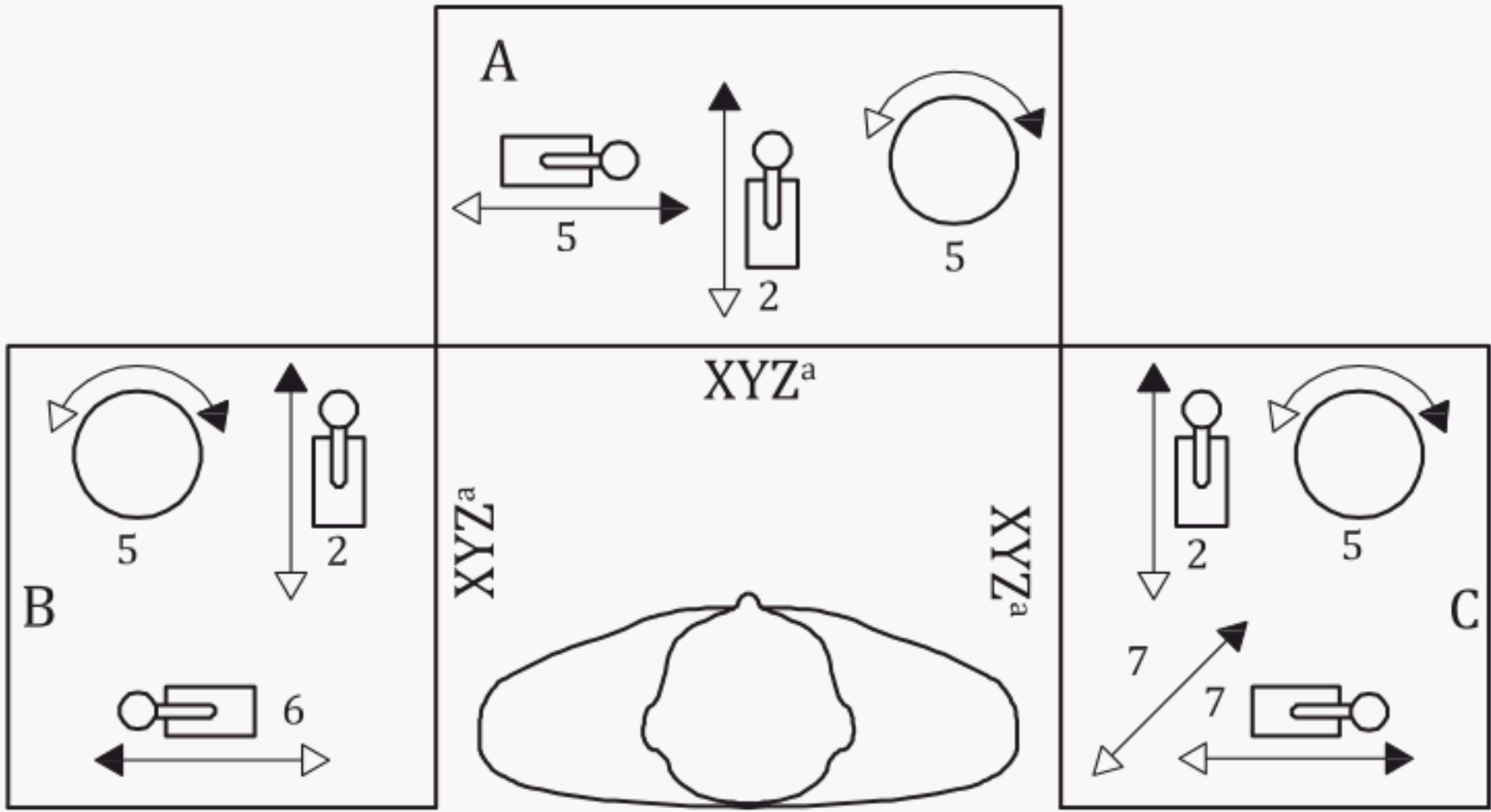
A.2.3.4 When a sequence of controls is repeated on another panel, the sequence of controls should be the same for each panel.

A.2.3.5 Control design and spacing should allow unobstructed operation without unintentional actuation of other controls. Overlapping of controls is permissible to provide independent or simultaneous control application.

A.3 Direction of motion

A.3.1 Preferred direction of movement

A.3.1.1 The preferred direction of movement of controls and the anticipated response for the various control locations are shown in [Figure A.3](#). The alternative responses linked to the control movements are described in [Table A.2](#).



Key

- control movement for the response listed
- opposite response for the black-headed arrows

^a Sequential order for related controls: if a normal or natural order exists for related controls, the order on different panels should be in the sequence shown.

Figure A.3 — Typical alternative control movements

Table A.2 — Alternative responses

1	2	3	4	5	6	7	8	9
Increase	Increase	Increase	Increase	Increase	Increase	Increase	On	Increase
On	On	On	On	On	On	On		
Start	Start	Start	Start	Start	Start	Start		
Forward	Forward	Forward	Backward	Clockwise	Anti-clockwise	Clockwise		
Clockwise	Down	Up	Clockwise	Right	Down	Down		
	Lower	Raise			Lower	Lower		
					Left	Right		

A.3.2 Controls — General

A.3.2.1 Manual hydraulic valves rotate clockwise to shut off flow.

A.3.2.2 Push-pull controls should pull for “ON” and push for “OFF”. Rotary controls may have their on-off functions activated by the same push-pull principle.

A.3.2.3 Lever motion indicated in the figure represents the motion of several control types such as levers, rocker switches, sliders and pairs of push buttons.

A.3.3 Controls — Location and movement recommendations

A.3.3.1 In panels B and C, right-left actuated control usage can lead to control ambiguity and should be avoided.

If a rotary control on panel G is related to, or operated simultaneously with, a rotary control on panel F, the control motion should be opposite to that shown on G for backward, increase, on, and start.

Levers on panels B and C may be oriented at an angle to provide movement away from, and towards, the operator provided the general principles of operation are met.

Annex B

(normative)

Operator controls associated with virtual terminals

B.1 General

Operator controls associated with virtual terminals include, but are not limited to, auxiliary input units as defined in ISO 11783-6, proprietary control units, soft keys and data masks (for example, buttons). These controls also include the interface elements of the virtual terminal that activate the soft keys and data mask objects such as bezel buttons, touch screens or keypads. Critical functions shall only be controlled by critical VT operator controls.

B.2 Marking and labelling of controls

B.2.1 Markings

B.2.1.1 Each VT operator control shall be permanently marked. VT operator controls that have more than one actuation position or direction (for example, joysticks, multi-position switches) shall be marked for each actuation position or direction. Each VT operator control designator displayed on the virtual terminal shall display the corresponding markings.

NOTE Soft keys physically located relative to the VT operator control designator displayed on the screen such that the relationship is clear need not be provided with additional markings.

B.2.1.2 Auxiliary input units and other input units intended to be installed by the operator shall be marked to show the intended mounting orientation.

B.2.2 Labels

Auxiliary input units shall be designed in such a way as to allow 20 mm² or larger labels to be applied either on or near the VT operator control. Other data mask objects that can control critical functions (for example, touch screen button objects) shall be provided with labels which are clearly visible. Appropriate labels shall be provided by the function owner (for example, implement). Symbols, when used, shall conform to ISO 3767-1 or ISO 3767-2.

NOTE The label area for virtual terminal soft keys is provided in the soft key designator specified in ISO 11783-6.

B.3 Installation

Manufacturers of input units intended to be installed by others (for example, auxiliary input units) shall publish and provide installation instructions to ensure the input unit is mounted in the correct orientation and in such a way as not to interfere with other controls and reduce the likelihood of inadvertent actuation of VT operator controls. Wired input units intended to be used within the operator station shall be equipped with connection cables of appropriate length to allow proper mounting, but not so long as to allow the unit to be operated outside of the operator station.

B.4 Protection against inadvertent actuation

Each critical VT operator control shall be provided with a means of protecting against inadvertent actuation. Such means may include more than one motion to activate the control, shielding around the control, or other methods that fulfil the intent of this requirement.

NOTE See AEF 006 for guidance.

B.5 Additional requirements for pointing units including touch screen controls

Pointing unit controls need requirements for use in addition to the requirements given in this document.

- Activation of a function may occur on either depression/touch or upon depression/touch and valid release. Activation upon depression/touch should be avoided except in special circumstances (for example, a control which serves as an emergency stop, a press-and-hold button used for setting a changeable value).
- A valid release shall only be achieved if the release occurs in the object on the screen that was touched (for example, if the operator touches a touch screen button object and slides his finger off the button object, a valid release has not occurred).

B.6 Operator's manual

Information shall be provided with each unit containing VT operator controls, addressing at a minimum the following items:

- a) mounting instructions, including selection of appropriate locations and preferred mounting orientation;
- b) warnings about the hazards associated with operating the input unit in inappropriate locations;
- c) instructions as required to properly identify the markings on the VT operator controls and to allow the user to properly assign the control to appropriate critical and non-critical functions;
- d) instructions on how to apply appropriate labels to the VT operator controls;
- e) an appropriate warning about the hazards of operating VT operator controls without appropriate labels;
- f) information about the number of each type of VT operator control provided and the types of functions supported by each type of control;
- g) instructions for reading and reviewing the virtual terminal manual to determine its procedure for setting and reviewing VT operator control assignments;
- h) information that this operator's manual only covers the VT operator control unit and that the user should not attempt to use or assign the VT operator controls prior to reading and reviewing the operator's manuals of all other connected components (for example, tractor, implement, virtual terminal);
- i) an appropriate warning that the person who makes the assignments is responsible for ensuring that the correct labels for all VT operator controls are installed prior to operating the VT operator control unit and that these labels shall be replaced as necessary when assignments are changed;
- j) an appropriate warning that the person who makes or changes the assignments of the VT operator control unit shall inform all operators of the VT operator control unit of the new or changed assignments.

Annex C (informative)

Identification of hand controls by colour coding

C.1 General

C.1.1 For the purposes of this annex, hand controls include, but are not limited to, levers, switches, knobs, handles and buttons that the operator manipulates to activate or control machine functions.

C.1.2 When new types of hand control are adopted or combination controls are used, the colour should be selected in accordance with the primary function.

C.1.3 If it is not practical to colour code the control, it is sufficient to colour code either the area surrounding the control or the identification of that control rather than the control.

C.1.4 Colour coding does not replace the need for identification by symbols. Controls for functions that are not obvious should be identified in accordance with ISO 3767-1 and ISO 3767-2.

C.2 Colour coding

The colour coding should be in accordance with [Table C.1](#).

Table C.1 — Colour Coding

Colour			Controls
C.2.1	Red	RAL ^a 3000, 3001, 3002, 3013, 3020 or RGB 169 30 31, 158 21 25, 159 22 28, 153 41 35, 190 17 16	Single-function engine stop controls. Where key switches, ignition switches or hand throttles are used to stop the engines, the “off” or “stop” positions shall be indicated with red lettering, symbols, or both. Hazard light flashers
C.2.2	Orange	RAL 2003, 2004, 2008, 2009, 2010, 2011 or RGB 236 83 0, 247 119 38, 239 107 27, 225 81 5, 209 89 26, 233 114 19	Machine ground motion controls only EXAMPLE Engine speed controls, transmission controls, parking brakes, parklocks, independent emergency brakes, transmission disconnect. Exceptions: — where the engine speed and engine stop controls are combined, the controls may be red; — steering wheels or steering controls may be black or any colour other than red or yellow.
^a https://www.ral.de			

Table C.1 (continued)

Colour			Controls
C.2.3	Yellow	RAL 1003, 1016, 1018, 1021, 1023 or RGB 246 172 0, 240 232 64, 250 210 51, 243 188 0, 248 192 0	Function controls which involve the engagement of mechanisms only. EXAMPLE PTO, separators, cutterheads, feed rolls, picking units, elevators, unloading augers.
C.2.4	Black or any other colour except red, orange or yellow	RAL 9004, 9005, 9011, 9017 or RGB 38 38 39, 18 19 20, 33 35 38, 29 28 29	All controls not covered by C.2.1, C.2.2 or C.2.3. EXAMPLE 1 Component lift or position such as implement hitch, header height, blade shift and reel lift. EXAMPLE 2 Control for unloading components such as spout cap, unloading auger swing and bin dump. EXAMPLE 3 Setting and adjustment mechanisms such as chokes, cylinder speed, concave space, seat adjustment, steering column, concave lock, lift stops, rockshaft stops, reel speed, and flow dividers. EXAMPLE 4 Machine lights such as headlights, work lights or floodlights, tail lights, and turn signals. EXAMPLE 5 Cabin comfort such as pressurizer, cooling, heating and windshield wipers.
^a https://www.ral.de			

Bibliography

- [1] ISO 5697, *Agricultural and forestry vehicles — Determination of braking performance*
- [2] ISO 10998, *Agricultural tractors — Requirements for steering*
- [3] AEF 006¹⁾, *Guideline for protection against inadvertent actuation*

1) Agricultural Industry Electronics Foundation Available at: <https://www.aef-online.org>.

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than one device provided that it is accessible by the sole named user only and that only one copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than one copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright and Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email cservices@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email: cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK