TECHNICAL SPECIFICATION

ISO/TS 15079

First edition
2001-09-01

Powered lawn, garden and horticultural equipment — Operator controls — Guidance on actuating forces, displacement, location and methods of operation

Matériel à moteur pour jardins, pelouses et pour l'horticulture — Commandes de l'opérateur — Lignes directrices pour les forces d'actionnement, déplacements, emplacements et méthodes de fonctionnement

Reference number
ISO/TS 15079:2001(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed every three years with a view to deciding whether it can be transformed into an International Standard.

Attention is drawn to the possibility that some of the elements of ISO/TS 15079 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 15079 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 13, *Powered lawn and garden equipment*.

This first edition of ISO/TS 15079 replaces ISO 3789-3:1989, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Location and method of operation of operator controls — Part 3: Controls for powered lawn and garden equipment*, which has been technically revised.

Introduction

This Technical Specification gives guidance on the design of operator controls (herein called “controls”) with respect to their method of operation, actuating force, displacement and location. The controls are those located at the operator’s normal working position, readily accessible and conveniently placed for the operator. The provisions contained in this Technical Specification were derived from experience, current practice, ergonomic literature and existing standards.

Generalized control data pertaining to control-actuation forces, displacement and location found in a number of ergonomic texts and references are not in total agreement. The myriad of variables affecting control design indicates that these control parameters are interactive and that no single value is correct for a given control design. Control method of operation has been standardized for a number of years and the operational methods contained in this Technical Specification are consistent with the International Standard it replaces as well as other standards relating to controls.

Control design involves complex issues and is influenced by control size, actuation, direction, displacement, and the relationship with, or proximity to, other controls and the operator. Operator capabilities are also influenced by many factors, including body position and control location or displacement direction relative to the operator. The unique situation in which, and the purpose for which, a control device is to be used can materially affect the appropriateness of a given type of control and can justify (or virtually require) variations from a set of general recommendations or practice based on research or experience. It is therefore imperative that tests involving multiple operators be performed as a prerequisite to final judgement of a machine control design essential to the correct operation of that machine.

Control shape, size, texture, proximity, clearance and markings are essential elements of good control design. However, these control elements are not included in this Technical Specification. For additional information concerning these subjects, the reader should consult an ergonomic reference or references.

It is generally desirable to design a machine and its controls for the 5th to 95th percentile operator. In some cases, compromise is essential for meeting the multitude of objectives involved in the design of a machine. By testing a control system with multiple operators, final judgement can be made on controls involved in such compromises.

Powered lawn, garden and horticulture equipment — Operator controls — Guidance on actuating forces, displacement, location and methods of operation

1 Scope

This Technical Specification gives guidance on actuating forces for hand and foot controls on powered lawn, garden and horticulture equipment, and their displacement, preferred location and method of operation. It is applicable to operator controls on both ride-on machines and pedestrian-controlled machines. Handheld products are not covered.

This Technical Specification is not applicable to passive controls (e.g. seat-activated, operator-presence controls utilized on ride-on machines). It contains data applicable to frequently used controls that require intentional operator actuation for control function. Infrequently used control forces and displacements may exceed the magnitudes given in this Technical Specification.

NOTE The concept of frequently used controls is relative to a given machine type and its use or requirements.

2 Terms and definitions

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

2.1
control actuating force
force exerted on the control to effect a response

2.2
control displacement
movement of a control through its operational range

2.3
forward
direction in which the operator faces when in the normal operator's position as specified by the manufacturer

2.4
operator control
any device actuated by the operator without use of tools to effect a response of the machine

2.5
operator presence control
operator control that automatically interrupts power to a drive when the actuating force is removed

2.6
operator position
operator location required for safe operation and control of the machine

2.7
pedestrian-controlled machine
a ground-supported machine controlled by an operator walking behind or standing on the back of the machine

2.8
ride-on machine
a self-propelled machine controlled by an operator sitting on the machine

3 Control parameters

The controls for which provisions are given in this Technical Specification are not required on all machines, but when provided on a machine they should conform to its recommendations. Control requirements given in specific product standards shall take precedence over those given in this Technical Specification.

The location and means of operation of control types are indicated in clause 5 for ride-on machines, and clause 6 for pedestrian-controlled machines. The maximum actuating force and the displacement of controls are given in clause 7. Minimum values should be accessed for specific machine designs.

Clause 7 should be used as a starting point for control design. Maximum force magnitude and displacement should not be used on a given control. In addition, actual values may differ due to the

— users for which the machine is intended (e.g. women or seniors),

— frequency of use of the control,

— control location and displacement relative to the user,

— size of the control, and

— professional use of the machine.

Multifunction controls should follow the principles listed.

4 Control actuating force and displacement — Measurement

The measurement of a control actuating force is made through the entire displacement and from the centre of that part of the control designed to be actuated by the operator. The direction of the force measurement is perpendicular to the control surface designed to be actuated by the operator and in the direction of movement of the surface. The direction of movement for rotary controls may be clockwise or counterclockwise; the effort to move the control is measured as torque.

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

Control displacement measurement is made in a manner similar to the above-described force measurement method. Displacements listed in clause 7 in terms of linear dimensions are measured in a straight line.

5 Control location and method of operation — Ride-on machines

Type		Location	Operation
5.1	**Engine**		
5.1.1	**Starting**		
5.1.1.1	**Ignition switch (if separate from starter switch)**		Can be rotary, toggle, or rocker type. If rotary type, should rotate clockwise to “on” position. If toggle type, should move forward and/or upward to “on” position. If rocker type, the upper portion or position farthest away from the operator should be pushed to “on” position.

Type		Location	Operation
5.1.1.2	**Starter switch or starter means (if separate from ignition switch)**		Can be push or key type. If key type, should rotate clockwise to “start” position. All types should return to “off” position when released.
5.1.1.3	**Ignition/starter switch**		Switch should be rotated in a clockwise direction to “start” position with return to “run” position when released. If an engine preheater circuit is provided, this function should occur before or on the starting position but may be activated by rotating the control counterclockwise.
5.1.1.4	**Start by manual means**		Can be pull, kick or crank. Requires manual and intentional actuation without using a removable part and with return to its original position.
5.1.2	**Speed**		
5.1.2.1	**Foot-operated**	Should be readily accessible to the operator’s right foot and to the right or below and backwards of the brake pedal	Pedal should be pushed forward and/or downward to increase engine speed.
5.1.2.2	**Hand-operated**	Should be easily accessible to the operator	
5.1.2.2.1	**Lever**		Direction of motion should be in a plane generally parallel to the longitudinal axis of the machine. The direction of motion should be away from the operator (generally forward), and/or upward to increase engine speed.
5.1.2.2.2	**Twist grip**	Should be easily accessible to the operator’s right hand	The speed should increase when the top of the grip is rotated towards the operator.
5.1.3	**Stopping**		
5.1.3.1	**Battery start**	Should be easily accessible from the operator’s position	Can be rotary, toggle or rocker type. If rotary type, should rotate counterclockwise to “off” position. If toggle type, should move rearward and/or down to “off” position. Control should automatically remain in the stop position without the application of sustained manual effort. If stop control is combined with the speed control, it should be in the direction of, and beyond, the idle position.
5.1.3.2	**Manual means**	Should be easily accessible from the operator’s position	This is a means that does not depend on sustained manual force. If stop control is combined with the speed control, it should be in the direction of, and beyond, the idle position.

Type		Location	Operation
5.2	**Electric motor**		
5.2.1	**Starting**		
	Motor on-switch		Can be rotary, toggle, or rocker type. If rotary type, should rotate clockwise to “on” position. If toggle type, should move forward and/or upward to “on” position.
5.2.2	**Speed**		
5.2.2.1	**Foot-operated**	Should be readily accessible to the operator’s right foot and to the right or below and backwards of the brake pedal	Pedal should be pushed forward and/or downward to increase engine speed.
5.2.2.2	**Hand-operated**	Should be easily accessible to the operator	
5.2.2.3	**Lever**		Direction of motion should be in a plane generally parallel to the longitudinal axis of the machine. The direction of motion should be generally forward or upward to increase engine speed.
5.2.2.4	**Twist grip**	Should be easily accessible to the operator’s right hand	The speed should increase when the top of the grip is rotated towards the operator.
5.2.3	**Stop**		
	Motor stop-switch		Can be rotary, toggle or rocker type. If rotary type, should rotate counterclockwise the “off” position. If toggle type, should move rearward and/or down to “off” position. Control should automatically remain in the stop position without the application of sustained manual effort. If stop control is combined with the speed control, it should be in the direction of, and beyond, the slow speed position.
5.3	**Steering**		
5.3.1	**Hand-operated**	Should be convenient to the operator	The steering mechanism should not lock while in operation.
5.3.1.1	**Wheel/ handlebar**	Should be forward of the operator and aligned approximately with the centreline of the operator seat	A clockwise rotation should effect a right turn, and a counter-clockwise rotation should effect a left turn.
5.3.1.2	**Two levers**	Should be forward or to the sides of the operator. If to the sides of the operator, one lever should be on the left and one lever should be on the right.	The machine should turn right when the left lever is displaced further in the direction of the machine travel than the right lever. The machine should turn left when the right lever is displaced further in the direction of machine travel than the left lever.

Type		Location	Operation
5.3.1.3	**Joy stick**	Should be forward or to the side of the operator	A lateral motion of the lever to the right should effect a right turn and a lateral motion to the left should effect a left turn.
5.3.2	**Foot-operated**	Should be convenient to the operator's feet	The steering mechanism should not lock while in operation.
	Foot-operated steering assist	Should be convenient to the operator's feet	The direction of motion of the pedals should be generally forward and/or downward. The right pedal should control the right wheel and the left pedal the left wheel. Pushing either pedal will turn the machine in that respective direction.
5.4	**Brakes**		
5.4.1	**Service**		
5.4.1.1	**Foot-operated**	Should be convenient to the operator's right foot	The direction of motion should be generally forward and/or downward for stopping. Where separate brake pedals are provided for the independent right and left brake control, the left pedal should control the left wheel and the right pedal the right wheel.
5.4.1.2	**Hand-operated handle-bar steering**	Should be mounted on the handle bars and convenient to the operator's right hand	Should be squeezed upwards and/or rearwards to apply brake.
5.4.1.3	**Combined lever steer and brake controls**		Braking should be accomplished by movement of the lever(s) in a direction opposite to that of machine travel.
5.4.1.4	**Combined service and steering brakes**	Should be convenient to the operator	The direction of motion of the pedals should be generally forward and/or downward for stopping. When used with a foot-operated speed control (5.1.2.1), the brakes should be convenient to the operator's left foot. The right pedal should control the right brake and the left pedal the left brake.
5.4.2	**Parking**		The control should not be prone to accidental release. The parking brake may be in combination with the service brake or direction (forward-reverse) control. Recommendations do not apply to a service brake latch mechanism.
5.4.2.1	**Hand-operated**	Should be convenient to the operator	Direction of motion should be rearward and/or upward to engage.
5.4.2.2	**Foot-operated**	Should be convenient to the operator	Brake pedal should be depressed downward and/or forward to engage.
5.5	**Traction drive**		
5.5.1	**Traction clutch**		
5.5.1.1	**Foot-operated — Normally engaged**	Should be convenient to the operator's left foot	Pedal should be pushed forward and/or downward for drive disengagement.

Type		Location	Operation
5.5.1.2	**Hand-operated (handlebar)**	Should be accessible to the operator when hands positioned on steering device	Should be squeezed generally rearward or toward the operator for disengagement.
5.5.1.3	**Foot-operated — Normally disengaged**	Should be convenient to the operator's right foot. The control should be outboard of the service brake pedal.	Drive engagement should be produced by a forward and/or downward motion.
5.5.2	**Foot-operated combination clutch and brake control**	Should be convenient to operator's foot	The direction of activation should be forward, or downward, or both, to cause traction disengagement and brake engagement.
5.5.3	**Variable speed**		Fore-aft or up/down movement is preferred. Other movements as described are accepted practice.
5.5.3.1	**Hand-operated**	Should be convenient to the operator	Forward, upward or left displacement should cause forward motion of the machine, while rearward, downward or right displacement should cause rearward motion of the machine.
5.5.3.2	**Foot-operated**		
5.5.4	**Direction**		Fore-aft or up/down movement is preferred. Other movements as described are accepted practice.
	Hand-operated	Should be convenient to the operator	Forward, upward or to-the-left displacement should cause forward motion of the machine. Where the selection control can pass directly from forward to reverse through the neutral position, the control should have a distinct change in the actuation force or a provision should be made for secondary motion when passing through neutral.
5.5.5	**Fixed drive ratio gear selection**		Fore-aft or up/down movement is preferred. Other movements as described are accepted practice.
5.5.5.1	**In-line operation/fore-aft or up/down (hand-operated)**	Should be convenient to the operator	Control should move from neutral progressively in an upward and/or forward direction to select gears giving increased forward speeds; from neutral progressively in a rearward and/or downward direction to select reverse gears giving increased reverse speeds. Where the selection control can pass directly from forward to reverse through the neutral position, the control should have a distinct change in the actuating force or a provision should be made for secondary motion when passing through neutral.
5.5.5.2	**In-line operation — Lateral (hand-operated)**	Should be convenient to the operator	Control should move from neutral progressively in a generally left-hand lateral direction giving increased forward speed; from neutral in a right hand direction to select reverse gear. Where selection control can pass from forward to reverse through the neutral position, the control should have a distinct change in the actuating force or provision should be made for secondary motion when passing through neutral.

Type		Location	Operation
5.5.5.3	**Non-in-line operation (hand-operated)**	Should be convenient to the operator	Shift pattern should be simple and clearly marked. The neutral position should be clearly identified and easy to select.
5.5.6	**Variable drive ratio (continuously variable speed and direction combined control)**		Where the controls can pass directly from forward to reverse through the neutral position, the control should have a distinct change in the actuating force or provision should be made for a secondary motion.
5.5.6.1	**Foot-operated**		
5.5.6.1.1	**One pedal (treadle)**	Should be convenient to the operator's right foot	The control should have the effect of a pedal being pivoted under the operator's foot and should remain at rest in the neutral position. Forward and/or downward motion of the front/top of the pedal should cause forward motion and increasing forward speed; downward motion of the rear/ bottom of the pedal should cause reverse motion and increasing reverse speed.
5.5.6.1.2	**Two pedals, side by side (both operated by one foot)**	Should be convenient to the operator's feet	NOTE Due to differences in various standards and machine designs in various countries, no recommendations are given as to which pedal (outer or inner) should cause rearward or forward motion. Forward and/or downward motion of either pedal should cause motion and increasing speed.
5.5.6.1.3	**Two pedals (each operated by a different foot)**	Should be convenient to the operator's feet	Forward and/or downward motion of the right pedal should cause forward motion and increasing forward speed. Forward and/or downward motion of the left pedal should cause rearward motion, and increasing rearward speed.
5.5.6.1.4	**Two pedals — fore and aft**	Should be convenient to the operator's right foot	Forward and/or downward motion of the aft pedal should cause rearward motion and forward and/or downward motion of the fore pedal should cause forward motion.
5.5.6.1.5	**Hand-operated (includes lever steer)**	Should be convenient to the operator	Control should move from neutral position forward and/or upwards for forward motion and increasing forward speed; rearwards and/or downwards for reverse motion and increasing reverse speed.
5.6	**Attachment/tool drive**		
5.6.1	**Clutch**		
5.6.1.1	**Foot-operated**	Should be convenient to the operator's left foot	Pedal should be pushed forward and/or downward for disengagement. In the case of a combined traction-drive/PTO clutch, the PTO disengagement should be the second stage.

Type		Location	Operation
5.6.1.2	**Hand-operated**	Should be convenient to the operator	
5.6.1.2.1	**Lever**	Should be convenient to the operator	Motion should be generally forward or upward for engagement and rearward or downward for disengagement.
5.6.1.2.2	**Knob — push/pull**	Should be convenient to the operator	Should be pull to engage and push to disengage.
5.6.1.2.3	**Rocker or toggle switch**	Should be convenient to the operator	
5.6.1.3	**Combined with other hand or foot controls**	Should be convenient to the operator	Should be consistent with the operation of the control with which the attachment drive control is combined. When combined with a lift control the attachment drive should disengage when the attachment is raised.
5.7	**Tool attachment controls activated from operator's position** [a]		
5.7.1	**Lift**		
5.7.1.1	**Foot-operated non-powered (foot and leg)**	Should be convenient to the operator	The direction of motion should be downward to lift and upward to lower.
5.7.1.2	**Foot-operated powered (heel and toe)**	Should be convenient to the operator	The direction of motion of the forward part of the control should be downward to lower and upward to raise.
5.7.1.3	**Foot-operated powered (two pedal)**	Should be convenient to the operator	Pushing the right pedal should lower the attachment. Pushing the left pedal should raise the attachment.
5.7.1.4	**Hand-operated powered or non-powered**	Should be convenient to the operator	The direction of motion should be generally forward of downward to lower, and rearward or upward to raise the attachment.

[a] Applies only to raising the complete attachment.

6 Control location and method of operation — Pedestrian controlled machines

Type		Location	Operation
6.1	**Engine**		
6.1.1	**Starting**		
6.1.1.1	**Ignition switch (if separate from starter switch)**		Can be rotary, toggle, or rocker type. If rotary type, should rotate clockwise to "on" position. If toggle type, should move forward and/or upward to "on" position. If rocker type, should push the upper portion or position farthest away from the operator to "on" position.

Type		Location	Operation
6.1.1.2	**Starter switch or starter means (if separate from ignition switch)**		Can be push or key type. If key type, should rotate clockwise to “start” position. All types should return to “off” position when released.
6.1.1.3	**Ignition/starter switch**		Switch should rotate in a clockwise direction to “start” position with return to “run” position when released. If an engine preheater circuit is provided, this function should occur before or on the starting position or may be activated by rotating the control counterclockwise.
6.1.1.4	**Start by manual means**		Can be pull, kick or crank. Requires manual and intentional actuation without using a removable part and with return to its original position.
6.1.2	**Speed**		Does not apply to engine-mounted controls.
6.1.2.1	**Hand-operated**		
6.1.2.1.1	**Lever**	Should be forward of the operator and easily accessible	Direction of motion is in a plane generally parallel to the longitudinal axis of the machine. The direction of motion should be generally forward and/or upward to increase engine speed.
6.1.2.1.2	**Twist grip**	Should be convenient to the operator’s right hand	The speed should increase when the top of the grip is rotated towards the operator.
6.1.3	**Stopping**		
6.1.3.1	**Battery start**	Should be easily accessible from the operator’s position	Can be rotary, toggle or rocker type. If rotary type, should rotate counterclockwise to “off” position. If toggle type, should move rearward and/or down to “off” position. Control should automatically remain in the stop position without the application of sustained manual effort. If stop control is combined with the speed control, it should be in the direction of, and beyond, the idle position.
6.1.3.2	**Manual means**	Should be easily accessible from the operator’s position.	This is a means that does not depend on sustained manual force. If stop control is combined with the speed control, it should be in the direction of, and beyond, the idle position.
6.2	**Electric motor**		
6.2.1	**Starting**	Control(s) should be forward and within reach of the operator in the operator’s position	
	Motor on-switch		If rotary type, should rotate clockwise to “on” position. If toggle type, should move forward and/or upward to “on” position.

Type		Location	Operation
6.2.2	**Speed**		
6.2.2.1	**Hand-operated**		Does not apply to controls outside the operator's position.
6.2.2.1.1	**Lever**	Should be forward of the operator and easily accessible	Direction of motion should be in a plane generally parallel to the longitudinal axis of the machine. The direction of motion should be generally forward or upward to increase motor speed.
6.2.2.1.2	**Twist grip**	Should be convenient to the operator's right hand	The speed should increase when the top of the grip is rotated towards the operator.
6.2.3	**Stop**	Should be convenient to the operator unless machine equipped with hold to run traction (if applicable) and tool drive controls	The motor kill, operator presence control should be released (held to run) or returned to "off" position. Control should automatically remain in the stop position without the application of sustained manual effort. If stop control is combined with the speed control, it should be in the direction of a beyond-the-slow-speed position.
6.3	**Steering**		
	Clutch or brake (hand-operated)	Should be convenient to the operator	The right control should effect a right-hand turn and the left control should effect a left-hand turn.
6.4	**Brakes**		
6.4.1	**Service**		
	Hand-operated	Should be convenient to the operator	Should be squeezed to apply brake.
6.4.2	**Parking**		
6.4.2.1	**Hand-operated**	Should be convenient to the operator	Direction of motion should be rearward or upward to engage.
6.4.2.2	**Foot-operated**		The control should be depressed downward or forward to engage.
6.5	**Traction drive**		
6.5.1	**Traction clutch**		
6.5.1.1	**Hand-operated**	Should be convenient to the operator	Should be squeezed upwards and/or rearwards to disengage clutch.
6.5.1.2	**Operator presence control (hold to run)**	Should be convenient to the operator	The control may move in any direction.
6.5.2	**Variable speed**		
	Hand-operated	Should be convenient to the operator	Motion forward or away from the operator should cause an increase in machine speed.

Type		Location	Operation
6.5.3	**Direction**		Fore-aft or up/down movement is preferred. Other movements as described are accepted practice.
	Hand-operated	Should be convenient to the operator	Forward or lateral motion should cause forward machine motion and rearward or opposite lateral motion should cause machine rearward motion.
6.5.4	**Fixed drive ratio gear selection**		
6.5.4.1	**In-line operation/fore-aft or up/down (hand-operated)**	Should be convenient to the operator	Control should move from neutral progressively in an upward and/or forward direction to select gears giving increased forward speeds; from neutral progressively in a rearward and/or downward direction to select reverse gears giving increased reverse speeds. Where selection control can pass from forward to reverse through the neutral position, the control should have a distinct change in the actuating force or a provision should be made for secondary motion when passing through neutral.
6.5.4.2	**In-line operation — Lateral (hand-operated)**	Should be convenient to the operator	Control should move from neutral progressively in a generally left-hand lateral direction giving increased forward speed; from neutral in a right hand direction to select reverse gear. Where selection control can pass from forward to reverse through the neutral position, the control should have a detectable change in the actuation force or a provision should be made for secondary motion when passing through neutral.
6.5.4.3	**Non-in-line operation (hand-operated)**	Should be convenient to the operator	Shift pattern should be simple and clearly marked. The neutral position should be clearly identified and easy to select.
6.5.5	**Variable drive ratio (continuously variable combined control)**		Where the controls can pass directly from forward to reverse through the neutral position, the control should have a detectable change in the actuation force or a provision should be made for a secondary motion when passing through neutral.
	Hand-operated (includes lever steer)	Should be convenient to the operator	Control should move from neutral position forward and/or upwards for forward motion and increasing forward speed; rearwards and/or downwards for reverse motion and increasing reverse speed.
6.6	**Attachment/tool drive**		
6.6.1	**Clutch**		
6.6.1.1	**Hand-operated**	Should be convenient to the operator	Control movement should be simple and clearly marked.
6.6.1.2	**Operator presence control (hold to run control)**	Should be convenient to the operator	The control may move in any direction.

7 Actuating force and displacement of controls

Type of control action	Actuating force/torque		Displacement	
	unit	max.	unit	max.
7.1 Finger-operated				
7.1.1 Linear motion				
a) Membrance switch	N	11	mm	1,6
b) Push button	N	13	mm	8
c) Slide/toggle/rocker	N	13	mm	32
d) Thumb wheel				
1) discrete	N·m	0,3	mm	20
2) continuous	N·m	0,3		
e) Trigger	N	12	mm	40
7.1.2 Rotary motion (circular)				
a) Selector	N·m	0,75	degree	40
b) Key switch	N·m	0,75	degree	120
c) Continuous adjusting knob	N·m	0,075 [a]		
7.2 Hand-operated				
7.2.1 Linear motion				
a) Push button	N	25	mm	40
b) Push pull				
1) knob	N	18	mm	75
2) handle	N	70 [b]	mm	150
c) Lever		[d]	degree	90
1) Longitudinal	N	450 [h]	mm	550
2) Transverse	N	100	mm	250
3) Vertical	N	175 [c]	mm	320

Type of control action	Actuating force/torque		Displacement	
	unit	max.	unit	max.
7.2.2 Rotary				
a) Crank (120 mm radius)	N	60	turns	
b) Handle twist grip	N·m	2,5	degree	80
c) Wheel (2 hands — 240 mm diameter)	N	135	turns	5
d) Steering	N·m	[e]		
7.3 Foot-operated				
7.3.1 Push button	N	90 [f]	mm	65
7.3.2 Pedal				
a) Ankle action				
1) toe-operated	N	90 [f g]	mm	80
2) heel and toe	N	90 [f g]	mm	80
b) Leg and foot actuated				
1) no back support	N	270 [f g]	mm	175
2) with back support	N	625 [f g h]	mm	175

[a] Dependent upon size.

[b] T loop handle > 70 N.

[c] Hold to run (engaged position): 15 N max.

[d] Gear shift lever: 9 N min, 45 N max.

[e] 350 mm to 400 mm diameter: 45; 450 mm to 500 mm diameter: 80.

[f] Foot may rest on control: 45 N min.

[g] Push to run: 67 N max.

[h] Maximum values may be high for some frequently used controls.

Bibliography

[1] ISO/TS 15077, *Tractors and self-propelled machinery for agricultural and forestry — Operator controls — Actuating forces, displacement, location, and method of operation*.

ICS 65.060.70

Price based on 14 pages