International Standard 6682

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Earth-moving machinery — Zones of comfort and reach for controls

Engins de terrassement — Zones de confort et d'accessibilité des commandes

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6682 was developed by Technical Committee ISO/TC 127, *Earth-moving machinery*, and was circulated to the member bodies in July 1979.

It has been approved by the member bodies of the following countries :

Australia	France	South Africa, Rep. of
Austria	Germany, F. R.	Spain
Belgium	Italy	United Kingdom
Brazil	Philippines	USA
Chile	Poland	USSR
Czechoslovakia	Portugal	
Finland	Romania	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Japan
Sweden

Earth-moving machinery — Zones of comfort and reach for controls

1 Scope

This International Standard defines zones of comfort and reach for controls derived for the overlapping reach capability of large and small operators in the seated position.

2 Field of application

This document is intended as a guide for the design of the operator compartment controls for earth-moving machinery.

3 References

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

ISO 5353, *Earth-moving machinery — Seat index point (SIP).*

4 Definitions

4.1 SIP : Seat Index Point as defined by ISO 5353 (fixed at nominal seat adjustments).

4.2 control displacement : The travel or movement of a control through its operational range.

4.3 control location : The positions of a control, including the corresponding control displacement, defined from the SIP.

4.4 primary controls : Controls that are used frequently or continuously by the operator, such as :

a) Machine controls : transmission, brakes, steering, engine speed, etc.

b) Working tool controls : blade controls, bucket controls, ripper controls, etc.

4.5 secondary controls : Controls that are infrequently used by the operator, such as lights, windshield wipers, starter, heater, air conditioner, etc.

4.6 zones of comfort : Preferred control location zones for primary hand and foot controls. Both large and small operators should be able to reach controls comfortably in these zones.

4.7 zones of reach : Control location zones for secondary hand and foot controls. Both large and small operators should be able to reach controls in these zones from the seated position, but the operator may be required to rotate or lean forward and to each side.

4.8 *XYZ* **coordinate system** : coordinate system used to define the control zone locations :

a) Origin at the SIP.

b) *X*-axis; fore-aft, positive to front of the SIP.

c) *Y*-axis; lateral, positive to right of the SIP.

d) *Z*-axis; vertical, positive upward from the SIP.

4.9 flexion : Movement that changes the angle between body parts.

4.10 adduction : Movement in a plane normal to the plane of flexion and directed towards or past the mid-axis (*XZ* plane) of the body.

4.11 abduction : Movement in a plane normal to the plane of flexion and directed away from the mid-axis (*XZ* plane) of the body.

4.12 circumduction : Movement about an axis that circumscribes a cone.

5 Control location zones

5.1 The control location zones are determined in relation to the SIP.

5.2 The zones of comfort and zones of reach for hand and foot controls are shown in figures 1, 2 and 3. These zones correspond to the human physical dimensions given in ISO 3411.

5.3 Control location zones are defined by the common reach zones for large and small operators. The specific conditions which are used to derive these control location zones are presented in annex A.

5.4 The zone of comfort for hand controls may be rotated up to 30° about a vertical axis through the SIP for locating rear equipment controls that are used whilst the operator is turned in the seat.

5.5 The zones of comfort and reach for hand controls may be increased by 75 mm for controls operated by finger grasp.

5.6 Annex B lists the *X*, *Y* and *Z* coordinates and radii of figures 1, 2 and 3 which should be used when developing larger scale drawings as drafting aids.

Annex A

Specific conditions used to derive control location zones

(Refer to figures 1, 2 and 3)

A.1 Control location zones

A.1.1 The seat back cushion has a 10° nominal rake angle and a width of 500 mm. The control location zones may be affected if the nominal seat back cushion rake angle exceeds ± 5° variation from 10° or if the seat back cushion width exceeds 550 mm.

A.1.2 Both large and small operators position the seat at the nominal vertical adjustment. Vertical seat adjustment (75 mm recommended) is used by individual operators to account for anthropometric variations : long legs but short arms, long trunk but short legs, etc.

A.1.3 The seat has a 150 mm fore-aft adjustment. The small operator adjusts the seat to the most forward position and the large operator adjusts the seat to the most rearward position.

A.1.4 Control location zones for machines that have between 100 mm and 150 mm fore-aft seat adjustment can be derived as follows

a) use hand control location zones defined in figures 1, 2 and 3;

b) modify foot control location zones defined in figures 1, 2 and 3 by narrowing the foot control location zones by 25 mm in both the fore and aft directions.

Table 1 — Summary — Body pivot dimensions (see figure 1)

Dimensions in millimetres

Abb.	Body coordinates	Large operator	Small operator
SH	Shoulder — hip	480	396
HK	Hip — knee	452	372
KA	Knee — ankle	445	367
AA′	Ankle — shoe sole	119	98
A′P	Ankle — pedal (when A_4 = 90°)	150	124
SE	Shoulder — elbow	300	247
EW	Elbow — wrist	267	220
EHg	Elbow — hand grasp	394	325
A′T	Ankle — toe (when A_4 = 90°)	243	200
—	Hip — hip (lateral)	185	152
—	Shoulder — shoulder (lateral)	376	310

Table 2 — Summary — Range of movement angles (see figure 1)

Dimensions in degrees

Ref.	Angle (right side joint)	Movement	Angle	
			Comfort	Maximum
A_1	Seat back angle	Flexion	10	5 to 15
	Trunk	Abduction	0	− 20
A_2	Hip	Flexion	75 to 100	60 to 110
		Adduction	10	10
		Abduction	− 22	− 30
A_3	Knee	Flexion	75 to 160	75 to 170
A_4	Ankle	Flexion	85 to 108	78 to 115
A_5	Shoulder	Flexion	− 35 to 85	− 50 to 180
		Adduction	20	20
		Abduction	− 70	− 120
		Clavicle circumduction	20	20
A_6	Elbow	Flexion	60 to 180	45 to 180

Annex B

Summary of coordinates for defining control location zones

(Refer to 5.5)

Coordinates to define the zone of comfort and zone of reach for control location are summarized in tables 3, 4, 5 and 6. Since the control location zones are symmetrical about the (X, Z) plane, only one half is defined. The other half can be defined by changing the sign of the Y coordinates. (See 4.8.)

The control location zones are defined by coordinates for the corners of planar surfaces, and by the centre of curvature coordinates and the radii of spherical and cylindrical surfaces. The zone of reach for hand controls is defined by planar and cylindrical boundaries that are tangential to the spherical surfaces defined in table 4.

Table 3 — Coordinates for zone of comfort — Hand control location zone

Centre of curvature[1)]	Coordinates (X, Y, Z)	Radius
S_L	(– 159, 188, 476)	$R_1 = 734$ $R_2 = 691$
Point[1)]	**Coordinates (X, Y, Z)**	
A_1	(132, 500, 425)	
A_2	(132, 500, – 100)	
B_1	(132, 400, 425)	
B_2	(132, 400, – 100)	
C_1	(230, 250, 425)	
C_2	(230, 250, – 100)	
D_1	(296, 250, 425)	
D_2	(296, 250, – 100)	
E_1	(530, 500, 425)	
E_2	(221, 500, – 100)	
F_1	(573, 400, 425)	
F_2	(296, 400, – 100)	

1) Refer to figures 4, 5 and 6.

Table 4 — Coordinates for zone of reach — Hand control location zone

Centre of curvature[1)]	Coordinates (X, Y, Z)	Radius
S_{S1}	(6, 283, 368)	$R_3 = 625$
S_{S2}	(245, 283, 368)	$R_3 = 625$
S_M	(– 160, 0, 400)	$R_4 = 450$
Point[1)]	**(X, Y, Z) coordinates**	
G	$X = -400$	

1) Refer to figures 4, 5 and 6.

Table 5 — Coordinates for zone of comfort — Foot control location zone

Centre of curvature[1)]	Coordinates (X, Y, Z)	Radius
K_{S1}	(446, – 75, – 32)	$R_5 = 500$
Point[1)]	**Coordinates (X, Y, Z)**	
H	(581, – 275, – 470)	
I	(820, – 275, – 150)	
J	(932, – 275, – 150)	
K	(687, – 275, – 470)	

1) Refer to figures 4, 5 and 6.

Table 6 — Coordinates for zone of reach — Foot control location zone

Centre of curvature[1)]	Coordinates (X, Y, Z)	Radius
K_{S2}	(441, – 75, – 65)	$R_6 = 500$
Point[1)]	**Coordinates (X, Y, Z)**	
L	(581, – 375, – 470)	
M	(796, – 375, – 75)	
N	(941, – 375, – 75)	
O	(734, – 375, – 470)	

1) Refer to figures 4, 5 and 6.