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AMENDMENT 1
2022-07

Ergonomics — Manual handling —

Part 2:
Pushing and pulling

AMENDMENT 1

Ergonomie — Manutention manuelle —

Partie 2: Actions de pousser et de tirer

AMENDEMENT 1

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This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

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Ergonomics — Manual handling —

Part 2: Pushing and pulling

AMENDMENT 1

3.2.1.1

Replace the last sentence with the following:

Smooth continuous force exertions should be applied to the object, avoiding jerky movements and long duration. Sustained forces should be avoided if possible, as they increase the risk of muscle or whole-body fatigue.

A.2.2

Replace list item d) with the following:

- d) worker population, i.e. if all male, use male limits; if all female or if the population is mixed, use female limits;

Table B.12

Replace the last row with the following:

1/360 min (0,000 046 Hz)	0,04
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Table B.13

Add the unit symbol kN under the header "Compressive force limits of lumbar spine".

Table B.14

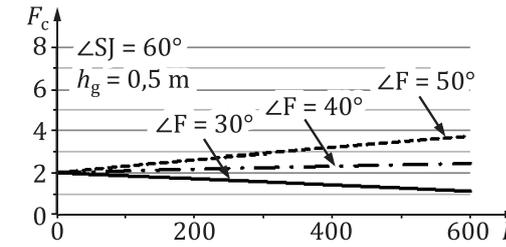
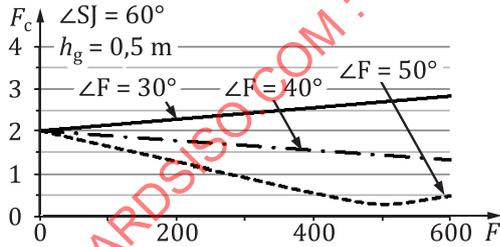
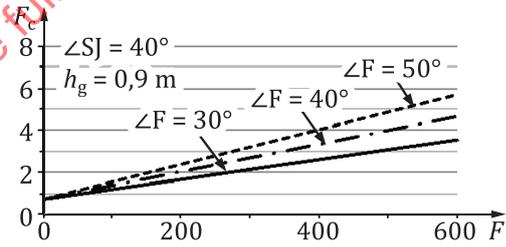
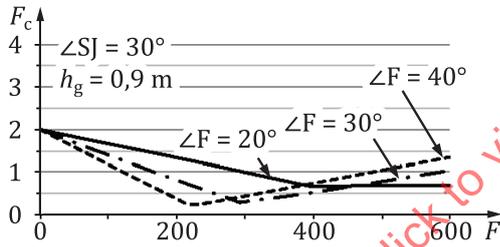
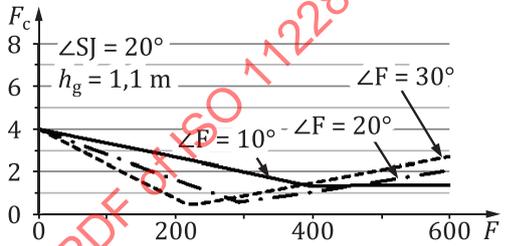
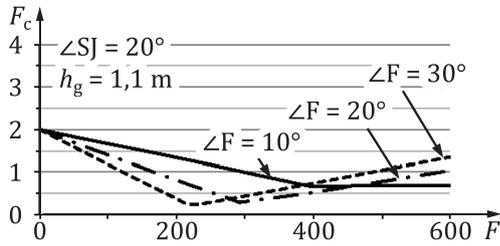
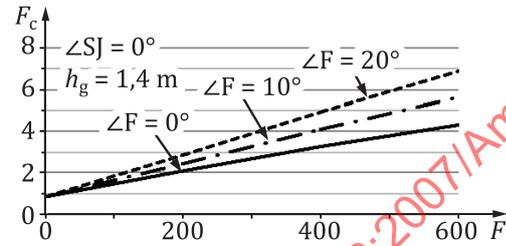
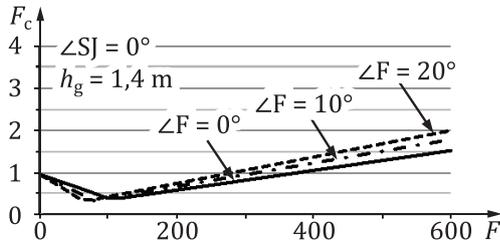
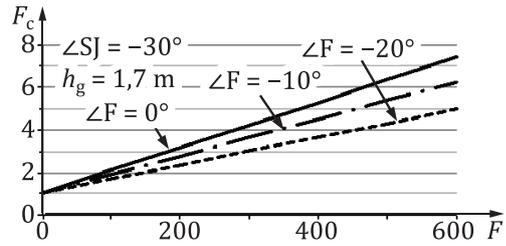
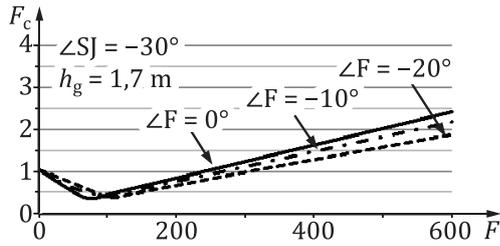
In the second row, replace the text in the first column with "Select or measure the absolute working height, i.e. grip height, h_g ."

In the formula in the sixth row, change F_{LS}^{15} to F_{LS}^5 .

In the footer, remove the entry " h_w " and change "compressive load" to "compressive force".

Figure B.4

Replace Figure B.4 with the following:



a) Pushing

b) Pulling

Add the following items to the key:

$\angle F$ force angle, degrees

$\angle SJ$ shoulder joint angle, degrees

h_g grip height, m

Annex C

Change the title to “General risk reduction systems”.

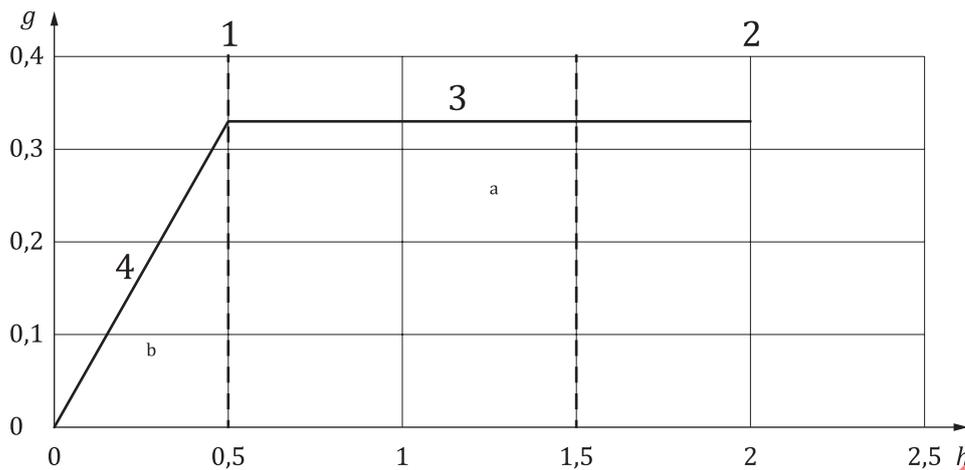
Annex D

Replace list items f) and g) with the following:

- f) The initial force is measured in two conditions: one with any swivel casters aligned perpendicular to the direction of travel and one with any swivel casters aligned parallel to the direction of travel. To conduct a test, align the casters in the appropriate position. If a hand-held force-measuring device is used, place the device firmly in contact with the handle or push plate of the cart. Starting with the cart at rest, move it in a straight line through a distance of 0,5 m in 3 s using a smooth, consistent application of force. It can be useful to mark the travel distance on the floor. These conditions equate to a uniform acceleration of $0,11 \text{ m/s}^2$ and a final velocity of $0,33 \text{ m/s}$. Record the peak force. Repeat the measurement process for each condition until three measurements that do not differ from their average value by more than $\pm 15 \%$ are achieved. This is approximately equivalent to force values that are within 0,4 standard deviation of their average value. Use the highest measured peak force of these consistent measurements to characterize the initial force.
- g) The sustained force is measured with any swivel casters aligned parallel to the direction of travel and while the cart has a constant velocity of $0,33 \text{ m/s}$. This is equivalent to moving the cart through a straight-line distance of 1 m in 3 s. Once the cart is moving at a constant velocity of $0,33 \text{ m/s}$, continue to push it through a distance of at least one 1 m. It can be useful to mark the travel distance on the floor. Record the force required to maintain movement of the cart. Repeat the measurement process until at least three consistent measurements of the force that are within $\pm 15 \%$ of their average value are achieved. This is approximately equivalent to force values that are within 0,4 standard deviation of their average value. Report the average of these consistent force measurements to characterize the sustained force.

Annex D

Insert a new Figure D.1 as follows:



Key

1 $t = 3 \text{ s}$

2 $t = 6 \text{ s}$

3 $\bar{v} = 0,33 \text{ m/s}$

4 $\bar{a} = 0,11 \text{ m/s}^2$

g velocity in m/s

h distance in m

^a Measure average sustained force.

^b Measure peak initial force.

Figure D.1 — Illustration of a measurement of initial and sustained cart movement forces

Bibliography

Add a new reference as follows:

[24] JÄGER, M. Extended compilation of autopsy material measurements on lumbar ultimate compressive strength for deriving reference values in ergonomic work design: The Revised Dortmund Recommendations. *EXCLI J.* 2018, 17, 362–385.