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Ergonomics — Evaluation of static working postures

Ergonomie — Évaluation des postures de travail statiques

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Foreword

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

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

International Standard ISO 11226 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

Annexes A and B of this International Standard are for information only.

Introduction

Pain, fatigue and disorders of the musculoskeletal system may result from sustained inadequate working postures that may be caused by poor work situations. Musculoskeletal pain and fatigue may themselves influence posture control which can increase the risk of errors and may result in reduced quality of work or production, and in hazardous situations. Good ergonomic design is a basic requirement to avoid these adverse effects.

This International Standard contains an approach to determine the acceptability of static working postures. The content of the standard is based on current ergonomic knowledge, and is subject to changes according to future research.

It is connected with ISO 11228-1, ISO 11228-2 and ISO 11228-3 (see [1], [2] and [3] in the Bibliography).

Ergonomics — Evaluation of static working postures

1 Scope

This International Standard establishes ergonomic recommendations for different work tasks. This standard provides information to those involved in design, or redesign, of work, jobs and products who are familiar with the basic concepts of ergonomics in general, and working postures in particular.

It specifies recommended limits for static working postures without any or only with minimal external force exertion, while taking into account body angles and time aspects.

It is designed to provide guidance on the assessment of several task variables, allowing the health risks for the working population to be evaluated.

It applies to the adult working population. The recommendations will give reasonable protection for nearly all healthy adults. The recommendations concerning health risks and protection are mainly based on experimental studies regarding the musculoskeletal load, discomfort/pain, and endurance/fatigue related to static working postures.

2 Terms and definitions

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

2.1
extreme body-joint position
towards the end of the range of motion, where there is a substantial mechanical load on the passive structures such as ligaments

2.2
Frankfurt plane
standard horizontal plane at the level of the upper edge of the opening of the external auditory meatus (external ear opening) and the lower border of the orbital margin (lower edge of the eye socket); the median plane of the head is held vertically

NOTE The Frankfurt plane is associated with the normal line of sight (relaxed extraocular muscles).

2.3
full arm support
support of the upper arm segment weight by the workplace (e.g. by the elbow/forearm on a table desk)

2.4
full head support
support of the head segment weight by the workplace (e.g. by a headrest)

2.5
full trunk support
support of the trunk segment weight directly by the workplace (e.g. by a high chair backrest in the case of trunk inclination backwards) or indirectly (e.g. through arm support at the workplace in the case of trunk inclination forwards)

2.6
holding time
duration that a static working posture is maintained

2.7
maximum holding time
maximum duration that a static working posture can be maintained continuously from a rested state (maximum remaining endurance capacity)

2.8
neutral posture for the trunk, upper arms, and head
upright trunk, upper arms hanging freely, and head posture according to the Frankfurt plane

2.9
recovery time
time available for recovering, i.e. the duration that a body segment is either fully supported or maintained in a neutral posture

2.10
reference posture
sitting or standing posture with a non-rotated upright trunk and the arms hanging freely, while looking straight forward along the horizontal

2.11
remaining endurance capacity
percentage of the maximum holding time that a static working posture can still be maintained continuously

2.12
static working posture
working posture maintained longer than 4 s; this applies to slight or non-existant variations around a fixed force level delivered by muscles and other body structures

2.13
working posture
position of body segments and joints while executing a work task

3 Recommendations

3.1 Introduction

Work tasks and operations should provide sufficient physical and mental *VARIATION*. This means a complete job, with sufficient *VARIATION* of tasks (for instance, an adequate number of organizing tasks, an appropriate mix of short, medium and long task cycles, and a balanced distribution of easy and difficult tasks), sufficient autonomy, opportunities for contact, information and learning. Furthermore, the full range of workers possibly involved with the tasks and operations should be considered, in particular their body dimensions.

With respect to working postures, the work should offer sufficient variation between and within sitting, standing and walking. Awkward postures, such as kneeling and crouching, should be avoided, whenever possible.

It is stressed that measures meant to induce variations of posture should not lead to monotonous repetitive work (for more information, refer to [4] in the Bibliography).

3.2 Evaluation procedure

The approach described below can be used to determine the acceptability of static working postures. The evaluation procedure considers various body segments and joints independently in one or two steps. The first step considers only the body angles (recommendations are mainly based upon risks for overloading passive body structures, such as ligaments, cartilage and intervertebral disks). An evaluation may lead to the result “acceptable”, “go to step 2” or “not recommended”.

An “acceptable” evaluation result means that a working posture is acceptable only if *VARIATIONS* of posture are also present (see 3.1). In any eventuality, every effort should be made to obtain a working posture closer to the neutral posture, if this is not already the case.

NOTE 1 The concept “reference posture” is used for determination of working postures (see 3.3).

An evaluation result “go to step 2” means that the duration of the working posture will also need to be considered (recommendations are based upon endurance data).

Extreme positions of joints should be evaluated as “not recommended”.

NOTE 2 Only those extreme joint positions that are most commonly found in practice are mentioned.

3.3 Determination of working postures

There are various ways to determine working postures, e.g. observation, photography/video, 3-dimensional opto-electronic or ultrasound measuring systems, body-mounted measuring devices such as inclinometers and goniometers. The appropriate method depends, amongst other things, on the accuracy of determination required by the evaluation. In most cases, direct observation (without measuring systems/devices) will do. However, for more precise determination of working postures, measuring systems/devices may be necessary (for an overview and detailed descriptions, see [5] in the Bibliography). Informative annex A describes the procedure for determining particular posture parameters appearing in 3.4 to 3.7, i.e. trunk inclination, head inclination, neck flexion/extension, upper arm elevation, and extreme joint positions.

3.4 Trunk posture

3.4.1 Step 1

Trunk posture should be evaluated by considering items 1, 2 and 3 in Table 1. Item 3 refers only to sitting.

3.4.2 Step 2

The holding time for trunk inclination is evaluated using Table 2.

It is recommended to provide adequate recovery time following the holding time for a certain trunk inclination. Informative annex B provides recommendations for evaluating holding time/recovery time regimes based on endurance data.

3.5 Head posture

3.5.1 Step 1

Head posture should be evaluated by considering head inclination (item 2 in Table 3), as well as head posture with respect to trunk posture (items 1 and 3 in Table 3).

3.5.2 Step 2

The holding time for head inclination is evaluated using Table 4.

It is recommended to provide adequate recovery time following the holding time for a certain head inclination. Informative annex B provides recommendations for evaluating holding time/recovery time regimes based on endurance data.

Table 1 — Trunk posture

Postural characteristic	Acceptable	Go to step 2	Not recommended
1) Symmetrical trunk posture [a]			
No			X
Yes	X		
2) Trunk inclination α [b]			
$> 60^\circ$			X
20° to 60° without full trunk support		X	
20° to 60° with full trunk support	X		
0° to 20°	X		
$< 0^\circ$ without full trunk support			X
$< 0^\circ$ with full trunk support	X		
3) For sitting: convex lumbar spine posture [c]			
No	X		
Yes			X

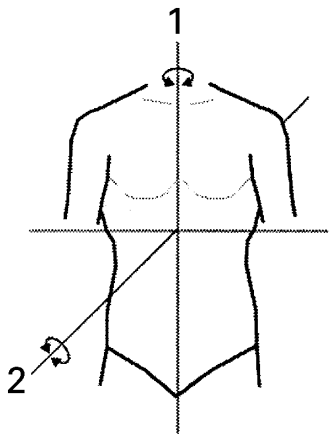
[a] With a symmetrical trunk posture, there is neither axial rotation nor lateral flexion of the upper part of the trunk (thorax) with respect to the lower part of the trunk (pelvis) (see Figure 1).

[b] Posture during task execution (dark body segment, solid line) with respect to the reference posture (white body segment, broken line) when viewed from the side of the trunk (for α see Figure 2, where forward inclination is given a positive sign). Annex A describes the procedure for determining trunk inclination.

[c] Convex curvature of the lumbar part of the spine (see Figure 3). This posture is more likely to occur

— when the lumbar spine is not supported by a backrest, and

— when a small hip angle is adopted (see 3.7).



Key

1 Axial rotation

2 Lateral flexion

Figure 1 — Trunk posture (axial rotation/lateral flexion of thorax vs. pelvis)

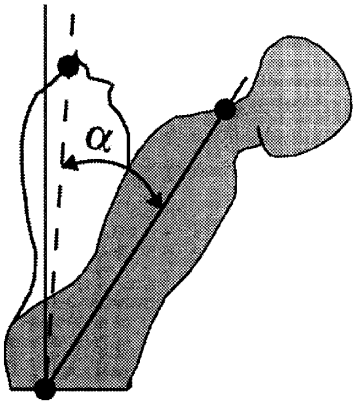


Figure 2 — Trunk inclination

Key

1 Convex lumbar spine posture

Figure 3 — Convex lumbar spine posture