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## Ergonomics guidelines for the optimization of musculoskeletal workload

*Lignes directrices ergonomiques pour l'amélioration des charges de  
travail musculo-squelettiques*

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## 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. [www.iso.org/directives](http://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. [www.iso.org/patents](http://www.iso.org/patents)

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

ISO/TS 20646:2014 replaces ISO/TS 20646-1:2004, of which it constitutes a technical revision. [www.iso.org/standard/6debff8b37de/iso-ts-20646-2014](http://www.iso.org/standard/6debff8b37de/iso-ts-20646-2014)

This corrected version of ISO/TS 20646:2014 incorporates the following corrections: the title has been changed from *Ergonomic procedures for the improvement of local muscular workloads* to *Ergonomics guidelines for the optimization of musculoskeletal workload*.

## Introduction

The onset of work-related musculoskeletal disorders, such as low back pain and upper and lower limb disorders, is becoming a great ergonomic concern in both industrialised and industrialising countries. The high incidence of work-related musculoskeletal disorders is an important problem to be solved not only to improve workers' health and the quality of working life, but also to improve productivity.

In order to solve the problem of work-related musculoskeletal disorders, it is important to work out primary preventive measures, through improving working conditions and providing adequate health guidance and training, as well as to establish measures for secondary prevention, treatment, and reassignment of the workers after a long sick leave.

Above all, the establishment of primary preventive measures, mainly measures to improve musculoskeletal workloads (MSWL), are considered to be the most cost-effective solution and improve the quality of working life. Various activities to improve MSWL have already been promoted. In addition, regarding ISO/TC 159/SC 3, new standards are developed to improve working conditions relating to the factors causing MSWL. However, in order to improve MSWL, it is indispensable to take a comprehensive work-related perspective and find a solution, in consideration of the aforementioned factors.

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# Ergonomics guidelines for the optimization of musculoskeletal workload

## 1 Scope

This Technical Specification provides information and guidelines to properly utilize various ergonomics standards concerning the factors related to musculoskeletal workload (MSWL), and helps develop activities to reduce or optimize MSWL in workplaces and non-professional activities, in an effective and efficient manner. The activities are intended to be based on a risk assessment. This Technical Specification is intended primarily for employers, ergonomics and occupational health-related staff and workers in enterprises, and workers. Prevention of MSWL is not always a matter of reducing the load. The approach to reducing MSWL also involves assessing the work environment and organization as a system to identify how changes can help to safely manage MSWL. Although this Technical Specification provides ideas of effective and efficient measures to reduce or optimize MSWL, it does not certify the complete prevention of health problems caused by MSWL.

## 2 Terms and definitions

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

### 2.1

#### **musculoskeletal workload** (standards.iteh.ai)

#### **MSWL**

loads on the musculoskeletal system required for working motions, maintaining working postures, and exerting forces

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### 2.2

#### **harm**

physical injury or damage to health

[SOURCE: ISO 12100]

### 2.3

#### **hazard**

potential source of harm

[SOURCE: ISO 12100]

### 2.4

#### **risk**

combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: ISO 12100]

### 2.5

#### **risk assessment**

overall process comprising a risk analysis and risk evaluation

[SOURCE: ISO 12100]

### 2.6

#### **risk analysis**

combination of the specification of work description, hazard identification, and risk estimation

2.7

**risk estimation**

defining likely severity of harm and probability of its occurrence

[SOURCE: ISO 12100]

2.8

**risk evaluation**

judgment on the basis of successive risk analysis of whether the risk reduction objectives have been achieved

[SOURCE: ISO 12100]

2.9

**work space**

volume of space allocated to one or more persons in the work system to complete a work task

[SOURCE: ISO 9241-5]

2.10

**workstation**

combination of work equipment for a particular person in a work space

Note 1 to entry: It is possible that several persons share a particular workstation, or that several persons alternate between several workstations within any period of time (i.e. hourly, daily, weekly basis).

[SOURCE: ISO 11064-2]

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**3 General guiding principles**

**3.1 Basic principles to improve MSWL**

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Management should clarify in writing existing and predicted MSWL and possible health- and productivity-related problems, and publish improvement goals and targets, a basic schedule to achieve the targets, and the organization to implement the improvement (see [Annex A](#)).

**3.2 Basic framework and responsibilities of MSWL-improvement activities**

**3.2.1 General**

As organizations draft, implement, and assess MSWL-reduction plans, organizations at the enterprise level and department level, and advisory organizations, should develop activities in a collaborative manner. The participation of workers and/or their representatives is essential.

**3.2.2 Enterprise level**

A structure to manage MSWL should be established at the enterprise level, either as part of existing management systems for work design or occupational safety and health, or as a specifically designated project activity. The owner or executive director with overall management authority should be responsible for the establishment and the conduct of this organization.

**3.2.3 Department level**

This refers to an organization within an individual department, for which the departmental manager should be responsible. Its function is to draft, implement, and assess the improvement plans for the department.



### 3.2.4 Advisory level

This refers to an organization offering advice concerning the validity of drafting, implementation, and assessment of improvement plans. The organization can be established inside or outside the enterprise.

## 3.3 Processes for MSWL risk assessment including implementation of risk reduction activity

### 3.3.1 General

An MSWL risk reduction plan should not be limited to a few specific factors causing loads. It should be based on MSWL risk assessment in the workplace. On the basis of comprehensive risk assessment using this multi-factorial analysis, specific action targets should be set to eliminate or reduce unacceptable risks. Basic processes in achieving this target(s) are given in 3.3.1 to 3.3.4 (see ISO 12100).

### 3.3.2 Risk assessment

#### 3.3.2.1 General

To study necessary activities to reduce the risks of MSWL, risk assessment should be implemented. This includes a risk analysis with work description, hazard identification, and risk estimation as well as a risk evaluation. Priority risks should be addressed immediately, so as to reduce risks or reinforce the ongoing measures.

#### 3.3.2.2 Specification of work situation

To study the characteristics of work, the following items should be described:

- a) production process, contents of work, and tasks to be performed at the workplace;
- b) statistics on occupational accidents, incidence of work-related diseases and other diseases, sick leave, etc.;
- c) work organization and shift systems;
- d) work hours per day, week, month, or year;
- e) operating time per day, continuous operating time, and a rest system;
- f) characteristics of the workers, such as body size, muscle strength, history of injuries and diseases affecting work, work experience, vocational education and training, and age;
- g) characteristics of the work, such as static workload, physical inactivity, repetitive work, and manual handling.

#### 3.3.2.3 Hazard identification

The following factors are the main hazards for MSWL (see [Annex B](#)). They are divided into six sections.

##### 3.3.2.3.1 Checklist section 1 — Work hours and work concentrations

- a) long working shifts more than 8 h a day
- b) frequent and long overtime work
- c) long continuous operating time
- d) insufficient rest breaks
- e) insufficient days off

- f) uneven work concentrations in a day, week, month, or year
- g) uneven work concentrations between the workers
- h) insufficient rest between shifts (less than 11 h)

**3.3.2.3.2 Checklist section 2 — Type of work**

- a) lifting and carrying heavy objects (see ISO 11228-1)
- b) work requiring great force
- c) high pushing and pulling forces (see ISO 11228-2)
- d) high repetitive work (see ISO 11228-3)
- e) work requiring frequent finger, hand, or arm motions (see ISO 11228-3)
- f) using hand-arm vibrating tools during the work
- g) work using vehicles transmitting whole-body vibration
- h) intensive work with a keyboard or other data entry devices
- i) precision work
- j) high visual requirements

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**3.3.2.3.3 Checklist section 3 — Postures and motions**

- a) awkward postures and motions (see ISO 11226)
- b) continuous and/or highly frequent change in joint positions (see ISO 11228-3)
- c) long-duration constrained posture (see ISO 11226)
- d) long-duration and/or long-distance walking (horizontal as well as on an inclined surface)
- e) frequent stair climbing
- f) prolonged sedentary/standing work

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**3.3.2.3.4 Checklist section 4 — Influencing work space and task factors**

- a) inadequate work space forcing an awkward posture or limited movement
- NOTE For consistency references, see ISO 11226.
- b) layout of the workstation forcing excessive movement or awkward postures
  - c) inadequate height and dimensions of the work surface
  - d) handling work objects above the shoulder or below the knee
  - e) work space forcing the worker to maintain the same working posture
  - f) work objects which are heavy and/or require high physical force
  - g) work objects which are difficult to hold or slippery
  - h) cold/hot work environment and/or objects handled
  - i) high contact stress or local pressure acting on the body

**3.3.2.3.5 Checklist section 5 — Influencing psychosocial factors**

- a) mental overload or underload
- b) time pressure and high demands
- c) work-related stress
- d) low job satisfaction
- e) lack of autonomy (low influence, low control)
- f) social support

**3.3.2.3.6 Checklist section 6 — Influencing environmental factors**

- a) slippery and/or uneven floor surface
- b) whole-body vibration (see ISO 2631)/hand-arm vibration (see ISO 5349)
- c) hot and cold work environment
- d) poor visual conditions (e.g. insufficient lighting)

**3.3.3 Risk estimation**

Risk estimation should take into account the severity of the hazard(s) and probability of its occurrence and the number of workers who will be affected.

**3.3.4 Risk reduction measures****3.3.4.1 Specifying risk reduction measures followed by a small trial of the improvement**

To study the importance of risk factors and evaluate possible preventive measures for risk reduction, the following factors should be considered:

- results of the risk analysis;
- ease of implementation of the risk reduction plan;
- effect of the improvement after reducing the risk;
- number of workers who will benefit;
- cost-efficiency of the plan.

Use of an action-oriented checklist is recommended to perform risk analysis, and to get hints for improvement (see [Annex C](#)). The recommended procedure for using the checklist is as follows.

- a) Organize a group to implement a checklist practice. In the group, the owner or executive director with management authority, managers and workers of concerned sections, and occupational health and safety personnel should be involved.
- b) Define the workplace to be checked.
- c) Fill out the checklist individually.
- d) Organize small group discussions on the risk factors found at the workplace and the factors with priority of improvement.
- e) Make an action plan to reduce risks for MSWL at the workplace.