International ergonomics standards (ISO and CEN) and relevant methods for risk assessment and management in WMSDs area

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Chair IEA TC on Musculoskeletal Disorders

Work and health in the EU
A statistical portrait

WMSDs are caused mainly by manual handling, heavy physical work, awkward and static postures, repetition of movements and vibration. The risk of MSDs can increase with the pace of work, low job satisfaction, high job demands and job stress.


PREVALENCE OF WORK RELATED HEALTH PROBLEMS
27 EU COUNTRIES

Table 1. Percentage of workers reporting each individual symptom, EU27 (%)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>EU27 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>24.7</td>
</tr>
<tr>
<td>Muscular pain</td>
<td>33.2</td>
</tr>
<tr>
<td>Fatigue</td>
<td>22.0</td>
</tr>
<tr>
<td>Backache</td>
<td></td>
</tr>
<tr>
<td>Irritability</td>
<td>10.5</td>
</tr>
<tr>
<td>Injuries</td>
<td>9.7</td>
</tr>
<tr>
<td>Sleep problems</td>
<td>8.7</td>
</tr>
<tr>
<td>Anxiety</td>
<td>7.8</td>
</tr>
<tr>
<td>Eye/ear problems</td>
<td>7.8</td>
</tr>
<tr>
<td>Hearing problems</td>
<td>7.2</td>
</tr>
<tr>
<td>Skin problems</td>
<td>6.6</td>
</tr>
<tr>
<td>Stomach ache</td>
<td>5.8</td>
</tr>
<tr>
<td>Breathing difficulties</td>
<td>4.8</td>
</tr>
<tr>
<td>Allergies</td>
<td>4.0</td>
</tr>
<tr>
<td>Heart disease</td>
<td>2.4</td>
</tr>
<tr>
<td>Other</td>
<td>1.6</td>
</tr>
</tbody>
</table>

PHYSICAL RISKS

THE SURVEY REVEALS THAT CERTAIN PHYSICAL RISKS STILL PERSIST. THE PROPORTION OF WORKERS REPORTING REPETITIVE HAND OR ARM MOVEMENTS HAS INCREASED (BY 4%), WITH 62% OF THE WORKING POPULATION REPORTING EXPOSURE FOR 25% OR MORE OF THE TIME; 37% OF WORKERS HANDLES HEAVY LOADS FOR ALMOST 25% OF WORKING TIME;

50% OF WORKERS REPORT WORKING IN PAINFUL OR TIRING POSITIONS AT LEAST 25% OF THE TIME.

Source: Fourth European Working Conditions Survey - European Foundation for the Improvement of Living and Working Conditions
4° SURVEY- 2005. PRELIMINARY RESULTS
EXPOSURE TO PHYSICAL RISK CONSIDERING
GENDER

WORK RELATED
MUSCULOSKELTAL DISORDERS
WMDSs
REPRESENT MORE THAN 50%
OF ALL OCCUPATIONAL
DISEASES IN EUROPE

Biomechanical overload as a risk factor
for occupational diseases in Europe

The most common
musculoskeletal occupational
diseases are:
tenosynovitis of the hand or wrist
epicondylitis of the elbow
and carpal tunnel syndrome.
Main occupational diseases in Spain - 2007

<table>
<thead>
<tr>
<th>Disease</th>
<th>Percentage (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Limb Disorders</td>
<td>15%</td>
</tr>
<tr>
<td>Lower Limb Disorders</td>
<td>10%</td>
</tr>
<tr>
<td>Lower Back Disorders</td>
<td>10%</td>
</tr>
<tr>
<td>Spinal Disorders</td>
<td>10%</td>
</tr>
<tr>
<td>Total WMSDs</td>
<td>50%</td>
</tr>
</tbody>
</table>

WMSDs represent 85% of all compensated occupational diseases in Spain (2006).

WMSDs are the biggest cause of absence from work in practically all Member States. In some states, WMSDs account for 40% of the costs of workers’ compensation, and cause a reduction of up to 1.6% in the gross domestic product (GDP) of the country itself. MSDs reduce companies’ profitability and add to the social costs of governments.

It has been estimated that the direct cost for a company of a WMSDs (as occupational disease) is about 40000 Euros.

PREVENTION OF WMSDs: AN EUROPEAN PRIORITY

The challenge of work-related health problems, including musculoskeletal disorders, has been recognized and addressed at the European level by the adoption of a number of EU directives, technical rules, strategies and policies.

Creating more and better quality jobs is an important EU objective and was reinforced at the Lisbon Council in 2000.

Successful prevention of WMSDs would greatly contribute to achieving this objective.

Many problems can be prevented or greatly reduced through employers complying with existing safety and health law, technical standards and following good practice.

ERGONOMICS

Definitions by IEA (International Ergonomics Association)

The Discipline of Ergonomics

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

Physical ergonomics

is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity.

Ergonomically designed work systems enhance safety, improve human working and living conditions and counteract adverse effects on human health.

Also they usually improve the operator-machine system performance and reliability.

Applying ergonomics to the design of work systems, ensures that human capabilities, skills, limitations and needs, as well as technological and economic effectiveness and efficiency are taken into account.
Framework Directive for health and safety at work

Requires, among others, employers to undertake a “risk assessment”.

Specifically the directive states that “the employers shall... evaluate (ALL) the risks to the safety and health of workers....

Subsequent to this evaluation and as necessary, the preventive measures and the working and production methods implemented by the employer must assure an improvement in the level of protection.

COMMISSION ASKS WORKERS AND EMPLOYERS WHAT ACTION SHOULD BE TAKEN TO COMBAT MUSCULOSKELETAL DISORDERS

The European Commission is seeking the views of workers' and employers' representatives on how best to tackle the growing problem of musculoskeletal disorders (MSD). These ailments, which include back pain and repetitive strain injury, are the biggest health and safety problem facing European workers today. Studies show that they affect over 40 million workers in all sectors across the EU and account for 40 to 50 per cent of all work-related ill-health. They are costing employers across the EU billions of euros. The problem is eroding Europe's competitiveness and leading to losses of 0.5 to 2 per cent of GNP each year.

The Commission is considering proposing a new legislative initiative addressing all significant risk factors of work-related musculoskeletal disorders.

This new legislative instrument would take the form of an individual directive.

The envisaged directive would cover all major work-related musculoskeletal disorders.

The envisaged directive would also incorporate the provisions of both Directive 90/269/EEC and Directive 90/270/EEC.

The envisaged directive would be supplemented by other non-regulatory initiatives.

SECOND STAGE OF CONSULTATION OF THE SOCIAL PARTNERS ON WORK-RELATED MUSCULOSKELETAL DISORDERS (14 MARCH 2007)

The Commission is considering proposing a new legislative initiative addressing all significant risk factors of work-related musculoskeletal disorders.

This new legislative instrument would take the form of an individual directive.

The envisaged directive would cover all major work-related musculoskeletal disorders.

The envisaged directive would also incorporate the provisions of both Directive 90/269/EEC and Directive 90/270/EEC.

The envisaged directive would be supplemented by other non-regulatory initiatives.

A new EU directive regarding all WMSDs : state of affairs

The initiative is actually slowed.

The Unions want a general directive on MSDs that would give weight to the impact of work organisation and psychosocial factors.

The European employers’ organisation, BusinessEurope, is against it and ask for a sectorial approach and the development of non-binding schemes like awareness-building and exchanges of “good practice”.

The Commission would like to favour an overall approach that combines regulatory and non-regulatory measures.

International technical standards for WMSDs prevention

Actual ergonomics standards (in physical ergonomics area) could be useful to enforce principles, requirements and criteria given by primary European social legislation.

This could happen both in relation to:

• general principles in the framework directive 89/331/EEC (i.e with reference to manual repetitive job)
• existing particular directives (i.e 90/269/EEC on manual handling of loads)

International technical standards for WMSDs prevention
EUROPEAN STANDARDS RELATED TO THE MACHINERY DIRECTIVE USEFUL FOR DESIGNING TASKS AND WORKPLACES AND FOR PREVENTING WMSDs

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>NUMBER</th>
<th>PHYSICAL PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction</td>
<td>EN 614-2</td>
<td>General requirements</td>
</tr>
<tr>
<td>Between</td>
<td></td>
<td>Anthropometric requirements</td>
</tr>
<tr>
<td>Task and</td>
<td>EN ISO 14738</td>
<td>Anthropometric requirements</td>
</tr>
<tr>
<td>Workstation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load Handling</td>
<td>EN 1005-2</td>
<td>Manual handling of loads</td>
</tr>
<tr>
<td>Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended</td>
<td>EN 1005-3</td>
<td>Force limits</td>
</tr>
<tr>
<td>Force limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>EN 1005-4</td>
<td>Features and movements</td>
</tr>
<tr>
<td>Working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postures</td>
<td>EN 1005-5</td>
<td>Action frequency</td>
</tr>
<tr>
<td>Repetitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handling at</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Frequency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Those standards specify ergonomics requirements when designing a new machinery and related tasks/workplaces. They are generally compulsory for the purposes of Machinery Directive.

ISO STANDARD USEFUL FOR ASSESSING AND RE-DESIGNING EXISTING TASKS AND WORKPLACES AND FOR PREVENTING WMSDs

ISO 11226

ISO 11228
“Ergonomics - Manual handling”

DETAILS ON STANDARDS

• Shortly on CEN standards (more useful at a design stage)
• Something more on ISO standard and their perspectives (more useful for assessing and re-designing actual tasks and workplaces)

DESIGNING TASKS AND WORKPLACES:
EUROPEAN STANDARDS RELATED TO THE MACHINERY DIRECTIVE

EN 614-2
ERGONOMIC DESIGN PRINCIPLES: INTERACTIONS BETWEEN THE DESIGN OF MACHINERY AND WORK TASKS

This European Standard helps the designer in applying ergonomics principles to the design of machinery, focusing especially on the interaction between the design of machinery and work tasks.

The designer shall ensure that ergonomics characteristics of well-designed work tasks are fulfilled.

These characteristics shall be pursued by designing machinery and work tasks in interaction.
EN ISO 14738

ANTHROPOMETRIC REQUIREMENTS FOR THE DESIGN OF WORKSTATIONS AT MACHINERY

This standard specifies procedures and principles for deriving dimensions from anthropometric measurements and applying them to the design of workstations at machinery (especially in industrial settings), also considering task characteristics.

EN ISO 14738

DESIGN OF WORKSTATIONS AT MACHINERY SHALL BE BASED ON AN ANALYSIS OF TASK REQUIREMENTS INCLUDING SEVERAL ELEMENTS:

- Time aspects;
- Size of working area and objects to be handled;
- Force and action demands;
- Dynamic body measurements;
- Co-ordination and stability demands;
- Visual demands;
- Need for communication;
- Frequency and duration of body, head and limb movements;
- Need to move between workstations;
- Possibility for adopting different postures.

EN ISO 14738

DECISION TREE FOR DETERMINATION OF MAIN WORK POSTURE

EN ISO 14738

OPERATIONAL AREAS FOR UPPER LIMBS

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>VALUE (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>480</td>
</tr>
<tr>
<td>B2</td>
<td>1300</td>
</tr>
<tr>
<td>C1</td>
<td>170</td>
</tr>
<tr>
<td>C2</td>
<td>415</td>
</tr>
</tbody>
</table>

Figure 3: Recommendations for working heights
EN ISO 14738

SITTING POSTURE: SPACE FOR LEGS

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>VALUE (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>820-495</td>
</tr>
<tr>
<td>A7</td>
<td>20</td>
</tr>
<tr>
<td>C</td>
<td>520</td>
</tr>
<tr>
<td>D</td>
<td>855</td>
</tr>
<tr>
<td>E</td>
<td>285</td>
</tr>
<tr>
<td>F</td>
<td>370-535</td>
</tr>
<tr>
<td>G</td>
<td>0-165</td>
</tr>
</tbody>
</table>

EN 1005-2

SAFETY OF MACHINERY –
- HUMAN PHYSICAL PERFORMANCE –
MANUAL HANDLING
OF MACHINERY AND COMPONENT PARTS
OF MACHINERY

EN 1005-2

RISK ASSESSMENT BASED ON NIOSH
METHOD FOR LIFTING (RNLE)

RISK INDEX = LOAD REALLY HANDLED
RECOMMENDED LOAD

RI < 0.85: the risk is tolerable (green).
0.85 < RI < 1.0: significant risk exists (yellow).
RI >1.0: a definite risk exists and redesign is necessary.

EN 1005-3

RECOMMENDED FORCE LIMITS
FOR MACHINERY OPERATION

Step A: Determination of basic force
Step B: Determination of adjusted force in relation to other risk factors
Step C: Evaluation of tolerability and risk.

Table 1 — Reference value (RNL) taking into consideration the intended user population

<table>
<thead>
<tr>
<th>Fields of application</th>
<th>Mu (kg)</th>
<th>Percentile of Fmax and Fmean</th>
<th>Fmax</th>
<th>Load really handled</th>
<th>Recommended load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic use</td>
<td>5</td>
<td>Data not available</td>
<td>85</td>
<td>Adult working pop.</td>
<td>Special working pop.</td>
</tr>
<tr>
<td>Professional use general¹</td>
<td>15</td>
<td>85  98  90</td>
<td>General working population</td>
<td>General working population</td>
<td></td>
</tr>
<tr>
<td>Professional use exceptional²</td>
<td>50</td>
<td>85  78  90</td>
<td>Adult working population</td>
<td>Special working pop.</td>
<td></td>
</tr>
</tbody>
</table>

¹When designing a machine for domestic use, RI should be used as a general reference value in the risk assessment. RI values are given in relation to the intended user population; the reference value should be taken as a general guidelines.
²This index is intended as a reference for professionals, and it should not be considered as a general guideline.

EN 1005-3

Step A – Basic Force Limits

<table>
<thead>
<tr>
<th>Activity</th>
<th>Professional use</th>
<th>Domestic use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P&lt;sub&gt;max&lt;/sub&gt; N</td>
<td>P&lt;sub&gt;max&lt;/sub&gt; N</td>
</tr>
<tr>
<td>Hand work (one hand)</td>
<td>Power grip</td>
<td>250</td>
</tr>
<tr>
<td>Arms work (sitting position, one arm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- upward</td>
<td>75</td>
<td>44</td>
</tr>
<tr>
<td>- downward</td>
<td>65</td>
<td>40</td>
</tr>
<tr>
<td>- sideways</td>
<td>55</td>
<td>25</td>
</tr>
<tr>
<td>Pushing</td>
<td>275</td>
<td>188</td>
</tr>
<tr>
<td>- without load support</td>
<td>60</td>
<td>38</td>
</tr>
<tr>
<td>- with load support</td>
<td>220</td>
<td>149</td>
</tr>
<tr>
<td>- with load support without manual support</td>
<td>50</td>
<td>26</td>
</tr>
<tr>
<td>Whole body work (standing position)</td>
<td>Pushing</td>
<td>200</td>
</tr>
<tr>
<td>- pushing</td>
<td>140</td>
<td>99</td>
</tr>
<tr>
<td>Pneumatic work (sitting position)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- with load support</td>
<td>250</td>
<td>154</td>
</tr>
<tr>
<td>- with load support</td>
<td>475</td>
<td>306</td>
</tr>
</tbody>
</table>
EN 1005-3
Step B – Determination of adjusted force (F_{br}) in relation to other risk factors

1. VELOCITY (FAST MOVEMENTS) (M_v)
2. FREQUENCY OF ACTION (M_f)
3. DAYLY DURATION (M_d)

\[ F_{br} = F_b \times M_v \times M_f \times M_d \]

EN 1005-3
Step C – Evaluation of tolerability and risk

The previous steps concern capability, starting from maximal isometric force. The risk multiplier stated below takes into consideration the tolerability of body tissues.

THE FORCE VALUE OBTAINED IN STEP B IS MULTIPLIED BY THE VALUES GIVEN IN THE FOLLOWING TABLE

<table>
<thead>
<tr>
<th>RISK AREA</th>
<th>Mr</th>
<th>RISK OF DISEASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECOMMENDED</td>
<td>&lt; 0.5</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>NOT RECOMMENDED</td>
<td>0.5 - 0.7</td>
<td>NOT NEGLIGIBLE</td>
</tr>
<tr>
<td>TO BE AVOIDED</td>
<td>&gt; 0.7</td>
<td>OBVIOUS AND NOT ACCEPTABLE</td>
</tr>
</tbody>
</table>

EN 1005-4
EVALUATION OF WORKING POSTURES AND MOVEMENTS IN RELATION TO MACHINERY

EN – 1005-4
TRUNK – FLEXION / EXTENSION

<table>
<thead>
<tr>
<th>STATIC POSTURE</th>
<th>MOVEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW FREQ (&lt;2 min.)</td>
<td></td>
</tr>
<tr>
<td>HIGH FREQ. (&gt;2 min.)</td>
<td></td>
</tr>
<tr>
<td>I° ACCEPTABLE</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>II° CONDITION. ACCEPTABLE (A)</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>III° NOT ACCEPTABLE</td>
<td>CONDITION. ACCEPTABLE (C)</td>
</tr>
<tr>
<td>IV° CONDITION. ACCEPTABLE (B)</td>
<td>CONDITION. ACCEPTABLE (C)</td>
</tr>
</tbody>
</table>

EN 1005-5
Risk assessment for repetitive handling at high frequency.

Guidance to the designer of machinery in assessing and controlling health and safety risks due to machine-related repetitive handling at high frequency. This standard presents a risk assessment method intended for risk reduction option analysis. It is a non-harmonized standard (not compulsory).
EN 1005-5 is based on OCRA method that was adapted considering the perspective of designing a new machinery and related manual tasks.

**OCRA INDEX CLASSIFICATION (EN 1005-5)**

<table>
<thead>
<tr>
<th>ZONE</th>
<th>OCRA RISK INDEX</th>
<th>RISK EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN</td>
<td>UP TO 2.2</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>YELLOW</td>
<td>2.3 – 3.5</td>
<td>CONDITIONALLY ACCEPTABLE</td>
</tr>
<tr>
<td>RED</td>
<td>FROM 3.6</td>
<td>NOT ACCEPTABLE</td>
</tr>
</tbody>
</table>

**OCRA METHOD FACTORS CONSIDERED IN RISK ASSESSMENT**

- **DURATION**
- **FREQUENCY OF ACTIONS**
- **USE OF FORCE**
- **AWKWARD POSTURES AND MOVEMENTS**
- **LACK OF RECOVERY PERIODS**

**EN 1005-5 ANNEXES**

Several annexes (A to H) explain how to apply the OCRA method for the purpose of the standard.

**ISO Standard 11228 (Parts 1-3)**

ISO 11228 “Ergonomics - Manual handling” consists of the following parts:

Each individual standard is a “voluntary” standard and provides information for designers, employers, employees and other persons engaged in prevention and work, job and product design.

In general those standards adopt a four-step approach involving both risk assessment and risk reduction: hazard identification, risk estimation, risk evaluation and risk reduction.

**ISO 11228-1**

Manual Handling
Lifting and carrying
This part of ISO 11228 specifies recommended limits for manual lifting and carrying.

- Applies to manual handling of objects with a mass of 3 kg or more.
- Applies to moderate walking speed.
- Is based on an 8 h working day.
- Does not concern analysis of combined tasks.

ISO 11228-1: SCOPE

FIVE STEP MODEL FOR EVALUATING LIFTING AND CARRYING IN ISO 11228-1

AN INITIAL SCREENING OF NON-REPETITIVE (OCCASIONAL) MANUAL LIFTING IN IDEAL CONDITIONS REQUIRES THE DETERMINATION OF THE OBJECT'S MASS (STEP 1).

ISO 11228-1

The following specifications have been proposed considering also EN 1005-2.

<table>
<thead>
<tr>
<th>Working population by gender and age</th>
<th>Reference mass (mref)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men (16-45 years old)</td>
<td>25 Kg</td>
</tr>
<tr>
<td>Women (18-45 years old)</td>
<td>20 Kg</td>
</tr>
<tr>
<td>Men (&lt;18 or &gt;45 years old)</td>
<td>20 Kg</td>
</tr>
<tr>
<td>Women (&lt;18 or &gt;45 years old)</td>
<td>15 Kg</td>
</tr>
</tbody>
</table>

NOTE 1: 23 kg is included in the 25 kg mass.

RECOMMENDED REFERENCE MASS AS A FUNCTION OF FREQUENCY OF LIFTS AND DURATION (IDEAL CONDITIONS) (STEP 2).

ISO 11228-1

Manual Handling – Lifting

STEP 3: Application of the Revised NIOSH Lifting Equation (RNLE) for no ideal lifting conditions.
MODEL TO ASSESS LIFTING TASKS

LIFTING INDEX =

ACTUAL LOAD WEIGHT

RECOMMENDED WEIGHT LIMIT

THE RECOMMENDED WEIGHT LIMIT IS EVALUATED BY:
1. MAXIMUM RECOMMENDED WEIGHT UNDER IDEAL CONDITIONS
2. REDUCED CONSIDERING OTHER RISK FACTORS (REDUCTION FACTORS/ MULTIPLIERS)

ISO 11228-1

Manual Handling – Carrying (ideal conditions)
Step 4 and 5

The recommended weight limit for manual handling is exceeded, then a risk is presumed and the task should be adapted.

Risk reduction can be achieved by minimizing or excluding hazards resulting from the task, the object, the workplace, the work organization or the environmental conditions.

Health surveillance should be provided by the employer with respect to work-related risks.

Technical means of reducing risk should be provided, and complemented with information and appropriate training with respect to work-related risks.

Interpretation of Lifting index (mA/m²) Values (proposals)

<table>
<thead>
<tr>
<th>Lifting Index</th>
<th>Exposure level</th>
<th>Interpretation</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>UI ≤ 0.8</td>
<td>Acceptable, No risk</td>
<td>Acceptable, no consequences</td>
<td></td>
</tr>
<tr>
<td>0.85 &lt; UI ≤ 1.6</td>
<td>Borderline or very low exposure</td>
<td>If possible, improve structural risk factors or take other organisational measures</td>
<td></td>
</tr>
<tr>
<td>UI &gt; 1.6</td>
<td>Risk present, low level</td>
<td>Redesign tasks and workplaces according to priorities</td>
<td></td>
</tr>
<tr>
<td>UI &gt; 1.6</td>
<td>Risk present, high level</td>
<td>Redesign tasks and workplaces as soon as possible</td>
<td></td>
</tr>
</tbody>
</table>

CONSIDERATIONS REGARDING ISO 11228-1

In several contexts, the standard is not “fully” applicable.

In the healthcare sector, patient handling assessment could hardly be achieved by methods proposed in the standard.


Its publication is foreseen in two years.
The standard does not concern analysis of combined tasks in a shift during a day.
With this purpose, reference should be made to updated proposals, based on NIOSH equation, that will be now referred.

### Definitions of Manual Handling Tasks

<table>
<thead>
<tr>
<th>Definition of Manual Lifting Types</th>
<th>Risk Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mono Task: task involving the lifting of only one kind of object (with the same posture) using always the same posture</td>
<td>LI</td>
</tr>
<tr>
<td>2. Composite Task (ex multitask): when lifting objects of one kind only according to different geometries (collection and positioning on shelves placed at several heights and/or depth levels). Practically each geometry takes the name of SUBTASK.</td>
<td>CLI</td>
</tr>
<tr>
<td>3. Variable Task: when lifting several objects with different weights on shelves placed at different heights and/or depth levels. Each different weight category and each different geometry takes the name of SUBTASK.</td>
<td>VLI</td>
</tr>
<tr>
<td>4. Sequential Task: where workers rotate between a series of single or multi-task lifting rotation slots during a work shift</td>
<td>SLI</td>
</tr>
</tbody>
</table>

### NIOSH Composite Lifting Index in multitask: not in the standard

- Calculation technique used when the loads or vertical/horizontal locations (at origin or destination) vary within the task/s (no more than 10 sub-tasks).
- The Composite Lifting Index (CLI) is computed by a "difficult" formula. Normally it is determined by the most overloading LI incremented by a "quota" determined by the other LI's.

### Sequential Lifting Index in multitask

A special VLI software will be freely available in EPM, CERPIE-UPC and NIOSH web sites.
This part of ISO 11228 provides methods for identifying the potential hazards and risks associated with whole-body pushing and pulling.

Pushing and pulling, as defined in this part of ISO 11228, is restricted to the following:

- whole-body force exertions (i.e., while standing/walking);
- actions performed by one person
- forces applied by two hands;
- forces used to move or restrain an object;
- forces applied in a smooth and controlled way;
- forces applied without the use of external support(s);
- forces applied on objects located in front of the operator;
- forces applied in an upright position (not sitting).

### Application of psychophysical criteria and tables for risk assessment of pushing and pulling tasks

#### Method 1

Application of psychophysical criteria and tables for risk assessment of pushing and pulling tasks

#### Method 2

If the checklist is insufficient and the situation or population is not addressable by the psychophysical tables of Method 1, then Method 2 should be used.

Method 2 adopts a procedure to determine whole-body pushing and pulling force limits according to specific characteristics of the population and the task.

Method 2 is divided into four parts:

- **Part A** — Muscle force limits;
- **Part B** — Skeletal force limits;
- **Part C** — Maximum forces permitted;
- **Part D** — Safety limits.

Method 2 adopts a three-zone approach to determine the level of risk (green, yellow and red).

The procedure is rather difficult to apply.
ISO 11228-3

Handling of low loads at high frequency

Devoted to repetitive movements of upper limbs

REFERENCE MODEL IN ISO 11228-3

Exposure Assessment of Upper Limb Repetitive Movements: A Consensus Document

Developed by the Technical Committee on Musculoskeletal Disorders of the International Ergonomics Association (IEA) and endorsed by the International Commission on Occupational Health (ICOH).


ISO 11228-3: RISK ASSESSMENT PROCEDURE

Method 1

Simple risk assessment

The procedure and checklist model in Annex B is preferred to carry out the simple risk assessment.

As a secondary choice, other simple methods and checklists reported in Annex A could be used.

Risk estimation by simple risk assessment should allow the classification of the risk by the 3-zone model (green; yellow; red)

ISO 11228-3: ANNEX B - CHECKLIST (preferred): METHOD 1

REPETITIVENESS AND POSTURES

ISO 11228-3: ANNEX B - CHECKLIST (preferred): METHOD 1

FORCE AND RECOVERY PERIODS
Method 2
Detailed risk assessment

If the risk estimated by Method 1 is in the ‘yellow’ or ‘red’ zone, or if the job is composed by two or more repetitive tasks (multitask job), it is recommended to perform a more detailed risk assessment.

For the purposes of a detailed risk assessment the OCRA method is preferred.

Method 2
Detailed risk assessment

Other detailed risk assessment methods are available which can be used for a detailed risk assessment. Annex D gives basic information about the other detailed risk assessment methods selected (Strain Index; HAL-TLV-ACGIH) together with some remarks about their current applicative limits.
ISO 11228-3: FULL DETAILS OF OCRA METHOD

ISO 11228-3: FACTORS CONSIDERED IN RISK ASSESSMENT

- DURATION
- FREQUENCY OF ACTIONS
- USE OF FORCE
- AWKWARD POSTURES AND MOVEMENTS
- LACK OF RECOVERY PERIODS
- ADDITIONAL FACTORS

ISO 11228-3: ANNEX C

FACTORS CONSIDERED IN RISK ASSESSMENT

- OCRA INDEX
- ATA
- RTA

It should be underlined that the OCRA index “critical values” reported in Table C.5 should be used as a help to better frame the risk assessment and guide any consequent preventative actions more effectively, rather than rigidly splitting results between “risk” or “no risk”.

ISO 11228-3: ANNEX D

IN THE LIST OF REFERENCES A LINK IS PROVIDED TO THE FOLLOWING WEBSITES:

- FOR OCRA:
  www.epmresearch.org

- FOR STRAIN INDEX:
  http://ergocenter.srph.tamhsc.edu/winsi/

- FOR HAL/ACGIH TLV:
  http://umrerc.engin.umich.edu/jobdatabase/RERC2/HAL/ApplyingTLV.htm

ISO 11228-3: REFERENCES AND WEBSITES

- BASIC INFORMATION ON OTHER METHODS FOR A DETAILED RISK ASSESSMENT
  - STRAIN INDEX
  - HAL/ACGIH TLV
PERSPECTIVES

In recent papers Authors give practical suggestions on how to apply the Strain Index method especially for jobs where multiple forces/tasks are developed.

Users of ISO 11228-3 are addressed to this and similar papers for a better knowledge on Strain index method application especially for multiple tasks.

STRAIN INDEX

In one 2005 paper from the “Michigan Group” that inspired the HAL/ACGIH TLV procedure the authors observed that even at “acceptable” levels of hand activity, many workers will still experience symptoms and/or upper extremity musculoskeletal disorders.

Similar findings (the action limit could be not considered as a “safe” limit) were addressed in other papers and some authors proposed to lower the Action Limits (for instance to a peak force of maximum 3-4 for an HAL of 1) for a broader prevention of UL WMSDs.

Users of ISO 11228-3 are addressed to those and similar papers when using the HAL/ACGIH TLV method and interpret the corresponding results.

HAL-AICGH-TLV

OCRA

OCRA INDEX method could result rather difficult and time consuming particularly when complex or multiple tasks should be analysed.

It is suggested to use the OCRA Checklist method,

much easier for risk assessment purposes, since it is based on the same general framework, criteria and definition of the “Consensus Document” assumed as a reference in the standard

Updates on OCRA (Index and Checklist):

Multitask Analysis

1. A “traditional” procedure has been proposed, whose results could be defined as “time weighted average”, it seems to be appropriate when considering rotations among tasks that are performed very frequently, for instance almost once every hour (or for shorter periods)

2. A new procedure, based on a more realistic concept that the most stressful task is the minimum starting point. It is more appropriate when rotation among repetitive tasks is less frequent (i.e. once every 1.5 or more hours).

The new procedure is actually experimentally used also for evaluating multiple repetitive tasks with long term rotations (week; month; year).

www.epmresearch.org

IN THE WEBSITE SOFTWARE AND TOOLS FOR USING OCRA METHODS (OCRA INDEX AND OCRA CHECKLIST) ALSO FOR MULTITASK ANALYSIS ARE FREELY AVAILABLE
ISO CD 12259 (Technical Report)
Ergonomics – Application document for standards on manual handling (ISO 11228 – 1,2,3) and working postures (ISO 11226).

The ISO (and CEN) groups are now going to produce “technical documents” that should facilitate the practical application of the ISO 11228 (and EN 1005) series.

*The ISO application document will contain the following:
- Detailed definition of field of application of different standards;
- Key enters (simple parametric hazard identification) to different standards;
- Updates of classification systems in part 1 (lifting) and 2 (push/pull);
- Updates of the main selected methods used in the standards with particular reference to multitask analysis of lifting and repetitive tasks;
- Reference to websites relevant for applying the standards.*

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