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Ergonomic principles in the design of work systems

Principes ergonomiques de la conception des systèmes de travail

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61 **Foreword**

62 ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies
63 (ISO member bodies). The work of preparing International Standards is normally carried out through ISO
64 technical committees. Each member body interested in a subject for which a technical committee has been
65 established has the right to be represented on that committee. International organizations, governmental and
66 non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the
67 International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

68 International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

69 The main task of technical committees is to prepare International Standards. Draft International Standards
70 adopted by the technical committees are circulated to the member bodies for voting. Publication as an
71 International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

74 ISO 6385 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 1, and by
75 Technical Committee CEN/TC 122, *Ergonomics* in collaboration.

76 This third edition cancels and replaces the second edition (EN ISO 6385:2004), which has been technically
77 revised. The terms were aligned with the terms given in ISO 26000. The definition of the term worker was
78 deleted. Furthermore clauses 3.2, 3.7 and 4 have been technically revised. The life cycle of a work system
79 was introduced in 3.2. The principle of adjustment was added to 3.7 and validation replaced by verification. A
80 new clause on conformity was added to clause 4. Examples were added in several clauses of this edition of
81 ISO 6385.

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82 Introduction

83 Technological, economic, organizational and human factors affect the work behaviour and well-being of
84 people as part of a work system. Applying ergonomic knowledge in the light of practical experience in the
85 design of a work system is intended to satisfy human requirements.

86 This International Standard provides a basic ergonomic framework for professionals and other people who
87 deal with the issues of ergonomics, work systems and working situations. The provisions of this International
88 Standard will also apply to the design of products for use in work systems.

89 Following the principles and requirements described in this International Standard will support management in
90 making better decisions, for instance related to the sustainability of investments in work system innovation.

91 In the design of work systems in accordance with this International Standard, the body of knowledge in the
92 field of ergonomics is taken into account. Ergonomic evaluations of existing or new work systems will show
93 the need for, and encourage attention to, the role of the worker within those systems.

94 ISO 26800 provides a general starting point for thought on ergonomics and determines the essential general
95 principles and concepts. This International Standard (ISO 6385) presents these in the context of the design
96 and evaluation of work systems.

97 This International Standard is also valuable in the application of management systems such as
98 OHSAS 18001. Besides guidelines for processes it also offers guidance for achieving good human
99 performance.

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100 Ergonomic principles in the design of work systems —

101 1 Scope

102 This International Standard establishes the fundamental principles of ergonomics as basic guidelines for the
103 design of work systems and defines relevant basic terms. It describes an integrated approach to the design of
104 work systems, where ergonomists will cooperate with others involved in the design, with attention to the
105 human, the social and the technical requirements in a balanced manner during the design process.

106 Users of this International Standard will include executives, managers, workers (or their representatives), and
107 professionals such as ergonomists, project managers and designers who are involved in the design or
108 redesign of work systems. Those who use this International Standard may find a general knowledge of
109 ergonomics (human factors), engineering, design, quality and project management helpful.

110 The term “work system” in this International Standard is used to indicate a large variety of working situations
111 including permanent and flexible work places. The intention of this International Standard is to assist in the
112 improvement, (re)design or change of work systems. Work systems involve combinations of workers and
113 equipment, within a given space and environment, and the interactions between these components within a
114 work organization. Work systems vary in complexity and characteristics, for example the use of temporary
115 work systems. Some examples of work systems in different areas are:

116 — production, e.g. machine operator and machine, worker and assembly line;

117 — transportation, e.g. driver and car or lorry, personnel in an airport;

118 — support, e.g. maintenance technician with work equipment;

119 — commercial, e.g. office worker with work station, mobile worker with a tablet computer, cook in a
120 restaurant kitchen;

121 — and other areas like health care, teaching and training.

122 The observance of ergonomic principles applies to all phases throughout the life cycle of the work system
123 from conception through development, realization and implementation, utilization, maintenance and support to
124 decommissioning.

125 The systems approach in this International Standard gives guidance to the users of this standard in existing
126 and new situations.

127 The definitions and ergonomic principles specified in this International Standard apply to the design of optimal
128 working conditions with regard to human well-being, safety and health, including the development of existing
129 skills and the acquisition of new ones, whilst taking into account technological and economic effectiveness
130 and efficiency.

131 The principles in this International Standard are applicable to many other human activities, e.g. in the design
132 of products for domestic and leisure activities. A more general description of the principles in this standard can
133 be found in ISO 26800.

134 NOTE This International Standard is considered to be the core ergonomic standard for work systems from which
135 many others on specific issues are derived.

136 **2 Terms and definitions**

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

138 **2.1**
139 **well-being**
140 <work system> internal state perceived by the worker while working by enhancing comfort and satisfaction
141 and reducing work fatigue and other adverse reactions

142 Note 1 to entry: Well-being can contribute to the quality of working life.

143 Note 2 to entry: This definition is based on EN 614-1:2006+A1:2009, definition 3.6.

144 **2.2**
145 **work system**
146 system comprising one or more workers and work equipment acting together to perform the system function,
147 in the workspace, in the work environment, under the conditions imposed by the work tasks

148 **2.3**
149 **ergonomics**
150 human factors
151 scientific discipline concerned with the understanding of interactions among human and other elements of a
152 system, and the profession that applies theory, principles, data and methods to design in order to optimize
153 human well-being and overall system performance

154 [SOURCE: ISO 26800:2011, definition 2.2]

155 **2.4**
156 **worker**
157 person performing one or more activities to achieve a goal within a work system

158 [SOURCE: ISO 26800:2011, definition 2.11, modified – synonym "operator" omitted]

159 **2.5**
160 **work organization**
161 sequence and interaction of work systems fitted together to produce a specific result

162 **2.6**
163 **work equipment**
164 tools, including hardware and software, machines, vehicles, devices, furniture, installations and other
165 components used in the work system

166 **2.7**
167 **work process**
168 sequence in time and space of the interaction of workers, work equipment, materials, energy and information
169 within a work system

170 **2.8**
171 **work environment**
172 physical, chemical, biological, organizational, social and cultural factors surrounding a worker

173 **2.9**
174 **workspace**
175 volume allocated to one or more persons in the work system to complete the work task

- 176 **2.10**
 177 **external work load**
 178 work stress
 179 external conditions and demands in a work system which influence a person's physical and/or mental internal
 180 load
- 181 Note 1 to entry: In some countries "external work load" is referred to as "work stress".
- 182 Note 2 to entry: Compare ISO 26800:2011, definition 2.4.
- 183 **2.11**
 184 **work strain**
 185 internal response of a worker to being exposed to external work load depending on his/her individual
 186 characteristics (e.g. body size, age, capacities, abilities, skills, etc.)
- 187 Note 1 to entry: In ISO 26800:2011, "work strain" is called "internal load".
- 188 Note 2 to entry: Compare ISO 26800:2011, definition 2.6.
- 189 **2.12**
 190 **usability**
 191 extent to which a system, product or service can be used by specified users to achieve specified goals with
 192 effectiveness, efficiency and satisfaction in a specified context of use
- 193 [SOURCE: ISO 9241-210:2009, definition 2.13]
- 194 Note 1 to entry: Systems, products or services are part of work systems and used by workers within those systems.
- 195 Note 2 to entry: In this standard the context of use is within a work system.
- 196 **2.13**
 197 **human-centred design**
 198 approach to systems design and development that aims to make interactive systems more usable by focusing
 199 on the use of the system and applying human factors/ergonomics and usability knowledge and techniques
- 200 [SOURCE: ISO 9241-210:2009, definition 2.7, modified – Notes 1 and 2 to entry omitted]
- 201 **2.14**
 202 **accessibility**
 203 extent to which products, systems, services, environments and facilities can be used by people from a
 204 population with the widest range of characteristics and capabilities to achieve a specified goal in a specified
 205 context of use
- 206 [SOURCE: ISO 26800:2011, definition 2.1, modified – Notes 1 and 2 to entry omitted]
- 207 Note 1 to entry: Products, systems, services and facilities are part of work systems and used by workers within those
 208 systems.
- 209 Note 2 to entry: In this standard the context of use is within a work system.
- 210 **2.15**
 211 **allocation of functions**
 212 process of deciding whether system functions will be implemented, by humans, by equipment and/or
 213 hardware and/or software
- 214 **2.16**
 215 **job**
 216 organization and sequence in time and space of an individual's work tasks or the combination of all human
 217 performance by one worker within a work system

218 **2.17**
 219 **work task**
 220 activity or set of activities required of the worker to achieve an intended outcome

221 **2.18**
 222 **workstation**
 223 combination and spatial arrangement of work equipment, surrounded by the work environment under the
 224 conditions imposed by the work tasks

225 **2.19**
 226 **work fatigue**
 227 impairing non-pathological manifestation of work strain, completely reversible with rest

228 Note 1 to entry: Work fatigue can be mental, physical, local and/or general.

229 Note 2 to entry: Compare ISO 26800:2011, definition 2.5.

230 **2.20**
 231 **design population**
 232 designated group of workers delimited as a percentile range of the general population, defined according to
 233 relevant characteristics, e.g. gender, age, skill level, etc.

234 **2.21**
 235 **system function**
 236 broad category of activity performed by a system

237 **3 Designing work systems**

238 **3.1 General principles**

239 Work system design considers human beings as the main factor and an integral part of the system to be
 240 designed, including the work process as well as the work environment.

241 In the design process of work systems, the major interactions between one or more people and the
 242 components of the work system, such as tasks, equipment, workspace and environment, need to be
 243 considered.

244 These interactions create demands on the worker that together constitute the external work load. This will
 245 result in reactions within the worker, depending on her/his individual characteristics (e.g. size, age, capacities,
 246 abilities, skills, etc.) called work strain. Work strain will result in impairing effects (e.g. fatigue generated by
 247 work), or facilitating effects (e.g. skill development), thus affecting the individual characteristics of the worker
 248 in a feedback loop.

249 Ergonomic work system design aims at optimizing work strain, avoiding impairing effects and promoting
 250 facilitating effects. Unimpaired human performance at the same time will often improve system effectiveness
 251 and efficiency, thus contributing to another important goal of ergonomic work system design.

252 Ergonomics shall be used in a preventive function by being employed from the beginning rather than being
 253 used to solve problems after the design of the work system is complete. However, ergonomics can be
 254 successfully employed in the redesign of an existing, unsatisfactory work system. Furthermore, in a risk
 255 assessment process the interaction between work system design and the worker's foreseeable behaviour
 256 should be considered in order to secure their safety and health.

257 The most important decisions that have consequences in the design are made at the beginning of the design
 258 process. Therefore, particular attention should be paid to the application of ergonomics principles at this
 259 stage. Ergonomic contribution to the work system design shall continue throughout the design process.
 260 However, the level of input can vary from being fundamental and extensive during the analysis of the system
 261 needs ("formulation of goals") to fine-tuning when the completed system is being implemented ("realization,