
**Safety of machinery — General principles
for design — Risk assessment and risk
reduction**

*Sécurité des machines — Principes généraux de conception —
Appréciation du risque et réduction du risque*



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.



COPYRIGHT PROTECTED DOCUMENT

© ISO 2010

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction.....	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Strategy for risk assessment and risk reduction	9
5 Risk assessment	12
5.1 General	12
5.2 Information for risk assessment	12
5.3 Determination of limits of machinery	13
5.3.1 General	13
5.3.2 Use limits	13
5.3.3 Space limits	14
5.3.4 Time limits	14
5.3.5 Other limits	14
5.4 Hazard identification	14
5.5 Risk estimation	16
5.5.1 General	16
5.5.2 Elements of risk	17
5.5.3 Aspects to be considered during risk estimation	19
5.6 Risk evaluation	21
5.6.1 General	21
5.6.2 Adequate risk reduction	21
5.6.3 Comparison of risks	21
6 Risk reduction	22
6.1 General	22
6.2 Inherently safe design measures	23
6.2.1 General	23
6.2.2 Consideration of geometrical factors and physical aspects	23
6.2.3 Taking into account general technical knowledge of machine design	24
6.2.4 Choice of appropriate technology	25
6.2.5 Applying principle of positive mechanical action	25
6.2.6 Provisions for stability	25
6.2.7 Provisions for maintainability	26
6.2.8 Observing ergonomic principles	26
6.2.9 Electrical hazards	27
6.2.10 Pneumatic and hydraulic hazards	27
6.2.11 Applying inherently safe design measures to control systems	28
6.2.12 Minimizing probability of failure of safety functions	33
6.2.13 Limiting exposure to hazards through reliability of equipment	33
6.2.14 Limiting exposure to hazards through mechanization or automation of loading (feeding)/ unloading (removal) operations	34
6.2.15 Limiting exposure to hazards through location of setting and maintenance points outside danger zones	34
6.3 Safeguarding and complementary protective measures	34
6.3.1 General	34
6.3.2 Selection and implementation of guards and protective devices	35
6.3.3 Requirements for design of guards and protective devices	40
6.3.4 Safeguarding to reduce emissions	43