

ISO 16090-1:2017-12 (E)

Machine tools safety - Machining centres, Milling machines, Transfer machines - Part 1: Safety requirements

Contents		Page
Foreword		v
Introduction		vi
1	Scope	1
2	Normative references	2
3	Terms and definitions	4
3.1	General terms	4
3.2	Groups of machines	7
3.3	Parts of machines	8
3.4	Mode of safe operations	10
3.5	Maximum permissible spindle speed and feed rate	11
4	List of significant hazards	12
4.1	General	12
4.2	Main hazard zones	12
4.3	Significant hazards and hazardous situations covered by this document	12
5	Safety requirements and/or protective/risk reduction measures	17
5.1	General requirements	17
5.1.1	General	17
5.1.2	Required characteristics for guards of all machine groups	17
5.1.3	Power-operated moveable guards for user access	18
5.2	Specific requirements resulting from mechanical hazards	20
5.2.1	Protective measures for Group 1 machines	20
5.2.2	Protective measures for Group 2 machines	20
5.2.3	Protective measures for Group 3 and Group 4 machines	21
5.2.4	MSO of machine operation	23
5.2.5	Optional or additional equipment for machines	30
5.3	Specific requirements resulting from electrical hazards	38
5.4	Specific requirements resulting from noise hazards	39
5.5	Specific requirements resulting from radiation hazards	39
5.6	Specific requirements resulting from material or substance hazards	39
5.6.1	Combustible coolants	39
5.6.2	Minimum quantity lubrication (MQL)	41
5.6.3	Dry processing and combustible dust	41
5.6.4	Requirements for biological or microbiological hazards	41
5.7	Specific requirements resulting from neglect of ergonomic principles hazards	42
5.8	Specific requirements resulting from unexpected start-up, over-run or over-speed hazards	43
5.8.1	General	43
5.8.2	Starting	43
5.8.3	Normal stop	44
5.8.4	Emergency stop	44
5.8.5	Safety related parts of control system (SRP/CS)	44
5.8.6	Monitoring rotational speed limits and limits of linear and rotary movements	45
5.8.7	Requirements for electromagnetic compatibility of electrical equipment	45
5.9	Specific requirements resulting from failure of any power supply	45
5.10	Release of trapped and/or clamped persons	46

5.11	Specific requirements resulting from errors of fitting hazards	46
5.12	Specific requirements resulting from ejected fluids or parts	46
5.12.1	General requirements	46
5.12.2	Ejection of parts – Guard strength	47
5.12.3	Power-operated workpiece and tool clamping	47
5.12.4	Additional requirements for Group 3 and Group 4 machines	48
5.13	Specific requirements resulting from loss of stability hazards	48
5.14	Requirements resulting from slips, trips, and fall of persons hazards	48
5.15	Requirements resulting from accessibility for maintenance or troubleshooting on high parts of the machine	48
5.16	Requirements for machinery with operator cabins and perimeter fencing	49
5.16.1	General	49
5.16.2	Overall concept for entering/leaving machinery	49
5.16.3	Requirements for moveable/adjustable operator cabins and operation platforms	49
5.16.4	Requirements for perimeter fencing	52
5.17	Verification of the safety requirements and/or protective measures	52
6	Information for use	56
6.1	General	56
6.2	Marking	56
6.3	Instruction for use	57
6.3.1	General	57
6.3.2	Tooling	59
6.3.3	Workpiece clamping	60
6.3.4	Machine functions accessible from the NC panel	60
6.3.5	Restart	60
6.3.6	Noise	60
6.3.7	Residual risks to be addressed to the machinery user	61
6.3.8	Installations instructions of machinery	62
6.3.9	Cleaning instructions of machinery	62
6.3.10	Machinery with operator cabins and/or perimeter fencing	62
Annex A	(normative) Impact test method for guards on machines	63
Annex B	(informative) Equipment for impact test and examples of tested materials	66
Annex C	(informative) Illustrative figures as examples of machines	68
Annex D	(informative) Illustrative figures as examples of guards	77
Annex E	(informative) Examples of the integration of exhaust and extinguishing systems when using combustible coolants or combustible dust	84
Annex F	(informative) Provisions when using combustible coolants and combustible dust	86
Annex G	(normative) Gravity-loaded axes	90
Annex H	(informative) Examples: Concept for leaving/returning to a cabin (control station) at Group 3 and Group 4 machines	97
Annex I	(informative) Typical demand rates of safety functions for calculations according to Table 5 and Annex J	99
Annex J	(normative) Safety functions	104
Annex K	(normative) Noise emission measurement	151
Bibliography	153