

ISO 16089:2015-11 (E)

Machine tools - Safety - Stationary grinding machines

Contents		Page
Foreword		v
Introduction		vi
1	Scope	1
2	Normative references	1
3	Terms and definitions	3
3.1	General terms	3
3.2	Parts of grinding machines	5
3.3	Modes of safe operation (MSO)	6
3.4	Types and groups of grinding machines defined in this International Standard	7
3.4.1	General	7
3.4.2	Group 1: manually controlled grinding machine without power operated axes and without numerical control	9
3.4.3	Group 2: manually controlled grinding machine with power operated axes and, if applicable, with limited numerically controlled capability	10
3.4.4	Group 3: numerically controlled grinding machine	11
3.5	Speeds and axes speed	12
4	List of significant hazards	13
4.1	General	13
4.2	Main hazard zones	14
4.3	Significant hazards and hazardous situations covered by this International Standard	14
5	Safety requirements and/or measures	18
5.1	General requirements	18
5.1.1	General	18
5.1.2	Requirements for guards for all groups of grinding machines	19
5.2	Specific requirements resulting from mechanical hazards identified in Table 2, Nos. 1.1 - 1.4, 1.6 and 1.7	19
5.2.1	Group 1 machines, manually controlled grinding machines without power operated axes and without numerical control	19
5.2.2	Group 2 machines, manually controlled grinding machines with power operated axes and, if applicable, with limited numerically controlled capability22 5.2.3 Group 3 machines, numerically controlled grinding machines	22
5.2.4	Tool holding device	24
5.2.5	Workpiece holding	24
5.2.6	Vertical or slant axes under gravity	25
5.2.7	Modes of machine operation	25
5.2.8	Optional or additional equipment for grinding machines	29
5.3	Specific requirements resulting from electrical hazards	31
5.4	Specific requirements resulting from noise hazards	32
5.5	Specific requirements resulting from vibration hazards	32
5.6	Specific requirements resulting from radiation hazards	32
5.7	Specific requirements resulting from materials or substance hazards	33
5.7.1	General	33
5.7.2	Devices for the use of metalworking fluids	33
5.7.3	Measures against fire and explosion hazards	34
5.8	Specific requirements resulting from neglect of ergonomic principles hazards	36

5.9	Specific requirements resulting from unexpected start-up, over-run, or over-speed hazards	37
5.10	Specific requirements resulting from variation in the rotational speed hazards	39
5.11	Specific requirements resulting from failure of the power supply hazards	39
5.12	Specific requirements resulting from failure of the control circuit hazards	40
5.13	Specific requirements resulting from ejected fluids or objects hazards	43
5.13.1	General requirements	43
5.13.2	Guards to prevent ejection in the event of abrasive product breakage	43
5.13.3	Devices protecting against ejection of workpieces and workpiece parts	44
5.14	Specific requirements resulting from loss of stability hazards	45
5.15	Specific requirements resulting from slips, trips and fall of persons hazards	45
6	Verification of the safety requirements and/or protective measures	45
7	Information for use	48
7.1	Marking	48
7.2	Instruction for use	48
7.2.1	General	48
7.2.2	Tooling	51
7.2.3	Workpiece holding	51
7.2.4	Machine functions accessible from the NC panel	51
7.2.5	Restart	52
7.2.6	Noise	52
7.2.7	Vibration	53
7.2.8	Ancillary handling devices	53
7.2.9	Residual risks to be addressed by the machinery user	53
7.2.10	Installation instructions for the grinding machine	54
7.2.11	Cleaning instruction for the machine	54
Annex A (normative)	Abrasive product guards, work zone enclosures, and their combinations	55
Annex B (informative)	Impact test for guards -- Bursting test	94
Annex C (informative)	Impact test for guards -- Projectile impact	97
Annex D (normative)	Clamping methods for abrasive products and safety requirements for tool holding devices	101
Annex E (informative)	Noise reduction	112
Annex F (informative)	Noise emission determination	113
Annex G (normative)	Requirements for grinding machines for the machining of materials generating flammable and explosive dusts	114
Annex H (informative)	Measures for the use of flammable metal working fluids	117
Annex I (informative)	Examples for the integration of extraction and fire extinguishing systems when using flammable metal working fluids	120
Annex J (informative)	Functional safety -- Example for rotational speed limit monitoring of the wheel spindle	122
Annex K (informative)	MSO 3 (Optional special mode for manual intervention under restricted operating conditions) - Examples	125
Bibliography	130