

# ISO 16090-1:2017-12 (E)

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

---

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

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