

# Safety of machine tools — Small numerically controlled turning machines and turning centres

The European Standard EN 12415:2001, with the incorporation of amendment A1:2002 has the status of a British Standard

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## National foreword

This British Standard is the official English language version of EN 12415:2000, including amendment A1:2002.

The start and finish of the text introduced or altered by amendments is indicated in the text by tags **A1** **A1**. Tags indicating changes to CEN text carry the number of the CEN amendment, for example text altered by CEN amendment A1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted by Technical Committee MTE/1, machine tools, to Subcommittee MTE/1/-/9, Safety of metal cutting machine tools, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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**Safety of machine tools - Small numerically controlled turning  
machines and turning centres  
(includes amendment A1:2002)**

Sécurité des machines-outils - Tours à commande  
numérique et centres de tournage de petites dimensions  
(inclut l'amendement A1:2002)

Sicherheit von Werkzeugmaschinen - Kleine numerisch  
gesteuerte Drehmaschinen und Drehzentren  
(enthält Änderung A1:2002)

This European Standard was approved by CEN on 6 July 2000. Amendment A1 was approved by CEN on 18 October 2002.

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## Foreword

This European Standard has been prepared by Technical Committee CEN/TC 143 "Machine tools – Safety", the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2001, and conflicting national standards shall be withdrawn at the latest by May 2001.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

Organisations contributing to the preparation of this European standard include the European Manufacturer Association CECIMO.

Normative and informative annexes to this standard are listed in the content list.

The European Standards produced by CEN/TC 143 are particular to machine-tools and complement the relevant A and B standards on the subject of general safety (see introduction of EN 292-1:1991 for a description of A, B and C standards).

The annexes A and C are informative ; the annexes B and D are normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## Foreword to amendment 1

This document (EN 12415:2000/A1:2002) has been prepared by Technical CEN /TC 143 "Machine tools - Safety", the secretariat of which is held by SNV.

This Amendment to the European Standard EN 12415:2000 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2003, and conflicting national standards shall be withdrawn at the latest by May 2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Annex E is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

NOTE This amendment takes account on recent research on ageing of machines tool vision panels.

## 0 Introduction

This European Standard has been prepared to be a Harmonised Standard to provide one means of conforming to the Essential Safety Requirements of the Machinery Directive and associated EFTA regulations.

This European Standard is a type C standard as defined in EN 292:1991.

The extent to which hazards are covered is indicated in the scope of this standard. In addition small numerically controlled turning machines and turning centres shall comply as appropriate with EN 292:1991 part 1 and 2 for hazards which are not covered by this standard.

The requirements of this European Standard concern designers, manufacturers, suppliers and importers of machines described in the scope.

This standard also includes information to be provided by the manufacturer to the user.

## 1 Scope

This European Standard specifies the requirements and/or measures to remove the hazards and limit the risks on general purpose numerically controlled turning machines and turning centres which are designed primarily to work cold metal with no access to the work-zone during machining as defined in 3.1 and 3.2 and hereafter referred to as "machines".

This standard covers the significant hazards, listed in clause 4.

This standard applies to :

- numerically controlled horizontal spindle turning machines and turning centres with distance between centres (BC) up to 2 000 mm which are designed to be equipped with workpiece clamping devices up to 500 mm outside diameter;
- numerically controlled vertical turning machines, inverted spindle turning machines including pick up machines and turning centres which are designed to be equipped with workpiece clamping device up to 500 mm outside diameter.

Larger machines may comply with this standard or shall comply with EN 12478:2000.

The standard also applies to ancillary devices, e.g. tools, chucks, workpiece handling devices and swarf handling equipment which are integral to the machine.

Where additional processes are involved, this standard can be taken as a basis (see also bibliography annex ).

This standard also applies to machines which are integrated into an automatic production line or turning cell where the hazards and risks arising are comparable to those of machines working separately.

This European Standard apply for automatic single spindle turning machines but does not apply to automatic multispindle turning machines which are dealt with in prEN 13788:1999.

This European Standard does not apply to NC turning machines with machining facilities under manual control which are dealt with in EN 12840:2000.

This standard applies to machines which are manufactured after the date of issue of this standard.

## 2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN 292-1:1991, *Safety of machinery – Basic concepts, general principles for design – Part 1 : Basic terminology, methodology.*

EN 292-2:1991, *Safety of machinery – Basic concepts, general principles for design – Part 2 : Technical principles and specifications*

EN 292-2/A1:1995, *Safety of machinery – Basic concepts, general principles for design – Part 2 : Technical principles and specifications.*

EN 294:1992, *Safety of machinery – Safety distances to prevent danger zone being reached by the upper limbs.*

EN 349:1993, *Safety of machinery – Dimensions gaps to avoid crushing of parts of the human body.*

EN 418:1992, *Safety of machinery – Emergency stop equipment – Functional aspects – Principles for design.*

EN 547-1:1996, *Safety of machinery – Human body measurements – Part 1 : Principles for determining the dimensions for openings for whole body access into machinery.*

EN 547-2:1996, *Safety of machinery – Human body measurements – Part 2 : Principles for determining the dimensions required for access openings.*

EN 574:1996, *Safety of machinery – Two hand control devices – Functional aspects – Principle for design.*

EN 614-1:1995, *Safety of machinery – Ergonomic design principles – Part 1 : Terminology and general principles.*

EN 894-1:1997, *Safety of machinery – Ergonomic requirements for the design of displays and control actuators – Part 1: Human interaction with display and control actuators.*

EN 894-2:1997, *Safety of machinery – Ergonomic requirements for the design of displays and control actuators – Part 2 : Displays.*

EN 894-3:2000, *Safety of machinery – Ergonomic requirements for the design of displays and control actuators – Part 3 : Control actuators*

EN 953:1997, *Safety of machinery – Guards – General requirements for the design and construction of fixed and moveable guards.*

EN 954-1:1996, *Safety of machinery – Safety related parts of control systems – Part 1 : General principles for design.*

EN 982:1996, *Safety of machinery – Safety requirements for fluid power systems and components – Hydraulics.*

EN 983:1996, *Safety of machinery – Safety requirements for fluid power systems and components – Pneumatics.*

prEN 1005-1:1998, *Safety of machinery – Human physical performances – Part 1 : Terms and definitions.*

prEN 1005-2:1998, *Safety of machinery – Human physical performances – Part 2 : Manual handling of machining and components parts of machinery.*

prEN 1005-3:1998, *Safety of machinery – Human physical performances – Part 3 : Recommended forces limits for machinery operation.*

prEN 1005-4:1998, *Safety of machinery – Human physical performances – Part 4 : Evaluation of working postures in relation to machinery.*

EN 1037:1995, *Safety of machinery – Prevention of unexpected start up.*

EN 1050:1996, *Safety of machinery – Principles for risk assessment.*

EN 1070:1998, *Safety of machinery – Terminology.*

EN 1088:1995, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection.*

EN 1550:1997, *Safety requirements for the design and construction of work holding chucks.*

EN 1760-1:1997, *Safety of machinery – Pressure sensitive protective devices – Part 1 : General principles for the design and testing of pressure sensitive mats and pressure sensitive floors.*

prEN 1760-2:1996, *Safety of machinery – Pressure sensitive protective devices – Part 2 : General principles for the design and testing of pressure sensitive edges and pressure sensitive bars.*

EN 1837:1999, *Safety of machinery – Integral lighting of machines.*

EN 12478:2000, *Machine tools – Safety – Large numerically controlled turning machines and turning centres.*

EN 12840:2000, *Machine tools – Safety – Manually controlled turning machines.*

ENV 26385, *Ergonomic principles of the design of work systems.*

EN 60204-1:1992, *Safety of machinery – Electrical equipment of machines – Part 1 : Specification for general requirements.*

EN 60529:1991, *Degrees of protection provided by enclosures (IP code).*

EN 60825-1:1994 + A11:1996, *Safety of laser products – Part 1 : Equipment classification, requirements and user's guide (IEC 60825-1:1993).*

EN ISO 3744:1995, *Acoustics – Determination of sound power level of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane.*

EN ISO 3746:1995, *Acoustics – Determination of sound power level of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane.*

EN ISO 9614-1:1995, *Acoustics – Determination of sound power level of noise sources using sound intensity – Part 1 : Measurement at discrete points.*

EN ISO 11202:1995, *Acoustics – Noise emitted by machinery and equipment – Measurement method of emission sound pressure levels at the workstation and at other specified positions – Survey method in situ.*

EN ISO 11204:1995, *Acoustics – Noise emitted by machinery and equipment – Method requiring environmental corrections.*

EN ISO 11688-1:1998, *Acoustics – Recommended practice for the design of low noise machinery and equipment – Part 1 : Planning.*

### 3 Terms and definitions

For the purposes of this standard and in addition to the terms and definitions given in EN 292:1991, EN 418:1992 and EN 1070:1998 the following terms and definitions apply :

#### 3.1

##### **numerically controlled turning machine**

A machine tool in which the principal movement is the rotation of the workpiece against the stationary cutting tool(s) and where cutting energy is brought by the workpiece and not by the tool. This machine is controlled by a numerical control (NC) providing automatic function according to 3.3.1 and can be of single spindle or multispindle type.

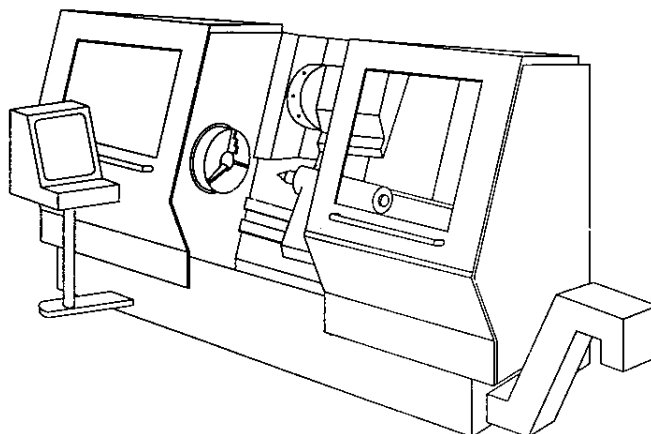


Figure 1 a) — Horizontal NC turning machine

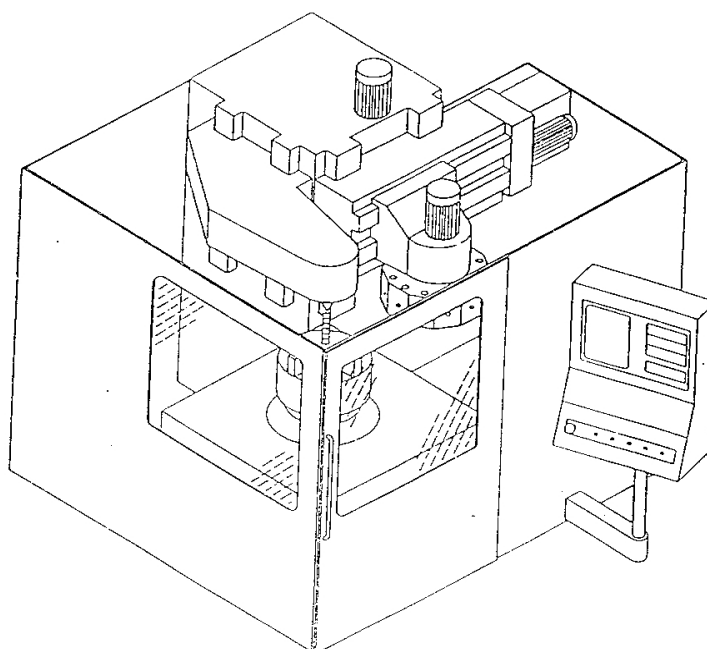


Figure 1 b) — Vertical NC turning machine

Figure 1 — Examples of horizontal and vertical turning machines

### 3.2 turning centre

A NC turning machine equipped with power driven tool(s) and the capability to orientate the workholding spindle around its axis. This machine may include additional features such as automatic tool changing from a magazine.

### 3.3 machine modes of operation

NOTE Definitions of modes of NC are given below :

mode of NC

A mode of operation of the NC or data entry device where entries are interpreted as functions to be executed.

a) manual mode of NC

Non automatic mode of NC of a machine in which the operator controls it without the use of pre-programmed numeric data for example by push button or joystick control.

b) manual data input mode

The entry of programme data by hand at the NC.

c) single block mode

The mode of NC in which, at the initiation of the operator only one block of control data is executed.

d) automatic mode

The mode of NC in which the machine operates in accordance with the programme data until stopped by the program or the operator.

### 3.3.1

#### **machining mode**

The automatic, programmed, sequential operation of the machine with the facility for manual or automatic loading/unloading of workpieces.

### 3.3.2

#### **machine setting mode**

Mode in which the operator performs adjustments for the subsequent machining process

The programming, testing and manual (under power) non sequential operation of the machine.

NOTE This mode comprises e. g. program sequence check, measurement of tool and/or workpiece position (e. g. by touching the workpiece with a measurement probe or with the tool).

## 4 List of significant hazards

The significant hazards associated with the machine have been identified (see table 1) in accordance with the procedures described in 5 of EN 292-1:1991 and EN 1050:1996.

The safety requirements and/or measures to eliminate these hazards or reduce their associated risks are laid down in clause 5 of this standard.

NOTE For machines which present additional hazards or do not conform to this standard guidance on risk assessment can be found in EN 1050:1996 and on measures to be taken for hazards elimination and risk reduction may be found in EN 292-1 and EN 292-2:1991.

The designers attention is focused on hazards which can occur during the life of the machine to both operator and other persons who have access to the danger zone(s) for conditions of intended use including reasonably foreseeable misuse of the machine (see 3.12 in EN 292-1:1991). The hazards for both machining operation and/or operations requiring intervention by the operator and/or other personnel (e.g. setting, cleaning maintenance and repair) have to be considered. An analysis of failure of machine components including failure in the control system(s) is part of the risk assessment guidance on this subject is given in EN 954-1:1996.

The significant hazards covered by this standard are listed in table 1. Particular attention is given to hazards dealing with :

- ejection of tools, chucks/jaws, workpieces or parts of them including swarf and chips (see 1.7 in table 1) ;
- entanglement on or drawing into moving parts of the machine, particularly chucks, tools, and the workpiece (see 1.4 and 1.5 in table 1) ;
- cutting and crushing between moving and fixed/moving parts of the machine (see 1.1 and 1.3 in table 1) ;

Main danger zones are :

- working areas with moving spindle(s), workpiece holding devices (e.g. chuck(s)), slide(s), turret(s), workpiece(s), swarf handling equipment (if integrated) ;
- workpiece loading/unloading devices including bar feeders for horizontal spindle machines ;
- external tool magazines and tool changers.

Table 1 — List of hazards

| EN1050<br>refer.<br>N°                             | Hazards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Annex A of<br>EN 292-2:1991/<br>A1:1995 | EN 292          |                           | Hazardous situation                                                                            | Relevant type B standard                | Relevant clause<br>in this standard                       |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------|---------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------|
|                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         | Part 1:<br>1991 | Part 2:<br>1991           |                                                                                                |                                         |                                                           |
| Hazards, hazardous situations and hazardous events |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         |                 |                           |                                                                                                |                                         |                                                           |
| 1                                                  | <b>Mechanical hazards</b> due to :<br>- machine parts or workpiece, e.g. :<br>a) shape ;<br>b) relative location ;<br>c) mass and stability (potential energy of elements which may move under the effect of gravity) ;<br>d) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion) ;<br>e) inadequacy of mechanical strength.<br>— accumulation of energy inside the machinery, e.g. :<br>f) elastic elements (springs) ;<br>g) liquids and gases under pressure ;<br>h) the effect of vacuum. | 1.3<br>1.5.3, 1.6.3                     | 4.2<br>4.2      | 3.1, 3.2, 4<br>3.8, 6.2.2 |                                                                                                |                                         |                                                           |
| 1.1                                                | Crushing hazard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.3                                     | 4.2.1           |                           | Between fixed and moving part including work clamping (chuck or tail stock) and tool magazine. | EN 294, EN 349, EN 574, EN 953, EN 1088 | 5.1.3, 5.1.7, 5.2.1.1, 5.2.1.4, 5.2.3.1, 5.2.3.4, 5.2.3.5 |
| 1.2                                                | Shearing hazard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         |                 |                           | Between fixed and moving part including tool magazine.                                         | EN 294, EN 349, EN 574, EN 953, EN 1088 | 5.1.7, 5.2.3.1, 5.2.3.5                                   |
| 1.3                                                | Cutting or severing hazard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         |                 |                           | During tool motion, by swarf.                                                                  | EN 294, EN 953                          | 5.1.3, 5.1.7                                              |
| 1.4                                                | Entanglement hazard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                         |                 |                           | By moving part including bar feed and tool magazine.                                           | EN 294, EN 953, EN 1088                 | 5.1.1, 5.1.3, 5.1.7, 5.2.3.1, 5.2.3.2, 5.2.3.4, 5.2.3.5   |
| 1.5                                                | Drawing-in or trapping hazard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         |                 |                           | By moving part.                                                                                | EN 294, EN 953                          | 5.1.1, 5.1.3, 5.1.7.                                      |

(to be continued)

Table 1 — List of hazards (continued)

| EN1050<br>refer.<br>N° | Hazards                                                                                                                                                                                                         | Annex A of<br>EN 292-2:1991/<br>A1:1995 | EN 292          |                 | Hazardous situation                                     | Relevant type B standard                                                 | Relevant clause<br>in this standard                  |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------|-----------------|---------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------|
|                        |                                                                                                                                                                                                                 |                                         | Part 1:<br>1991 | Part 2:<br>1991 |                                                         |                                                                          |                                                      |
| 1.6                    | Impact hazard                                                                                                                                                                                                   |                                         |                 |                 | By moving part including bar feed<br>and tool magazine. | EN 294, EN 1760, EN 953, EN 1088                                         | 5.1.1, 5.1.3, 5.1.7,<br>5.2.3.1, 5.2.3.2,<br>5.2.3.5 |
| 1.7                    | Stabbing or puncture hazard                                                                                                                                                                                     |                                         |                 |                 | At tailstock when clamping and tool<br>holding.         | EN 982                                                                   | 5.2.1.4, 6.2                                         |
| 1.9                    | High pressure fluid injection or ejection hazard                                                                                                                                                                | 1.3.2                                   | 4.2.1           | 3.8             | At coolant delivery.                                    | EN 982, EN 953, EN 1088                                                  | 5.2.2                                                |
| 2                      | <b>Electrical hazards</b> due to :                                                                                                                                                                              |                                         |                 |                 |                                                         |                                                                          |                                                      |
| 2.1                    | Contact of persons with live parts (direct contact)                                                                                                                                                             | 1.5.1, 1.6.3                            | 4.3             | 3.9, 6.2.2      | At electrical equipment during<br>maintenance.          | EN 60204                                                                 | 5.3.3                                                |
| 2.2                    | Contact of persons with parts which have become live<br>under faulty conditions (indirect contact)                                                                                                              | 1.5.1                                   | 4.3             | 3.9             | At electrical equipment during<br>maintenance.          | EN 60204                                                                 | 5.3.3                                                |
| 3                      | <b>Thermal hazards</b> , resulting in :                                                                                                                                                                         |                                         |                 |                 |                                                         |                                                                          |                                                      |
| 3.1                    | Burns, scalds and other injuries by a possible contact of<br>persons with objects or materials with an extreme high or<br>low temperature, by flames or explosions and also by the<br>radiation of heat sources | 1.5.5, 1.5.6, 1.5.7                     | 4.4             |                 | At hot swarf.                                           |                                                                          | 5.2.2, 6.2                                           |
| 4                      | <b>Hazards generated by noise</b> , resulting in :                                                                                                                                                              |                                         |                 |                 |                                                         |                                                                          |                                                      |
| 4.1                    | Hearing loss (deafness), other physiological disorders<br>(e.g. loss of balance, loss of awareness)                                                                                                             | 1.5.8                                   | 4.5             | 3.2, 4          | From cutting process and from bar<br>feed.              | EN ISO 3746, EN ISO 11202,<br>EN ISO 3744, EN ISO 9614<br>EN ISO 11688-1 | 6.2.5, 6.2.7, 5.3.8                                  |
| 6                      | <b>Hazards generated by radiation</b>                                                                                                                                                                           |                                         |                 |                 |                                                         |                                                                          |                                                      |
| 6.1                    | Low frequency, radio frequency radiation, micro waves                                                                                                                                                           | 1.5.10                                  | 4.7             |                 | At electrical equipment during<br>maintenance.          |                                                                          | 5.3.3                                                |

(to be continued)

Table 1 — List of hazards (continued)

| EN1050<br>refer.<br>N° | Hazards                                                                                                                  | Annex A of<br>EN 292-2:1991/<br>A1:1995 | EN 292          |                                   | Hazardous situation                                                          | Relevant type B standard | Relevant clause<br>in this standard |
|------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------|-----------------------------------|------------------------------------------------------------------------------|--------------------------|-------------------------------------|
|                        |                                                                                                                          |                                         | Part 1:<br>1991 | Part 2:<br>1991                   |                                                                              |                          |                                     |
| 6.5                    | Lasers                                                                                                                   | 1.5.12                                  | 4.7             |                                   | At laser equipment during machining setting and maintenance.                 | EN 60825-1               | 5.3.9                               |
| 7                      | <b>Hazards generated by materials and substances</b> (and their constituent elements) processed or used by the machinery |                                         |                 |                                   |                                                                              |                          |                                     |
| 7.1                    | Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts                                | 1.1.3, 1.5.13, 1.6.5                    | 4.8             | 3.3b, 3.4                         | At cutting fluids circuit during setting machining and maintenance.          |                          | 5.3.1, 6.2                          |
| 7.3                    | Biological or micro biological (viral or bacterial) hazards                                                              | 1.1.3, 1.6.5, 2.1                       | 4.8             |                                   | At cutting fluids circuit during loading/unloading maintenance               |                          | 5.3.1, 6.2                          |
| 8                      | <b>Hazards generated by neglecting ergonomic principles in machinery design as, e.g. hazards from :</b>                  |                                         |                 |                                   |                                                                              |                          |                                     |
| 8.1                    | Unhealthy postures or excessive effort                                                                                   | 1.1.2d, 1.1.5, 1.6.2, 1.6.4             | 4.9             | 3.6.1, 6.2.1, 6.2.3, 6.2.4, 6.2.6 | At control devices and during handling of workpiece tools and machine parts. | EN 614-1 and -2          | 5.1.2, 5.3.4                        |
| 8.2                    | Inadequate consideration of hand-arm or foot-leg anatomy                                                                 | 1.1.2d, 2.2                             | 4.9             | 3.6.2                             | At work/tool exchange.                                                       | prEN 1005-1 to -4:1998   | 5.3.4                               |
| 8.3                    | Neglected use of personal protection equipment                                                                           | 1.1.2e                                  |                 | 3.6.6                             | Manual operation/handling of tools during bar machining.                     |                          | 6.2                                 |
| 8.4                    | Inadequate local lighting                                                                                                | 1.1.4                                   |                 | 3.6.5                             | At cutting process, during setting, handling/positioning of workpiece        | EN 1837                  | 5.3.2                               |
| 8.6                    | Human error, human behaviour                                                                                             | 1.1.2d, 1.2.2, 1.2.5, 1.2.8, 1.5.4, 1.7 | 4.9             | 3.6, 3.7.8, 3.7.9, 5, 6.1.1       | At CN display, mode of operation, work clamping.                             |                          | 5.1.6, 5.1.7, 5.2.1, 6.2            |

(to be continued)

