



# SLOVENSKI STANDARD SIST EN ISO 16089:2016

01-marec-2016

Nadomešča:

SIST EN 13218:2003+A1:2008

SIST EN 13218:2003+A1:2008/AC:2010

---

**Obdelovalni stroji - Varnost - Nepremični brusilni stroji (ISO 16089:2015)**

Machine tools - Safety - Stationary grinding machines (ISO 16089:2015)

Werkzeugmaschinen - Sicherheit - Ortsfeste Schleifmaschinen (ISO 16089:2015)

Machines-outils - Sécurité - Machines à meuler fixes (ISO 16089:2015)

**Ta slovenski standard je istoveten z: EN ISO 16089:2015**

[SIST EN ISO 16089:2016](https://standards.iteh.ai/catalog/standards/sist/74b2737-56e1-485b-b841-1e5bc5366ab6/sist-en-iso-16089-2016)

<https://standards.iteh.ai/catalog/standards/sist/74b2737-56e1-485b-b841-1e5bc5366ab6/sist-en-iso-16089-2016>

---

**ICS:**

25.080.50

Brusilni in polirni stroji

Grinding and polishing  
machines

**SIST EN ISO 16089:2016**

**en,fr,de**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN ISO 16089:2016

<https://standards.iteh.ai/catalog/standards/sist/34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016>

EUROPEAN STANDARD

EN ISO 16089

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2015

ICS 25.080.01

Supersedes EN 13218:2002+A1:2008

English Version

## Machine tools - Safety - Stationary grinding machines (ISO 16089:2015)

Machines-outils - Sécurité - Machines à meuler fixes  
(ISO 16089:2015)

Werkzeugmaschinen - Sicherheit - Ortsfeste  
Schleifmaschinen (ISO 16089:2015)

This European Standard was approved by CEN on 3 October 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

<https://standards.iteh.ai/catalog/standards/sist/b34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016>



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

## Contents

Page

European foreword.....	3
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC.....	4

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN ISO 16089:2016](https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016)

<https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016>

## European foreword

This document (EN ISO 16089:2015) has been prepared by Technical Committee ISO/TC 39 "Machine tools" in collaboration with 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 June 2016, and conflicting national standards shall be withdrawn at the latest by June 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13218:2002+A1:2008.

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.

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## Endorsement notice

The text of ISO 16089:2015 has been approved by CEN as EN ISO 16089:2015 without any modification.

**Annex ZA**  
(informative)  
**Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC**

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

**WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.**

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

[SIST EN ISO 16089:2016](https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016)

<https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016>

INTERNATIONAL  
STANDARD

ISO  
16089

First edition  
2015-11-15

---

---

**Machine tools — Safety — Stationary  
grinding machines**

*Machines-outils — Sécurité — Machines à meuler fixes*

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN ISO 16089:2016](https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016)

<https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016>



Reference number  
ISO 16089:2015(E)

© ISO 2015

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN ISO 16089:2016

<https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org



# Contents

	Page
<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>3</b>
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
<b>4 List of significant hazards</b> .....	<b>13</b>
4.1 General.....	13
4.2 Main hazard zones.....	14
4.3 Significant hazards and hazardous situations covered by this International Standard.....	14
<b>5 Safety requirements and/or measures</b> .....	<b>18</b>
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 capability.....	22
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

## ISO 16089:2015(E)

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
<b>6</b>	<b>Verification of the safety requirements and/or protective measures</b>	<b>45</b>
<b>7</b>	<b>Information for use</b>	<b>48</b>
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
<b>Annex A</b>	<b>(normative) Abrasive product guards, work zone enclosures, and their combinations</b>	<b>55</b>
<b>Annex B</b>	<b>(informative) Impact test for guards — Bursting test</b>	<b>94</b>
<b>Annex C</b>	<b>(informative) Impact test for guards — Projectile impact</b>	<b>97</b>
<b>Annex D</b>	<b>(normative) Clamping methods for abrasive products and safety requirements for tool holding devices</b>	<b>101</b>
<b>Annex E</b>	<b>(informative) Noise reduction</b>	<b>112</b>
<b>Annex F</b>	<b>(informative) Noise emission determination</b>	<b>113</b>
<b>Annex G</b>	<b>(normative) Requirements for grinding machines for the machining of materials generating flammable and explosive dusts</b>	<b>114</b>
<b>Annex H</b>	<b>(informative) Measures for the use of flammable metalworking fluids</b>	<b>117</b>
<b>Annex I</b>	<b>(informative) Examples for the integration of extraction and fire extinguishing systems when using flammable metalworking fluids</b>	<b>120</b>
<b>Annex J</b>	<b>(informative) Functional safety — Example for rotational speed limit monitoring of the wheel spindle</b>	<b>122</b>
<b>Annex K</b>	<b>(informative) MSO 3 (Optional special mode for manual intervention under restricted operating conditions) – Examples</b>	<b>125</b>
<b>Bibliography</b>		<b>130</b>

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information \(standards.iteh.ai\)](http://Foreword - Supplementary information (standards.iteh.ai))

The committee responsible for this document is Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 10, *Safety*.

This first edition of ISO 16089 is an adaptation of European Standard EN 13218:2002+A1/AC:2010-04. Significant differences between the European Standard and ISO 16089 are as follows.

- a) Introduction of a subdivision of grinding machines into three groups, based on the degree of automation. Specific safety measures for safe design for each group of grinding machines.
- b) Introduction of the Mode of safe operation 3 (*optional special mode for manual intervention under restricted operating conditions*) with a separate selection device and specific safety measures, and a new informative Annex providing examples.
- c) Instead of the categories of EN 954-1, the required performance level according to ISO 13849-1 is defined for relevant safety functions.
- d) The decrease in the impact resistance of unprotected polycarbonate depending on the duration of use is shown in the form of an aging curve in Annex A.
- e) Measures for the use of flammable metalworking fluids are given in the new Annex H.
- f) Examples for the integration of extraction and fire extinguishing systems when using flammable metalworking fluids are given in the new Annex I.
- g) Example for rotational speed limit monitoring of the wheel spindle given in the new Annex K.

## ISO 16089:2015(E)

### Introduction

In order to take technological progress into account, it was decided to revise EN 13218 for this purpose. Due to the worldwide use of these machines, an agreement was made by CEN/TC 143 and ISO/TC 39/SC 10. According to the Vienna Agreement, this revision was carried out as ISO 16089.

A decisive aspect for the preparation of this standard was the consideration of foreseeable misuse, e.g. by means of manipulation of protective devices.

Safety measures for grinding machines are, in particular, characterized by guards with interlocking and guard locking, to effectively counteract risks of fracture of ceramic tools. In some special cases of grinding operations, guards can be regarded as disturbing by the operator because they obstruct process monitoring. Then, by means of manipulation of the interlocking devices, automatic mode without guard can occur with dramatically increased hazards for the operator. To reduce the incentive for manipulation, the possibility of using a special mode (MSO 3) was provided in the operating mode concept for grinding machines such as in the preceding standard EN 13218. This implies the same strong safety measures as for the operating mode setting. These restrictions offer a significant motivation for switching back into automatic mode where higher speeds and feed rates are available for a more profitable production. Comparisons of risks show that the provision of a special mode presents a much lower risk than a manipulated automatic mode.

At the time this International Standard was developed, it was already foreseen that the information given in [A.3.2](#) on the wall thickness of abrasive product guards and in [A.3.5](#) on the work zone enclosure will probably be modified by an Amendment to this International Standard, depending on the result of further scientific research.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN ISO 16089:2016](#)

<https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc5366ab6/sist-en-iso-16089-2016>

# Machine tools — Safety — Stationary grinding machines

## 1 Scope

This International Standard specifies the requirements and/or measures to eliminate the hazards or reduce the risks in the following groups of stationary grinding machines which are designed primarily to shape metal by grinding:

**Group 1:** Manually controlled grinding machines without power operated axes and without numerical control.

**Group 2:** Manually controlled grinding machines with power operated axes and limited numerically controlled capability, if applicable.

**Group 3:** Numerically controlled grinding machines.

NOTE 1 For detailed information on the groups of grinding machines, see the definitions in [3.1](#) and [3.4](#).

NOTE 2 Requirements in this International Standard are, in general, applicable to all groups of grinding machines. If requirements are applicable to some special group(s) of grinding machines only, then the special group(s) of grinding machine(s) is/are specified.

This International Standard covers the significant hazards listed in [Clause 4](#) and applies to ancillary devices (e.g. for workpieces, tools, and workpiece holding devices, handling devices), which are integral to the machine.

This International Standard also applies to machines which are integrated into an automatic production line or grinding cell inasmuch as the hazards and risks arising are comparable to those of machines working separately.

This International Standard also includes in [Clause 7](#) a minimum list of safety-relevant information which the manufacturer has to provide to the user. See also ISO 12100:2010, Figure 2, which illustrates the interaction of manufacturer's and user's responsibility for the operational safety.

The user's responsibility to identify specific hazards (e.g. fire and explosion) and reduce the associated risks can be critical (e.g. whether the central extraction system is working correctly).

Where additional metalworking processes (e.g. milling, turning, laser processing) are involved, this International Standard can be taken as a basis for safety requirements. For specific information on hazards arising from other metalworking processes, which are covered by other International Standards, see the Bibliography.

This International Standard applies to machines that are manufactured after the date of issue of this International Standard.

This International Standard does not apply to stationary honing, polishing, and belt grinding machines and not to transportable motor-operated electric tools in accordance with IEC 61029-2-4 and IEC 61029-2-10.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 447, *Machine tools — Direction of operation of controls*

**ISO 16089:2015(E)**

- ISO 2553, *Welding and allied processes — Symbolic representation on drawings — Welded joints*
- ISO 3834-1, *Quality requirements for fusion welding of metallic materials — Part 1: Criteria for the selection of the appropriate level of quality requirements*
- ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*
- ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*
- ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*
- ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*
- ISO 9355-1, *Ergonomic requirements for the design of displays and control actuators — Part 1: Human interactions with displays and control actuators*
- ISO 9355-2, *Ergonomic requirements for the design of displays and control actuators — Part 2: Displays*
- ISO 9355-3, *Ergonomic requirements for the design of displays and control actuators — Part 3: Control actuators*
- ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*
- ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys*
- ISO 10218-1:2006, *Robots for industrial environments — Safety requirements — Part 1: Robots*
- ISO 11161, *Safety of machinery — Integrated manufacturing systems — Basic requirements*
- ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*
- ISO 13849-1:2006, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*
- ISO 13850, *Safety of machinery — Emergency stop — Principles for design*
- ISO 13856-2, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars*
- ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*
- ISO 14118:2000, *Safety of machinery — Prevention of unexpected start-up*
- ISO 14119:1998, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*
- ISO 14120:2002, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*
- ISO 14122-1, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two levels*
- ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*
- ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*
- ISO 14122-4, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders*

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 19719, *Machine tools — Work holding chucks — Vocabulary*

IEC 60204-1:2009, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60825-1, *Safety of laser products — Part 1: Equipment classification and requirements*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments*

IEC 61800-5-2, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements - Functional*

IEC 62061, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems*

EN 1127-1, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100, ISO 13849-1, and the following apply.

iTeh STANDARD PREVIEW

#### 3.1 General terms (standards.iteh.ai)

##### 3.1.1

**grinding machine** SIST EN ISO 16089:2016  
https://standards.iteh.ai/catalog/standards/sist/f34b2737-56c1-48bb-b841-1e5bc556a86/sist-en-iso-16089-2016  
machine tool intended to machine workpieces by means of rotating grinding tools

Note 1 to entry: The machine can combine different types of grinding methods, e.g. external cylindrical grinding and internal cylindrical grinding.

##### 3.1.1.1

**stationary grinding machine**  
*grinding machine* (3.1.1) fixed in position during operation

Note 1 to entry: For types and groups of stationary grinding machines, see 3.4.

Note 2 to entry: In the following text of this International Standard, the term “grinding machines” will stand for “stationary grinding machines”.

##### 3.1.2

**manual control**  
control where each movement of the machine is individually initiated and controlled by the operator

##### 3.1.3

**manually controlled grinding machine**  
*grinding machine* (3.1.1) for which all process steps for the machining are controlled or started by an operator without support by an NC-machining program

##### 3.1.4

**numerical control**  
**NC**  
automatic control of a process performed by a device that makes use of numeric data introduced while operation is in progress

[SOURCE: ISO 2806:1994, 2.1.1]