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Geometrical product specifications (GPS) — Dimensional measuring equipment: Electronic digital-indicator gauge — Design and metrological characteristics

Spécification géométrique des produits (GPS) — Instruments de mesurage dimensionnel: Comparateurs à tige rentrante à affichage numérique — Caractéristiques de conception et caractéristiques métrologiques

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 13102 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

Introduction

This International Standard is a Geometrical Product Specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences chain link 5 of the chain of standards on size and distance in the general GPS matrix.

The ISO/GPS Masterplan given in ISO/TR 14638 gives an overview of the ISO/GPS system of which this standard is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this standard, and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this standard, unless otherwise indicated.

For more detailed information of the relation of the standard to other standards and the GPS matrix model, see Annex D.

Geometrical product specifications (GPS) — Dimensional measuring equipment: Electronic digital-indicator gauge — Design and metrological characteristics

1 Scope

This International Standard specifies the most important design and metrological characteristics of electronic digital-indicator gauges.

2 Normative references

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

ISO 14253-1, *Geometrical Product Specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for proving conformance or non-conformance with specifications*

ISO 14253-2, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 2: Guide to the estimation of uncertainty in GPS measurement, in calibration of measuring equipment and in product verification*

ISO 14978:2006, *Geometrical product specification (GPS) — General concepts and requirement for GPS measuring equipment*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14978, and the following apply.

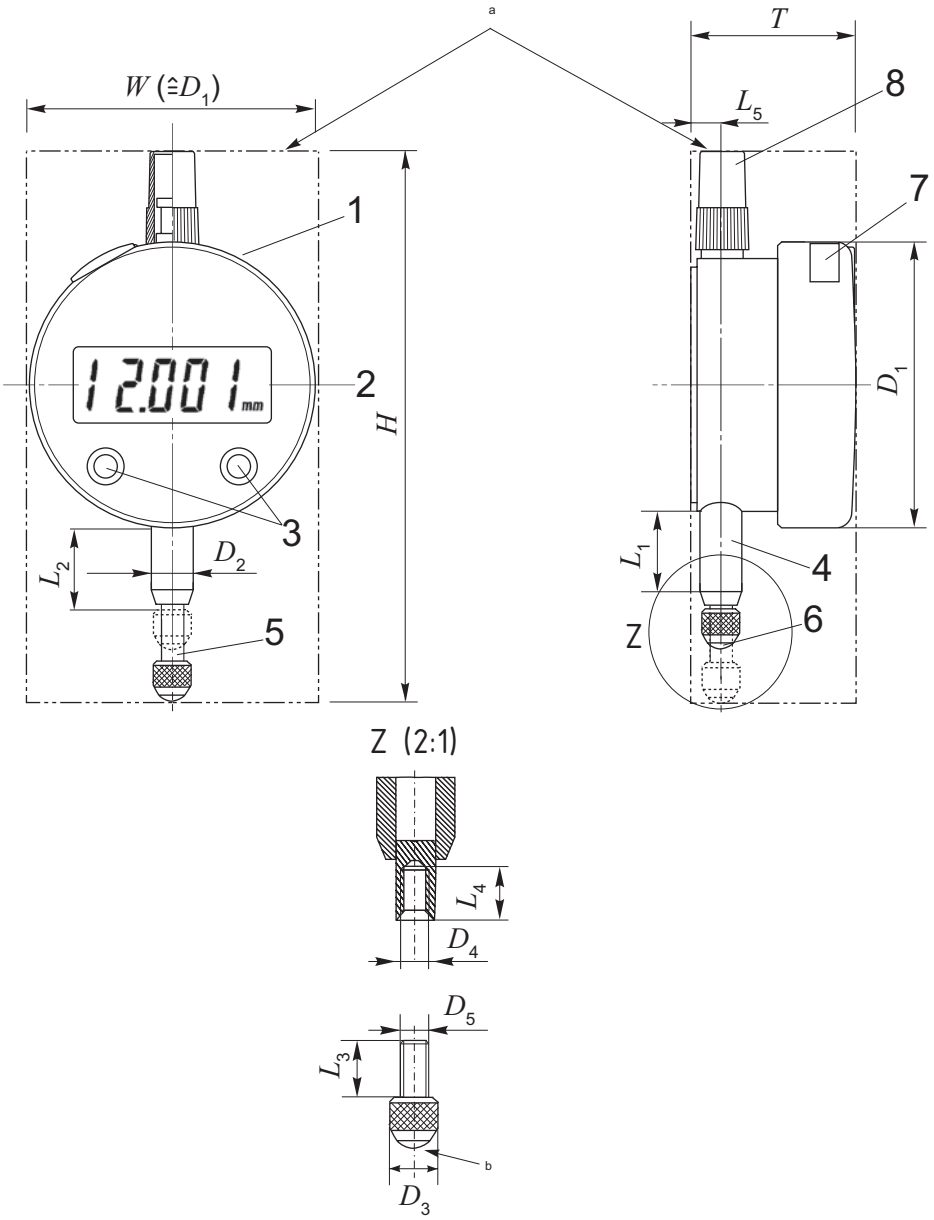
3.1
electronic digital-indicator gauge
measuring instrument in which the axial displacements of a plunger are obtained by a transducer and converted into an electronic signal by suitable electronic means and transmitted to a physically integrated digital display

4 Design characteristics

4.1 General design and nomenclature

The general design and workmanship shall be such that the performance of the electronic digital-indicator gauge complies with the requirements of this International Standard.

The design and rigidity of the electronic digital-indicator gauge shall be such that the freedom of movement of the plunger is not impaired by clamping the stem of the instrument, providing that such clamping is carried out in a proper manner. Where alternative methods of mounting are provided, e.g. attaching the lug on the back plate, the design and rigidity of that mounting shall be such that the performance is not impaired.



Key

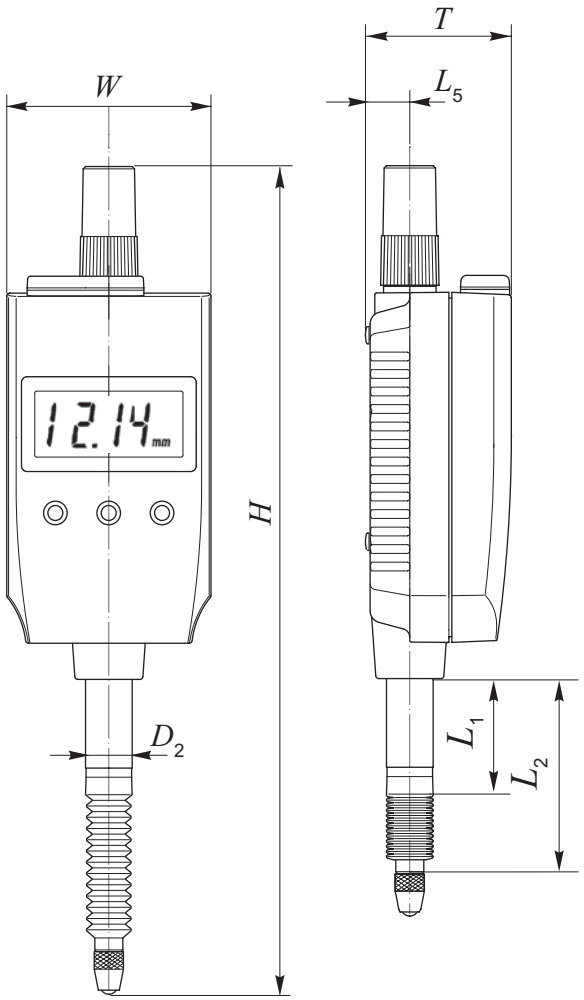
1	bezel	5	plunger	*W*	width
2	display	6	contact element	*H*	height
3	operating buttons	7	data output — optional	*T*	thickness
4	stem	8	protection cap — optional		

a Overall dimension.

b Measuring face.

See Table 1 for the *D* and *L* dimensions.

Figure 1 — Nomenclature and general design of an electronic digital-indicator gauge



See Table 1 for the D and L dimensions.

Figure 2 — Nomenclature and general design of electronic digital-indicator gauge (rectangular type)

4.2 Main dimensions

The electronic digital-indicator gauge shall conform to the dimensions specified in Figures 1 and 2 and Table 1 to ensure interchangeability.

Table 1 — Dimensions of an electronic digital-indicator gauge

Values in millimetres

Dimension	Nominal value
Bezel diameter D_1 ($\triangleq W$)	[a]
Stem diameter D_2	8 h6
Contact element outside diameter D_3	max. 7,5
Thread size D_4	M2,5-6H
Thread size D_5	M2,5-6g
Stem length L_1	min. 10
Length L_2 [b]	[c]
Thread length L_3	max. 5
Thread length L_4	min. 6
Distance L_5	max. 12

[a] Generally the diameter of the bezel D_1 equals the maximal width (W) of the electronic digital-indicator gauge.

[b] L_2 is the length between the housing and the end of the plunger if the plunger is pressed in.

[c] Depending on the measuring range.

4.3 Digital indicating display

The design of the digital indication shall be such that the measured values are clearly displayed in any position of the plunger. The unit of measure shall be clearly identified. In the case of negative values the – sign shall be indicated.

4.4 Error messages

The electronic digital-indicator gauge shall include means suited for displaying operation- and system-error messages.

EXAMPLE Error message caused by excessively rapid plunger movement or insufficient power supply.

4.5 Interface

When the unit provides an electronic interface, the manufacturer shall describe the transmission format and protocol of data outputs with as much details as possible.

4.6 Protection for field use

Manufacturers shall clearly indicate, referring to the applicable standard(s), the kind of water and dust protection (e.g. IP code according to IEC 60529), as well as the type of electromagnetic field protection, if present.

4.7 Contact element

The contact element shall be interchangeable. A selection of elements shall be available. They shall have wear-resistant measuring surfaces and shall be of suitable form and surface finish allowing the user to select a suitable contact element depending on the measuring task (see Figure 1).

4.8 Zero adjustment

Each electronic digital indicator shall be provided with means for setting the indicator to a zero indication in any measuring position.

4.9 Additional functions

Additional functions such as counting direction change, value preset and value storage shall be documented by the manufacturer.

4.10 Design characteristics (manufacturer's specification)

As a minimum requirement, the manufacturers shall specify the design characteristics of the electronic digital-indicator gauge, given in Table 2.

Table 2 — Design characteristics

Characteristics				Value	Unit
Overall dimensions	Width	W ($\triangleq D_1$)			mm
	Thickness	T			
	Height	H			
Measuring range					
Resolution (equal to the digital step)					
Height of figures displayed					
Maximum plunger movement speed					mm/s
Presence of:	Data output		Yes/No		
	Plunger lifting device		Yes/No		
	Attachment mounting and type		Yes/No		
	Fluid (water) and dust protection		Yes[a]/No		
	Electromagnetic field protection (if present)		Yes/No		
	Rotating display		Yes/No		
Type of power supply			Battery/ External		

[a] IP code according to IEC 60529.

5 Metrological characteristics

5.1 General

The manufacturer shall specify MPE and MPL information for the metrological characteristics of the electronic digital-indicator gauge which are listed in Table 3. Unless otherwise specified by the manufacturer, the static response of the electronic digital-indicator gauge shall comply with the MPE/MPL values at any orientation of the gauge.

The metrological characteristics of this International Standard apply when the zero or reference point is set at any position within the measuring range.

5.2 Maximum permissible error of indication

5.2.1 Hysteresis of error of indication (limited by MPE_H)

Range of the results measured at the same measuring point using both directions of the plunger displacement.

5.2.2 Repeatability of error of indication (limited by MPE_R)

Range of the results of successive measurements of the same measurand carried out under the same conditions of measurement.

5.2.3 Maximum permissible error of indication for the partial measuring range (limited by MPE_P)

Error of indication when the measurement is performed by using any partial measuring range.

5.2.4 Maximum permissible error of indication for the total measuring range (limited by MPE_E)

The requirements for the error of indication apply to any indication based on the zero or reference-point setting stated in 5.1.

5.3 Maximum permissible limit

5.3.1 Measuring forces (limited by MPL)

The measuring force shall be given as maximum and minimum measuring force. The data sheet given in Annex B can be used for the indication of the numerical values of the MPE and MPL.

The measuring force characteristics are based on a two-sided specification given in 7.5.6 of ISO 14978:2006.

Table 3 — Metrological characteristics

Characteristics		MPE or MPL			
Hysteresis of error of indication MPE_H					mm
Repeatability of error of indication MPE_R					
Errors of indication in:	Resolution (equal to the digital step)	0,01	0,001	0,000 5	
	Partial measuring range (50 times of the digital step)	0,5	0,05	0,025	
	MPE_P (any partial measuring range)				
	Measuring range				
	MPE_E				
Measuring forces	Maximum				N
	Minimum				

6 Proving of conformance with specification

For the proving of conformance and non-conformance with specifications, ISO 14253-1 applies. Uncertainty evaluation shall be performed according to ISO 14253-2 and ISO/IEC Guide 98-3.

7 Marking

The marking shall indicate at least the following data:

— the measuring range;

— the resolution (equal to the digital step);

— the unique alphanumeric identification (i.e. serial number).

Any marking shall be easily readable and permanent and shall be placed on the surface of the gauge at a place not impairing the metrological quality of the equipment.

Annex A
(informative)

Example of a diagram of errors of indication

Figure A.1 shows an example of a diagram of errors of indication. This data set is simplified in order to illustrate the characteristics of the electronic digital-indicator gauge with a measuring range of 10 mm and a digital step of 10 µm. The partial measuring range is 0,5 mm, i.e. 50 times that of 10 µm. See also Clause 7 of ISO 14978:2006.

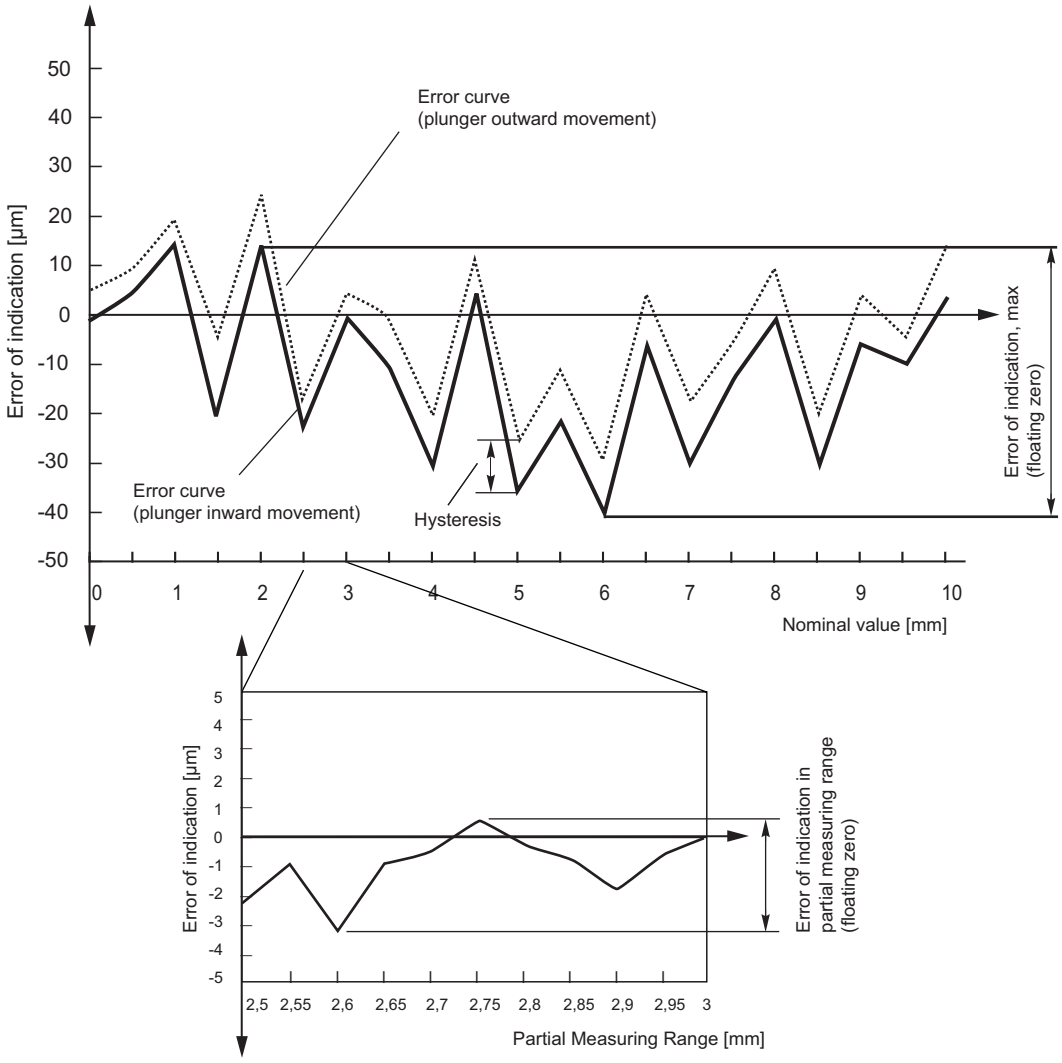


Figure A.1 — Diagram of errors of indication

Annex B
(informative)

Data sheet (example)

This data sheet is intended for the structured communication between the technical experts and the purchasing department of the same company.

Name of equipment: .....

Detailed requirements (e.g. contact element, protection against water and dust, shock protection, lifting device, back plate lug): .....

.....

.....

Functions (e.g. counting direction change, value preset, value storage): .....

.....

Possible suppliers: .....

Price range (optional): .....

Additional requirements (e.g. inspection report, calibration certificate): .....

.....

Accessories: .....

The design and metrological characteristics refer to the International Standard ISO 13102.

Design characteristics

Overall dimensions: Thickness T: ..... mm Width W: ..... mm Height H: ..... mm

Mesuring range: ..... mm

Digital step: ..... mm

Metrological characteristics

Hysteresis of indication (MPE_H): ..... µm

Repeatability of indication (MPE_R): ..... µm

Errors of indication over a range of:

Partial measuring range (MPE_P) ..... µm

Total measuring range (MPE_E) ..... µm

Measuring forces (MPL): Maximum: ..... N Minimum: ..... N

Company: .....

Department: ..... Person responsible: .....

Date: ..... Signature: .....

Annex C
(informative)

Calibration of metrological characteristics

The methods should evaluate the performance of the instrument within its measuring range using both of the plunger's displacement directions.

NOTE It is essential that the electronic digital-indicator gauge be held rigidly in a fixture which is undisturbed by the operating force of the instrument itself.

The global calibration of a sufficient number of measuring points over the total measuring range will necessitate a large number of readings to be taken. When the intended use of the indicator is considered not to warrant global calibration, partial calibration or task-related calibration should be considered.

For the determination of the indication errors according to Table 3, a suitable number of intervals are necessary, which are dependent on the digital step and the measuring range or the measuring range used. With these values calibration curves with fixed or floating zeros can be recorded. The MPE-function for the characteristics is given as only one two-sided specification with the constant symmetrical limits USL and LSL as the MPE for the measuring range (see Figure 9 in ISO 14978:2006).

It is possible to perform a modified global calibration with a reduced number of measuring points by using a suitable sampling technique, but this will result in an increase in the uncertainty of measurement.

Annex A shows an example of a diagram (with a very small number of measuring points) of errors of indication (calibration curve) and the hysteresis band of an electronic digital-indicator gauge with a digital step of 10 µm, where zero was fixed at the lower limit of the measuring span.

By means of these measuring values, the errors are obtained for various measured length over the measuring range that could be calculated (see Figure 7 in ISO 14978:2006); i.e. the indicator is used with floating zero indicating measuring equipment (see 7.2.2 in ISO 14978:2006).

Annex D
(informative)

Relation to the GPS matrix model

D.1 General

For full details about the GPS matrix model, see ISO/TR 14638.

The ISO/GPS Masterplan given in ISO/TR 14638 gives an overview of the ISO/GPS system of which this standard is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this standard, and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this standard, unless otherwise indicated.

D.2 Information about the International Standard and its use

This International Standard provides the most important design and metrological characteristics of electronic digital indicators.

D.3 Position in the GPS matrix model

This International Standard is a general GPS standard, which influences chain link 5 of the chain of standards on size and distance in the general GPS matrix, as graphically illustrated by Figure D.1.

Fundamental GPS standards

Global GPS standards

General GPS standards						
Chain link number	**1**	**2**	**3**	**4**	**5**	**6**
Size					X	
Distance					X	
Radius						
Angle						
Form of a line independent of datum						
Form of a line dependent on datum						
Form of a surface independent of datum						
Form of a surface dependent on datum						
Orientation						
Location						
Circular run-out						
Total run-out						
Datums						
Roughness profile						
Waviness profile						
Primary profile						
Surface imperfections						
Edges						
Areal surface textures						

Figure D.1 — Position in the GPS-matrix model

Bibliography

[1] ISO 8015, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

[2] ISO/TR 14638:1995, *Geometrical Product Specifications (GPS) — Masterplan*

[3] ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

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