INTERNATIONAL STANDARD

ISO 1938-1

First edition
2015-11-01

Geometrical product specifications (GPS) — Dimensional measuring equipment —

Part 1: Plain limit gauges of linear size

Spécification géométrique des produits (GPS) — Équipement de mesure dimensionnel —
Partie 1: Calibres lisses à limite de taille linéaire

Reference number
ISO 1938-1:2015(E)

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Foreword

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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).

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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

The committee responsible for this document is ISO/TC 213, *Geometrical product specifications and verification*.

This first edition cancels and replaces ISO/R 1938:1971, which has been technically revised.

ISO 1938 consists of the following parts, under the general title *Geometrical product specifications (GPS) — Dimensional measuring equipment*:

— *Part 1: Plain limit gauges of linear size*

— *Part 2: Reference disk gauges*

This part of ISO 1938 does not include requirements for setting plug gauges and setting ring gauges, which were dealt with in ISO/R 1938:1971, 3.9.4.

This part of ISO 1938 covers the concepts and principles developed in ISO 14978.

Introduction

This part of ISO 1938 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences chain links E, F and G of the size chain of standards in the general GPS matrix. For more detailed information of the relation of this part of ISO 1938 to other standards and the GPS matrix model, see Annex C.

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

The terms and concepts used in this first edition of ISO 1938-1 (compared to the former edition ISO/R 1938:1971) have been changed according to needs and terminology in the other GPS standards.

This part of ISO 1938 deals with verification, using plain limit gauges, of linear sizes for features of size when the dimensional specifications are required (see ISO 14405-1), for rigid workpieces.

NOTE Tables 4 and 5 use the modifiers given in ISO 14405-1 and ISO 1101.

Geometrical product specifications (GPS) — Dimensional measuring equipment —

Part 1:
Plain limit gauges of linear size

1 Scope

This part of ISO 1938 specifies the most important metrological and design characteristics of plain limit gauges of linear size.

This part of ISO 1938 defines the different types of plain limit gauges used to verify linear dimensional specifications associated with linear size.

This part of ISO 1938 also defines the design characteristics and the metrological characteristics for these limit gauges as well as the new or wear limits state Maximum Permissible Limits (MPLs) for the new state or wear limits state for these metrological characteristics.

In addition, this part of ISO 1938 describes the use of limit gauges. It covers linear sizes up to 500 mm.

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 286-1:2010, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 1: Basis of tolerances, deviations and fits*

ISO 1101:2012, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 14405-1:2010, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

ISO 14253-1:2013, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for proving conformity or nonconformity with specifications*

ISO 14253-2:2011, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 2: Guidance for the estimation of uncertainty in GPS measurement, in calibration of measuring equipment and in product verification*

ISO 17450-1:2011, *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

ISO 17450-2:2012, *Geometrical product specifications (GPS) — General concepts — Part 2: Basic tenets, specifications, operators, uncertainties and ambiguities*

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

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

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 286-1, ISO 14405-1, ISO 17450-2, ISO/IEC Guide 98-3 and ISO/IEC Guide 99 and the following definitions apply.

3.1 Limits

3.1.1
maximum material limit of size
MMLS
limit of size corresponding to the maximum material condition of feature of size

Note 1 to entry: MMLS includes the numerical value for the size and the specified association criteria.

Note 2 to entry: A number of different association criteria for size are given in ISO 14660-2 and ISO 14405-1.

3.1.2
least material limit of size
LMLS
limit of size corresponding to the least material condition of feature of size

Note 1 to entry: LMLS includes the numerical value for the size and the specified association criteria.

Note 2 to entry: A number of different association criteria for size are given in ISO 14660-2 and ISO 14405-1.

3.1.3
upper limit of size
ULS
largest permissible size of a feature of size

Note 1 to entry: ULS is a numerical value.

[SOURCE: ISO 286-1:2010, 3.2.3.1]

3.1.4
lower limit of size
LLS
smallest permissible size of a feature of size

Note 1 to entry: LLS is a numerical value.

[SOURCE: ISO 286-1:2010, 3.2.3.2]

3.1.5
upper specification limit
USL
<of the gauge> limit of a specification for a metrological characteristic of a gauge having the largest value

3.1.6
lower specification limit
LSL
<of the gauge> limit of a specification for a metrological characteristic of a gauge having the smallest value

3.2 Gauge types

3.2.1
limit gauge
gauge designed and intended to verify only if workpiece characteristics are inside or outside the tolerance at one of its tolerance limits

Note 1 to entry: When a limit gauge is designed to verify an internal feature of size (a hole for example), then it can be called internal limit gauge.

Note 2 to entry: When a limit gauge is designed to verify an external feature of size (a shaft for example), then it can be called external limit gauge.

Note 3 to entry: General application of limit gauge is given in Annex A.

Note 4 to entry: A limit gauge may be physical or virtual.

3.2.2
plain limit gauge
physical limit gauge with only one or two gauge elements, each one simulating a perfect feature of size, whose size is derived from upper or lower specification limits of the size of a feature of size

Note 1 to entry: When a plain limit gauge consists of only one element, it is qualified as simple (simple plain limit gauge: GO plain limit gauge or NO GO plain limit gauge).

Note 2 to entry: When a plain limit gauge consists of two elements, it is qualified as double (double plain limit gauge: GO and NO GO).

3.2.3
full form cylindrical plug gauge
gauge type A
plain limit gauge designed to simulate a cylinder as a contacting feature with an internal cylinder

Note 1 to entry: See Table 1.

Note 2 to entry: The GO gauge type A simulates a dimensional specification defining the maximum material limit of size with the envelope requirement when the gauge length is greater or at least equal to the length of the feature of size of the workpiece.

3.2.4
segmental cylindrical bar gauge
gauge type B
plain limit gauge designed to simulate two opposite angular portions of a cylinder as a contacting feature with an internal cylinder

Note 1 to entry: See Table 1.

3.2.5
segmental cylindrical bar gauge with reduced gauging surfaces
gauge type C
segmental cylindrical bar gauge designed to simulate two reduced opposite angular portions of a cylinder as a contacting surface with an internal cylinder

Note 1 to entry: See Table 1.

3.2.6
full form spherical plug gauge
gauge type D
plain limit gauge designed to simulate a circle as a contacting feature with an internal cylinder

Note 1 to entry: See Table 1.

Note 2 to entry: The shape of this gauge type is not spherical, but a torus - per tradition the name is “spherical plug gauge”.

3.2.7
segmental spherical plug gauge
gauge type E
plain limit gauge designed to simulate two opposite angular portions of a circle as a contacting feature with an internal cylinder

Note 1 to entry: See Table 1.

Note 2 to entry: The shape of this gauge type is not spherical but a torus - per tradition the name is “segmental spherical plug gauge”.

3.2.8
bar gauge
gauge type F
full form bar gauge
plain limit gauge designed to simulate two opposite planes as a contacting feature with an internal feature of size consisting of two opposite planes

Note 1 to entry: See Table 1.

3.2.9
rod gauge with spherical ends
gauge type G
plain limit gauge designed to simulate two opposite points as a contacting feature with an internal feature of size consisting of two opposite planes or of a cylinder

Note 1 to entry: See Table 1.

Note 2 to entry: The active part of a rod gauge with spherical ends consists only of two points: the two points at the largest distance between the two spheres.

Table 1 — Types of limit gauge for internal feature of size

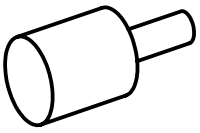
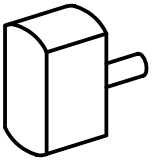
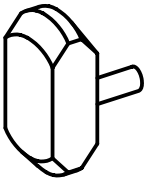
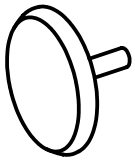
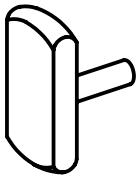
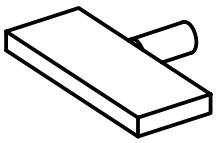
Limit gauge	Type	Illustration	Nominal contacting feature with feature of size of “type Cylinder”	Nominal contacting feature with feature of size of type “two opposite parallel planes”
Full form cylindrical plug gauge	Gauge type A		Cylinder	Two opposite parallel straight lines
Segmental cylindrical bar gauge	Gauge type B		Two opposite angular portions of cylinder	Two opposite parallel straight lines
Segmental cylindrical bar gauge with reduced gauging surfaces	Gauge type C		Two opposite angular reduced portions of cylinder	Two opposite parallel line segments

Table 1 *(continued)*

Limit gauge	Type	Illustration	Nominal contacting feature with feature of size of "type Cylinder"	Nominal contacting feature with feature of size of type "two opposite parallel planes"
Full form spherical plug gauge	Gauge type D		Circle	Two points
Segmental spherical plug gauge	Gauge type E		Two opposite angular portions of circle	Two points
Bar gauge	Gauge type F		Not applicable	Two opposite parallel planes
Rod gauge with spherical ends	Gauge type G		Two points	Two points

3.2.10
full form cylindrical ring gauge
gauge type H
plain limit gauge designed to simulate a cylinder as contacting feature with an external cylinder

Note 1 to entry: See Table 2.

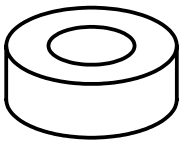
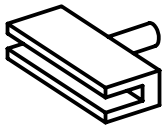
3.2.11
full form notch gauge
gauge type J
plain limit gauge designed to simulate straight lines or flat surfaces on two opposite parallel planes as contacting features with an external feature of size consisting of a cylinder or two opposite planes

Note 1 to entry: See Table 2.

3.2.12
gap gauge
gauge type K
plain limit gauge designed to simulate portions (straight lines or flat surfaces) on two opposite planes as contacting feature with an external feature of size consisting of a cylinder or two opposite planes

Note 1 to entry: See Table 2.

Table 2 — Types of limit gauge for external feature of size

Limit gauge	Type	Illustration	Nominal contacting feature with feature of size of type:	
			"cylinder"	"two opposite parallel planes"
Full form cylindrical ring gauge	Gauge type H		Cylinder	Not applicable
Full form notch gauge	Gauge type J		Two opposite parallel straight lines	Two opposite parallel planes
Gap gauge	Gauge type K		Two opposite parallel straight line segments	Two opposite parallel portions of planes

3.3 Characteristics and function of gauges

3.3.1
non-adjustable gauge
gauge with an inherent, stable and not changeable nominal metrological characteristic

Note 1 to entry: The metrological characteristics of a non-adjustable gauge may change with e.g. temperature and wear.

EXAMPLE A full form cylindrical plug gauge and a full form cylindrical ring gauge are non-adjustable gauges.

3.3.2
adjustable gauge
gauge designed in a way that the inherent nominal metrological characteristic can be intentionally changed by the user

Note 1 to entry: The metrological characteristics of an adjustable gauge may also change with e.g. temperature and wear.

EXAMPLE A variable gap gauge and a variable rod gauge with spherical ends are adjustable gauges.

3.3.3
GO gauge
gauge designed to verify the size of the workpiece relative to maximum material size according to dimensional specification

Note 1 to entry: Usually relative to the maximum material limit of size (MMLS) of the dimensional specification, the GO gauge passing over the actual feature of size of the workpiece, defines an acceptance and the GO gauge, not passing over the actual feature of size of the workpiece defines a non-acceptance.

3.3.4
NO GO gauge
gauge designed to verify the size of the workpiece relative to least material size according to dimensional specification

Note 1 to entry: Usually relative to the least material limit of size (LMLS) of the dimensional specification, the NO GO gauge not passing over the actual feature of size of the workpiece defines an acceptance and the NO GO gauge passing over the actual feature of size of the workpiece defines a non-acceptance.