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ISO

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R 463

DIAL GAUGES READING IN 0.01 mm, 0.001 in AND 0.0001 in

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BRIEF HISTORY

The ISO Recommendation R 463, *Dial Gauges Reading in 0.01 mm, 0.001 and 0.0001 in* was drawn up by Technical Committee ISO/TC 3, *Limits and Fits*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question by the Technical Committee began in 1949 and led, in 1960, to the adoption of a Draft ISO Recommendation.

In March 1963, this Draft ISO Recommendation (No. 561) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Australia	France	Portugal
Austria	Germany	Romania
Belgium	Greece	Spain
Burma	Hungary	Switzerland
Canada	India	United Kingdom
Chile	Italy	U.S.S.R.
Czechoslovakia	Japan	Yugoslavia
Denmark	Norway	
Finland	Poland	

Three Member Bodies opposed the approval of the Draft:

Netherlands, Sweden, U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, wich decided, in December 1965, to accept it as an ISO RECOMMENDATION.

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ISO Recommendation R 463 December 1965

DIAL GAUGES READING IN 0.01 mm, 0.001 in AND 0.0001 in

1. GENERAL

1.1 Scope

The object of this ISO Recommendation is to establish the most important dimensional and functional characteristics of 0.01 mm, 0.001 in and 0.0001 in dial gauges and to give certain recommendations on characteristics of accuracy.

Tests for checking these characteristics are described.

This ISO Recommendation may later be completed to include other indications concerning

(*a*) 0.001 mm dial gauges,

(*b*) a range of recommended contact point radii,

(*c*) establishment of a common range of external diameters of the case,

(*d*) particulars concerning the graduation and numbering of dials.

1.2 Definition

A dial gauge is a measuring instrument in which the displacements of a plunger are transmitted by suitable mechanical means to a pointer which moves in front of a circular dial graduated in equal divisions over the whole of its circumference.

In 0.01 mm dial gauges, each division corresponds to a displacement of the plunger of 0.01 mm. Two types of dial gauges graduated in accordance with the inch system are recognized: the 0.001 in dial gauge, in which each division corresponds to a displacement of the plunger of 0.001 in and which is sometimes subdivided to 0.0005 in, and the 0.0001 in dial gauge in which each division corresponds to a displacement of the plunger of 0.0001 in. All three types may be provided with a revolution-counting device in which an auxiliary pointer moves in front of a scale which indicates the total number of revolutions of the main pointer or the linear displacement of the plunger.

2. SPECIFICATION

A dial gauge may be regarded as satisfactory, at any time in its service, if it meets the requirements below:

Design features,
Quality characteristics.

2.1 Design features

2.1.1 *General dimensions and designations*

See Figure, page 6.

2.1.2 *Dial*

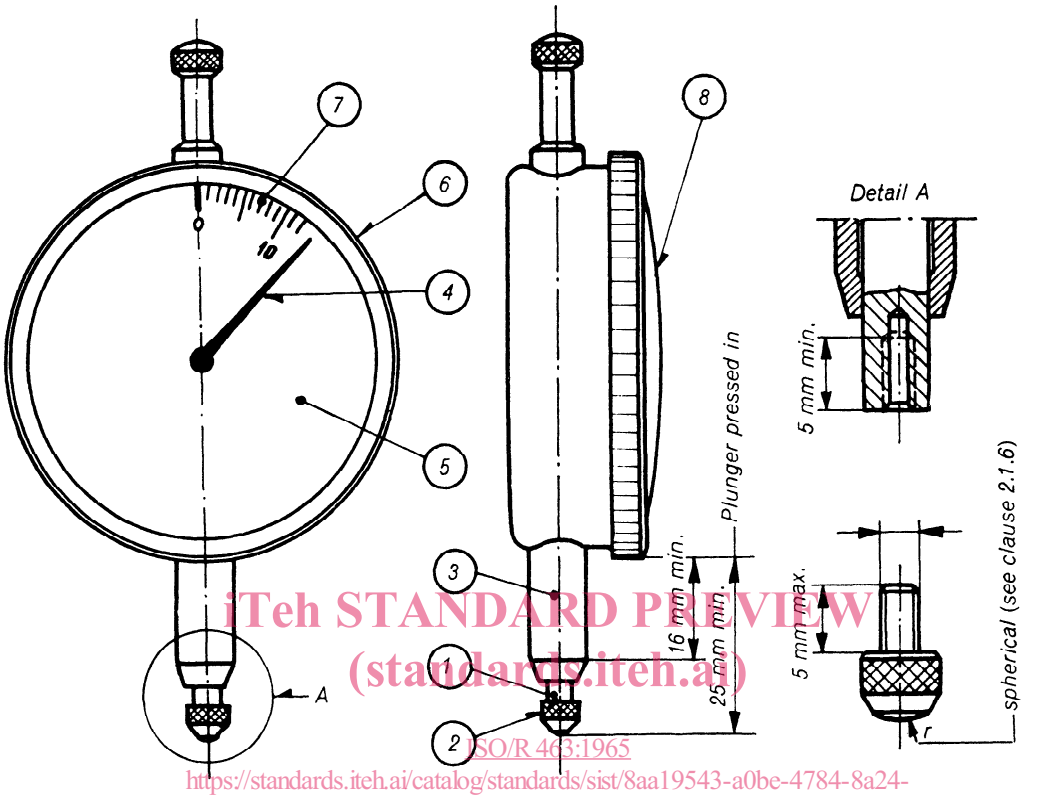
The dial should be graduated with sharp lines which contrast with the background, permitting ease of reading. The interval between graduations should never be less than 1 mm (0.04 in).

2.1.3 *Pointer*

The pointer should move in a clockwise direction, when the plunger is pressed in.

The dial gauge should be so made, or capable of such adjustment, that when the plunger, in a completely free state, is pressed in, the pointer has a traverse of at least 1/10 of a revolution before its tip passes for the first time over the point of the dial farthest from the contact point of the plunger. At this stage, the pointer of the revolution-counter should indicate zero.

This dead motion is not included in the total useful travel indicated by the manufacturers.



1 Plunger	5 Dial
2 Contact Point	6 Bezel
3 Stem	7 Scale
4 Pointer	8 Transparent Dial Cover

FIGURE. — **Dial gauge**

2.1.4 *Useful travel of the plunger*

Recommended lengths of useful travels of the plunger are:

for dial gauges graduated in 0.01 mm : 3, 5 and 10 mm;

for dial gauges graduated in 0.001 in : 0.5 in;

for dial gauges graduated in 0.0001 in : 0.025 in.

2.1.5 *Zero setting*

Every dial gauge should have a device allowing the pointer and the zero mark on the dial to be set to correspond, for any position of the plunger within its useful travel.

2.1.6 *Plunger contact point*

The plunger contact point should be easily removable and interchangeable (see Figure, page 6). It normally has a wear-resistant end, of spherical form with a radius r selected as large as possible, for metrological reasons, with regard to the application envisaged.

2.1.7 *Fixing devices*

The external diameter of the stem should be either 9.5 mm or 8 mm. In both cases, the attachment of the contact point to the plunger should have a screw thread of M 2.5×0.45.

The fastening should be adequate to ensure repeatability of reading.

2.2 Quality characteristics

2.2.1 *Repeatability*

Repeatability is defined as the ability of a dial gauge to repeat its readings for a given measured length under all normal conditions of use.

Normal conditions of use are as follows:

(*a*) lowering the plunger several times in succession, at various speeds, onto a fixed plate of hard material which is as non-deformable as possible;

(*b*) moving the same part of the plate or cylinder under the contact point of the plunger, in any direction in a plane perpendicular to the axis of the plunger;

(*c*) measuring small movements, of the order of 0.025 mm (0.001 in) for 0.01 mm and 0.001 in dial gauges, and of the order of 0.005 mm (0.0002 in) for 0.0001 in dial gauges;

(*d*) bringing the pointer slowly over the same division of the scale several times, first in one direction and then in the other.

When the dial gauge is used under any of the above conditions, the error of repeatability should not exceed the tolerance given in column 2 of the Table.

2.2.2 *Accuracy*

Accuracy is defined as the ability of a dial gauge to give readings, over specified intervals, the systematic error of which is within the tolerances given in columns 3, 4, 5 and 6 of the Table, and should apply to any position of useful travel of the plunger (see clause 2.1.4).

TABLE. — **Tolerances**

Deviations in scale units

1	2	3	4	5	6
Type of dial gauge	**REPEAT-ABILITY**	**ACCURACY (total deviation)**			
		any 0.1 revolution	any 0.5 revolution	any 2 revolutions	any larger interval
0.01 mm	0.3	0.5	1.0	1.5	2.0
0.001 in	0.3	0.3	0.5	0.75	1.0
0.0001 in	0.3	0.5	1.0	2.0	7.0

2.2.3 *Measuring force*

The maximum measuring force for all types of dial gauge should be about 150 gf (or 150 cN) (eliminating friction).
Variations in the measuring force should not exceed 60 gf (or 60 cN) at any point in the useful travel of the plunger.

3. METHODS OF TEST

3.1 General arrangements for tests

All measurements should be based on the standard reference temperature of 20 °C (68 °F).

For all measurements of repeatability and accuracy, the dial gauge should be mounted on a stand sufficiently rigid for the readings not to be affected by the flexibility of the stand.

All the requirements of test should be met for any direction of the plunger in relation to gravity.

3.2 Repeatability

The tests for repeatability (*a*) (clause 2.2.1) should be carried out at least 5 times for each point of travel checked.

The tests for repeatability (*a*), (*b*), (*c*), (*d*) (clause 2.2.1) should be made at the beginning, middle and end of the plunger travel.

3.3 Accuracy

The calibration of the accuracy of a dial gauge is generally carried out by means of a fixture in which the dial gauge is mounted opposite to and in line with a calibrated micrometer head * or above and perpendicular to a base plate on which slip gauges can be placed. *
In either case a series of readings is taken at intervals suitably spaced over the whole length of the useful travel of the dial gauge (in principle, every tenth of a revolution).

The results obtained are best analysed by means of a calibration curve in which the observed errors in the dial gauges are plotted as ordinates and the positions of the plunger along its travel as abscissae. From the graph obtained by joining successive points, the following may be estimated:

(1) any local error of accuracy, by noting the maximum algebraic difference between the ordinates in an interval of given magnitudes of the useful travel of the plunger;

(2) the overall error of accuracy, by noting the maximum algebraic difference between the ordinates in the whole of the useful travel of the plunger (see clause 2.1.4).

3.4 Measuring force

The measuring force may be checked by means of a calibrated spring, a dynamometer or any device specially designed for this purpose.

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* In all cases of dispute regarding accuracy, the slip gauge method should be used, in which case the arithmetical mean of a series of at least 5 measurements over each of the points in dispute should be taken.

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