International Standard 1880

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Instruments for the measurement of surface roughness by the profile method — Contact (stylus) instruments of progressive profile transformation — Profile recording instruments

Instruments de mesurage de la rugosité des surfaces par la méthode du profil — Instruments (à palpeur) avec contact à transformation progressive du profil — Enregistreurs de profil

Second edition — 1979-11-01

UDC 620.179.118 **Ref. No. ISO 1880-1979 (E)**

Descriptors : measuring instruments, surface condition, roughness, vocabulary.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1880 was developed by Technical Committee ISO/TC 57, *Metrology and properties of surfaces*. It has been approved by the member bodies of the following countries :

Austria	India	Romania
Belgium	Israel	South Africa, Rep. of
Brazil	Italy	Spain
Bulgaria	Japan	Sweden
Canada	Mexico	Switzerland
Chile	Netherlands	Turkey
Czechoslovakia	Norway	United Kingdom
Denmark	New Zealand	USA
Egypt, Arab Rep. of	Peru	USSR
Germany, F. R.	Poland	Yugoslavia
Hungary	Portugal	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
France
Greece

This second edition cancels and replaces the first edition (i.e. ISO 1880-1974).

It also incorporates draft Addendum 1, which was approved by member bodies in 1978 but not published.

Printed in Switzerland

Instruments for the measurement of surface roughness by the profile method — Contact (stylus) instruments of progressive profile transformation — Profile recording instruments

1 Scope and field of application

This International Standard relates to contact profile recording instruments used for the measurement of surface roughness. It specifies

— the basic terms, definitions and symbols relating to profile recording instruments;

— the main parameters of these instruments and their numerical values;

— the standards of accuracy for profile recording instruments (admissible values for errors of vertical and horizontal magnifications, deviations of the tip radius of the stylus and stylus angle).

Calibration methods are given in the annex.

2 References

ISO/R 468, *Surface roughness.*

ISO 1878, *Classification of instruments and devices for measurement and evaluation of the geometrical parameters of surface finish.*

ISO 1879, *Instruments for the measurement of surface roughness by the profile method — Vocabulary.*

3 Terms and definitions

Definitions of the terms "surface roughness" and "irregularities" used in this International Standard are given in ISO/R 468.

Definitions of the terms "instrument for the measurement of surface roughness by the profile method" and "contact (stylus) instrument of progressive transformation of a profile" are given in ISO 1879.

3.1 profile recording instrument : An instrument recording the coordinates of the profile of the surface.

3.2 vertical magnification of a profile recording instrument (V_v) : The scale of transformation of the profile coordinates, by the profile recording instrument, in the direction of stylus displacement normal to the surface.

3.3 horizontal magnification of a profile recording instrument (V_h) : The scale of transformation of the profile coordinates, by the profile recording instrument, in the direction of stylus displacement along the surface.

NOTE — (Definitions 3.2 and 3.3.) By "scale of transformation" is meant the relationship between the recorded quantity and the displacement of the stylus in the relevant direction. In the case of a profile graph it is therefore the ratio of the movement of a pen or a carrier to that of the stylus in the relevant direction.

3.4 relative error of vertical magnification of a profile recording instrument (δ_v) : The difference between the real and the nominal values of the vertical magnification of a profile recording instrument, referred to the nominal value and expressed as a percentage.

3.5 relative error of horizontal magnification of a profile recording instrument (δ_h) : The difference between the real and the nominal values of horizontal magnification of a profile recording instrument, referred to the nominal value and expressed as a percentage.

3.6 recording traversing length : The maximum recording movement of the stylus along the surface, as permitted by the construction of the instrument.

3.7 static measuring force of a contact profile recording instrument : The force which the stylus exerts on the examined surface, without taking into account the dynamic components arising in the process of traversing the surface by a stylus.

3.8 rate of change of measuring force of a contact profile recorder : The change, per unit displacement, of the static measuring force acting on the stylus along its axis.

3.9 profile recording instrument calibration : A metrological operation having as its objective the determination of the errors of a profile recording instrument using standardized measuring means.

Instruments for the measurement of surface roughness by the profile method — Contact (stylus) instruments of progressive profile transformation — Profile recording instruments

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4 Basic parameters

4.1 Stylus tip radius

The nominal value of the tip radius of the stylus shall be selected from the following series :

2 µm 5 µm 10 µm

4.2 Included angle of the stylus

The nominal value of the included angle of the stylus shall be

1,05 rad (60°) or 1,57 rad (90°)

4.3 Measuring force

The measuring force of an instrument shall ensure continuous contact of the stylus with the profile being measured.

The maximum values of static stylus force and the rate of change of measuring force shown in table 1 are recommended.

Table 1 — Measuring force

Nominal value of the stylus tip radius, µm	2	5	10
Maximum static measuring force at mean level of the stylus, N (gf)	0,000 7 (0,07)	0,004 (0,4)	0,016 (1,6)
Maximum rate of change of measuring force, N/m (gf/µm)	35 (0,003 5)	200 (0,02)	800 (0,08)

NOTE — The values given in table 1 for the maximum rate of change of measuring force are provisional and may be amended.

4.4 Vertical and horizontal magnifications

Nominal values of vertical (V_v) and horizontal (V_h) magnifications of profile recording instruments should be selected respectively from the series of numerical values given in table 4.

5 Standards of accuracy

5.1 Admissible relative errors of magnifications

The admissible relative errors of the vertical and horizontal magnifications of the profile recording instrument at all the values of magnification and for all the recorded irregularities shall be selected from the following series of numerical values (expressed as percentages) :

± 1, ± 1,6, ± 2,5, ± 4, ± 6, ± 10

5.2 Deviations of stylus tip radius

Admissible deviations of the tip radius of the stylus from the nominal values are given in table 2.

Table 2 — Deviations of stylus tip radius

Nominal tip radius	µm	2	5	10
Admissible deviation	µm	± 0,5	± 1	± 2,5

5.3 Deviations of stylus angle

Admissible deviations of the stylus angle from the nominal values are given in table 3.

Table 3 — Deviations of stylus angle

Nominal angle	radians	1,05	1,57
	degrees	60	90
Admissible deviation	radians	+ 0,18 − 0,09	+ 0,09 − 0,18
	degrees	+ 10 − 5	+ 5 − 10

Table 4 — Vertical and horizontal magnifications

Magnification	1st Preference			2nd Preference		Other values				
V_v nominal	100	200	500	250	400	125	160	315	630	800
	1 000	2 000	5 000	2 500	4 000	1 250	1 600	3 150	6 300	8 000
	10 000	20 000	50 000	25 000	40 000	12 500	16 000	31 500	63 000	80 000
	100 000									
V_h nominal	10	20	50	25	40					
	100	200	500	250	400					
	1 000	2 000	5 000	2 500	4 000					

Annex

Calibration methods

A.1 Scope and field of application

This annex defines terms and parameters and gives basic rules for the calibration of contact profile recording instruments.

A.2 Methods of calibration

A.2.1 Characteristics to be calibrated and apparatus required

A.2.1.1 Tip radius and included angle of the stylus (see 4.1 and 4.2)

The qualitative determination of the condition of the stylus tip should be made by means of optical apparatus with a magnification of at least 200 X which will detect gross faults.

The quantitative determination of the condition of the stylus should be made by means of calibration specimens[1].

A.2.1.2 Static measurement force (see 4.3)

Checking should be performed by means of a balance with a measuring capacity not exceeding 0,05 N and with a resolution better than 0,000 1 N.

A.2.1.3 Vertical magnification (see 4.4)

The checking of the vertical magnification should be carried out by means of, for example, instrument calibration specimens with profiles so proportioned that the calibration is not affected by the shape of the stylus tip or by the skid(s), if used.

The vertical magnification should be checked over the whole frequency range for which the profile recording instrument is intended (for example as indicated in A.2.2.3).

A.2.1.4 Horizontal magnification (see 4.4)

Checking should be performed by means of specimens with grooves cut at definite spacings.

A.2.2 Calibration methods

A.2.2.1 Tip radius and included angle of the stylus (see 4.1 and 4.2)

Checking of the condition of the operating part of a stylus by means of a microscope is performed, as far as possible, in two mutually perpendicular sections through the stylus. With a magnification of at least 200 X no significant damage to the operating part of the stylus should be visible.

A.2.2.2 Calibration of static measuring force and rate (see 3.8)

The most convenient method is to use a balance dependent on elastic deflection. The balance may comprise a stiff elastic member of which the very small deflection is determined optically or electrically, or it may have the form of a spring or torsion balance.

Alternatively, with care a gravitational balance (for example chemical balance) can be used. A platform convenient for receiving the stylus is placed on one pan and counterbalanced by weights in the other. The pick-up is then mounted adjustably in height over the platform with the stylus resting on it, and weights are added to the other pan to represent the stylus force. Adjustment is made of height and weight until the system comes to rest with the stylus and balance simultaneously in their mean positions. The weight may then be increased or decreased, and the rate found from the change in level of the stylus.

A.2.2.3 Vertical magnification (see 4.4)

If the manufacturer indicates the frequency range for which the profile recording instrument is used, the checking of the vertical magnification within this range is performed at 10 equally spaced points (between the upper and the lower limits of the frequency range). Checking is performed, for example, by means of a specimen with a sinusoidal profile the spacing of which corresponds to the upper limit of the frequency range. To increase the spacing (the working frequency), the specimen is turned in such a way that the angle between the direction of specimen scratches and the pick-up direction of movement is reduced. It is stressed that the instrument datum must remain straight and smooth throughout. The values of vertical magnification should conform to those given in table 4 and should be within the admissible relative errors specified in 5.1.

1) Calibration specimens will be the subject of a future International Standard.