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Graphic technology — Method for radius determination of printing cylinders

Technologie graphique — Méthode de mesure du rayon de cylindres d'impression

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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.

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).

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).

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

The committee responsible for this document is ISO/TC 130, *Graphic technology*.

Introduction

Although the external radius of the cylinders used in offset presses is fixed by the design of the printing press, there are applications in flexography and gravure printing where the diameter of individual cylinders is critical for the final result and has to be determined. This International Standard provides a recommended device and procedure to accomplish such measurements.

The body of this International Standard describes the operational principles and general requirements, including all relevant parameters necessary for the functional design. Different areas of application are covered in different annexes. For each particular application, a normative annex contains the set of critical parameters and a corresponding informative annex contains a set of technical drawings to be utilized in the creation of a suitable device. Functional variables are defined in the body of this International Standard and the aims and tolerances for each targeted application are given in the applicable normative annex.

Standard hand-held micrometers have traditionally been used for checking and determining the radius of printing cylinders. Because the micrometer positioning on a cylinder surface is normally carried out by a human operator, problems with poor repeatability, low precision, and weak reliability of the measurements have been reported. The test method and subsequent device(s) described in the present International Standard represent a cost-efficient, reliable, and operator-independent means of determining the radius of printing cylinders.

The normative annex included in this International Standard defines a particular methodology for measuring the external radius of flexographic printing sleeves and the informative annex provides guidance for the physical design of the instrument.

Sleeves are the structural, mechanical, and dimensional base of a printing forme for different web printing methods. Flexographic printing plates are assembled/mounted on the surface of a sleeve to create a printing forme. Dimensional variations of a sleeve radius can lead to length variations of the printed matter that can have a direct impact on the final appearance of prints. Dimensional variations of a sleeve radius can also have an impact on other functional properties (e.g. in the case of packaging).

Graphic technology — Method for radius determination of printing cylinders

1 Scope

This International Standard defines a method for measuring the external radius of printing cylinders, specifies critical parameters and operational instructions and provides recommendations for instrument design.

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 1101:2004, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 6507-1:2004, *Metallic metarials — Vickers hardness test — Part 1: Test method*

ISO 12637-1, *Graphic technology — Vocabulary — Part 1: Fundamental terms*

3 Terms, definitions, and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12637-1 and the following apply.

3.1.1
flexographic printing
forme-based process/method using flexible relief formes where the raised inked areas reproduce images onto a substrate using low viscosity inks

3.1.2
sleeve
seamless tube used to fasten printing plates to rapidly change printing forme on a press

3.1.3
mandrel
cylindrical shaft equipped with a mechanism that allows a sleeve to be securely attached

3.1.4
repeat
circumference of the external surface of a printing forme when installed for printing

Note 1 to entry: Sleeves are commonly designated by their repeat.

3.1.5
printing cylinder
rotating carrying component of a printing forme structure

Note 1 to entry: A printing cylinder can either be a sleeve on a mandrel or a solid cylinder.

3.2 Symbols

For the purposes of this document, the following symbols apply.

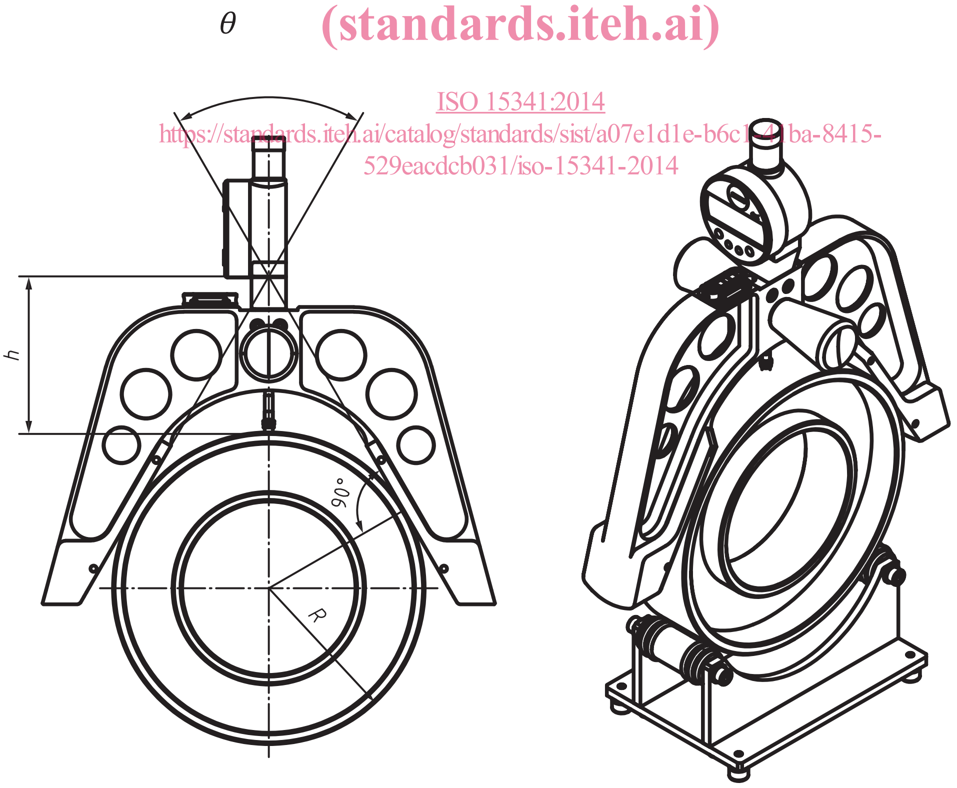
α thermal expansion coefficient (K^{-1})

4 Measurement device

4.1 Principle

The measuring device is formed by a mechanical frame supporting two flat surfaces arranged at a precise angle, as illustrated in Figure 1. A standard high-precision indicator (micrometer) is mounted at the intersection of the two planes created by the previously defined surfaces, as shown in Figure 1.

The device positioning on a cylinder surface is an action physically independent of the measuring using a dedicated frame for positioning. The cylinder radius, *R*, in contact with the measuring tool surface is always at a right angle to the plane. This geometric arrangement allows for the measurement to always be performed perpendicularly to the tangent of the cylinder surface.



Key

η frame angle
R radius of the cylinder
h measured distance

Figure 1 — Operational principle and 3D rendering (example of a device with a 60° angle)

When the device is correctly calibrated, the measured distance, *h*, is a measure of the cylinder radius and can be converted using a suitable formula based on the frame angle. In practice, the measured distance, *h*, can be used to estimate the cylinder radius since the equality is only true if the cylinder is perfectly round. This feature makes the device sensitive to the cylinder shape, allowing for capture of deviations from a perfect round. For measurement of out-of-roundness, it is recommended to take at least three measurements, rotating the cylinder by 60° between measurements.

4.2 Apparatus

Table 1 defines the critical parameters necessary for the construction of an apparatus. Aims and tolerances for specific applications are provided in the annexes.

NOTE 1 It is intended that future editions of this International Standard will contain specific applications beyond that included in Annex A.

Table 1 — Critical parameters

Parameter	Unit
Frame angle	°
Thermal expansion coefficient, *α*	K^{-1}
Total weight of assembled apparatus	kg
Total width of the frame active surfaces	mm
Edge radius of the frame active surfaces	mm
Position of the apparatus centre of mass[a]	mm
Indicator spindle movement range	mm
Calibration tool (ring) diameter	mm

[a] Located along the spindle axis, distance measured from the top of the frame.

Annex A provides information for measurement of mid-web flexographic sleeves.

NOTE 2 Annex A lists the critical parameters for a particular application, measuring mid-web flexography sleeves having a repeat between 490 mm (radius of 77,986 mm) and 740 mm (radius of 117,775 mm).

The device shall contain a mechanism capable of assuring that, during operation, both contact lines generated between the printing cylinder surface and the frame surfaces are parallel to the cylinder longitudinal central axis to ensure a correct reading of the distance. The same or a complementary mechanism shall be capable of assuring the correct operational positioning of the indicator spindle axis during operation.

NOTE 3 A possible implementation is the usage of a mechanism (e.g. by means of a spirit level or an electronic measure) assuring that the frame is horizontal, and therefore also indirectly assuring that the spindle axis is vertical, during operation while in contact with a cylinder.

4.3 Material

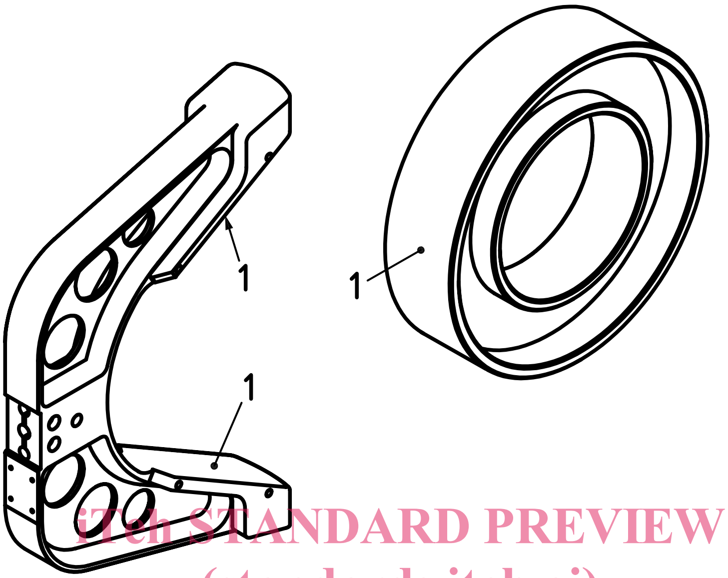
The apparatus frame and calibration tool shall be constructed in a material resistant to minor shocks resulting from normal manual handling. The material shall have an α equal or less than the value specified in Annex A. Handles made from a non-thermal conducting material shall be assembled to the frame in order to minimize temperature increase resulting from hand contact.

The total weight of the assembled apparatus including frame, handles, indicator, rods, and eventual extender shall be inside the aim and tolerances specified in the applicable normative annex. Defining a mass tolerance improves inter-instrument repeatability, specifically when measuring cylinders with a surface of compressible nature.

All active surfaces shall be surface-finished in order to attain a roughness value (Ra) of at least 0,8 µm defined according to ISO 4287.

To increase abrasion and corrosion protection, all active surfaces shall be coated using a material having a Vickers Pyramid Number (HV) equal or higher than 1100HV30 according to ISO 6507-1:2004. Active surfaces are identified in Figure 2. The required protection can be achieved by any means of surface treatment deposition and material choice. The treatment shall not compromise dimensional tolerances or roughness specifications.

NOTE 15 µm of chemical nickel plating (electroless nickel plating) is an example of a suitable surface treatment.



Key

1 active surfaces

Figure 2 — Active surfaces identification of frame and calibration tool

4.4 Dimensions of critical functional parts

The two identical flat active surfaces of the mechanical frame which are in contact with the cylinder during measurement shall have a width and edge radius as specified in Annex A. The specified total width dimension includes the width of the contact line and the two-edge radius. Their length shall be sufficient to ensure a correct physical contact between the device active surface and the cylinder, in this way covering the complete range of specified radius.

The indicator shall be mounted in a position assuring the spindle axis absolute symmetry in relation to the frame.

The assembled apparatus centre of mass shall be located along the spindle axis at a position specified in Annex A.

4.5 Indicator

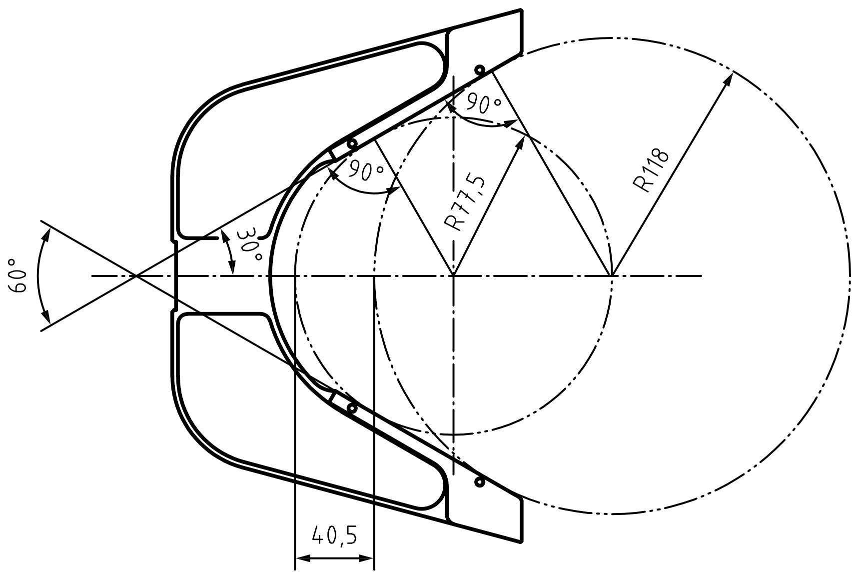
The indicator shall be mounted following the manufacturer's instructions in order not to interfere with performance.

The indicator shall have a precision of at least 0,001 mm, an accuracy of at least 0,003 mm, and a measuring force less than 1,8 N. The valid operating temperature shall be between 10 °C and 40 °C.

The indicator measuring tip shall be flat with a round section, made of hard metal, and have a diameter of 6,5 mm.

The indicator spindle movement shall have a range as specified in Annex A. Extenders to the measuring tip can be used. The range shall be such to cover the complete range of specified radius, as exemplified in Figure 3.

NOTE Informative suggestions regarding the choice of suitable components are made in Annex B.



NOTE An example of a device covering a repeat range between 490 mm and 740 mm, corresponding to a radius between 77,986 mm and 117,775 mm.

Figure 3 — Indicator range

4.6 Calibration tool

A calibration tool with an external surface diameter corresponding approximately to the middle of the measurement range covered by the device shall be used, unless determined by a specific application and, in that situation, the calibration tool diameter can differ. An example of specific application is the particular case where only a subset of the device range of specified radius is used in practice. The calibration tool surface is considered an active surface and shall be constructed and surface finished in accordance with instructions provided in 4.3. Furthermore, the calibration tool surface shall have a roundness of 0,003 mm and shall not exceed 0,008 mm, according to ISO 1101:2004.

The external diameter of the calibration tool shall be measured with a precision of at least 0,001 mm and the resulting measure indicated.

5 Test procedure

5.1 Calibration

The device shall be calibrated

a) prior to use for a series of measurements,

b) every time the indicator is powered on,

c) if the ambient temperature varies more than ±4 °C since the last calibration, and

d) every 30 min when in use.

The calibration tool and the measuring apparatus shall be exposed to the same environment where the measurements shall be performed and be allowed sufficient time to reach thermal equilibrium.