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# INTERNATIONAL STANDARD



# 3685

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

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## Tool-life testing with single-point turning tools

*Essais de durée de vie des outils de tournage à partie active unique*

First edition — 1977-05-15

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UDC 621.941.025 : 620.178.3

Ref. No. ISO 3685-1977 (E)

**Descriptors:** tools, cutting tools, lathe tools, metal working, tests, cut tests, fatigue tests, wear tests, life (durability), wear, test conditions, reference materials, test results, technical data sheets.

Price based on 40 pages

## FOREWORD

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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 3685 was developed by Technical Committee ISO/TC 29, *Small tools*, and was circulated to the member bodies in April 1975.

It has been approved by the member bodies of the following countries :

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

Austria  
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# Tool-life testing with single-point turning tools

## 0 INTRODUCTION

Tool-life testing has been carried out for at least 75 years, in tremendously increasing volume, but under a variety of cutting conditions and methods having little in common with each other. Thus, a need exists for standardization of tool-life testing conditions applicable not only in laboratories but also in production plants.

The test conditions have been specified in such a way that the different factors which affect the results of tool-life testing will all be under a reasonable and practical degree of control.

This International Standard has been so framed that it can be directly applied to industrial testing and in research. For research purposes, however, this International Standard should be considered to be only a minimum set of conditions, since greater attention may have to be given to the factors which affect the variability of the tool-life values. Although the test parameters are standardized, any one or more of them may become variables in any given test when they are the quantities being examined.

The limits of the specification of the reference materials are left rather wide for practical reasons. It should be understood that results may vary from batch to batch. If reproducibility is essential, special requirements should be discussed with the supplier of the work material.

The specifications for test conditions given in this International Standard are primarily suited to testing on steel and cast iron work materials. However, with suitable modification they can also be made applicable to testing on other materials.

The specifications for test conditions are also mainly applicable to tool-life testing in which the tool wears at a conventional rate and in a conventional manner. However, it is evident that they may also be applied to some types of accelerated tool-life testing.

If, for some reason, it is necessary to deviate from the specifications given in this International Standard, this shall be reported in detail.

**NOTE** — This International Standard is not an acceptance test and it is not advisable to use it as such.

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## 1 SCOPE AND FIELD OF APPLICATION

This International Standard establishes specifications for the following factors of tool-life testing with single-point turning tools: workpiece, tool, cutting fluid, cutting conditions, tool wear and tool life, equipment, test procedures, recording and reporting and presentation of results.

Further general information is given in annex A.

## 2 REFERENCES

ISO 3, *Preferred numbers — Series of preferred numbers.*

ISO 80, *Rockwell hardness test (B and C scales) for steel.*<sup>1)</sup>

ISO 81, *Vickers hardness test for steel (load 5 to 100 kgf).*<sup>1)</sup>

ISO/R 185, *Classification of grey cast iron.*

ISO 229, *Machine tools — Speeds and feeds.*

ISO/R 468, *Surface roughness.*

ISO 513, *Application of carbides for machining by chip removal — Designation of the main groups of chip removal and groups of application.*

ISO 525, *Bonded abrasive products — General features — Designation, ranges of dimensions, and profiles.*

1) In preparation. (Revision of ISO/R 80-1968 and ISO/R 81-1967.)

ISO/R 643, *Micrographic determination of the austenitic grain size of steels.*

ISO/R 683/III, *Heat-treated steels, alloy steels and free-cutting steels — Part III : Wrought quenched and tempered unalloyed steels with controlled sulphur content.*

ISO 1832, *Indexable (throwaway) inserts for cutting tools — Designation — Code of symbolization.*<sup>1)</sup>

ISO 2854, *Statistical interpretation of data — Techniques of estimation and tests relating to means and variances.*

ISO 3002/I, *Geometry of the active part of cutting tools — General terms, reference systems, tool and working angles.*

ISO 3534, *Statistics — Vocabulary and symbols.*

ISO 5479, *Statistical interpretation of data — Test for departure from normality.*<sup>2)</sup>

3 WORKPIECE

3.1 Work material

In all cutting tests in which the work material is not itself the test variable or is not itself an important parameter, the investigation shall be conducted on the appropriate one of the reference materials indicated in 3.1.1, 3.1.2 and 3.1.3. In the exceptions quoted, however, it is desirable to conduct tests on a reference material for comparative purposes.

The provision of a well-defined reference work material shall be discussed with the manufacturer.

3.1.1 Steel

The steel reference material shall be a hot-rolled medium carbon steel of the following composition corresponding to steel C 45 ea, in conformity with ISO/R 683/III.

C %	Si %	Mn %	S %	P %
0,42 to 0,50	0,15 to 0,40	0,50 to 0,80	0,02 to 0,035	0,035 max.

The presence of the following elements in excess of the maximum values given below shall disqualify the steel as a reference test material.

- Ni = 0,20 %
- Cr = 0,15 %
- Mo = 0,05 %
- V = 0,02 %
- Cu = 0,20 %

The steel shall be deoxidized with aluminium and the minimum aluminium content shall be 0,01 %. Special deoxidants shall not be used.

The nitrogen content, being to some extent dependent on the steelmaking source, shall be as follows :

Source	Nitrogen content
Open hearth or Oxygen convertors	0,003 to 0,006 %
Arc, single slag	0,004 to 0,008 %

It will be necessary to analyse the steel for nitrogen. The steel shall be purchased to ISO/R 683/III delivery condition 1 (chemical analysis only). The limits of the elements and deoxidation practice shall be discussed with the steel-maker and analyses of C, Si, Mn, Ni, Cr, Mo, P, S, V, Cu, Al and N requested at the time of the order.

The minimum initial test bar diameter shall be 100 mm, but the actual initial diameter shall be reported.

The test bars, after being cut to length, shall be normalized to a Brinell hardness of 180 to 200 HB. The actual hardness shall be reported.

3.1.2 Cast iron

The cast iron reference material shall be supplied to ISO/R 185, grade 25, with a Brinell hardness of 200 to 220 HB.

If available, the following material shall be used.

The microstructure throughout the entire volume of each cast iron test bar shall consist essentially of a matrix of 100 % pearlite with flake graphite within the following specification :

— pearlite	100 %
— free iron carbide	0 %
— free ferrite	5 % max.
— steadite (iron-iron phosphide eutectic)	5 % max.
— graphite	flake graphite only

3.1.3 Other work materials

Where the work material is not one of the reference materials, if possible the grade, chemical composition, physical properties, microstructure and complete details of the processing route of the work material (for example hot-rolled, forged, cast or cold drawn) and any heat treatment shall be reported.

1) At present at the stage of draft. (Revision of ISO/R 1832-1971.)

2) At present at the stage of draft proposal.