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**Sintered metal materials, excluding hard metals —  
Determination of apparent hardness —  
Part I : Materials of essentially uniform section hardness**

*Matériaux métalliques frittés à l'exclusion des métaux-durs — Détermination de la dureté apparente —  
Partie I : Matériaux ayant essentiellement une dureté uniforme dans la section*

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**Descriptors** : sintered products, tests, hardness tests.

## 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 4498/1 was developed by Technical Committee ISO/TC 119, *Powder metallurgical materials and products*, and was circulated to the member bodies in June 1977.

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

Australia	Germany	Sweden
Austria	Ireland	Turkey
Bulgaria	Italy	United Kingdom
Canada	Mexico	U.S.A.
Chile	Poland	U.S.S.R.
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France	Spain	

No member body expressed disapproval of the document.

# Sintered metal materials, excluding hardmetals — Determination of apparent hardness — Part I : Materials of essentially uniform section hardness

## 0 INTRODUCTION

The hardness value obtained by testing a sintered metal material with Brinell, Rockwell and Vickers test equipment is called apparent hardness. Since the sample is a composite of solid material and pores, the hardness value is usually lower than that of solid material of the same composition and metallurgical condition. However, this does not imply that the functional characteristics (for example wear resistance) are necessarily inferior to those of an equivalent fully dense material.

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies methods of hardness testing of sintered metal materials.

It applies to

- a) sintered materials not subjected to heat treatment;
- b) sintered materials heat treated in such a way that hardness is essentially uniform to a depth of at least 5 mm below the surface.

NOTE — Sintered metal materials which, because of a surface treatment, for example case hardening, do not conform with requirement b) will be covered by subsequent parts of this International Standard.

## 2 REFERENCES

ISO/R 79, *Brinell hardness test for steel*.

ISO/R 80, *Rockwell hardness test (B and C scales) for steel*.

ISO/R 81, *Vickers hardness test for steel*.

## 3 APPARATUS

The testing equipment shall be in accordance with ISO/R 79, ISO/R 80 and ISO/R 81.

## 4 SAMPLING AND PREPARATION OF TEST PIECES

4.1 Since the apparent hardness of a sintered material is affected by density, which can vary throughout the part, the position of the hardness indentations, for the purpose of quality control, shall be agreed between the interested parties.

4.2 The sintered metal surface shall be clean, smooth and flat to obtain well-defined hardness indentations. This is particularly important when determining Vickers and Brinell hardness. It is generally found sufficient to clean the surface with a suitable solvent. If not, the surface may be lightly polished provided that laboratory measurements have shown that the influence of such polishing is insignificant.

NOTE — This polishing may be carried out, for example, by using metallographic paper or a 6 µm diamond paste.

## 5 TEST REQUIREMENTS

5.1 The tests shall be made in accordance with the requirements of ISO/R 79, ISO/R 80 or ISO/R 81 but with the additional requirements given in 5.2 to 5.5.

5.2 The hardness class to which a test piece belongs shall be determined by Vickers hardness testing using a load of 49,03 N (HV 5). The test conditions shall then be selected from table 1 according to the determined class. Details of the conditions for the Rockwell test are given in table 2 in the annex.

The Vickers hardness shall be the reference method and shall be used, for example, in cases of dispute.

If, after the initial HV 5 test, there is any doubt as to the hardness class to be chosen, the lower class shall be selected.

When a material specification covers more than one hardness class, the test shall be conducted according to the conditions appropriate to the lower hardness limit of the material specification.

TABLE 1

Hardness class (HV 5)	Test conditions
> 15 to 60	HV 5 HB 2,5/15,625/30 HRH
> 60 to 105	HV 10 HB 2,5/31,25/15 HRF
> 105 to 180	HV 30 HB 2,5/62,5/10 HRB
> 180 to 330	HV 50 HB 2,5/187,5/10 HRA
> 330	HV 100 HB 2,5/187,5/10 HRC

5.3 For some test pieces it will be necessary to use smaller loads than those specified in table 1 in order to meet the requirements of ISO/R 79, ISO/R 80 or ISO/R 81. This will be particularly so for :

- a) thin test pieces;
- b) test pieces of small section;
- c) instances where the designated test area is very small;
- d) instances where the test piece or its mount is likely to be distorted.

When such test conditions are necessary, the details shall be agreed between the interested parties.

It should be noted that, in these circumstances, the scatter of the results will be greater than under normal test conditions and that the value obtained will be less representative of the state of the material since the indentation will be very small.

5.4 When determining Vickers hardness, an indentation shall be discarded if it does not have clearly defined corners.

5.5 Five acceptable indentations shall be made and the corresponding hardness values calculated (or simply read in the case of Rockwell testing). The lowest hardness value shall be discarded.

**6 EXPRESSION OF RESULTS**

Report the arithmetical mean of the four determinations retained (see 5.5) rounded to the nearest whole number.

Hardness values shall not be converted from one scale, i.e. Vickers, Brinell or Rockwell, to another.

**7 TEST REPORT**

The test report shall include the following information :

- a) reference to this International Standard;
- b) all details necessary for the identification of the test sample;
- c) the results obtained, followed by the appropriate symbol and test conditions according to ISO/R 79, ISO/R 80 or ISO/R 81;
- d) all operations not specified by this International Standard or regarded as optional;
- e) details of any occurrence which may have affected the result.

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## ANNEX

## CONDITIONS FOR ROCKWELL HARDNESS TEST

TABLE 2

Rockwell hardness	Type of indenter	Preload N	Total load N
HRA	Diamond cone : 120°	98,07	588,4
HRB	Ball : 1,587 5 mm (1/16 in)	98,07	980,7
HRC	Diamond cone : 120°	98,07	1 471
HRF	Ball : 1,587 5 mm (1/16 in)	98,07	588,4
HRH	Ball : 3,175 mm (1/8 in)	98,07	588,4

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