
**Hardmetals — Metallographic
determination of microstructure —**

**Part 2:
Measurement of WC grain size**

*Métaux-durs — Détermination métallographique de la microstructure —
Partie 2: Mesurage de la taille des grains de WC*



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Contents

Page

Foreword.....	iv
1 Scope	1
2 Normative references	2
3 Terms, definitions, abbreviations, symbols and units.....	2
4 General information.....	4
5 Apparatus	5
6 Calibration	6
7 Grain-size measurement by the linear-intercept method	6
8 Reporting	9
Annex A (informative) Measurement case study	11
Annex B (informative) Report proforma	15
Bibliography	17

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 4499-2 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 4, *Sampling and testing methods for hardmetals*.

ISO 4499-2, together with ISO 4499-1, cancels and replaces ISO 4499:1978, which has been technically revised. A new section has been added for the quantitative measurement of the WC grain size of hardmetals.

ISO 4499 consists of the following parts, under the general title *Hardmetals — Metallographic determination of microstructure*:

- *Part 1: Photomicrographs and description*
- *Part 2: Measurement of WC grain size*

Hardmetals — Metallographic determination of microstructure —

Part 2: Measurement of WC grain size

1 Scope

This part of ISO 4499 gives guidelines for the measurement of hardmetal grain size by metallographic techniques only using optical or electron microscopy. It is intended for sintered WC/Co hardmetals (also called cemented carbides or cermets) containing primarily WC as the hard phase. It is also intended for measuring the grain size and distribution by the linear-intercept technique.

This part of ISO 4499 essentially covers four main topics:

- calibration of microscopes, to underpin the accuracy of measurements;
- linear analysis techniques, to acquire sufficient statistically meaningful data;
- analysis methods, to calculate representative average values;
- reporting, to comply with modern quality requirements.

The part of ISO 4499 is supported by a measurement case study to illustrate the recommended techniques (see Annex A).

The part of ISO 4499 is not intended for the following.

- Measurements of size distribution.
- Recommendations on shape measurements. Further research is needed before recommendations for shape measurement can be given.

Measurements of coercivity are sometimes used for grain-size measurement, but this current guide is concerned only with a metallographic measurement method. It is also written for sintered hardmetals and not for characterising powders. However, the method could, in principle, be used for measuring the average size of powders that are suitably mounted and sectioned.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3326, *Hardmetals — Determination of (the magnetization) coercivity*

ISO 3369, *Impermeable sintered metal materials and hardmetals — Determination of density*

ISO 3738-1, *Hardmetals — Rockwell hardness test (scale A) — Part 1: Test method*

ISO 3738-2, *Hardmetals — Rockwell hardness test (scale A) — Part 2: Preparation and calibration of standard test blocks*

ISO 3878, *Hardmetals — Vickers hardness test*

ISO 4489:1978, *Sintered hardmetals — Sampling and testing*

ISO 4499-1, *Hardmetals — Metallographic determination of microstructure — Part 1: Photomicrographs and description*

ISO 4505, *Hardmetals — Metallographic determination of porosity and uncombined carbon*

3 Terms, definitions, abbreviations, symbols and units

3.1 General

A very wide range of terms are used to describe powders or sintered hardmetals of different sizes. For example, the following have been used in a variety of publications and reports.

Extra coarse	Fine	Microfine
Coarse	Very fine	Micrograin
Coarse/Medium	Ultra fine	Nanophase
Medium	Extra fine	Nanograin
Medium/Fine	Submicron	Super fine

None of these terms have commonly agreed or well-defined size ranges among users and producers of powders or sintered products.

Consequently, following discussion in the hardmetal community, the following terms for the sizes defined in 3.2 are recommended.

The uncertainty associated with the measurement of linear-intercept grain size is about 10 %, if typically 200 grains to 300 grains are counted. Thus, measurements on or close to the class boundaries should be treated carefully. It is recommended that measurements that fall within 10 % of any of the class boundaries should be classed as follows:

EXAMPLE

0,19 µm as Nano/Ultrafine	0,21 µm as Ultrafine/Nano
0,75 µm as Submicron/Fine	0,85 µm as Fine/Submicron
1,29 µm as Fine/Medium	1,31 µm as Medium/Fine
2,4 µm as Medium/Coarse	2,6 µm as Coarse/Medium