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Copper and copper alloys — Estimation of average grain size

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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 2624 was drawn up by Technical Committee ISO/TC 26, *Copper and copper alloys,* and circulated to the Member Bodies in November 1971.

It has been approved by the Member Bodies of the following countries :

Austria	Hungary	Spain
Belgium	India	Sweden
Canada	Japan	Switzerland
Chile	Netherlands	Thailand
Czechoslovakia	New Zealand	Turkey
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France	Romania	U.S.S.R.
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No Member Body expressed disapproval of the document.

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Copper and copper alloys — Estimation of average grain size

0 INTRODUCTION

On a section of metal, a grain is that area within the boundary of a crystal. For the purpose of applying the methods described in this International Standard, a crystal and its twin bands are considered as one grain. Sub-grains, minor constituent phases, inclusions and additives are not considered in the estimation of the grain size.

It is important, in using these methods, to recognize that the estimation of grain size is not a precise measurement. A metal structure is an aggregate of three-dimensional crystals of varying sizes and shapes. Even if all these crystals were identical in size and shape, the grain cross-sections produced by a random plane (surface of observation) through such a structure would have a distribution of areas varying from a maximum value to zero, depending upon where the plane cuts each individual crystal. Clearly, no two fields of observation can be exactly the same.

Practical reasons limit the number of grains that can reasonably be counted to less than the number statistically desirable.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies three procedures for estimating, and rules for expressing, the average grain size of copper and copper alloys consisting principally of a single phase. The respective procedures are termed the comparison procedure, the intercept procedure and the planimetric procedure.

The comparison procedure (comparing the specimen with a standard chart) is most convenient and is sufficiently accurate for most commercial purposes.

Higher degrees of accuracy in estimating grain size are obtainable by using the intercept (Heyn) or planimetric (Jeffries) procedures. In cases of dispute, it is recommended that the use of one of these procedures be agreed between the parties.

For material with non-equiaxed structures it is recommended that the intercept procedure be used.

2 SYMBOLS AND DESIGNATIONS

Symbol	Designation
f	Jeffries' multiplier used to obtain number of grains per square millimetre by planimetric method
m	Number of grains per square millimetre
d	Average grain "diameter" in millimetres; an arbitrary measure defined as $1/\sqrt{m}$
l	Average intercept length
M	Magnification

3 TEST SAMPLES

3.1 Grain size estimations shall be made on three or more representative fields of each sample section. In known equiaxed structures only a representative section need be taken on the sample. For non-equiaxed or unknown structures three sections must be prepared each at right angles to the other.

3.2 The specimen shall be carefully prepared to reveal the grain boundaries using a contrast etch to match the standard charts.

4 PROCEDURES

4.1 Comparison procedure

The estimation of grain size is made by direct comparison of a projected image of a photomicrograph of a representative field of the test specimen, either with the photomicrographs of the standard grain size series or with suitable reproductions of them (for standard grain size charts, see the Annex); when a projection microscope is not available a bench microscope may be used. It is recommended that, to facilitate comparison, mechanical arrangements be made to permit bringing the standard photomicrographs successively into juxtaposition with the projected image.