AS 1733—1976
Reconfirmed 2018

Australian Standard®

METHODS FOR THE DETERMINATION OF GRAIN SIZE IN METALS

The following scientific, industrial and governmental organizations and departments were officially represented on the committee entrusted with the preparation of this standard:

Associated Chambers of Manufactures of Australia
Bureau of Steel Manufacturers of Australia
Commonwealth Aircraft Corporation
Department of Defence
Federated Chamber of Automotive Industries
Institute of Steel Service Centres of Australia
Metal Trades Industry Association of Australia
Railways of Australia Committee
Society of Automotive Engineers— Australasia
Telecom Australia
University of New South Wales (School of Metallurgy).

This standard, prepared by Committee MT/8, Metallography, was approved on behalf of the Council of the Standards Association of Australia on 28 November 1975, and was published on 1 May 1976.

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RECONFIRMATION

OF
AS 1733–1976
Methods for the determination of grain size in metals

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Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 29 August 2018.

NOTES

Australian Standard®

METHODS FOR THE DETERMINATION OF GRAIN SIZE IN METALS

First published (as AS G13) 1968
Revised and issued as AS 1733 1976

PUBLISHED BY STANDARDS AUSTRALIA
(STANDARDS ASSOCIATION OF AUSTRALIA)
1 THE CRESCENT, HOMEBUSH, NSW 2140
ISBN 0 7262 0676 8

PREFACE

This standard was prepared by the Association's Committee on Metallography as a revision of AS G13—1968, which it accordingly supersedes.

The standard has been sectionalized for ease of reference; general requirements are given in Section 2, Section 3 covers the austenite grain size in steels, and Section 4 covers the measurement of grain size of metals which consist essentially of a single phase.

Section 3, on the determination of the austenite grain size in steels, is primarily based on ISO/R 643, Micrographic Determination of the Austenite Grain Size of Steels. The committee also considered BS 4490: 1969 The Determination of the Austenite Grain Size of Steel. Whereas ASG13, which was based on ASTM E112, Estimating the Average Grain Size of Metals, was limited to the 'comparison method' for determining grain size, this standard permits the use of the planimetric and intercept methods for the calculation of the grain size.

Section 4 is intended to cover all types of metals and alloys for which grain size measurements are normally required to be known.

For the assistance of committees drafting steel specifications, detailed guidance is given in Appendix A. A short list of etchants is included in Appendix B. The list is not comprehensive and is not intended to be restrictive. Grain size charts have been included in an appendix for ready reference.

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard for METHODS FOR THE DETERMINATION OF GRAIN SIZE IN METALS

SECTION 1. SCOPE AND APPLICATION

1.1 SCOPE. This standard describes methods for the determination of the grain size in metals and alloys.

1.2 APPLICATION. The standard is divided into sections covering various applications as follows:

(a) Section 2 covers the general procedures for determining grain size.
(b) Section 3 covers procedures for determining the prior austenite grain size in transformed steels.
(c) Section 4 covers procedures for determining the grain size of metals and alloys which consist principally of a single phase.

SECTION 2. GENERAL PROCEDURES FOR METHODS OF GRAIN SIZE DETERMINATION

2.1 SCOPE OF SECTION. This Section outlines the basis for estimating the grain size by the comparison method and the calculation of the grain size number by the intercept and planimetric methods.

2.2 GRAIN SIZE NUMBER. The standard grain size numbers given in Table 1 are based on the following formula:

$$m = 8 \times 2^G$$

where m = number of grains per square millimetre

and G = grain size number.

NOTE: The ASTM index (N) derived from formula $N = G + 0.0456$ gives a grain size slightly larger than that defined by this standard. The difference is not more than 0.5 unit, and the estimation of grain size cannot generally be closer than 0.5 unit under the most favourable circumstances. For these reasons ASTM charts may be used for the determination of grain size number.

2.3 ESTIMATION OF GRAIN SIZE.

2.3.1 General. It is important to recognize that the estimation of grain size is not precise. The metal structure is an aggregate of three-dimensional grains of varying sizes and shapes. Even if these grains 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 grain. Clearly no two fields of observation can be exactly the same.

In each of the three methods for determination of the grain size number good judgement on the part of the metallographer is necessary to select the magnification to be used, the proper size of the area, the proper number of grains (normally not less than 50 per given area), and the number and location in the test piece of representative sections and fields.

2.3.2 Accuracy of Equipment. The actual magnification used shall be verified to within an accuracy of 1 percent by direct comparison with an engraved micrometer. All distance measuring equipment used in the determinations shall be accurate to ±1 percent.

2.4 COMPARISON METHOD.

2.4.1 Method. The test piece shall be examined at an appropriate magnification and the grain size determined by direct comparison with the standard grain size chart (see Appendix C) the appearance of which most closely resembles that of the test piece. The estimated grain size shall be reported to the nearest unit listed in Table 1.

NOTE: The standard grain size charts cover three categories of microstructure as follows:
Plate 1 — Untwinned grains, hat etch, 100×
Plate 2 — Twinned grains, flat etch, 100×
Plate 3 — Heavily twinned grains, contrast etch, 75×.

Where grain sizes significantly different from the average are observed, the range shall be reported and also an indication of the distribution within the range.

Grain size of a given test piece shall be determined on a minimum of three representative fields.

2.4.2 Alternative Magnification. Where the grains are of a size outside the range covered by the standard charts, alternative magnifications that are usually simple multiples of the standard 100 diameters may be employed. (See Table 2.) A correction factor shall then be added to the apparent grain size observed.

The correction factor Q to be added to the apparent grain size number viewed at magnification M to give the standard grain size number shall be determined from the following formula:

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