INTERNATIONAL STANDARD 945

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Cast iron — Designation of microstructure of graphite

Fonte — Désignation de la microstructure du graphite

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

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.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 25 has reviewed ISO Recommendation R 945 and found it technically suitable for transformation. International Standard ISO 945 therefore replaces ISO Recommendation R 945-1969 to which it is technically identical.

ISO Recommendation R 945 was approved by the Member Bodies of the following countries :

Belgium	Greece	Portugal
Brazil	India	Romania
Canada	Ireland	South Africa, Rep. of
Chile	Israel	Sweden
Czechoslovakia	Italy	Switzerland
Egypt, Arab Rep. of	Korea, Rep. of	Thailand
Finland	Netherlands	Turkey
France	Norway	United Kingdom
Germany	Poland	Yugoslavia

No Member Body expressed disapproval of the Recommendation.

The Member Bodies of the following countries disapproved the transformation of ISO/R 945 into an International Standard :

Sweden
Switzerland

Printed in Switzerland

Cast iron — Designation of microstructure of graphite

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method of designating the microstructure of graphite in cast iron. It is not intended as a basis for acceptance specifications.

2 GENERAL

2.1 When iron-carbon alloys are examined under a microscope, the graphite occurring in these alloys can be classified by

a) its form (designated by roman numerals, see figure 1);

b) its distribution (designated by capital letters, see figure 2);

c) its size (designated by arabic numerals, see figures 3 to 6).

2.2 The three series of reference diagrams included in this International Standard for evaluating the type of graphite form a basis for such a classification. The characteristic features of the graphite which occur are designated by letters and numerals. For this purpose, microstructures of graphite are arranged side by side in the series. Form, distribution and size of the graphite observed are determined by comparison with the diagrams and the allocation of the same classification as that of the diagrams that resemble them most closely. This method permits quick identification of the graphite, promotes mutual understanding between technicians in this field, permits clear representation of the findings, facilitates statistical analysis and saves a vast amount of photographic work.

2.3 The comparison of the graphite observed with the three series of reference diagrams in figures 1 to 6 does not give any information on the suitability of the iron-carbon alloys for any particular service.

3 SAMPLING AND PREPARATION OF SPECIMENS

3.1 When taking specimens from the casting, it is essential that attention be paid to the location, to the wall thickness, to the distance from the surface and to the presence of chills and the like. The location of the surface examined shall be carefully recorded in any report.

3.2 The area of polished surface shall be sufficient to give a true representation of the graphite distribution. Attention shall be paid to the careful grinding and polishing of the specimens in order that the graphite particles appear in their true form and size. The examination of the graphite under the microscope is usually carried out on the unetched polished section, though final etching is recommended in the case of some special alloy cast irons, for example those containing high silicon.

4 MICROSCOPIC EXAMINATION

4.1 The polished specimens shall be viewed under a microscope so that the entire polished area may be examined. A comparison shall first be made with the reference diagrams for the graphite form and distribution (see figures 1 and 2) and the microstructures observed shall then be identified from the corresponding reference diagrams. Following this, the size of the graphite particles shall be determined at a magnification of 100 diameters, by reference to figures 3 to 6 inclusive and/or the table.

4.2 Examination under the microscope can be carried out by direct observation or by projection on the ground glass of the microscope. The field of view shall have approximately the same size as the reference diagrams (about 80 mm diameter).

4.3 The measurement of the graphite particles can be facilitated by the use of suitable calibrated eye-pieces.

4.4 The method described above gives good results, but any other method of examination which gives good results may be used.

5 REFERENCE DIAGRAMS

A series of reference diagrams is provided for form, distribution and size of graphite. The reference diagrams show microstructures of an ideal character instead of actual photomicrographs, thus avoiding the minor effects which might interfere with the results of the observation.

5.1 Reference diagrams for graphite form

The reference diagrams for graphite form (figure 1) show six characteristic forms which are designated by the roman

numerals I to VI. These represent the principal types of graphite found in cast iron. However, other forms are also known to occur occasionally.

5.2 Reference diagrams for graphite distribution

The reference diagrams for the graphite distribution (figure 2) show five examples designated by the letters A to E.

The diagrams in figure 2 apply to form I graphite. The other forms generally occur in distribution A, but other distributions may sometimes be found.

5.3 Reference diagrams for graphite size

Figures 3 to 6 and the table serve to determine the graphite size. For the 100 diameter reproduction scale, sizes are indicated ranging from a maximum dimension of the particle of > 100 mm (size 1) down to < 1,5 mm (size 8). The size ranges covered by the size reference numbers 3 to 7 inclusive are based on an average particle size which is half that of the larger size range.

6 DESIGNATION OF GRAPHITE BY FORM, DISTRIBUTION AND SIZE

6.1 To characterize the graphite observed, indications are generally necessary on the form, distribution and size of the graphite particles. To this purpose, the roman numerals of figure 1 are used for the form, the capital letters of figure 2 for the distribution and the arabic numerals of figure 3 and the table for the size, in that order. Thus, for example, type I A 4 means that, with a 100 mm diameter magnification, graphite particles, form I, distribution A, having a maximum dimension of 12 to 25 mm, have been observed.

TABLE – **Dimension of the graphite particles forms I to VI**

Reference number	Dimension of the particles observed at × 100 magnification	True dimension
	mm	mm
1	> 100	> 1
2	50 to 100	0,5 to 1
3	25 to 50	0,25 to 0,5
4	12 to 25	0,12 to 0,25
5	6 to 12	0,06 to 0,12
6	3 to 6	0,03 to 0,06
7	1,5 to 3	0,015 to 0,03
8	< 1,5	< 0,015

6.2 If the graphite observed lies between two sizes, reference to both is possible (for example 3/4).

In a given case the predominating size may be emphasized by underlining (for example 3/4).

This method can be extended to cover structures where more than two sizes are present.

6.3 Mixed structures with different types of graphite may be defined by estimating the percentage proportion of the different types of graphite : for example,

60 % I A 4 + 40 % I D 7

means 60 % graphite of the form I, distribution A and size 4, and 40 % graphite of the form I, distribution D and size 7.

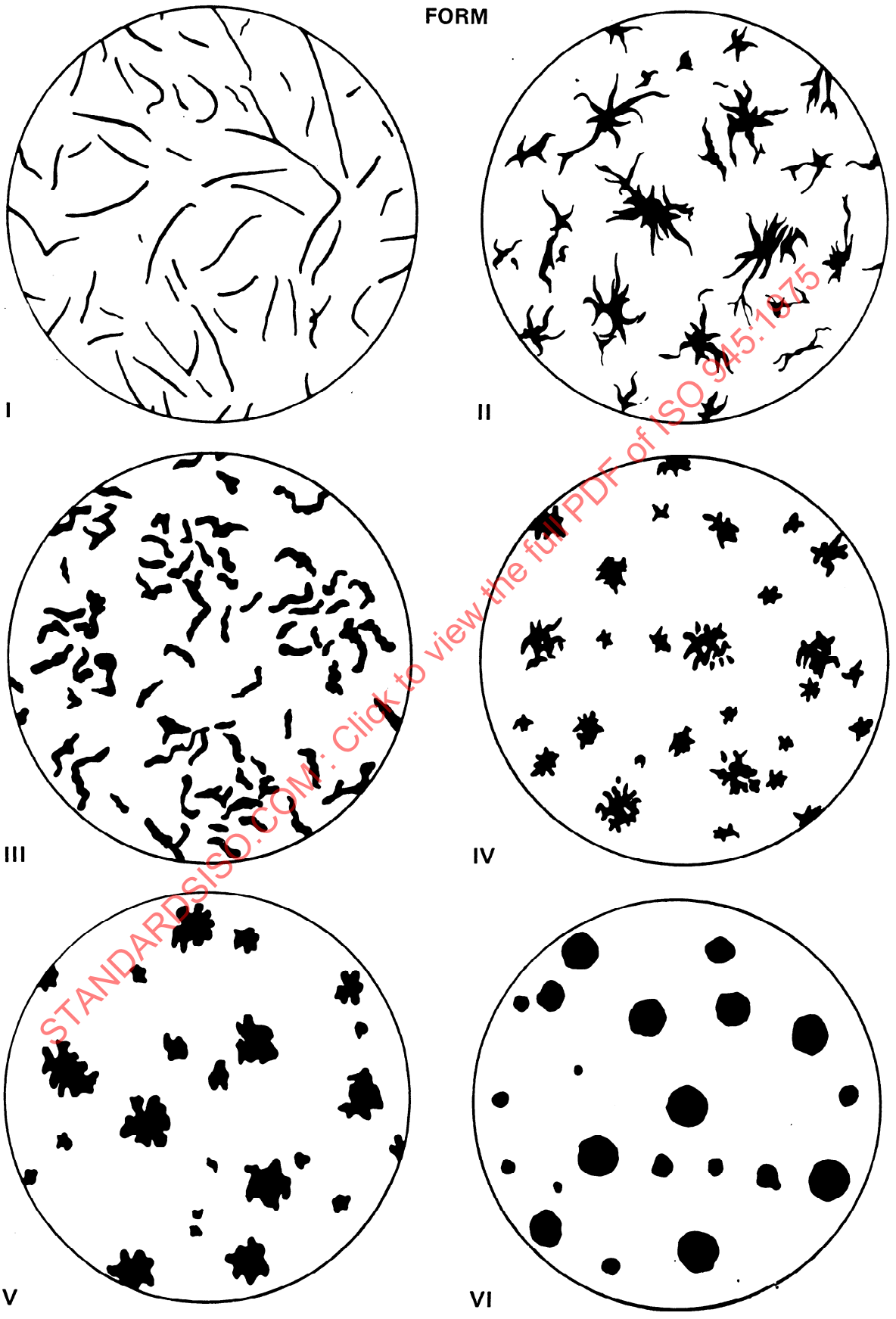


FIGURE 1 — **Reference diagrams[1] for the graphite form (Distribution A)**

1) The diagrams show only the outlines and not the structure of the graphite.

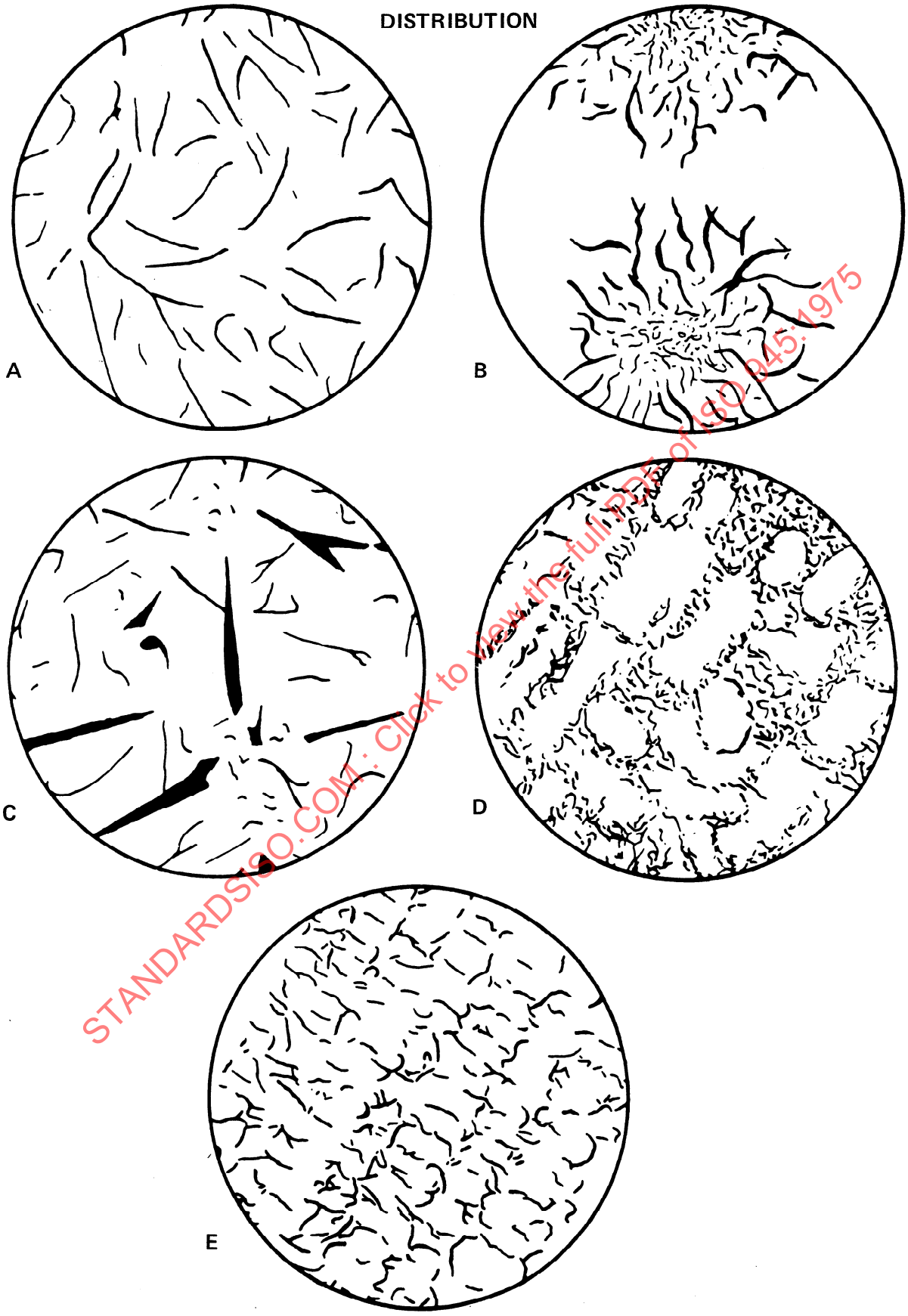


FIGURE 2 — **Reference diagrams[1] for the graphite distribution (Form 1)**

1) The diagrams show only the outlines and not the structure of the graphite.

SIZE

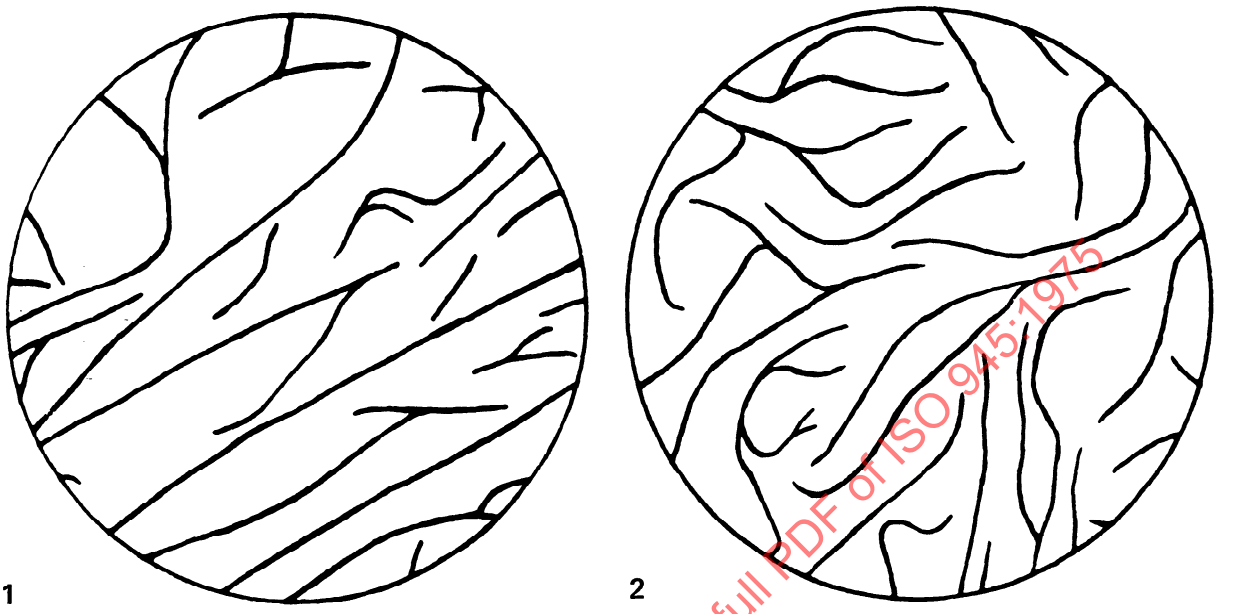
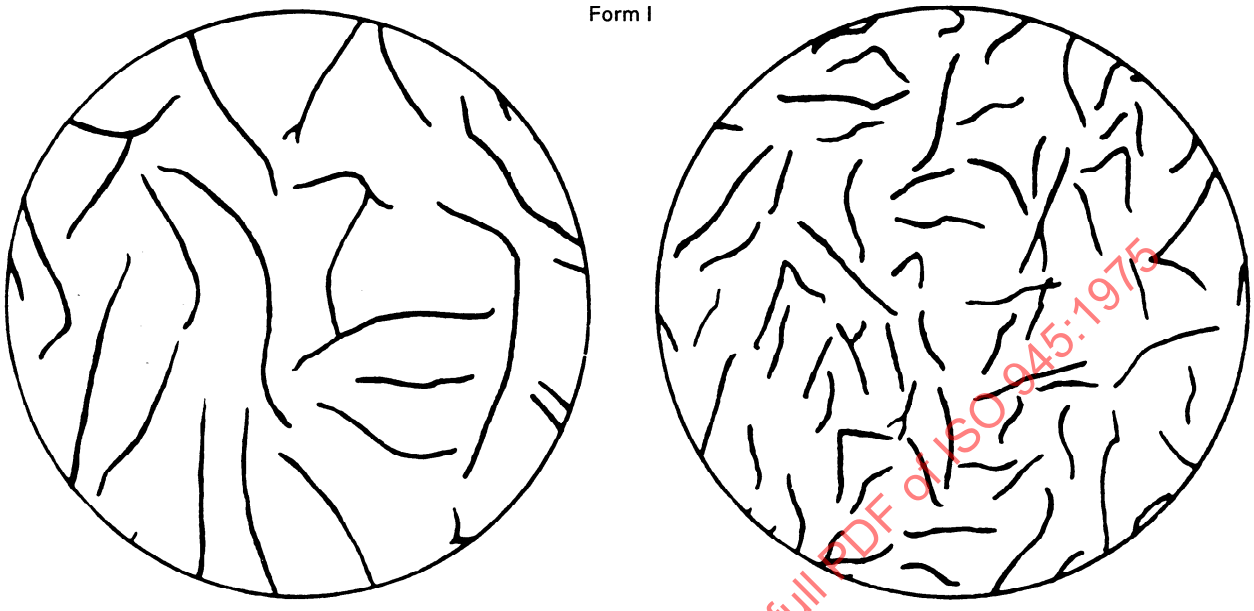


FIGURE 3 — **Reference diagrams[1] for the graphite size (Form I — Distribution A) (magnification X 100) — Reference Nos. 1 and 2**

1) The diagrams show only the outlines and not the structure of the graphite.

SIZE

Form I



3 4

Form VI

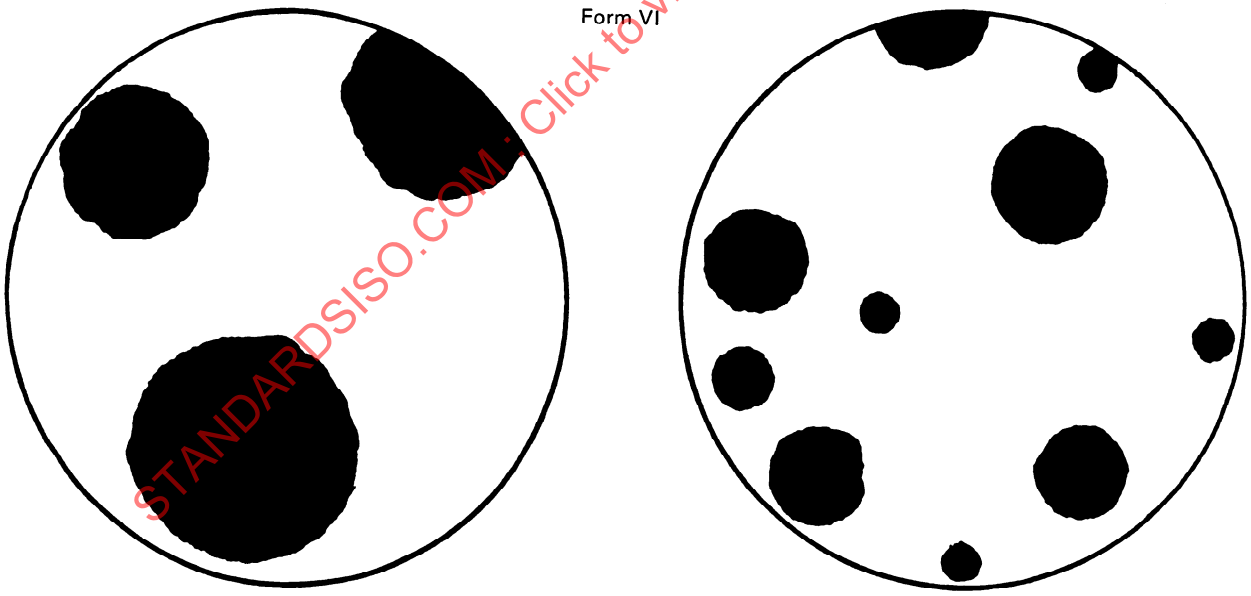


FIGURE 4 — **Reference diagrams[1] for the graphite size (Forms I and VI — Distribution A) (magnification × 100) — Reference Nos. 3 and 4**

1) The diagrams show only the outlines and not the structure of the graphite.