

	<p style="text-align: center;"><b>Cast iron</b> Designation of microstructure of graphite (ISO 945: 1975) English version of DIN EN ISO 945</p>	<p style="text-align: center;"><b>DIN</b> <b>EN ISO 945</b></p>
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This standard incorporates the English version of **ISO 945**.

ICS 77.080.10.

Descriptors: Cast iron, graphite, microstructure, microscopic examination.

Gußeisen; Bestimmung der Mikrostruktur von Graphit (EN ISO 945:1994)

**European Standard EN ISO 945: 1994 has the status of a DIN Standard.**

*A comma is used as the decimal marker.*

### National foreword

This standard has been published in accordance with a decision taken by CEN/TC 190 to adopt, without alteration, International Standard ISO 945 as a European Standard.

The responsible German body involved in its preparation was the *Normenausschuß Gießereiwesen* (Foundry Practice Standards Committee).

### International Patent Classification

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EN ISO comprises 10 pages.



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UDC 669.13:620.186:546.26-162

Descriptors: Cast iron, graphite, microstructure, microscopic examination.

**English version**

**Cast iron**

**Designation of microstructure of graphite  
(ISO 945:1975)**

Fonte; désignation de la microstructure du  
graphite (ISO 945:1975)

Gußeisen; Bestimmung der Mikrostruktur  
von Graphit (ISO 945:1975)

This European Standard was approved by CEN on 1994-07-05 and is identical to the ISO Standard as referred to.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

**CEN**

European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

**Central Secretariat: rue de Stassart 36, B-1050 Brussels**

## **Foreword**

In 1994, CEN/TC 190 'Foundry technology' decided to submit International Standard ISO 945:1975 Cast iron; designation of microstructure of graphite for Formal Vote. The result was positive.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by January 1995 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

## **Endorsement notice**

The text of the International Standard ISO 945:1975 was approved by CEN as a European Standard without any modification.

## 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 DIAGRAMMS

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,

$$60 \% \text{ I A } 4 + 40 \% \text{ I D } 7$$

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

FORM

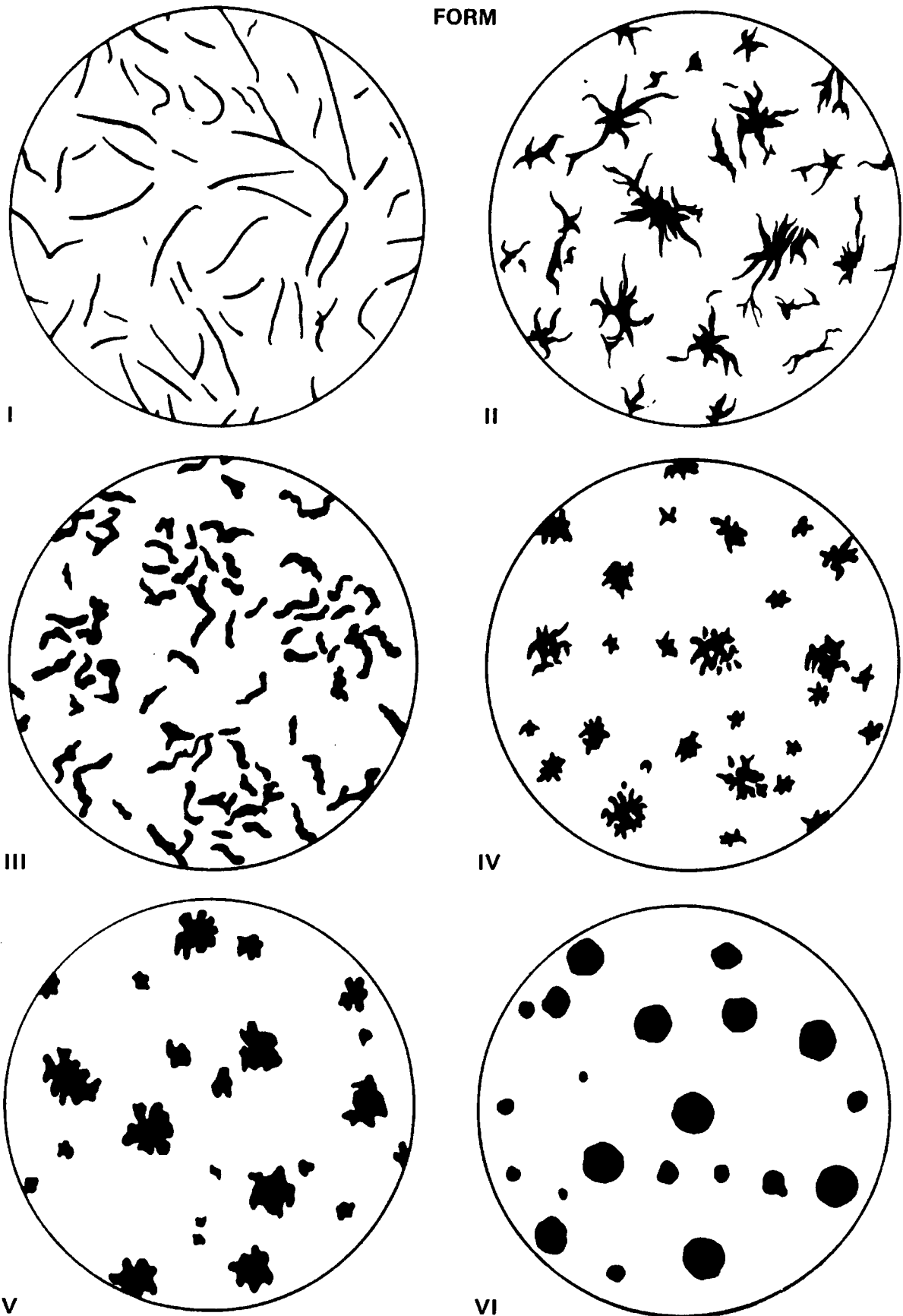


FIGURE 1 – Reference diagrams<sup>1)</sup> for the graphite form (Distribution A)

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

DISTRIBUTION

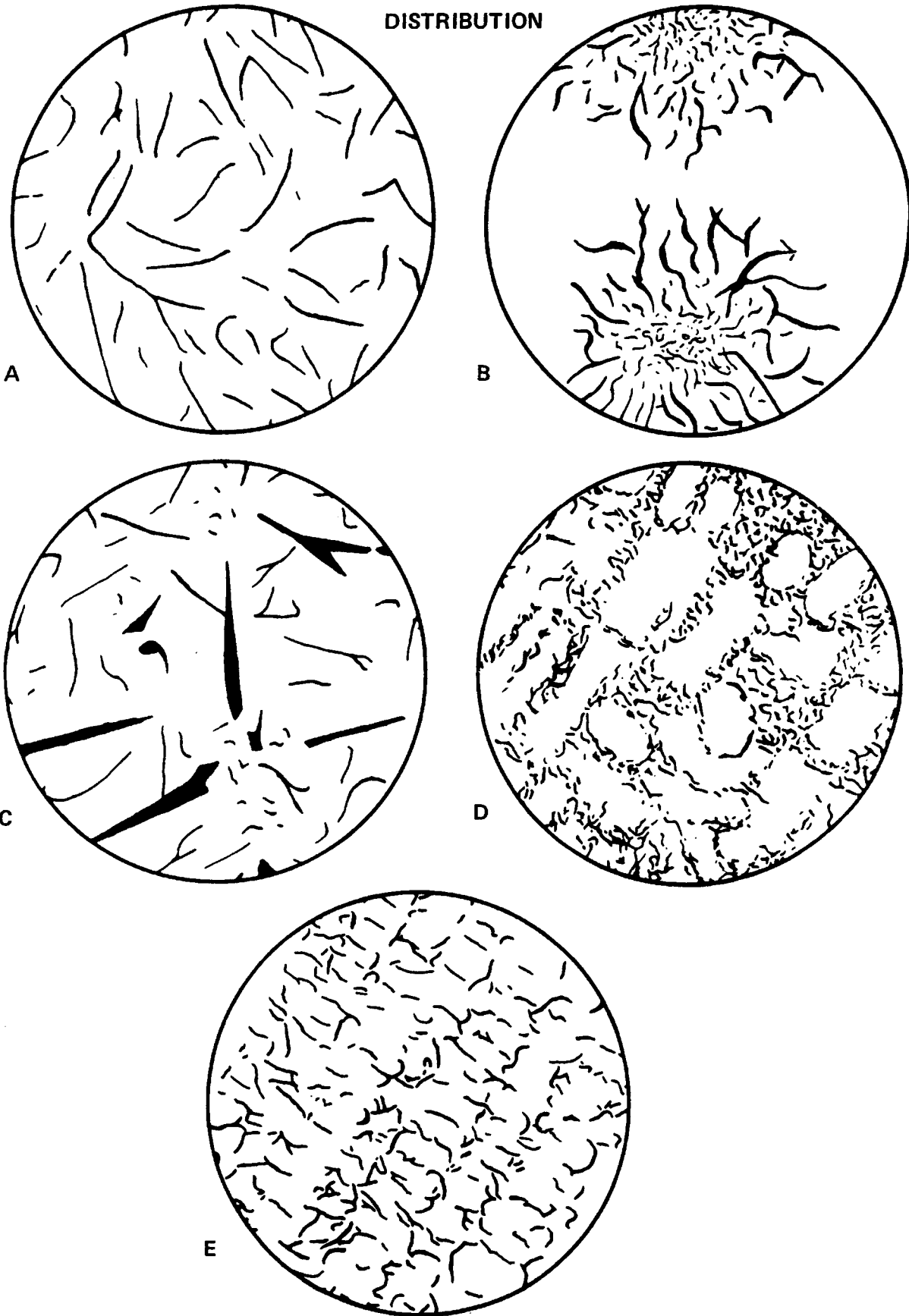


FIGURE 2 – Reference diagrams<sup>1)</sup> for the graphite distribution (Form 1)

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

SIZE

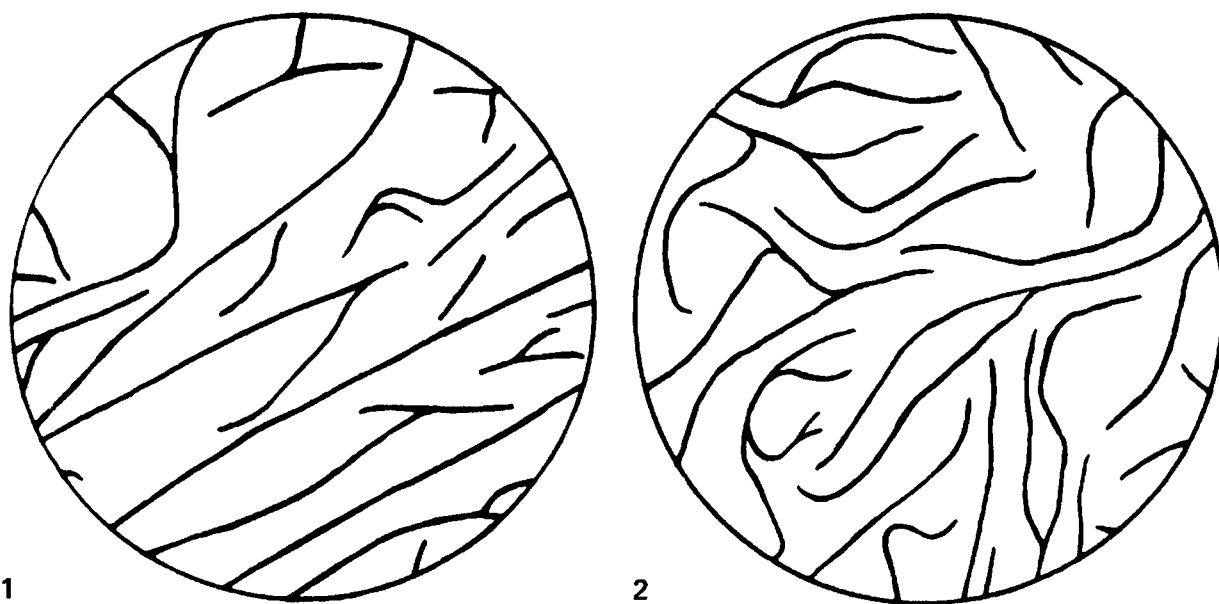
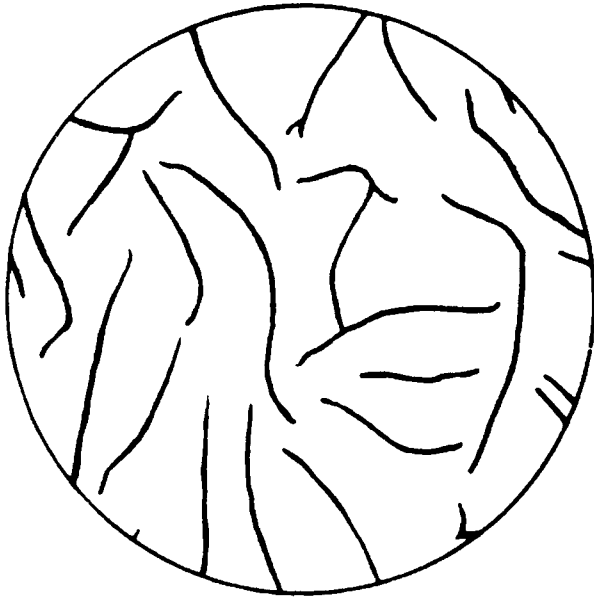


FIGURE 3 – Reference diagrams<sup>1)</sup> for the graphite size (Form I – Distribution A) (magnification X 100) – Reference Nos. 1 and 2

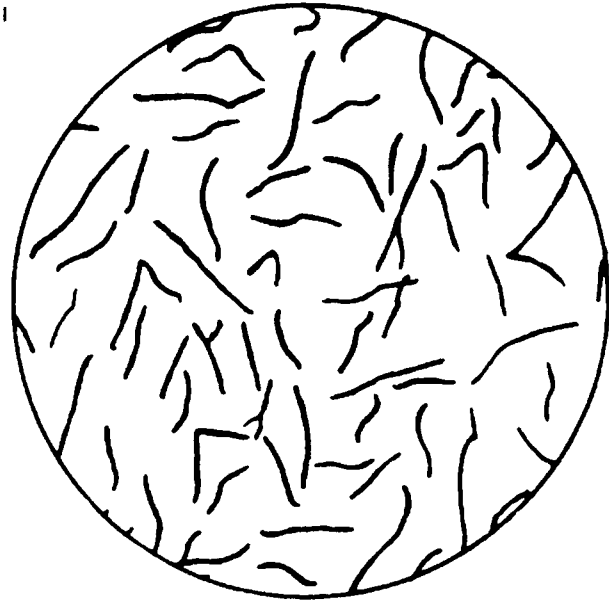
<sup>1)</sup> The diagrams show only the outlines and not the structure of the graphite.

SIZE

Form I



3



4

Form VI

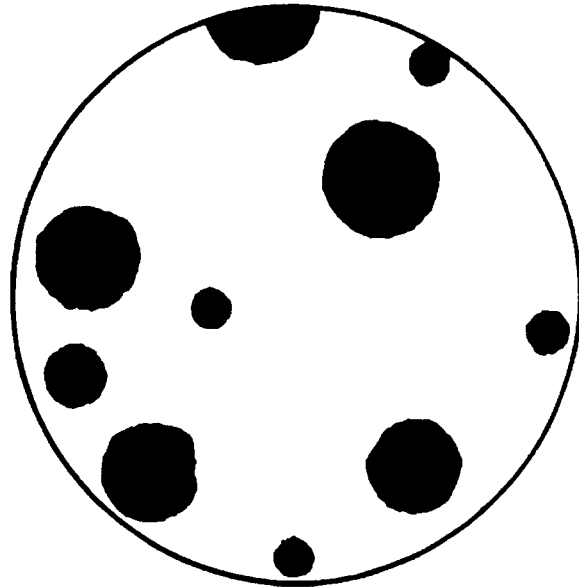
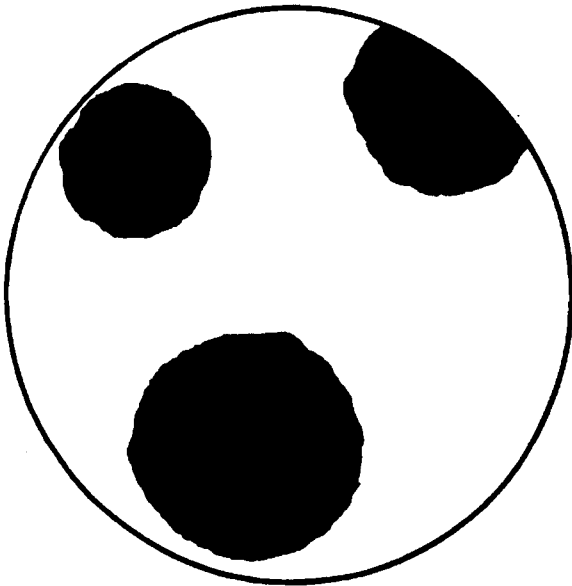


FIGURE 4 – Reference diagrams<sup>1)</sup> for the graphite size (Forms I and VI – Distribution A) (magnification  $\times 100$ ) – Reference Nos. 3 and 4

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

SIZE

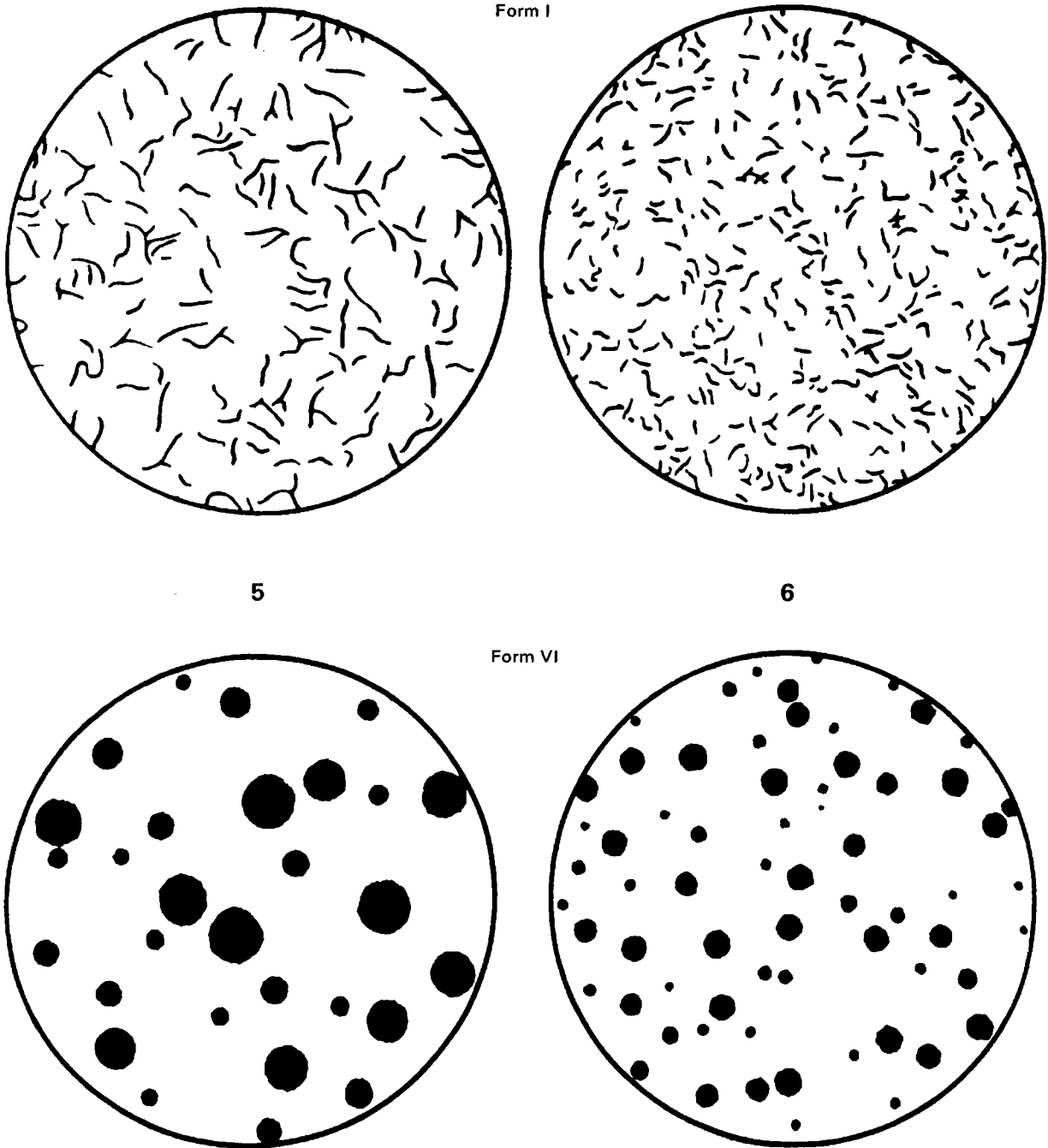
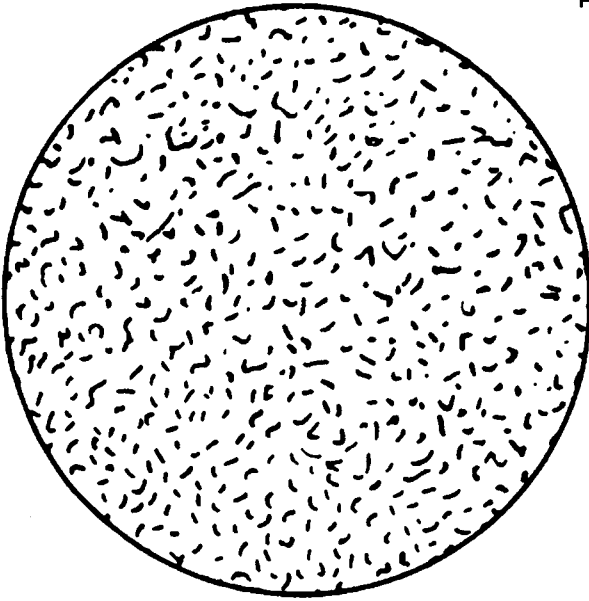


FIGURE 5 — Reference diagrams<sup>1)</sup> for the graphite size (Forms I and VI — Distribution A) (magnification  $\times 100$ ) — Reference Nos. 5 and 6

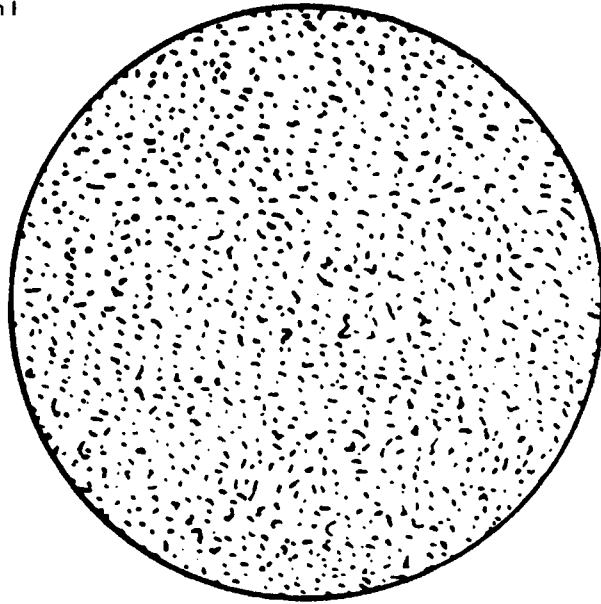
1) The diagrams show only the outlines and not the structure of the graphite

SIZE

Form I



7



8

Form VI

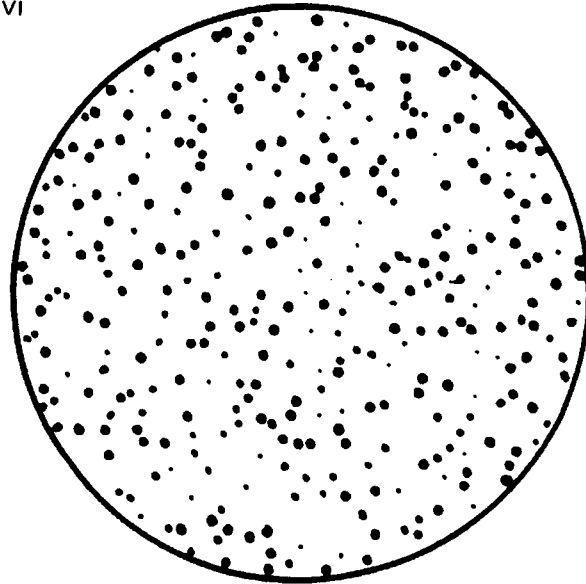
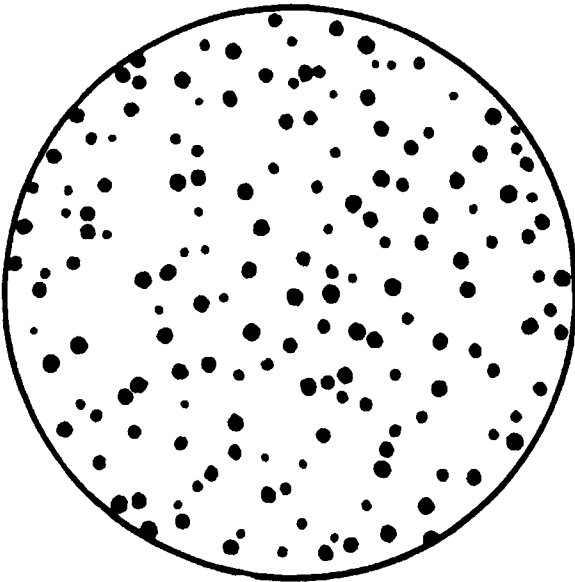


FIGURE 6 — Reference diagrams<sup>1)</sup> for the graphite size (Forms I and VI — Distribution A) (magnification  $\times 100$ ) — Reference Nos. 7 and 8

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