International Standard 5949

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Tool steels and bearing steels — Micrographic method for assessing the distribution of carbides using reference photomicrographs

Aciers à outils et aciers de roulement — Méthode micrographique d'évaluation de la répartition des carbures à l'aide d'images-types

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (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 authorized 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.

International Standard ISO 5949 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in September 1982.

It has been approved by the member bodies of the following countries :

Australia	Ireland	Portugal
Austria	Italy	South Africa, Rep. of
Belgium	Japan	Spain
Czechoslovakia	Kenya	Sweden
Egypt, Arab Rep. of	Korea, Dem. P. Rep. of	Tanzania
France	Korea, Rep. of	Turkey
Germany, F.R.	Netherlands	United Kingdom
Hungary	New Zealand	USA
India	Norway	
Iran	Poland	

No member body expressed disapproval of the document.

Printed in Switzerland

Tool steels and bearing steels — Micrographic method for assessing the distribution of carbides using reference photomicrographs

1 Scope and field of application

This International Standard specifies the micrographic method for assessing the distribution of carbides in tool and bearing steels, with C levels between 0,1 % and 1,5 % and a total content of alloy elements less than or equal to 5 %. The use of this method for other steels shall be subject to special agreement.

2 References

ISO 683/17, *Heat-treated steels, alloy steels and free-cutting steels — Part 17 : Ball and roller bearing steels.*

ISO 4957, *Tool steels.*

3 Principles of the method

3.1 The distribution of carbide is assessed by comparison with the reference photomicrographs given in the plate in the annex.

3.2 The reference photomicrographs are divided into four main series[1)] according to shape, dimensions and the distribution of carbides :

— series NA relating to the distribution of carbides at grain boundaries in the annealed condition;

— series NH relating to the distribution of carbides at grain boundaries in the quenched and tempered condition;

— series LE relating to carbide streaking of enclosed shape. Only heavy carbide streaking is taken into consideration;

— series LD relating to carbide streaking of diffused shape.

3.3 Each series is made up of 10 reference photomicrographs which represent the increasing levels of carbides. These photomicrographs are marked by the figures 0 to 9, the figures increasing with the quantity of carbides.

According to the series, these photomicrographs correspond to field sizes of :

0,08 mm observed at a magnification of 1 000 for series NA;

0,4 mm observed at a magnification of 200 for series NH;

0,8 mm observed at a magnification of 100 for series LE and LD;

3.4 The characteristic number for the distribution of carbides is made up of the symbol of the series taken for reference and the number of the photomicrograph corresponding to the field observed.

4 Sampling

4.1 Samples are generally taken from rounds, bars and wide flats. Sampling shall be carried out so that the surface to be examined coincides with the direction of greatest elongation of the steel so that it is possible to observe the carbides in the longitudinal direction, the surface observed being parallel to the metal fibre. In the case of assessment using series NA and NH, the surface examined may also be taken perpendicular to the metal fibre, i.e. in a transverse section.

In the absence of any indication in the International Standard for the product, the method of sampling in the case of rounds or bars may be that specified in the figure.

The polished surface of the sample used for assessing the distribution of carbides shall be approximately 100 mm^2 . Its posi-

1) The symbols NA, NH, LE and LD are derived from the English terminology, as follows :

N : Network (in French : réseau);

A : Annealed condition (in French : à l'état recuit);

H : Hardened condition (in French : à l'état trempé et revenu);

L : Lines (in French : alignements);

E : Enclosed shape (in French : de forme nette);

D : Diffused shape (in French : de forme diffuse).

tion in the longitudinal or transverse section may vary depending on the aim of the examination and its selection, if it is not specified in the product standard or the order, is left to the discretion of the manufacturer.

4.2 The number of samples to be examined shall be specified in the International Standard for the product or, if it is not specified in the product standard, its selection shall be subject to special agreement.

4.3 In all the evaluations, it is very important that the samples selected should be representative of the metal being studied.

Comparative measurements can only be carried out on samples taken by the same method.

5 Preparation of samples

5.1 In the case of assessment in accordance with series NA, the conditions of annealing shall be specified in the product standard or shall be the subject of a special agreement.

In the case of assessment in accordance with series NH, LE and LD, the samples shall be quenched and tempered. The heat-treatment conditions shall be those specified in the product standard. Holding time at the austenitizing temperature is dependent upon the section size of the sample and shall be sufficient to ensure complete austenitization of this sample.

5.2 The sample is then polished in accordance with metallographic techniques; electrolytic polishing may only be used by agreement between the interested parties. The sample usually undergoes etching :

a) using picral (solution of picric acid with alcohol) for assessment of NA series;

b) using nital (solution of nitric acid with alcohol) for assessment according to series NH, LE and LD. Picral may also be used.

The etching shall be prolonged so as to show up the carbides clearly on a dark matrix for series NH, LE and LD.

6 Assessment of the distribution of carbides

6.1 Method of observation

Microscopic examination shall be carried out solely by observation using an eyepiece for the NA series. For series NH, LE and LD, the examination shall be carried out either using an eyepiece or by projection microscopy. The method of observation selected shall be constant throughout the entire examination for series NH, LE and LD. In the case of series NA, because of the 1 000 magnification, it is recommended that a preliminary examination be carried out at 500 magnification in order to be able to minimize the number of fields to be examined at 1 000 magnification.

It is essential that the diameter of the visual field be that relating to the series used. Slight variations in magnification are of little importance as assessment is only an estimation of the volume of the carbides in proportion to the visual field.

6.2 Actual examination

The polished surface shall be examined in the area specified in the product standard and each field of the area is compared with the reference photomicrographs of the series corresponding to the case being studied. If the product standard does not specify the area to be examined, this shall be the subject of agreement between the interested parties.

By special agreement, it is possible to carry out a partial examination only observing a reduced number of visual fields following a pre-determined pattern. The number of fields observed and their distribution on the surface to be examined shall be the subject of prior agreement.

The characteristic number of visual fields (indicated on the left of the reference photomicrographs) which best corresponds to the field examined shall be noted.

7 Expression of results

Unless otherwise specified in the International Standard for the product, the following methods can be used for the expression of results :

— for series NA and NH : statement of the average of the measurements;

— for series LE and LD : statement of the characteristic number corresponding to the predominant worst field.

8 Test report

The test report shall state :

a) the grade of steel;

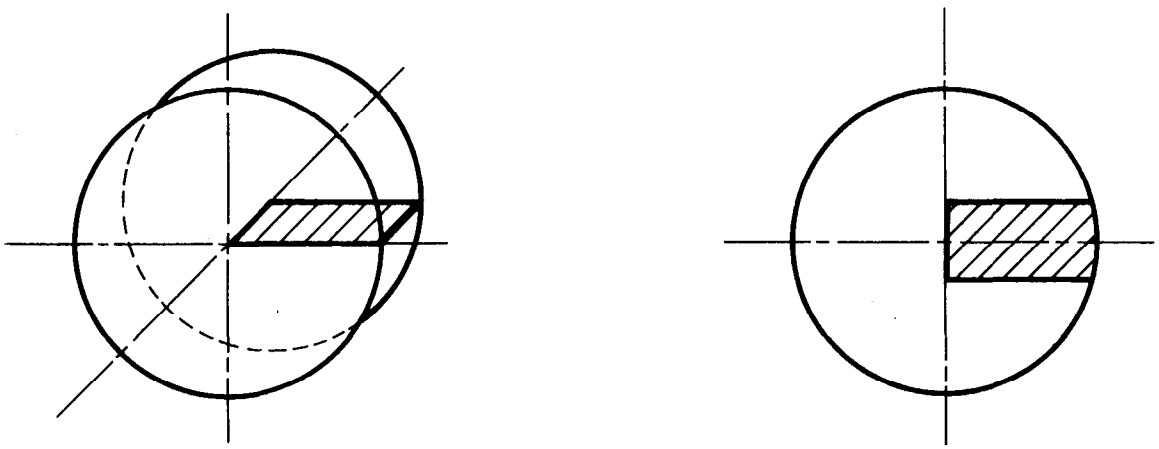
b) the nature of the sampling method and the position of the surface examined;

c) the number of visual fields examined for series NA and NH;

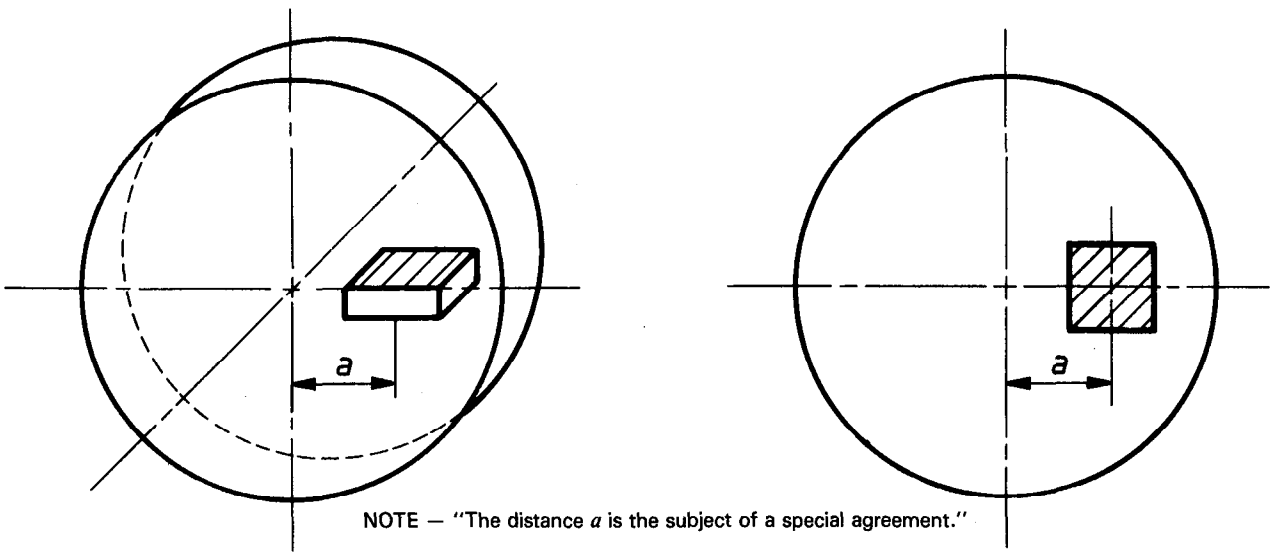
d) conditions of heat treatment, where appropriate;

e) the results of the examination.

a) Bar of diameter or side ≤ 25 mm



b) Bar of diameter or side 25 to 50 mm

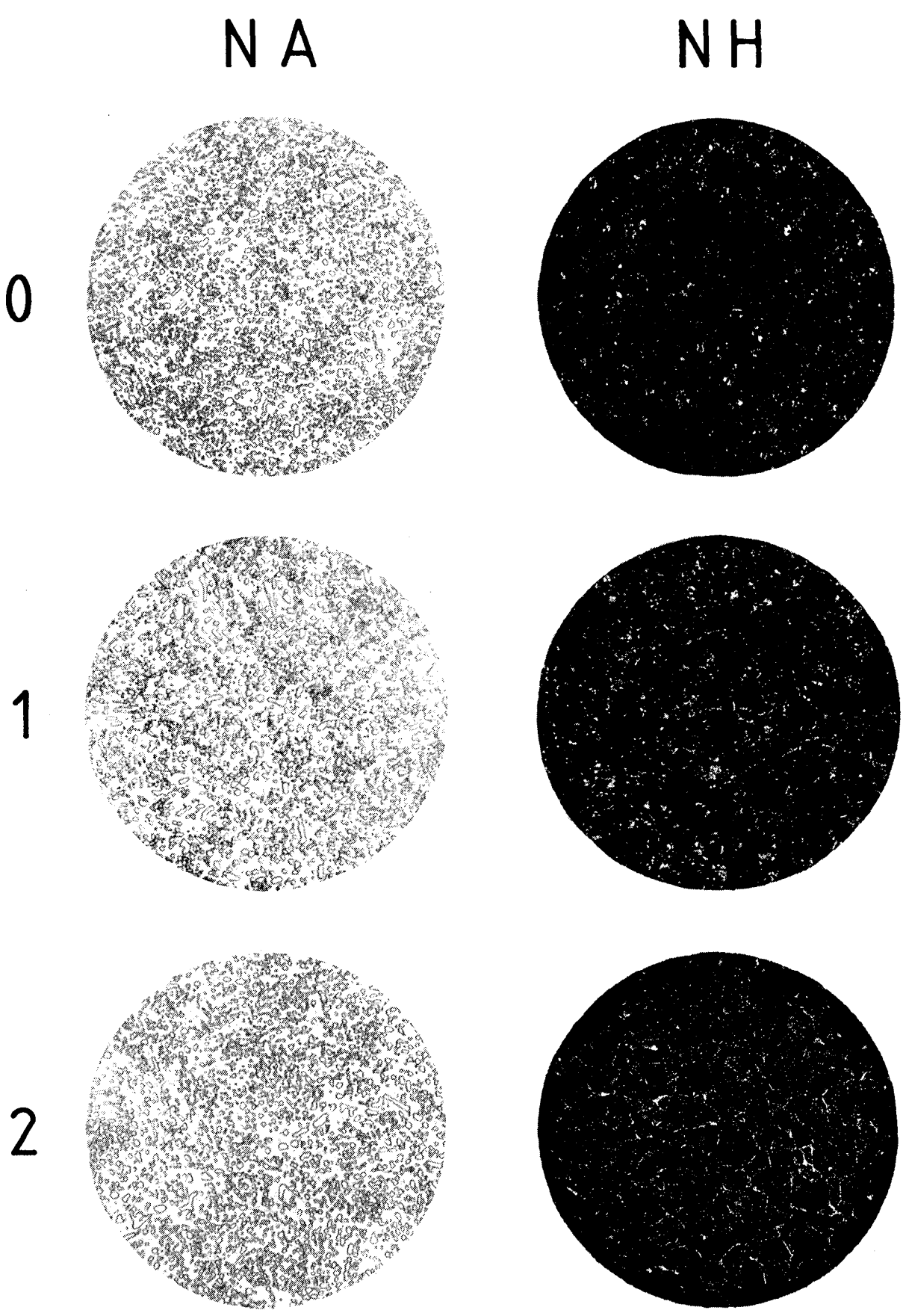


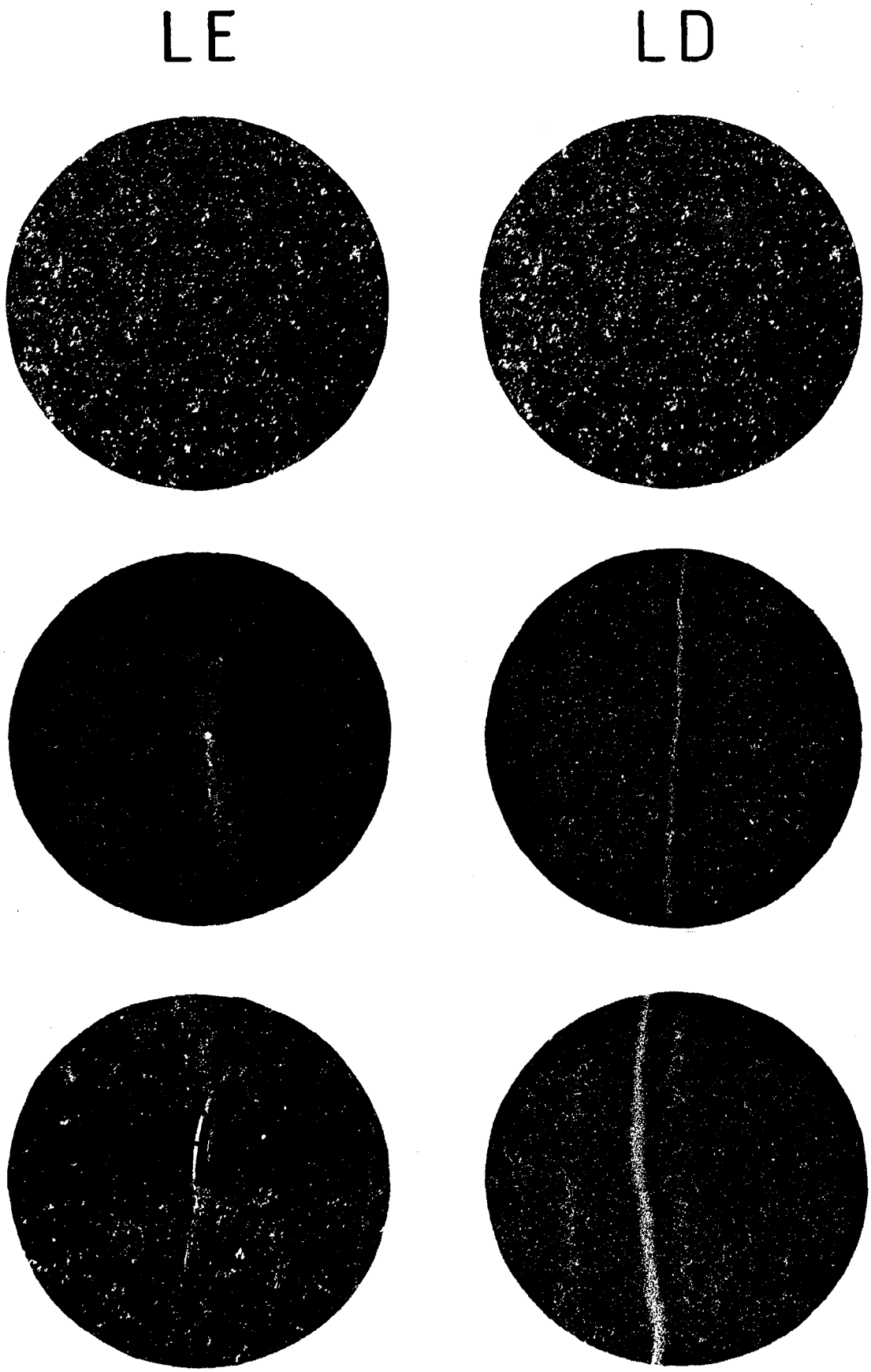
NOTE — "The distance *a* is the subject of a special agreement."

c) Bar of diameter of side ≥ 50 mm

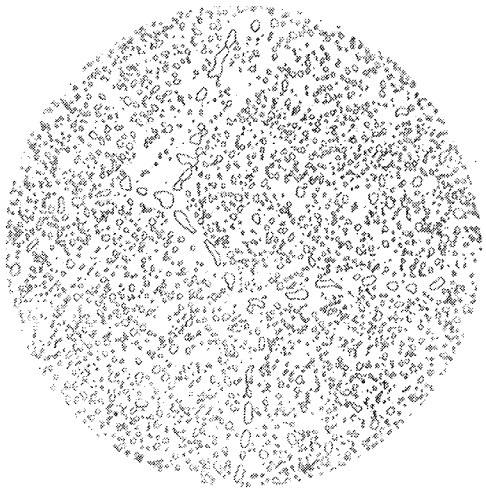
Figure — Method of sampling for rounds and bars

Annex/Annexe
Reference photomicrographs/Images-types




LE
LD

3



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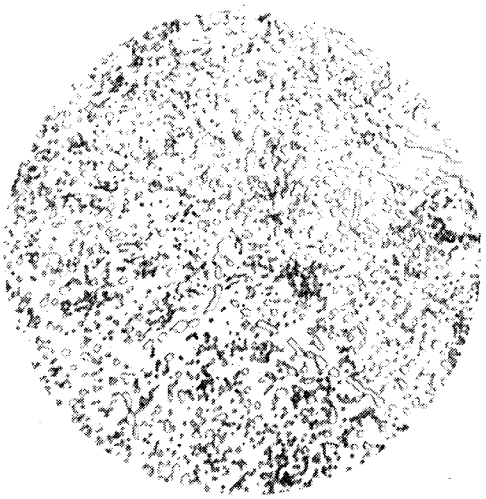

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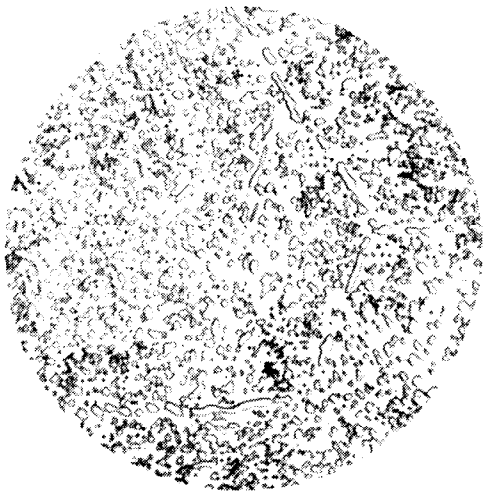

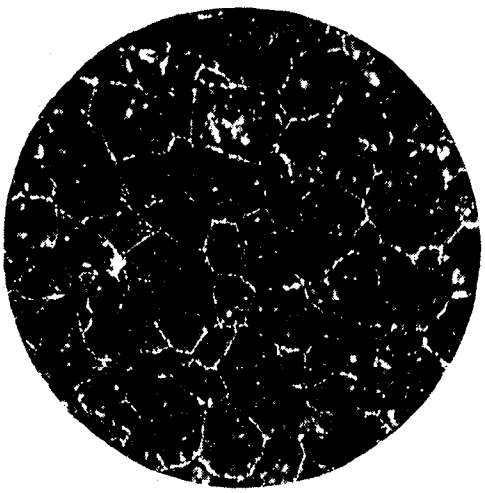

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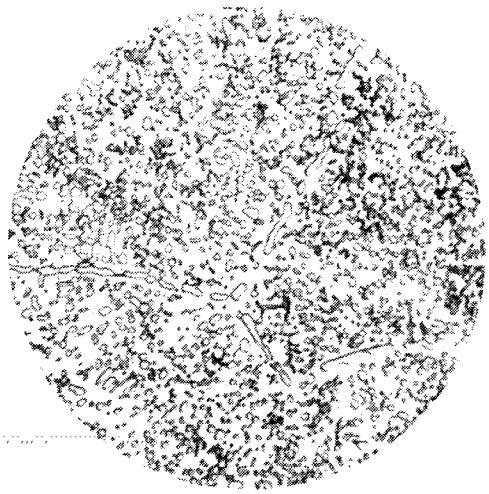
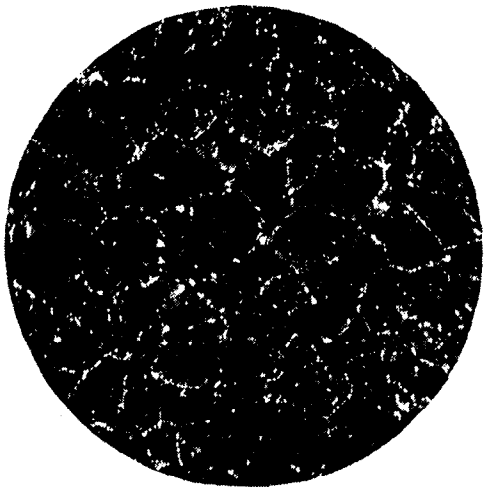
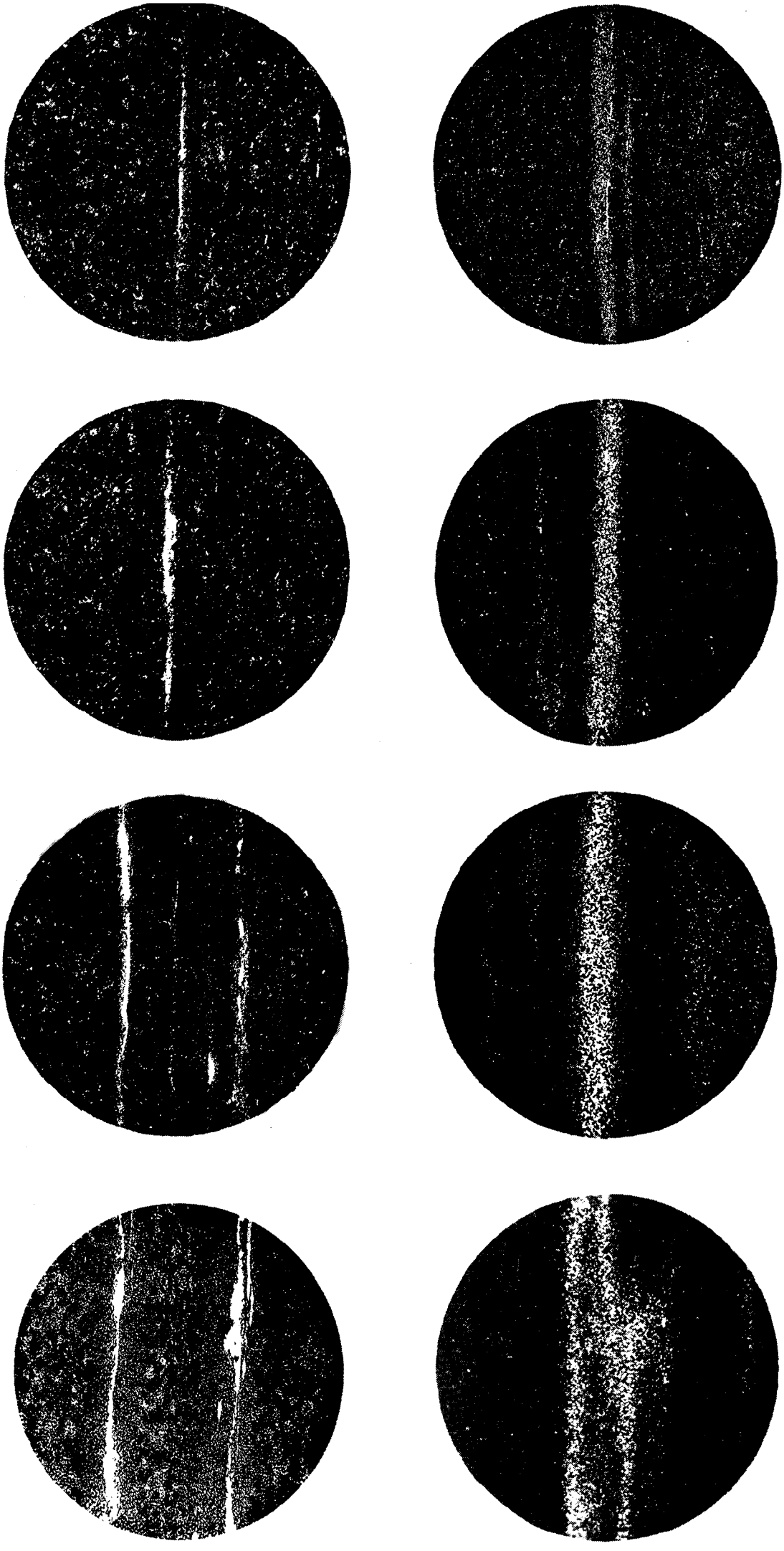
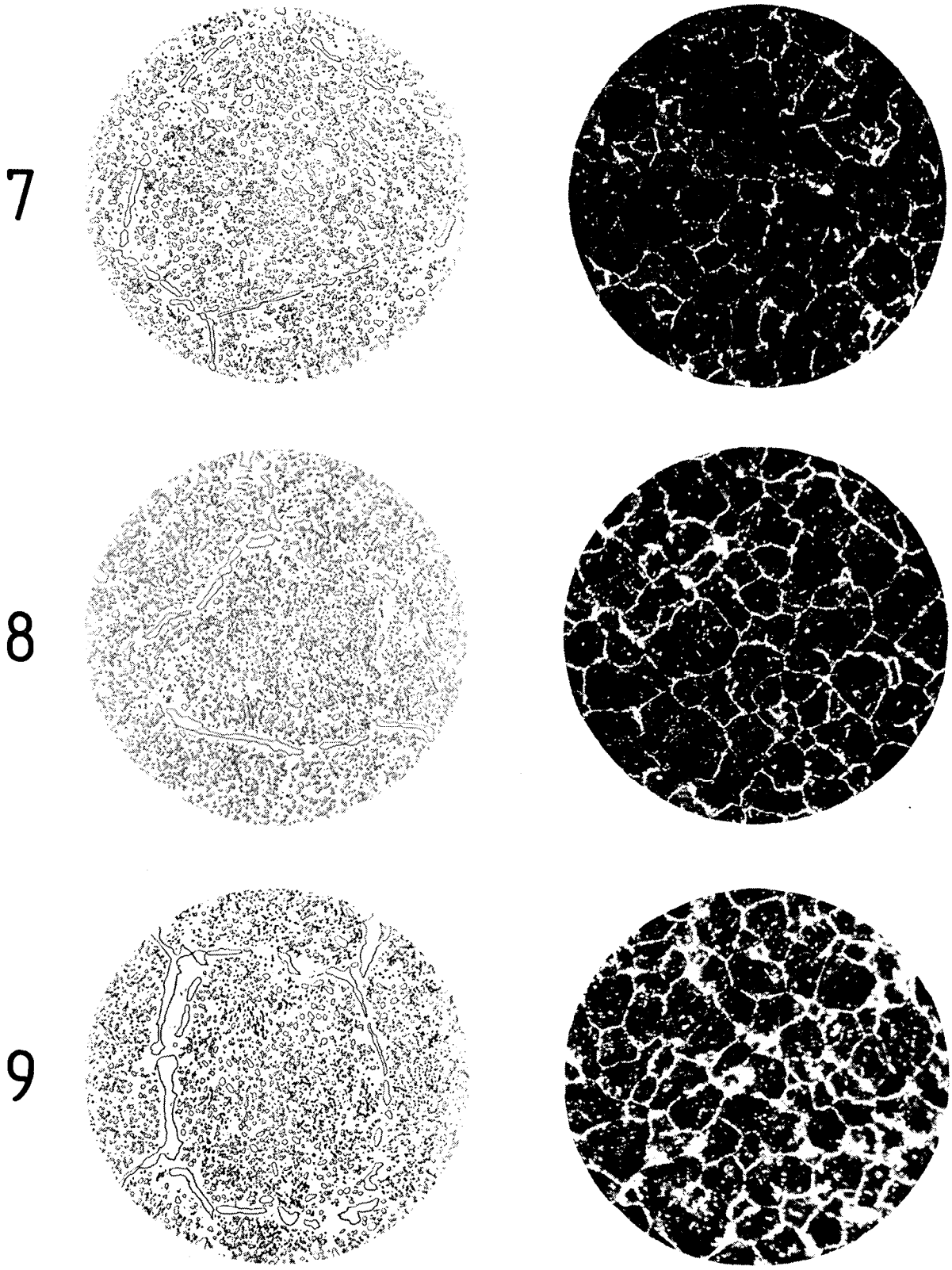


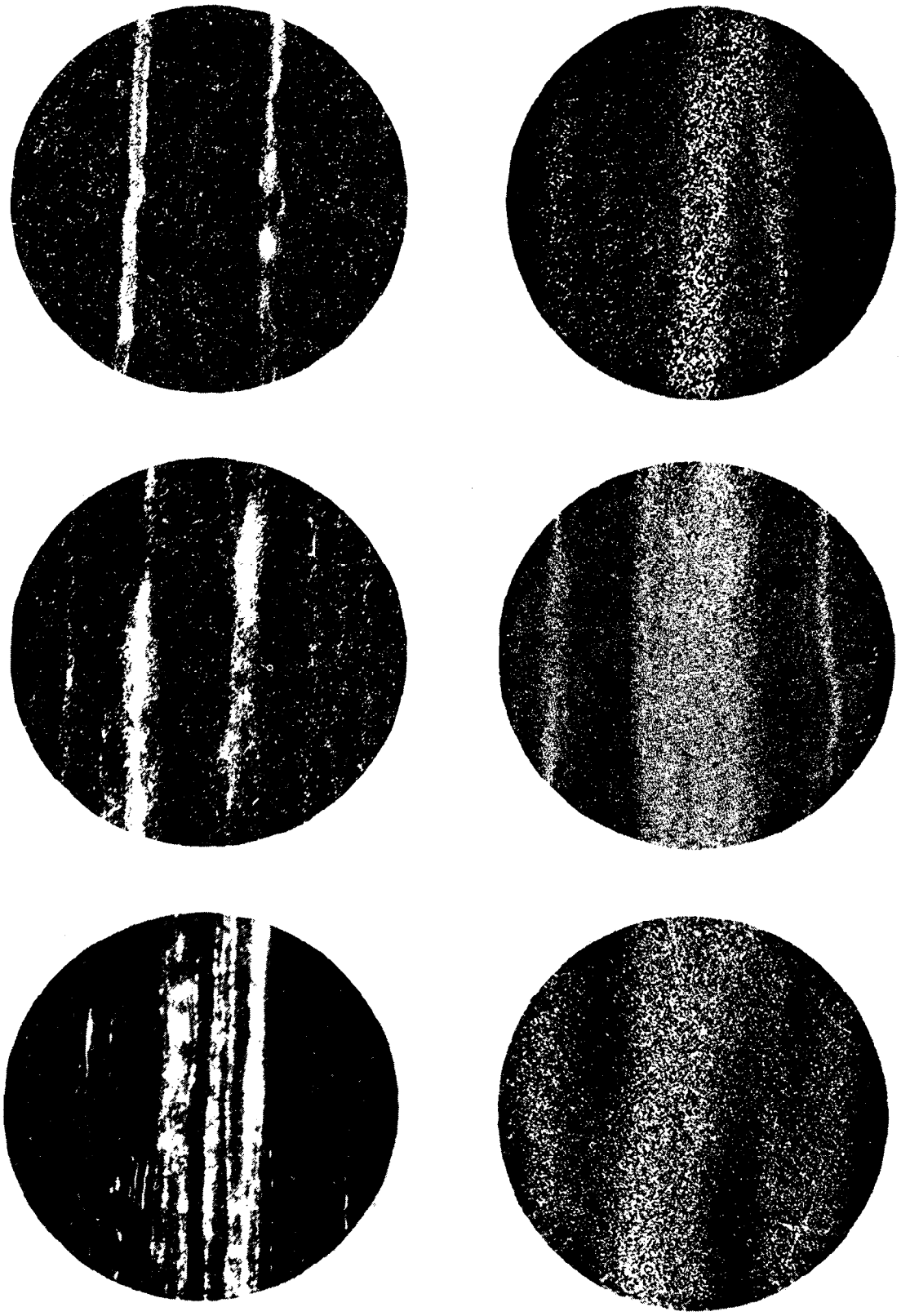






NOTE — The reference photomicrographs plate given above are taken from the Stahl-Eisen-Prüfblatt 1520 edition March 1978 (series 4, 5,

NOTE — Les images-types de la planche donnée ci-dessus sont extraites du Stahl-Eisen-Prüfblatt 1520, édition mars 1978 (Séries 4, 5, 6 et 7



6 and 7), Verlag Stahleisen GmbH, Düsseldorf, Germany, and they correspond to the micrographics taken from the 100 Cr 6 steel samples.

7), Verlag Stahleisen GmbH, Düsseldorf, Allemagne, R.F. et correspondent à des micrographies prises sur des échantillons d'acier 100 Cr 6.