
International Standard



4969

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Steel — Macroscopic examination by etching with strong mineral acids

Acier — Examen macroscopique par attaque aux acides minéraux forts

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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 4969 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in May 1978.

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

Australia	Germany, F. R.	Norway
Austria	Hungary	Poland
Belgium	India	Portugal
Brazil	Iran	South Africa, Rep. of
Bulgaria	Ireland	Spain
Canada	Italy	Sweden
Chile	Japan	Switzerland
Czechoslovakia	Korea, Dem. P. Rep. of	Turkey
Denmark	Korea, Rep. of	USA
Egypt, Arab Rep. of	Mexico	USSR
Finland	Netherlands	Yugoslavia
France	New Zealand	

The member body of the following country expressed disapproval of the document on technical grounds :

United Kingdom

Steel — Macroscopic examination by etching with strong mineral acids

1 Scope and field of application

This International Standard lays down guidelines for the macroscopic examination of steel by etching with strong mineral acids.

The method has very wide application. Selection of the type and concentration of the reagent, the temperature of the reaction and the conditions of surface preparation of the test piece make it possible to achieve the required aim.

NOTE — Depending on the conditions of surface preparation of the test piece, and on the etching process, this macroscopic examination does not always make it possible to distinguish on the one hand porosities from segregations, and on the other hand cracks from lines of inclusions or segregations.

2 General

2.1 The use of the test, and the conditions for interpreting the results observed, depend on the particular case : details are laid down in product standards or shall be subject to special agreement.

2.2 Observation of the etched surface is carried out with the unaided eye or with a magnifying glass (magnification up to $10\times$).

3 Principle and aim of the test

3.1 Macrographic etching with strong mineral acids reveals the macrostructure of a metal test piece and indicates any physical or chemical irregularities.

3.2 The reagent acts by dissolving different parts of the metal surface at unequal rates and thus produces differences in level which make observation possible.

3.3 Macroscopic examination after etching with mineral acids reveals lack of chemical uniformity (segregation of elements) lack of physical uniformity (cracks, porosity) and any intentional or accidental structural variations such as those caused, for instance, by hardening, decarburization, and case hardening.

3.4 In addition, very great sensitivity may be achieved by altering the conditions of preparation and attack. For instance, it is possible to reveal the dendritic structure of a metal or the presence of inclusions or very small defects.

4 Reagents

The list of reagents given below is not restrictive. These reagents are used successfully for most routine examinations and for an extensive range of steel grades (hydrochloric and sulphuric etching). Aqua regia is used for special steels which are resistant to attack by the following reagents.

Furthermore, depending on the objective, the type and concentration of the acid used may be varied, as may the temperature and time of application. For very detailed examinations, cold dilute nitric solutions similar to reagents used for micrographic testing may be needed.

4.1 Hydrochloric acid, dilute solution, having the following volumetric composition :

HCl (ρ_{20} 1,19 g/ml)	: 1 volume
H ₂ O	: 1 volume

This solution is used hot (60 to 80 °C).

4.2 Sulphuric acid, dilute solution, having the following volumetric composition :

H ₂ SO ₄ (ρ_{20} 1,84 g/ml)	: 15 volumes
H ₂ O	: 85 volumes

This solution may be used cold or hot (60 to 80 °C).

4.3 Sulphuric-hydrochloric acids, solution having the following volumetric composition :

HCl (ρ_{20} 1,19 g/ml)	: 38 volumes
H ₂ SO ₄ (ρ_{20} 1,84 g/ml)	: 12 volumes
H ₂ O	: 50 volumes

This solution is used hot (60 to 80 °C).