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Non-destructive testing — Metallographic replica techniques of surface examination

Essais non destructifs — Techniques de réplique métallographique pour l'examen des surfaces

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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.

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It has been approved by the Member Bodies of the following countries :

Austria	France	South Africa, Rep. of
Belgium	Germany	Spain
Bulgaria	India	Sweden
Canada	Israel	Thailand
Chile	Mexico	Turkey
Czechoslovakia	Portugal	United Kingdom
Egypt, Arab Rep. of	Romania	U.S.S.R.

No Member Body expressed disapproval of the document.

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Non-destructive testing — Metallographic replica techniques of surface examination

1 SCOPE

This International Standard specifies techniques of surface examination in which a transparent nitrocellulose varnish, or plastics material, with or without supports, is used to record inhomogeneities, both mechanical and metallurgical, in the condition of a metal surface.

2 FIELD OF APPLICATION

The techniques specified in this International Standard have the advantage of being suitable for locations where access is restricted. In addition, the replicas can be inspected on site with low-power optical aids or they may be transferred to a laboratory and examined under a powerful metallurgical microscope.

3 SURFACE PREPARATION

3.1 Degreasing

The surface shall be thoroughly cleaned, degreased and dried. This is conveniently achieved by the application of a suitable, approved solvent followed by acetone and drying in heated air.

3.2 Macrographic preparation

This preparation is applicable to all surfaces, including those resulting from service conditions, and to fracture faces. It calls for nothing more than the cleaning, degreasing and drying referred to in 3.1 above.

3.3 Micrographic preparation

3.3.1 This is intended for examination aimed at revealing the metallurgical state of the surface. After degreasing, the surface shall be subjected to a series of very fine mechanical polishing operations, each one progressively finer than the preceding one. In general, the dressing of the surface need not extend to a depth of more than 0,2 mm. In many cases, it will be considerably less. During these operations, care should be taken to avoid over-heating and work-hardening the metal by ensuring that excessive pressure is not applied to the polishing tool. It is advisable to criss-cross successive polishing runs and to clean the surface after each run with acetone.

3.3.2 The mechanical polishing described above shall be followed by a final polishing. This may be done in any of the following ways :

1) by electrolytic means using a stainless steel electrode surrounded by spongy material impregnated with a suitable electrolyte;

2) by electrolytic means in a small bath;

3) by mechanical polishing with diamond paste.

After this polishing has been completed, the surface shall be washed first with water and then with acetone and dried in heated air. The final stage of the surface preparation is etching by an appropriate reagent. After etching, the surface shall once again be washed in water and acetone and dried.

4 APPLICATION OF THE REPLICATE

All possible precautions shall be taken to ensure that the replicate is applied under the driest possible conditions with all dust excluded.

4.1 Varnish replicate

The varnish shall be transparent and of a nitrocellulose or plastics base. Great care shall be taken not to agitate it prior to application, as such agitation can give rise to the formation of air bubbles which have a detrimental effect on results. The varnish shall be spread over the surface by means of a spatula (see note) made of rubber or plastics material, so as to form a thin layer of uniform thickness. The varnish shall then be allowed to dry for between 60 and 90 min.

NOTE — A brush should not be used for applying the varnish as it gives rise to air bubbles which remain trapped in the replica.

4.2 Sheet replicate

4.2.1 The surface to be examined shall be moistened with a suitable solvent. A piece of sheet plastics material of suitable composition and size and of minimum thickness 0,1 mm shall be placed over it without pressure being applied.

4.2.2 It is recommended that the central part of the plastics sheet be placed near the middle of the surface to be examined. This facilitates the removal of displaced solvent and thus helps to avoid the formation of creases and air bubbles. To assist the plastics sheet to adhere to the metal surface, it is necessary to apply pressure to it with the fingers, starting at the middle and pressing out in the direction of two opposite edges.

5 REMOVAL OF THE REPLICA FROM THE SURFACE

5.1 The replica shall be removed from the surface by lifting it along one edge as evenly as possible, and care should be taken to ensure that the angle at which it is removed does not exceed 80°.

5.2 Great care should be taken to maintain a smooth, continuous action and to avoid finger marking the replica while this is being done.

6 MOUNTING AND EXAMINATION OF THE REPLICA

6.1 The replica shall be examined in either reflected or direct light. For examination in reflected light, the replica shall be fixed to a mirror or to a metal plate with a good reflecting surface (for example by means of adhesive tape) in such a way that the surface containing the impression is facing the objective lens of a microscope. Alternatively, the surface not containing the impression may be made reflecting by the vacuum deposition on it of aluminium.

6.2 For examination in direct light, the replica shall be treated as though it were a lantern slide and mounted between two glass plates and its image projected on a screen.

NOTE – It is very important to ensure that the replica is not damaged, either by stretching during mounting or by excessive heat from the light source during examination.