
**Non-destructive testing — Metallographic
replica techniques of surface examination**

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



Foreword

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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 plastic material, with or without supports, is used to record inhomogeneities, both mechanical and metallurgical, in the condition of a metal surface.

The techniques specified in this International Standard have the advantage of being suitable for some 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.

2 Surface preparation

2.1 Degreasing

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

2.2 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 2.1 above.

2.3 Micrographic preparation

2.3.1 This is intended for examination aimed at revealing the metallurgical state of the surface. After degreasing, the surface shall be subjected to series of mechanical grinding operations followed by series of 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 grinding and polishing runs and to clean the surface after each run with acetone or alcohol.

2.3.2 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 suitable equipment and electrolyte;
- 2) by electrolytic means in a small bath;
- 3) by mechanical polishing with diamond paste or other compounds that will produce the desired surface.

After the polishing has been completed, the surface shall be cleaned and dried as described in 2.1. The final stage of the surface preparation is etching with an appropriate reagent(s). After etching, the surface shall once again be cleaned and dried as described in 2.1.

3 Application of the replicate

3.1 General

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

3.2 Varnish replicate

The varnish shall be transparent and of a nitrocellulose or plastic 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 a means that does not give rise to turbulence, air bubbles and brush marks, so as to form a thin layer of uniform thickness. The varnish shall be allowed to dry in accordance with the manufacturer's recommendations.

3.3 Sheet replicate

3.3.1 The surface to be examined and/or the replica shall be moistened with a suitable solvent. A piece of sheet plastic material of suitable composition and size and of a thickness that will ensure a durable and representative replica shall be placed over the surface.

3.3.2 It is recommended that the central part of the plastic 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 help the plastic sheet to adhere to the metal surface, it might be necessary to apply pressure to it with the fingers, starting at the middle and pressing out in the direction of two opposite edges.

4 Removal of the replica from the surface

4.1 The replica shall be carefully removed from the surface in such a manner as to keep it in one piece.

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

5 Mounting and examination of the replica

5.1 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 vacuum deposition of aluminium on it.

5.2 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 to 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.