INTERNATIONAL STANDARD 3868

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Metallic and other non-organic coatings — Measurement of coating thicknesses — Fizeau multiple-beam interferometry method

Revêtements métalliques et autres revêtements non organiques — Mesurage de l'épaisseur — Méthode basée sur le principe de Fizeau d'interférométrie à faisceaux multiples

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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 3868 was drawn up by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings*, and was circulated to the Member Bodies in July 1975.

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

Bulgaria	Italy	South Africa, Rep. of
Czechoslovakia	Japan	Switzerland
France	Mexico	Turkey
Germany	New Zealand	U.S.A.
Hungary	Poland	U.S.S.R.
India	Portugal	
Israel	Romania	

The Member Body of the following country expressed disapproval of the document :

United Kingdom

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Metallic and other non-organic coatings — Measurement of coating thicknesses — Fizeau multiple-beam interferometry method

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for the measurement of the thickness of thin, highly reflective coatings (up to 2 μm) by the use of Fizeau multiple-beam interferometry.

The method described cannot be applied to vitreous enamel coatings.

2 PRINCIPLE

By completely dissolving a small area of the coating without attack of its substrate (or by masking before plating), a step is formed from the surface of the coating to that of its substrate. The height of this step is measured with a multiple-beam interferometer.

A monochromatic light beam is reflected back and forth between the specimen surface and a superimposed transparent mirror serving as a planar reference plate, so as to produce a pattern of interference fringes observed through a low-power microscope. The reference plate is tilted slightly with respect to the surface being inspected, so that the fringe pattern is a series of parallel lines. A step in the specimen surface causes a shift in the fringe pattern. A shift of one full fringe spacing is equivalent to a vertical displacement of 1/2 of the wavelength of the monochromatic light. The whole and fractional number of fringe spacings occupied by the fringe shift is determined with an eyepiece micrometer.

3 DEFINITIONS

3.1 filar micrometer eyepiece : A device for observing and measuring an image. It includes an adjustable lens, a hairline that is moved with a graduated knob, and a pattern of lines (graticule lines) across the field of view.

3.2 filar units : The graduations on the micrometer control which are proportional to the absolute unit of length.

3.3 Fizeau plate : An optically flat, smooth surface with high reflectivity and low absorption.

3.4 fringe lines : The dark lines caused by interference of light waves.

3.5 hairlines : The part of the filar eyepiece moved by means of the graduated knob to measure fringe line-spacing and offset.

3.6 offset : The displacement of a fringe line which occurs when it encounters a vertical variation on the surface of a specimen.

3.7 spacing : The distance between fringe lines.

4 EQUIPMENT

The instrument employs :

a) a beam of monochromatic light;

b) optics to direct the light through a specially coated Fizeau plate which comes into contact with the specimen at a slight angle and forms an air wedge. An interference fringe pattern is produced in the air wedge and viewed through a microscope equipped with a filar micrometer eyepiece. The spacing and shape of the fringe lines can be interpreted to determine an extremely accurate contour map of the specimen surface.

5 FACTORS AFFECTING THE MEASURING ACCURACY

The following factors may affect the accuracy of a coating thickness measurement :

5.1 Reflective overcoat

In order to obtain dark, narrow fringe lines necessary to achieve an accurate measurement, and in order to avoid errors due to different phase shifts, when light reflects over different materials, the test specimen shall be coated with a highly reflective material such as aluminium or silver. If the surfaces at the step are highly reflective and the errors due to phase shift are known and corrected for, then the reflective layer can be avoided.

5.2 Step form

For specimens with a coating thickness of less than 0,3 μm special fabrication is not normally necessary.

If the step being measured is abrupt, so that it is not possible to follow the fringes across the step, it will not be possible to observe how many full fringe intervals of displacement have occurred. This may be determined by an independent estimate of thickness on the basis of prior knowledge, or on measurements by other techniques such as profilometry, white-light interferometry, etc.

By the appropriate method the stem can often be made less abrupt so that each fringe can be followed across each step. The optimum angle is normally in the range 95 to 100°.

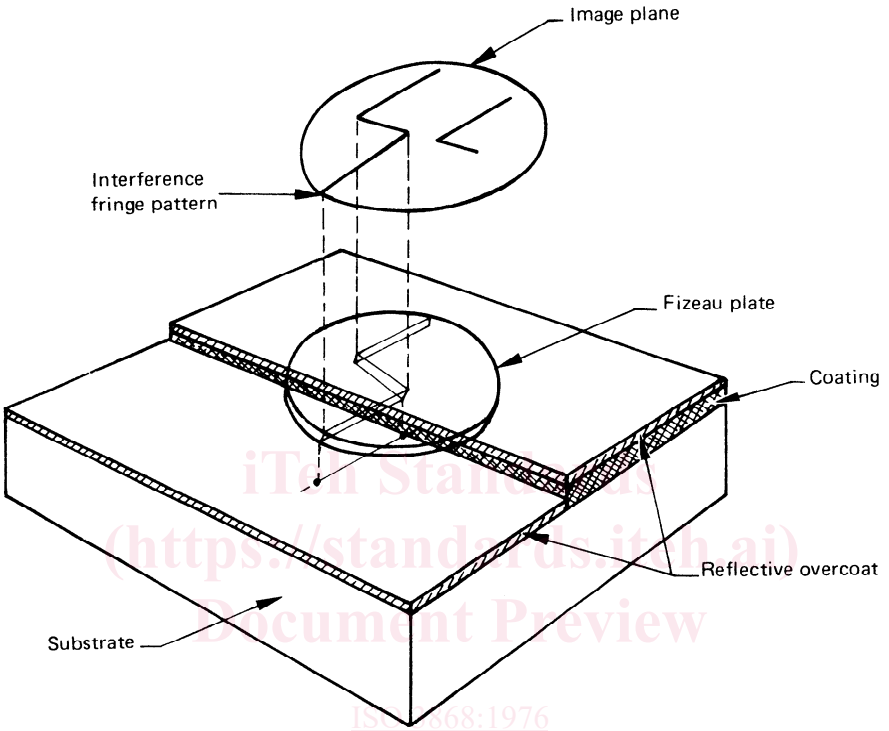
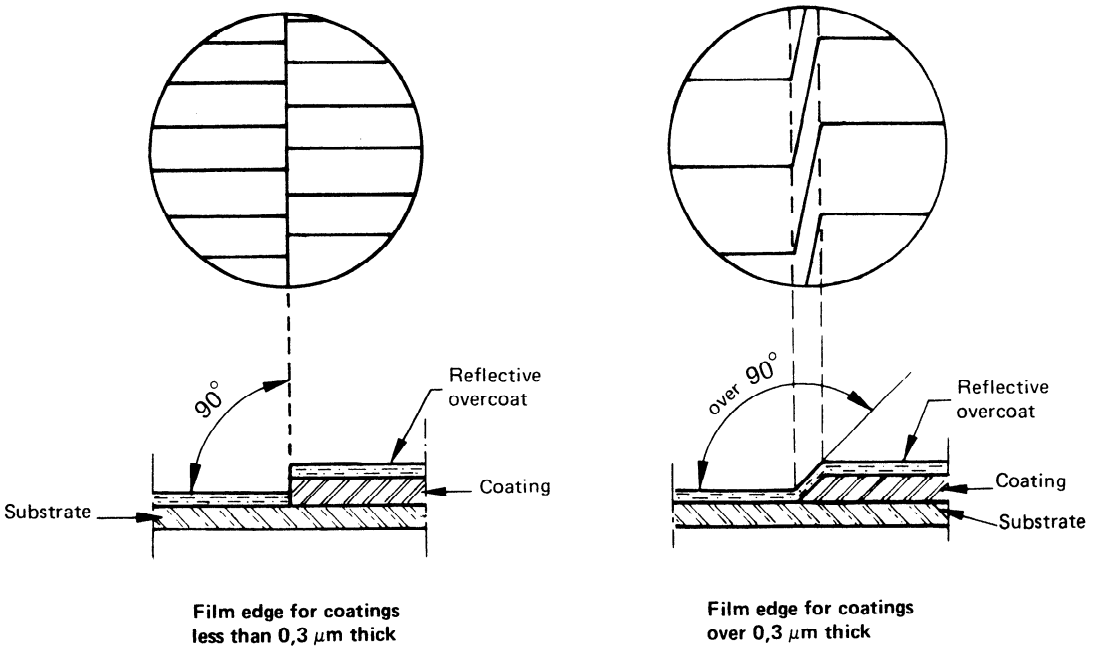


FIGURE 1



Film edge for coatings less than 0,3 μm thick

Film edge for coatings over 0,3 μm thick

FIGURE 2