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BRITISH STANDARD : AEROSPACE SERIES
METHODS FOR
MEASURING COATING THICKNESS BY
NON-DESTRUCTIVE TESTING

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FOREWORD

This British Standard, prepared under the authority of the Aerospace Industry Standards Committee, is one of a series for the non-destructive testing of aerospace materials, components and structures. Other standards in this series cover radiographic, magnetic particle, etch and penetrant inspection methods.

For the purposes of this standard, combinations of coating and substrate are classified in association with the available methods of measuring coating thickness, and the basic principles of the methods of measurement by means of non-destructive testing techniques are described together with the procedures for their application. The standard is not intended to be used as a level of acceptance or rejection as both of these aspects should be covered in an appropriate application standard or be agreed between the interested parties.

It is emphasized that non-destructive testing

methods, being complementary to one another, should always be considered in relationship to testing as a whole. When non-destructive testing methods or techniques are specified for measuring coating thickness, the most suitable method and amount of inspection compatible with the ultimate application for the product should be employed. Bearing in mind that the characteristics of individual types of equipment can vary, it is also essential for the operator to be fully conversant with the equipment used.

This standard makes reference to the following:

- BS 204. Glossary of terms used in telecommunication (including radio) and electronics.
- BS 205. Glossary of terms used in electrical engineering.
- BS 3683. Glossary of terms used in non-destructive testing.
- BS 4758. Electroplated coatings of nickel for engineering purposes.

METHODS

1. SCOPE

1.1 This British Standard is concerned with methods for the measurement by non-destructive means of the thickness of single coatings, such as paint or plating on metallic substrates, and applies both to the inspection of components during their manufacturing stages and also when subsequently in service.

1.2 While one of the methods described can be applied to the estimation of the thickness of anodic coatings on aluminium alloys, the general measurement of the depth of conversion coatings, of corrosion, of case hardening and of decarburization is not considered.

1.3 The standard does not specify checks on the physical condition of the coatings, e.g., on their surface texture, continuity or adhesion, and it should be borne in mind that variation in these factors may affect the accuracy of thickness measurement.

2. TERMS AND DEFINITIONS

2.1 For the purposes of this British Standard, the terms and definitions given in BS 3683 apply. Attention is also drawn to BS 204 and BS 205.

2.2 Unless otherwise stated, the terms 'conducting' and 'magnetic' refer specifically to electrically conducting and magnetic electrically conducting properties of materials respectively.

2.3 In addition, 'by agreement' means that specific agreement has been reached between the purchaser and the supplier, and any inspecting authority concerned.

3. CLASSIFICATION OF COATINGS AND SUBSTRATES

3.1 The applicability of the available methods of measurement by means of non-destructive testing depends on the particular combination of coating and substrate under consideration. These combinations, together with examples given in parentheses, include the following:

(1) Non-conducting coatings on non-magnetic conducting substrates. (Paint or plastics on aluminium alloys.)

(2) Non-conducting coatings on magnetic substrates. (Paint or plastics on steel.)

(3) Non-magnetic conducting coatings on non-magnetic conducting substrates. (Chromium on brass.)

(4) Non-magnetic coatings on non-conducting substrates. (Chromium on plastics.)

(5) Non-magnetic conducting coatings on magnetic substrates. (Chromium on steel.)

(6) Magnetic coatings on non-magnetic conducting substrates. (Nickel on stainless steel or brass.)

(7) Magnetic coatings on magnetic substrates. (Nickel on steel.)

(8) Magnetic coatings on non-conducting substrates. (Nickel on plastics.)

3.2 Attention is drawn to Appendix A in which a convenient means of identifying the methods which can be applied to any particular coating-substrate combination has been tabulated. Although a number of methods are listed for each general coating-substrate combination, it should not be inferred that each method will necessarily be suitable for every material combination eligible for inclusion in that particular coating-substrate group.

4. UNDERLYING PRINCIPLES AND APPLICATIONS OF METHODS OF MEASUREMENT

4.1 Eddy current method

4.1.1 The factors which govern the effective reactance and resistance of the test coil in eddy current inspection include:

(1) the size and shape of the test coil,

(2) the size and shape of the workpiece,

(3) the frequency of the alternating current in the test coil,

(4) the electrical conductivity, magnetic permeability and homogeneity of the workpiece,

(5) temperature,

(6) the coupling or separation between the coil and the surface of the workpiece.

4.1.2 If the influence of the other factors remains sensibly constant, the last mentioned effect can be used to measure the thickness of non-conducting coatings on non-magnetic or magnetic substrates. If the thicknesses and relative electrical conductivities of the coating and substrate are suitable the method may also be applied to the measurement of non-magnetic conducting coatings on a non-magnetic conducting base.

4.2 Magnetic attraction method

4.2.1 In the magnetic attraction method, one pole of a permanent magnet is placed in contact with non-magnetic coatings on magnetic substrates. The normally applied force required to pull off the magnet becomes a measure of the coating thickness.

4.2.2 Its applications include the measurement of paint and plating on steel and also, of thin magnetic coatings on a non-metallic backing.

4.3 Magnetic reluctance method

4.3.1 By the magnetic reluctance method, a non-magnetic coating on a magnetic substrate becomes a gap in a magnetic circuit and its thickness is estimated in terms of the reluctance which it thus introduces. The magnetic circuit may be achieved by either a permanent magnet or an electro-magnet.