INTERNATIONAL STANDARD

ISO 2063

Third edition
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Thermal spraying — Metallic and other inorganic coatings — Zinc, aluminium and their alloys

Projection thermique — Revêtements métalliques et autres revêtements inorganiques — Zinc, aluminium et alliages de ces métaux

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 2063 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

This third edition cancels and replaces the second edition (ISO 2063:1991), which has been technically revised.

For the purposes of this International Standard, the CEN annex giving a list of EN documents corresponding to ISO documents mentioned as normative references has been removed.

Contents

Foreword

This document (EN ISO 2063:2005) has been prepared by Technical Committee CEN/TC 240 “Thermal spraying and thermally sprayed coatings”, the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 107 “Metallic and other inorganic coatings”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2005, and conflicting national standards shall be withdrawn at the latest by September 2005.

This document supersedes EN 22063:1993.

Annex A and B are informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom

Introduction

Thermal-sprayed metallic coatings are produced by heating the coating metal to its molten stage and projecting it in a stream of gas onto the prepared surface to be coated.

It is essential that the purchaser specifies the coating metal or alloy and the thickness of the coating required: merely to ask for thermal metal spraying to be carried out in accordance with this standard, without this information, is insufficient.

It is essential that the design of the article is such that it may be coated properly.

1 Scope

This standard applies to thermal-sprayed metallic coatings for the protection of iron and steel against corrosion by applying zinc or aluminium or their alloys to uncoated surface to be protected.

This standard deals with characteristic properties and gives test methods for coatings obtained by the spraying of zinc and aluminium and their alloys for the general purpose of corrosion protection.

It gives firstly the definition, classification and symbols for these coatings in relation to their thickness.

It then deals with the preparation of surfaces, application of coatings and their characteristic properties: namely, thickness, appearance and adhesion.

Finally it gives test methods for checking these properties.

For other metals some of the provisions are valid and can be adopted by agreement between the interested parties.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method (ISO 1463:1982).*

EN ISO 2064:2000, *Metallic and other inorganic coatings — Definitions and conventions concerning the measurement of thickness (ISO 2064:1996).*

EN ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method (ISO 2178:1982).*

EN ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings (ISO 8501-1:1988).*

EN ISO 11124-2, *Preparation of steel substrates before application of paints and related products — Specifications for metallic blast-cleaning abrasives — Part 2: Chilled-iron grit (ISO 11124-2:1993).*

EN ISO 11126-3, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 3: Copper refinery slag (ISO 11126-3:1993).*

EN ISO 11126-4, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 4: Coal furnace slag (ISO 11126-4:1993).*

EN ISO 11126-7, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 7: Fused aluminium oxide (ISO 11126-7:1995).*

EN ISO 12944-1, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction (ISO 12944-1:1998).*

EN ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments (ISO 12944-2:1998).*

EN ISO 12944-3, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 3: Design considerations (ISO 12944-3:1998).*

EN ISO 12944-4, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 4: Types of surface and surface preparation (ISO 12944-4:1998).*

EN ISO 12944-5:1998, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems (ISO 12944-5:1998)*.

EN ISO 12944-6, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods (ISO 12944-6:1998).*

EN ISO 12944-7, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 7: Execution and supervision of paint work (ISO 12944-7:1998).*

EN ISO 12944-8, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 8: Development of specifications for new work and maintenance (ISO 12944- 8:1998).*

EN ISO 14919:2001, *Thermal spraying — Wires, rods and cords for flame and arc spraying — Classification — Technical supply conditions (ISO 14919:2001)*.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 2064:2000 and the following apply.

3.1
significant surface
part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance

3.2
minimum local thickness
lowest value of the local thickness found on the significant surface of a single article

4 Manner of specifying requirements

When specifying the coating of articles by thermal spraying in accordance with this standard, the purchaser shall state, in addition to the number of the standard, the significant surface of the metal coating and its thickness in accordance with the symbols indicated in Table 1.

5 Classification

The zinc, aluminium or Zn-Al alloy coatings considered in this standard are classified in a scale according to their thickness, in conformity with the indications in Table 1.

Table 1 — Classification of sprayed metal coatings

Thermal spray material according to EN ISO 14919	Minimum local thickness (µm)[a] 50[b]	100	150	200	250	300[c]
Zn99,99 Al99,5 AlMg5 ZnAl15						
This classification gives a series of thickness values applicable to zinc, aluminium and Zn-Al alloy coatings. Intermediate values may be specified by agreement between the parties concerned. The symbol corresponding to each coating shall be composed of the symbol according to EN ISO 14919 followed by the minimum local thickness[d].						

[a] In conformity with EN ISO 2064.

[b] Thicknesses requiring an agreement between the interested parties, notably on the spraying technique used to achieve uniformity of thickness, the use of paints or sealers and the test methods.

[c] By special agreement between the interested parties, greater minimum thicknesses may be used if the coating obtained remains in conformity with this standard.

[d] To specify an alloy coating, the chemical symbol corresponding to EN ISO 14919 shall be followed by the minimum local thickness e. g. a coating of 120 µm consisting of thermal spray material according to ZnAl15 alloy shall be specified as (EN ISO 14919 ZnAl15) 120, the parentheses being essential for the identification of the alloy terms.

6 Manufacture

6.1 Preparation of surfaces to be coated by thermal spraying[1)]

The surface shall be thoroughly cleaned and roughened by blasting using a suitable abrasive grit. Blasting shall be continued until the surface has a metallic appearance and uniform texture according to EN ISO 8501-1, grade Sa 3.

Immediately before spraying, the surface shall be dry and free from dust, grease, scale, rust and any contaminants.

In all cases, the roughness of the surface shall be verified by comparison with a reference surface having similar properties to the workpiece, prepared according to specifications agreed between the interested parties.

Unless otherwise specified, one of the following abrasives shall be used in the preparation of the surface:

— hematitic chilled cast iron grit according to EN ISO 11124-2;

— copper refinery slag according to EN ISO 11126-3;

1) This subclause specifies the most important elements of surface preparation before thermal spraying of zinc, aluminium and their alloys. For more detailed specifications, it is recommended to refer to EN 13507.

— coal furnace slag according to EN ISO 11126-4;

— aluminium oxide grit according to EN ISO 11126-7.

In certain cases[2)], other abrasives may be used, by agreement between the interested parties, but with special precautions to achieve sufficient cleanliness and roughness to ensure the adhesion of the sprayed material.

The grit size of the abrasive is generally between 0,5 mm and 1,5 mm.

The abrasive used, whatever its type, shall be clean, dry and not contaminated. In the case of abrasive blasting using compressed air, the air shall be sufficiently clean and dry to prevent contamination of the abrasive or the surface to be sprayed with metal.

6.2 Coating metal

The thermal spray material of zinc and zinc alloys or aluminium and aluminium alloys shall comply with EN ISO 14919, especially

— Zn 99,99 according to EN ISO 14919:2001, 2.1;

— Zn Al15 according to EN ISO 14919:2001, 2.3;

— Al 99,5 according to EN ISO 14919:2001, 3.2;

— Al Mg5 according to EN ISO 14919:2001, 3.3.

6.3 Thermal spraying

The thermal spraying shall be carried out after the surface has been prepared by abrasive blasting, within a period that ensures that the prepared surface is still clean, dry and not visibly oxidized, when spraying commences.

This time delay shall be as short as possible and typically less than 4 h, depending on local conditions.

Spraying shall not be carried out under conditions leading to condensation of humidity on the surface to be sprayed and the surface shall be maintained at a temperature of at least 3 °C above the dew-point to avoid blistering.

If deterioration of the surface to be coated is observed, any affected areas shall be prepared again to bring them to the required quality (see 6.1).

6.4 Sealing

The purpose of sealing is to reduce inherent porosity of the sprayed coating.

Natural sealing can be achieved by oxidation of the metallic coating under normal environmental exposure conditions when resulting oxides, hydroxides and/or basic salts are not soluble in this environment.

Artificial sealing can be achieved either by chemical conversion of the metallic coating surface (by phosphating, reactive painting, etc) or by applying an appropriate sealant to seal any porosity. The sealant shall be applied before the coating can take up any moisture.

6.5 Painting

Painting of sealed metallic coatings may be done either for aesthetic reasons or to extend the service life of the protective system. In the case of corrosion protection of steel structures the system and the paint system shall apply according to EN ISO 12944-5:1998, Table A.10.

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2) In some countries, the use of dry siliceous material is subject to statutory regulations.

For the execution of painting EN ISO 12944-1 to EN ISO 12944–8 shall be considered.

7 Required characteristics

7.1 Thickness

7.1.1 General

Metallic coatings deposited by thermal spraying are defined by their minimum local thickness (see 3.2).

The method of measurement, the number and distribution of the measurements over the whole surface area treated shall be done in accordance with 7.1.2 and 7.1.3.

7.1.2 Coatings with a surface area of between 1 cm^2 and 1 m^2

In the case of coatings with a surface area of between 1 cm^2 and 1 m^2, the local thickness at any given point shall be the arithmetic mean of three measurements distributed within an area of 1 cm^2 (see Figure 1).

If the geometry of the component does not allow this, an appropriate reference piece shall be agreed between the contacting parties, which shall be sprayed at the same time, using the some conditions and shall be measured by metallographic or mechanical means.

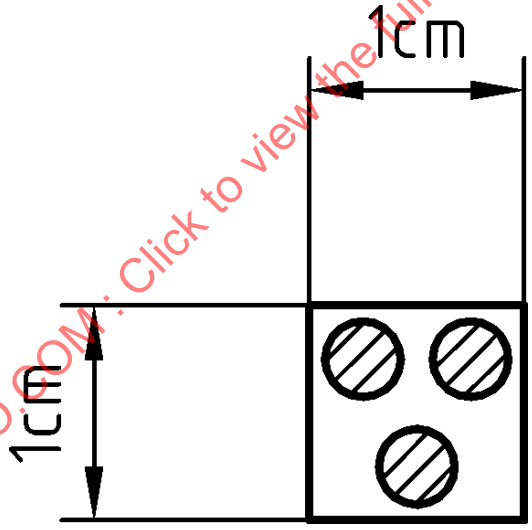


Figure 1 — Distribution of measurement points in the reference square centimeter

7.1.3 Coatings with a surface area greater than 1 m^2

In the case of coatings with a surface area greater than 1 m^2, the local thickness at any given point is the thickness of the coating measured on a reference surface which shall be approximately 1 dm^2 in area.

The local thickness shall be the arithmetic mean of 10 measurements distributed over the reference square decimetre in accordance with Figure 2.

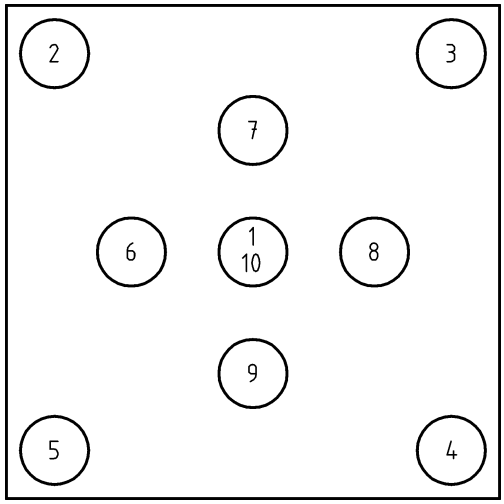


Figure 2 — Distribution of measurement points in the reference square decimetre

7.1.4 Location of thickness test points

The measurement of the local thickness for the purpose of determining the minimum characteristic thickness of the coating takes place in practice at points at which the thickness of the coating is presumed to be at its lowest. These points, and their number, may be defined by agreement between the parties concerned and stipulated at the time of placing the order. It is recommended that these points should, wherever possible, be those specified in the product standards. In the absence of any agreement between the parties concerned, the choice of these points is left to the discretion of the customer.

7.1.5 Methods of measurement

The measurement of thickness shall be made by magnetic measuring methods (see 8.1.2) which can be used in all cases, provided that specifications are observed concerning the number of measurements which shall be used to obtain the arithmetic mean.

In the case of dispute, use the micrographic cross-section method if this possible (see 8.1.3).

7.2 Appearance

The surface of the coating shall be of uniform appearance, without blisters or bare patches, and free from non-adhering metal and defects which can be detrimental to the service life and expected use of the protective coating.

7.3 Adhesion

If at the end of the test according to annex A no separation from the parent metal or within the metallic coating has occurred, the coating should be deemed to be satisfactory.

The tensile adhesive strength should be determined according to A.2. The minimum values of tensile adhesive strength shall be agreed between the contracting parties.

8 Test methods

8.1 Measurement of thickness

8.1.1 Field of application of the methods

8.1.1.1 Magnetic measurements have the advantage of being non-destructive, rapid and capable of being carried out directly at any point on the surface to be controlled. Furthermore, the nature of the coating (zinc, aluminium) sprayed onto a ferrous metal, and the values of the standard thicknesses, contribute to the

achievement of satisfactory accuracy. As a result, in conformity with the specifications of this standard and by agreement between the interested parties on the correct calibration of magnetic instruments for a given sample, magnetic measurements make it possible to carry out effective and accurate acceptance checks.

8.1.1.2 The micrographic cross-section method used as a reference method for sprayed metallic coatings, is difficult to perform correctly. Therefore, this method shall be used only after prior agreement between the interested parties, the test being made according to the requirements of 8.1.3.

8.1.2 Magnetic measuring method

The tests shall be carried out according to EN ISO 2178.

8.1.3 Micrographic cross-section

8.1.3.1 Principle

Microscopic examination of a cross section taken from a sample coating in accordance with EN ISO 1463.

8.1.3.2 Comments

In order to prevent the separation of the coating from the substrate and rounding of the edges, the test piece shall be mounted in an appropriate mounting material such as plastic or low melting point alloy. The surface to be examined shall be carefully polished with a suitable material.

Ten measurements shall be made, uniformly distributed along one of the sides of the test piece and covering approximately the 20 mm length of the cross-section (object surface), and the arithmetic mean of these measurements shall be taken.

8.2 Adhesion test

The choice of the test method and its interpretation shall be carried out by agreement between the interested parties. An explanation of the methods is given in annex A.

Annex A
(informative)

Adhesion test methods

A.1 Grid test

A.1.1 Principle

Cutting through the coating to the parent metal to give a lattice pattern having squares of specified dimensions. No separation of the coating should occur.

A.1.2 Apparatus

Cutting tool with a hard point, of a type similar to that shown in Figure A.1.

A.1.3 Procedure

Using the tool (see A.1.2), cut a lattice with the dimensions given in Table A.1.

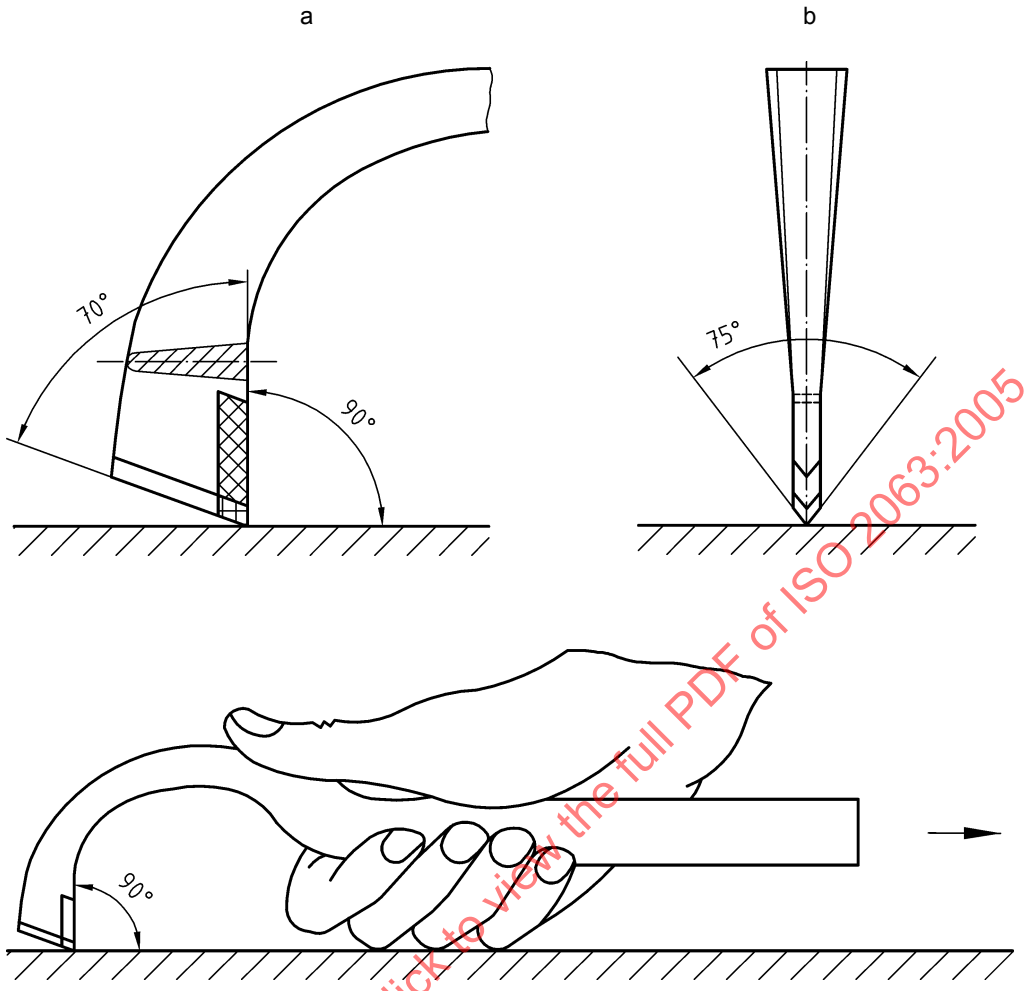
Table A.1 — Lattice dimensions

Approximate surface covered by the lattice	Thickness of coating verified	Distance between cuts
	µm	mm
15 mm x 15 mm	≤ 200	3
25 mm x 25 mm	> 200	5

The depth of the cuts should be such that the coating is cut through to the parent metal.

Wherever possible, after the lattice has been cut, apply a suitable adhesive tape, agreed upon between the interested parties, to this part by means of a roller with a loading of 5 N. Then pull off the adhesive tape quickly and abruptly, in a direction perpendicular to the surface.

If this is not possible, the method of scribing the coating should be agreed upon between the interested parties.



Key

a Side view
b Front view

Figure A.1 — Cutting tool

A.2 Tensile test method

A.2.1 General requirements

Inconsistent results will be obtained unless a pneumatic or hydraulic tester, which ensure a pulling force truly normal to the surface, is obtained.

The coated substrate shall be sufficiently rigid to avoid flexing during testing. Choose a flat, level part of the test surface. Remove any loose material from the test area.

A.2.2 Preparation of the Test Dolly

The test dolly (pull stub) shall be cleaned either mechanically (abrasion) or chemically and degreased with clean paper or textile moistened with an appropriate solvent such as alcohol. The face of the dolly shall be abraded or roughened to improve the key. Epoxy-type adhesives require a coarse surface, acrylic-type adhesives work better with a smooth one. Place new silicon carbide paper on a flat and hard surface and rub the test surface of the test element firmly against the silicon carbide paper several times until the characteristic grey pure steel colour appears.

With the micro-grooves the effective surface area is now many times larger than the nominal size of the test element, and this will strengthen the bond between the adhesive and the test element and reduce glue failure. Unless there is reason to suspect new contamination such as from handling with bare hands, there is no need to degrease once more at this point.

A.2.3 Preparation of the coating

The inherent key in thermal sprayed coatings is normally sufficient to prevent glue failure without further pre-treatment. If required the metal coating could be slightly abraded with a grit paper to create more metal contact between dolly and coating and if contamination is suspected degreasing with a clean paper or textile moistened with an appropriate solvent.

A.2.4 Applying adhesive

The adhesive shall be able to form a stronger bond between the dolly and the coating than that at the coating–substrate interface. It should be of high viscosity to prevent it seeping into the slightly porous metal spray. Otherwise, cover the coating with a wash primer to prevent the adhesive from penetrating to the substrate.

Apply sufficient adhesive to the face of the dolly to cover it and also to fill the uneven surface of the sprayed metal.

Press the dolly by hand down onto the test surface and continue to apply pressure for about half a minute to expel air and to even out the thickness of the adhesive. Allow time for the adhesive to harden.

A.2.5 Before stressing

Unless specifically agreed between interested parties, carefully cut around the periphery of the dolly to remove excess adhesive and to penetrate to the substrate. Cutting eliminates the lateral bond within the coating but can introduce cracks, which then undermine the dolly, resulting in a lower breaking stress.

A.2.6 Stressing

Attach the adhesion tester carefully to avoid disturbing the adhesive under the dolly. Reset the indicator to zero. Gradually and smoothly increase the stress on the dolly (pull stub) until the bond breaks. This should be done no faster than 1 MPa/s [EN ISO 4624 < 90 s, ≤ 1 MPa/s].

A.2.7 Assessment

Assess the area where the break in the coating occurred, if it was adhesive or cohesive failure, if it was over the full or partial area. Record the result, the thickness type of coating and if wash primer was used, the adhesive and adhesion tester, whether cut around the dolly or not, the name of the test operator.