International Standard 4522/2

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Metallic coatings — Test methods for electrodeposited silver and silver alloy coatings — Part 2 : Adhesion tests

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Foreword

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Metallic coatings — Test methods for electrodeposited silver and silver alloy coatings — Part 2 : Adhesion tests

1 Scope and field of application

This part of ISO 4522 specifies methods for assessing the adhesion of electrodeposited silver and silver alloy coatings for engineering, and decorative and protective purposes.

NOTE — Other methods are described in ISO 2819, *Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion.*

2 Reference

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method.*

3 Burnishing test

Select an area of not more than 6 cm^2 of the significant surface, and rub rapidly and firmly for 15 s with a suitable burnishing tool. Apply a pressure sufficient to burnish the coating metal at every stroke, but not so great as to cut the coating. Examine the specimen for signs of blistering of the coating under a magnification of X 8, or X 4 under an illuminated viewer.

NOTES

1 This test will only detect extremely poor adhesion and is not recommended if the electroplated items are required for severe engineering environments. It is not applicable to coatings thicker than 40 µm.

2 An agate dental spatula with a handle 60 to 100 mm long and agate blade 30 to 50 mm long, 5 to 10 mm wide, and sharpened to a slightly radiused edge has been found satisfactory.

4 Barrel burnishing test

Wet burnish, unless dry burnishing is specified, the sample for 40 min in a suitable burnishing machine, for example a hexagonal rubber-lined burnishing barrel about 250 mm across the flats, at about 25 r/min. Examine the sample for signs of blistering or peeling of the coating under a magnification of X 8, or X 4 under an illuminated viewer.

NOTE — An advantage of this method, provided that a burnished finish is acceptable, is that complete batches of electroplated articles may be tested, if it is required to have 100 % inspection for adhesion and that only those individual articles failing the test need be rejected.

5 Peel test (for coating thicknesses of 10 µm or greater)

Solder a strip of tinned steel or brass of dimensions approximately 10 mm × 75 mm × 0,5 mm, at not more than the normal soldering temperature, flat to the silver-electroplated surface so that a length of about 15 mm is included in the joint. The solder shall contain approximately 60 % of tin, 38 % of lead and 2 % of silver; a non-corrosive rosin-based flux shall be used. The soldering heat shall not produce blistering of the coating. Then apply a force to the soldered strip at right angles to the test piece sufficient to detach the strip. Examine the specimen for signs of detachment of the coating under a magnification of X 8, or X 4 under an illuminated viewer.

6 Bend test

Place the sample in a bend testing machine with a bending radius of 4 mm (or in the jaws of a suitable vice). Bend the sample through 90° and back to its original position. Carry out this procedure three times. Examine the specimen for signs of detachment of the coating under a magnification of X 8, or X 4 under an illuminated viewer.

7 Shear test

Cut through the sample using a hacksaw (1 1/4 tooth/mm), with the blade set to cut on the outward push stroke. Position the sample so that the cutting stroke pushes the coating away from the basis metal. File the cut edge smooth using a second cut mill file, moving the file from the basis metal towards the coating. Examine the coating for separation from the basis metal and signs of blistering, flaking and peeling under a magnification of X 8, or X 4 under an illuminated viewer.

8 Shot peening test

8.1 General

This test method is used to evaluate the adhesion on steel of silver deposits of thicknesses between 100 and 600 µm. The results refer to qualitative tests only. The method does not destroy the parts on which the adhesion of the coating is satisfactory.

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8.2 Test equipment

8.2.1 Peening equipment

Normal compressed air or centrifugal-type shot-peening equipment.

8.2.2 Shot

Spherical steel shot of average diameter 0,4 mm and hardness not less than 350 HV 30 shall be used. Dimensions are determined by screening and shall correspond to those given in the table.

Table

Screen mesh	Shot held
µm	%
707	< 10
420	> 85
354	> 97

Inspection of shot dimensions shall be performed by screening at least once a week on a sample of 100 g of shot taken from the peening nozzles.

8.3 Regulation of peening intensity

Use a test specimen made from carbon steel sheet, hardness range 400 HV 30 to 500 HV 30 and thickness of 1,6 mm, which has been cut to a size of 76 ± 0,2 mm × 19 ± 0,1 mm and ground to a thickness of 1,30 ± 0,02 mm (Almen A specimen).

The deviation from flatness shall not exceed an arc height of 38 µm when measured as specified below.

With the specimen rigidly held in the fixture shown in figure 1, peen it on the exposed side.

After peening, remove the specimen from the fixture and measure the curvature of the unpeened surface with a depth gauge, the specimen being supported on four 5 mm diameter balls forming a rectangle 32 mm × 16 mm. Align the gauge symmetrically on the specimen with its centre stylus at the centre of the specimen. Measure the arc height at the centre of the specimen over the gauge length of 32 mm, measuring to the nearest 25 µm. The conditions of peening are then adjusted, if necessary, to give the required arc height.

8.4 Procedure

Before peening, submit all parts to stress relieving by heating at 190 ± 10 °C for 2 h.

Mask all surfaces that are not to be peened.

Measure the thickness of the silver using a non-destructive method (for example according to ISO 2178). Discard the parts where silver thickness is less than 100 µm or greater than 600 µm and those where the difference between the maximum and minimum thickness is 125 µm or more. Mark all acceptable parts with their maximum thickness and group them in lots in which the difference in maximum thickness is 125 µm, or less.

Peen the silver-plated surfaces at the minimum peening intensity relative to the maximum measured thickness (see figure 2). Peening intensity shall be regulated by tests on an Almen A specimen (see 8.3) before beginning treatment of each lot.

Control of peening intensity shall be performed on an Almen A specimen (see 8.3) at least once an hour.

Remove the mask from the surfaces that have not been peened.

Inspect the peened surface visually; it should be completely peened. If there are non-peened areas, treatment shall be repeated.

Check that no steel shot has been trapped in the coating. Remove any residual shot by means of air blowing.

8.5 Evaluation

Examine the silver-plated surface carefully with the naked eye. Where adhesion has been poor, bubbles or blisters will form during the test on the silver deposit or the coating itself will be detached.

9 Thermal shock test

Heat the sample in an oven at a temperature between 200 and 300 °C for approximately 30 min and quench it by immersion in water at ambient temperature. Examine the coating for signs of blistering or detachment under a magnification of X 8, or X 4 under an illuminated viewer.

10 Test report

The test report shall include at least the following information :

a) a reference to this part of ISO 4522, including an identification of the specific method used;

b) the result(s) of the test(s) carried out and the form in which these are expressed;

c) any unusual features noticed during the determination;

d) any operation not included in this part of ISO 4522 or in the International Standard to which reference is made;

e) any other relevant information requested by the purchaser.

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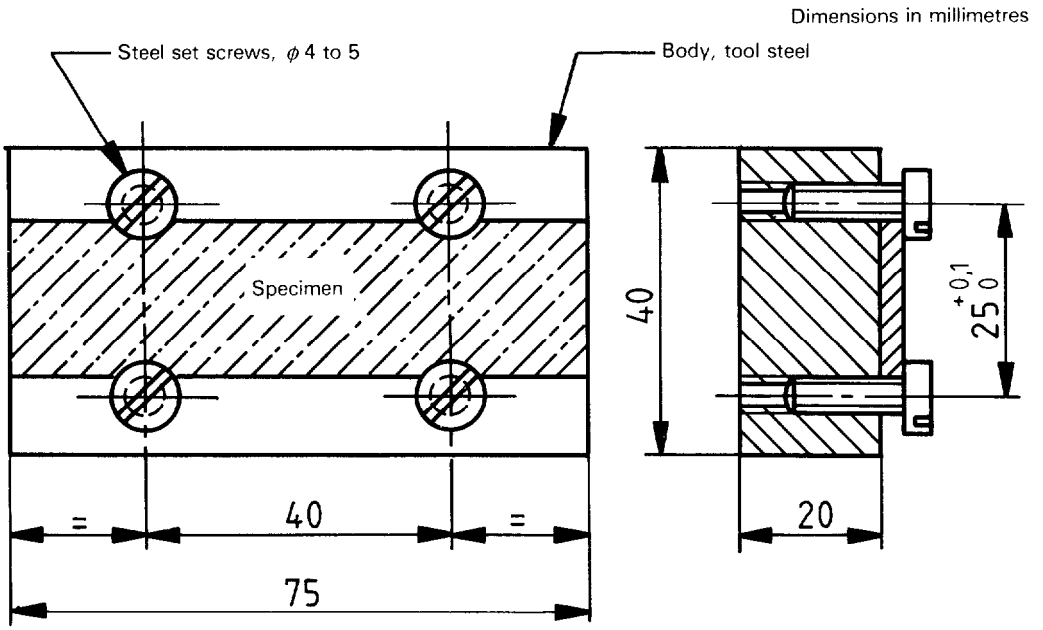

Figure 1 — Fixture for peening test specimen

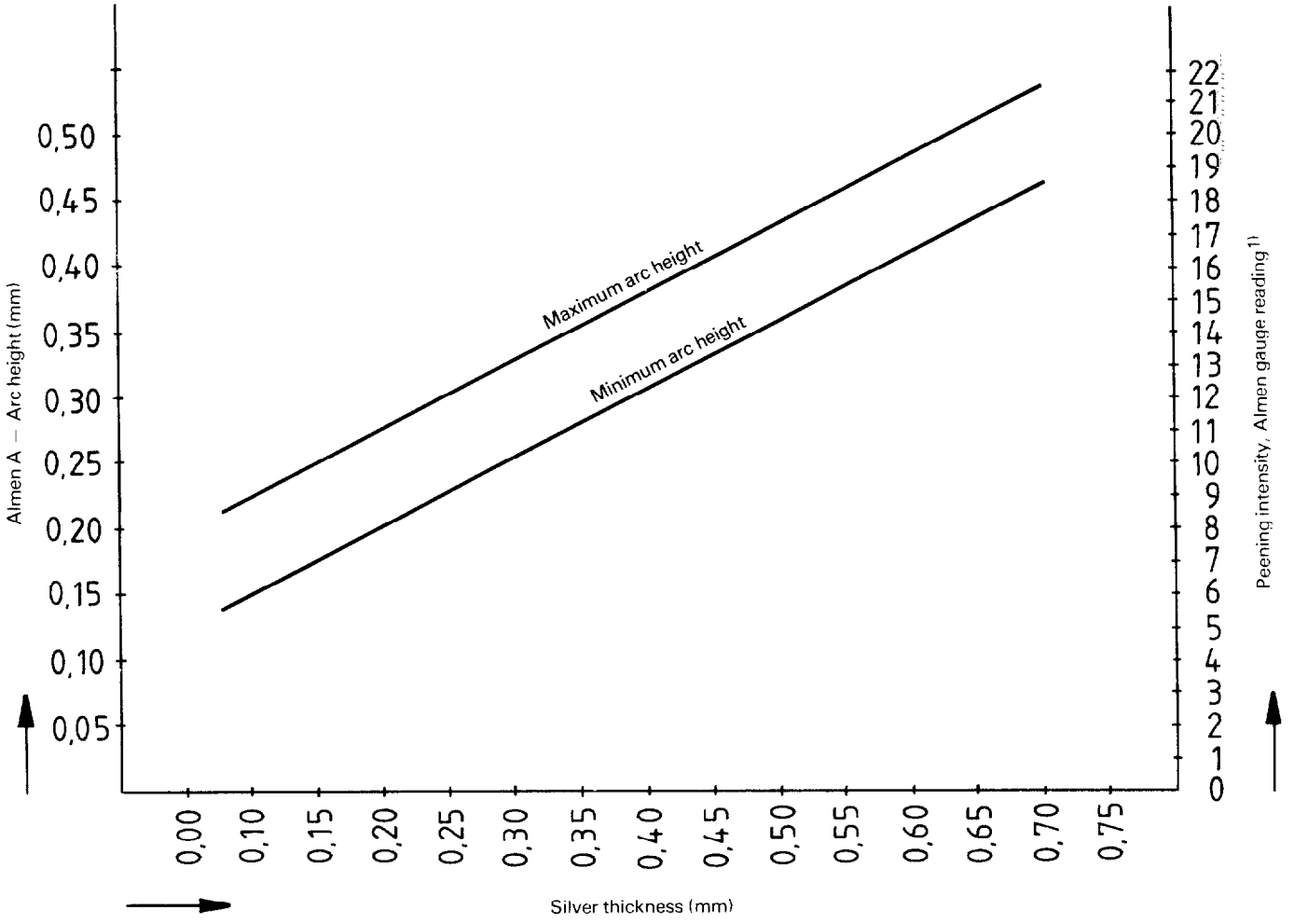

Figure 2 — Peening intensity as a function of coating thickness

1) For further explanation, see Society of Automotive Engineers (USA) Standard SAE J 442 a, *Test strip, holder and gage for shot peening.*

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