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Paper, board and graphic technology — Determination of the coating strength in the inner fold

Papier, carton et technologie graphique — Détermination de la résistance du revêtement dans le pli intérieur

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 6 *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*, in collaboration with Technical Committee ISO/TC 130, *Graphic technology*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

When folding coated paper during post-press operations, the paper surface can crack in the fold and coating particles can be separated. In the final printed product, the cracking of coatings can cause aesthetic and technical disturbances. Separated particles can occur on both sides of the fold but only remain between sheets of the product, if separated from the inner fold. In case of a good contrast between particles and the printed surface, aesthetic quality problems result, which can cause customer complaints. Cracks can also occur on both sides of the fold but can only result in aesthetic quality problems, if both the fold is still present in the final product and in case of a good contrast between cracked fold and printed surface. Technical quality problems can occur, e.g. on thread-sewn products, if weakened coatings disturb the spine-gluing quality.

To improve the folding behaviour of paper and board, creasing is recommended. For woodfree coated papers (WFC), creasing is typically recommended for grammages of 170 g/m^2 and higher. Thereby, it should not be neglected that some post-press operations (e.g. folding of signatures) do not allow an effective creasing, and creasing cannot always achieve the desired improvement.

The coating strength in the fold can be determined both in the inner and outer side of a fold. This document contains a test method for the inner fold. This method has been developed in a research project[3] and is intended to be performed as general paper test to acquire knowledge on a material property and either as a print finishing quality prognosis or a quality acceptance test.

The test consists of four processes: folding of unprinted paper, separation of particles using an impact test device, image capturing of separated particles and image analysis.

Paper, board and graphic technology — Determination of the coating strength in the inner fold

1 Scope

This document specifies a test method for the evaluation of the paper coating strength in the inner fold. The test method is intended for single or multiple coated papers up to a thickness of 150 µm that can be folded without creasing.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
inner fold
fold on the inside of a folded sheet

3.2
coating strength in the inner fold
resistance of a paper coating against cracking and particle separation due to external forces

3.3
machine direction
MD
direction in a paper or a board parallel to the direction of travel of the web on the paper or board machine

[SOURCE: ISO 4046-3:2016, 3.79]

3.4
cross direction
CD
direction in a plane of the paper perpendicular to the machine direction

[SOURCE: ISO 4046-3:2016, 3.35]

3.5
pressure sensitive adhesive
PSA
type of adhesive which, in a dry state, is permanently tacky at room temperature and adheres readily when activated by pressure

4 Principle

A test piece of given dimensions is folded with a specified folding pressure using a laboratory folding device. The folded test piece is inserted into an impact tester to separate loose particles from the fold onto a carrier. An image of the carrier with the collected particles is then captured followed by an image analysis. The mean particle area in mm^2 is determined and reported as the test result.

5 Apparatus

5.1 Folding device

The folding device is used to perform folds in a defined and reproducible way. It shall contain two rotatable rollers made of non-compressible material. One of the rollers shall be equipped with a manual or automatic drive mechanism, and one of the rollers shall be height adjustable and able to apply a predetermined line pressure. The adjustment shall be done in two steps: first by adjusting the roller distance to double paper thickness of the test piece, and second by reducing the roller distance by applying the selected line pressure. The line pressure scale of the folding device shall include a line pressure of 80 N/cm.

NOTE 1 The folding device can be constructed in a way such that the non-adjustable roller is on one end of a beam balance and a spring assembly is on the other end.

NOTE 2 The test result probably depends on the geometric size of the folding device (folding rollers). Thus, results obtained with different folding devices could not be directly comparable.

NOTE 3 FG II Precision Folding Device and Fogra Folding Instrument FI meet these requirements.[1)]

5.2 Impact device

The purpose of the impact device is to separate the loose coating particles from the fold of the sample. The impact device shall be constructed in a way such that an impulse momentum of (6,8 ± 0,2) Ns is applied. The basic calculation of the impulse momentum and a construction example of the impact device are given in Annex A. The impact device consists of a vertically movable insert holder that is able to execute a guided free fall that stops by reaching the impact plate where an impulse momentum is applied.

The insert holder is the mount of both the upper and lower insert. The upper insert is for the folded test piece, the lower insert for the receptor (see 7.3.2). The specified dimensions of both inserts are given in Figure 1 and Figure 2.

1) FG II Precision Folding Device, a product supplied by prüfbau Dr.-Ing. H. Dürner GmbH, Peissenberg, Germany and Fogra Folding Instrument FI, a product supplied by Fogra e.V., Aschheim, Germany, are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Dimensions in millimetres with a tolerance of ±0,05 mm

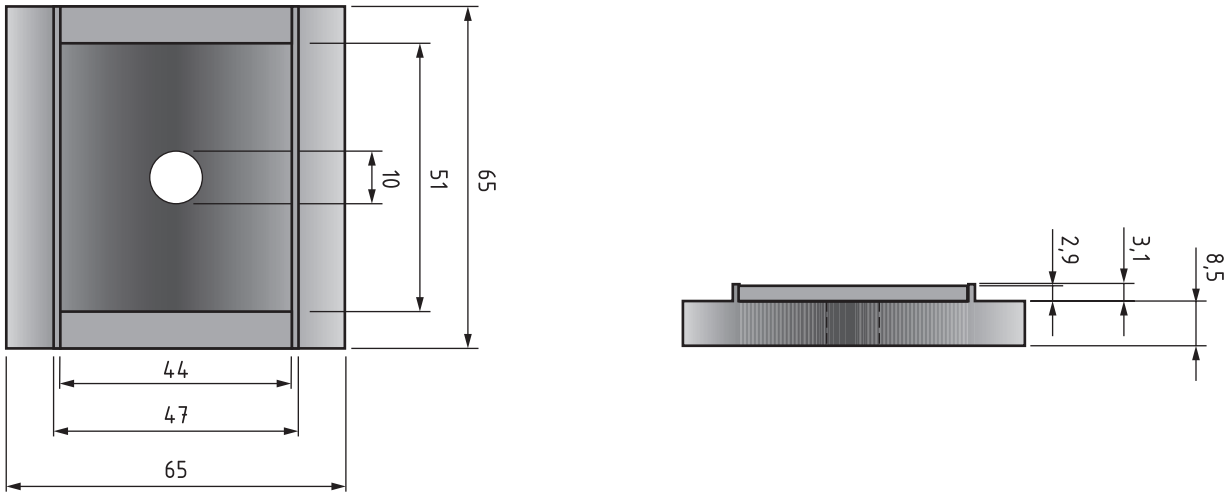

Figure 1 — Plan and front view of the lower insert for the receptor

Dimensions in millimetres with a tolerance of ±0,05 mm

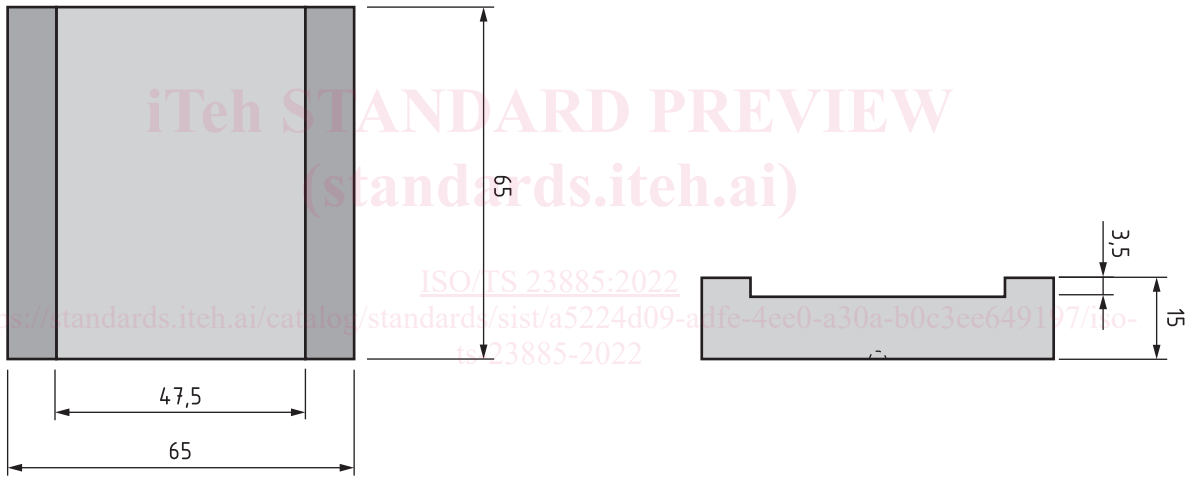

Figure 2 — Plan and front view of the upper insert for the test piece

NOTE The lower insert contains a hole in the base plate in order to simplify the removal of the receptor after the test. The upper insert contains a notch for the central alignment of the inserts. Upper and lower inserts are designed to fit to each other and to fix the long edges of the test piece during the test.

5.3 Image capturing system

The image capturing system consists of a digital camera and an illumination unit. It shall ensure the uniformity of the field of view. The illumination unit shall ensure a homogeneous and reflection-free illumination of the sample. The irradiation intensity shall be adjusted to the camera system used.

The digital camera shall be able to capture an 8 Bit grey scale image. If a RGB camera is used, the image shall be converted by the weighted grey level model.

The image capturing system shall be able to detect particles of a minimum size of 12 µm. The contrast ratio of the captured image shall ensure a good separability of particles and background.

NOTE The image quality of the digital camera depends on the product of the resolution of the camera sensor, the magnification, and the distortions caused by the lens system. Good results can be achieved using a monochromatic line camera, having a sensor length of 40,96 mm, a resolution of 4 096 × 1 pixel, a focal length of 100 mm, and a dynamic range of 50 dB. The use of spacer rings can be necessary to adjust the image area to the test piece dimensions. The use of a line camera requires a flatbed portal unit with a controlled step function synchronized with the image capturing. For the use of a line camera, a convergent beam illumination system with high irradiance, having an illumination angle of 45°, is advantageous.

6 Calibration and adjustment of apparatus

6.1 Folding instrument

The accuracy class of the main components of the folding device shall be given by the manufacturer. The folding force of the folding device shall be calibrated. A method and scheme for periodic reviews shall be given by the manufacturer and shall be determined as a function of the instrument design (wear tendency) and frequency of use.

6.2 Impact device

The accuracy class of the main components of the impact device shall be given by the manufacturer. The impact force of the impact device shall be calibrated. A method and scheme for periodic reviews shall be given by the manufacturer and shall be determined as a function of the instrument design (wear tendency) and frequency of use.

6.3 Image capturing system

The main parameters of the image capturing system (camera, light source) shall be given by the manufacturer. Main parameters of the camera (resolution, colour depth) can be checked by using commercial photographic test charts or certified reference materials. Main parameters of the light source (illumination, irradiance) can be checked by using a spectroradiometer.

7 Sampling and preparation of test materials

7.1 Sampling

The sampling should be performed in accordance with ISO 186.

7.2 Conditioning

The samples shall be conditioned in accordance with ISO 187.

7.3 Preparation of test materials

7.3.1 Test pieces

The preparation of the test pieces shall be performed in the same atmospheric conditions used for conditioning of the samples (see 7.2).

The test piece is a strip of coated paper with the dimensions (47 ± 0,5) mm × (200 ± 20) mm in MD or CD. For each direction, a minimum of 10 + 1 samples shall be prepared. The extra sample is used to adjust the folding device. If both sides of the paper are intended to be evaluated separately, the amount of samples doubles accordingly.

7.3.2 Receptors

The receptor is either made from magnetic material (if the lower insert of the impact device is made of steel) or from steel (if the lower insert of the impact device is magnetic) with a maximum thickness of 1,5 mm. The receptor shall have an adhesive side made from PSA with a minimal initial adhesion on steel of 8 N/cm that is covered by a release liner. If double-sided adhesive tape is used, the backing material shall be made of transparent plastic film. The colour of the adhesive side of the receptor shall be homogeneous and either dark coloured or black. A colour measurement on the adhesive side of the receptor shall be performed in accordance with ISO 13655. It shall result in a maximum CIE-L*-value of 25 and a maximum CIE-L*-value standard deviation of 1,5 based on 10 or more measurements.

NOTE A suitable material for the receptor is a magnetic film material widely offered. It is characterized by a homogeneous dark surface and an adhesive layer made from transparent double-sided adhesive tape.

The receptor shall be cut to the dimensions of the lower insert with a tolerance of - 0,5 mm in both directions.

8 Procedure

8.1 General

The test shall be performed in the atmospheric conditions specified in ISO 187. Test at least 10 test pieces in each test condition (fold parallel to MD, fold parallel to CD, front side and reverse side).

8.2 Folding

The fold shall be performed parallel to the short edge of the test piece approximately at half of the test piece length.

The fold shall be prefolded in advance. The prefold shall be made using significantly lower forces than the fold made by the folding device. The prefold can be performed manually (using gloves), or using an appropriate device.

The folding shall be performed using the folding device. The gap distance shall be adjusted to twice the thickness of the test piece type using one of the test pieces to be discarded afterwards. The folding line pressure shall be set to (80 ± 5) N/cm. The prefolded test piece shall be folded with the prefold heading to the rollers and ensuring a parallel alignment of fold and rollers. In order to avoid uncontrolled spreading of the particles to be analysed later on, a maximum folding speed of 0,5 m/s and a careful handling of the folded test piece are recommended. A careful handling especially prevents shaking and tilting of the folded test piece.

8.3 Separation of particles

Both inserts used for the particle separation shall be thoroughly cleaned to ensure that no particles from previous tests are present.

The cleaning can be efficiently realized using compressed air. Any contamination of the samples needs to be avoided.

The receptor is prepared by removing the release liner from its adhesive layer without touching the adhesive layer.

NOTE 1 The release liner can be used after the test to preserve the particle-loaded film carrier.

The prepared receptor is set into the lower insert of the impact device with the adhesive side showing upwards. The step is shown in Figure 3.