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Graphic technology — Prints and printing inks — Assessment of resistance of prints to various agents

Technologie graphique — Impressions et encres d'imprimerie — Évaluation de la résistance des impressions à divers agents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 130, *Graphic technology*.

This fourth edition cancels and replaces the third edition (ISO 2836:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

— consistency and document structure have been improved and an Introduction has been added;

— new agents have been added;

— information that aspects of food safety and consumer protection for food contact materials are not covered has been added.

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

During its service life, prints might need to resist certain agents. These agents can come in contact with prints during finishing operations like varnishing, or accidentally via interactions with certain vapours, fluids or solids like spilling of package contents onto the print. These kinds of agents can cause visual alterations to the print. These changes are due to either the colorants used in the inks or the substrate itself not being resistant to the particular agent.

This document defines laboratory test methods for the interaction of agents and prints and gives guidelines and requirements for the evaluation of changes on the print caused by those agents. All the methods within this document aims to allow a reasonable choice of raw materials to be used for the printing inks and substrates and for the testing of the prints for qualification purposes. The aim of all these methods is to avoid visual changes of the prints caused by the agents. Aspects of food safety and consumer protection for food contact material are not covered.

Graphic technology — Prints and printing inks — Assessment of resistance of prints to various agents

1 Scope

This document specifies methods of assessing the resistance of printed materials to liquid and solid agents, solvents, varnishes and acids.

It applies to printing on all substrates by any of the traditional printing process (offset, screen, gravure, flexo) as well as the newer digital processes (inkjet, electrophotography).

Aspects of food safety and consumer protection for food contact materials are not covered.

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 105-A03, *Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining*

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*

ISO 14487, *Pulps — Standard water for physical testing*

3 Terms and definitions

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

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

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

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

3.1
agent
liquid or solid to which a sample of printed material is exposed for the purpose of determining the *resistance* (3.2) characteristics of that printed sample

3.2
resistance
ability of a printed material to withstand exposure to a specified *agent* (3.1) as determined by the tests defined in this document

3.3
test piece
section of a test print or section of a print from a conventional or digital printing press

4 Principle

A test piece is either immersed in the prescribed agent, pressed between agent-soaked filter papers or brought into direct contact of its printed side with the agent for a given time.

Colour changes of the test piece, the agents and the filter papers are noted, characterized and reported.

5 Agents

5.1 General

The type of agent used, and its concentration shall be reported.

5.2 Water

This document does not specify the type of water used for the assessment of resistance of prints. It may be tap water, distilled water, deionized water, natural water, etc. The type of water used shall be reported. For the purpose of rinsing filter papers and test pieces after tests, deionized water according to ISO 14487 shall be used.

5.3 Alkali

This document specifies a 1 % by mass solution of sodium hydroxide in distilled water used for the assessment of resistance of prints.

5.4 Oils and fats

This document does not specify the oil or the fat to be used for the assessment of resistance of prints. It may be animal, vegetable, mineral, essential or synthetic. Examples of such oils include but are not limited to: fish oil, olive oil, liquid paraffin, lavender oil, silicone oil, butter, margarine, lanolin, grease.

5.5 Cheese

This document does not specify the type of cheese, for example soft cheese or hard cheese, used for the assessment of resistance of prints. However, the cheese shall be used as a solid agent in a natural state, i.e. not liquefied.

5.6 Detergents

This document does not specify the type of detergent, such as liquid or solid, used for the assessment of resistance of prints, only its concentration: 1 % by mass.

5.7 Soaps

This document does not specify the type of soap, hard or soft, used for the assessment of resistance of prints, only its concentration: 1 % by mass.

5.8 Waxes

This document does not specify the type of wax to be used for the assessment of resistance of prints, i.e. animal, vegetable, mineral or synthetic, such as beeswax, carnauba wax, paraffin wax, Fischer Tropsch wax.

5.9 Spices

This document does not specify the spice to be used for the assessment of resistance of prints.

5.10 Organic solvents and varnishes

Ethanol shall be denatured. The solvent mixture of ethanol, ethyl acetate and 1-methoxy-propanol-2 shall have a volume composition of 60 % ethanol, 30 % ethyl acetate and 10 % 1-methoxy-propanol-2. Methyl ethyl ketone (MEK) is a suitable solvent to test the degree of curing for uv inks. Any other solvent or varnish for assessing the resistance of prints may be used.

5.11 Acids

This document does not specify any particular acid or concentration. It give examples of acids that are commonly found commercially and in homes, which can be used for the assessment of resistance of prints. The acid and concentration should be chosen according to the intended application of the print. The following acids are mentioned in this document:

— lactic acid to simulate cheese and cheese products;

— citric acid to simulate the juice of citrus fruits;

— acetic acid to simulate pickles and vinegars;

— hydrochloric acid to simulate products with pH values <2;

— sulfuric acid.

5.12 Other agents

The test methods set out in this document may be used in the assessment of the resistance of prints to other agents such as the following:

— hydraulic fluids;

— perfumes, deodorants;

— beverages: coffee, tea, beer, spirits, carbonated drinks;

— cosmetics: lipstick; skin cream;

— perspiration simulants according to ISO/IEC 10373-1;

— carbonated water, sea water;

— sodium hypochlorite solution (1 %);

— sodium carbonate solution (1 %);

— saliva simulants.

NOTE A composition for saliva simulant can be found in DIN 53160.

6 Apparatus

This clause lists supplies and equipment necessary to perform resistance tests.

6.1 Glass plates, 2 glass plates, 60 mm × 90 mm × 2 mm.

6.2 Laboratory filter paper[1)], for qualitative chemical analysis, white, neutral, with a very smooth and soft surface, cut into strips 60 mm × 90 mm. Filter paper shall be manufactured from cotton linter. It

1) Whatmann filter paper grade 1 is an example of suitable filter paper available which meets these requirements. This information is given for the convenience of this document and does not constitute an endorsement by ISO of this product.

shall contain a minimum of 98 % alpha cellulose, have a basis weight of (90,0 ± 1,0) g/m^2 and a thickness of (180 ± 20) µm.

6.3 Petri dish, ≥100 mm in diameter with an additional glass disk with a diameter slightly smaller than the inner diameter of the dish.

6.4 Test tubes, 2 test tubes, of colourless glass, with inside diameter of approximately 16 mm and a height of approximately 160 mm.

6.5 Mass, 1 kg.

6.6 Stop watch, with an accuracy of 1 s.

6.7 Thermometer, capable of measuring from 10 °C to 50 °C with an accuracy of ±0,5 °C and in case of measuring molten wax a thermometer suitable for measuring up to 200 °C.

6.8 Oven, capable of maintaining a temperature of (50 ± 2) °C.

6.9 Hot plate, capable of heating to 40 °C above melting point of the wax.

6.10 White background wall, with side illumination for colour determination.

6.11 Grey scale, for colour contrast evaluation according to ISO 105-A03.

6.12 pH measuring device, e.g. test strip or meter.

6.13 Spectrocolorimeter, conforming to the requirements of ISO 13655.

7 Preparation of test pieces

Test pieces may be taken from existing printed material or may be prepared to be representative of a planned printed product.

If production samples are tested, it is important to know the time of production and preferably the storage conditions. Conditioning of the test pieces in accordance with ISO 187 is recommended.

Prepare production prints or test prints using any suitable method that allows a uniform distribution of ink to be formed on a specified substrate and cured in an appropriate manner, for example, prepared in accordance with ISO 2834-1 for offset printing process, with ISO 2834-2 for gravure or flexographic printing processes, or with ISO 2834-3 for screen printing process. Prints shall be set, dried or cured completely before assessing the resistance. Heatset inks shall be heated to the recommended temperature, oxidative setting inks shall be allowed to fully oxidize, water or solvent inks shall be given suitable time for the loss of solvent and energy cured inks shall be exposed to the appropriate radiation (UV, LED-UV, EB) for a reasonable exposure time. Prepare at least two but preferably 4 extra test pieces for reference and comparison with the treated test pieces.

8 Test methods

8.1 General

All tests are comparative by nature. Blind tests for all methods where filter papers and/or solid surfaces are used shall be performed. For tests with solid agents the environmental conditions according to ISO 187 shall be applied.

8.2 Liquid agents and solutions

Tests using liquid agents shall be performed according to the test conditions summarized in Table 1.

Four strips of filter paper (6.2) to be used for the test shall be immersed totally in the liquid agent being tested and then shall be drained until no free agent drips from the filter paper.

Place two saturated strips of filter paper on the lower glass plate (6.1).

Place the 20 mm × 50 mm test piece being evaluated on the filter paper and cover it with the other two strips of saturated filter paper in a way that the test piece is fully covered by the filter paper.

Cover with the other glass plate and place a 1 kg mass (6.5) on top. The package shall be in contact for the test duration specified in Table 1.

The test piece being tested for alkali, detergent or soap resistance shall be rinsed with deionized water until the rinse water has a neutral pH and test pieces (except those for oil resistance) shall be dried in an oven for 30 min at a temperature of (50 ± 2) °C.

Tests with solvents, varnishes and acids are described in 8.6 and 8.8 respectively.

8.3 Cheese

Tests using cheese shall be performed according to the test conditions in Table 1.

Place a 20 mm × 50 mm test piece with its printed side fully in contact with the surface of the cheese being tested.

Sufficient pressure shall be exerted on the test piece to ensure optimum contact with the cheese. The package shall be stored for the test duration under the conditions specified in Table 1.

Carefully remove the test piece and, if required, allow to dry naturally.

8.4 Meltable solid agents

Tests using fat and wax shall be performed according to the test conditions in Table 1.

50 g of the solid agent shall be molten in the Petri dish and a temperature of 40 °C higher than its melting point shall be maintained.

A 20 mm × 50 mm test piece shall be immersed for 5 min, leaving a small section unimmersed to facilitate handling.

Remove the test piece and allow to drip on a white filter paper while it is cooling.

8.5 Solid spices

Tests using solid spices shall be performed according to the test conditions in Table 1.

A 20 mm × 50 mm test piece shall be placed on the bottom of the Petri dish, with the printed side up.

Place a filter paper on top of the test piece and a layer of the test agent shall be spread to a height of at least 3 mm.

Place a glass plate on the layer of the test agent and cover the Petri dish with the lid.

8.6 Solvents and varnishes

The tests shall be performed in a test tube filled with the chosen solvent or varnish to half of its height. The test piece with an area of 6 cm^2 shall be submerged in the solvent or varnish. The test temperature shall be (23 ± 2) °C.

If only a limited solvent resistance is required from the ink, the duration of the test shall not exceed 5 s; otherwise, the test piece shall be removed after 5 min and whether the solvent has changed colour shall be noted. For this purpose, the test tube shall be compared the to a second test tube containing only the solvent, both test tubes placed in front of the white background wall according to 6.10 and illuminated from the side.

The test piece shall be dried for 10 min in the oven (6.1.8) at approximately 40 °C.

8.7 Test conditions for various liquid and solid agents

Table 1 — Test conditions for various liquid and solid agents

Test agent	Receptor surface	Temperature °C	Test duration	Contact conditions
water (5.2)	filter paper	23 ± 2	24 h	contact pressure[b]
hot water (5.2)	none	100 °C	20 min	immersion
NaOH (5.3)	filter paper	23 ± 2	10 min	contact pressure[b]
sodium hypochlorite solution (1 %) (5.12)	none	23 ± 2	20 min	immersion
sodium carbonate solution (1 %) (5.12)	none	23 ± 2	20 min	immersion
cheese (5.5) [a]	cheese	23 ± 2	72 h	no pressure
solid fat (5.4)	solid fat	23 ± 2	24 h	no pressure
oils (5.4)	filter paper	23 ± 2	24 h	contact pressure[b]
detergent (5.6)	filter paper	23 ± 2	3 h	contact pressure[b]
spice (5.9)	filter paper	23 ± 2	7 d	vapour
saliva and perspiration simulant	filter paper	37 ± 2	2 h	contact pressure[b]
soaps (5.7)	filter paper	23 ± 2	3 h	contact pressure[b]
washing machine detergent (5.6)	none	90 ± 2	20 min	immersion
wax (5.8)	molten wax	melting point + 40	5 min	(partial) immersion

a Fresh cheese: 4 °C and 24 h in a water-vapour-saturated atmosphere.

b This is achieved by 1 kg on a sandwich containing 2 layers of filter paper (60 mm × 90 mm), 1 layer of test piece (20 mm × 50 mm) and 2 layers of filter paper (60 mm × 90 mm) between two glass plates.

8.8 Acids

The recommended concentrations and durations of exposure for testing the resistance of prints to the most commonly used acids are given in Table 2. These recommended acids, concentrations and duration of exposures shall be used when no other guidelines concerning acids and test conditions are given.

The test shall be conducted at a standard temperature of (23 ± 2) °C.

The two strips of filter paper to be used for the test shall be immersed totally in the acid being tested and shall be drained until no free solution drips from the filter paper.

Place one of the sheets of filter paper on the lower glass plate.

A 20 mm × 50 mm test piece to be evaluated shall be placed on the filter paper and shall be covered with the second piece of filter paper.

The upper glass plate shall be placed on top and the whole package shall be placed in a moisture-tight wrapper or container. A 1 kg load shall be placed on the glass plates to provide pressure.

The test piece shall be exposed to the test acid for the specified duration (see Table 2), removed and rinsed with deionized water until the rinse water has a neutral pH.

The test piece shall be dried for 30 min in the oven (6.8) at (50 ± 2) °C.

The strips of filter paper used for the test shall be dried in free air. Do not rinse them before examining them.

Table 2 — Recommended acid solutions

Acids	Option	Concentration % by volume	Duration of exposure	Typical products for which testing of acid resistance can replace testing of resistance against the product itself
Lactic acid	1	10	1 h	cheese and cheese products
	2	5	24 h	
Citric acid	1	5	1 h	juice of citric fruits
	2	1	24 h	
Acetic acid	1	5	30 min	vinegar and pickles
	2	1	24 h	
Hydrochloric acid	1	5	10 min	products with pH < 2
	2	1	24 h	
	3	10	20 min	security print
Sulphuric acid	1	5	10 min	—
	2	1	24 h	

9 Evaluation of results

9.1 General

Record any changes in a consistent manner, including whether the ink film is completely intact. Any solid surface (test piece and/or filter paper) shall be evaluated in comparison to a solid surface being treated according to the test procedure applied but without a test piece.

NOTE Changes can be visually rated as follows:

0 = no visible change

1 = minor change or <10 % change

2 = considerable change or 10<x<50 % damage

3 = serious change or 50<x<90 % damage

4 = total change >90 % damage.

Colour measurements using a device according to 6.13 on solid surfaces should be used to evaluate colour changes CIEDE2000 of (test) prints and receptors/filter papers.

9.2 Liquid and solid agents, solutions

The treated test piece shall be compared to an untreated test piece. Any changes shall be observed, in particular:

— record whether the agent has caused a discoloration of the test piece;

— record whether the ink film is completely intact and if any blistering is visible and whether its adhesion to the substrate is maintained;

NOTE 1 The ink adhesion failure blistering can be visible directly after the test but can become invisible after short time. This does not mean that the ink film is still adhering to the substrate.

— observe the receptor surface that has been used in the test for staining and/or ink transfer, and record any changes that have been observed.

NOTE 2 There can be bleeding from the test piece to the receptor, migration from the printed side of the test piece to the back side or damage on the print.

9.3 Solvents and varnishes

The dried test piece shall be compared with an untreated test piece. Any changes shall be observed, in particular:

— record whether the solvent has caused a discoloration of the test piece.

— record whether the ink film is completely intact and whether its adhesion to the substrate is maintained.

— record whether the solvent has changed colour by using the white background wall according to 6.10.

9.4 Acids

The dried test piece shall be compared with an unexposed test piece and the filter paper shall be compared to a new filter paper.

The results shall be evaluated in accordance with the following.

— If the print has changed significantly in appearance, it shall not be considered to be acid-resistant.

— If the appearance of the print has not changed, but the filter paper shows staining, this shall be evaluated as to intensity. The print is deemed to have bled when the stain on the filter paper is just visible, i.e. reaches step 4 of the grey scale as specified in ISO 105-A03 or have a $\Delta E(00) > 1{,}4$.

— Record any colour change in the substrate.

10 Test report

The test report shall include the following information:

— a reference to this document, i.e. ISO 2836:2021;

— identification of the material tested;

— substrate, if known, on which the print was prepared;

— agent used for the test;

— concentration of the agent in the test solution;

— room temperature and the temperature of the test solution;

— type and duration of the exposure used for the test;

— any test condition different from the specifications in Tables 1 or 2.

— observation whether the ink film is completely intact, and any changes observed, i.e. changes of the colour of the print and all changes of the substrate;

— whether or not the filter paper in contact with the test print was stained;