

Testing of substance transfers from consumer articles made of paper, cardboard and paperboard

BfR guideline of 28 September 2023

In case of contradictions between the English and the German version of this document, the German version shall prevail.

1 General remarks

The testing of substance transfer from consumer goods made of paper, cardboard or paperboard, as well as moulded fibreboard, which are not yet in contact with food, is basically composed of the procedure for simulating the transfer (migration, gas phase transition or extraction) as well as the actual determination method for migrating substances. Both methods contribute to the final result.

Methods for simulating the transfer must be selected in such a way that they are orientated towards realistic worst-case conditions when the article comes into contact with food. Taking into account the different types of contact, which reflect recommendations XXXVI and XXXVI/1 to XXXVI/3, the methods are described in chapters 1-5 (see below).

The analysis of extracts (cold water extract according to EN 645, hot water extract according to EN 647 and solvent extract according to EN 15519¹) is a convention method and generally not a complete extraction. If the convention method does not adequately reflect the real conditions - by significantly over- or underestimating the migration - further migration tests (e.g. as described in sections 2.1, 2.2 and 4) or the analysis of a representative foodstuff in the sense of a graduated procedure. The food simulants and the contact conditions must be selected according to the current state of scientific knowledge, or a real food that is representative of the intended contact must be used.

¹ For additional information on analysing paper, board and cardboard using the cold or hot water extract, see: Collection of methods for paper, cardboard and paperboard (https://www.bfr.bund.de/de/methodensammlung_papier__karton_und_pappe-32620.html).

If there are findings of substance transfer into a simulant and into a representative foodstuff, which represents the most unfavourable foreseeable case, the transfer into the foodstuff always has priority for the assessment.

Analytical methods used to analyse paper, cardboard and paperboard in accordance with the BfR's XXXVI series of recommendations include chromatographic, spectroscopic and mass spectrometric methods. Individual methods can be found in the official collection of test methods according to §64 LFGB². Furthermore, test methods in the form of standards are developed at national level within the framework of the DIN Standards Committee for Paper, Cardboard and Fibre (NPa)³, the DIN Standards Committee for Packaging (NAVp)⁴, or the DIN Standards Committee for Food and Agricultural Products (NAL)⁵ and at European level within the framework of CEN TC 172⁶ and CEN TC 194^{7,8}. Reference is made to these procedures in the BfR collection of methods⁹.

Sensory tests are carried out in accordance with the following standards:

- DIN 10955 Sensory testing - Testing of food contact materials and articles (FCM)¹⁰
- DIN EN 1230-1 Paper and board intended to come into contact with foodstuffs - Sensory analysis - Part 1: Odour
The odour test can be used to confirm the quality of the material in accordance with GMP Regulation (EC) No. 2023/2006. For conformity testing, however, test foodstuffs must be tested for odour impairment.
- DIN EN 1230-2 Paper and board intended to come into contact with foodstuffs - Sensory analysis - Part 2: Flavour transfer

These standards define specific contact conditions that are tailored to the special requirements of sensory analyses.

The same analytical procedures and requirements apply to food contact materials manufactured using recovered fibres (secondary fibre pulp) from paper, cardboard and paperboard as for items made from virgin fibres (primary fibre pulp). In addition, the focus here must also be on contaminants that may originate from use prior to the recycling process. According to the current state of knowledge, mineral oil hydrocarbons and the contaminants listed in the Annex to Recommendation XXXVI should be mentioned in this context.

Kitchen rolls and napkins are also categorised as food contact materials.

² Official collection of test methods according to §64 LFGB, consumer goods; BVL <http://www.methodensammlung-bvl.de/>.

³ <https://www.din.de/de/mitwirken/normenausschuesse/npa>

⁴ <https://www.din.de/de/mitwirken/normenausschuesse/navp>

⁵ <https://www.din.de/de/mitwirken/normenausschuesse/nal>

⁶ <https://www.din.de/de/mitwirken/normenausschuesse/npa/europaeische-gremien/wdc-grem:din21:54739970>

⁷ <https://www.din.de/de/mitwirken/normenausschuesse/naebm/europaeische-gremien/wdc-grem:din21:54740080>

⁸ published standards of the CEN committees: <https://standards.cencenelec.eu/dyn/www/f?p=205:105:0>.

⁹ See collection of methods at https://www.bfr.bund.de/de/methodensammlung_papier__karton_und_pappe-32620.html

¹⁰ Test specifications of the AG Sensorik von Bedarfsgegenständen see: <https://www.dgsens.de/best-practice.html> or <https://eurolab-d.de/dokumente/eurolab-d/methodensammlung-des-ak-sensorik>

2 Conditions for determining the mass transfer

2.1 Consumer goods made of paper, cardboard or paperboard for contact with dry foodstuffs in accordance with recommendation XXXVI

The packaging of dry foods, such as sugar, semolina, rice, pasta or cocoa, in consumer goods made of paper or cardboard is a common application for these materials. With this type of contact, the transfer takes place mechanistically mainly as an exchange of substances via the gas phase. This physicochemical process can be simulated by adsorption of the transferred substances on modified polyphenylene oxide (MPPO). For this purpose, a representative section of the paper is covered with an even layer of MPPO in a Petri dish or a migration cell and thus subjected to "migration". The adsorbed substances are then extracted with an organic solvent and determined^{11,12}. The test temperature for the transition is based on the actual conditions of use. The test conditions from Annex V, Chapter 2 of Regulation (EU) No. 10/2011 or the technical guidelines of the Joint Research Centre (JRC) on kitchenware¹³ can serve as a guide.

The transfer of substances from packaging that is already in contact with a foodstuff is always determined in this foodstuff.

2.2 Consumer goods made of paper, cardboard or paperboard for contact with moist or fatty foods in accordance with recommendation XXXVI

If contact with moist foodstuffs is intended, the water extracts according to DIN EN 645⁹ and DIN EN 647⁹ serve as a standard test for determining hydrophilic substances capable of migrating.

For fillable and other objects that withstand a migration test with aqueous food simulants (e.g. drinking straws or cutlery) and for plastic-coated objects, a migration test can also be carried out under the following conditions:

- The most unfavourable surface-to-volume ratio for the actual or planned use should be assumed. If this cannot be determined (e.g. due to unknown or strongly varying use), a surface-to-volume ratio of 13.3 dm²/kg food should be assumed.
- The selection of time-temperature conditions and simulants should be based on the specifications for plastic food contact materials in Regulation (EU) No. 10/2011 and in the JRC guide¹³ for the most unfavourable foreseeable (contact) conditions.
- A migration cell, for example, can be used to simulate one-sided contact.

However, the BfR recommendations stipulate that certain analytes should not be detectable in the water extract (e.g. 1,3-dichloropropanol or lead). In these cases, the result of the water extract is to be used without further conversion.

¹¹ Piringer, O.; Wolff, E.; Pfaff, K. (1993) Use of High Temperature-Resistant Sorbents as Simulants for Testing. Food Additives and Contaminants 621-629.

¹² DIN EN 14338; Edition 2004-03: Paper and board intended to come into contact with foodstuffs - Requirements for the determination of the transition of paper and board by the use of modified polyphenylene oxides (MPPO) as a simulant, Berlin, Beuth-Verlag.

¹³ JRC Technical Report, Testing conditions for kitchenware articles in contact with foodstuffs: plastics metals, silicone & rubber, paper & board, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC134290/JRC134290_01.pdf.

If contact with fatty foods is intended, the solvent extract according to DIN EN 15519⁹ is used to determine hydrophobic substances that are capable of migrating.

3 Cooking and hot filter papers according to recommendation XXXVI/1

Coffee filters, tea bags or cooking bags are subjected to hot water extraction in accordance with DIN EN 647⁹.

4 Paper, cardboard and paperboard for baking purposes according to recommendation XXXVI/2

In addition to the hot water extract, MPPO migration is the standard method for determining the migration of substances from paper and cardboard intended for contact at higher temperatures^{11,12}. Thermal desorption or pyrolysis methods can also be used for more detailed information.

In general, baking paper must withstand a temperature of 220 °C for two hours without decomposing. This can be done by means of sensory and visual testing.

If the paper or cardboard is used exclusively in microwave ovens, the migration tests must be carried out for 30 minutes at 150 °C¹⁴.

5 Cellulose fibre-based absorbent pads for food packaging according to recommendation XXXVI/3

The requirements in Recommendation XXXVI/3 with regard to the transfer of substances refer to the cold water extract.

¹⁴ The JRC guideline (https://publications.jrc.ec.europa.eu/repository/bitstream/JRC134290/JRC134290_01.pdf) specifies 30 minutes at 121 °C for the FPU/CAH6 test category. However, the previous assessments of the BfR paper recommendations are based on migration tests for 30 minutes at 150 °C. As this covers the conditions according to the JRC guideline and is considered appropriately conservative with regard to the actual conditions of use, the previous test conditions are retained here.