

DK-VAND 1-3-1, 16 November 2021

Test requirements for containers and container materials of plastic for drinking water storage

Requirements for the release of health hazardous substances, flavour and odour for containers of plastic materials

The test is composed of several analyses which aim to reveal whether substances are released from the material to the drinking water. These substances may be hazardous to health and result in change of flavour and/or odour.

Definition: Containers include water tanks and containers made of plastic. Both circular and quadrangular containers are included and so are containers consisting of a single layer or various layers. Plastic materials of extruded plates used as the inner sides of containers are also included.

The test and assessment of containers of plastic include all the material ingredients of all layers that may migrate into the drinking water. For containers designed with various layers, all layers of materials are included - from the layer in contact with the drinking water to the outside of the container. Adhesive layers are also regarded as layers.

Table 1 – Analysis requirements

Parameter	Analysis method	Requirements ¹
TOC	SM5310B	Detection limit: ≤0.1 mg/l
Flavour and odour	DS/EN 1420 and DS/EN 1622	'Unforced choice paired test' is used with a minimum of five assessors for determination of TON and TFN.
Turbidity	DS/EN ISO 7027-1	Detection limit: ≤0.06 FNU or FTU
Phenols	DS 281 or DS/EN ISO 14402	Detection limit: ≤2 µg/l
Specific substances	Specified in the test outline	Detection limit is specified in the test outline
Enhancement of microbial growth, EMG	DS/EN 16421, method 2	The test is performed with positive and negative control

1) If possible, the analyses should be performed accredited.

Table 2 – Acceptance criteria for migration of components from the test material

Parameter ²	Migration period	Acceptance criteria ⁴
TOC ²	3	C ≤ 0.3 mg/l and the migration rate ≤ 1.0 mg/m ² /day. Both requirements must be met.
Flavour and odour ²	3	TFN and TON = 1
Turbidity ²	3	No changes compared to the blind test.
Phenols ²	3	The sum of phenols must not be detectable at a detection limit of 2 µg/l.
Specific degradation products ²⁺³	3	Migration of degradation products from antioxidants which are not specifically mentioned in 'Executive order on water quality and surveillance of water supplies', but which may be found in and released from pipes, is assessed individually. Besides, degradation products with identical toxicological effect are assessed as a whole.
Specific substances	3	Migration of each substance is assessed (including residue monomers and fractions of substances). The migration must be less than the quality requirement of the tap, cf. 'Executive order on water quality and surveillance of water supplies'. Migration of other health hazardous substances which are not specifically mentioned in 'Executive order on water quality and surveillance of water supplies' but may be found in and released from pipes are assessed individually. Besides, substances with identical toxicological effect are assessed as a whole. Migration of substances that are or are under suspicion of being endocrine disrupting or carcinogenic are not accepted.

- 2) Further analyses are accepted up to the 9th migration period. The analysis result is accepted provided that the concentration shows a declining tendency and meet the acceptance criterion after the last migration period.
- 3) The acceptable level for specific degradation products must maximum constitute an exceeding of 10% of the acceptance criterion for the parameter in the last measured extraction, however provided that that a declining tendency is shown.
- 4) The overall assessment is made in accordance with DK-VAND's 'Supplementary provisions for certification of products for drinking water supply' and follows the guideline 'Baggrund for toksikologiske vurderinger af kemiske stoffer fra drikkevandsinstallationer'.

Table 3 – Acceptance criteria for microbial growth

Parameter	Test period	Acceptance criteria ^{5, 6}
EMG	1 month 2 months 3 months	All values ≤ (0.05 + 0.02) ml/800 cm ²

- 5) During all test periods, only permanently attached surface colonization or surface growth ≤ (0.05 + 0.02) ml/800 cm² must be detected.
- 6) The surface of the products must not have biocide impact on the drinking water, which is why products without visible biofilm are tested for surface colonization and compared with the negative control.

Sampling

To obtain a DK-VAND certificate for a container included in a well-defined product range, an approved test result must be available for each type of container and for each manufacturing site.

Representative test samples are selected according to table 4. Test of containers with the highest S/V ratio (largest contact surface of the water with regard to area and thickness) validates other containers made of the same material(s) and by same production method.

If the container is solely manufactured in dimensions larger than what is practically possible for the analysis laboratory to test for the specified S/V ratio, it is accepted that test samples are specially manufactured in a smaller dimension of the material(s) corresponding to the S/V ratio.

For the migration test, test samples may be specially manufactured (see Annex 1), where the migration water is solely in contact with intact parts of the container.

For the test of microbial growth, test plates of the size 20x20 cm and with a minimum thickness of 0.2 cm are used according to EN 16421, method 2.

Time limits

The test must be performed in such a way that it represents the shortest time between production and entry into service of the container. If the time between production and entry into service is more than 60 days, the following time limits must be kept:

- The test samples must not be more than 60 days old when sampled at the manufacturer.
- The test must be commenced not later than 60 days after the analysis laboratory has received the test sample.
- The test must be completed not later than 120 days after the analysis laboratory has commenced the test.

Table 4 – Test scope

Material	Manufacturer	Production method	Type
One sample for each material	One sample for each material for each manufacturer	One sample for each production method	Plastic containers for water

Table 5 – Test conditions

Internal diameter	Migration S/V dm ⁻¹	Flavour and odour S/V dm ⁻¹	Method
-	DS/EN 12873-1	DS/EN 1420	23 °C
80 mm ≤ d < 300 mm	≥ 5	≥ 2.5	Filled or cylinder
d ≥ 300 mm	≥ 5	= 2.5	Cylinder ⁸
Others ⁷	S/V according to the test outline	S/V according to the test outline	According to the test outline

7) Containers for water consisting of only one homogenous material must be submersed or filled.

8) If the S/V (surface/volume ratio) is smaller than specified in the table, a cylinder must be used, cf. DS/EN 12873-1 Annex B, test arrangement 2 or the test set-ups described in Annex 1 for pipes with a very large diameter.

Annex 1 – Test of large containers for water

Examples of test set-ups according to the principles of EN 12873-1 are shown below. Tests performed in accordance with these test requirements must be carried out for a test sample corresponding to the container the way it is used in the usage situation. The test must be carried out in such a way that the migration water is not in contiguity with ends that are cut.

For large pipes, the end plates must be made of the same material as the inside of the pipe. If extrusion welding is applied, the toxicological consultant must be informed about the additional plastic that is used, so that this material is also included in the assessment and the test outline.

Example of the construction of test samples for large pipes

An appropriate number of test samples are specially manufactured in order to make it possible to test flavour, odour and other migration, cf. the test outline.

The end plates are made of the same material as the internal pipe and are welded on the inside by extrusion welding, so that the two weldings are also included in the migration test.

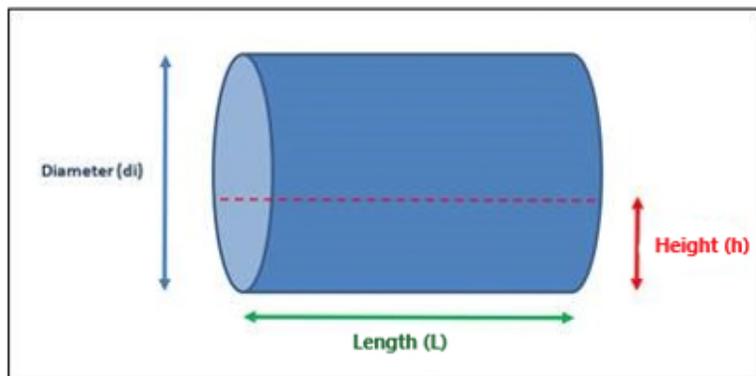


Figure 1: Specification of pipe dimensions

The principles of EN 12873-1

The test set-up in figure 1 is based on “Test arrangement 1” of EN 12873-1, annex B. In test set-ups carried out in accordance with these test requirements, the end plates must not be made of stainless steel. Instead, the end plates must be made of the same material as the inside of the tested pipe. The test can be carried out on a whole pipe in order to avoid cut ends and pipe tensions when cut (see figure 2). The end plates may function as support for the test set-up. The exact construction of the test samples is determined in agreement with the test laboratory according to the applicable test outline. The height (h) is the height for the migration water corresponding to the minimum height of the test sample.

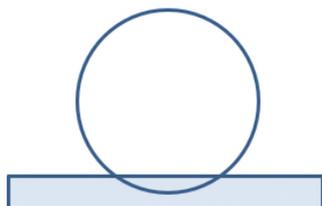


Figure 2: Test set-up with a pipe

Example of test sample constructed of plates

If the test samples are constructed of plates, the same principles as described for the large pipes are applied. However, boxes of an appropriate volume can be welded in accordance with the test outline. The dimensions of the box (L1, L2 and L3, see figure 3) are determined in agreement with the test laboratory, so that the correct surface area/volume ratio is obtained in accordance with the test outline and the required volume of migration water can be sampled for the test.

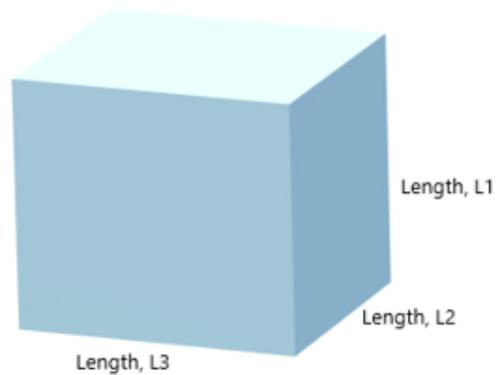


Figure 3: Test sample constructed of plates