

Standards and requirements for materials in contact with drinking water

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Drinking water is the most rigorously controlled food product in many countries. This valuable resource comes into contact with building products during storage, transportation and distribution, including domestic installations.

The materials used in these products are selected and evaluated based on technical requirements and criteria. These criteria include the impact on water quality, such as the release of substances and effects on the water's odor, taste or color.

However, water quality issues can also arise if these materials promote the growth of microorganisms.

The testing procedures vary significantly from country to country.

Country	Standard	Testing procedure
GB	WRAS/BS 6920	Microbiological growth, chemical and organoleptic properties
GER	KTW	Organoleptic properties, migration test
GER	EN 16421-2	Microbiological growth
FRANCE	ACS	Migration and cytotoxicity tests
USA	NSF 61	Migration test and inspection of production facility

Germany: KTW-BWGL

The drinking water hygiene requirements for materials are specified in the Evaluation Criteria for Plastics and Other Organic Materials in Contact with Drinking Water (KTW-BWGL) in accordance with §17(3) of the Drinking Water Ordinance (TrinkwV). According to these criteria, materials and substances used in the construction or maintenance of installations for the extraction, treatment or distribution of drinking water, which come into contact with drinking water, may not, in accordance with §17(2) sentence 1 of the Drinking Water Ordinance (TrinkwV):

1. directly or indirectly reduce the protection of human health as required by the Drinking Water Ordinance (TrinkwV),
2. adversely affect the odor or taste of water, or
3. release substances into the drinking water in quantities greater than is unavoidable when adhering to the generally accepted rules of technology.

If only individual parts of a product need to be replaced during the maintenance of older systems, and the required component is made of a material that does not meet the evaluation criteria but does not affect drinking water quality, a complete replacement of the entire system is not necessary.

On March 21, 2019, the Federal Environment Agency (UBA) published the KTW-BWGL, which will gradually replace the previous KTW guidelines for organic materials and the UBA Elastomer Guideline.

With the publication of the third amendment to the legally binding KTW-BWGL on March 7, 2022, the UBA has included elastomers as Annex D in the guideline. The requirements

of Annex D will become legally binding on March 1, 2025 and the transition period for components manufactured and certified according to the Elastomer Guideline will end at this time.

Components made of elastomers must be evaluated specifically for each product or component, as the production process (vulcanization parameters, tempering process, etc.) significantly affects the migration behavior of the finished parts and thus the drinking water hygiene properties of the final product. The evaluated and approved starting materials for the recipe composition are listed in material-specific positive lists in the annexes of these evaluation criteria.

Finished parts must be evaluated for the transfer of substances into drinking water, which is done by a recipe-dependent migration test. Additionally, the migration water must be evaluated for any impact on odor and appearance. Testing is always carried out in cold water at 23 ± 2 °C and can also be performed in warm (60 ± 2 °C) or hot water (85 ± 2 °C). The test water is examined for both basic and additional requirements, which result from material and recipe verification.

The KTW-BWGL follows a risk-based approach, categorizing components into different risk groups (**P1 to P3**) depending on their surface-to-volume ratio or the proportion of the water-contacting surface area of the component in the assembly, as well as a group with negligible contact (**P4**):

- P1: e.g., pipes, fittings and tanks
- P2: e.g., components of fittings and components in tanks
- P3: e.g., small-surface components of fittings and small-surface components in tanks

P4: products with a negligible impact on drinking water quality

A conversion factor is established to calculate the expected concentrations at the water tap (ctap) of individual substances. The conversion factor is based on "worst-case" assumptions regarding the contact time of drinking water with the respective products or components, as well as their surface-to-volume ratios in the drinking water distribution system.

Additionally, product groups are defined, grouping together different products or components with the same conversion factor. These groups are comparable in terms of their frequency of use in drinking water distribution and their surface-to-volume ratio.

Each product group or the elastomer material used for it is also assigned a requirement regarding the promotion of microbial growth according to EN 16421.

Germany: EN 16421

The KTW-BWGL specifies requirements for the prevention of microbial growth. These are tested according to EN 16421, preferably on test plates. Successful testing is a mandatory prerequisite for a successful component testing.

According to the German KTW-BWGL, both method 1 (testing the biomass production potential, measured as ATP) and method 2 (testing using the volumetric method) are permissible. The most commonly used method in Germany is method 2, which is identical to the test described in DVGW Worksheet W 270.

In the volumetric method described in method 2, the total amount of both active and inactive biofilm on the surface of the material to be tested (living and dead microorganisms

as well as extracellular polymeric substances) is determined volumetrically. The harvested volume of the biofilm is evaluated in conjunction with its growth behavior over the entire test period according to method 2 of EN 16421 and then assigned to graded requirements.

The assignment of these requirements (M1, M2, and M3) depends on the conversion factor (risk/product categorization) of the components according to KTW-BWGL and takes into account the surface area in contact with water:

- M1: $\leq (0,05+0,02)$ ml/800 cm²
- M2: $\leq (0,12+0,03)$ ml/800 cm²
- M3: $\leq (0,20+0,03)$ ml/800 cm²

The surface of the products must not have a biocidal effect on the drinking water, which is why products without surface colonization generally do not meet the requirements. This is demonstrated by a negative control during the testing according to EN 16421-2.

It is important to note that none of the methods allow for conclusions regarding the physical, chemical or toxicological behavior of the materials. Furthermore, none of the methods provide information on the pathogenicity of microorganisms, whose numbers may increase due to nutrients originating from the tested material.

GB: WRAS/BS 6920

In the United Kingdom, water fittings must comply with water regulations and standards of adequate quality and must not cause contamination of the water supply. Non-metallic materials must comply with British Standard 6920. These provisions are

included in the Water Supply (Water Fittings) Regulations 1999 for England and Wales, the Water Fittings Regulations and Scottish Water Byelaws 2014 and the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.

Similar to the German regulations, WRAS also distinguishes between the maximum allowable operating temperatures of the tested materials. The test conditions are based on these operating temperatures. The materials are tested for aspects such as migration, organoleptic impact on water and extraction of metal compounds.

Certification is not mandatory for manufacturers. However, since plumbers are responsible for using compliant products, they naturally prefer to work with water fittings and materials that have been tested and approved.

WRAS is a well-known British approval scheme for this purpose. However, as an approval body, it does not carry out its own tests but relies on external testing laboratories. For WRAS approval, a test report from an accredited laboratory is required.

France: ACS

The Attestation de Conformité Sanitaire (ACS) is an official approval that has been mandatory in France since December 24, 2006. It applies both to components of equipment that come into contact with water intended for human consumption and to the equipment itself.

To meet the requirements, all assemblies that come into contact with water in water supply networks for human consumption must have a certificate of conformity with sanitary requirements. This includes both drinking water and water to be treated to

make it potable (principle: "from pump to tap").

The decree of May 29, 1997, established the general principles for materials in contact with water intended for human consumption and specified the obligations of the various manufacturers (health safety of materials). This decree has been supplemented by various amendments describing the procedures to be followed depending on the material and/or equipment category.

Materials used in drinking water supply can negatively affect the quality of water supplied to consumers. Depending on the component size and the resulting contact surface area, either an evaluation of the recipe composition by an accredited testing institute is sufficient or additional tests on the finished part are required for migration, organoleptic impact on the water, chlorine consumption and cytotoxicity.

USA: NSF 61

NSF/ANSI/CAN 61-2023 "Drinking Water System Components - Health Effects" sets minimum requirements for the health impacts of chemical contaminants and impurities introduced by products, components and materials into drinking water systems. It does not address taste and odor effects on the water or microbial growth.

NSF 61-2023 focuses on the evaluation of contaminants that indirectly enter drinking water and covers a range of materials, including sealing materials, valves, distribution systems, separation membranes, drinking water treatment systems and mechanical plumbing devices such as faucets and endpoint control valves. The materials chosen to construct these products play a key role in the impact they can have on the water system throughout their lifetime. Therefore, NSF/ANSI/CAN 61-2023 requires the use of specific materials known to be suitable for contact with drinking water.

Component evaluation is conducted through migration testing and an inspection of the manufacturing facility, depending on the installation situation (public supply or household installation), maximum water temperature, contact time, etc.