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NSF/ANSI 61

Drinking Water System Components

Health Effects

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4 Pipes and related products

4.1 Scope

4.1.1 The requirements in this section apply to pipes and pipe-related products and the water-contact materials associated with these products. Pipe-related products include, but are not limited to, the following items: fittings, couplings, flexible and rigid tubing, riser tubing, dip tubes, hoses, well casings, drop pipes, screens, and pipe-related coatings.

4.1.2 Coatings and other barrier materials not exclusively intended for application to pipes or pipe-related products are evaluated under 5.

NOTE – Coatings and other barrier materials that meet the requirements of 5 at a specific surface-area-to-volume ratio shall be considered to meet the requirements of a pipe or pipe-related product application for a surface-area-to-volume ratio less than or equal to the ratio accepted under the 5 evaluation.

4.1.3 Individual ingredients of cement-based pipes and related products (including Portland and blended hydraulic cement and admixtures) are evaluated under 5.

4.1.4 Products and materials intended to join or seal pipes or pipe-related products are evaluated under 6.

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4.5 Extraction procedures

4.5.1 Analytical summary

An analytical summary shall be prepared for each product or material. The analytical summary shall consist of the formulation-dependent analytes identified in 3.2 and the applicable material-specific analytes listed in table 3.1.

4.5.2 Preparation of test samples

4.5.2.1 ~~In all cases, t~~Test samples shall be prepared so that the laboratory surface-area-to-volume ratio is equal to or greater than the surface-area-to-volume ratio at which the product is intended to be used in the field.

4.5.2.1.1 For the evaluation of metal and metal containing product samples that are connected to pipe or tubing products under normal installation conditions (e.g., fittings), the samples shall be attached to lengths of pipe or tubing of the appropriate nominal diameter. **Plugs shall not be used in a manner that cover an otherwise wetted surface.** The exposed surface area to volume ratio of the fitting test sample shall represent a percentage of the total exposed surface area (test sample plus the attached pipe or tubing) that is equal to (+/- 5%) the percentage specified in the table 4.5 normalization assumptions (e.g. 14.6 or 29.3 square inches/liter for nominal half inch pipe which is part of a flexible or rigid piping system

respectively). The pipe or tubing material ~~used in the assembly shall be made out of material expected to be attached under field conditions and also~~ be present in the method blank as required in annex B, section B.2.8.1.

Assemblies should be made of relatively inert materials and designed in a manner which eliminates or minimizes the occurrence of the same contaminant being present in the control and the test sample whenever possible. The control shall be made of the same material and exposed at the same surface area to volume ratio as the test sample.

Threaded products shall be assembled by threading a pipe material which has been cut to an appropriate length equal to the $V_{F(\text{static})}$. For products being tested which are less than a liter, the attached pipe volume combined with the product volume shall be equal to 1 L (+/- 5%) for the test sample. When preparing a product which has a soldered joint, the control shall be prepared using the same solder and extension material as the test sample. Products with quick connect fitting ends are most easily assembled by attaching polyethylene tubing, cut to the appropriate length and diameter using the same polyethylene tubing for the control.

Non-metal and copper (C12200) product samples that are connected to pipe or tubing products under normal installation conditions (e.g., fittings) may be prepared as described for metal and metal containing product samples. Non-metal containing products and copper (C12200) may also be prepared so that the laboratory surface area-to-volume ratio is equal to or greater than the surface area-to-volume ratio at which the product is intended to be used in the field.

Components (e.g., gaskets or “O” rings) of a fitting that are wetted under normal operating pressures but are not wetted under the conditions of a static exposure shall be tested separately from the assembly in an “in vessel” exposure. The laboratory surface area for the “in vessel” exposure shall be a minimum of ten fold greater than the wetted surface area of the product to ensure that the reporting level of the analysis, when normalized, is equal to or less than the pass/fail criteria for all contaminants. The result of the “in vessel” exposure shall then be normalized to the applicable surface area of the product.

~~NOTE—To facilitate the exposure of product samples that are connected to pipe or tubing products under normal installation conditions (e.g., fittings), the samples may be attached to lengths of pipe or tubing of the appropriate nominal diameter. When a test sample is prepared in this manner, the exposed surface area of the fitting test sample shall represent a percentage of the total exposed surface area (test sample plus the attached pipe or tubing) that is equal to or greater than the percentage specified in the table 4.5 normalization assumptions, for the specific nominal diameter and end use of the product (flexible or rigid piping system). The pipe or tubing material shall also be present in the method blank as required in annex B, section B.2.8.1.~~

4.5.2.2 Unless the manufacturer’s instructions direct otherwise, test samples shall be rinsed in cold tap water until any extraneous debris or contamination that occurred during shipping and handling is removed. The samples shall then be rinsed in reagent water that meets the requirements of annex B, section B.9.2.1

4.5.2.3 If the exterior surface of a product is to be exposed, all markings that are not integral to the product (e.g., ink markings) shall be removed.

4.5.2.4 When the test sample contains internal threaded outlets, 75% of the threaded surface area shall be covered by insertion of a threaded component of the appropriate diameter to produce a watertight seal.

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B.4 Mechanical devices

B.4.1 Samples

Samples shall consist of the entire device, portion(s)/ component(s) of the device, or a specimen of the material(s). The manufacturer shall have the option to request that the samples represent a product line of varying sizes, as described below. When it is necessary to calculate normalization factor(s), the wetted exposed surface area of the sample shall be calculated and recorded prior to testing.

B.4.1.1 Entire device

A single device shall represent a product line of varying sizes when:

- materials are of the same alloy, composition, or formulation; and
- materials have undergone the same manufacturing process, e. g., casting or extrusion; and
- designs are analogous; and
- it has the greatest exposed wetted surface-area-to-volume ratio.

The wetted surface-area-to-volume ratio shall be calculated as $SA_F/V_{F(\text{static})}$, with SA_F equal to the surface area exposed in the field, and $V_{F(\text{static})}$ equal to the volume of water to which the device is exposed under the static condition. The surface-area-to-volume ratio for a device with an internal volume of less than 1 L (0.26 gal) shall be calculated with the assumption that $V_{F(\text{static})}$ is equal to 1 L (0.26 gal).

NOTE 1 – For a product line of varying sizes with volumes of less than 1 L (0.26 gal), the device with the largest wetted surface area will be the device with the greatest exposed surface-area-to-volume ratio.

NOTE 2 – Design differences such as external and internal threaded outlets shall not be considered analogous.

NOTE 3 – For internal threaded products, SA_F shall be equal to the normally wetted surface area of the product including 25% of the threaded area(s). The capacity of the product shall be equal to the volume of water contacted by the wetted surface area of the product including the volume contained within 25% of the threaded area(s). When the product capacity is less than 1 L (0.26 gal), $V_{F(\text{static})}$ shall equal 1 L (0.26 gal). When the product capacity is equal to or greater than 1 L (0.26 gal), $V_{F(\text{static})}$ shall be equal to the capacity.

B.4.1.2 Component

A component shall represent a product line of varying sizes when:

- materials are of the same alloy, composition, or formulation; and
- materials have undergone the same manufacturing process, e. g., casting or extrusion; and
- designs are analogous; and
- it has the greatest exposed wetted surface-area-to-volume ratio.

The wetted surface-area-to-volume ratio shall be calculated as $SA_F/V_{F(\text{static})}$, with SA_F equal to the surface area exposed in the field, and $V_{F(\text{static})}$ equal to the volume of water to which the component is exposed under the static condition. The surface-area-to-volume ratio for a component with an internal volume of less than 1 L (0.26 gal) shall be calculated with the assumption that $V_{F(\text{static})}$ is equal to 1 L (0.26 gal).

NOTE 1 – For a product line of varying sizes with volumes of less than 1 L (0.26 gal), the component with the largest wetted surface area will be the component with the greatest exposed surface-area-to-volume ratio.

NOTE 2 – Design differences such as external and internal threaded outlets shall not be considered analogous.

NOTE 3 – For internal threaded products, SA_F shall be equal to the normally wetted surface area of the product including 25% of the threaded area(s). The capacity of the product shall be equal to the volume of water contacted by the wetted surface area of the product including the volume contained within 25% of the threaded area(s). When the product capacity is less than 1 L (0.26 gal), $V_{F(\text{static})}$ shall equal 1 L (0.26 gal). When the product capacity is equal to or greater than 1 L (0.26 gal), $V_{F(\text{static})}$ shall be equal to the capacity.

B.4.1.3 Material

The material shall be representative of that used in the component or device.

Materials shall be evaluated using a minimum surface-area-to-volume ratio of 50 cm²/L.

B.4.2 Sample preparation

Prior to conditioning and exposure, the samples shall be washed as described in annex B, section B.2.4, unless the manufacturer's instructions direct otherwise. When required, the device shall be properly prepared per the manufacturer's recommendations.

Metal and metal containing product samples that are connected to pipe or tubing products under normal installation conditions, shall be attached to lengths of pipe or tubing of the appropriate nominal diameter for the extraction test. ~~Plugs shall not be used in a manner that cover an otherwise wetted surface~~ When preparing a test sample in this manner, the assembly shall be designed such that the volume of the test sample plus the attached pipe or tubing is equal to the $V_{F(\text{static})}$ for the product when the unit volume exceeds 1 liter. If the unit volume of the product being tested is less than a liter, the attached pipe volume combined with the product volume shall be equal to 1 L (+/- 5%) for the test sample. The pipe or tubing material ~~used in the assembly~~ shall also be present in the method blank as required in annex B, section B.2.8.1. ~~and be made out of the material expected to be attached to product under field conditions.~~

When the test sample contains internal threaded outlets, 75% of the threaded surface area(s) shall be covered by insertion of a threaded component of the appropriate diameter to produce a watertight seal. The threaded component shall also be present in the method blank (see Annex B, section B.2.8.1).

~~Assemblies should be made of relatively inert materials and designed in a manner which eliminates or minimizes the occurrence of the same contaminant being present in the control and the test sample whenever possible. The control shall be made of the same material and exposed at the same surface area to volume ratio as the test sample.~~

~~Threaded products shall be assembled by threading a pipe material which has been cut to an appropriate length equal to the $V_{F(\text{static})}$. For products being tested which are less than a liter, the attached pipe volume combined with the product volume shall be equal to 1 L (+/- 5%) for the test sample. When preparing a product which has a soldered joint, the control shall be prepared using the same solder and extension material as the test sample. Products with quick connect fitting ends are most easily assembled by attaching polyethylene tubing, cut to the appropriate length and diameter using the same polyethylene tubing for the control.~~

~~NOTE — To facilitate the exposure of product samples that are connected to pipe or tubing products under normal installation conditions (e. g., valves), the samples may be attached to lengths of pipe or tubing of the appropriate nominal diameter. When a test sample is prepared in this manner, the assembly shall be designed so that the volume of the test sample plus the attached pipe or tubing is equal to the $V_{F(\text{static})}$ for the product. The pipe or tubing material shall also be present in the method blank as required in annex B, section B.2.8.1.~~

Non-metal product samples that are connected to pipe or tubing products under normal installation conditions may be prepared as described for metal and metal containing product samples. Non-metal containing products may also be prepared so that the laboratory surface area-to-volume ratio is equal to (+/- 5%) or greater than the surface area-to-volume ratio at which the product is intended to be used in the field.

Components (e.g., gaskets or "O" rings) of a mechanical device that are wetted under normal operating pressures but are not wetted under the conditions of a static exposure shall be tested separately from the assembly in an "in vessel" exposure. The laboratory surface area for the "in vessel" exposure shall be, at a minimum, ten fold greater than the wetted surface area of the product ~~to ensure that the re-~~

porting level of the analysis, when normalized, is equal to or less than the pass/fail criteria for all contaminants. The result of the “in vessel” exposure shall then be normalized to the applicable surface area of the product.

B.4.3 Conditioning

Conditioning shall be conducted either in the device or in a vessel. Table B7 provides examples of typical exposures for the various products covered by this section. The test samples shall be preconditioned by exposure at room temperature 23 ± 2 °C (73 ± 4 °F) to the extraction water used for testing (annex B, section B.2.5) for 14 d or less if specified by the manufacturer. The water shall be changed at least 10 times (during the 14-d conditioning period), or fewer if specified by the manufacturer. There shall be a minimum period of 24 h per exposure.

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