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Ductile iron pipes, fittings and accessories — Sanitary characteristics and test methods

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National foreword

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Ductile iron pipes, fittings and accessories - Sanitary characteristics and test methods

Tuyaux, raccords et accessoires en fonte ductile - Aspects sanitaires et methodes d'essais

Rohre, Formstücke und Zubehör aus duktilem Gusseisen - Trinkwasserhygienische Eigenschaften und Prüfverfahren

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Contents

Page

European foreword

This document (CEN/TR 16950:2016) has been prepared by Technical Committee CEN/TC 203 “Cast iron pipes, fittings and their joints”, the secretariat of which is held by AFNOR.

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Introduction

This Technical Report is in conformity with the general requirements already established by CEN/TC 164 in the field of water supply (e.g. potable water).

This Technical Report contains the essential sanitary characteristics to be verified in performance tests by materials of pipes, fittings, accessories of ductile cast iron and their joints within the scope of this Technical Report, which are in contact with water intended for human consumption. In addition, the national regulations of member states apply, including positive lists of substances for organic and inorganic materials.

Tests carried out using EN test methods to demonstrate compliance with existing national regulations may be used to show that the sanitary characteristics of pipes, fittings, accessories of ductile cast iron and their joints are verified, e.g. compliance with the sanitary requirements applicable either in F, G, NL or UK ensures compliance with the properties of this Technical Report. Since the sanitary requirements of construction products remain in the framework of the national regulations, Annex A of this Technical Report contains a compilation of the different national requirements.

1 Scope

This Technical Report contains the sanitary characteristics and test methods applicable to those factory applied lining-, coating- and jointing materials of ductile iron pipes and fittings conforming to EN 545 that are in contact with water intended for human consumption for use at operating temperatures up to 50 °C. Ductile cast iron itself is not in direct contact with the conveyed water and therefore no characteristics in respect to the sanitary behaviour are necessary. As ductile cast iron is impermeable against diffusion of organic substances, the water quality is maintained in service. Different surface/volume ratios are used in the tests for pipes, fittings and joints to reflect the different impact of their surface areas exposed to the water in the overall pipeline.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1420, *Influence of organic materials on water intended for human consumption — Determination of odour and flavour assessment of water in piping systems*

EN 1622, *Water quality — Determination of the threshold odour number (TON) and threshold flavour number (TFN)*

EN 12873-1, *Influence of materials on water intended for human consumption — Influence due to migration — Part 1: Test method for factory-made products made from or incorporating organic or glassy (porcelain/vitreous enamel) materials*

EN 14718, *Influence of organic materials on water intended for human consumption — Determination of the chlorine demand — Test method*

EN 14944-1, *Influence of cementitious products on water intended for human consumption — Test methods — Part 1: Influence of factory made cementitious products on organoleptic parameters*

EN 14944-3, *Influence of cementitious products on water intended for human consumption — Test methods — Part 3: Migration of substances from factory-made cementititous products*

EN 16421, *Influence of materials on water for human consumption — Enhancement of microbial growth (EMG)*

EN ISO 7027-1, *Water quality — Determination of turbidity — Part 1: Quantitative methods (ISO 7027-1)*

EN ISO 7393-1, *Water quality — Determination of free chlorine and total chlorine — Part 1: Titrimetric method using N, N-diethyl-1,4-phenylenediamine (ISO 7393-1)*

EN ISO 7887, *Water quality — Examination and determination of colour (ISO 7887)*

EN ISO 14402, *Water quality — Determination of phenol index by flow analysis (FIA and CFA) (ISO 14402)*

EN ISO 17993, *Water quality — Determination of 15 polycyclic aromatic hydrocarbons (PAH) in water by HPLC with fluorescence detection after liquid-liquid extraction (ISO 17993)*

3 Terms and definitions

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

3.1
ductile iron
cast iron used for pipes, fittings and accessories in which graphite is present substantially in spheroidal form

Note 1 to entry: Ductile iron is impermeable to diffusion (e.g. contaminated soils).

3.2
cement mortar lining
internal coating system for ductile iron pipes and fittings, principally consisting of a blend of cement, sand and water applied to the internal surfaces

Note 1 to entry: It may be applied and hardened by a number of different processes to achieve its desired properties.

3.3
finishing layer
layer of an organic varnish or polymeric resin which protects the zinc layer against direct contact with soil components

3.4
porous seal coat
layer of an organic varnish or polymeric resin which is intended to reduce the contact between a cement mortar lining and the contents of a water pipeline thereby restricting the leaching of inorganic materials into the water supply

3.5
organic lining
internal layer of a polymeric resin which acts as a barrier between the ductile cast iron and the conveyed water

3.6
organic coating
external layer of an organic varnish or polymeric resin which acts as a protection between the ductile cast iron and the soil

Note 1 to entry: A small part of this external surface has contact with the conveyed water in the assembled pipeline in the joint area.

3.7
bituminous lining
internal layer of a bituminous varnish in fittings or joint areas

3.8
enamel
vitreous a smooth, durable coating or lining made of melted and fused glass powder

3.9
rubber gaskets
sealing component of a joint

3.10
lubricant
water-solluble substance that enables an easy assembly by reducing friction in the joint and that dissolves during the commissioning of the pipeline

4 Test samples

For pipes, pipe sections where the lining has been produced under standard factory controlled conditions (same materials, same process) are used as test samples.

For fittings, pipe sections or sections of straight fittings where the lining has been produced under standard factory controlled conditions (same materials, same process) are used as test samples.

For rubber gaskets, rubber plates or gasket sections produced under standard factory controlled conditions (same materials, same process) are used as test samples.

5 Characteristics

5.1 Cement mortar linings of pipes

5.1.1 General

As organic free cementitious products, the cement mortar linings have to verify organoleptic and migration properties.

5.1.2 Organoleptic parameters (flavour and odour, colour and turbidity)

When tested in accordance with EN 14944-1, using chlorine-free test water at a fixed S/V of 2,5 dm^2/l for pipes and 1,0 dm^2/l for fittings, the following properties shall be determined after the third contact period:

a) threshold flavour number (TFN) and threshold odour number (TON) according to EN 1622;

b) change in colour according to EN ISO 7887 and

c) change in turbidity according to EN ISO 7027-1.

5.1.3 Migration

When tested in accordance with EN 14944-3, using chlorine-free test water at a fixed S/V of 10 dm^2/l, the following properties shall be determined after the third contact period:

a) migration of organics expressed as TOC for pipes and fittings [in $mg/(m^2 \cdot d)$]; and

b) migration of metals; if the cement contains higher metal concentrations than indicated in Table 1, migration rates of metals given in Table 2 shall be determined.

Table 1 — Maximum metal content of the cement where no migration test is necessary

Type of metal	Maximum metal content
Arsenic (As)	< 0,01 %
Cadmium (Cd)	< 0,001 %
Chromium (Cr)	< 0,05 %
Lead (Pb)	< 0,05 %
Nickel (Ni)	< 0,05 %

Table 2 — Migration rates

Type of metal	max. migration rate
Arsenic (As)	according to the national regulations
Cadmium (Cd)	
Chromium (Cr)	
Lead (Pb)	
Nickel (Ni)	

5.2 Porous seal coat on cement mortar linings of pipes

In the case of cement mortar linings with porous seal-coat, the cement mortar lining shall comply with 5.1 and the seal coat material with 5.3. In addition, test one sample of porous seal-coated cement mortar lined pipe taken at random from each of three different production batches of the cured product.

When tested in accordance with EN 14944-1 using chlorine-free test water, at a fixed S/V of 2,5 dm^2/l, the following properties shall be determined by all three samples after the third contact period:

a) threshold flavour number (TFN) and threshold odour number (TON) according to EN 1622;

b) change in colour and turbidity under visual inspection; and

c) enhancement of microbial growth according to EN 16421.

5.3 Cement mortar linings of fittings

Fittings are lined with cement mortar in a procedure where organic constituents, mostly acrylic resin dispersions, are used to lower the w/c-ratio. These linings have to be tested in the same way as organic free cement mortar linings. Additionally they have to be tested to their enhancement of microbial growth (EMG) according to EN 16421.

5.4 Organic linings (except bitumen)

5.4.1 Organoleptic parameters

When tested in accordance with EN 1420, using chlorine-free test water at a fixed S/V of 2,5 dm^2/l for pipes and 1,0 dm^2/l for fittings and joint areas, the following properties shall be determined after the third contact period:

a) threshold flavour number (TFN) and threshold odour number (TON) according to EN 1622; and

b) change in colour and turbidity under visual inspection.

5.4.2 Migration

When tested in accordance with EN 12873-1, using chlorine-free test water at a fixed S/V of 10 dm^2/l, the migration of organics shall be determined after the third contact period (expressed as TOC for pipes and for fittings and joint areas [in $mg/(m^2 \cdot d)$]).

In addition, maximum migration rates of specific organics may be defined in national regulations and positive lists.

5.4.3 Enhancement of microbial growth (EMG)

All organic linings (epoxy, polyurethane, polyolefin etc.) are tested to their enhancement of microbial growth (EMG) according to EN 16421.

5.5 Bituminous linings for fittings and joint areas

5.5.1 Organoleptic parameters

When tested in accordance with EN 1420, using chlorine-free test water at a fixed S/V of 1,0 dm^2/l, the following properties shall be determined after the third contact period:

a) threshold flavour number (TFN) and threshold odour number (TON) according to EN 1622; and

b) change in colour and turbidity under visual inspection.

5.5.2 Migration

When tested in accordance with EN 12873-1, using chlorine-free test water at a fixed S/V of 10 dm^2/l, the following properties shall be determined after the third contact period:

a) migration of organics expressed as TOC [in $mg/(m^2 \cdot d)$]; and

b) migration data of specific constituents of bituminous linings are tested and analysed according the test methods given in Table 3.

Table 3 — Test methods for bituminous linings

Parameter	Test procedure	Analytical method
Chlorine consumption	EN 14718	EN ISO 7393-1
Phenols	EN 12873–1	EN ISO 14402
Polycyclic aromatic hydrocarbons	EN 12873–1	EN ISO 17993
Benzo-a-pyrene	EN 12873–1	EN ISO 17993

In addition, maximum migration rates of specific organics may be defined in national regulations and positive lists.

5.5.3 Enhancement of microbial growth (EMG)

Bituminous linings of the inner socket profile and coatings of the outside spigot end surface are in contact with drinking water with a very small volume/surface-ratio. They shall be tested according to EN 16421.

5.6 Enamel coatings and linings

5.6.1 Organoleptic parameters

Enamel doesn't influence odour and flavour of the conveyed water. Therefore a test of organoleptic parameters is not necessary.

5.6.2 Migration

When tested in accordance with EN 12873-1, using deionised test water of 23 °C ± 2 °C at a fixed S/V of 5 dm^2/l, the migration of metal oxides shall be determined after the third contact period:

The maximum migration rates of specific metal ions may be defined in national regulations and positive lists.

5.6.3 Enhancement of microbial growth (EMG)

Testing of enhancement of microbial growth is not necessary because of the smooth surface and missing organic nutrients in the material the microbial growth is not enhanced.

5.7 Rubber gaskets

5.7.1 Organoleptic parameters

When tested in accordance with EN 1420, using chlorine-free test water at a fixed S/V of 0,2 dm^2/l, the following propertie shall be determined after the third contact period:

a) threshold flavour number (TFN) and threshold odour number (TON) according to EN 1622; and

b) change in colour and turbidity under visual inspection.

5.7.2 Migration

When tested in accordance with EN 12873-1, using chlorine-free test water at a fixed S/V of 0,2 dm^2/l, the following properties shall be determined after the third contact period:

a) migration of organics expressed as TOC [in $mg/(m^2 \cdot d)$];

b) migration of formaldehyde [in $mg/(m^2 \cdot d)$]; and

c) migration of phenol [in $mg/(m^2 \cdot d)$].

In addition, maximum migration rates of specific organics may be defined in national regulations and positive lists.

5.7.3 Chlorine consumption

When tested in accordance with EN 14718, at a fixed S/V of 0,2 dm^2/l, the chlorine demand shall be determined after the third test period [in $mg/(m^2 \cdot d)$].

Annex A
(informative)

National regulations on sanitary requirements, limit values, positive lists

A.1 General

The following list is the result of an internal enquiry in CEN/TC 203 and discussions within CEN/TC 203/WG 7 and is not considered to be complete. It gives the current status at the publication of the document. The list will be developed and updated in the future according to the progress of the national regulations.

A.2 Austria

Empfehlung betreffend Anforderungen an Materialien in Kontakt Wasser für den menschlichen Gebrauch (Trinkwasser) im Hinblick auf die Bestimmungen der Trinkwasserverordnung. (Austrian Health Ministry).

A.3 Belgium

Acceptance of materials in contact with drinking water (Belgaqua, Belgian Federation for the Water Sector), Edition 01 October 2012.

A.4 France

Sanitary certificates of conformity (ACS) are available for all products in contact with drinking water and a conformity to positive list (CLP) exists for cement mortar.

A.5 Germany

A.5.1 Cementitious materials

Bewertungsgrundlage für zementgebundene Werkstoffe im Kontakt mit Trinkwasser - Zement-Bewertungsgrundlage (ZTW), Umweltbundesamt Entwurf November 2013 (Assessment of Cementitious Products in Contact with Drinking Water) according to the Assessment of Cementitious Products in Contact with Drinking Water 4MS Common Approach (JMC Approved April 2012)

A.5.2 Organic materials

Positive lists for organic materials combined positive list of organic substances in contact with drinking water.

A.5.3 Bewertungsgrundlage für Emails und keramische Werkstoffe im Kontakt mit Trinkwasser (Email/Keramik-Bewertungsgrundlage) Entwurf Umweltbundesamt Juni 2013.

A.5.4 Leitlinie zur hygienischen Beurteilung von Elastomeren im Kontakt mit Trinkwasser (Elastomerleitlinie) Umweltbundesamt Dezember 2011.

A.5.5 Leitlinie zur hygienischen Beurteilung von organischen Beschichtungen im Kontakt mit Trinkwasser (Beschichtungsleitlinie) Umweltbundesamt November 2010.

A.6 Italy

Decreto Ministeriale 174 (6 aprile 2004) “Regolamento concernente i materiali e gli oggetti che possono essere utilizzati negli impianti fissi di captazione, trattamento, adduzione e distribuzione delle acque destinate al consume umano.

A.7 Netherlands

Regulation issued by the State Secretary for Infrastructure and the Environment dated June 29, 2011, Nr. BJZ2011048144 laying down further rules for the use of materials and chemicals in the supply of drinking water and warm tap water (Materials and chemicals in the supply of drinking water and warm tap water Regulation).

A.8 Romania

The sanitary notification of the products used in contact with drinking water is made in accordance with the Decision no. 275/2012 of the Romanian Ministry of Public Health regarding the approval of the sanitary regulation procedure for products, chemicals/compounds and equipments in contact with drinking water, according to the Article 10 of the National Law 458/2002 on quality of drinking water, republished.

A.9 Spain

Royal Decree 140/2003 of 7 February by which health criteria for the quality of water intended for human consumption are established.

A.10 Switzerland

A.10.1 Bundesgesetz über Lebensmittel und Gebrauchsgegenstände (Lebensmittelgesetzgebung LMG)

A.10.2 Lebensmittel- und Gebrauchsgegenständeverordnung (LGV)

A.10.3 Verordnung des EDI über Trink-, Quell- und Mineralwasser

A.10.4 Hygieneverordnung des EDI (HyV)

A.10.5 Verordnung des EDI über Bedarfsgegenstände

A.10.6 Bauproduktegesetzgebung

A.11 United Kingdom

A.11.1 Conformance with the requirements of UK Statutory Instrument “The Water Supply (Water Quality) Regulations 2000” as amended by S.I. 2001/2885, S.I. 2002/2469, S.I.2005/2035 and S.I. 2007/2734 is necessary for all products and substances in contact with water intended for human consumption.

A.11.2 Regulation 31.4.a of the above UK Statutory Instrument covers products that have a significant contact with the water, e.g. pipelines, reservoirs, treatment chemicals. These products require a positive approval from the Secretary of State. This approval is normally given on the recommendation of DWI (Drinking Water Inspectorate) and is based upon tests which are specific to the product involved.

A.11.3 A product with a small surface area in contact with the water (or a very transient contact time) can be used by a water company under Regulation 31.4.b of the above Statutory Instrument providing that it does not give rise to unintended odour/flavour to the water and does not support the growth of microbial organisms, i.e. it passes the test requirements of BS 6920 — 2.2 and 2.4.

Bibliography

EN 545, *Ductile iron pipes, fittings, accessories and their joints for water pipelines — Requirements and test methods*

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