

# Composition List - Introduction for Copper Alloys

## Introduction

Metal release into drinking water is caused by corrosion. This is a long term process and leads to the build-up of corrosion product layers which influence further metal release.

Two different periods of metal release from a metallic product in contact with drinking water can be distinguished. The initial period of about three months (short term behaviour) is mainly influenced by the surface characteristics of the product (e.g. lead film on the surface), whereas the long term behaviour is characterized by the bulk metallic material.

As it is the bulk metallic material that defines the long term behaviour of products, it is possible to accept metallic materials for use with drinking water. For the acceptance of metallic materials other factors affecting the interaction between metals and water have to be taken into account, such as:

- Chemical and physical characteristics of water
- Design and construction of the distribution system (e.g. density of use of fittings, design of products)
- Flow regime, as determined by the water consumption habits of consumers
- Contact time of the metallic material with water

The procedure for accepting metallic materials takes reasonable worst case situations of the above factors into account.

As the interpretation of test results is very complex a “Committee of Experts” is required to decide about the acceptance of materials based on these results and other significant data. The acceptance will lead to a listing on a Composition List.

The acceptance of materials and their listing in the Composition List requires a clear definition of the material's composition and test methods to identify the complete composition. The Composition List reflects currently available information on the performance of copper alloys.

## Principles of the acceptance procedure for a product in contact with drinking water

The acceptance procedure for products containing metals is based on requirements for:

- the short term behaviour (product specific surface properties) and
- the long term behaviour (material specific properties)

The long term behaviour of the alloy (metallic material) is relied upon rather than a long term product test. Once an alloy has been tested and accepted it is placed onto the Composition List, which will identify the alloy's metallic component(s). The listing of an alloy used in a product will be a prerequisite for the product to be considered fit for use. Alloys used for a product in contact with drinking water must be listed in the Composition List.

An alloy not on the Composition List, intended for use in contact with drinking water, will be unable to get approval until that alloy fulfils the requirements for addition to the List.

## Structure of the Composition List

The Composition List is compiled based on evidence and Regulators' assessment. The list deals with composition of materials. It does not deal with products made from those materials.

The Composition List contains different categories of metallic materials. Within each category is a closely defined material representative of that category and known as the Reference Material. Additionally, commercially available materials accepted by the regulator are listed as accepted materials within the category together with any restriction with regard to water quality and/or surface contribution or other relevant information.

A **Category** is defined as:

a group of alloys with the same characteristics in respect of their field of application, behaviour in contact with drinking water and restrictions with regard to water composition and/or surface area. A category is therefore a general description of an alloy group e.g. Copper-Zinc Alloys.

A **Reference Material** is defined as:

an alloy falling within a category for which the characteristics of metal release into drinking water are known and reproducible, the composition is strictly controlled and elements of interest will be at or near the upper limit of acceptability. Effects of some constituents to inhibit metal release will be taken into account. Industry may propose a Reference Material but Regulators may impose tighter requirements on the alloying element ranges.

**Accepted Materials** (Commercially available alloys)

Under each category commercially available alloys accepted for use in products in contact with drinking water will be listed. The alloys will be allocated a product group reflecting any restrictions with respect to the surface area.

### **Product with up to 100% contact surface**

For pipes in a building installation the same material can be used for all diameters. A single material can contribute to nearly 100% of the surface in contact with water e.g. copper tube. The evaluation of the conditions for safe use must assume the maximum possible percentage. The acceptance of a composition for the use as pipes includes the acceptance for all uses (e.g. fittings, components, etc.).

### **Product with up to 10% contact surface**

Fittings or ancillaries can be produced from one alloy or from slightly different alloys throughout the buildings' installation. Due to the potential of alloys containing lead to release lead to water there is a need to restrict the total contact surface of products made from these alloys. For assessments of materials for these products a contribution of 10% water contact surface area is assumed.

### **Product with less than 1% contact surface**

For technical reasons, there might be a need to produce small parts from compositions not accepted for the previous two product groups. Other compositions with higher release rates may be accepted in these devices as long as their use will not significantly increase the total metal release to drinking water. The use of such compositions should be restricted to parts that do not exceed 1% of the total surface in contact with drinking water; for example, the body of a water meter would need to be produced from an alloy for use up to 10% contact surface but a moving part may be produced from a material listed for less than 1% contact area.

## **Data required for the assessment of a material for acceptance onto the Composition List**

Acceptance of metallic materials is based on results of long term tests on a rig test according to EN 15664-1. The minimum test period is six months, which can be extended.

**Acceptance of a reference material for a category** requires acceptance of results from the EN 15664-1 test carried out with three different waters according to EN 15664-2 representing the range of compositions of drinking waters in the EU.

**To add a material into a category, a comparative test against the reference material** is required using EN 15664-1. For comparative testing it is sufficient to use only one drinking water, provided this water is suitably corrosive according to EN 15664-2.

Additionally the following information shall be provided to the Committee of Experts:

- For each composition, information on the boundaries for major alloying constituent elements and maximum values for impurities. Such boundaries will be tighter for Reference Materials than for commercially available alloys
- Existing applicable European standard(s) for the material
- The material characteristics
- Products to be manufactured from the material
- The production process
- Other information considered appropriate in support of the assessment

### **Acceptance criteria**

The acceptable contribution of metallic elements from metallic products in contact with drinking water to the total concentration of those metals at consumers' taps is called the Reference Concentration.

This Reference Concentration is based on modified chemical and indicator parametric values in the Drinking Water Directive (DWD) using the following principles:

- 90% of the DWD value for elements for which the metallic product in contact with drinking water constitute the only major source of that element;
- 50% of the DWD value for elements for which other sources are possible and the element is essential for a product.

In the case of parameters not listed in the DWD, aesthetic and toxicologic evaluations have been used.

In order to allow time for the development of natural protective layers, the test procedure simulates a conditioning period of three months, in which a slight non-compliance with the reference concentration is tolerated.

**Table 1 Acceptable contributions and reference concentrations for acceptance of metallic constituents of metallic products in contact with drinking water**

Parameter	Acceptable contribution from metallic product in contact with drinking water	DWD parametric value or proposed reference value in drinking water	Reference Concentration for Acceptance Scheme
		(µg/l)	(µg/l)
<b>Part B: Chemical parameters</b>			
Antimony	50%	5	2.5
Arsenic	50%	10	5
Chromium	50%	50	25
Cadmium	50%	5	2.5
Copper	90%	2000	1800
Lead	50%	10	5
Nickel	50%	20	10
Selenium	50%	10	5
<b>Part C: Indicator parameters</b>			
Aluminium	50%	200	100
Iron	50%	200	100
Manganese	50%	50	25
<b>Others: not listed in DWD</b>			
Bismuth	90%	10	9
Molybdenum	50%	20	10
Tin	50%	6000	3000
Titanium	50%	15	7.5
Zinc	90%	3000	2700

### Adding a Reference Material for a Category or a Material not falling under a listed Category

The addition or change of range of an alloying element may move an alloy outside a Category and this change may significantly influence the metal release characteristics of the material. In this case, and for a Reference Material, the following information shall be provided:

- The information listed in the section “Data required for assessment” above
- Where a proposed new composition is not comparable to a listed Category of materials the full test results from pipe rig testing according to EN 15664-1 using at least the three different drinking waters defined in EN 15664-2 shall be provided.

### Adding Materials to the Composition List within a Category of materials

Where the constituents of a candidate alloy for approval are shown to fall within a Category, the alloy can be added to the Composition List provided that a comparative test run against the respective Reference Material in a standardised rig test, EN 15664-1 using one water; shows satisfactory results.

For each material, the following information shall be provided:

- The information listed in the section “Data required for assessment” above
- Results from comparative testing using the pipe rig test EN 15664-1 relative to the Category’s Reference Material

# Requirements for Calculation of Test Specimens

## Declaration of the Composition

All elements exceeding 0.02% could be of relevance and have to be declared for the composition.

For impurities below 0.02% it is the responsibility of the producer of the alloy/material to guarantee that no release occurs with the potential to cause negative health impacts.

## Calculation of the Composition / Candidate Reference Material

(Calculation of the composition of the candidate Reference Material for comparative testing of new alloys according to EN 15664-1)

- **Constituents** have to be in the range as declared
- **Impurities to be analysed** in contact water (see subsequent paragraph 'Elements to be Analysed in the Contact Water') must be greater than 60% of the declared range
- **Impurities not to be analysed** must be lower or equal than the maximum value

## Calculation of the Composition / Alloy for Testing Purpose

(Calculation of the composition of the Alloy for testing according to EN 15664-1)

### Constituents

<b>Cu, Zn</b>	as declared (range, maximum value or remainder)
<b>Al, Si, P</b>	less than 50% of the declared range (e.g. If the declared range is 0.8 to 1.0% then 50% of the range (0.2%) is 0.1%; therefore element content should be 0.8 – 0.9%.)
<b>As</b>	greater than 66% of the declared range (e.g. If the declared range is $\leq 0.15\%$ then 66% of the range (0.15%) is 0.10%; therefore, element content should be 0.10 – 0.15%.)
<b>All other</b>	constituents shall be greater than 80 % of the declared range (e.g. If the declared range is 1.6 to 2.2% then 80% of the range (0.6%) is 0.48%; therefore, element content should be greater than 2.08%.)

**Impurities to be analysed** in the contact water (see subsequent paragraph 'Elements to be Analysed in the Contact Water') shall be greater than 60% of the declared range.

**Impurities not to be analysed** must be lower or equal than the maximum value

## Elements to be analysed in the Contact Water

Elements to be analysed in the contact water are those declared in the alloy with the exception of:

Sn, Si and P	if present as constituents
Fe, Sn, Mn, Al, Si and P	if present as impurities

Calculations have been accepted by DVGW PK "DIN 50930-6" (Document W-PK-3-4-22~10-0020) and will be part of draft DIN 50930-6.