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Winter service equipment and products - De-icing agents - Part 3: Other solid and liquid de-icing agents - Requirements and test methods

Winterdienstausrüstung und Produkte - Enteisungsmittel - Teil 3: Andere feste und flüssige Enteisungsmittel - Anforderungen und Prüfverfahren

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Équipements de viabilité hivernale - Agents de dégivrage - Partie 3: Autres agents de dégivrage solides et liquides - Exigences et méthodes d'essai

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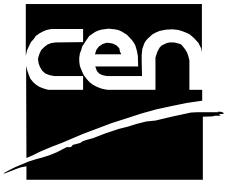

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European foreword

This document (CEN/TS 16811-3:2015) has been prepared by Technical Committee CEN/TC 337 “Road operation equipment and products”, the secretariat of which is held by AFNOR.

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Introduction

De-icing agents are important for the winter maintenance of roads and other traffic areas. They can prevent or eliminate slippery conditions. The Technical Specification describes the requirements for de-icing agents with different properties from de-icing agents according EN 16811-1 and EN 16811-2, and which are used for specific services on roads. The testing methods are included in the Technical Specification.

The multitude of products which can be used in winter maintenance - liquid or solid, natural or industrial produced substances – requires the defining of performance criteria with which the products have to comply.

These criteria are used to assess the usability of the de-icing products while taking into consideration all aspects of the safety of the road user, of the protection of the environment and of the road conditions.

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1 Scope

This Technical Specification defines general specifications and performance criteria of other solid and liquid de-icing agents than chlorides of sodium, calcium and magnesium, hereinafter referred to products, which are used with their particular properties for specific uses in winter service on roads and other traffic areas, with the exception of runways and parking areas of aircrafts. It establishes the test methods to control them. The products include inorganic and organic de-icing agents, and mixtures of chlorides of sodium, calcium, magnesium and potassium with organic and inorganic components which are intended for special properties like inhibition of corrosion, enhanced melting capacity or improved spreading pattern.

NOTE This Technical Specification defines specifications and performance criteria and offers for each a variation in the form of classes of requirements. This does not mean that there are products likely to respond to all the classes and criteria of the standard. Therefore, when defining the demand the user needs to make sure prior the appropriateness of his choice and the availability of suitable products.

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 15144, *Winter maintenance equipment — Terminology — Terms for winter maintenance*

prEN 16811-1:2015, *Winter service equipment — De-icing agents — Part 1: Sodium chloride — Requirements and test methods*

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prEN 16811-2:2015, *Winter maintenance equipment — De-icing agents — Part 2: Calcium chloride and Magnesium chloride — Requirements and test methods*

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EN 573-1, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 1: Numerical designation system*

EN 573-2, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 2: Chemical symbol based designation system*

EN 573-3, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition and form of products*

EN 573-5, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 5: Codification of standardized wrought products*

EN 932-1, *Tests for general properties of aggregates — Part 1: Methods for sampling*

EN 1236, *Fertilizers — Determination of bulk density (loose) (ISO 3944, modified)*

EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 10025-5, *Hot rolled products of structural steels — Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance*

EN 13036-1, *Road and airfield surface characteristics — Test methods — Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique*

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EN 14231, *Natural stone test methods — Determination of the slip resistance by means of the pendulum tester*

EN 1484, *Water analysis — Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)*

EN 27888, *Water quality — Determination of electrical conductivity (ISO 7888)*

EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods (ISO 1461)*

EN ISO 1523, *Determination of flash point — Closed cup equilibrium method (ISO 1523)*

EN ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity (ISO 3104)*

EN ISO 9377-2, *Water quality — Determination of hydrocarbon oil index — Part 2: Method using solvent extraction and gas chromatography (ISO 9377-2)*

EN ISO 11130, *Corrosion of metals and alloys — Alternate immersion test in salt solution (ISO 11130)*

EN ISO 11885, *Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES) (ISO 11885)*

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ISO 649-2, *Laboratory glassware — Density hydrometers for general purposes — Part 2: Test methods and use*

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

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ISO 758, *Liquid chemical products for industrial use — Determination of density at 20 degrees C*

ISO 2479, *Sodium chloride for industrial use — Determination of matter insoluble in water or in acid and preparation of principal solutions for other determinations*

ISO 2480, *Sodium chloride for industrial use — Determination of sulphate content — Barium sulphate gravimetric method*

ISO 5815-1, *Water quality — Determination of biochemical oxygen demand after n days (BODn) — Part 1: Dilution and seeding method with allylthiourea addition*

ISO 6060, *Water quality — Determination of the chemical oxygen demand*

ISO 2591-1, *Test sieving — Part 1: Methods using test sieves of woven wire cloth and perforated metal plate*

ISO 12846, *Water quality — Determination of mercury — Method using atomic absorption spectrometry (AAS) with and without enrichment*

ISO 15705, *Water quality — Determination of the chemical oxygen demand index (ST-COD) — Small-scale sealed tube method*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15144 and the following apply.

3.1
De-icing agent
product designed to prevent ice formation and / or to ensure the fusion of ice or snow

Note 1 to entry: It can be in a solid or liquid form. It can be applied pure, diluted, dissolved or mixed. It has a set of physical-chemical properties giving it value for winter service operations (storage, use, efficiency, de-icing performance, level of impact to the road structure, environment and public health).

4 Requirements and test methods

4.1 General

The solid and liquid de-icers shall be tested in accordance with the following methods and shall conform to the following requirements.

4.2 De-icing performance

4.2.1 General

De-icing performance can be evaluated by one of the following two test methods.

4.2.2 Nancy-Test

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The ability of the product to melt ice at −10 °C is determined, depending on its condition, solid or liquid form, according the test method described in C.1.

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This test determines:

— the immediate melting performance (PFI) corresponding to the amount of ice melted by the product after 20 min of contact; and

— the efficient melting performance (PFE), which corresponds to the integration of the relationship between the amount of ice melted by the product and the time, over a period of 60 min.

The minimum requirements for the couple PFI / PFE are:

— PFI ≥ 5,0 ml;

— PFE ≥ 300 ml x min.

These results are obtained on the products marketed before any possible future aqueous dilution or mixing with other solid or liquid products.

4.2.3 Inzell-Test (informative)

The ability of the product to melt ice at −2 °C and −10 °C is determined, depending on its condition, solid or liquid form, according the test method described in Annex D.

The test determines the de-icing capacity corresponding to the amount of ice melted by the product after 10 min and 60 min of contact.

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4.2.4 Freezing curve

The supplier shall supply the product freezing point as a function of mass percentage (weight %) in aqueous solution. It shall be complemented by the graph (freezing curve) with the freezing data (y-axis is freezing temperature, x-axis is mass percentage).

Additives for liquid and solid de-icers shall be tested with the recommended additive concentration for application in winter service.

The freezing point shall be determined by cryoscopic or spectroscopic methods. The used method shall be documented in the test report.

4.3 Slip resistance

The measurement of the variation of adhesion on a road surface, after application of the product, is performed according to the test method described in C.2.

The variation of the friction coefficient is evaluated using the apparatus described in EN 14231 compared to a water-wet road surface at +5 °C. The measurement with the product shall be performed at +5 °C and −5 °C.

Depending on the type of road or road specific use, the product shall belong to one of the following two classes (see Table 1).

Table 1 — Grip level classes

Class	Grip level induced by the product
1	$SRT_1 \geq 0{,}90\ SRT_e$
2	$SRT_1 \geq 0{,}75\ SRT_e$

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The friction coefficients SRTi correspond to surface conditions as follows:

— SRT_e in the presence of de-mineralized water;

— SRT_1 in the presence of the product.

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4.4 Heavy metals and hydrocarbons

The limits for heavy metals, hydrocarbons can be found in table 2.

Table 2 — Heavy metals and hydrocarbons

Parameter	Limit mg/l
Aluminium (Al)	≤ 5,00
Arsenic (As)	≤ 0,25
Chromium (Cr)	≤ 0,50
Cadmium (Cd)	≤ 0,20
Copper (Cu)	≤ 0,50
Mercury (Hg)	≤ 0,05
Nickel (Ni)	≤ 0,50
Lead (Pb)	≤ 0,50
Zinc (Zn)	≤ 2,00
Cobalt (Co)	≤ 0,20
Hydrocarbons	≤ 10

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NOTE 1 The limits are for an aqueous solution of 100 g product per litre buffered to pH 4.

The content of heavy metals, except for mercury, shall be determined by inductively coupled plasma optical emission spectrometry (ICP-OES), on the basis of the test method in EN ISO 11885.

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NOTE 2 Alternatively, the determination of contents of heavy metals can be carried out by atomic absorption spectrometry (AAS), in accordance with the test method in ISO 15586.

The content of mercury shall be determined by cold vapour atomic absorption spectrometry, on the basis of the test method in ISO 12846.

The content of hydrocarbons shall be determined on the basis of the test method EN ISO 9377-2.

4.5 pH

The pH of the product shall be between 5,5 and 11,5.

The pH shall be determined in accordance with the test method in EN ISO 10523 (modified: determination in a 10 weight % aqueous solution; dissolving and dilution with distilled water).

4.6 Sulphate

The content of water soluble sulphates shall be less than 3 weight % (expressed as SO_4).

The sulphate shall be determined based on the test method ISO 2480 (gravimetric method; modified).

NOTE Alternatively, the determination of content of sulphate can be carried out by inductively coupled plasma optical emission spectrometry (ICP-OES), on basis of ISO 11885 or EN 15749. A further alternative test method for the determination of sulphate is the ionic chromatography method (IC), on basis of EN 15749.

4.7 Corrosiveness

The corrosiveness of the product is determined for the following three reference metals:

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— the non-alloy steel standard quality (S355 and S450) as defined in EN 10025-2 and -5;

— the non-alloy steel standard quality (S355 and S450) as defined in EN 10025-2 and -5, having received a galvanizing according to EN ISO 1461;

— the aluminium standard quality [EN AW 5754] according to EN 573-1, EN 573-2, EN 573-3 and EN 573-5.

The corrosiveness is determined according to the test method described in C.3.

The product is assigned in one of the classes of corrosion (see Table 3).

Table 3 — Corrosion classes

Class	Degree of corrosion	Corrosiveness (µm/year)
1	low	< 50
2	average	50 to < 200
3	strong	≥ 200

The corrosiveness of the product is expressed in two forms coded as follows:

$F_{10i} \cdot G_{10j} \cdot A_{10k}$ - $F_{Maxi} \cdot G_{Maxj} \cdot A_{Maxk}$

where

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— F, G, A represent the tested metals (steel, galvanized steel, aluminium);

— the indices i, j, and k represent the classes of corrosion corresponding;

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— the indices Max and 10 correspond to the two concentrations tested.

4.8 Flash point

The minimum required is 100 °C.

The flash point shall be determined in accordance with EN ISO 1523.

4.9 Biodegradability

The lower the ratio of chemical oxygen demand (COD) and biochemical oxygen demand (BOD_5) is (see table 4).

Table 4 — Ratio of chemical oxygen demand (COD)

Biodegradability	Ratio COD/BOD_5
Readily biodegradable	< 2
Fairly biodegradable	2 to 3
Not readily biodegradable	> 3

The minimum requirement for the ratio of COD/BOD_5 is ≤ 5.

This provision does not apply if the COD and / or BOD_5 are not measurable.

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The biodegradability of the product is assessed, firstly, by determining the chemical oxygen demand (COD) and biochemical oxygen demand in 5 days (BOD_5) in accordance with ISO 6060, ISO 15705 and ISO 5815-1, and on the other hand, the ratio of these two terms. These tests are performed on aqueous dilutions to 10 g/l in distilled water or quality equivalent.

The supplier shall supply the individual values for COD and BOD_5.

For products with chlorides, the supplier shall supply the content of total organic components (TOC). The content of TOC shall be determined on the basis of the test method in EN 1484 (modified: the presence of chloride requires an appropriate pre-treatment).

4.10 Water insoluble matter

The content of water insoluble matter shall be less than 0,3 weight % for liquid products and less than 0m5 weight % for solid products.

The matter insoluble in water shall be determined according to the test method described in C.4.

4.11 Kinematic viscosity

The supplier shall supply results of measurements of kinematic viscosity at −5 °C, +5 °C and +20 °C. Kinematic viscosity (in mm^2/second) expresses the ratio between dynamic viscosity and density.

The kinematic viscosity shall be determined in accordance with the test method in EN ISO 3104.

Solid and liquid de-icers with additives shall be tested with the recommended additive concentration for the application in winter service.

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4.12 Conductivity

The supplier shall supply results of measurements of electrical conductivity (in mS x cm^{-1}).

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The conductivity shall be determined in accordance with the test method in EN 27888.

The test is performed on liquid de-icers and concentrated aqueous solutions of solid de-icers (saturation at 20 °C). Additives for liquid and solid de-icers with additives shall be tested with the recommended additive concentration for the application in winter service.

4.13 Bulk density

The supplier shall supply the bulk density (loose) of solid products for information purposes.

The bulk density shall be determined in accordance with the test method in EN 1236.

4.14 Density

The supplier shall supply the density (at 20 °C) of liquid products for information purposes.

The density shall be determined in accordance with the test method in ISO 758 or in accordance with the test method in ISO 649-2.

4.15 Requirements for additives and mixtures

Organic and inorganic additives for liquid and solid de-icers which are intended for special properties like inhibition of corrosion, enhanced melting capacity or improved spreading pattern shall be additional tested with the recommended additive concentration in de-icers for the application in winter service.

Mixtures of chlorides of sodium, calcium, magnesium and potassium with organic and inorganic components (additives) have to apply to the chemical requirements and to the requirements for sieve analysis of sodium chloride in prEN 16811-1:2015 and to the chemical requirements and sieve analysis of calcium chloride and magnesium chloride in prEN 16811-2:2015.