SLOVENSKI STANDARD
SIST EN 17084:2019

01-marec-2019

Železniške naprave - Požarna zaščita v železniških vozilih - Preskušanje toksičnosti materialov in sestavnih delov

Railway applications - Fire protection in railway vehicles - Toxicity test of materials and components

Bahnanwendungen - Brandschutz in Schienenfahrzeugen - Prüfung der Toxizität von Materialien und Komponenten

Applications ferroviaires - Protection contre les incendies dans les véhicules ferroviaires - Essai de toxicité des matériaux et des composants

Ta slovenski standard je istoveten z: **EN 17084:2018**

ICS:

13.220.40	Sposobnost vžiga in obnašanje materialov in proizvodov pri gorenju	Ignitability and burning behaviour of materials and products
45.060.01	Železniška vozila na splošno	Railway rolling stock in general

SIST EN 17084:2019 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

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ICS 13.220.40; 45.060.01

English Version

Railway applications - Fire protection on railway vehicles - Toxicity test of materials and components

Applications ferroviaires - Protection contre les incendies dans les véhicules ferroviaires - Essai de toxicité des matériaux et des composants

Bahnanwendungen - Brandschutz in Schienenfahrzeugen - Prüfung der Toxizität von Materialien und Komponenten

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 17084:2018) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

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For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

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Introduction

This document has been developed with the aim to take over the content of EN 45545-2:2013+A1:2015, Annex C.

NOTE It is also based on the results of the European project TRANSFEU - Transport Fire Safety Engineering in the European Union - FP7 (Contract Number: 233786) [8], [9].

1 Scope

This document describes the measurement of the toxicity potential of the products of combustion based on two test methods:

— Method 1: EN ISO 5659-2 Smoke chamber area-based test with Fourier transform infrared spectroscopy (FTIR) gas analysis techniques;

— Method 2: NF X70-100-2 Tubular furnace small mass-based test.

NOTE 1 This document also specifies test equipment and set out the calculation procedures for evaluation of toxicity data.

NOTE 2 This document can be used in addition to others for the determination of toxic gases from devices installed in tunnel.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 45545-1, *Railway applications — Fire protection on railway vehicles — Part 1: General*

EN ISO 5659-2:2017, *Plastics — Smoke generation — Part 2: Determination of optical density by a single-chamber test (ISO 5659-2:2017)*

EN ISO 13943, *Fire safety — Vocabulary (ISO 13943)*

ISO 8421-1, *Fire protection — Vocabulary — Part 1: General terms and phenomena of fire*

ISO 12828-1, *Validation method for fire gas analysis — Part 1: Limits of detection and quantification*

ISO 12828-2, *Validation method for fire gas analysis — Part 2: Intralaboratory validation of quantification methods*

ISO 19701, *Methods for sampling and analysis of fire effluents*

ISO 19702:2015, *Guidance for sampling and analysis of toxic gases and vapours in fire effluents using Fourier Transform Infrared (FTIR) spectroscopy*

NF X70-100-1, *Fire tests — Analysis of gaseous effluents — Part 1: Methods for analysing gases stemming from thermal degradation*

NF X70-100-2, *Fire tests — Analysis of gaseous effluents — Part 2: Tubular furnace thermal degradation method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 13943, ISO 8421-1 and EN 45545-1 shall apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
***CIT*(n)**
conventional index of toxicity (dimensionless value) where *n* is the elapsed time since the start of testing in minutes

3.2
FEC
fractional effective concentration

Note 1 to entry: For full details see EN ISO 13943.

3.3
FED
fractional effective dose

Note 1 to entry: For full details see EN ISO 13943.

4 Principles

4.1 Product assessment for toxicity

4.1.1 General principles

Test specimens for a product used in a railway vehicle are heated to induce combustion under controlled conditions. The gases are analysed to determine the potential toxicity of the combustion products.

The product shall be tested in relation to the surface exposed in the real conditions of use. In the case where both surfaces are exposed and the product is not symmetrical, each surface shall be tested.

The specimens shall be representative of the product to be tested. They shall be cut, sawn, formed or printed from the same sample area of material and shall be the same thickness and density as in end use, as far as is practicable.

Covering materials shall be prepared to be as similar to end use conditions as practicable. The test specimen may include adhesives, varnishes, substrates and supports. Details of test specimen preparation shall be reported.

The conditions selected are representative of fires that may impact on the railway product during either the developing stages or the developed stage of a fire inside or outside the railway vehicle.

There are two methods detailed in this document that shall be used for determining the composition of gases generated by the combustion of specified railway products:

— Method 1: EN ISO 5659-2 Smoke chamber area-based test with Fourier transform infrared spectroscopy (*FTIR*) gas analysis techniques;

— Method 2: Tubular furnace NF X70-100-2 Small mass-based test.

The document, which specifies the reaction to fire performance requirements of the product, such as EN 45545-2, shall indicate which test method, test specifications and testing rules are to be used and results required.

CIT values shall be calculated in accordance with this document (see Clause 7).

In the case of Method 1, *FED* and *FEC* values should also be calculated (see Annex A).

4.1.2 Method 1: Smoke Chamber

This method is based on the exposure of a test specimen to radiant heat with or without application of a pilot flame.

The test apparatus for Method 1 is described in EN ISO 5659-2 with additional information provided in this document.

This method gives toxicity data which is processed according to Clause 7 for product evaluation and eventual classification purposes (which are outside the scope of this document).

NOTE The smoke density measurement can be made simultaneously as described in EN ISO 5659-2.

4.1.3 Method 2: Tube Furnace

This method is based on the exposure of small test specimens (mass of 1 g) to heat in a tube furnace. The test apparatus and procedures for Method 2 are described in NF X70-100-2 and ISO 19701, with additional information provided in this document.

This method gives toxicity data, which is processed according to Clause 7 for product evaluation and eventual classification purposes (which are outside the scope of this document).

4.2 Analysis of fire effluents

For the scope of this document, the following 8 gas components shall be analysed:

— CO_2, carbon dioxide;

— *CO*, carbon monoxide;

— *HF*, hydrogen fluoride;

— *HCl*, hydrogen chloride;

— *HBr*, hydrogen bromide;

— *HCN*, hydrogen cyanide;

— SO_2, sulfur dioxide;

— NO_x, oxides of nitrogen.

NOTE 1 NO_x includes NO_2 and NO quoted as NO_2.

The conventional index of toxicity, *CIT*, shall be calculated:

— CIT_G: Method 1, according to 7.2;

— CIT_{NLP}: Method 2, according to 7.3.

Values of *FED* and *FEC* should be calculated for Method 1 in accordance with Annex A.

NOTE 2 *FED* and *FEC* are calculated to allow comparative data to be accumulated in anticipation of a change from *CIT* to *FED* and *FEC*.

5 Method 1 – Smoke chamber

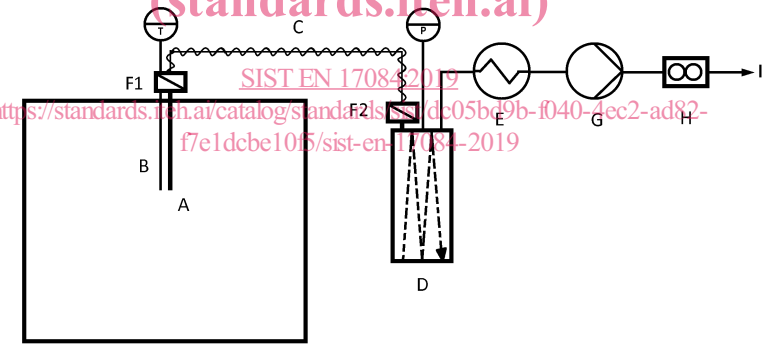
5.1 Gas sampling test apparatus

The test apparatus specified in EN ISO 5659-2 shall be used.

The gas sampling system shall conform to the general requirements set out in ISO 19702 and shall conform to the specific requirements set out in this document.

The gas sampling system shall consist of a sampling probe, a main filter, a gas sampling line, a secondary filter, a gas cell, a pressure transducer, an optional cooler, a pump and a flowmeter. The main filter shall be located directly after the probe. The gas analyser shall be located after the end of the sampling line and up-stream of the pump. An example of suitable sampling system is shown in Figure 1. Other arrangements are possible, if they respect key points of this document: flow rate conditions, main heated filter just after the smoke chamber and sampling probe, and a heated zone from outlet of the smoke density chamber to the outlet of the FTIR gas cell, no gas return system.

The smoke density chamber shall be equipped with a pressure transducer, which allows recording internal pressure $P_{chamber}$ as function of time.



Key

A	EN ISO 5659-2 smoke chamber and sampling probe	F2	secondary heated filter, see 5.1.4
B	thermocouple extremity, see 5.1.1	G	pump
C	heated sampling line, see 5.1.3	H	flowmeter
D	FTIR heated gas cell, see 5.1.5	I	to exhaust, at atmospheric pressure
E	gas cooler	P	pressure transducer
F1	3-way valve and main heated filter, see 5.1.2	T	thermocouple transducer

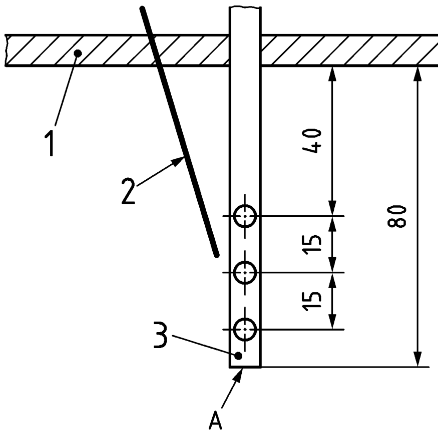
Figure 1 — Schematic of an example layout of sampling system

5.1.1 Sampling probe.

The internal probe shall be made from a 5 mm ± 0,1 mm internal diameter stainless steel tube with a closed end, as shown in Figure 2. It shall be fixed in the central point of the chamber roof and projected into the chamber by 80 mm from the chamber ceiling.

The probe shall have three 2 mm ± 0,1 mm diameter sampling holes, facing toward the rear of the chamber, as shown in Figure 2, positioned at 40 mm ± 0,5 mm, 55 mm ± 0,5 mm and 70 mm ± 0,5 mm measured from the internal ceiling of the chamber.

Dimensions in millimetres



Key

1 chamber ceiling

2 thermocouple

3 probe with three holes (2 mm diameter)

A closed end

Figure 2 — Internal probe

Close to the central hole on the internal probe, a shielded thermocouple (*K*-type, maximum diameter 2 mm) shall be placed at a distance of (8 ±2) mm from the hole, to measure the temperature of the gas being sampled.

The thermocouple shall be positioned to the side of the internal probe and on the side furthest from the radiative cone and/or the burning test specimen.

The temperature shall be recorded when the sampling has been made in order to calculate the mass concentration of gas species.

5.1.2 Main filter.

The FTIR cell shall be protected by a filter unit from contamination of soot and other solid particles that are often contained in fire effluents. The filter unit shall be such that the filter element can be changed. ISO 19702 describes characteristics of suitable filter units.

The main filter unit shall be placed between the chamber and the sampling line, immediately after the 3-way valve placed after the sampling probe (see F1 in Figure 1). The temperature of the filtering system shall be set to (180 ± 10) °C.

NOTE A filtering system constituted of a cylindrical PTFE cartridge of 30 mm diameter and 75 mm length with porosity of 2 µm inside a heated housing has been found suitable for the purpose of this analysis.

The use of PTFE is recommended as it is not reactive with fire effluents. Fibre glass is often inappropriate as it is known to react with HF, and ceramic wool is often inappropriate as it is known to absorb hydrogen halides even at high temperature.

5.1.3 Sampling line before gas cell.

The sampling line used between the main filter and the FTIR gas cell shall be made of a heated flexible PTFE tube. The sampling line shall have an inner diameter of (4,0 ± 0,2) mm and a maximum length of 3 m. Temperature of the sampling line shall be (180 ± 10) °C. The sampling line shall be manufactured so that the PTFE tube is able to be replaced as needed.

5.1.4 Secondary filter.

To increase the level of protection of internal mirrors, a secondary filter shall be placed just before FTIR gas cell. This secondary filter shall be heated to the same temperature as the sampling line and gas cell.

NOTE A small circular planar filter (47 mm diameter) using a 1 µm porosity PTFE membrane has been found suitable as secondary filter.

5.1.5 FTIR gas cell.

The gas cell used shall have a volume not greater than 0,5 l. Temperature of the gas cell shall be (180 ± 10) °C. Pressure shall be monitored and corrected, in order to maintain pressure conditions during the test identical to the calibration pressure with a maximum deviation of ± 1,33 kPa, as specified in ISO 19702.

The renewal of gas in the cell is at least 3 renewals per minute. The response time of the analysis, determined according to ISO 19702, shall be short enough to permit at least acquisition of 3 spectra per minute so that the interval between spectra is less or equal to 20 s. Other systems shall be allowed if they demonstrate the compliance with these performance requirements.

NOTE Gas cells with a volume from 0,2 l to 0,4 l and an optical path length from 2 m up to 5 m have been found suitable for the purposes of this document.

5.1.6 Conditioning of sampling flow and pump capacity.

The flow rate shall be maintained at (1,5 ± 0,1) l/min, using a flowmeter connected to an outlet at ambient pressure. The flow rate shall be maintained using a manual regulation valve or an automatic flow control system. The temperature of the gas entering in the flowmeter shall be less than 30 °C.

NOTE A gas cooler followed by a pump with a capacity of at least four times the inner volume of the gas cell plus gas sampling line per minute has been found suitable.

5.1.7 Sampling flow rate.

The sampling flow rate shall be maintained to (1,5 ± 0,1) l/min during the test.

NOTE Sampling flow rate of (1,5 ± 0,1) l/min has been found suitable for the following reasons [8]:

1) No influence has been found on smoke density measurement according to EN ISO 5659-2.

2) The volume drawn out of the chamber during 20 min is limited so as to avoid any under-pressure effects inside the Smoke Chamber.

5.1.8 FTIR Spectrometer.

The following FTIR spectrometer parameters are required for application of this document:

— an IR source stabilized at high intensity and temperature;

— a resolution better or equal to 4 cm^{-1} over a range between 600 cm^{-1} and 4 400 cm^{-1};