



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 42924.1-2023

**Plastics - Smoke generation - Determination of the corrosivity
of fire effluents - Part 1: General concepts and applicability**

Issued on: August 6, 2023

Implemented on: March 1, 2024

Issued by: SAMR; SAC

Table of Contents

Foreword	3
Introduction	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 Purpose	7

Introduction

Smoke corrosivity refers to the reduction in functionality of a material or product due to the corrosive effect of smoke. All fire effluents and thermal effects, including the heat released, are corrosive to a certain extent. Therefore, smoke corrosivity is one of the important factors when assessing the extent of fire damage and losses. However, there are many and complex factors that affect the degree of smoke corrosion damage, which may include the following aspects:

- combustion growth rate, which determines the concentration of the effluent;
- the volume into which the effluent diffuses;
- ventilation conditions of the box, including windows, smoke exhaust vents, and mechanical ventilation;
- the nature of the combustible materials involved in the fire;
- the nature and composition of the exposed surface;
- exposure time;
- conditions for pyrolysis (heat flow, oxygen) and conditions for combustion;
- specific environmental conditions (temperature and humidity) of the contact surface;
- effectiveness of active and passive fire protection, fire suppression, and smoke management systems.

At present, there is no smoke corrosivity determination method related to the plastic field in China, so it is necessary to develop it to provide technical support for subsequent related research work. GB/T 42924 aims to provide a method for determining the corrosivity of fire effluents of plastics and is intended to consist of two parts.

- Part 1: General concepts and applicability. The purpose is to provide guidance on the

applicability of the corrosivity test of fire effluents in GB/T 42924.4, introduce other existing test methods, and illustrate the differences between acidity, corrosivity, and toxicity.

- Part 4: Dynamic decomposition method using a conical radiant heater. The purpose is to provide users with a specific dynamic test method for the corrosivity of fire effluents.

NOTE: Two other methods, ISO 11907-2 and ISO 11907-3, were used in the past but are no longer used. The relevant international standards have been abolished.

Plastics - Smoke generation - Determination of the corrosivity of fire effluents - Part 1: General concepts and applicability

1 Scope

This document defines terms related to smoke corrosivity, smoke acidity, and smoke toxicity. It proposes a scenario-based approach to control smoke corrosivity. It describes the test methods for evaluating smoke corrosivity at laboratory scale. It discusses the applicability of the tests and post-exposure conditions.

This document applies to the determination of the corrosivity of smoke generated by combustion of materials.

2 Normative references

The following referenced documents are indispensable for the application 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.

GB/T 16172 Test method for heat release rate of building materials (GB/T 16172-2007, ISO 5660-1:2002, IDT)

ISO 13943 Fire safety - Vocabulary

3 Terms and definitions

For the purpose of this document, the terms and definitions defined in ISO 13943 and the following apply.

3.1 smoke corrosivity The extent to which the functionality of a material or product is reduced due to the corrosive effects of smoke.

3.2 smoke acidity - provide guidance on the applicability of fire effluent corrosivity tests in GB/T 42924.4;

- introduce other existing test methods;

- explain the differences between acidity, corrosivity, and toxicity.

The definitions in Clause 3 are provided to avoid confusion between smoke corrosivity, smoke acidity, and smoke toxicity. Acid gas emissions are sometimes used as an indirect assessment of smoke corrosivity. This is usually evaluated by dissolving a known amount of fire effluent in a known volume of water, and then testing the resulting solution for pH, conductivity, or acid concentration. However, smoke corrosivity is not exactly equivalent to the above values.

Smoke corrosiveness is related to the fire effluent and the conditions under which it propagates to the corrosion target. It is also affected by the exposure time and the length of placement time after exposure. Some fire effluents are alkaline, some are acidic, some are organic matter, and some are inorganic matter. Often, condensation of water is a factor that enhances corrosivity. The method specified in GB/T 42924.4 improves the technology for evaluating the corrosivity of combustion materials.

Smoke acidity is related to the change in pH value of a certain volume of liquid after exposure to the fire effluent. The acidity of smoke-forming liquids during combustion is related to the released amount of acid gases (usually hydrogen chloride, hydrogen bromide and hydrogen fluoride) and organic acids (such as acetic acid or formic acid).

GB/T 17650.2 describes the method for determining the smoke acidity by measuring the pH value or conductivity of an aqueous solution of combustion products. Usually about 1 g of material is decomposed in a tube furnace at a temperature of 750 degrees C ~ 950 degrees C, while air is introduced, and the flue gas generated by combustion is collected through a cleaning bottle filled with deionized water, and then its pH value and conductivity are analyzed.

GB/T 17650.1 describes the methods for measuring halogen content in combustion products. This method is commonly used for cable materials. A sample with a mass of approximately 0.5 g ~ 1 g is heated in a tube furnace (usually 800 °C). The decomposed gases are collected and processed through a cleaning bottle containing aqueous sodium hydroxide solution to absorb all acidic gases. Then use traditional wet chemical methods (see ISO 19701) to determine the contents of chloride ions, bromide ions, and fluoride ions. Results are generally expressed in HCl equivalents.

The toxicity and corrosivity of fire effluents are entirely different. Toxicity refers to adverse effects on living organisms, while corrosivity refers to damage to equipment, usually caused by damage to metal parts.

NOTE: GB/T 38310 and ISO 13571 give useful information on the toxicity of fire effluents.

products is expressed as a function of the increase in resistance of the corrosion target within 1 h of exposure to combustion products.

NOTE: The static test method of ISO 11907-2 has been abolished.

6.3 Dynamic decomposition method

6.3.1 General The dynamic decomposition method is that the sample is burned in an air flow, and the air flow transports the combustion products to the corrosion target location.

These methods do not limit test scale and may therefore be suitable for testing certain industrial products.

Control variables for these methods include combustion temperature, combustion time, effluent flow rate, and effluent air dilution ratio. The temperature and relative humidity of the test environment and the temperature of the corrosion target are not conditions that need to be controlled. This means that during dynamic test, unless post-combustion exposures are performed in a separate combustion chamber, corrosion patterns (with or without condensation) are generally not precisely controlled.

The method described in ISO 11907-3 and the method described in GB/T 42924.4 are dynamic test methods.

NOTE: This method of ISO 11907-3 has been abolished.

6.3.2 GB/T 42924.4 In this test, after testing according to GB/T 16172, some of the decomposed or burned products are taken from the top of the conical radiant heater and continuously passed through a 11.2 L exposure chamber at a rate of 4.5 L/min. The average residence time of the combustion products in the exposure chamber is about 150 s. Expose the corrosion target to the corrosion products for 1 h, and then expose the corrosion target to a controlled relative humidity and temperature environment in a separate chamber for 24 h. Monitor the increase in resistance of the corrosion target, and calculate the decrease in metal thickness on the corrosion target based on the increase in resistance.

NOTE: This test method is similar to ASTM D5485.

6.3.3 IEC/TS 60695-5-3 This method is described in GB/T 5169.36. This method is used to measure electric leakage and metal corrosion damage. The sample is decomposed in a quartz glass tube (see GB/T 17650.1), and the fire effluent is sent into the collection chamber where the corrosion target is located. A variety of different corrosion damage assessment indicators are used, and electric leakage assessment is performed using specified corrosion targets. The placement after exposure is performed under the condition of increased relative humidity.

NOTE: This method of IEC/TS 60695-5-3 has been abolished.

7 Applicability of test results Corrosion damage caused by fire effluents can be extrapolated from one fire scenario to another. Before any extrapolation can be made to actual scale fires, the results of the corrosion tests need to be carefully analyzed.

The test procedure shall be designed so that the test results can be applied to actual corrosion damage analysis and used as part of the overall fire hazard analysis. To ensure