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

GB/T 43316.4-2023

**Plastics - Determination of resistance to environmental stress
cracking (ESC) - Part 4: Ball or pin impression method**

塑料 耐环境应力开裂(ESC)的测定 第4部分:球压或针压法

(English Translation)

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Table of Contents

- Foreword
- Introduction
- 1 Scope
- 2 Normative reference documents
- 3 Terms and definitions

Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents" Drafting:

This document is Part 4 of GB/T 43316 "Determination of Environmental Stress Crack Resistance (ESC) of Plastics": GB/T 43316 has been released the following sections are included:

- Part 1: General principles;
- Part 2: Constant tensile load method;
- Part 3: Bending method;
- Part 4: Ball pressure or acupressure method;
- Part 5: Constant tensile deformation method;
- Part 6: Slow strain rate method:

This document is modified to adopt ISO 22088-4:2006 "Determination of environmental stress cracking (ESC) resistance of plastics - Part 4: Ball pressure or needle pressure Law":

Compared with ISO 22088-4:2006, this document has made the following structural adjustments:

- 5:6:2 corresponds to 5:6:1 in ISO 22088-4:2006, and the following chapter numbers are postponed;
- 6:1:1 corresponds to 6:1 in ISO 22088-4:2006, and the following chapter numbers are postponed:

The technical differences between this document and ISO 22088-4:2006 and their reasons are as follows:

- Change the accuracy from 0:005mm to 0:001mm (see 5.4) to adapt to my country's

technical conditions;

---Replaced ISO 3290 (see 5.6:2) with normatively cited GB/T 308.1, and GB/T 9341 replaced ISO 178 (see 5.11, 6:1:3), GB/T 1040.2 replaced ISO 527-2 (see 5.11, 6:1:3), GB/T 1040.1 replaced ISO 527-1 (See 6.1:3), GB/T 9352 replaces ISO 293 (see 6.1:3), GB/T 11997 replaces ISO 3167 (see 6.1:3), GB/T 39812-2021 replaces ISO 2818 (see 6.1:3), GB/T 17037.1-2019 replaces ISO 294-1 (see 6.1:3, 6:2) to adapt to my country's technical conditions and increase operability;

---Added stopwatch requirements (see 5.10) to improve test accuracy;

---Deleted "Determine the shrinkage level of the specimen in accordance with ISO 2557-1" (see 6.2), ISO 2557-1 has been abolished, and there are no other standards substitute;

---Added the requirement for re-drilling (see 8.2:4) to facilitate the use of this document;

---8.2.3 The middle note is changed to the main text content to adapt to my country's technical conditions:

The following editorial changes have been made to this document:

---Deleted the note in Chapter 1;

---Deleted ISO 291 that was not cited in ISO 22088-4:2006;

---Deleted the note in 8.2:2;

---Reference removed:

Please note that some content in this document may be subject to patents: The publisher of this document assumes no responsibility for identifying patents:

Introduction

When plastics are subjected to effects below their yield stress in the air, external or internal stresses, or the combined effect of both stresses can cause Cracking occurs, and this type of cracking is often accelerated by the chemical environment in which the plastic is located: This phenomenon is called environmental stress cracking (ESC): Bag ESC failure can occur in many materials, including plastics, which can significantly reduce the stress or strain that allows the material to be used for long periods of time:

The ESC process is as follows:

- 1) After applying stress, microscopic holes are formed in the sample due to stress concentration;
- 2) The action of the chemical environment causes the rupture of intermolecular bonds, causing the formation and expansion of larger pores, thereby forming interconnected pores: Silver streaks composed of holes and microfiber structures;

3) Under the combined action of stress and chemical environment, the microfiber structure breaks and silver streaks grow;

4) Cracks appear at the tip of the craze and continue to develop, eventually leading to brittle failure:

Cracks may continue to develop along the thickness of the material until the material breaks into two or more fragments; cracks may also develop when low stress is reached:

forces, different materials, and/or different morphological regions:

The ESC test is relatively complex and is affected by the following parameters:

- Sample size;
- Sample state (orientation, microstructure, internal stress);
- Sample preparation method;
- Thermal history of the specimen;
- Stress and strain;
- Test temperature;
- Test duration;
- Chemical environment;
- Methods for applying stress and strain;
- Failure criterion:

By using one parameter as a variable and keeping other parameters unchanged, the impact of variable parameters on ESC can be evaluated: The main purpose of the ESC test the purpose is to determine the relative impact of the test medium on the plastics (specimens and articles) exposed to it:

When the failure modes are consistent with those obtained in actual use, these test results can be used to evaluate the impact of molding conditions on the system:

impact on product quality:

Since the influencing factors of product ESC performance in actual applications are more complex, the sample ESC test results and actual product performance are established:

Direct correlation is very difficult:

The ball intrusion and needle intrusion methods are quick and sensitive methods to evaluate the ESC properties of plastics: Due to the different preparation methods of the samples, the surface properties of the plastics may vary:

The directional state is directional: While chemical corrosion only occurs on the outer

surface of plastic, the needle intrusion method is comparable to other methods in this series of documents:

ratio, it is less affected by the near-surface orientation of the sample:

GB/T 43316 "Determination of Environmental Stress Crack Resistance (ESC) of Plastics" aims to specify the environmental stress cracking resistance of thermoplastic plastics:

The general principles and description of its determination methods are intended to be composed of six parts:

---Part 1: General principles: The purpose is to establish general principles for determining the resistance of plastics to environmental stress cracking:

---Part 2: Constant tensile load method: The purpose is to establish the resistance of thermoplastics to a constant tensile load in a test medium:

An operational, traceable, and verifiable determination procedure for environmental stress cracking:

---Part 3: Bending method: The purpose is to establish thermoplastics capable of withstanding fixed bending strains in the presence of test agents:

An operational, traceable, and verifiable determination procedure for environmental stress cracking resistance:

---Part 4: Ball pressure or acupressure: The purpose is to establish a thermoplastic ring that can withstand constant strain when a ball or needle is pressed into it:

Operable, traceable, and verifiable measurement procedures for environmental stress cracking:

---Part 5: Constant tensile deformation method: The purpose is to establish a test medium for thermoplastics when subjected to constant tensile deformation:

Operable, traceable, and verifiable measurement procedures for environmental stress cracking resistance:

---Part 6: Slow strain rate method: The purpose is to establish for thermoplastics slowly increasing the sample at a constant rate in the test medium:

An operational, traceable, and verifiable procedure for determining environmental stress cracking resistance under strain conditions:

Part 4 and other parts of this series of standards support each other and together constitute the standard for determining the environmental stress cracking resistance of plastics system:

The above tests for environmental stress cracking (ESC) resistance are essentially rating tests and are not intended to provide information for design or performance prediction: