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**Polimerni materiali - Zaporne folije za razkuževanje kmetijske in vrtnarske zemlje z zaplinjevanjem - 1. del: Specifikacije za zaporne folije**

Plastics - Barrier films for agricultural and horticultural soil disinfection by fumigation - Part 1: Specifications for barrier films

Kunststoffe - Sperrschichtfolien zur Desinfektion durch Begasung von Landwirtschafts- und Gartenbauböden - Teil 1: Spezifikationen für Sperrschichtfolien

Plastiques - Films barrière pour la désinfection par fumigation des sols agricoles et horticoles - Partie 1 : Spécifications des films barrière

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**Ta slovenski standard je istoveten z: EN 17098-1:2018**

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**ICS:**

65.060.99	Drugi kmetijski stroji in oprema	Other agricultural machines and equipment
83.140.10	Filmi in folije	Films and sheets

**SIST EN 17098-1:2018****en,fr,de**

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EUROPEAN STANDARD

**EN 17098-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM

January 2018

ICS 83.140.10

English Version

## Plastics - Barrier films for agricultural and horticultural soil disinfection by fumigation - Part 1: Specifications for barrier films

Plastiques - Films barrière pour la désinfection par fumigation des sols agricoles et horticoles - Partie 1: Spécifications des films barrière

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This European Standard was approved by CEN on 20 November 2017.

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**EN 17098-1:2018 (E)****European foreword**

This document (EN 17098-1:2018) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by July 2018, and conflicting national standards shall be withdrawn at the latest by July 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN not be held responsible for identifying any or all such patent rights.

EN 17098, *Plastics — Barrier films for agricultural and horticultural soil disinfection by fumigation*, consists of the following parts:

- *Part 1: Specifications for barrier films*
- *Part 2: Method for determining film permeability using a static technique*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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## Introduction

Use of barrier films designed for agricultural and horticultural soil disinfection by means of fumigation has the main objectives of protecting operators and personnel during and after the fumigation operation, limiting the consumption of harmful substances and safeguarding the environment.

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**EN 17098-1:2018 (E)****1 Scope**

This document specifies the requirements relating to the dimensional, mechanical and physical-chemical characteristics of thermoplastic barrier films designed for agricultural and horticultural soil disinfection by means of fumigation.

This document specifies also the test methods for verifying these requirements, except the method for determining film permeability using a static technique, which is specified in EN 17098-2.

This document defines also guidance for installation, use and disposal of barrier films.

This document is applicable to films used during soil disinfection by fumigation (class 1), and to films used during soil disinfection subsequently kept *in situ* as mulch films (class 2).

On the date of publication of this document, the barrier films are multi-layer films.

**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 16472, *Plastics - Method for artificial accelerated photoageing using medium pressure mercury vapour lamps*

EN 17098-2, *Plastics — Barrier films for agricultural and horticultural soil disinfection by fumigation — Part 2: Method for determining film permeability using a static technique*

EN ISO 291, *Plastics - Standard atmospheres for conditioning and testing (ISO 291)*

EN ISO 527-1, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1)*

EN ISO 527-3, *Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets (ISO 527-3)*

EN ISO 4892-1, *Plastics - Methods of exposure to laboratory light sources - Part 1: General guidance (ISO 4892-1)*

EN ISO 4892-2:2013, *Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 4892-2:2013)*

EN ISO 4892-3:2016, *Plastics - Methods of exposure to laboratory light sources - Part 3: Fluorescent UV lamps (ISO 4892-3:2016)*

EN ISO 7765-1:2004, *Plastics film and sheeting - Determination of impact resistance by the free-falling dart method - Part 1: Staircase methods (ISO 7765-1:1988)*

ISO 4592, *Plastics — Film and sheeting — Determination of length and width*

ISO 4593, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning*

**3 Terms and definitions, and abbreviated terms****3.1 Terms and definitions**

For the purposes of this document, the following terms and definitions 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>

### 3.1.1

#### **barrier film**

plastic film designed to have low permeability to gas, intended for soil disinfection by fumigation

### 3.1.2

#### **permeability**

ability of a material to transmit gases and liquids by passage through one surface and out at another surface by diffusion and sorption processes

[SOURCE: EN ISO 472:2013 [1], definition 2.690]

### 3.1.3

#### **width**

total film width once laid flat

Note 1 to entry: It is expressed in millimetres (mm).

### 3.1.4

#### **nominal width**

film width, as declared by the manufacturer/supplier

Note 1 to entry: It is expressed in millimetres (mm).

### 3.1.5

#### **nominal thickness**

film thickness, as declared by the manufacturer/supplier

Note 1 to entry: It is expressed in micrometres ( $\mu\text{m}$ ).

### 3.1.6

#### **roll length**

longest dimension of the film, corresponding to the length of the un-winded roll

Note 1 to entry: It is expressed in metres (m).

### 3.1.7

#### **nominal roll length**

roll length, as declared by the manufacturer/supplier

Note 1 to entry: It is expressed in metres (m).

### 3.1.8

#### **longitudinal direction**

##### **MD**

direction parallel to the roll length corresponding to the extrusion direction

### 3.1.9

#### **transverse direction**

##### **TD**

direction parallel to the film width (at right angle to the length)

**EN 17098-1:2018 (E)****3.2 Abbreviated terms**

For the purposes of this document, the following abbreviated terms apply.

EVOH	ethylene-(vinyl alcohol) plastic
PA	polyamide
PE	polyethylene
TIF	totally impermeable film
VIF	virtually impermeable film

**4 Classification of films by service life**

Barrier films are classified under two classes, depending on their service life:

- Class 1: films providing a protective function only. They are held in place during the fumigation operation and then withdrawn before planting.
- Class 2: films providing protection and mulch functions. They are held in place during the fumigation operation, and then kept in place as mulch films.

**5 Permeability to fumigants****5.1 General**

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CEN/TC 249/WG 7 conducted a synthesis of the published studies about film permeability to the fumigants. These studies were all carried out in the USA with major films on the market, described as:

- PE films made from polyethylene (PE) materials, exclusively;

NOTE In these studies, PE films were used as blank films and they are not in the scope of this document.

- virtually impermeable films (VIFs) containing polyamide (PA) materials as barrier layer;
- totally impermeable films (TIFs) containing ethylene-(vinyl alcohol) plastic (EVOH) materials as barrier layer.

The key criteria in these studies were the following:

- the influence of the temperature;
- the influence of the relative humidity;
- the influence of the fumigant.

Taking into account the results of these studies, the conclusions of the CEN/TC 249/WG 7 were the following:

- the film permeability increases with the temperature (from 20 °C to 35 °C) for every film and every tested fumigant but without a highly significant difference. The most common temperature, 25 °C, is therefore considered to be acceptable and has been selected as the standard test temperature (see Conditions 1 and 2 in 5.2);
- the film permeability increases with the relative humidity (from 35 % to 100 %) for every film and every tested fumigants with highly significant differences particularly for VIFs. The relative

humidity in the range of 90 % RH to 100 % RH is the worst case. This range of relative humidity, similar to that measured *in situ* in drip applications, has been selected as the standard relative humidity (see Condition 1 in 5.2).

Considering that fumigant could be applied also by shank application without water a second standard relative humidity of  $(50 \pm 10)$  % RH has been considered as acceptable for films to be used exclusively in shank application without water (see Condition 2 in 5.2);

- f) the film permeability varies significantly depending on the fumigants. In these conditions the choice of a fumigant for the test is under the responsibility of the applicant and the film permeability threshold remains under the responsibility of the holder of the authorization for placing the fumigant on the market.

Information related to the influence of temperature and relative humidity on the film permeability to soil fumigants is given in the bibliography [14] to [18].

## 5.2 Determination of the film permeability

The permeability of the film to fumigant(s) shall be determined according to EN 17098-2.

Unless otherwise specified, the permeability of the film to fumigant(s) shall be determined in at least one of the following test conditions in the transmission cell:

- Condition 1: Test temperature:  $(25 \pm 2)$  °C and  $(95 \pm 5)$  % RH;

NOTE 1 Condition 1 is corresponding to environment conditions with the addition of water (e.g. in drip application).

- Condition 2: Test temperature:  $(25 \pm 2)$  °C and  $(50 \pm 10)$  % RH.

NOTE 2 Condition 2 is corresponding to environment conditions without the addition of water (e.g. in shank application).

Condition 2 shall be used only for shank application.

NOTE 3 Even by injection of the fumigant by means of coulters without the addition of water, quickly the humidity of soil condensates under the film which causes formation of droplets.

When the performance of a film to fumigant permeation is declared, the test conditions (Condition 1 or condition 2 or both) and the type(s) of fumigant(s) shall be declared as well.

Studies are in progress to define the maximum threshold(s) depending on the type and approval threshold(s) of the fumigant(s) set by the regulation.

## 6 Requirements

### 6.1 General requirements

When tested in accordance with the test methods specified in Table 1, the barrier film shall have the characteristics conforming to the requirements stated in Table 1.

Table 1 — Requirements for barrier films

Characteristics	Unit	Requirements		Test method
		Class 1	Class 2	
<b>Appearance</b>		Shall conform to 6.2		6.2
<b>Dimensional characteristics</b>				
Tolerance of average thickness/nominal thickness	%	±5	±5	7.1
Tolerance of single point thickness/nominal thickness	%	- 15, + 25	- 15, + 25	7.1
Width tolerance/nominal width	%	±2	±2	7.2
Tolerance roll length/nominal length	%	-1	-1	7.3
<b>Mechanical characteristics on unexposed film</b>				
Tensile stress at yield point (MD and TD)	MPa	No requirement	≥ 9,5	7.4
Tensile stress at break (MD, TD)	MPa	≥ 25	≥ 25	7.4
Tensile strain at break (MD, TD)	%	≥ 350	≥ 350	7.4
Weathering resistance	<b>STANDARD PREVIEW</b>			
Exposure time (xenon arc lamps) <sup>a</sup>	h	No requirement	≥ 1 510 <sup>b</sup>	7.5
Peel strength <sup>c</sup> (per 15 mm specimen width)	N	≥ 6	≥ 6	7.6
Impact resistance	<b>STANDARD PREVIEW</b>			
On flatwise film	g	100	100	7.7
On folds (if any)	g	50	d	
<b>Optical characteristic on unexposed film</b>				
Relative light transmission $I_R$ (only for opaque black films)	—	No requirement	≤ 10 <sup>-2</sup>	7.8

<sup>a</sup> Other light sources may be used provided that a correlation between the test results obtained with these light sources and these obtained after a natural exposure can be demonstrated. Details of these methods are given in Annex A (informative). In case of dispute, the exposure to xenon-arc lamps according to 7.5 shall be used.

<sup>b</sup> For black coloured films, weather resistance corresponds to an exposure of one year after being installed in a climatic zone corresponding to a global solar radiant exposure of 4,2 GJ/m<sup>2</sup>/year to 5,4 GJ/m<sup>2</sup>/year (100 kLy/year to 130 kLy/year) (data from EN 13655 [2]). For films intended to be exposed during longer durations and/or in more severe conditions, the minimum duration of exposure to artificial weathering shall be defined by agreement between the manufacturer/supplier and the customer.

<sup>c</sup> The peel strength may also be determined by a peel test according to EN ISO 2411 [3], subject to an agreement between the parties. The corresponding requirement shall also be defined by agreement between the parties.

<sup>d</sup> Class 2 barrier films are generally supplied without folds.

For barrier films to be joined together by gluing *in situ*, the method to assess bondability and the corresponding requirement shall be defined by agreement between the parties.