IEC 60721-2-7

Edition 2.0 2018-03

INTERNATIONAL STANDARD

Classification of environmental conditions – Part 2-7: Environmental conditions appearing in nature – Fauna and flora

IEC 60721-2-7:2018-03(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC 60721-2-7

Edition 2.0 2018-03

INTERNATIONAL STANDARD

Classification of environmental conditions – Part 2-7: Environmental conditions appearing in nature – Fauna and flora

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 19.040

ISBN 978-2-8322-5483-7

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 2-7: Environmental conditions appearing in nature – Fauna and flora

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60721-2-7 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

This second edition cancels and replaces the first edition published in 1987. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) This edition has been entirely rewritten.

The text of this International Standard is based on the following documents:

CDV	Report on voting
104/741/CDV	104/792/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60721 series, published under the general title *Classification of environmental conditions,* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 2-7: Environmental conditions appearing in nature – Fauna and flora

1 Scope

This document addresses the occurrence of fauna and flora, including its main effects on electrotechnical products. Exposure and damage from the effects of fauna and flora can occur at almost any time in a product's life cycle. Moreover, there are many agents of attack with various actions.

This document addresses the occurrence and damage arising from fauna and flora in all locations a product can be stored, transported or used. Generally, fauna can be present and cause damage to products in both the natural environments experienced in open-air locations as well as in artificially created environments, such as in a warehouse or building. However, flora will predominantly be present and cause damage to products only in open-air locations. Fungus and bacteria can be present in both open-air locations as well as in warehouses or buildings.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 General

The main attacking agents considered in this document are micro-organisms including fungi, bacteria, as well as insects, rodents, algae and marine organisms. Hazards due to other agents are considered to be of lesser importance and have been omitted. These include the corrosive action of juices secreted by some plants, the mechanical action due to the growth of the larger trees, which may be sufficiently great to destroy the foundations of a building or to break cables, and the damage caused by animals such as monkeys and elephants. Birds in flight can be a hazard to aircraft, and in the region of bird colonies, widespread droppings can create corrosion problems. In addition, some agents which are mentioned have other modes of action which have not been included; for example both rodents and insects are occasionally responsible for chemical corrosion or soiling.

The frequency of occurrence of fauna and flora with a possibility of damaging products very much depends on conditions of temperature and humidity. In geographical areas with warm damp climates, fauna and flora, especially insects and micro-organisms such as mould and bacteria, will find favourable conditions of life. Moreover, humid or wet rooms in buildings, or rooms for processes producing humidity, are suitable living spaces for rodents, insects and micro-organisms.

Fauna and flora can affect products in various ways, the most important of which are given in the following examples.

a) Deterioration by physical attack: The functioning of products may be affected by physical attacks of fauna and flora. The materials of a product may be attacked by fauna, particularly by rodents and insects, by the actions of feeding from material, gnawing at material, eating into material, chewing material or cutting holes into material. The severe damage arising from the physical attack by termites is especially emphasized in this respect. Among materials susceptible to attack are natural materials such as wood, paper, leather, textiles, but also plastic materials, including elastomers and even some metals such as tin and lead.

b) Deterioration by deposits: The functioning of products may be affected by deposits originating from fauna and flora. These surface deposits affect the products by chemical and mechanical reactions. Deposits from fauna, especially from insects, rodents, birds, etc., may consist of elements such as the presence of the animal itself, the building of nests or settlements, feed stock as well as the metabolic products such as excrements, enzymes. Deposits from all kinds of flora may consist of material such as detached parts of plants (leaves, blossom, seeds, fruits, etc.), growth layers of cultures of moulds or bacteria and effects of their metabolic products.

5 Occurrence of fauna and flora

5.1 Fungi

5.1.1 Background

The name fungus is used to denote members of a large heterogeneous group of organisms, of which there are about a hundred thousand known species. Most fungi are so small that they can be observed only with the aid of a microscope. The terms 'mould' and 'mildew', although not exactly defined in the biological sense, are used by both biologists and laymen to refer to small non-parasitic fungi, such as those which do not live on other living organisms.

A fungus can, in general, be divided into two parts: the vegetative and the reproductive. The vegetative part, known as the hypha, is essentially a threadlike filament normally having a diameter between 2 µm and 20 µm and may be several centimetres long. In the simplest fungi the hyphae are merely continuous tubes of living matter; in others they are divided by cell walls, called septa, into separate cells. Collectively the hyphae are referred to as the mycelium. The mycelium, together with the reproductive spores, is commonly observed on mouldy bread, shoes, oranges, etc.

In the vast majority of cases the unit of reproduction is the spore. Normally it is unicellular and microscopic, though occasionally, giants 500 µm in length occur. They may be produced directly via the hyphae or from a structure created for this specific purpose, as in the mushroom. From a functional viewpoint spores may be divided into two classes each of which may be produced by the same organism: those which can be produced rapidly and in large numbers but have little resistance to adverse environmental factors, and those which are comparatively few in number but much more resistant to adverse conditions. The former enable the fungus to spread rapidly during good growing conditions and the latter enable it to survive hard times such as winter or drought and have been known to survive for many years in a dry condition.

5.1.2 Growth and survival factors

In order to adapt themselves to changes in their environment or food supply, most species of fungi can slightly change their characteristics and needs over several generations. This may be a very short time; in many cases the whole cycle from spore to spore can be completed in a few days. In addition, it should be noted that the conditions required for the production and dispersal of spores are generally more exacting than those for growth and survival.

The precise minimum, maximum and optimum temperatures for growth appear to be a matter of debate between the various authorities. This may be because these values vary from one species to another. However, in general, the minimum is 2 °C to 5 °C, the maximum 40 °C to 50 °C and the optimum 22 °C to 27 °C. In addition, there are a few fungi that can grow at and below 0 °C, and one species has been reported growing at a maximum of 62 °C. They are, of course, capable of surviving even greater extremes in a quiescent state.

The optimum humidity for the growth of nearly all moulds is a relative humidity of 95 % to 100 %. If submerged in water, however, most fungi will not grow. Any reduction from this optimum will mean a reduced growth rate and few species will grow in a relative humidity of less than 70 %. Optimum growth conditions also occur in still air.

A suitable source of carbon that can be absorbed as food is essential to fungi for their growth. Almost all naturally occurring carbon containing compounds, together with many synthetic organic compounds of a similar structure can be used by fungi as a source of food. All fungi can utilize an organic supply of nitrogen and a few can also use an inorganic source such as ammonia. Nitrogen, other than as a gas, is essential for the growth of fungi.

Most fungi are strictly aerobic, that is they cannot grow in complete absence of free oxygen. In the small number of cases where fungi grow in water, they always do so in a few centimetres near the surface.

Other elements required for the growth of fungi include sulfur (as sulfate), potassium, phosphorus (as phosphate) and magnesium. In some cases minute traces of iron, zinc, manganese, molybdenum, or calcium are required, though in such small quantities that only in a few fungi is there a clear picture of these requirements. Some fungi also require a supply of certain vitamins for growth.

Ultra-violet is known to inhibit the growth of most fungi, although daylight normally has no effect. In a very few instances daylight can influence growth and indeed can cause it to increase. However, the production and dispersal of spores is dependent upon the presence of light for many species.

Most fungi grow best in a slightly acid medium within the range pH 5 to pH 6,5. This varies from one species to another, but few will grow at all below pH 3 or above pH 9.

5.1.3 Habitat and geographical distribution

Since fungi can survive adverse growth conditions in a quiescent state and can gradually evolve to survive more extreme conditions, and since new species are still being identified, it is not possible to define exactly the geographical areas in which fungi will grow. There are, however, certain tendencies which are relevant.

Fungi of one sort or another are found in the soil, water and air over a large part of the earth's surface, whilst others live on or upon both living and dead animals and plants. Those found in the air do not grow there, but are in the form of spores. Most live in the soil and only about 2 % live in water; in both cases they grow in the few centimetres just below the surface.

The best conditions for most types of mould growth are in humid tropical areas, although deterioration due to mould is not confined to the tropics. Equally serious damage can occur in temperate regions, though not so rapidly, and at least one species of mould is often found in the form of spores in the air over arctic regions.

Conditions favourable for mould growth may easily be created artificially inside a building or equipment. Those which are parasitic upon particular animals or plants are among the few which are restricted to geographical regions.

The map in Figure 1 shows areas in which climatic conditions are most favourable for fungal corrosion. It is based on an analysis of relative humidity and temperature data from approximately two thousand meteorological stations throughout the world, as follows:

a) Region A – includes areas with at least one month a year in which the mean monthly relative humidity is from 70 % to 75 % in the hours from 12:00 h (noon) to 14:00 h, and with a mean monthly minimum temperature at the same time of not less than 15 °C.

b) Region B – includes areas where the equivalent relative humidity is from 75 % to 80 %, again with the same temperature as Region A.

c) Region C – includes areas where the equivalent relative humidity is greater than 80 %, again with the same temperature as Region A.

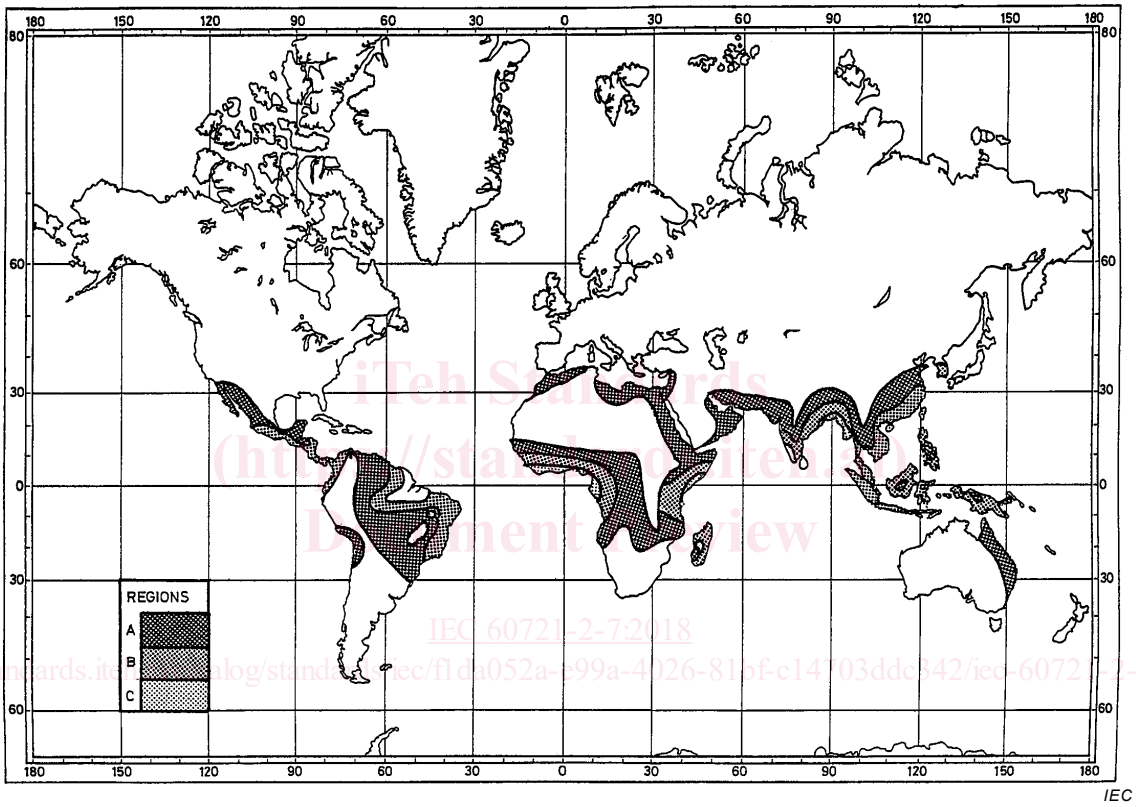

Figure 1 – Map of regions with different degrees of fungal corrosion

It should be noted that the above climatic conditions do not take account of other naturally occurring factors mentioned earlier, such as air flow. It also does not cover cases where favourable conditions may be artificially induced, inside buildings or containers for example. Nevertheless, within these limits, it does provide a useful indication of the natural liability to attack by micro-organisms.

5.1.4 Effects of fungi on materials

Unlike most plants, fungi contain no chlorophyll, the green colouring matter with which plants utilize the sun's energy to manufacture their food from absorbed raw materials. Thus they have to rely on the food in the substratum on which they grow. However, the structure of the cell walls only allows them to absorb this food if it is in solution. To achieve this, the fungi secrete enzymes via their hyphae. This substance converts the food into a soluble form which can then be readily absorbed.

There are three ways in which fungi may cause damage. Each can occur independently, or in association with one or both of the others: