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TECHNICAL REPORT

Guidance on fungus resistance of optical fibre cables

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colour inside

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IEC TR 63484 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
86A/2485/DTR	86A/2489/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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GUIDANCE ON FUNGUS RESISTANCE OF OPTICAL FIBRE CABLES

1 Scope

This document provides information about fungal growth on the outer sheath of optical fibre cables and on the inner components of the cable. It also provides guidance for specifying fungus resistance performance of optical cable outer sheath and internal cable components, including recommendations for fungus resistance test method as well as evaluation after test.

This document applies to optical fibre cables for use with telecommunication equipment and devices employing similar techniques, and to hybrid telecommunication cables having a combination of both optical fibres and electrical conductors.

Since conditions suitable for fungal growth include high relative humidity and a warm atmosphere, the document is applicable to optical cables intended for transportation, storage and use under such environment over certain period, for instance, some days at least.

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 terminology databases for use in standardization at the following addresses:

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

4 Mechanisms of fungal infection and growth

4.1 Mechanisms of fungal infection

Fungi grow in or on many types of common materials. They propagate by producing spores. These spores are very small (1 µm to 10 µm) and easily carried in moving air. They also adhere to dust particles and various surfaces.

Thus, the cable surface and the cable end into which air penetrates can be infected with spores. The infection can also occur during handling, for example, spores can be transferred by touch.

4.2 Environmental conditions for fungal growth

There are various factors which affect the germination and growth of spores. But the key factors are shown as follows:

a) Moisture

Adequate moisture is necessary for spore growth and propagation. 65 % humidity is the threshold for fungal growth, whereas explosive growth occurs in excess of 90 %.

Fungal spores can survive for an extended period of time in a state of hibernation when humidity levels are below 65 %. Once adequate moisture becomes available, these spores will activate and start growing.

Water-absorption products on cable surfaces will accelerate fungal spore growth. These materials will absorb water from the atmosphere and fungi can access that water for metabolic use.

b) Temperature

Most fungi require temperatures between 10 °C to 35 °C, with some exceptions based on fungal species. Within this range, the closer to 35 °C, more growth will occur. Almost no fungi types grow below 0 °C or above 40 °C.

Fungal spores do not die when exposed to extreme temperatures, rather they go into a hibernation state. Once temperatures return to a suitable level, they will activate and start growing again.

c) Nutrient

Fungi require certain essential nutrients for growth including nitrogen, potassium, phosphorus, and sulphur, amongst others from a nutrient base for energy. Generally, nutrients can include inorganic salts and a carbon source. Basic plastic resins do not typically serve as carbon sources for fungal growth, but other components such as plasticizers, stabilizers, colorants, lubricants, and cellulosics can be responsible for fungal attack.

d) Airflow

Airflow also has an effect on the rate of fungal growth. High airflow can limit the growth and propagation of fungi. Stagnant air spaces and lack of ventilation can encourage fungal growth. In vacuum conditions, fungi cannot grow.

In addition, pH value, sunlight, surface roughness, interaction of organisms, exposure time and so on can affect fungal growth as well.

5 Effects of fungal growth on optical cable

5.1 General

Organic materials are commonly used in optical cable production, such as the sheath, buffer, filling/flooding compound, strength member, conductor insulation and fibre coating.

Fungi can live on most organic materials. They decompose certain organic materials as a normal metabolic process, thus degrading them and causing porosity and loss of structural integrity, even to function failure.

Fungal growth normally occurs only on surfaces exposed to the air. Surfaces which adsorb moisture, will generally be more susceptible to attack from fungal spores. The cable sheath, the cable components at cable ends and mid-span points, which can be exposed in the air, face high potential risk of fungal growth.

5.2 Main effects on optical cable

The detrimental effects of fungi on optical cables can either directly impact performance or have indirect causes to poor performance. A direct impact would be the fungal consumption and metabolization of cable components. An indirect influence can be attributed to the waste by-products of fungal growth, which are enzymes and organic acids that can break down cable components. The main effects are as follows:

a) Surface discoloration, leaving traces after cleaning the fungal growth area;
b) Sheath performance degradation, such as cracking, corrosion, modulus increase, weight and dimension change, embrittlement;
c) Hardening of cable filling/flooding compounds;
d) Mycelial growth into cable ends that are exposed to moisture or water. Mycelium can cause microbends where they touch the optical fibres;
e) Decrease in conductor insulation resistance.

6 Prevention of fungal growth

6.1 General

If optical cable is properly deployed, the cable sheath will be the most probable component which is subject to fungal attack. Usually, fungal growth occurs only on the sheath of optical cable. However, there are situations where cable internal components are exposed to the air with a risk of fungal growth. These situations include, but are not limited to:

a) Accidental sheath damage, by mechanical force, rodent bite;
b) Sheath cracking by environmental stress or ageing;
c) Optical cable closure is damaged or not tightly sealed after operation;
d) Improper installation or termination of optical cable;
e) Severe shrinkage of cable components after termination.

6.2 Cable sheath

Usually, there are physical methods and chemical methods for the prevention of fungal growth.

6.2.1 Physical methods

As to the cable sheath, physical methods for the prevention of fungal growth are listed below:

a) When possible, install cable in an environment that is not conducive to fungal growth (i.e. low temperature, low humidity, and adequate ventilation).
b) The cable surface can be smooth to which dust is not easy to adhere.
c) Avoid fungal nutrients attached to the sheath surface.
d) For easy-to-maintain optical cables, for example, data centre cables, remove the existing fungi from the cable in time to prevent its further propagation.

6.2.2 Chemical methods

It is also common to prevent fungal growth by chemical means:

a) The preferred method is to select materials which do not promote fungal growth.
b) When selected jacket material is inadequate to repel fungal growth, a mildew inhibitor can be added to the base resin during or prior to extrusion. Non-polar mildew inhibitors are recommended for polyolefin materials, as cracking can occur in the jacket when polar inhibitors are used.
c) Spray suitable fungicides directly on the cable surface to prevent fungal growth.