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Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by ~~Microbial (Fungal~~ Fungal or Algal~~)~~ Growth, or Soil and Dirt Accumulation[1]

This standard is issued under the fixed designation D 3274; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

~~1.1The photographic reference standards available for use with this test method provide a numerical basis for rating the degree of fungal and algal growth or soil and dirt accumulation on paint films.~~

~~1.2~~*

1.1 Fungal growth, frequently referred to as mildew in the paint industry, causes defacement of paint film exposed outdoors. The visual rating of paint surface disfigurement due to fungal or algal attack is required in order to compare the performance of different coatings.

1.2 This method of rating mildew evaluation is intended to be used on exterior exposed paint films. This method may be used to rate interior fungal or algal growth, but it should be noted that the growth patterns on interior surfaces are different than exterior due to the lack of weathering influences. It is primarily intended for test specimens, but can also be sued for rating mildew growth on larger structures such as entire houses. If this is used for large areas, the project should be broken down into smaller sections.

1.3 This method is intended for field use for the macro rating of surface disfigurement only. The visual scales are meant to be used by the unaided eye to rate algal, fungal, or dirt disfigurement on larger surface areas such as test panels, siding boards, or entire buildings. Techniques are included for the differentiation of soil and dirt.

1.4 Fungi will grow on most paint films exposed outdoors that are located in conditions favorable to growth. Test procedures such as Practices D 1006, D 3456, and G 7 are available describing natural exposure tests that can be used to expose paint films, in order to create fungal or algal growth.

1.5 The pictorial references available for use with this test method provide a numerical basis for rating the degree of fungal or algal growth on paint films.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D 1006 Practice for Conducting Exterior Exposure Tests of Paints on Wood

D 3456 Practice for Determining by Exterior Exposure Tests the Susceptibility of Paint Films to Microbiological Attack

D 4610 ~~Guide for Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings~~

~~2.2*ASTM Adjuncts:*~~

~~Pictorial Photographic Standards~~ Guide for Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings

G 7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

3. Terminology

3.1 ~~*Types of Fungal and Algal Growth*— Fungi are heterotrophs capable of reproducing both asexually and sexually. Asexual~~

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.28 on Biodeterioration.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* ~~, Vol 06.01.~~volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard.**

reproduction takes place either by the fragmentation of the mycelium or by the production of spores. Sexual reproduction can occur by fusion of gametes, penetration of a gamete into a reproductive structure known as a gametangium, or by fusion of gametangia. Some common definitions include: Types of Fungal Growth—During examination of a paint film, it may be possible to distinguish between the several types of fungal or algal growth. If required, it may be necessary to note the type of fungal or algal growth found. Under magnification, and with some identification training, it is possible to be able to distinguish growth types. The following definitions are some growth types that may be found.

3.2 *hyphae*, *n*—thread-like, tubular fungal filaments that compose the mycelium.

3.3 *mildew*, *n*—a popular term for the conglomerations of fungi that grow on and disfigure paint films.

3.4 *mycelium*, *n*—vegetative mass of hyphae forming the body of a fungus.

3.5 *spore*—an asexual reproductive cell capable of developing into a mature fungus without fusion with another cell.

3.2.1

3.5.1 *Discussion*—Spores tend to be spherical in morphology and are observed singly or in clusters. Spores may or may not be associated with fungal mycelia and can range in a wide variety of colors. Although primarily gray or black, some spores are even green in color and have been mistaken as terrestrial algae. Spores of *Aureobasidium pullulans* magnified 100× are shown in —Spores tend to be spherical in morphology and are observed singly or in clusters. Spores may or may not be associated with fungal mycelia and can range in a wide variety of colors. Although primarily gray or black, some spores are green in color and have been mistaken as terrestrial algae.

4. Significance and Use

4.1 The growth of fungi in and on the surface of paint films represents a major cause of discoloration or disfigurement of painted surfaces. Because of their dark pigmentation, it is frequently difficult to distinguish fungi from dirt or soil particles.

4.2 *Use of Pictorial Standards:*

4.2.1 The pictorial references that are part of this test method are for illustration purposes and may be used for visual comparisons.

4.2.2 The diagrams represent an idealized schematic of various growth levels on paint films. they are intended as a representation only, but will serve as a useful guideline to establish amount and type of growth.

4.2.3 The diagrams represented in Fig. 1.

3.3*hyphae*—thread-like, tubular, fungal filaments that compose the mycelium. Hyphae may appear individually or have spores attached.

3.3.1*Discussion*—Hyphae of *Aureobasidium pullulans*, magnified 50× are shown in Fig. 2 .

3.4*mycelium*—vegetative mass of hyphae forming the body of a fungus.

3.5*fruiting body*—fungus structure consisting of specialized hyphae where sexual reproduction occurs.

3.6Amorphous growth typical of an alga such as *Chlorococcum* Sp. appears in Fig. 3at a magnification of 39×. Terrestrial algae can appear green to dark brown in color.

4.Significance and Use

4.1The growth of fungi and algae in and on the surface of paint films represents a major cause of discoloration or disfigurement of painted surfaces. Because of their dark pigmentation, it is frequently difficult to distinguish fungi and algae from soil or dirt particles. The use of magnification of as much as 100× affords easy distinguishability among fungal spores, fungal mycelia, algae, and dirt and is recommended in cases where such difficulty is apparent.

4.2Dirt accumulation observed on specimens can occur more readily with coatings formulated at lower pigment volume concentration or those containing softer resins.

4.3*Use of Photographic Standards:* [3]

4.3.1The photographic reference standards that are part of this test method are for illustration purposes and should be used for visual comparisons.

4.3.2The photographic standards illustrated in Fig. 4 rate the disfigurement of paint films from 0 to 8. A rating of 10 would indicate a film totally absent of disfigurement by particulate matter.

4.3.3The ratings used in this standard more closely match a nonlinear scale. are not derived from a linear scale. The scale is intended to provide for more discrimination at the earlier stages of fungal or algal growth. It is at these levels that greater discernment is necessary.

4.2.4 Comparisons made on dark colored substrates will be much more difficult, and will therefore require much more care and attention. It must be noted that because it is difficult to distinguish mild fungal or algal growth on the very dark substrates, there may be a tendency to under-rate those specimens.

5. Soil or Dirt Particles

5.1Soil or dirt particles may range from light brown to black. The particles, viewed at 50× to 100× magnification, are generally amorphous and are frequently translucent. Soil particles on paint magnified 100× are shown in Fig. 5.

6.Procedure

6.1Compare each specimen with the photographic standards associated with this test method to determine which most closely

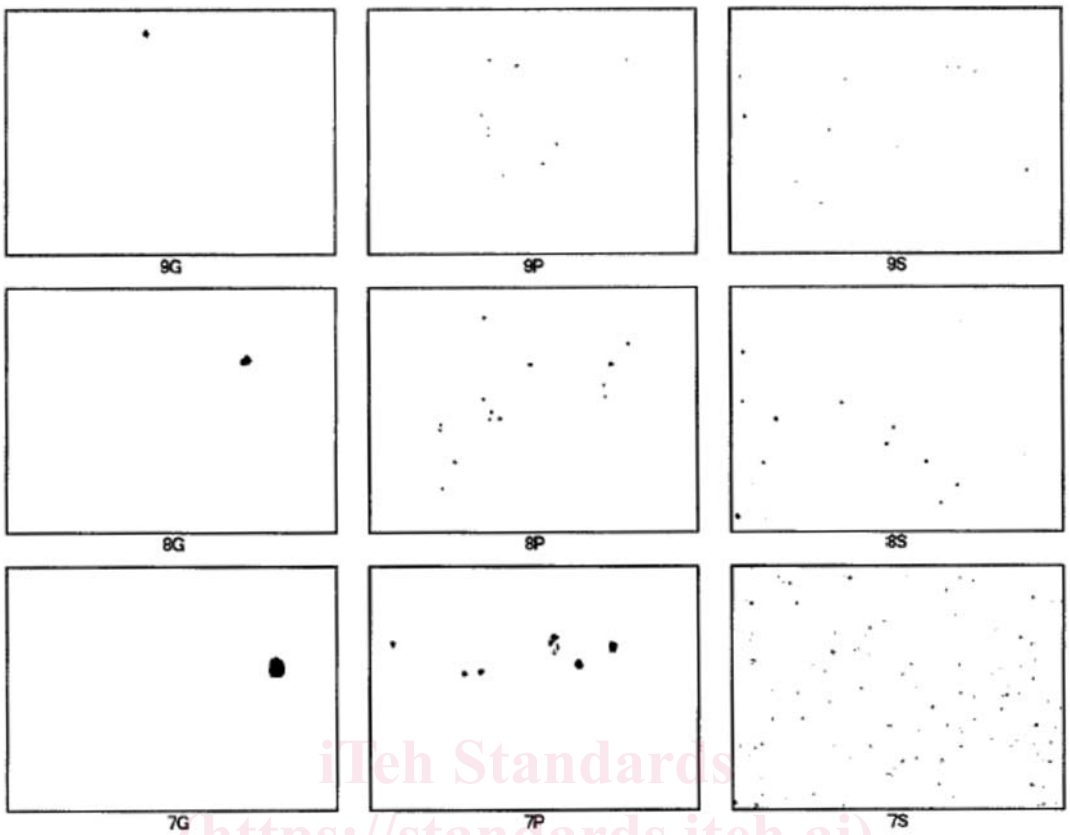

FIG. 1 ~~Spo~~Early Stages of~~A~~ Fureobasidium pullulans, ~~Magnified 100×~~ al Growth

(a)

~~matches the degree of disfigurement on the specimen. When the degree is intermediate between two adjacent standards select the intermediate odd number as the disfigurement rating.~~

~~6.2The density of fungal or algal growth as well as dirt accumulation may vary over the painted surface being evaluated. This variation may be the result of the location of the surface (that is, under an eave of a house *versus* an exposed area), nonuniformity of the substrate, film thickness or other factors. Note such variation when reporting the rating assigned to specimen under test. In examining test specimens for fungal, algal, or dirt disfigurement, make sure that the possibility of failure due to the wood substrate is recognized and reported.~~

~~6.3When microbial disfigurement is detected (or established), distinguish between algal and fungal growth. For the latter, estimate whether spores or mycelia predominate (see Guide D4610).~~

5.1 Fungal or algal ratings can be made more difficult by the presence of dirt and soil particles. The distinction between dirt accumulation and surface mildew is sometimes difficult to distinguish to the naked eye.

5.2 Use visual evaluation under high power binocular magnification to assist in determining whether the particle is soil, dirt, or mildew.

~~NOTE1—Applying sodium hypochlorite to coatings is optional, however, the invasiveness of this technique may contaminate test substrates that could inhibit future fungal/algal growth.~~

~~6.4If fungal or algal growth is only observed on dirt or soil particles that have accumulated on the specimen, disregard the assignment of a rating. In this case the organism is not actually utilizing the coating as a food source. Make sure that special mention as to this observance is noted as agreed upon between all parties involved with the testing.~~ 1—After experience has been gained in a certain geographic location, recognition of mildew becomes easier and can often be achieved without the aid of magnification.

5.3 In some cases it is necessary to to place a drop of 5 % sodium hypochlorite (common household bleach) on the paint surface to determine if the defacement is biological in accordance with Guide D 4610.

5.3.1 The bleach will remove the coloration from any living organic matter, therefore if the color of the "particles" under the bleach drop do not change color, that object is probably either dirt or soil.

5.4 The addition of a drop of bleach is an invasive and destructive test. The future growth of organisms on that spot and in the

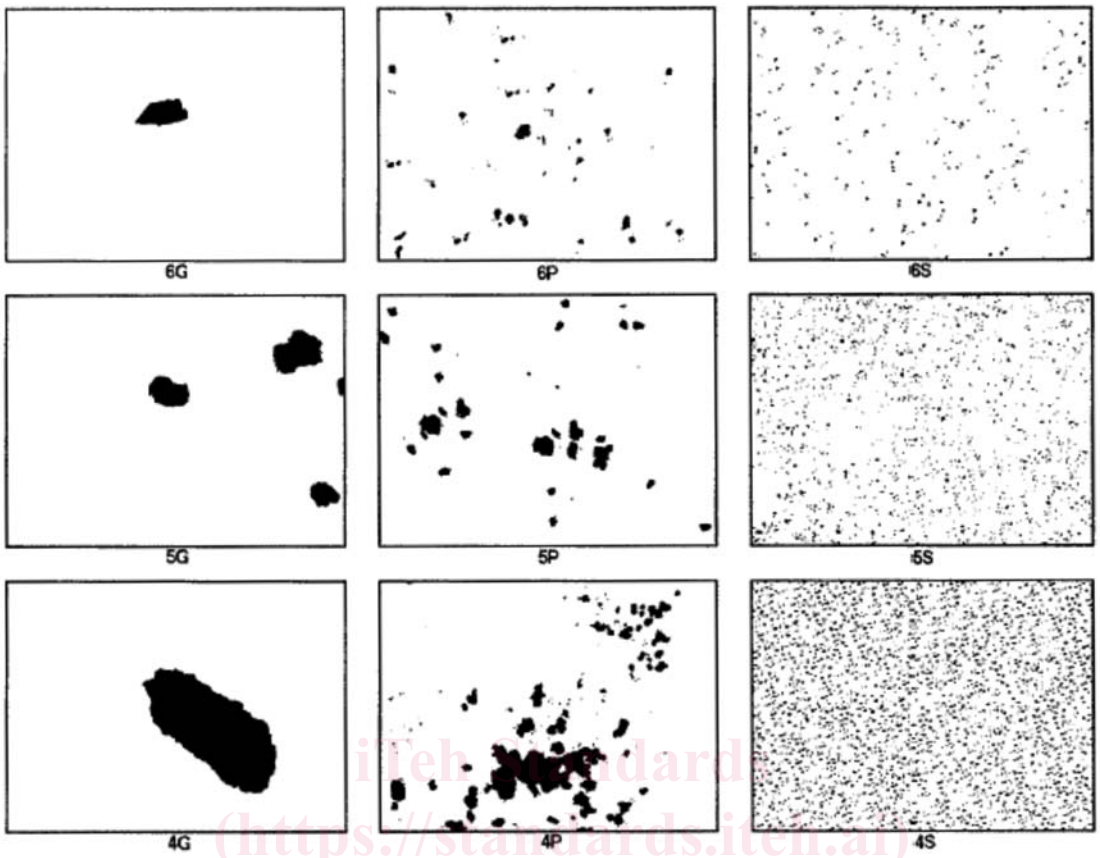

FIG. 2 1 HEarlyph Stages ofA Fureobngasidium pullula Growth *(cons, Magntifinued 50×)*

(b)

immediate surrounding area will be inhibited for a long time after the addition. Do not use bleach unless absolutely necessary, and make a note on the report form if used.

6. Visual Evaluations

6.1 Whenever fungal or algal growth is being rated visually it should be done without the aid of magnification. The rating should be made as it appears to the naked eye. Up to 10× magnification can be used to assist in the identification of mildew and to clarify the rating. Magnification will also help to distinguish between dirt attachment and mildew growth. If magnification is used, it should be noted on the report.

6.2 View the paint film under good illumination conditions, either in a controlled light booth under daylight light source, or outside in the shade. Occasionally it may be necessary to view the paint film under strong sunlight.

6.3 Rate the specimen using one of the following methods. Under most field use conditions, comparison to the drawings provides a satisfactory numerical rating. Use a transparent grid scale to determine percent area coverage for more accurate ratings as described in 6.3.3.

6.3.1 There are three different growth patterns described in this standard:

Description	Designation
Spot Growth	S
Non Uniform Spread	P
Complete Coverage	G

6.3.2 Determine which growth pattern most closely matches that seen on the specimen. See Fig. 1 a through c, for visual representation of these patterns.

6.3.3 Compare the growth to the drawings. Estimate which pictorial reference most closely matches the actual test specimen being evaluated. Rate the number and type of growth pattern. Derive the numerical rating directly from the rating scales shown in Table 1. Include the growth pattern type as determined from Fig. 1 a through c. Actual photographs of fungal or algal surface growth are shown in Fig. 2.

6.4 *Rating Scales*— Rate the mildew growth using either an estimate of the percentage of the surface covered, or by applying a descriptive term to the general appearance. The cross-reference of these three items is detailed in Table 1.