



# Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation<sup>1</sup>

This standard is issued under the fixed designation D3274; 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 ( $\epsilon$ ) 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

1.1 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 used 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 **D1006**, **D3456**, and **G7** 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 appro-*

*priate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

**D1006** Practice for Conducting Exterior Exposure Tests of Paints on Wood

**D3456** Practice for Determining by Exterior Exposure Tests the Susceptibility of Paint Films to Microbiological Attack

**D4610** Guide for Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings

**G7** Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

## 3. Terminology

3.1 *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.

3.5.1 *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

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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 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**

5.1 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.

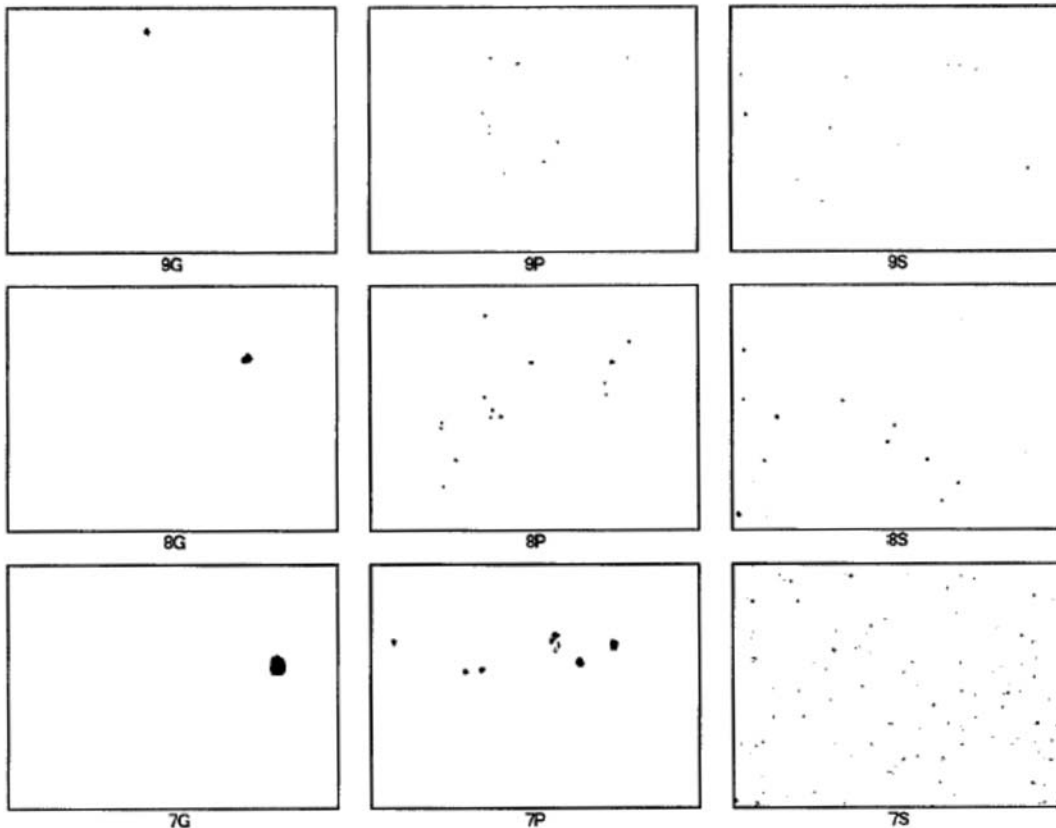
5.2 Use visual evaluation under high power binocular magnification to assist in determining whether the particle is soil, dirt, or mildew.

NOTE 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 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 D4610.

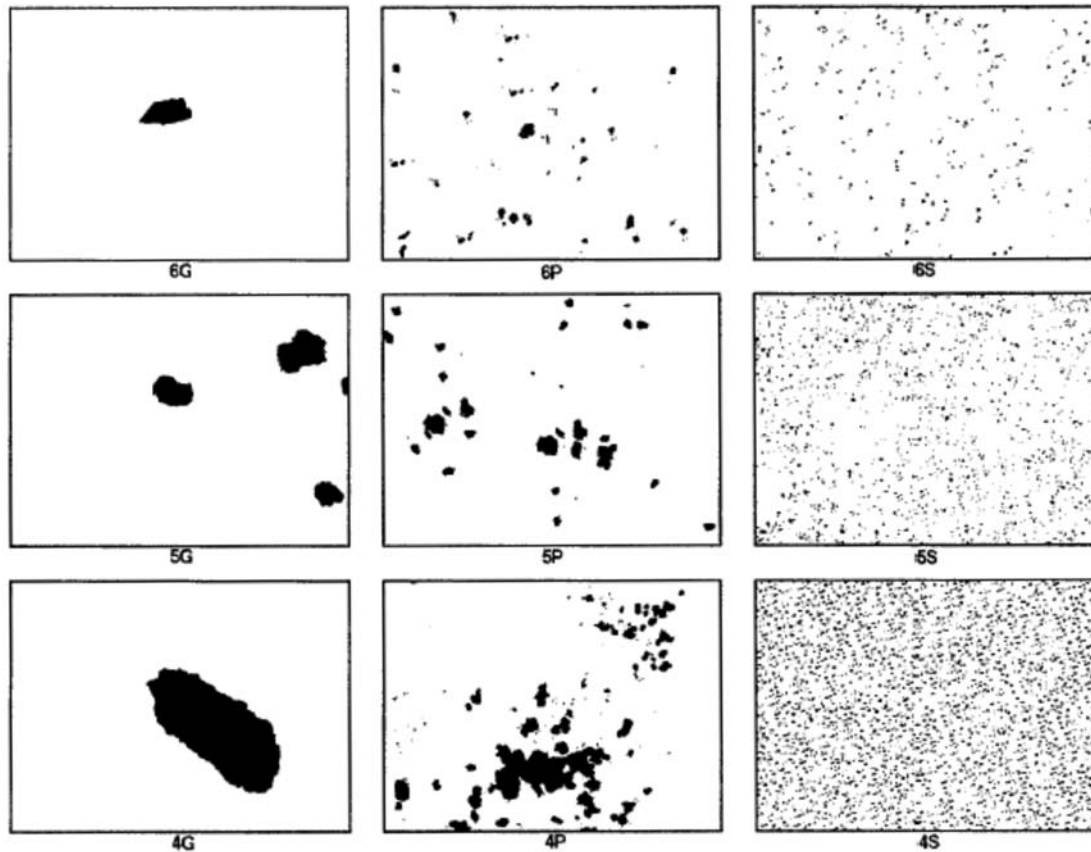
5.3.1 The bleach will remove the coloration from any living organic matter, therefore if the color of the “particles” under the bleach drop do not change color, that object is probably either dirt or soil.

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



(a)

**FIG. 1 Early Stages of Fungal Growth**



(b)

FIG. 1 Early Stages of Fungal Growth (continued)

and in the 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.

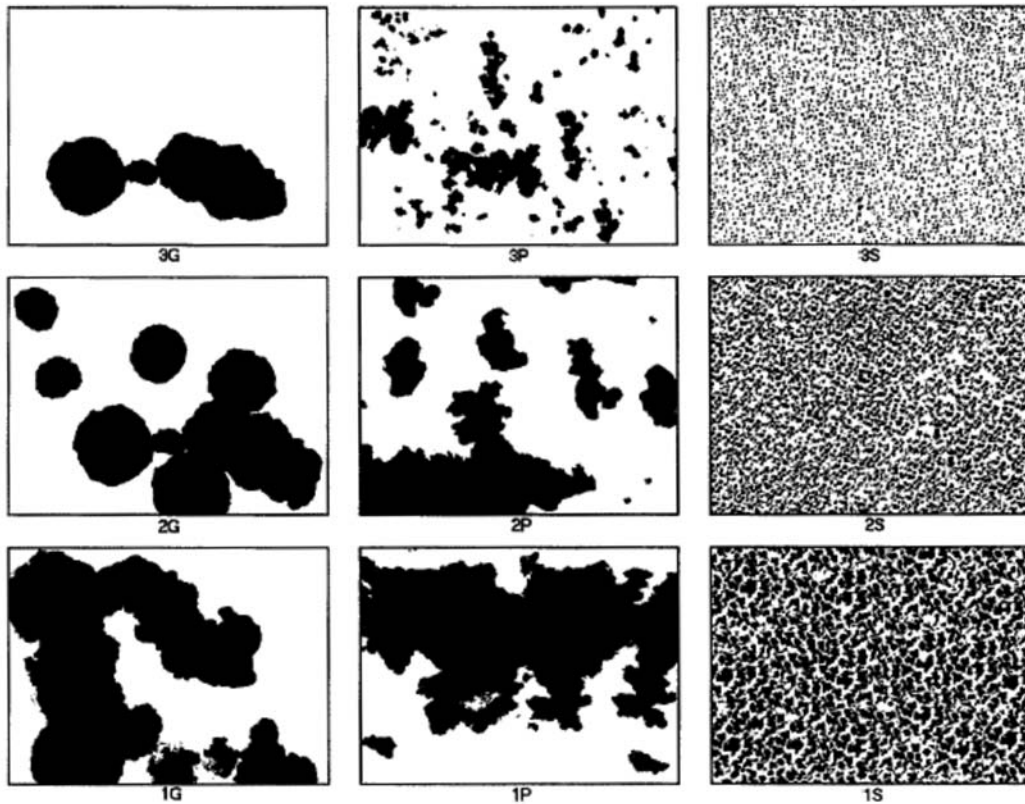
6.3.1 There are three different growth patterns described in this standard:

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



(c)

FIG. 1 Early Stages of Fungal Growth (continued)

TABLE 1 Rating Scales

Rating	Coverage %	Description
10	0	No Fungal Growth
9	0.03	Trace
8	0.1	Slight
6	1	Moderate
4	10	Pronounced
2	33	Severe
0	50	Complete Coverage

applying a descriptive term to the general appearance. The cross-reference of these three items is detailed in Table 1.

6.4.1 The odd numbered ratings not shown in Table 1 may be applied by interpolation. Odd numbered ratings are shown in Fig. 1 a through c. No pictures for 10 or zero ratings are shown in the figures.

6.5 When the growth is found to be concentrated in one area of the test surface, enter a note in the report to this effect. State where the concentration was found, and what type of growth was most prevalent.

6.6 Ignore the area around the outer edge of the test surface if the mildew growth extends all the way to the edge. The mildew growth here may be due to other influences and therefore not necessarily reflect the true resistance of the paint film. If there is growth occurring along one edge that has

invaded other areas on the surface, originating typically at the bottom, report this as a special note.

6.7 If there are two growth types, for example, Spot and Non-Uniform, report the coverage and type for both types. It is possible that the type of coverage might change during the course of the exposure, typically from Spot to Non-Uniform or Complete Coverage.

6.8 Identification—If the fungal or algal species is known, indicate on the report the name of the organism and the method by which the identification was made.

## 7. Report

7.1 The report should include the numerical rating value, plus any notes regarding uniformity or other morphology.

7.2 Use a report format as agree upon between the contractual parties. As a minimum, report the following criteria. Note that all the following information may not be available if the exposure is carried out by an independent testing agency.

7.2.1 Unique reference number to identify test series.

7.2.2 Paint panel identification.

7.2.3 Date of report.

7.2.4 Date of exposure.

7.2.5 Location of exposure.

7.2.6 Numerical fungus rating.

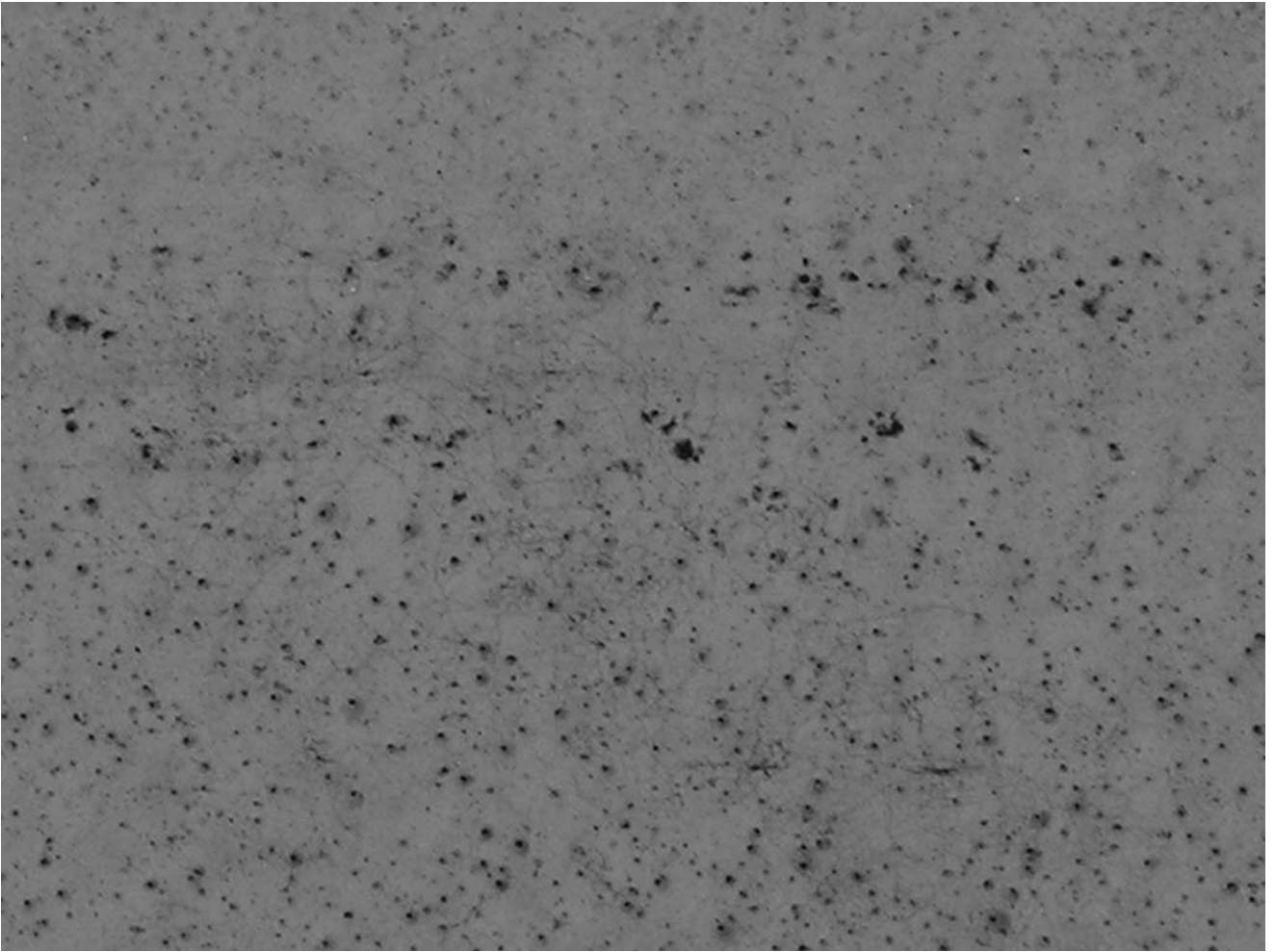
7.2.7 Any notes about morphology or uniformity.





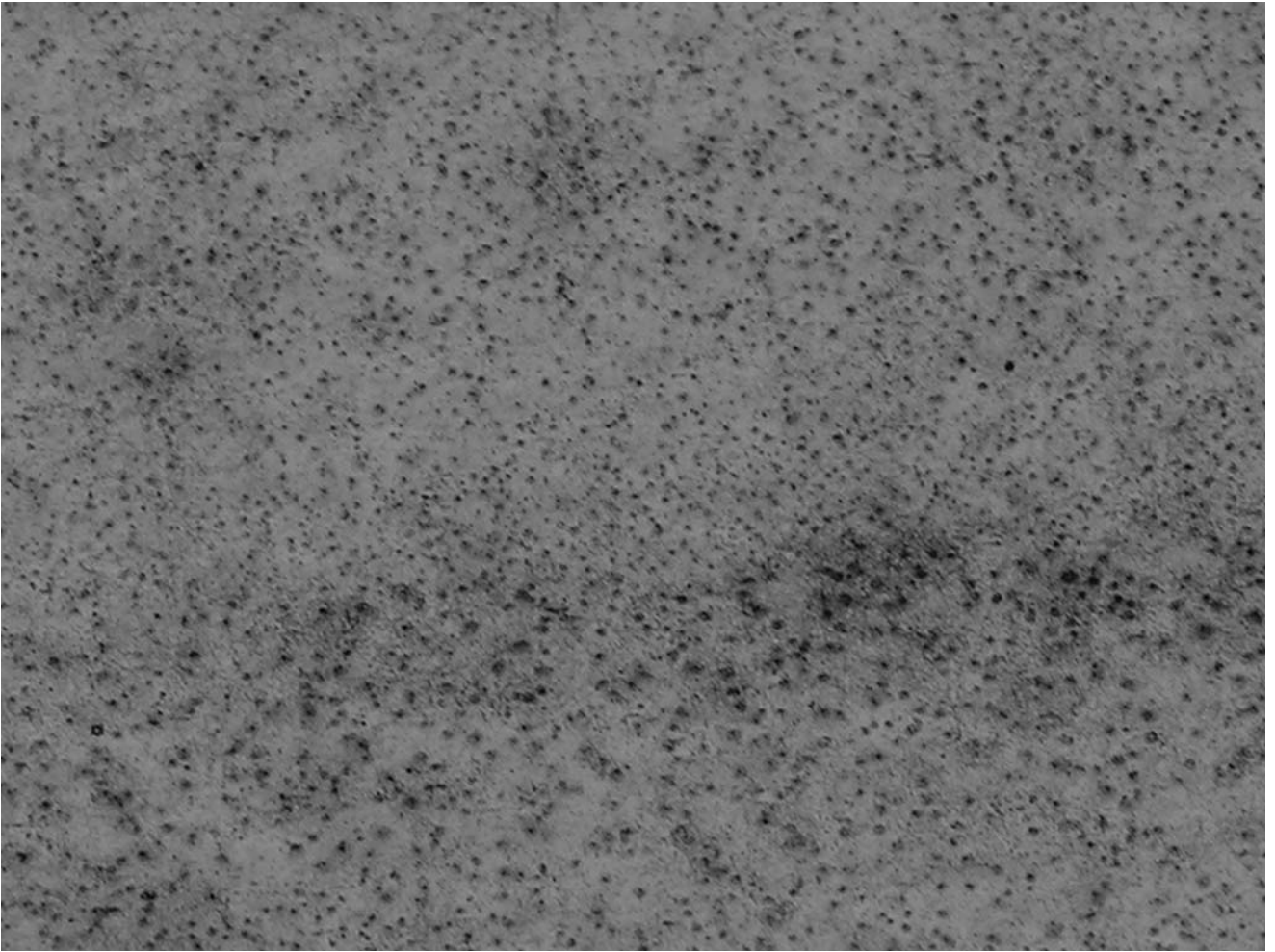
Slight Mildew

**FIG. 2 Examples of Paint Disfigurement through Fungal or Algal Growth**



Moderate Mildew

**FIG. 2 Examples of Paint Disfigurement through Fungal or Algal Growth** *(continued)*



Severe Mildew

**FIG. 2 Examples of Paint Disfigurement through Fungal or Algal Growth** *(continued)*

## 8. Precision and Bias<sup>3</sup>

8.1 The precision of this test method has been tested by subcommittee D01.28 by means of round robin testing. Repeatability of evaluations by the same inspector has been shown to improve when using the pictorial references even with little or no training. Overall variability between users of this standard is  $\pm 2.4$  rating points without training and  $\pm 1.6$  points with training. When removing high and low values and correcting for individual biases, the overall variability can be reduced to  $\pm 1.1$  rating points. This was measured using 12 individuals, rating 20 specimens, at 2 different time periods.

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<sup>3</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1149.

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8.1.1 The use of this rating method to rank specimens is extremely reliable and repeatable. The ranking of the specimens by these individuals was repeatable at  $R = 0.99$  using the Spearman Rank Coefficient to compare the ranking at each of the two rating times.

8.2 Bias cannot be determined due to the lack of a standard reference to be used for comparison. This is a highly subjective method of evaluation, but some individual biases can be determined by frequent intercomparisons amongst groups of raters.

## 9. Keywords

9.1 disfigurement; fungus; mildew; pictorial standards