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Standard Test Method for Intensity of Scratches on Aerospace Transparent Plastics[1]

This standard is issued under the fixed designation F548; 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.

1. Scope

1.1 This test method covers the visual inspection of shallow or superficial scratches on the surface of aerospace transparent plastic materials.

1.2 *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]

F428 Test Method for Intensity of Scratches on Aerospace Glass Enclosures

3. Summary of Test Method

3.1 A visual comparison is made between a set of graded scratch standards and the scratch on the plastic material to determine the relative intensity of the scratch.

4. Significance and Use

4.1 Scratches exist on all transparent plastic surfaces. Usually they are very fine scratches from cleaning operations that are not visible when looking through the plastic. Deeper scratches may result from careless cleaning or handling. While these may not be deep enough to affect the structural integrity of the part, their appearance in certain locations may be distracting to the observer looking through the plastic. Therefore, a procedure to define these scratches is useful.

5. Reference Materials

NOTE 1—Adjuncts for scratches on plastic are not currently available. However, adjuncts are available for scratches on glass surfaces and a study has been done to equate the two (see the Appendix). Refer to F428 for sources of the glass adjuncts.

6. Procedure

6.1 Place the part in a suitable inspection position. This may be horizontal on a padded table, vertical against a neutral background, or at an angle. The scratched surface shall be toward the observer. The light level shall be a minimum of 80 lux. Either natural or artificial light may be used. Place the scratch in the ASTM comparison standard beside and parallel to the scratch to be assessed on the plastic material. Rotate the part or viewing angle to get the best definition of the scratch. Disregarding the length of the scratch on the plastic material and on the standard, select and record the highest-numbered standard scratch that most clearly matches the appearance of the scratch on the plastic material. Measure and record the length of the scratch to the nearest 1 mm (0.04 in.).

7. Interpretation

7.1 Customer specifications for transparent plastic materials and parts may detail allowable frequency, location, length, and standard number for scratches and they may assign maximum scratch limits for critical and noncritical optical viewing areas.

8. Report

8.1 For each scratch within the scope of the plastic scratch standard, report its ASTM standard number (for example, ASTM F548-09), length, frequency, and location.

9. Precision and Bias[3]

9.1 *Precision:*

9.1.1 The repeatability of judging the intensity of a scratch within one scratch value, for the same observer, is 92 % or better.

9.1.2 The reproducibility (between observers) of judging the intensity of a scratch within one scratch value is 90 % or better for scratch values 14 and above. The reproducibility of judging the intensity of a scratch within two scratch values is 92 % or better for scratch values below 14. The data reflect that it is more difficult to judge finer scratches.

9.2 *Bias*—The procedure in this test method has no bias because the scratch intensity is defined only in terms of the test method.

[1] This test method is under the jurisdiction of ASTM Committee F07 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.08 on Transparent Enclosures and Materials.

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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* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] A research report is available from ASTM International Headquarters. Request RR:F07-1007.

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10. Keywords

10.1 comparison standard; scratches; transparent plastic

APPENDIX

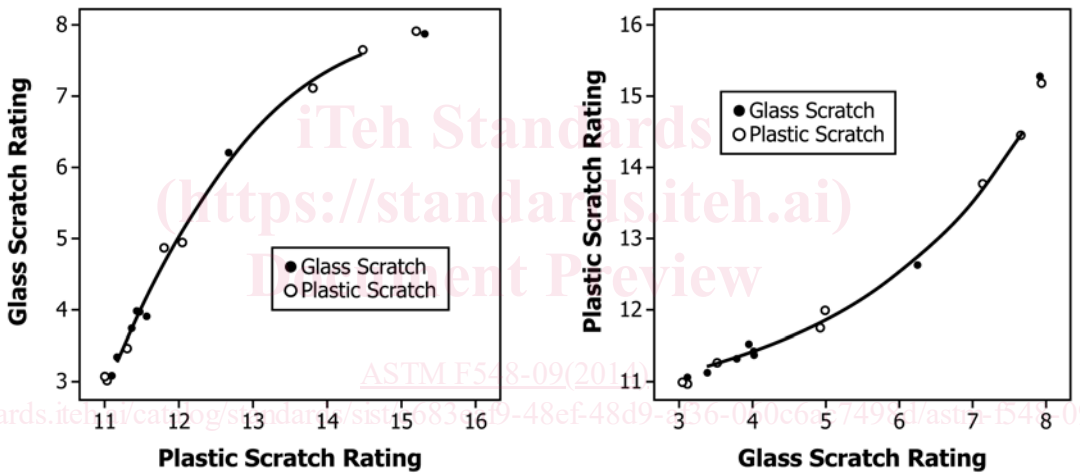
(Nonmandatory Information)

X1. COMPARISON OF GLASS AND PLASTIC SCRATCH RATINGS

X1.1 A study was performed to determine equivalent relationships between glass and plastic scratch adjuncts. This empirically defined relationship can be used if needed when: (*1*) only glass adjuncts are available to judge the intensity of scratches in plastic, (*2*) only plastic adjuncts are available to judge the intensity of the scratches in glass, or (*3*) it is desirable to convert between the glass and plastic scales.

X1.2 Five trained observers rated eight glass and eight plastic scratches. Each scratch was rated using both glass and plastic adjuncts three times. The 96 trials for each observer were randomized with the constraint that there be at least five trials between replications of the same scratch and either glass or plastic adjunct.

X1.3 Fig. X1.1 contains the estimated relationship between the glass (G) and plastic (P) scratch ratings and between the plastic and glass ratings. Fig. X1.2 shows the number of trials for each observer and scratch having a particular scratch rating when compared with either glass or plastic adjunct.



$$G = 8.06\left(1 - e^{-\left(\frac{P - 9.48}{2.54}\right)^{1.57}}\right) \qquad P = 9.76 + e^{\left(\frac{G}{5.86}\right)^{1.64}}$$

NOTE 1—The 3 means near (P = 11, G = 3) and the 2 means near (P = 15, G = 8) were not used since they contained multiple trials where the glass rating was either 3– or 8+.

FIG. X1.1 Non-Linear Regression Fit of Mean Scratch Ratings (N = 15)

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