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Designation: F 428 – 03

Standard Test Method for Intensity of Scratches on Aerospace Glass Enclosures[1]

This standard is issued under the fixed designation F 428; 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 scratches on the glass surface of aerospace transparent enclosures.

1.2 *This standard may involve hazardous materials, operations, and equipment. 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 *Other Standards:*
Glass Scratch Visual Comparison Standard[2]

3. Summary of Test Method

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

4. Significance and Use

4.1 Scratches exist on all glass surfaces. Often there are very fine scratches from cleaning operations that are not visible when looking through the glass. Visible scratches may be distracting to the observer looking through the enclosure. Therefore, a procedure to define scratches is useful. A visual standard is used because it is not practical to measure the dimensions of the fine scratches in the scope of this test method.

5. Reference Materials

5.1 *Glass Scratch Visual Comparison Standard* consists of a set of six hermetically sealed glass plates 38 mm (1.5 in.) square with scratches of graded intensity on the inside surface. The lightest scratch is identified as ASTM F 428-3 and the heaviest as ASTM F 428-8.[3]

6. Procedure

6.1 Place the part in a suitable inspection position. This may be horizontal on a padded table, vertical against a neutral to dark background, or at an angle simulating the installed position. 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. If possible, move the light until the scratch has the highest contrast against the background. Place the scratch in the visual comparison standard beside and parallel to the scratch in question. Rotate the part or viewing angle to get the best definition of the scratch. Disregarding the length of the scratch on the part and on the standard, select and record the standard that most closely matches the appearance of the scratch on the part. Measure and record the length of the scratch to the nearest 1 mm (or 0.05 in.).

7. Interpretation

7.1 Customer specifications for aerospace glass surfaced transparent enclosures 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 glass scratch standard, report its standard number, length, frequency, and location.

9. Precision and Bias

9.1 *Precision*:

9.1.1 The repeatability of judging the intensity of a scratch within one scratch value, for the same observer, is 90 % or better.

9.1.2 The reproducibility (between observers) of judging the intensity of a scratch within two scratch values is 87 % or better.

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[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] The sole source of supply of the Glass Scratch Visual Comparison Standard known to the committee at this time is Davidson Optronics, Inc., 2223 Ramona Blvd., West Covina, CA 91790. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[3] Originally an adjunct that contained seven scratches. The finest scratch (ASTM F 428–2) was determined to be too difficult to use and manufacture. Subsequently, it has been discontinued. Continued use of the older, seven-piece set is acceptable.

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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.

10. Keywords

10.1 glass scratches; scratches; windscreen quality; windscreen scratches

APPENDIX

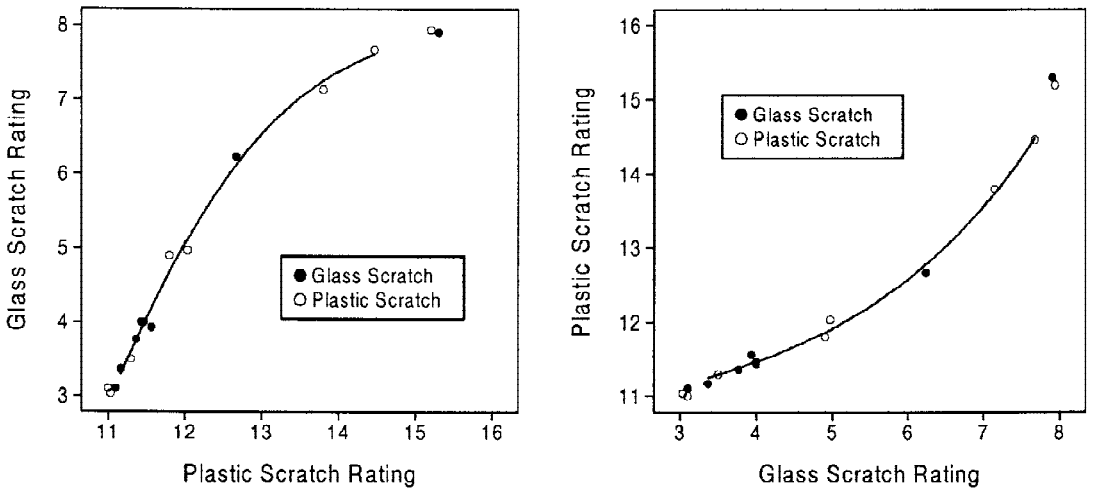
(Nonmandatory Information)

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 derived 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 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 trails between replications of the same scratch and either glass or plastic adjunct. Fig. X1.3 shows the number of trials for each observer and scratch having a particular scratch rating.

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. Table X1.1 and Fig. X1.2 contain the mean scratch rating for each scratch.



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

$$P = 9.76 + e^{\left(\frac{G}{5.86}\right)^{1.64}}$$

NOTE—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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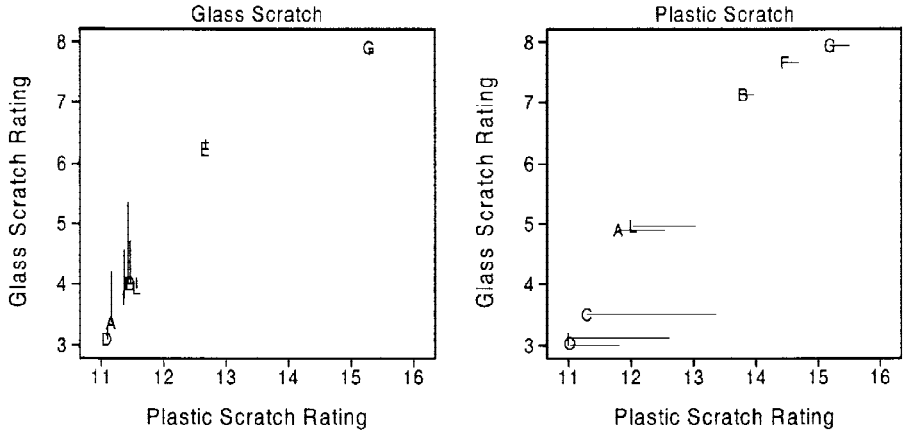
TABLE X1.1 Mean Glass and Plastic Scratch Rating for Each Scratch (N = 15)

NOTE—Ratings are sorted by glass adjunct.

Scratch Material	Scratch	Mean Rating (N = 15)	
		Glass Adjunct	Plastic Adjunct
Glass	D	3.1	11.1
	A	3.4	11.2
	I	3.8	11.4
	L	3.9	11.6
	B	4.0	11.5
	F	4.0	11.4
	E	6.2	12.7
	G	7.9	15.3
Plastic	O	3.0	11.0
	I	3.1	11.0
	C	3.5	11.3
	A	4.9	11.8
	L	5.0	12.0
	B	7.1	13.8
	F	7.7	14.5
	G	7.9	15.2



NOTE—Solid line segments connect means in this study with means from previous studies involving glass or plastic only.

FIG. X1.2 Mean Glass and Plastic Scratch Rating for Each Scratch (N = 15)

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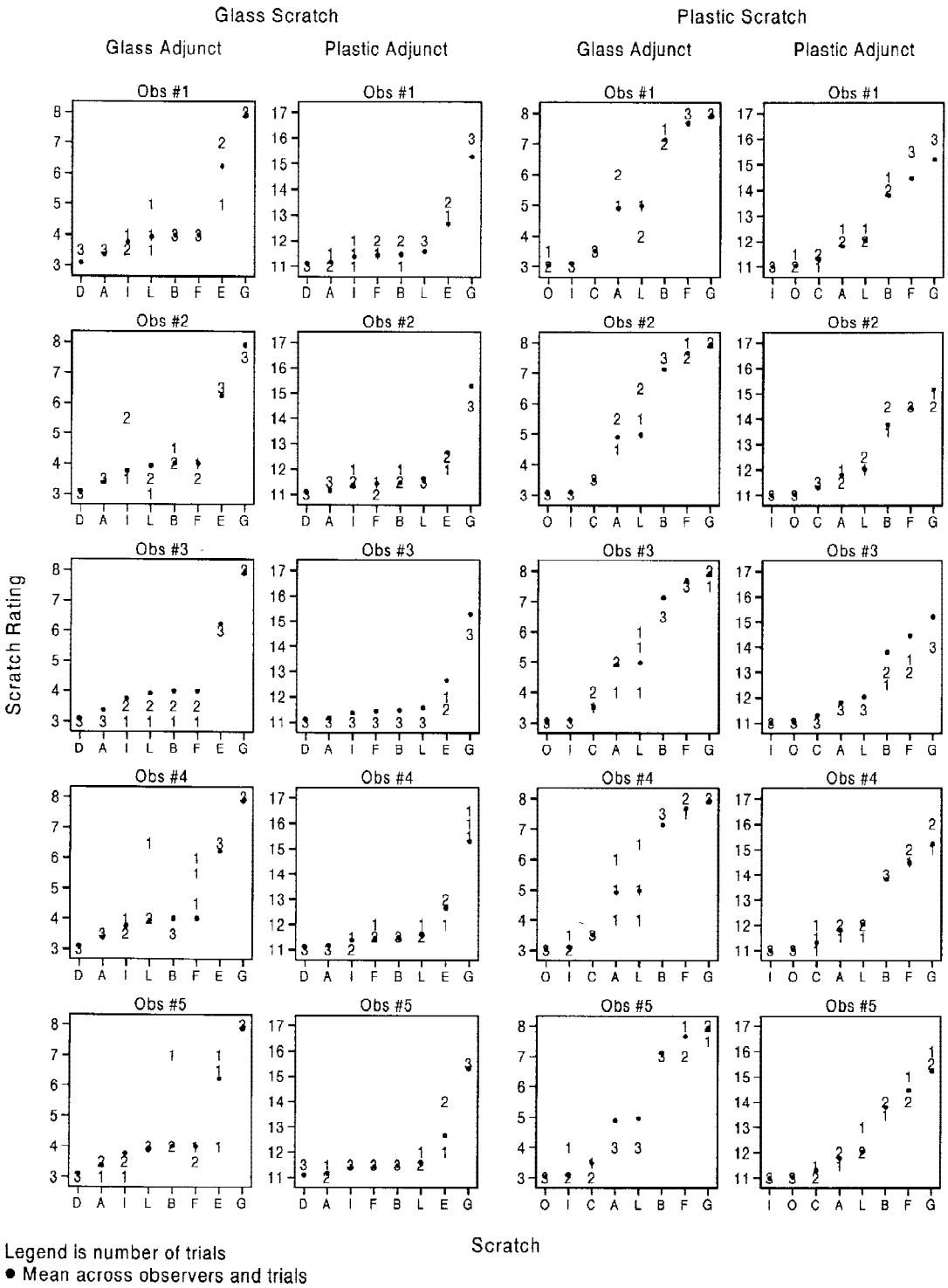

FIG. X1.3 Number of Trials for Each Observer and Scratch (N = 3) Having a Particular Scratch Rating when Compared with Either Glass or Plastic Adjunct

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