



Standard Test Method for Chipping Resistance of Coatings¹

This standard is issued under the fixed designation D 3170; 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

1.1 This test method covers the determination of the resistance of coatings to chipping damage by stones or other flying objects.

NOTE 1—This test method is similar to SAE J-400.

1.2 The values stated in metric units are to be regarded as the standard. The English units given in parentheses are for information only. All dimensions are nominal unless otherwise specified.

1.3 *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:

D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products²

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels²

D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers²

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base²

D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base²

D 1733 Method of Preparation of Aluminum-Alloy Panels for Testing Paint, Varnish, Lacquer, and Related Products³

D 2201 Practice for Preparation of Zinc-Coated and Zinc-Alloy-Coated Steel Panels for Testing Paint and Related Products²

2.2 Other Documents:

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 D 01.55 on Factory-Applied Coatings on Preformed Products.

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² *Annual Book of ASTM Standards*, Vol 06.01.

³ Discontinued, see 1980 *Annual Book of ASTM Standards*, Part 27.

Test for Chip Resistance of Surface Coatings (J-400)⁴
*Chipping Rating Standards*⁴

3. Summary of Test Method

3.1 Standardized road gravel is projected by means of a controlled air blast at the coated specimens. All testing is conducted under controlled temperature conditions, generally either at ambient (room) temperature or at $-29^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($-20^{\circ} \pm 5^{\circ}\text{F}$). After the gravel impact, tape is applied to remove any loose coating chips and the degree of chipping is determined.

4. Significance and Use

4.1 Owners consider chipping of coatings, particularly on the leading faces and edges of automobile surfaces, unacceptable. In formulating a coating or coating system to meet service requirements, the resistance to chipping damage by flying objects such as gravel is one of the properties of importance since it can vary considerably as other properties are adjusted. Since resistance to chipping decreases at lower temperatures partly as the result of decreased flexibility, the test may be more directly related to service conditions by performing it at a low temperature. This test method is designed to produce a controlled amount of impact by the media on the coated panel in order to enhance reproducibility.

5. Apparatus

5.1 *Gravel-Projecting Machine (Gravelometer)*, constructed according to the design specifications shown in Fig. 1.⁵ There are two types of Gravelometers: the old cabinet style and the newer, modular style with an electronic feed mechanism.

NOTE 2—It is recommended that the operation/maintenance checklist shown in Appendix X1 should be completed at least once per month for gravelometers that are operated on a weekly basis, and once every 6 months for gravelometers that are operated less frequently. Note that values in the checklist are specific to the standard gravel testing protocol. Different specifications may be necessary for other media types.

⁴ Available from the Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

⁵ The sole source of a suitable apparatus meeting these specifications known to the committee at this time is Q-Panel Co., 26200 First St., Westlake, OH 44135. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

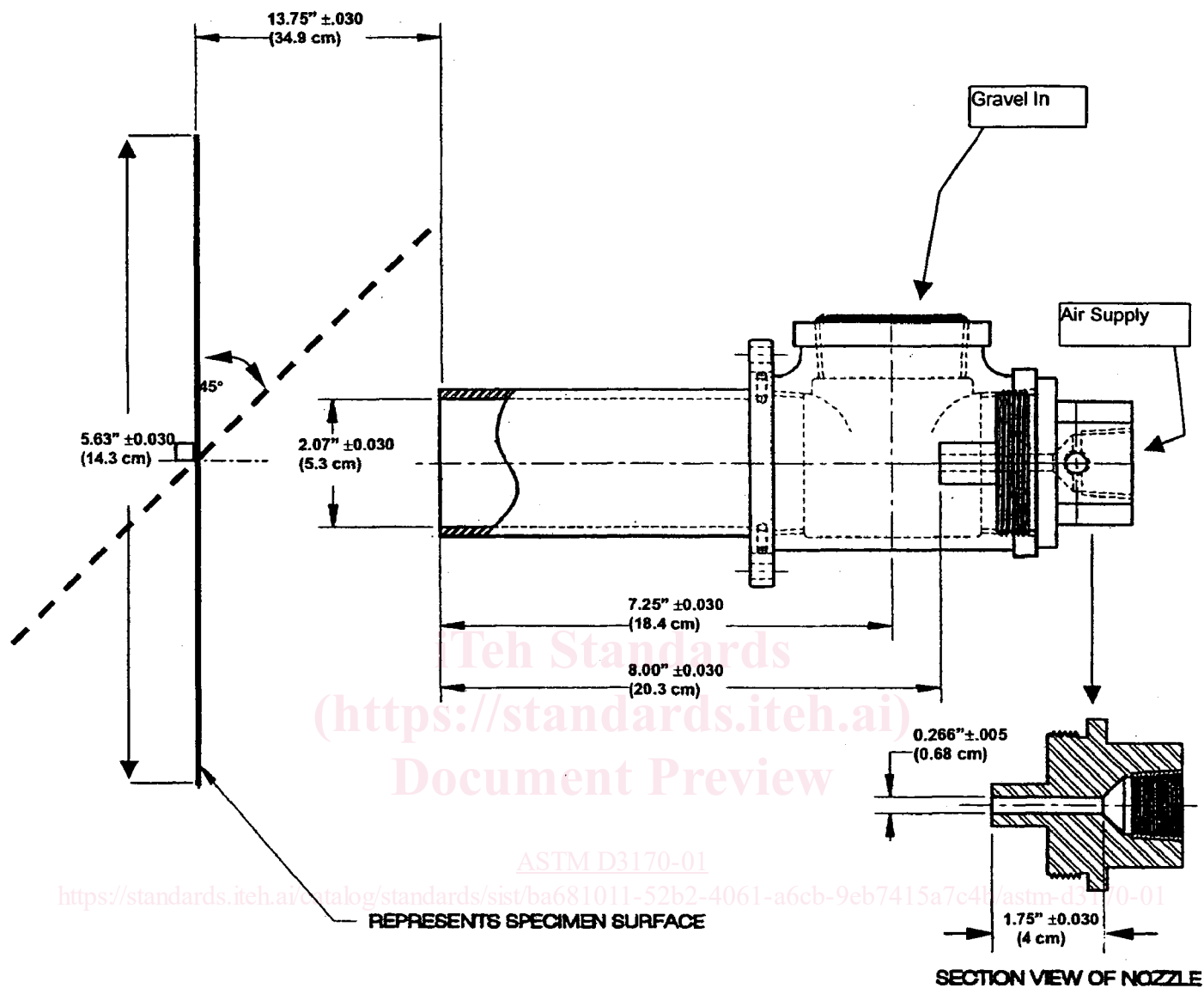


FIG. 1 Gravel Projecting Machine

5.2 *Gravel*—Water-eroded alluvial road gravel⁶ passing through a 16-mm (5/8-in.) space screen but retained on a 9.5-mm (3/8-in.) space screen. Note that mesh screen is not a substitute for a space screen. It is important to remove the small pieces of gravel before reusing the gravel. Other media may be used as agreed by contractual parties.

5.3 *Tape*, 100 mm (4 in.) wide.⁷ Other tape may be used as agreed upon by the contractual parties.

⁶ The sole source of supply of gravel meeting these specifications known to the committee at this time is Q-Panel Co. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

⁷ The sole source of supply of No. 898 filament strapping tape known to the committee at this time is the 3M Co., St. Paul MN 55101. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

5.4 *Temperature-Conditioning Equipment (alternatives):*

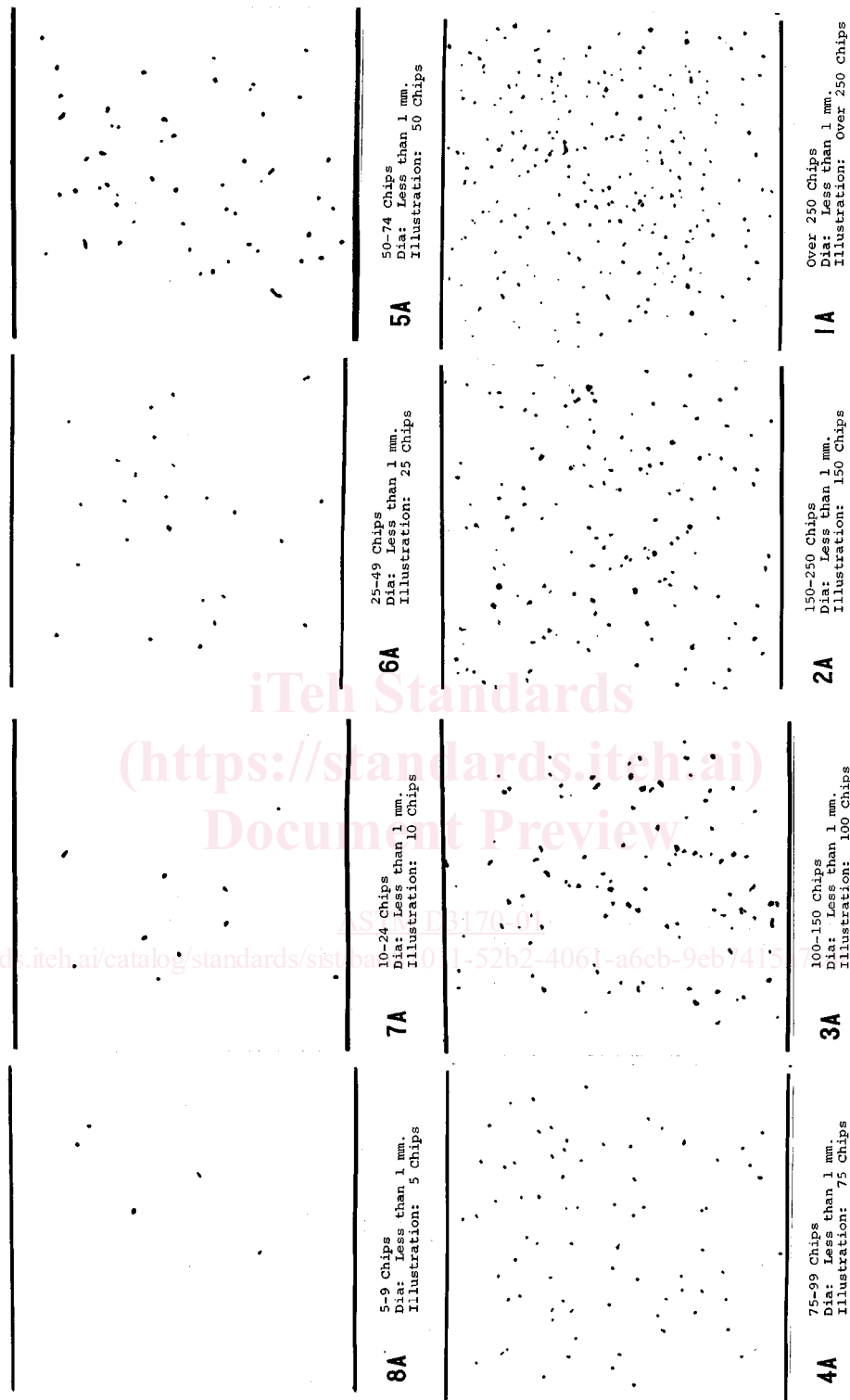
5.4.1 A cold room or freezer of sufficient size in which the gravel-projecting machine and test specimens can be maintained at the specified temperature of testing.

5.4.2 A freezer or cooler in which the test panels can be cooled 5°C (10°F) below the specified test temperature.

5.4.3 *Ambient*—Room maintained at a temperature between 20°C (68°F) and 30°C (86°F).

5.5 *Transparent Grid*—A chip counting aid constructed of transparent plastic approximately 3.176 mm thick by 12.7 cm square (1/8 by 5 by 5 in.), on which a 10.16 cm by 10.16 cm (4 by 4 in.) grid of 2.54 cm (1 in.) squares has been etched or scribed.

5.6 *Chipping Rating Standards*—A photographic transparency⁴ depicting size and number of chips in each category. See Fig. 2, Fig. 3, Fig. 4, and Fig. 5 for a representation of this transparency.



NOTE 1—Reprinted with permission from SAE EA-400 (c) 1985, Society of Automotive Engineers, Inc.
FIG. 2 Representation of Chipping Ratings

6. Test Specimens

6.1 The composition, surface preparation, and size of specimens shall be agreed upon between the purchaser and the seller. Test panels of 102 by 305 mm (4 by 12 in.) are commonly used.

NOTE 3—It is recommended that three replicates of each test specimen be exposed in the gravimeter. More replicates will improve the accuracy.

6.2 The number, type, method of application, and aging of

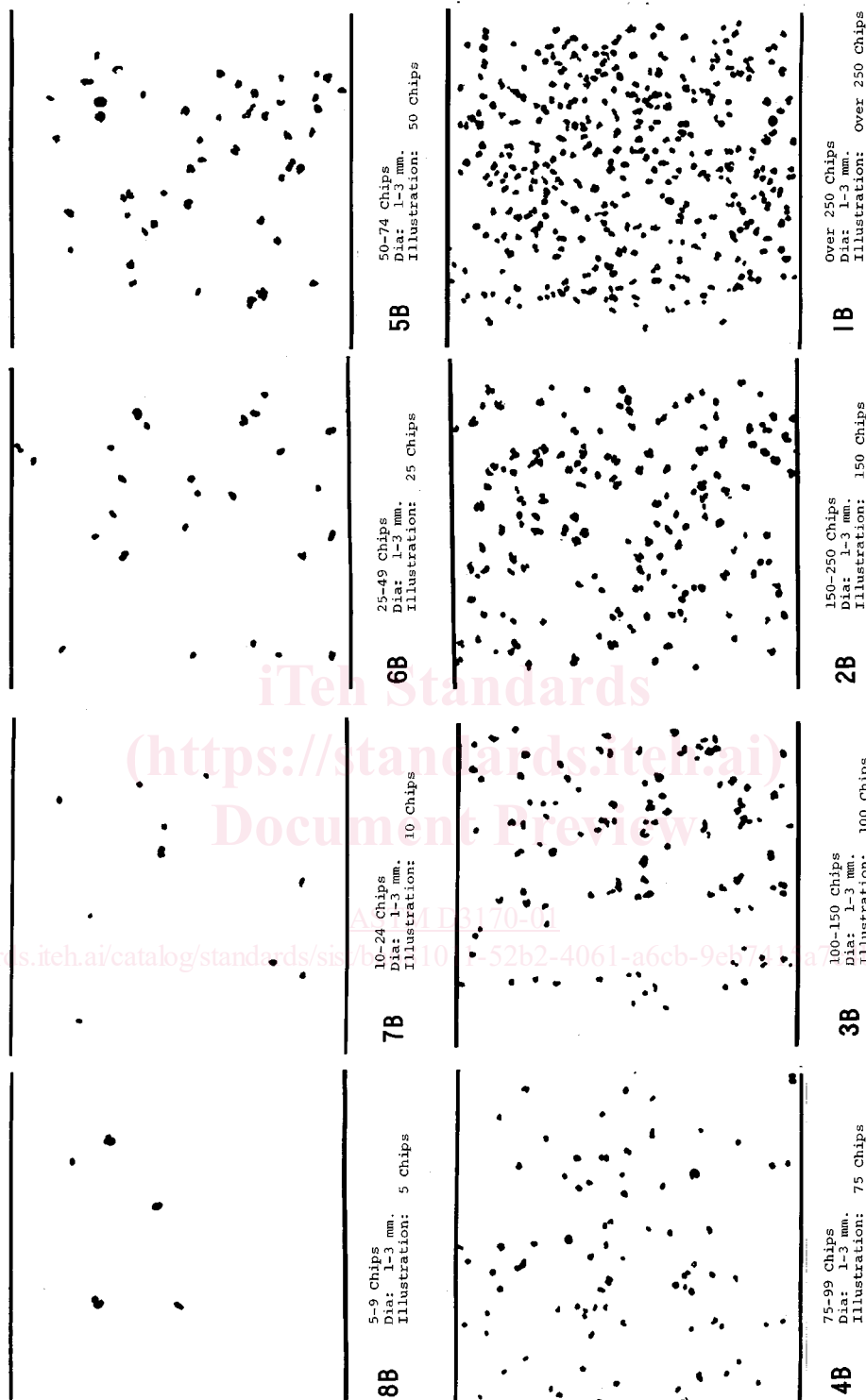


FIG. 3 Representation of Chipping Ratings, Continued

coatings shall be agreed upon between the purchaser and the seller.

NOTE 4—Application, metal preparation, and film thickness measurement methods are given in the following ASTM Practices: D 609, D 823 and D 2201, and Test Methods D 1005, D 1186, D 1400, and D 1733.

7. Procedure

7.1 Condition the specimens for a minimum of 1 h at the specified test temperature in the equipment specified in 5.4. Make certain the test specimens are separated and have free

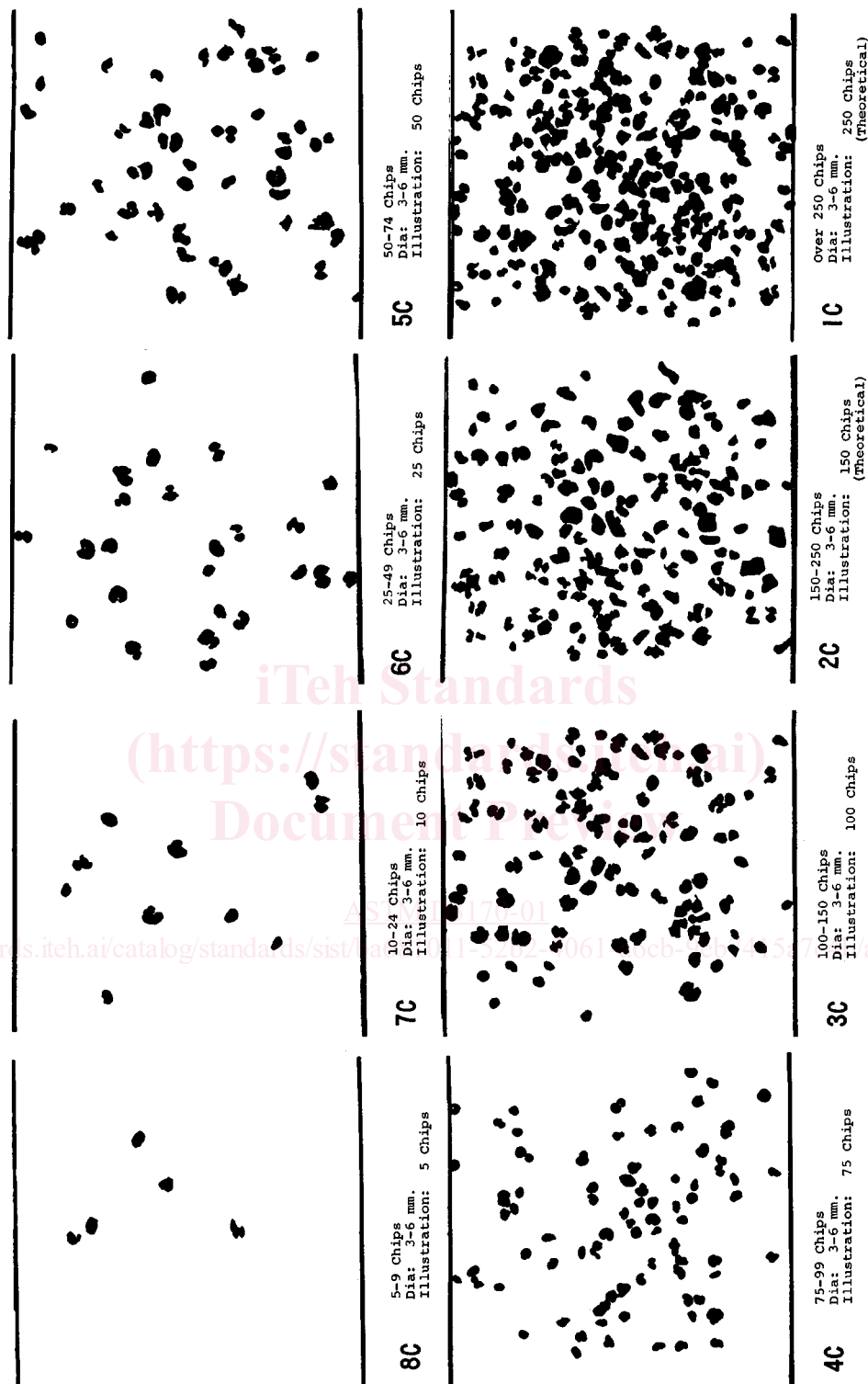


FIG. 4 Representation of Chipping Ratings, Continued

access to the conditioning environment so that optimum heat transfer occurs.

7.2 Adjust the air pressure on the gravel apparatus to 480 ± 20 kPa (70 ± 3 psi) with the air valve open.

NOTE 5—For cabinet type gravelometers, keep the lid to the gravel chamber closed during this operation as a safety precaution. Other air

pressures can be used as agreed upon by the contractual parties.

7.3 Cabinet Style Gravelometer:

7.3.1 After adjusting the air pressure, shut off the air valve, open the lid to the gravel chamber and collect 550 mL (1 pt) of graded gravel (approx 250 to 3000 stones) in a suitable container. Collect the gravel by scraping across the screen to

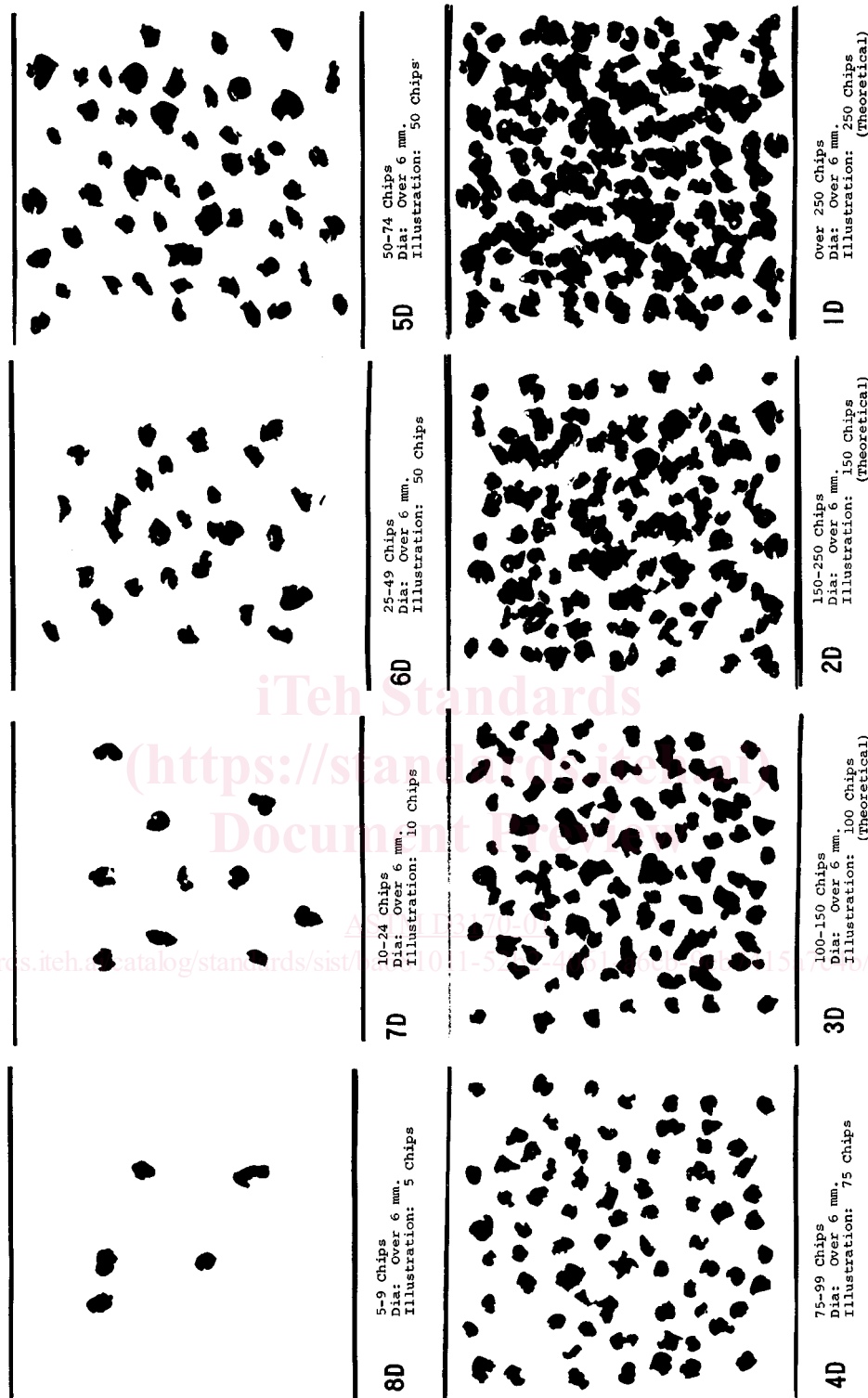


FIG. 5 Representation of Chipping Ratings, Continued

allow fines to fall through.

7.3.2 Place one test specimen at the desired test temperature in the panel holder with the coated side facing the front of the apparatus and close the lid to the panel chamber.

7.3.3 Open the gravel feed door and pour gravel from the one pint container obtained from 7.3.1 into the top of the gravel

hopper. Do not allow gravel to fall into the nozzle entrance.

7.3.4 Open the air valve to allow the air to project the gravel at the specimen.

NOTE 6—The gravel hopper must empty in 7 to 10 s. If gravel remains in the hopper after 10 s, stop the test and investigate the cause. The