Designation: ~~F109 – 12 (Reapproved 2018)~~ F109 – 21

Standard Terminology Relating to Surface Imperfections on Ceramics[1]

This standard is issued under the fixed designation F109; 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 terminology describes and illustrates imperfections observed on whitewares and related products. For additional definitions of terms relating to whitewares and related products, refer to Terminology C242. To observe these defects, examination shall be performed visually, with or without the aid of a dye penetrant, as described in Test Method C949. Agreement by the manufacturer and the purchaser regarding specific techniques of observation is strongly recommended.

1.2 This terminology does not cover every defect or imperfection possible for whitewares or related products. The standard is not intended to be an all inclusive document for ceramic imperfections. New defect types may be created as ceramic processes, materials, and technology evolve.

1.3 Some of the imperfection photos utilize magnification for clarity in documentation. Unless otherwise noted, typical observation conditions for detection of tile imperfections/defects shall consist of current ANSI A137.1 viewing criteria for the specific defect type

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C242 Terminology of Ceramic Whitewares and Related Products
C485 Test Method for Measuring Warpage of Ceramic Tile
C949 Test Method for Porosity in Vitreous Whitewares by Dye Penetration
~~E165~~E165/E165M Practice for Liquid Penetrant Testing for General Industry

2.2 *ANSI Standard:*[3]

ANSI A137.1 American National Standards Specifications For Ceramic Tile

3. Terminology

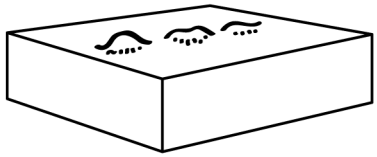
~~**blemish**—strained or discolored area attributable to normal composition or forming, or both. (See also **inclusion**.~~

[1] This terminology is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and is the direct responsibility of C21.01Editorial and Terminology on Nomenclature.

Current edition approved ~~Feb. 1, 2018~~Feb. 1, 2021. Published ~~February 2018~~March 2021. Originally approved in 1969. Last previous edition approved ~~2012~~2018 as ~~F109 – 12.~~F109 – 12 (2018). DOI: ~~10.1520/F0109-12R18.~~10.1520/F0109-21.

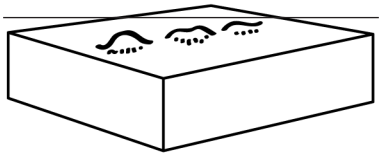
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.



3.1 *Definitions:*

blemish—strained or discolored area attributable to normal composition or forming, or both; see Fig. 1 in addition to the image below. (See also **inclusion**.)



blister—bubble or gaseous inclusion at the surface which if broken could form a pit, pock, or hole; see Fig. 2 in addition to the image below.

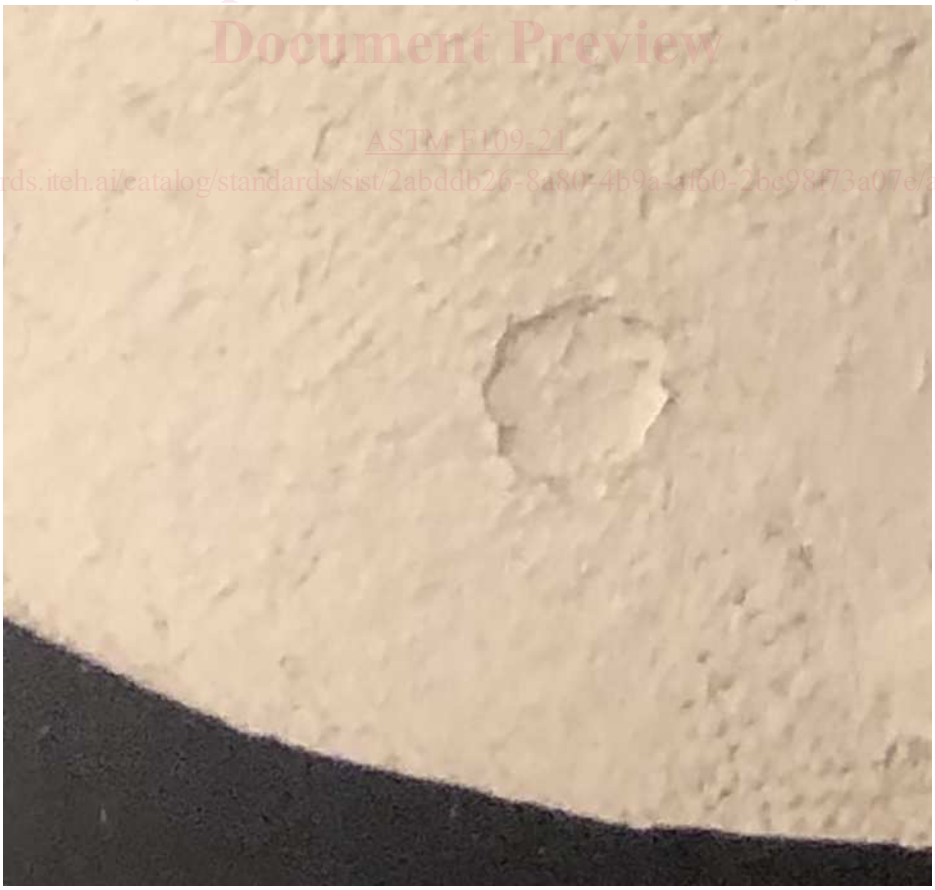


FIG. 1 Blemish

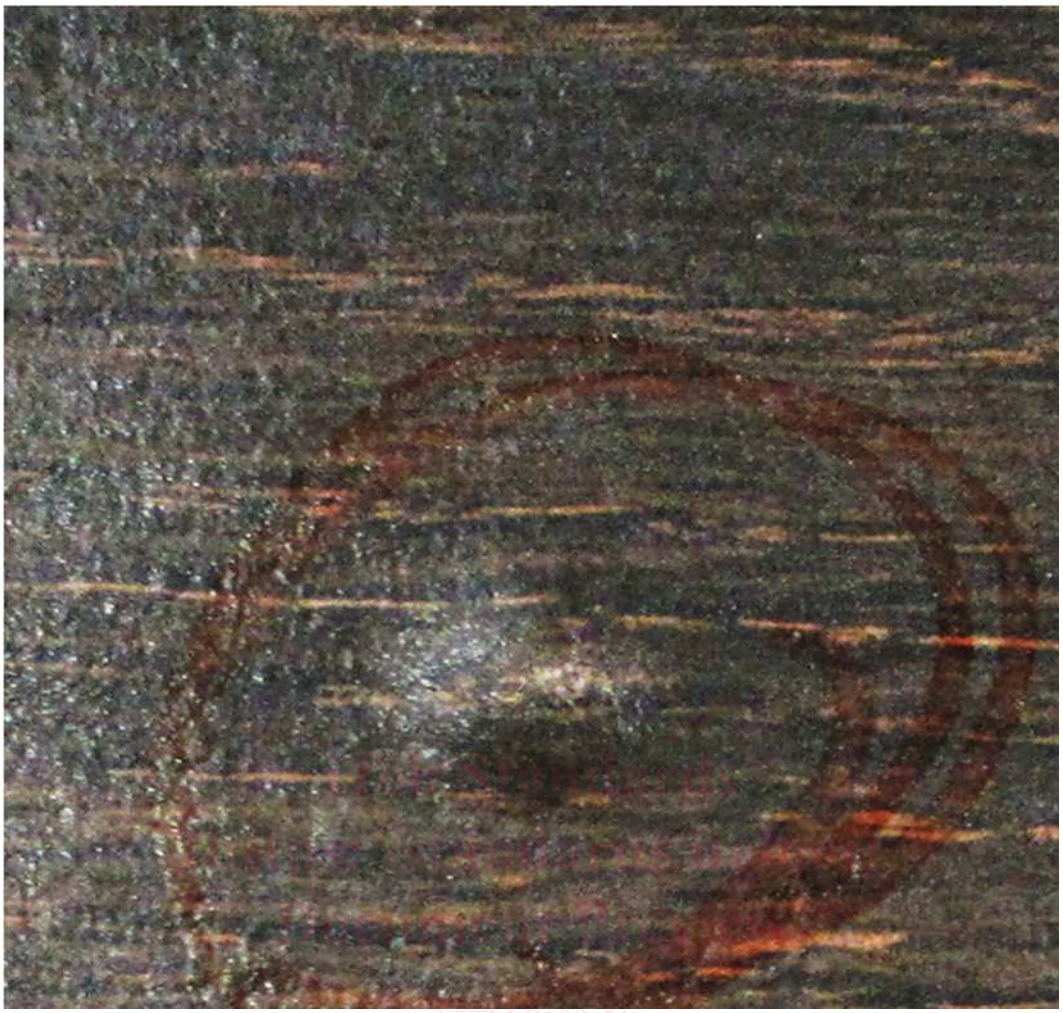
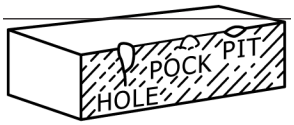
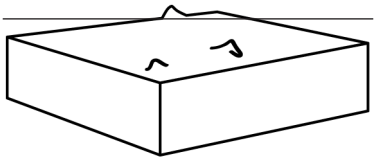


FIG. 2 Blister

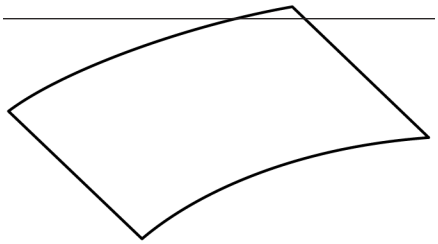


burr—fragment of excess material or foreign particle adhering to the surface; the photographed example was the result of debris from a ware explosion during firing; see Fig. 3 in addition to the image below.

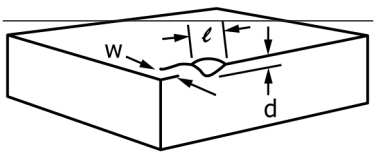


camber—a single arch of curvature; also called warpage when related to ceramic tile and defined as ANSI A137.1; warpage measurement for ceramic tile shall be evaluated with Test Method C485; see Fig. 4 in addition to the image below. (See also **waviness**.)

FIG. 3 Burr



chip, basic—area along an edge or corner where the material has broken off; see Fig. 5 in addition to the image below.



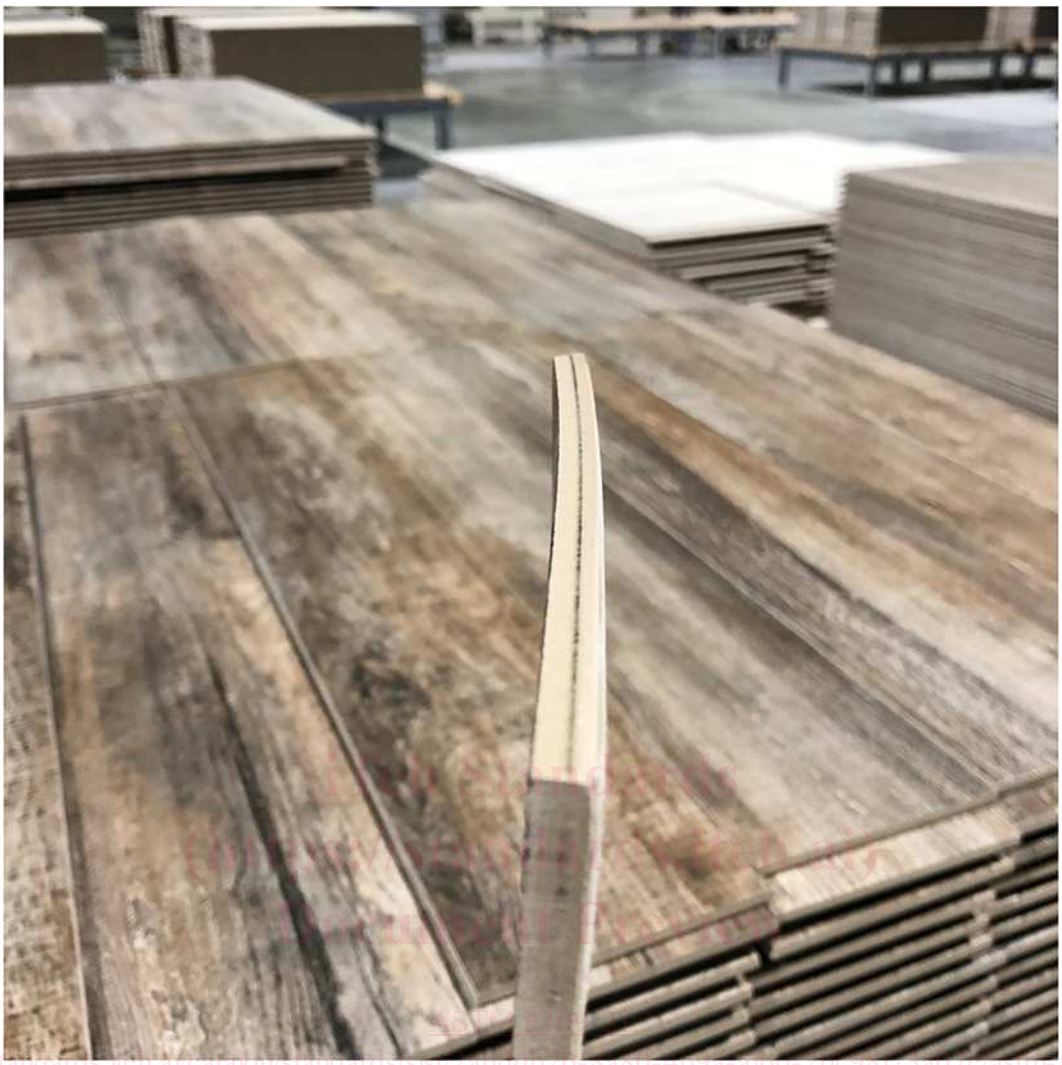
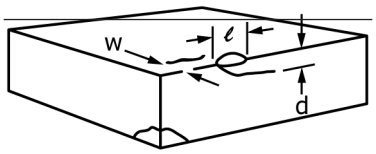


FIG. 4 Camber

where:

w = width
l = length, and
d = depth.

chip, closed —fractured area on the edge or corner when the material has not broken off; see Fig. 6 in addition to the image below. (Syn. *potential chip*)



where:

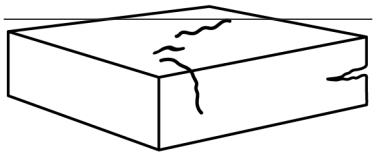
W = width
l = length, and
d = depth.

FIG. 5 Chip, Basic

chip, pre-print or pre-glaze—Surface damage that occurs prior to decorative glazing or printing; these may occur before or after the base color; the photographed examples in Fig. 7 show chips that were printed over with graphic, making them more difficult to detect; the upper picture of in Fig. 7 is a tile that was chipped after the base glaze, but prior to printing; the lower picture in Fig. 7 is a tile that was chipped prior to the initial glaze.

FIG. 5 Chip, Basic *(continued)*

crack, basic—line of fracture without complete separation; see Fig. 8 in addition to the image below.



crack, (cooling) dunting—a type of fracture that consists of long curving cracks with smooth and shiny edges; these tend to happen in the cooling area of the kiln; this is most often caused by the beta to alpha quartz transition around 573 °C; the transition causes a volume change between the crystal structures and corresponding internal stresses can lead to cracking; the fracture face tends to be smooth and slightly glossy compared to other types of fractures; these may or may not originate from a pre-existing flaw in the product; these are similar in appearance and cause to a **crack, (cooling) thermal shock**; see Fig. 9 in addition to the image below.

crack, (cooling) thermal shock—a cracky very similar in appearance to **crack, (cooling) dunting** as it is also the result of internal stress; however, this type of crack requires a thermal gradient in the ware to occur; the result of low thermal conductivity and high thermal expansion; the resultant stresses cause cracking when the stress exceed the tensile strength of the material; this

FIG. 6 Chip, Closed

may occur on the cooling cycle of product in a kiln; the photographs in Fig. 10 were the result of a forced thermal shock test that was conducted around 400 °C to avoid the quartz inversion effect.

crack, liquid contamination in greenware—water, oil, or other liquid gets into a localized region of the title prior to firing; on drying or firing it can cause an area of localized cracking; see Fig. 11.

crack, drying—typically small fissures that form 90 °C to the tile edge; these can occur when the greenware drying is uneven or too rapid; these may only be present on the glazed surface, or span through the body as well; the image at the bottom is a forced drying crack in a clay sample; see Fig. 12.

crack green—typically a fissure that does not extend far into the body; the causes can be impact damage, flexing, or other stresses to the pre-fired piece prior to firing; the crack tends to widen during the firing; the fracture edges tend to be rougher than other types of cracks (see Fig. 13, bottom photo); this may or may not seed a cooling crack.

crawling—a parting and contraction of the glaze on the surface of ceramic ware during drying or firing, resulting in unglazed areas bordered by coalesced glaze; see Fig. 14 in addition to the image below.

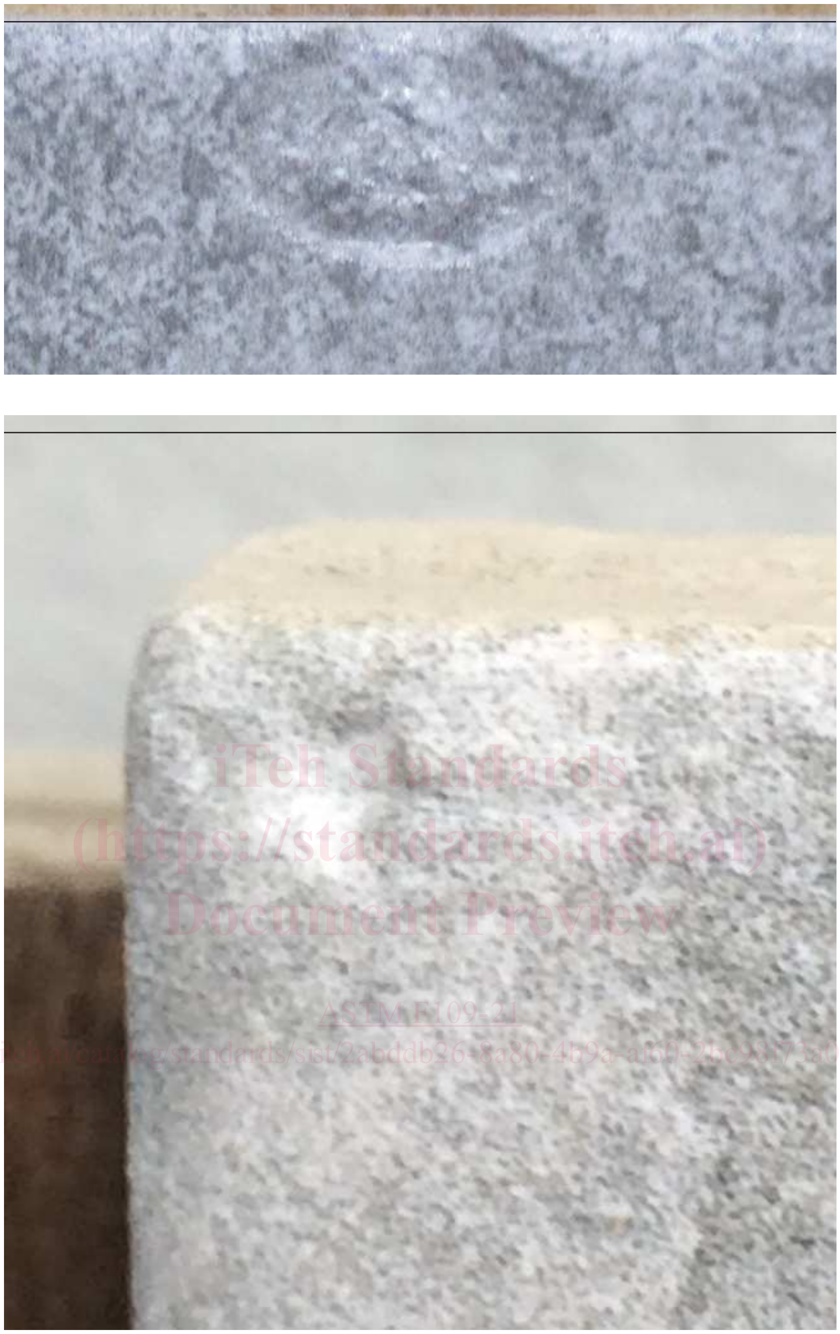


FIG. 7 Chip, Pre-print or Pre-glaze

FIG. 8 Crack, Basic

FIG. 9 Crack, (Cooling) Dunting

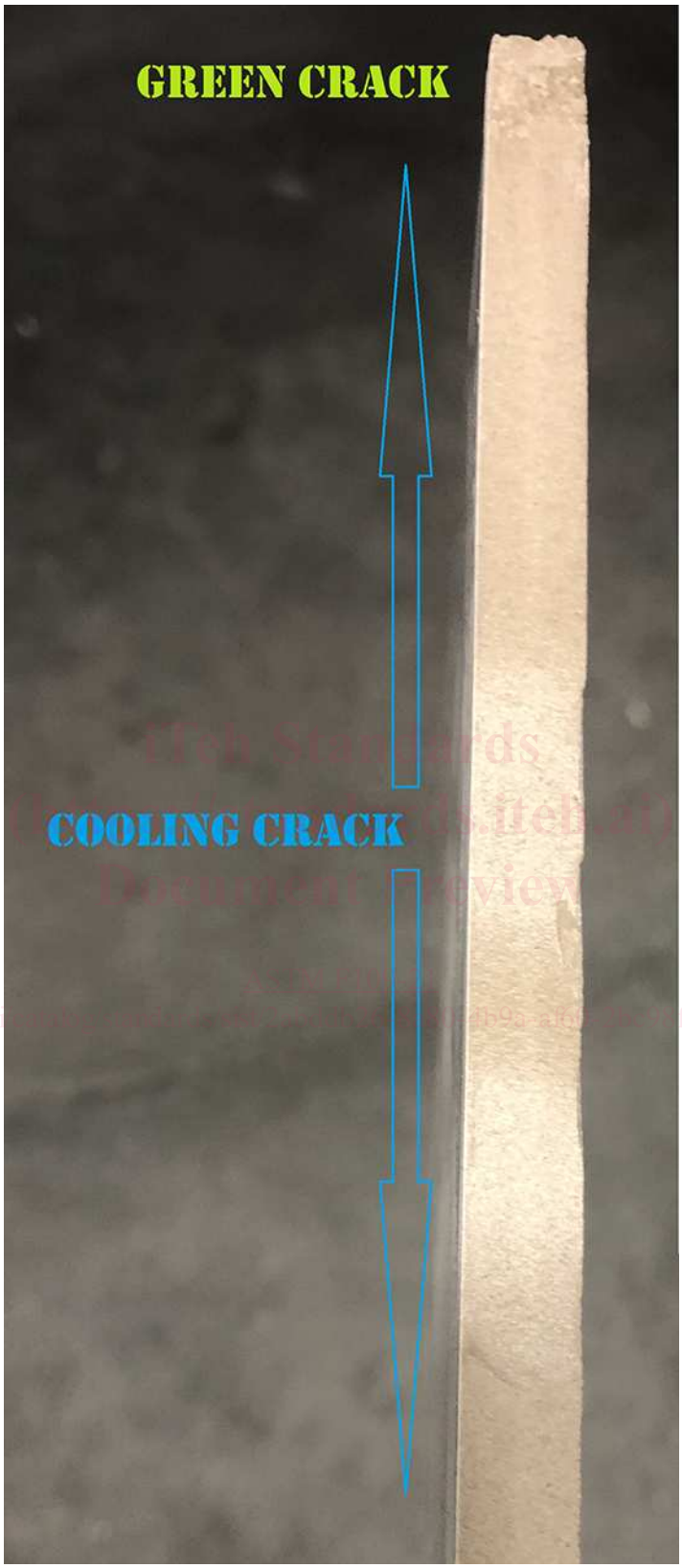
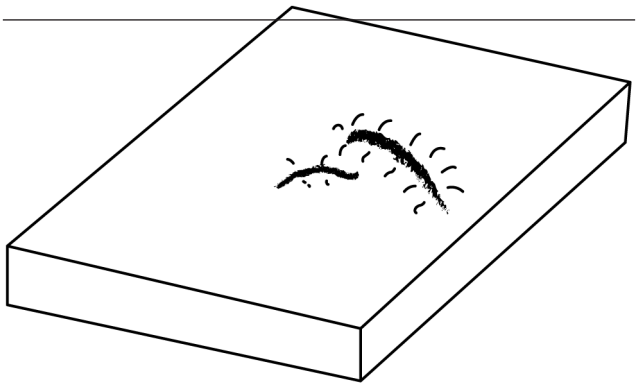


FIG. 9 Crack, (Cooling) Dunting *(continued)*

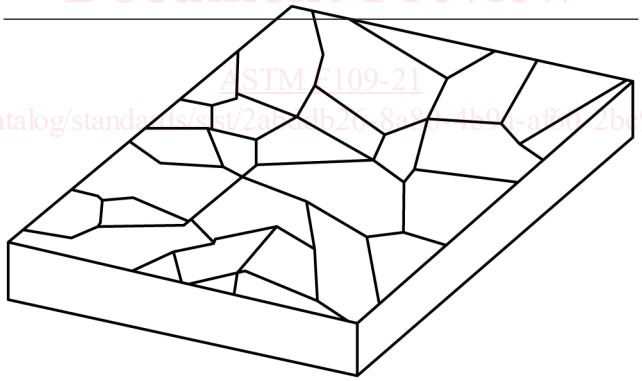
FIG. 10 Crack, (Cooling) Thermal Shock

FIG. 11 Crack, Liquid Contaminaon in Greenware



crazing—the cracking that occurs in fired glazes or other ceramic coatings as a result of tensile stresses; some surfaces are intentionally crazed for aesthetic reasons; in these cases crazing would not be considered an imperfection or defect; see Fig. 15 in addition to the image below.

FIG. 11 Crack, Liquid Contaminaon in Greenware *(continued)*



delaminaon—cracks that tend to run horizontal to the tile thickness; they may or may not break the surfaces; when broken, the areas tend to shale off in large flakes; this defect occurs during the body forming process (pressing or extrusion); see Fig. 16.

divot—a shallow depression; this can be the result of a pinhole or pit that was subjected to polishing; the result is a roughly circular halo effect; the phenomena can occur flat or as a very shallow depression; this defect is often more visible under glare conditions; see Fig. 17.

fin—fine feather-edge protrusion from the surface; on tile this can occur when the edges miss cleaning after pressing; on glazed products, the fin can shear off and expose the layer underneath the glaze; see Fig. 18 in addition to the following image. (Syn. *flash*)