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Standard Terminology Relating to Porcelain Enamel and Ceramic-Metal Systems¹

This standard is issued under the fixed designation C286; 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 U.S. Department of Defense.

1. Scope

- 1.1 These definitions pertain to the terminology used in the porcelain enamel and ceramic-coated metal industries.
- 1.2 Words adequately defined in standard dictionaries are not included. Included are words that are peculiar to these industries.
- 1.3 Hyphenated words, double words, or phrases are listed alphabetically under the first word; additional important words are cross-referenced.
- 1.4 When a word or phrase, listed as a synonym, is not separately defined, the defined word or phrase is the accepted or preferred form.

1.5 *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

[ASTM C286-22](https://standards.iteh.ai/catalog/standards/sist/74b28a88-7448-4a52-853a-117de2483181/astm-c286-22)

<https://standards.iteh.ai/catalog/standards/sist/74b28a88-7448-4a52-853a-117de2483181/astm-c286-22>

2.1 ASTM Standards:²

- [A424 Specification for Steel, Sheet, for Porcelain Enameling](#)
- ~~[A919B487 Terminology Relating to Heat Treatment of Metals](#)~~ [Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section](#) (Withdrawn 1999)
- [B915 Test Method for Measuring Static Heat Resistance of Self-Cleaning Oven Coating](#)
- [B916 Test Method for Adherence of Porcelain Enamel Coatings to Sheet Metal](#)
- [C282 Test Method for Acid Resistance of Porcelain Enamels \(Citric Acid Spot Test\)](#)
- [C283 Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid](#)
- [C285 Test Methods for Sieve Analysis of Wet-Milled and Dry-Milled Porcelain Enamel](#)
- ~~[C313 Method of Test for Adherence of Porcelain Enamel and Ceramic Coatings to Sheet Metal](#)~~ (Withdrawn 1989)³
- ~~[C314 Test Method for Flatness of Porcelain Enameled Panels](#)~~ (Withdrawn 1979)³
- [C346 Test Method for 45-deg Specular Gloss of Ceramic Materials](#)
- ~~[C347 Test Method for Reflectivity and Coefficient of Scatter of White Porcelain Enamels](#)~~ (Withdrawn 1990)³
- [C374 Test Methods for Fusion Flow of Porcelain Enamel Frits \(Flow-Button Methods\)](#)

¹ This terminology is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.12 on Materials for Porcelain Enamel and Ceramic-Metal Systems.

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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.

[C385 Test Method for Thermal Shock Resistance of Porcelain-Enameled Utensils](#)
[C448 Test Methods for Abrasion Resistance of Porcelain Enamels](#)
[C614 Test Method for Alkali Resistance of Porcelain Enamels](#)
[C633 Test Method for Adhesion or Cohesion Strength of Thermal Spray Coatings](#)
[C743 Test Method for Continuity of Porcelain Enamel Coatings](#)
[C756 Test Method for Cleanability of Surface Finishes](#)
[C774 Test Method for Yield Strength of Enameling Steels After Straining and Firing](#)
[D523 Test Method for Specular Gloss](#)
[D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates](#)
[D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser](#)

3. Terminology

abrasion resistance—resistance, *n*—the degree to which a porcelain enamel will resist attack by abrasive materials.

NOTE 1—See Test Methods [C448](#) and [D4060](#).

~~**acid annealing**—an annealing process in which ferrous metal shapes are coated with acid before and in conjunction with the annealing.~~

acid resistance—resistance, *n*—the degree to which a porcelain enamel will resist attack by acids.

NOTE 2—See Test MethodMethods [C283](#) and Test Method [C282](#).

adherence—adherence, *n*—(1) the degree of adhesion of a porcelain enamel or other ceramic coating to a metal substrate.

NOTE 3—See Test Method ~~[C343](#)~~[B916](#).
 (2) Stress necessary to cause separation of one material from another at their interface.

NOTE 4—See Test Method [C633](#).

aging—aging, *n*—the storing of porcelain enamel slips or powders before use. The change occurring in slips or powders with the lapse of time.

air atomizing—atomizing, *n*—air used to atomize powder and to control powder/air mix and powder cloud density.

air fluidizer—fluidizer, *n*—air used to impart fluid-like properties to powder via a fluid bed.

alkali resistance—resistance, *n*—*for porcelain enamels*, the degree to which a porcelain enamel will resist attack by aqueous alkaline solutions.

NOTE 5—See Test Method [C614](#).

alligator hide—hide, *n*—a defect characterized by an extreme roughness of the porcelain enamel surface: a severe case of orange peel.

aluminum enamel—enamel, *n*—a porcelain enamel specifically designed for application to aluminum.

annealing—see Terminology [A919](#).

annealing acid—see ~~**acid annealing**~~ and ~~**annealing**~~.

anti-scale compound—compound, *n*—a preparation that is applied to burning tools to protect them from scaling in service.

back emission—emission, *n*—the electrical breakdown of air due to excessive charge build-up in the porcelain enamel powder film during powder application. This is due to the self-limiting characteristic of electrostatic powders.

back ionization—ionization, *n*—see **back emission**.

ball mill—mill, *n*—*in porcelain enamels*, a dense, ceramic-lined rotating cylinder in which ceramic materials are wet or dry ground, generally using pebbles or porcelain balls as grinding media.

base coat—coat, *n*—for two coat-one fire application, the thin layer of bonding frit applied first and used to promote adherence after firing to the metal substrate.

base metal—metal, *n*—the metal to which porcelain enamel is applied.

basis metal—see **base metal**.

basket, pickle—see **pickle basket** and **pickling**.

batch smelter—smelter, *n*—any smelter that operates as a periodic unit, being charged, fired, and discharged according to a predetermined cycle.

beading—beading, *n*—(1) the application of porcelain enamel, usually of a contrasting color, to the edge or rim of porcelain enameled articles.

(2) Removal of excess slip from the edge of dipped ware.

(3) In dry processing enameling, a bead of porcelain enamel along the edge of ware.

beading enamel—enamel, *n*—any of the special porcelain enamels used for beading.

bisque—bisque, *n*—a coating of wet-process porcelain enamel that has been dried, but not fired.

<https://standards.iteh.ai/catalog/standards/sist/74b28a88-7448-4a52-853a-117de2483181/astm-c286-22>

blackboard enamel— see **chalkboard enamel**.

black edging—edging, *n*—a black porcelain enamel applied over the ground coat and exposed in specified areas by brushing the cover coat bisque prior to firing (see also **edging**).

black speck—speck, *n*—a defect that appears in the fired cover coat as a small dark spot.

blank—blank, *n*—the piece cut from metal sheet that is to be used in forming the finished article.

blemish—blemish, *n*—*in dry process enameling*, an insignificant imperfection in the porcelain enamel surface.

blister—blister, *n*—a defect caused by gas evolution consisting of a bubble that forms during fusion and remains when the porcelain enamel solidifies.

blow-off resistance—resistance, *n*—the degree to which a deposited layer of powder resists being blown off by a standard jet of air.

blue enamel—enamel, *n*—(1) *in dry-process porcelain enameling*, an area of enamel coating so thin that it appears blue in color.

(2) *In wet-process enameling*, a cover coat applied too thin to hide the substrate.

boiling—boiling, *n*—a defect visible in the fired porcelain enamel caused by gas evolution which results in the formation of blisters, pinholes, black specks, dimples, or spongy surface.

bolt-hole brush—brush, *n*—a special round brush used to remove porcelain enamel bisque from in and around small openings in the ware.

bond, *bond* *n*—see **adherence**.

box furnace—a furnace in which, periodically, a load of ware is ~~introduced~~;introduced, fired, and removed.

break out—out, *n*—*in dry process enameling*, a defect characterized by an area of blisters with well defined boundaries.

bright annealing—see Terminology **A919**.

brush—brush, *v*—to remove bisque in a definite pattern by means of a brush.

brush, bolt-hole~~bolt-hole, *n*~~—see **bolt-hole brush**.

brushing, *brushing* *v*—see **brush**.

bubble structure—structure, *n*—size and spatial distribution of voids within the fired porcelain enamel.

buck—buck, *n*—a special support for ware during the firing of porcelain enamel on heavy ware.

burning, *burning* *n*—see **firing**.

burning bars, points, or tools—tools, *n*—equipment used to suspend or support ware during the firing operations.

burning tool mark—mark, *n*—a defect in the porcelain enamel appearing on the surface opposite to the point of contact with the supporting burning tool.

button test—test, *n*—a test designed to determine relative fusibility of porcelain enamel frit or powder and so called because the completed specimens resemble buttons.

NOTE 6—See **flow button** and Test Methods **C374**.

cast iron enamel—enamel, *n*—a porcelain enamel specifically designed for application to cast iron.

ceramic coating—coating, *n*—an inorganic, essentially nonmetallic coating, on ~~metal~~metal that is a product of sintering and fusion of glass or ceramic materials, or both, applied by wet spray, dipping, electrophoresis, flow coating, dry electrostatic spray, or flame spraying.

ceramic colorant~~colorant, *n*~~—see **color oxide**.

ceramic ink—ink, *n*—an ink containing a ceramic pigment that develops its color on firing. Also known as stamping, screening, or printing ink.

ceramic-metal coating—coating, *n*—a mixture of one or more ceramic materials in combination with a metallic phase applied to a metallic substrate which may or may not require heat treatment prior to service. This term may also be used for coatings applied to nonmetallic substrates, for example, graphite.

cermet coating—coating, n—see **ceramic-metal coating**.

chalkboard enamel—enamel, n—a special type of mat porcelain enamel used to provide a writing surface for chalk.

chalky or chalked—chalked, adj—the condition of a porcelain enameled surface that has lost its natural gloss and become powdery.

charge decay—decay, n—loss of charge on the deposited powder due to electrical leakage.

charge decay rate—rate, n—loss of charge per unit of time.

charge retention—retention, n—the ability of an electrically charged layer to retain its initial charge.

charge to mass ratio—ratio, n—ratio of the charge on a powder expressed in coulombs to the mass of the powder expressed in kilograms.

chipping—chipping, n—fracturing and breaking away of fragments of a porcelain enameled surface.

cleanability—cleanability, n—the relative ease with which soils or stains can be removed from a material.

NOTE 7—See Test Method [C756](#).

cleaner—cleaner, n—a solution, usually alkaline, used to remove oil, grease, drawing compounds, and loose dirt from metal as a step in preparing the surface for porcelain enameling.

clear frit—frit, n—a frit that remains essentially transparent or non-opaque when processed into a porcelain enamel.

coating, coatingn—see **ceramic coating** and **ceramic-metal coating**; see **ceramic coating** and **ceramic-metal coating**.

NOTE 8—See Test Method [D2244](#).

coefficient of scatter—the rate of increase of reflectance with thickness at infinitesimal thickness of porcelain enamel over an ideally black backing.

NOTE 8—See Test Method [C347](#).

cold-rolled steel—steel, n—a low-carbon, cold-reduced cold-reduced, and annealed sheet steel; steel with carbon content below 0.05 % (see Specification [A424](#) Type II).

color, n—a sensual impression caused by light coming from a source of light or reflected from an irradiated object. See Test Method [D2244](#) for measurement by colorimetry.

color difference, n—see Test Method [D2244](#).

color oxide—oxide, n—a material used to impart color to a porcelain enamel.

colored frit—frit, n—a frit containing a colorant in order to produce a strong color in the porcelain enamel.

comb-rack—comb-rack, *n*—(1) a burning tool shaped like a comb used for supporting ware during firing.
(2) A comb-like tool for supporting ware during the metal pickling operation.

comeback—comeback, *n*—the time required for a box furnace to return to temperature after the introduction of a load of ware.

cone-screen test—test, *n*—a method for testing fineness of enamel with a cone-shaped sieve. (see also **screen test**)

consistency—consistency, *n*—the properties of a slip that control its draining, flowing, and spraying behavior.

continuity of coating—coating, *n*—the degree to which a porcelain enamel or ceramic coating is free of defects, such as bare spots, boiling, blisters or copperheads, that could reduce its protective properties.

NOTE 9—See Test Method **C743**.

continuous cleaning (coating)—(coating), *n*—a term describing a type of porcelain enamel designed to provide the continuous removal, at normal use temperatures, of food soils accumulated on the interior surfaces of ovens.

continuous furnace—furnace, *n*—a furnace into which ware is fed continuously and through which it progresses during firing.

continuous smelter—smelter, *n*—a type of smelter into which the raw mix is fed continuously and from which the molten product is discharged continuously.

contrast ratio—the ratio of the reflectance of a coating over black backing to its reflectance over a backing of reflectance of 0.80 (80 percent).

NOTE 10—See Test Method **C347**.

cooling zone—zone, *n*—that part of the continuous furnace in which the ware is allowed to cool after firing.

copper enamel—enamel, *n*—a porcelain enamel specifically designed for application to copper.

copperhead—copperhead, *n*—a defect occurring in sheet metal ground coat that appears as a small freckle or pimple-like spot, reddish brown in color.

cover coat—coat, *n*—a decorative porcelain enamel finish applied and fused over a ground coat or direct to the metal coat that requires the use of a base coat or a ground coat for adherence to the substrate.

covering power—power, *n*—the degree to which a porcelain enamel coating obscures the underlying surface.

cracking—cracking, *n*—a defect in the bisque consisting of fractures or separations.

crackled—crackled, *n*—a mottled textural effect in a wet process porcelain enamel resembling a wrinkled surface.

crater, *n*—a dimple defect greater than 1 mm in diameter; see **dimple**.

crawling—crawling, *n*—a defect in the porcelain enamel appearing as agglomerates or irregularly shaped islands.

craze, crazing—crazing, *n*—a defect appearing as one or more fine cracks in the porcelain enamel.

erinkled—crinkled, *adj*—a textural effect in a porcelain enamel surface having the appearance of fine wrinkles or ridges.

crossbend test—test, *n*—a test in which fired or bisque porcelain enamel panels are progressively distorted by bending to determine the resistance of the coating to cracking.

cup gun—gun, *n*—a spray gun with a fluid container as an integral part.

eupping—cupping, *v*—the pouring of slip over areas of a part during draining to produce uniform application.

curling—curling, *n*—a defect similar to crawling.

curtains—curtains, *n*—a defect in sheet steel ground coatings characterized by a draped pattern of darkened areas that are sometimes blistered. May also appear in cover coats applied over the ground coat or direct-on.

decarburized enameling steel—steel, *n*—a special type of steel sheet of extremely low carbon content, suitable for porcelain enamel cover coat application direct to the metal (Type I of content below 0.008 % achieved by open coil annealing (see Specification [A424](#)); Type I).

decarburized steel—steel, *n*—see **decarburized enameling steel**.

decking—decking, *v*—the multiple layer loading of ware for firing.

de-enameling—de-enameling, *v*—the removal of porcelain enamel from the base metal.

deflocculating—deflocculating, *v*—the thinning of the consistency of a slip by adding a suitable electrolyte. [ASTM C286-22](#)

delayed fishscaling—fishscaling, *n*—a fishscaling defect that occurs after the final porcelain enamel processing (see also fishscaling).

devitrification—devitrification, *n*—a surface defect manifested by loss of gloss as a result of crystallization.

dimple—dimple, *n*—a shallow depression in the porcelain enamel, sometimes a defect.

dipping—dipping, *v*—the process of coating a metal shape by immersion in slip, removal, and draining. In dry process enameling, the method of coating by immersing the heated metal shape for a short time in powdered frit.

dipping weightweight, *n*—see **pick-up**.

direct fire—fire, *n*—a method of maturing porcelain enamel wherein the products of combustion come in contact with the ware.

direct-on, *direct-on*—see **cover coat**. a single coat of enamel on the metal substrate.

double draining—draining, *n*—a defect evidenced by flowing of the slip on the ware, which occurs after it appears that draining has been completed.