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भारतीय मानक मसौदा

पारिभाषिक शब्दावली विट्रियस एनामेलवेयर से संबंधित और सिरेमिक-धातु प्रणाली

(*दूसरा पुनरीक्षण*)

Draft Indian Standard

GLOSSARY OF TERMS RELATING TO VITREOUS ENAMELWARE AND CERAMIC-METAL SYSTEMS

(*Second Revision*)

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FOREWORD

(*formal clause to be added later*)

In the preparation of this standard assistance had been derived from publication C286-1977 ‘Standard definitions of terms relating to porcelain enamel and ceramic-metal systems’, issued by the American Society for Testing and Materials, USA.

This standard was first published in 1964 under the title ‘Glossary of terms used in vitreous enamelware industry’. The first revision of this standard was brought out in 1979. In this revision, new terminologies have been added and due assistance has been derived from publication ISO 19496-1 ‘Vitreous and porcelain enamels — Terminology — Part 1: Terms and definitions’, issued by the International Organization for Standardization.

1 SCOPE

This standard covers the terms and definitions relating to vitreous enamelware and ceramic-metal systems.

2 TERMS AND DEFINITIONS

A

Ablation — Wearing and carrying away of the surface layer used as a protective coverage of an object exposed to an environment of intense heat and/or abrasion.

Abrasion Resistance — The degree to which an enamel coating will resist attack by abrasive materials.

Abrasives — Materials used for wearing off the surface.

Acid Annealing — An annealing process in which ferrous metal shapes are coated with acid before and in conjunction with annealing.

Acid Resistance — The degree to which an enamel coating will resist attack by acid solutions.

Adherence — The degree to which an enamel or other ceramic coating remains attached to the metal substrate.

Adherence of powder — Ability of a vitreous enamel powder to remain attached by static attraction to a grounded *substrate* before *firing*.

Ageing — The storing of enamel slip after milling for predetermined time to improve its suspension properties.

Air Seal Air Curtain — flow of pressurized air across the entrance and exit of a *continuous furnace* that prevents heat escaping from the furnace but allows ware to pass through

Alkali Degreasing — removal of oil, grease, lubricants, and loose debris from the surface of the metallic substrate by immersion or spraying with an aqueous alkali degreaser in preparation for *vitreous enamelling*

Alkali Resistance — The degree to which an enamel coating will resist attack by aqueous alkali solutions.

Alligator Hide — A defect characterized by extreme roughness of the enamel surface, a severe case of ‘orange peel’.

Aluminium Enamel — An enamel specifically designed for coating aluminium or aluminium alloys.

Anatase — One of the crystalline forms of titanium dioxide which imparts characteristic white colour to vitreous enamel.

Annealing — Heating metal shapes or raw castings to a suitable temperature to relieve stress prior to cleaning.

Anti-scale Compound — A preparation which is applied to ‘Burning Tools’ to protect them from scaling, while in service.

Architectural Enamel — An enamel used for manufacturing architectural panels to produce a texture and finish for indoor or outdoor use in building construction.

B

Back Emission Back Ionization — Defect often with the appearance of localized, very heavy *orange peel*, due to excessive charge build-up in the powder film resulting in electrical breakdown of air (i.e. back emission).

NOTE — The effect of the self-limiting characteristics of the electrostatic powder during application.

Ball Mill — A rotating cylinder lined with porcelain, silex or any other such tiles, used for wet or dry milling of ceramic materials. Generally, pebbles, porcelain balls, etc, are used as grinding media.

Base Metal — The metal on which enamel coating is applied.

Batch — A mixture of raw materials used for the preparation of frit.

Batch Smelter — Smelter that operates as a periodic unit, being charged, fired and discharged according to a predetermined cycle.

Bead

a) A turned edge on any fabricated article.
b) Spherical or semi-spherical accumulation of enamel on an enamelled surface.

Beading

a) The process of turning the edge of any fabricated article.
b) The application of enamel of contrasting colour on the bead or rim of any article.

Beading Enamel — Enamel specially prepared for beading [see '**Beading** (b)']

Beading Enamel Rim Enamel — *Vitreous enamel* specifically formulated for *beading*.

Bend Test — A test in which the enamelled article is progressively distorted by bending to determine resistance of the enamel coating to fracture.

Bentonite — Highly colloidal clay mineral which greatly increases the 'set' of an enamel slip when used in small amounts with clay.

Biocide — Anti-bacterial agent used to inhibit fermentation of organic *mill additions* such as gums.

Biscuit Cracking — The fracturing of the enamel biscuit.

Biscuit or Bisque — The dried coating of wet process enamel before firing.

Bisque — Dry unfired vitreous enamel coating

Black Edging

a) A black enamel used for beading [*see* ' **Beading** (b)']
b) The process of brushing off cover coat bisque and then applying the black vitreous enamel over the ground coat or exposed area prior to firing.

Blackboard Enamel — A special type of cover coat enamel used for providing a writing surface for chalk.

Blackhead — A defect similar to copperhead, but smaller and black, It may occur on ware that has been enamelled following nickel dip.

Black Speck — A defect that appears in the fired cover coat as a small dark speck.

Blank — A piece cut from metal sheet to the size required to form a finished article.

Blasting — The cleaning of metal surface by impingement of abrasive material projected against it at high speed.

Blister — A defect consisting of a bubble or a circular hole in the enamel coat exposing ground coat or metal.

Bloom — Visual exudation or efflorescence on the vitreous enamel surface

Blowhole

a) A void in the metal castings.
b) A void in the enamel surface associated, with a void in the 'base metal '.

Blue Enamel — In dry process enameling, an area of enamel coating so thin, that it appears blue.

Boiling — Defects visible in fused enamel surface which may take the form of numerous blisters, pin-holes, black specks, dimples or spongy surface.

Bolt-Hole Brush — A special round brush used to remove bisque from in and around small openings in the ware.

Box Furnace — A furnace in which a load of ware is periodically introduced, fired and removed.

Break Out — In dry process enameling defect characterized by an area of blisters with well-defined boundaries.

Bright Annealing — The heating of steel to red heat in a reducing atmosphere to avoid oxidation.

Bubble Structure — The size and distribution of voids or bubbles in the fused enamel surface.

Buck— A special support for heavy ware during the firing of enamel.

Burning Bars, Points or Tools — An equipment used to suspend or support the ware during firing operations.

Burning Tool — *See* 'Perrett'.

Burn Off — A surface lacking in gloss due to overfiring of enamel.

Button Test — A test to determine the relative fusibility of enamel frits or powder, so called because the fused test specimens resemble buttons.

C

Cascading — Defect that starts with a few particles of powder detaching themselves after application and as they cascade down the ware they gather more and more powder leaving a trail of thinner and thinner coating.

NOTE — Excess powder, inadequate powder adhesion and vibration contribute to this defect.

Cast Iron Enamel — An enamel specifically designed for application to cast iron

Ceramic Coating — An inorganic, non-metallic protective coating on metal, generally for use at high temperatures (above red heat).

Ceramic Fertilizer — Special types of enamel or glass frits containing minute quantities of certain trace elements, which are gradually released into the soil to provide nutrients to the plants.

Ceramic Ink — An ink containing a ceramic pigment which develops its colour on firing, used for ceramic transfers and in the silk-screen process.

Chalkboard Enamel — *See* '**Blackboard Enamel**'.

Chalky — The condition of an enamelled surface which has lost its gloss due to devitrification, or atmospheric corrosion, frequently leaving a loose deposit.

Chemical Resistance — Degree of resistance of *vitreous enamel* to attack by corrosive chemicals.

Chempleve — Jewellery enamelling in which different coloured enamels are separated by ridges of metal remaining after the design has been cut into the surface.

Chilled Shot — Metallic abrasive comprising crushed, chilled iron or rounded steel shots used for blasting cast metal surfaces prior to enamelling.

Chipping — Fracturing and breaking away of fragments of fused enamel from the surface.

Chromel Metal — Heat resistant nickel-chromium alloy used for making jigs for suspending or supporting enamelware in the furnace during firing.

Cleanability — Relative ease with which soils or stains can be removed from a fused vitreous enamel surface.

Cleaner — An alkaline solution or organic solvent used to remove oil, grease, drawing compounds or dirt from the sheet metal ware prior to pickling.

Cleaning Degreasing — Removal of foreign materials, such as abraded metallic particles from pressing or blasting, grease, oil, oxides, scale, rust, swarf, etc., from the surface.

NOTE — *See* vapour degreasing.

Clear Frit — A frit which remains essentially transparent after fusing.

Cloisonné — Jewellery enamelling in which enamels of different colours are separated by fine wires secured to the metal base.

Coating — Application of enamel to cover a surface.

Coefficient of Expansion — Rate at which a material will expand under the influence of increasing temperature.

Coefficient of Scatter — The rate of increase of reflectance with thickness at infinitesimal thickness of enamel over an ideal black backing.

Cold-Rolled Steel — A low-carbon, cold-reduced sheet steel.

Colour Difference Meter — An instrument for measuring, by reflectance, the difference between shades of colour.

Coloured Frit — A frit obtained by melting a raw batch in which a colourant has been added.

Colour Matching — comparison of two or more samples of products that are notionally the same colour.

Colour Oxide — Material used to impart colour to vitreous enamel.

Comb-Rack — A burning tool shaped like a comb.

Comeback —The time required by a box furnace to return to temperature after the introduction of a load of ware.

Cone-Screen Test — A method for testing fineness of milled enamels with a cone-shaped sieve [*see* also 'Screen Test']

Consistency —The property of an ename1 slip which controls its draining, flowing and spraying behaviour [*see* also 'Viscosity' and '**Thixotropy**'].

Consistometer — An instrument in which a standard volume of slip is allowed to pass through a standard orifice for measuring its yield and mobility.

Continuity of Coating — The degree to which a vitreous enamel or ceramic coating is .free from defects such as 'boiling', 'blisters' and' copperheads ' that could reduce its protective properties.

Continuous Furnace — A furnace into which the ware is fed continuously and through which it progresses during firing.

Continuous Smelter — A type of smelter into which the raw mix is fed continuously and from which the molten product is discharged continuously.

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

Conventional Enamelling — application of vitreous enamel ground coat(s) and cover coat(s), each one followed by a firing operation.

Cookingware — Articles which are intended to be used for heating in the course of preparation of food and beverages.

Cooling Zone — That part of the continuous furnace in which the ware is allowed to cool after firing.

Copper Enamel —An enamel specifically designed for application on copper.

Copperhead — A defect occurring in fused sheet, metal ground coat enamel which usually appears as reddish-brown spots.

Cover Coat – A layer of vitreous enamel normally applied over a ground coat.

Covering Power — The degree to which an enamel coating obscures the underlying surface.

Cracking — A defect in the bisque consisting of fractures or separations.

Crackled — A mottled textural effect in a wet process vitreous enameling, resembling a wrinkled surface.

Crawling — A defect in the vitreous enamel appearing as agglomerates or irregularly shaped islands.

Craze, Crazing — A defect appearing as fine cracks or fractures in the vitreous enamel surface.

Crinkled — A textural effect on the enamelled surface giving the appearance of fine wrinkles or ridges.

Cross Bend Test — *See* '**Bend Test**'.

Cullet — Crushed or broken glass used as a part of raw batch.

Cup Gun — A spray gun with a fluid container as an integral part.

Capping — The pouring of slip over areas of a part during draining to produce uniform application.

Curling — A defect similar to 'crawling '.

Curtains — A defect in sheet steel ground coats characterized by a draped pattern of darkened areas that are sometimes blistered.

D

Decarburized Steel Zero Carbon Steel — special type of steel sheet of extremely low carbon content.

NOTES

1 This type of steel is suitable for direct-on white cover-coat application after acid pickle and nickel flash.

2 Decarburized steel does not undergo a permanent phase change during firing hence it is sag resistant and is therefore suitable for large panels, etc.

Decalcomania (Decal) — A design or wording printed on tissue paper with ceramic ink and transferred to a fused enamel surface and then refried to form an integral part of the enamel coating.

Decking — The multiple. Layer loading of ware for firing.

De-enamelling —The removal of fused enamel from cast iron or sheet metal by means of sand blasting or using chemicals.

Deflocculating —Thinning of the consistency of an enamel slip by the addition of a suitable electrolyte.

Degreasing — Process of removing grease or oil either by heating or immersion in hot alkaline solutions in preparation of the metal surface for enamelling.

Delayed Fish Scaling — Fish scaling which occurs sometime after the final enamel processing (*see* also '**Fishs caling** ').

Dent — A defect in the form of depression on the base metal, manifested in the finished articles.

De-Setting Agent — Electrolytes that reduce the *viscosity* of the vitreous enamel slip.

Detergent Resistance — The degree to which an enamel coating will resist attack by detergent solution.

Devitrification — A surface defect manifested by loss of gloss as a result of crystallization.

Dimple — A shallow depression in the fused enamel.

Dipping — The process of coating a metal shape by immersion in slip, removal, and draining; in dry process enamelling, the method of coating by immersing the heated metal shape for a short time in powdered frit.

Dipping Weight —The weight of enamel slip retained per unit area on dipped ware. Usually expressed as dry weight.

Dip Weight Pick-Up Plate Weight — Amount of *vitreous enamel* retained on a test plate after *dipping*, *flow coating* or by *slushing*.

NOTE — This is specified as either dry weight or wet weight retained per unit area on a test plate.

Direct Firing —The firing operation in a furnace in which the ware is not shielded from the products of combustion.

Direct-on-Cover Enamel — Cover coat directly applied on base metal.

Discontinuity — Weakness within the vitreous enamel coating that is detected by spark testing.

Double Draining — A defect caused by the movement of the wet slip on the ware after it appears that the draining has been completed.

Double-Face Ware — A ware which has a finish coat on both surfaces.

Drag — The flow of enamel during its fusion on the vertical surface resembling heavy 'orange peel ', or developing into short runs.

Draining — The part of the dipping or flow-coating process in which the excess slip flows from suitably positioned ware.

Drain Line — A non-uniform thickness of coating appearing as a line or streak in the dipped or flow-coated ware.

Drain Time — Time required for vitreous enamel slip applied by *dipping*, *slushing*, or *flow coating* to complete its movement across the surfaces of a coated part.

Dredge — A sieve used for the application of dry process enamel.

Dredging — 'The application of dry enamel powder to hot ware by screening or sifting.

Drop Test — A test to determine the resistance of a vitreous enamel to fracture caused by a sudden blow/impact.

Dry Grinding — The milling of frit without liquid medium.

Drying Crack — A defect characterized by a fissure in the bisque.

Dry Milling Dry Grinding — Milling/grinding of vitreous enamel materials in the absence of liquid.

Dry Process — The application of dry powdered enamel to heated castings.

Dry Process Enamelling — process whereby cast iron components are heated to a temperature above the maturing temperature of the *vitreous enamel*, then coated with vitreous enamel powder by *hot dusting*/*dredging* or *dipping* and subsequently fired.

Dry Spray — A defect confined to sprayed ware manifesting itself in the fired vitreous enamel as a rough, sandy texture.

Dry Weight — The weight per unit area of enamel bisque.

Dummy Hole — A smooth, well-covered depression on the surface of fused dry process enamel, generally caused by sucking of the enamel into a cavity in the casting on cooling. Similar to a large 'dimple'.

Dulling — Lustreless finish to the vitreous enamelled surface

Dust Coat — A relatively thin, sprayed coating of enamel slip.

Dusted

a) Long handled sieve used for the application of dry process enamel, Vibrated by hand or mechanical means [see also '**Dredge'**].
b) The operator applying the above process.

Dusting

a) *See* '**Dredging'**.
b) To remove extraneous material from the biscuit before firing, generally after brushing.

E

Easy-To-Clean Enamel ETC Enamel — *Vitreous enamel* specifically formulated to allow the easy removal of food soil deposits from its surface.

NOTE: — ETC enamel needs to be neither pyrolytic nor catalytic.

Edging

a) The process of removing bisque from the edge of a piece of ware to expose the underlying vitreous enamel.
b) The spraying or coating of special slip on to the edge of the ware.

Edging Brush — A stiff-bristled brush with metal guide, used to remove bisque from the edges of a ware before the firing operation.

Egg-Shell Finish (Semi-matt Finish) — The appearance of a correctly fused enamel which has a smooth but non-glossy surface like an egg shell.

Electrolyte — A chemical used to adjust the 'set' of enamel slip.

Electrolytic Cleaning — The process of cleaning or pickling by the application of electric current to the cleaning or pickling bath for, accelerating the chemical cleaning process. The ware is generally made the cathode (negative pole) and the metal tank or an iron rod dipped in it, the anode (positive pole).

Electrophoretic Deposition — Deposition of vitreous enamel particles onto a work-piece from an enamel slip under the influence of an applied direct current voltage.

Electrostatic Dry Powder Application — Process in which the component is coated by electrostatically charged vitreous enamel powder.

Electrostatic Wet Application — Process in which the component is coated by electrostatically charged vitreous enamel slip.

Enamel (Vitreous Enamel) — A substantially vitreous or glassy inorganic material bonded to any metal surface by fusion.

Enamel Frit — The frit having specific ceramic composition to produce ceramic coating on metals.

Enamelling Aluminium — Aluminium suitable for use as a metallic substrate for vitreous enamelling.

Enamelling Cast Iron — Cast iron suitable for use as a metallic substrate for vitreous enamelling.

Enamelling Iron — Sheet metal specially prepared for vitreous enamelling, usually having a low carbon content.

Enamel Stain — *see* '**Colour Oxide**'.

Etched — An altered surface texture resulting from chemical attack.

F

Faraday Cage Effect — Defect resulting from poor penetration by charged enamel particles into concave areas leading to thin spray and potentially to burn-off.

Filler — A ceramic putty used to fill holes in castings before enamelling.

Film Strength —The relative resistance of enamel biscuit to mechanical damage.

Fineness — The degree to which an enamel frit has been milled.in wet or dry form, usually expressed in grams of residue retained on a specific sieve from a 50 ml or 100 g sample.

Finish Coat — The final cover coat.

Fire Tool Marks Burning Tool Marks Fire Marks Pin Marks Point Marks — Defect characterized by very small indentations similar in appearance to shallow pinholes.

NOTE — Fire tool marks may also appear on the surface opposite to the point of contact with the supporting tool.

Firing — The process of heating to fuse the applied costing on to the substrate.

Firing Range — The time-temperature interval in which a vitreous enamel or ceramic coating is satisfactorily matured.

Firing Temperature — The degree of heat attained by the ware during maturing of the coating.

Firing Time — The period during which the ware remains in the firing zone of the furnace to mature the coating.

Firing Zone — That portion of a continuous furnace through which the ware passes and that remains at or near the firing temperature of the coating.

Fish scaling — A defect appearing as small half moon-shaped fractures resembling the scales of a fish.

Flake Frit — Frit which, after smelting, has been quenched by passing between water-cooled rollers.

Flaking Off — The breaking away of conchoidal slivers of the enamel layer.

Flame Spraying, Thermal Spraying — The process of coating metals with vitreous enamels, oxides, carbides, silicides, nitrides, etc, rendered into molten form by passing them through high temperature flame.

Flatware — Articles having an internal depth not exceeding 25 mm, measured from the lowest internal point to the horizontal plane passing through the point of ever flow.

Flaw — Defect in ware causing rejection.

Flocculating — Thickening the consistency of the enamel slip by the addition of suitable electrolytes.

Flow Button — Pellet of compressed powdered frit used in the *fusion flow test.*

Flow Coating — The process of coating a metal shape by causing the slip to flow over its surface and allowing it to drain.

Fluidity — Ability of a powder to develop a fluid-like *consistency* and flow properties when aerated.

Flux — Substance that interacts with infusible (or partially infusible) materials, thus increasing fluidity of the melted mix.

Flux

a) A substance which promotes fusion in a ceramic mixture.
b) A low-melting clear enamel added to colorings oxides to make them fusible.

Foodware — A flatware and hollow-ware used in the preparation, serving or storage of food and beverages.

Ford Cup — device for measuring the flow out time for a defined volume through a specified area (hole).

Fork — A piece of metal equipment used during the firing operation for placing a ware in and removing it from a box furnace.

Frit — It is an intermediate product formed by quenching in water or between water-cooled rolls, a mixture of inorganic materials in the molten state. It may be partially crystalline. It is used for providing a protective coating in admixture with various additives on different ceramics, glassware and metal.

Fritted Trace Elements (FTE) — *See* '**Ceramic Fertilizer**'.

Fritting — The rapid chilling of the molten glassy material to produce frit.

Fusibility — The readiness or otherwise with which an enamel can be fused.

Fusion Flow Test — A method of measuring the relative flow of enamels in the molten state; a measure of 'fusibility'.

G

Galvanic Nickel Dip — Deposition of a nickel coating produced by a displacement reaction in which one metal displaces another from solution.

Example: $Fe + Ni^{++} \rightarrow Ni + Fe^{++}$

Gasatura Gassing Grizzle Spongy Enamel — Defect in which the vitreous enamel surface is disfigured by a myriad of minute bubbles or *blisters*, some broken and accompanied by a loss of *gloss*.

NOTE — The condition is associated with the evolution of hydrogen, principally originating from moisture.

Gas Pocket — A subcutaneous cavity in cast iron filled with gas, liable to cause a blister or black speck.

Gassing

a) Enamel defects, such as scumming and lack of gloss, caused by fusing the ware in a furnace containing gases other than air, mainly Sulphur oxides.
b) The formation of gas bubbles in milled enamel slip.

Gassy Surface — A surface defect characterized by poor gloss and minute bubbles.

Glass — Term synonymous with *vitreous enamel* or *frit*, in particular by chemical vessel manufacturers.

Glass-Coated Steel (Glass-Lined Steel, Glassed Steel) — Steel equipment coated with special type of glass or vitreous enamel to provide high resistance to attack by chemicals at elevated temperature and pressure.

Glass Eye — Defect consisting of large unbroken *blister* in the surface of the fused *vitreous enamel*.

Glass Enamel —An enamel specifically designed for decorating glass.

Glass Eye — A defect consisting of a large unbroken blister usually pertaining to '**Dry Process**'.

Gloss — Shine or *lustre* of vitreous enamel surface.

Glossy Undercoat —*See* '**Underglaze**'.

Graining — A process for producing a decorative finish by transferring a pattern to the enamel surface by means of rolls.

Graining Paste —A mixture of colour oxides, fluxes and oils.

Graining Roll — A specialized type of roll used for transferring the grain pattern to the vitreous enamel.

Granite Ware — A single coat enamelled article with a mottled pattern produced by controlled corrosion of the metal base during drying of the slip.

Grit Blasting — Process for *cleaning* and abrading the surface by means of small irregular pieces of steel or malleable cast iron directed at high velocity against the work piece.

Ground Coat (Grip Coat) — The first layer of enamel applied to sheet or cast metal, containing ingredients specially designed to produce adherence to the metal.

Gum Arabic — A vegetable gum used in small amounts to act as binder and suspending agent in enamel slips

H

Hair Lines (Strain Lines, Stress Lines) — Group of parallel or near parallel lines, usually at a place where metal has been worked, having the appearance of cracks healed by fusion and appearing as a variation in colour or the enamel. They may show the colour of the ground coat in which case they are sometimes called 'Strain Lines'.

Hard Enamel — An enamel melting at a high temperature.

Hardness

a) The degree of resistance of a fused enamel to abrasion.
b) The degree of resistance of a frit to milling.
c) The relative refractoriness of a vitreous enamel or frit.

Heat Craze — Lines or cracks which may be parallel or have a common source either on part or on the whole of the enamelled surface of a casting.

Holloware — Articles having an internal depth greater than 25 mm, measured from the lowest internal point to the horizontal plane passing through the point of overflow.

a) *Small Hollow-ware* — Hollow-ware with a capacity of less than 1.1 litres.
b) *Large Hollow-ware* — Hollow-ware with a capacity of 1.1 to 5 litres.

Hot Dusting Dredging — Application of dry powdered frit to red hot ware by sifting.

Hue — The predominant colour of an enamelled surface.

I

Image Gloss (of a Surface) — The distinctness with which a sharply outlined character is reflected in the surface.

Impact Test — *See* '**Drop Test**'.

Inhibitor — A reagent added to an acid pickling solution to retard its attack on the metal.

J

Jar Mill — A small ball mill.

Jewellery Enamel — A special type of enamel used in the manufacture of Jewellery, insignia and objects of art.

Jumping — The spontaneous chipping off of pieces of fired enamel during subsequent drying or fusing of cover coat.

L

Lamination — A fault in sheet iron in which a void expands during firing to produce a blister or a line of blisters.

Lead Enamel — An enamel containing lead compounds.

Luminous or Luminescent Enamel

a) An enamel which emits light in darkness.
b) An enamel which emits visible light when exposed to ultraviolet light.

Lumps — *See* '**Bead** (b)'.

Lustre or Lustre Finish — A special iridescent finish produced by spraying fused enamel coating of the ware, whilst still hot, with ferric chloride or other medium to produce a lustre effect.

M

Magnetic Separator — An equipment designed for removal of metallic iron or magnetic iron oxide from enamel slip.

Majolica Enamel — A transparent enamel of composition and properties such that when applied over a white ground or as under coat on curved surfaces or patterns in relief, the convex surfaces retain less enamel than the concave or flat surfaces, with consequent variation in the density of colour.

Marbleized Finish — An enamel finish imitating the appearance of grained marble.

Matt Enamel — An enamel which, when correctly fused, has flat nonglossy surface.

Matt Ground Coat — A type of cast iron ground coat which is not completely melted, but only sintered to give a porous layer with a matt surface (*see* also '**Ground Coat**').

Matt Surface — A non-glossy surface.

Maturing

a) Heating an enamelled ware for a sufficient time in the fusing furnace to develop the full properties of coating.
b) *See* '**Ageing**'

Maturing Temperature — The temperature at which vitreous enamel is to be held for a specific time to achieve the desired properties.

Medium Squeegee Oil — Oil or mixture of oils used to suspend *pigments* and *fluxes* in *screening inks*.

Metal Blister (Blistered Iron) — A blister formed on the surface of sheet metal during grease burning, pickling or fusing of the ground or cover coats, caused by inclusions or cavities in the metal.

Metal Grit — *See* '**Chilled Shot**'.

Metal Strain — Lines of fine blisters, often parallel lines, originating from metal.

Mill Additions —Material added to the ball mill charge of a frit.

Millscale — Thick oxide layer formed during hot rolling or heat treatment of certain metals.

Monet Metal — An acid-resisting nickel-copper alloy used in the enamel industry for making pickling baskets which carry the ware through all the cleaning operations prior to enamelling.

Mottled Ware — An enamel finish having a background of uniform colour on which an enamel of a different shade or colour has been applied in small spots or patches.

Muffle Furnace — Refractory chamber heated from the outside.

N

Neutralizer — A dilute alkaline solution in which the sheet metal ware is placed after acid pickling in order to neutralize acid remaining on the surface of the ware.

Nickel Dipping — The Process of dipping acid-pickled ware in a bath of nickel salts to promote the deposition of metallic nickel on the metal.

O

Oil Mark — A defect on fired enamel surface due to contamination with oil or oily condensate.

One-Coat Ware

a) Articles finished in one cover coat of enamel; in the case of sheet metal over a ground coat, or direct on to cast iron.
b) Articles finished in single coat of vitreous enamel.

One-Fire Finish — Vitreous enamel coating on the finished product processed in a single firing.

Opacifier — A material which increases the diffuse reflectance or covering power of enamel.

Opacity — The property in an enamel of reflecting light diffusively or its covering power.

Opaque Enamel —An enamel that is dense to light. An enamel that hides the surface to which it is applied.

Optical Pyrometer — An instrument employed for checking the temperature of a furnace by comparing the colour of the filament of its electric lamp with that of the furnace interior.

Orange Peel — A condition of the fused enamel coat showing a rippled surface characteristic of orange peel.

Organic Stain — A substance used for colorings slips, which burns out on fusing; used to identify slips of the same colour but of different types.

Overfiring — The fusing of an enamel for too long a time or at too high a temperature, or both.

Overspray — The slip from the spray gun not deposited on the ware. Also, spray application of a light coat of slip to an unfired vitreous enamel.

P

Pastel Colour —The term employed to a light colour.

Pearl Lines Bubble Lines — Defect characterized by a number of bubbles or *blisters* in a single line or a series of parallel lines.

NOTES

1 This is a severe case of strain-lines and is a result of the release of mechanical stresses within the steel during firing.

2 Pearl lines should not be confused with the out-gassing from steel lamination which occurs as a single line along the direction of rolling.

Pebble Mill — A ball mill in which pebbles are used as grinding media.

Peeling—The detachment of large pieces of cast iron enamel applied over a matt ground coat.

Perrett (Perrit, Burning Tool) — A support for enamel ware during the fusing process, 'usually made from special heat-resisting metal.

Perrett Marks (Burning Tool Marks, Pin Marks) — Marks on the ware resulting from contact with Perrett's.

Pickle Basket — A basket fabricated from corrosion resistant material to hold ware during pickling.

Pickle Pills — Small capsules (or pills) used for testing the strength of the pickling solutions.

Pickling — The chemical process by which the surface of metal ware is cleaned and prepared for enamelling.

Pick-Up — *See* '**Dipping Weight**'.

Pigments — Insoluble inorganic colouring agents.

Pig Skin Leather — Surface defect with the appearance characterized by similarity to the texture of pig skin.

Pin-Hole — An enamel surface defect characterized by a small depression, as though made by a pin, resulting from the breaking of a gas bubble, and frequently reaching the base metal:

Pin Marks — *See* '**Perrett Marks**'.

Pit — A defect similar to a dimple, but smaller and deeper.

Plasma Spraying — The process of coating metals with oxides, carbides, silicides, nitrides, and other vitrifiable materials by transfer through the recombination zone of a constricted electric arc of a plasma gun.

Plugging Compound Filler — Putty-like mixture of inorganic materials used to fill holes in iron castings to ensure an even surface for vitreous enamelling.

Pop-Off —Jumping off of small pieces of enamel from enamel surface in ground coat or cover coat, similar to fish-scale, but round in shape.

Poppers — A defect characterized by randomly occurring, relatively small, circular-shaped areas of ground coat appearing in the first cover coat sheet steel vitreous enamel.

Pore — Defect characterized by a hole in the fired *vitreous enamel* connecting the surface with the metallic substrate.

NOTE — *See* '**Pin-Hole**'.

Porosity — Degree to which voids are present in the fired *vitreous enamel.*

Porosity — Capacity of *catalytic enamels* to absorb oil or fatty substances.

Pot Furnace — A furnace used to smelt vitreous enamel raw batch contained in a crucible.

Powder enamel — Vitreous enamel powder coated with an encapsulant which allows it to carry an electrostatic charge and a particle size to enable it to be transported by the electrostatic charge.

Powder enamel — *Frit*, in power form, applied to red hot cast iron by sieving or *dipping*.

Powder enamelling — Electrostatic application of a vitreous enamel coating in dry powder form to a cold substrate.

Powder-Powder Enamelling — Application of a powder coat over an unfired powder ground coat and followed by *firing*.

Preheat Zone —The portion of a continuous furnace through which the ware passes before entering the firing zone.

Pressure Tank — A container from which slip is removed by air pressure.

Primary Boiling — The evolution of gas during the initial firing of enamel; sometimes a defect.

Process Fish-Scale Poppers — Defect arising from fish-scaling of ground coat during drying or *firing* of the cover coat resulting in small discoloured or black oxide patches in the fired cover coat.

NOTE — *See* '**Fish-Scale**' and '**Delayed Fish-Scale**'.

Pyro — A common expression for tetra sodium pyrophosphate ($Na_4P_2O_7$) either hydrous or anhydrous.

Q

Quenching — The operation of cooling the molten frit by pouring it into water or by passing through water-cooled rollers.

R

Raw Batch — *See* '**Batch**'.

Ready-to-use Enamel RTU Enamel — Pre-milled vitreous enamel mixture for wet processing, requiring to be blended with water and sieved before application or delivered ready-to-apply.

Re-boiling — The evolution of gas from sheet metal during the fusing of the first or subsequent cover coat causing in the enamel bubbles which do not subside, and frequently leave dark marks resembling specks, or a mass of bubbles under the surface.

Recirculating Dip Tank — A dip tank provided with a means for keeping the slip in constant circulation.

Reclaim

a) Enamel recovered from the spray booth, which is suitable for reconditioning for use.
b) Enamel powder recovered from the pit in the dry process.

Reduction Nickel Dip Auto-Catalytic Nickel Dip Electroless Nickel Dip — Deposition of a nickel coating by a controlled chemical reduction that is catalysed initially by the metallic component and continued by the deposited nickel.

Refractory Composite Coating — Combination of heat-resistant ceramic materials applied to a metallic substrate that may or may not require heat treatment prior to service.

NOTE — Refractory composite coating is also used to describe a coating applied to non-metallic substrates such as graphite or concrete.

Reflectance — The percentage of the incident light which is reflected diffusively from an enamelled surface.

Reflectivity —The reflectance of a coating so thick that any additional thickness does not change the reflectance.

Reflectometer — An instrument to measure reflectance.

Refractory — Difficult to fuse.

Resistivity — Electrical resistance offered to the passage of a steady current.

Rheology — Characterization of the flow properties of an enamel slip or powder.

Rim Enamel — A dry process enamel with expansion suitable for use on small radii convex surfaces.

Ripple — defect having the appearance of a uniform, wide-ranging waviness in the surface of fused dry *powdered enamel*.

Rotary Smelter —Any of the cylindrical smelters that depend on slow rotation about a horizontal axis for agitation of the molten mass.

Rotospray — A rotary spray-screening device which sieves enamel by centrifugal force.

Rubbing Stone — A shaped abrasive used in stoning vitreous enamel.

Rust Inhibitor — Coating compound comprising particular salts applied to prevent atmospheric oxidation.

NOTE — Rust inhibitor is also used to describe an electrolyte that inhibits rusting at the interface between application and firing of the enamel.

Rust Spotting —The formation of specks or spots of rust on the base metal when the first coat is dried too slowly, due to moisture left in the processing of the metal before enamel application, or iron salts left on the surface of the metal after pickling. Controlled rust spotting is sometimes used as a special speckled finish (granite ware).

Rutile — One of the crystalline forms of titanium dioxide which imparts a characteristic yellow colour to vitreous enamels. This also refers to one of the natural ores of titanium dioxide.

S

Sag Test — Evaluation of the capacity of the *substrate* to undergo firing cycle(s) without excessive deviation from its original shape.

Sagging —The, bending of metal ware during fusion due to insufficient support for the weight of the metal.

Sagging Distortion Warping — Defect in which the shape of the work piece is permanently deformed during *firing* as a result of yielding under its own weight and/or as a result of phase changes occurring within the steel.

Sanitaryware — Enamelled ware, such as sinks; lavatories, bath-tubs, etc.

Satin Finish — Lustrous (but not mirror-like) surface finish having no directional texture.

Saponification — The formation of soap from an animal or vegetable oil which occurs during the alkali degreasing process if these types of oils are present on the surface of the ware.

Scab — A defect in vitreous enamelling metal sheets or castings, having the appearance of a loose piece of metal, tongue, or flap on the surface.

Scale — Oxide on the surface of sheet metal, either remaining from the manufacturing process or purposely created by heating to redness.

Scaling —The process of forming scale with or without acid fumes; sometimes refers to spontaneous detachment of scale.

Scouring

a) The cleaning of met.al surface by rubbing with an abrasive material and water, as in the cleaning of castings for dry process enamelling, when it is not essential to use sand blasting.
b) Deep scratching in parallel lines on pressings, usually on vertical faces.

Scrapings — The overspray that has been recovered from a spray booth.

Scratch Test — Test used to determine the relative resistance of an enamel surface to scratching.

Screening — Application of. Enamel by the screen process.

Screening Ink Screening Paste Ceramic Ink — Blend of *fluxes* and *pigments* suspended in a *medium* and used as the ink in screen printing.

Screen Test — A standard test for fineness of vitreous enamel or slip.

Scumming — The formation of areas of poor gloss on the surface of an enamel ware during or after firing; usually associated with the action of Sulphur which may be picked up before firing by the biscuit, or from the furnace atmosphere.

Scumming — Defect exhibiting a loss of *gloss* on fired vitreous enamel surface, sometimes accompanied by an iridescent *bloom* or *chalky surface* depending on cause and severity, not always immediately apparent.

NOTE — *See* '**Bloom**'.

Self-Clean (Continuous Clean) Enamel — A special type of porous enamel coating finish, mostly used on walls of roasting chambers of cooking ovens. The porous coating accelerates oxidation of oils and greases that are deposited on the walls of the oven during its use and no further cleaning is required.

Semi-matt Finish — *See* '**Egg Shell Finish**'.

Semi-muffle Furnace — A furnace with a partial muffle, in which the products 'of combustion come in contact with the ware.

Semi-Opaque Enamel — vitreous enamel frit which exhibits only partial opacity after *firing*, through which the underlying coating or *substrate* is partially visible.

Set —The property which enables an enamel slip to leave a layer of definite thickness on a non-porous surface immersed in the slip and allowed to drain.

Setting - Up Agent — A substance used to produce or increase 'pick up' in an enamel slip.

Set Up — To adjust the flow properties of an enamel so that it will leave a layer of definite thickness either by dipping or spraying.

Sheet Iron Enamel — An enamel specifically designed for application to sheet iron.

Shiner — A form of fish-scaling in which the scales or 'shiners' are very minute in size.

Shorelines — Rings or lines appearing in a fused enamel surface resembling in appearance the lines produced by waves on the shores, caused by too rapid drying or by unsuitable setting up of the enamel.

Sign Enamel — A brilliant high gloss enamel particularly adaptable for sign work, having high resistance to weather attack.

Silex — A fine crystalline, natural silica rock of irregular and rough surface, used for linmg ball mills.

Silk Screen — A piece of silk, metal or nylon cloth tightly stretched over a frame, through which enamel colour (ceramic ink) may be pressed. Usually the screen is blocked out in the desired design.

Silver Steel Silver Metal — Defect characterized by a shiny metallic spot visible after spontaneous *chipping* or *spalling* of the *vitreous enamel*.

NOTE — The shiny silver spot is often of a more noble nature than the surrounding steel, the result of a chemical reaction between Co, Ni and Cr, etc., with the steel substrate.

Sliding — A defect in the draining characteristics of slip wherein patches of the coating slide produce an uneven coating.

Slip — The prepared suspension of frit in water produced by the wet grinding operation.

Slump Test — Test to determine the degree of consistency of a slip whereby measurement is made of the spreading of a specified volume of slip over a Hat plate.

Slushing— Manipulation of the dipped ware to distribute the slip uniformly and to remove excess material.

Smelter — A furnace in which the raw materials of the frit batch are melted.

Smelter Drippings — Drippings of molten glassy material formed on the crown of the smelter.

Smelting — Melting of vitreous enamel raw materials together in a smelter to form the *vitreous enamel*.

NOTE: The raw materials are thoroughly mixed before charging the smelter. They are then allowed to remain in the smelter for several hours until thoroughly and uniformly melted. The smelt is then tapped out as a white-hot stream either over water-cooled rollers or into a quenching tank of water, the former producing flake and the latter frit.

Softening Temperature —The temperature, under specified conditions, at which vitreous enamel or frit begins to flow.

Solubility — Tendency of a vitreous enamel frit to dissolve, as a function of time and temperature, in the medium in which it is present, such that the *rheology* of the enamel slip is affected.

Solution Ceramics — Method for producing an adherent inorganic (usually oxide) coating on a heated metal surface by spraying with solution of soluble salts of refractory metals.

Spalling — A defect characterized by separation of the vitreous enamel from the base metal without apparent external cause.

Spark Test —A high voltage electrical test used to detect discontinuity of the non-conducting enamel coating on a metallic base.

Specking — *See* '**Black Speck**'

Specular Gloss — The ratio of reflected light to incident light, multiplied by 1 000, for specified apertures of illumination and reception when the with the mirror image of the axis of illumination.

Spider — A defect characterized by a star-shaped fracture in the vitreous enamel.

Spongy Enamel — Imperfections in the enamel layer caused by the presence of masses of bubbles.

Spray Booth — Open fronted booth that allows components to be spray coated within it.

NOTE — The spray booth should be fitted with extraction to contain the over-spray within the booth, together with the means of collecting waste enamel.

Spray Gun — Device that applies a coating of atomized vitreous enamel slip or powder to components with means of adjusting application rate, degree of atomization and spray pattern.

Spray-Rate — Amount of *vitreous enamel* discharged by the spray-gun in unit time.

Soilability — The relative ease with which extraneous matter deposits on the surface of a material.

Speckled Ware — A decorative finish with particles of one colour appearing in a uniform background of another colour or shade.

Spot Welding — A process of welding where two pieces of thin metal parts are joined by application of pressure on a series of spots close together.

Spray Sagging — A process defect characterized by a wavy line or lines appearing on the vertical surfaces of Sprayed ware prior to drying.

Squeegee Oil — A liquid mixture of organic materials used as vehicle in squeegee paste.

Squeegee Paste (Screening Ink, Screening Paste) — A mixture of squeegee oil and finely divided inorganic materials such as colour oxides and fluxes.

Stainability — Relative ease with which *vitreous enamel* is penetrated and discoloured by a foreign material.

Stain Enamels — *See* '**Colour Oxide**'.

Stainless — An enamelled surface which is not stained, discoloured or otherwise attacked by acids (except hydrofluoric), chemicals, dyes, fruit juices under atmospheric conditions or ordinary conditions of use.

Star-Marks — A defect sometimes characterized by a star-shaped fracture.

Stencil —A template used in brushing a design:

a) Brush-Out Stencil — Where the design is removed by brushing.
b) Brush-On Stencil — Where the surplus enamel is removed to leave the design.

Stippled Finish — A pebbly textured vitreous enamel, often multicolored.

Stoning — The operation of removing, by abrasion, the undesirable portions of vitreous enamel.

Strain Lines — *See* '**Hair Lines**'.

Stripping — *See* '**De-enamelling**'.

Substrate — Material upon which a coating is directly deposited.

NOTE — In the case of a single or first coating, the substrate is identical with the metallic substrate.

Super-opaque Enamel — An enamel having high opacity, and requiring little or no Opacifier as a mill addition.

Suspension — The property of an enamel slip which keeps the solid particles uniformly distributed throughout that liquid without settling under the influence of gravity.

Swab Test — A low voltage electrical test used to evaluate continuity of vitreous enamel.

Sweat Spot — Imperfection of enamel surface caused by a drop of perspiration falling on the bisque ware.

Swilling — The application of enamel to both sides of metal ware by immersion in enamel slip, and subsequently draining or shaking.

T

Tanks and Vessels — Article having a capacity of 5 litres or more.

Tearing (Tear) — A defect in the cover coat enamel distinguished by minute breaks in the enamel which have healed.

Thermal Shock — A sudden change of temperature.

NOTE — Resistance to thermal shock is measured by the difference between the upper temperature I_1 to which an article is heated, and the lower temperature t, of the cold water bath, in which the article is subsequently immersed or the cold water spray to which the article is subsequently subjected.

Thixotropy — The condition of a system consisting of a solid dispersed in a liquid, which sets when at rest but flows freely on agitation, setting again on standing.

NOTE — It is the property which allows the ware to be dipped readily in enamel slip and when drained to leave a regular even layer of predetermined thickness on the surface.

Thread Test — A test performed by draining a thread from the enamel during the melting process to ascertain its degree of melting, and to examine for undissolved or unmelted particles.

Transfer — *See* '**Decalcomania**'

Transparent Enamel — An enamel which has the property of transmitting a high percentage of the incident light striking its surface (*see* also '**Clear Frit** ').

Triangle Bars — Burning bars of triangular cross-sect ion (*See* '**Burning Bars, Points or Tools**).

Tube Furnace — A muffle furnace in which combustion occurs within alloy tubes.

Two-Coat Ware — Ware finished in two cover coats.

U

Under firing — The fusing of enamel for too short a time, or at too low a temperature, or both.

Underglaze (Glossy Undercoat) — An enamel applied to cast iron to facilitate the release of gases from the metal before the application of an acid-resisting enamel as the finish coat.

U-Type Furnace — A continuous furnace wherein the ware travels in a U-shaped path.

V

Vapour Degreasing — Removal of oil and grease by solvent vapours condensing on the work pieces being cleaned.

Vignette Shading — Application of a further layer of *vitreous enamel*, usually of a contrasting colour, to the area bordering the edge or rim of enamelled articles.

Viscosity — The measure of the resistance of a fluid to flow, but in the enamelling industry the term is used in relation to the flow properties of the complex mixture of liquids and solids which constitute enamel slip (*see* also '**Thixotropy**').

Vitreous Enamel — See '**Enamel**'.

W

Warping — Change in the original contour of the enamel ware.

Water Line (Water Streak) — A line caused by the absence of enamel resulting from water running down the wet bisque surface, or from separation dclring drying.

Water Mark (Water Spot) —An appearance defect characterized by a depressed spot.

Weathering — Deterioration of the enamel surface by the action of atmosphere, bacteria, or temperature fluctuations in the course of use.

Wet Milling — The grinding of vitreous enamel materials with sufficient liquid to form a slurry.

Wet Process Enamelling — A method of enamelling in which the slip is applied to a metal article at ambient temperature, prior to drying and firing.

Whales — Drain marks from holes, cut-outs, etc, which appear in the swilling process as think lines of enamel.

Whale-Scale — Defect characterized by an enlarged form of *fish-scale* encountered in under-fired *groundcoat*.

NOTE — *See delayed fish-scale* and *fish-scale*.

White Ground Coat — White enamel applied direct to the metal as a ground coat.