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Vitreous and porcelain enamels — Terminology

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British Standards

National foreword

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Foreword

This document (EN 15826:2009) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

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1 Scope

This European Standard defines a number of terms relating to vitreous and porcelain enamels and their technology. This list is not complete and only comprises those terms for which the definition is considered necessary for correct and adequate understanding in order to clarify these processes.

It should be understood that the interpretations given are those corresponding to the practical usage in this field and that they do not necessarily coincide with those used in other fields.

For purposes of clarification, the term Vitreous Enamel, used throughout this European Standard, is synonymous with Porcelain Enamel, the term favoured in the United States and some other countries.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Annex A lists alternative terms and cross refers to primary terms used below.

2.1
abrasive blasting
process for cleaning or finishing by means of an abrasive directed at high velocity against the work piece

2.2
abrasion resistance
degree of resistance of vitreous enamel to be abraded by solid materials

2.3
acid resistance
degree of resistance of vitreous enamel to attack by acidic corrosive chemicals

2.4
adherence (enamel-metallic substrate)
adhesion
degree of bonding between the fused vitreous enamel and the metallic substrate

2.5
adherence of powder
ability of a vitreous enamel powder to remain attached by static attraction to a grounded substrate before firing

2.6
ageing
change in properties of vitreous enamel slips, powders, reagents, or steel with the lapse of time

2.7
air seal
air curtain
flow of pressurised air across the entrance and exit of a continuous furnace that prevents heat escaping from the furnace but allows ware to pass through

2.8
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

2.9
alkali resistance
degree of resistance of vitreous enamel to attack by alkaline corrosive mediums

2.10
aluminium enamel
vitreous enamel specifically formulated for application on aluminium substrates

2.11
anneal
annealing
thermal treatment of metals generally made by controlled heating and subsequent cooling

NOTE Raw castings are heated in the range from 650 °C to 950 °C to relieve stresses and strains, burn off grease and in some cases to change the structure of the iron and in so doing improve the castings condition prior to coating with vitreous enamel.

2.12
anti-scale compound
agent that is applied to furnace tooling and other items to protect them from scaling during firing

2.13
back emission
back ionisation (electrostatic powder)
defect often with the appearance of localised, 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.

2.14
ball mill
ceramic or ceramic-lined rotating cylinder in which vitreous enamel materials are either wet or dry ground, generally using alumina, porcelain or steatite balls as grinding media

2.15
batch smelter
discontinuous smelter
smelter which is charged, fired, and discharged according to a predetermined periodic cycle

2.16
bead
defect resulting from accumulation of enamel usually at the point where the enamel drains off the ware in dipping

2.17
beading
rim enamelling
application of ridge of vitreous enamel, along the edge or rim of ware

2.18
beading enamel
rim enamel
vitreous enamel specifically formulated for beading

2.19
biocide
anti-bacterial agent used to inhibit fermentation of organic mill additions such as gums

2.20
bisque
dry unfired vitreous enamel coating

2.21
black specks
defect that appears as black particles at the surface of vitreous enamel coating

NOTE 1 See boiling (2.26) and carbon boil (2.34).

NOTE 2 This can be the result of reaction with the substrate or with contamination on the substrate surface.

2.22
blank
sized piece of untreated metal sheet that will be used in forming the finished article

2.23
blasting
process whereby solid metallic, mineral, synthetic resin, vegetable particles or water are projected at high velocity against a work piece for the purpose of cleaning, abrading or shot peening the surface

2.24
blister
defect that appears as a localised bubble under the surface of the fired vitreous enamel

2.25
bloom
visual exudation or efflorescence on the vitreous enamel surface

NOTE See scumming (2.212).

2.26
boiling
defect resembling areas of ground-coat pull-through, blisters and pinholes, visible after first cover-coat fire

NOTE 1 See carbon boil (2.34) and black specks (2.21).

NOTE 2 This can be the result of excessive ground-coat activity during cover-coat fire, as the ground-coat boils up through the cover-coat it maybe accompanied by a release of gases.

2.27
bolt-hole brush
specially designed round brush used to remove vitreous enamel bisque from in and around small openings in the ware

2.28
box furnace
furnace in which ware is fired according to a predetermined periodic cycle

2.29
break out
defect characterised by areas of blisters, having well-defined boundaries

2.30
bubble structure
size and spatial distribution of voids within the fired vitreous enamel layer

2.31
burn-off
defect that appears as a localised area of rough oxides erupting through the enamel coating

NOTE This can be caused by too thin an application of enamel, allowing excessive oxidation of the metal substrate during firing, leading to super saturation of the enamel coating with metal oxides.

2.32
burning bar
burning point
burning tool
tool used to suspend or support ware during firing operations

2.33
button test
fusion button test
control test to determine the relative fusibility of vitreous enamel frit or powder

NOTE 1 See fusion flow test (2.126).

NOTE 2 The completed test specimen resembles a button.

2.34
carbon boil
defect resembling areas of blisters, pinholes, or black specks, visible in fired vitreous enamel

NOTE 1 See boiling (2.26) and black specks (2.21).

NOTE 2 Result of the oxidation of carbides and free carbon at or near the surface of the steel substrate during firing, resulting in evolution of gasses.

2.35
cascading
<electrostatic powder> 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.

2.36
cast iron enamel
vitreous enamel specifically formulated for application on cast iron substrate

2.37
cermet
ceramic-metal coating
mixture of one or more ceramic materials in combination with a metallic phase applied to a metallic substrate

2.38
chalkboard enamel
blackboard enamel
special type of matt vitreous enamel, used to provide a writing surface for chalk

2.39
chalky surface
surface defect where the vitreous enamel surface has lost its gloss and taken on a powdery appearance

NOTE See scumming (2.212).

2.40
chemical resistance
degree of resistance of vitreous enamel to attack by corrosive chemicals

2.41
chipping
defect characterised by fracturing and detachment of irregular enamel particles from the vitreous enamel surface

2.42
cleanability
relative ease with which soils or stains can be removed from a fused vitreous enamel surface

2.43
cleaner
pre-treatment solution, usually alkaline, used to remove oil, grease, lubricants, and loose debris from the surface of metal substrate in preparation for vitreous enamelling

2.44
cleaning
degreasing
vapour degreasing
removal of foreign materials, such as abraded metallic particles from pressing or blasting, grease, oil, oxides, scale, rust, swarf, etc. from the surface

2.45
clear frit
transparent frit
vitreous enamelling frit that remains essentially transparent or non-opaque when fused

2.46
coefficient of expansion
rate at which a material will expand under the influence of increasing temperature

2.47
cold-rolled steel
low carbon, cold-reduced and annealed sheet steel, not necessarily enamelling quality

2.48
colour matching
comparison of two or more samples of products that are notionally the same colour

2.49
colouring oxide
calcined mixture of inorganic material used as a mill addition to impart colour to a vitreous enamel

2.50
coloured frit
vitreous enamel frit containing a colorant in order to produce a strong colour in the fired vitreous enamel

2.51
consistency
rheological properties of a vitreous enamel slip that control its draining, flowing, and spraying behaviour

2.52
continuity of coating
degree to which a vitreous enamel is free from defects such as bare spots, boiling, blisters, or copperheads, etc. that could reduce its protective and/or its aesthetic properties

NOTE See discontinuity (2.82).

2.53
continuous furnace
furnace through which ware is fed continuously and from which the fired product is discharged continuously

2.54
continuous smelter
smelter from which the molten product is discharged continuously

2.55
conventional enamelling
application of vitreous enamel ground coat(s) and cover coat(s), each one followed by a firing operation

2.56
cooling zone
exit part of a continuous furnace in which the ware is allowed to cool after firing

2.57
copper enamels
vitreous enamels specifically formulated for application on copper substrate

2.58
copperheads
defect resembling small freckle or pimple-like reddish brown spots occurring in ground-coats, or direct-on enamels on iron substrates, in principle in an isolated round burn-off

NOTE See burn-off (2.31).

2.59
cover coat enamel
vitreous enamel with specific chemical, physical and/or aesthetic properties applied as either intermediate or final coat

2.60
covering power
degree to which a vitreous enamel coating obscures the underlying surface

2.61
crack
cracking
defect caused by laminar interruptions in the fused coating running vertical to the surface

NOTE 1 Cracking can also occur at different angles.

NOTE 2 The causes are mainly the result of mechanical or thermal tensile stresses within the enamel coating.

2.62
crawling
curling
incomplete formation of the enamel layer on the substrate with the appearance of agglomerates or irregularly spaced islands in the vitreous enamel during firing

2.63
crazing
defect resembling a network of fine cracks in the vitreous enamel coating

2.64
cross-bend test
determination of the resistance of bisque or fused vitreous enamel coating to cracking by progressively distorting the coated panels by bending

2.65
cup spray gun
cup-gun
spray gun with a fluid container as an integral part

2.66
cupping
pouring of vitreous enamel slip over areas of a component during draining, to improve coverage in certain areas

2.67
curtains
defect with the appearance of a draped pattern of darkened areas that sometimes blisters

NOTE Curtains occur mainly in ground-coats and direct-on enamels but may also be seen in cover coats.

2.68
decal
transfer
design or wording printed on paper with ceramic ink and transferred to a fired enamel surface and then refired to form an integral part of the vitreous enamel coating

2.69
decarburised steel
zero carbon steel
special type of steel sheet of extremely low carbon content

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

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

2.70
de-beading
removal of excess vitreous enamel slip from the edge of dipped ware

2.71
decking
multiple layer loading of ware for drying and/or firing

2.72
de-enamelling
removal of fired vitreous enamel from the metallic substrate

2.73
de-setting agent
electrolytes that reduce the viscosity of the vitreous enamel slip

2.74
delayed fish-scale
small half-moon shaped defects occurring in the vitreous enamelled surface which are not immediately apparent on cooling

NOTE See fish-scale (2.116).

2.75
de-vitrification
change from the vitrified state to the crystalline state

NOTE Some vitreous enamels will de-vitrify to produce dull lustre and opacity.

2.76
dimple
defect resembling a shallow depression in the vitreous enamel surface

2.77
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.

2.78
dipping (wet process)
swilling (wet process)
application of vitreous enamel by immersing the component in a bath of vitreous enamel slip, and subsequent removal of excess enamel by draining

2.79
dipping (dry process)
application of vitreous enamel in dry process enamelling by briefly immersing the red hot component in powdered frit

2.80
direct fired furnace
open flame furnace

NOTE The products of combustion come into contact with the ware during firing.

2.81
direct-on-enamelling
vitreous enamel coating, applied directly onto the metallic substrate and functioning as either a ground coat or as a finish coat

2.82
discontinuity
weakness within the vitreous enamel coating that is detected by spark testing

2.83
double draining
evidence of further flow having occurred after the apparent end of draining

2.84
double-face ware
ware that has a finish coating on both surfaces

2.85
drain line
defect resembling a streak of thicker or thinner enamel

NOTE Drain lines result from the flow of excess enamel after dipping.

2.86
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

2.87
draining
removal of excess vitreous enamel slip from the ware after dipping, slushing or flow coating

2.88
dredge
sieve used to apply powdered vitreous enamel frit to hot ware in dry process enamelling

2.89
dry milling
dry grinding
milling/grinding of vitreous enamel materials in the absence of liquid

2.90
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

2.91
dry spray
appearance of a rough sandy texture on spray coated ware

NOTE Dry spray is the result of not wetting out the wet sprayed surface.

2.92
dry weight
weight of the vitreous enamel bisque, per unit area

NOTE See dip weight (2.77).

2.93
drying crack
defect characterised as a fissure in the bisque, visible after firing

2.94
dulling
lustreless finish to the vitreous enamelled surface

2.95
dust coat
relatively thin, sprayed coating of vitreous enamel slip

2.96
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.

2.97
edging
process of removing vitreous enamel bisque from the edge of a piece of ware to expose the underlying vitreous enamel

or

spraying of special slip onto the edge of the ware

2.98
edging brush
stiff bristled brush with a metal guide, used for removal of vitreous enamel bisque from edges of ware before the firing operation

2.99
eggshell
fused vitreous enamel surface exhibiting a smooth, matt texture, reminiscent of an egg shell

NOTE In sanitary ware it is a defect.

2.100
electrophoretic deposition
deposition of vitreous enamel particles onto a work-piece from an enamel slip under the influence of an applied direct current voltage

2.101
electrostatic dry powder application
process in which the component is coated by electrostatically charged vitreous enamel powder

2.102
electrostatic wet application
process in which the component is coated by electrostatically charged vitreous enamel slip

2.103
enamelling aluminium
aluminium suitable for use as a metallic substrate for vitreous enamelling

2.104
enamelling cast iron
cast iron suitable for use as a metallic substrate for vitreous enamelling

2.105
enamelling iron
cold reduced low carbon steel, specifically produced as a metallic substrate for vitreous enamelling

2.106
etched
loss of gloss and/or roughening of the surface as a result of chemical attack

2.107
Faraday cage effect
<electrostatic application> defect resulting from poor penetration by charged enamel particles into concave areas leading to thin spray and potentially to burn-off

2.108
film strength
relative resistance of the vitreous enamel bisque to mechanical damage

NOTE See cross-bend test (2.64).

2.109
fineness test
control test used to measure the degree to which a vitreous enamel frit has been milled in either the wet or dry form, usually expressed in grams residue retained on a particular mesh sieve from a given sample size

2.110
fire tool marks
burning tool marks
fire marks
pin marks
point marks
defect characterised 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.

2.111
firing
controlled heat treatment of vitreous enamelled ware in a furnace, in order to fuse and develop the coating's desired properties

2.112
firing range
time-temperature interval in which a vitreous enamel or ceramic coating is satisfactorily fused

2.113
firing temperature
maturing temperature
temperature at which vitreous enamel must be held for a selected time to achieve the desired properties

2.114
firing time
period of time during which the ware remains in the firing zone of the furnace to mature the vitreous enamel coating

2.115
firing zone
portion of the furnace, usually a continuous furnace, through which the ware passes during the firing time

2.116
fish-scale
small half-moon shaped defects occurring in the vitreous enamelled surface

NOTE 1 See delayed fish-scale (2.74), shiner-scale (2.219), whale-scale (2.257) and process fish-scale (poppers) (2.184).

NOTE 2 Fish-scaling can occur immediately on cooling or after some time has elapsed following firing. This defect originates from super saturation of the substrate with hydrogen (acquired during firing), which explosively fractures the enamel coating in order to relieve the pressure that has accumulated with time at the enamel-steel interface.

2.117
flaw
defect in ware causing rejection

2.118
flow button
pellet of compressed powdered frit used in the "fusion flow test"

2.119
flow coating
process of coating a metal shape by causing the slip to flow over its surface, and allowing it to drain

2.120
fluidity
ability of a powder to develop a fluid-like consistency and flow properties when aerated

2.121
flux
substance that interacts with infusible (or partially infusible) materials, thus increasing fluidity of the melted mix

2.122
ford cup
device for measuring the flow out time for a defined volume through a specified area (hole)

2.123
fork
tool used to load and remove ware from the furnace during the firing operation

2.124
frit
flake
result of fusing a mixture of different inorganic raw materials, which constitute the vitrifiable base of the enamel, molten at temperatures between 1 150 °C and 1 350 °C and then quenched the molten glassy mass from these temperatures

NOTE Granulated frit is produced by quenching the discharging melt into water and flake is produced by discharging the melt between water cooled rollers.

2.125
fritting
process of quenching and shattering molten glass into small friable frit particles

2.126
fusion flow test
control test to compare the relative fluidity behaviour of molten samples of frit compared to an accepted standard

2.127
galvanic nickel dip
deposition of a nickel coating produced by a displacement reaction in which one metal displaces another from solution

EXAMPLE $Fe + Ni^{++} \rightarrow Ni + Fe^{++}$

2.128
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.

2.129
glass
term sometimes used for vitreous enamel or frit, in particular by chemical vessel manufacturers

2.130
glass eye
defect consisting of large unbroken blister in the surface of the fused vitreous enamel

2.131
gloss
shine or lustre of vitreous enamel surface

2.132
graining
application of a vitreous enamel finish resembling wood grain

2.133
graining roller
specialised type of roller used for transferring a grain pattern to the vitreous enamel

2.134
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

NOTE In the United Kingdom, this term can also apply to the use of non-metallic particles of similar shape, e.g. silicon carbide or aluminium oxide.

2.135
ground-coat
vitreous enamel applied directly to the substrate to function as an intermediate bonding layer between the substrate and the cover coat

2.136
hairlines
strain-lines
tension-lines
defect resembling one or a series of near parallel lines in the fused vitreous enamel surface, and giving the appearance of cracks healed by fusion

NOTE Hairlines can be caused, for example by the release of mechanical stresses within the steel during firing.

2.137
hardness
relative refractoriness of a vitreous enamel or frit

2.138
hollow ware
cookware
ovenware
kitchen utensils such as pots, pans, and kettles

2.139
hot dusting
dredging
application of dry powdered frit to red hot ware by sifting

2.140
impact test
test to determine the resistance of a vitreous enamel to fracture from a sudden blow

2.141
jar mill
pot mill
small porcelain ball mill

2.142
jewellers' enamel
vitreous enamel specifically formulated for use in the manufacture of jewellery, insignia, and art objects

2.143
lamination
<steel> defect characterised by a linear row of blisters in the vitreous enamel surface along the direction of rolling, in severe cases a metal blisters will form

2.144
lump
defect characterised by rounded projection on an enamelled surface

NOTE A lump is commonly the result of spray-gun spit.

2.145
lustre
decorative surface finish with an iridescent appearance

or

pearly or silky sheen of a vitreous enamel surface

2.146
marble effect
decorative surface finish produced by colouring and graining that resembles variegated marble however in the case of white enamels often noted as a defect due to a lack of opacity

2.147
matt enamel
vitreous enamel specifically formulated to provide a surface with low specular gloss

NOTE Matt enamel is also used to express a lack of gloss.

2.148
medium
squeegee oil
oil or mixture of oils used to suspend pigments and fluxes in screening inks

2.149
metal blister
defect with the appearance of a bulge in the enamelled surface due to entrapped gasses in a steel lamination resulting in localised swelling in the metal substrate during firing

NOTE Historically, metal blisters originated from pipe lamination in ingot route steel.

2.150
mill additions
materials used to prepare enamel slip, such as bisque strengtheners, electrolytes, pigments, refractories and suspension agents, etc. and which together with the frit comprise the mill charge

2.151
millscale
thick oxide layer formed during hot rolling or heat treatment of certain metals

2.152
mottled ware
graniteware
decorative finish with particles of one colour appearing in a uniform background of another colour or shade

NOTE See self-mottled ware (2.214).

2.153
muffle furnace
refractory chamber heated from the outside

NOTE The heat is transferred through the walls of the firing chamber in order to fire the ware inside and hence the ware has no contact with the products of combustion.

2.154
neutraliser
agent used to remove excess acid or alkali remaining on the surface of the work piece after pre-treatment

2.155
nickel dip
chemical deposition of a discontinuous layer of metallic nickel on to the surface of the steel in order to enhance the steel/enamel bond

NOTE See galvanic nickel dip (2.127) and reduction nickel dip (2.192).

2.156
one-coat enamelling
vitreous enamelling of ware is completed in a single coat application

2.157
one-fire enamelling
coat or coats of vitreous enamel fused in a single fire

2.158
opacifier
material that imparts or increases the opacity of vitreous enamel

2.159
opaque vitreous enamel
vitreous enamel frit which exhibit opaque properties after firing, through which neither the underlying coating or substrate is visible

2.160
orange peel
defect in the fused enamel coat showing a dimpled or wavy surface characteristic of orange peel

2.161
over-spray
slip from the spray gun not deposited on to the target area of the ware

or

spray application of a light coat of slip to an unfired vitreous enamel

2.162
pearl lines
bubble lines
defect characterized by a number of bubbles or blisters in a single line or a series of parallel lines

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

NOTE 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 - see lamination (2.143).

2.163
peeling
defect characterised by spontaneous detachment of large pieces of vitreous enamel from the metallic surface after firing

NOTE Peeling is a manifestation of poor adhesion.

2.164
perritts
comb-rack
comb shaped rack used for supporting ware during pickling, drying or firing operations

2.165
pickle basket
container fabricated from corrosion resistant material, used to hold ware during the pickling process

2.166
pickling
chemical process used to remove oxides and other compounds from the metal surface and to acid etching the metal surface in preparation for enamelling in order to enhance the steel-enamel bond

2.167
pigments
insoluble inorganic colouring agents

2.168
pig skin
leather
surface defect with the appearance characterised by similarity to the texture of pig skin

2.169
pinhole
pinholing
holiday
defect characterised by a small hole in the fired enamel

NOTE See pore (2.173).

2.170
pit
defect resembling a small surface depression

2.171
plugging compound
filler
putty-like mixture of inorganic materials used to fill holes in iron castings to ensure an even surface for vitreous enamelling

2.172
pop-off
defect in which small conical pieces of enamel, partially or fully detached themselves from enamelled ware

2.173
pore
defect characterised by a hole in the fired enamel connecting the surface with the metallic substrate

NOTE See pinhole (2.169).

2.174
porosity
degree to which voids are present in the fired enamel

2.175
porosity
<catalytic enamels> capacity of catalytic enamels to absorb oil or fatty substances

2.176
pot furnace
heating apparatus used to smelt raw materials contained in crucibles

2.177
powder enamel
<electrostatic> 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

2.178
powder enamelling
electrostatic application of a vitreous enamel coating in dry powder form to a cold substrate

2.179
powdered enamel
frit, in powder form, applied to red hot cast iron by sieving or dipping

NOTE Powdered enamel should not be confused with powder enamel.

2.180
powder-powder enamelling
application of a powder coat over an unfired powder ground coat and followed by firing

2.181
preheat zone
portion of a continuous furnace through which the ware passes before entering the firing zone

2.182
pressure pot
pressure tank
pressurised container from which slip is supplied under pressure to the spray-gun

2.183
primary boiling
evolution of gas during the initial firing of vitreous enamel

NOTE Primary boiling can sometimes cause rejection.

2.184
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 (2.116) and delayed fish-scale (2.74).

2.185
pyro
hydrated or anhydrous form of tetra sodium pyro-phosphate ($Na_4P_20_7$)

2.186
pyrolytic enamel
vitreous enamel specifically formulated with heat resistant properties

NOTE Pyrolytic enamel is used to coat ovens to allow food soils to be burnt-off when subjected to a cleaning cycle at a temperature at or above 500 °C.

2.187
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

2.188
reboiling
defect arising from the sudden appearance of bubbles on the surface of sheet steel ground coats during second and subsequent firings

2.189
re-circulating dip tank
container provided with the means of keeping the contents in constant circulation

2.190
reclaim enamel
vitreous enamel over-spray that is recovered from spray booths and reconstituted for re-use

2.191
recovery time
comeback
time required for a furnace to return to temperature after the introduction of a load of ware

2.192
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

2.193
reflectance
fraction of incident light that is diffusely reflected, measured relative to magnesium oxide, and using standard conditions

2.194
reflectivity
reflectance of a coating whose thickness is such that no further increase in reflectance occurs by increasing coating thickness

2.195
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

or

coating applied to non-metallic substrates such as graphite or concrete

2.196
resistivity
electrical resistance offered to the passage of a steady current

2.197
rheology
characterisation of the flow properties of an enamel slip or powder

2.198
ripple
defect having the appearance of a uniform, wide-ranging waviness in the surface of fused dry powdered enamel

2.199
rotary smelter
smelter that turns gradually on its horizontal axis in order to agitate continually the molten charge

2.200
rubbing stone
rubbing down stone
abrasive tool used to remove undesirable portions of fused vitreous enamel

NOTE See stoning (2.240).

2.201
rust inhibitor
coating compound comprising particular salts applied to prevent atmospheric oxidation

or

electrolyte that inhibits rusting at the interface between application and firing of the enamel

2.202
sag test
evaluation of the capacity of the substrate to undergo firing cycle(s) without excessive deviation from its original shape

2.203
sagging
distortion
warping
<steel> 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

2.204
sagging
<enamel> defect in which wavy lines of increased vitreous enamel thickness are evident due to flow or slippage of the coating occurring on those surfaces that are vertical during firing

2.205
sand blasting
abrasive blasting with a sand substitute, e.g. aluminium oxide

NOTE Blasting with sand is forbidden in most countries for reasons of health and safety.

2.206
sanitary ware
vitreous enamelled ware such as bathtubs, shower trays and sinks

2.207
satin finish
lustrous (but not mirror-like) surface finish having no directional texture

2.208
scab
defect having the appearance of a flap or tongue of loose metal rolled into the steel surface

2.209
scale
oxide formed on the surface of a metal during heating at elevated temperatures

2.210
scaling
process of forming scale

2.211
screening ink
screening paste
ceramic ink
blend of fluxes and pigments suspended in a medium and used as the ink in screen printing

2.212
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 (2.25).

2.213
self clean enamel
continuous clean enamel,
catalytic enamel
types of vitreous enamel designed to provide the continuous removal, at normal cooking temperatures, of food soils accumulated on the interior surfaces of ovens

NOTE The first type depends on porosity increasing the surface area to aid decomposition of the food soils, the second type incorporates transition metal oxides that catalyses the decomposition of the food soils.

2.214
self-mottled ware
decorative finish with particles of one colour appearing in a uniform background of another colour produced from slip containing two or more contrasting coloured frits

2.215
semi-muffle
any furnace in which products of combustion are not completely excluded from contact with the ware

2.216
semi-opaque enamel
vitreous enamel frit which exhibits only partial opacity after firing, through which the underlying coating or substrate is partially visible

2.217
set
rheological property of enamel slip affecting the rate of draining, residual thickness, and uniformity of coating

2.218
setting-up agent
set-up salt
electrolyte that is used to increase the measured pick-up of slip

2.219
shiner scale
shiner
defect appearing as a minute form of fish-scale encountered in over-fired ground-coat

NOTE See fish-scale (2.116).

2.220
shorelines
defect appearing as a series of roughly concentric wavy lines in the fired enamel surface

2.221
silver steel
silver metal
defect characterised 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.

2.222
sliding
defect caused by poor draining of the slip leading to patches of the coating sliding under its own weight and resulting in an uneven coat

2.223
slip
slurry
suspension of finely divided vitreous enamel material in a liquid, generally water

2.224
slip gauge
tool used to measure the consistency of the slip

2.225
slump test
test to determine consistency of slip whereby measurement is made by the spreading of a specified volume of slip over a flat surface

2.226
slushing
coating of ware with liquid enamel by pouring, dipping or throwing the slip onto the ware and removing the excess material by shaking to obtain a uniform coating

2.227
smelt
specific batch or lot of frit

2.228
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.

2.229
softening temperature
temperature at which, under specified conditions, vitreous enamel or frit begins to flow

2.230
soilability
relative ease with which extraneous matter attaches to or builds up on the surface of fused vitreous enamel

2.231
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

2.232
spall
spalling
defect resulting from the spontaneous fracturing and detachment of enamel mostly characterised by conchoidal fracture (i.e. the substrate may sometimes be visible)

NOTE Spalling often occurs on corners, sharp radii or panel edges and can be the result of too low enamel coefficient of expansion for the substrate, the external radii and the enamel thickness concerned. Mechanical and thermal stresses can aggravate the spalling.

2.233
spark test
high voltage electrical test in which a spark is used to detect discontinuity in coating

2.234
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.

2.235
spray gun
device that applies a coating of atomised vitreous enamel slip or powder to components with means of adjusting application rate, degree of atomisation and spray pattern

2.236
spray-rate
amount of enamel discharged by the spray-gun in unit time

2.237
stainability
relative ease with which vitreous enamel is penetrated and discoloured by a foreign material

2.238
star mark
spider
defect caused by bisque damage leaving a spider or star shape fracture in the fused enamel

NOTE 1 See fire tool marks (2.110).

NOTE 2 A star mark is often the result of impact damage on the underside whilst in bisque.

2.239
stippled finish
pebbly textured decorative vitreous enamel finish, often multicoloured

2.240
stoning
removal by abrading of undesirable portions of fused enamel with an abrasive stone

2.241
suspending agents
colloidal material that suspends the frit particles in enamel slip

2.242
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.

2.243
swab test
sponge test
<coating continuity> low voltage electrical test used to evaluate the continuity of vitreous enamel

2.244
swab test
<surface cleanliness> test used to validate the cleanliness of the vitreous enamel surface

2.245
tearing
defect characterised by short cracks or fissures in the enamel bisque, on firing the cracks usually heal, but leave a visible trace of the cracks in the enamel surface

NOTE Depending on the degree of cracking tearing can form a network of cracks.

2.246
thixotropy
property of suspensions which shows a reduction in viscosity when shaken or stirred

2.247
thread test
test performed by pulling or drawing a thread from the vitreous enamel melt during smelting to ascertain its degree of melting and to examine for un-dissolved or un-melted particles

2.248
triangle bars
three sided burning bars

2.249
tube furnace
furnace in which gas is burned inside radiant tubes, avoiding contact between the ware and the products of combustion

2.250
two coat-one fire enamelling
single firing of vitreous enamelled ware having received both ground and cover coats

2.251
U-type furnace
continuous furnace in which the ware travels into the firing zone, U-turns, and travels out along a parallel path

2.252
vapour degreasing
removal of oil and grease by solvent vapours condensing on the work pieces being cleaned

2.253
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

2.254
viscosity
Resistance offered by a fluid to flow

2.255
vitreous enamel
porcelain enamel (USA, Canada)
enamel
substantially vitreous, or glassy inorganic silica coating bonded to metallic substrate by fusion at a temperature above 480 °C

NOTE 1 This coating is applied for protective functional and/or aesthetic purposes.

NOTE 2 This coating is produced by the proprietary formulation of silica glass, minerals and clays to produce a sprayable medium, dry or suspended in water on to the surface of the metallic substrate, and its subsequent fusion bonding.

2.256
vitreous enamelling
porcelain enamelling
enamelling
process of covering a metal surface with one or more coatings of fusion bonded vitrified, inorganic material

2.257
whale-scale
defect characterised by an enlarged form of fish-scale encountered in under-fired ground-coat

NOTE See delayed fish-scale (2.74) and fish-scale (2.116).

2.258
water-break test
test used to validate the cleanliness of pickled or degreased substrate

NOTE A water-break is a discontinuous film of water on a surface signifying non-uniform wetting and usually associated with surface contamination.

2.259
water mark
water spot
water stain
defect characterised by a depression and/or a discolouration around the edges

2.260
water streak
water line
defect occurring in the bisque characterised by a washed out pattern in the form of a streak

Annex A
(informative)

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