TABLE OF POTTERY AND WHITEWARES DEFECTS

Extracted from a Number of References and my Old Gray Head: See Reference List Below

If you do not find the defect you are looking for in this table see the Table Index in The Ceramic and Pottery Defect Series 1-10 (CPDS 1-10)

DEFECT	PROCESS	CAUSES AND CORRECTIONS
black coring	bisk firing	Insufficient oxidation of carbon compounds during firing.
blackness	maiolica colors	Colors rely on glaze to supply flux to color. No flux results in blackening. Add borax frit softened glaze to color. Reducing atmosphere is a problem with some colors. Application is a factor too. Reference 3 REFERENCES
black spots	decorating	Bone china and porcelain. Usually on foot of ware. Ware not completely vitrified. Due to carbon and lack of oxidation in kiln. See reference 3. REFERENCES
bittiness	glazing	Thin glaze reveals body surface and feels rough. Calcium has been dissolved from frit and reacts with carbonate in processing water forming small spheres. This occurs if glaze is stored in a too warm environment. Prepared glazes from supplier can be kept dry until needed. Less soluble frits can be used. Acid can be added but that flocculates the glaze slurry.
blistering	bisk ware	Over firing, internal gases are trapped in a viscous body. Flame impingement can cause local blistering.
blistering	decorating	Rare, pinholes from impurities as far back as the raw materials are more common.

blistering (or boiling)	glazing	Overfiring of the glaze resulting in boiling. Flame impingement can cause blistering. Slowing down the heat up cycle, extending the maturation time, and slowing cooling can often correct this problem. It takes time to mature the glaze. Reducing the molten viscosity of the glaze may help. Manganese compounds decompose releasing oxygen that can exasperate this situation. If whiting decomposition is a problem use a frit containing CaO rather than whiting.
blistering	green ware	Does your slip stink? Maybe something is decomposing. Use formaldehyde or other antibacterial agent to kill the bugs. Small blisters can be caused by overfiring. See ***bloating***.
bloating	green ware	Does your slip stink? Maybe something is decomposing. Use formaldehyde or other antibacterial agent to kill the bugs.
bloating	bisk & glost ware	Overfiring is the prime suspect . If the preheat was not long enough or high enough in temperature to allow decomposition of carbonates, etc., before vitrification sets in, you can have bloating. Fast firing may not allow gases to escape from the interior of parts, especially thick sections. ***Black Coring*** occurs if the kiln atmosphere is not sufficiently oxidizing. Reduction can also increase vitrification due to the formation of FeO which can seal off areas before the carbon containing materials are removed. Bloating sometimes occurs in refired ware. That can be like overfiring so refire schedules need to be controlled.

blow-out	bisk	See ***lime popping***. Or perhaps ***bird pooping*** if that is what is occurring in the rafters of your factory. Keep slip and slop containers covered. Lime, plaster, concrete, cement dust can present problems. Lime particles can hydrate after firing and swell. Pop! If the defect doesn't show up in glazing it is because of the good action of the glaze in dissolving the particle or by keeping it from hydration. Increase bisk firing temperature. Check the quality of grog. Check your scrap for plaster mold bits. Iron pyrites can cause problems.
blurred decorations	underglaze	On vertical surfaces with Co and Ni colors. Solvent action of covering glaze. Keep glaze coat thin. Lower firing temperature. Add 10% china clay (alumina) to glaze. Shorten maturation time.
casting, brittle	cast ware	Sodium silicate may be the culprit. Use some Dispex® from Allied Chemical.
casting, flabby	cast ware	Soda ash may be the culprit. Balance with sodium silicate and I suggest that you use some Dispex® from Allied Chemical.
casting, mold release problems	cast ware	Excess deflocculant. Molds can be dusted with talc but the government frowns on this. I suggest rubbing fuel oil or kerosene on the mold but don't over do it. A damp cloth is good.
casting, run-off problems	cast ware	Make sure the slip specific gravity is high. Carefully increase the amount of dispersant.

casting, slow	cast ware	Finer dispersions build up a barrier layer next to the mold which then slows down casting. Over dispersion of the slip hastens this process. Particle size distribution and state of flocculation determined by thixotropy measurements by a torsion viscometer are important. Low slip specific gravity decreases the casting rate. Wet molds slow casting. For a detailed analysis of this problem with appropriate slip control techniques see ***References 1 & 3***. REFERENCES
casting, wreathing	cast ware	Surface skin effect causing fine lines on the inside of ware during pouring. Tapping the molds worked for us. Use some soda ash with sodium silicate. I like to add Dispex®. Keep molds in good condition or replace.
black spots	bone china decorating	
blow-out (see also ***lime popping***)	bisk, glost, decorating	Lime particles popping out after they hydrate and swell. Colemanite in glazes has a similar effect causing ***colemanite splutter***. May cause enamels to roughen.
chittered edge	plastic forming	See also ***Cracking, edge***. Sometimes called ***fish cracks***. Fettling tools on plate rollers finishing machines and other plastic forming finishing machines are not properly adjusted or not in proper condition. The ware is almost completely dry which exasperates the situation.
color, frizzled	decorating	Roughing or bubbling of overglaze decorations. Too rapid firing. Organic burnout. Reduce medium in color. Lower binder in medium. Fire more slowly. Increase kiln ventilation.

color variation	glazing	Can be caused by glaze thickness or kiln conditions or other conditions. See Reference 3 or a detailed description. REFERENCES
color variation	overglaze	Underfiring or overfiring is generally the problem. Combustion products can blacken or change some colors. See reference 3. REFERENCES
color variation	underglaze	Inconsistent color, glaze, application, firing. Sulphur from oil firing. See reference 3. REFERENCES
cracking	bisk	See **dunting**. Cracks can be from handling or thermal shock.
cracking	cast ware	Related to slip quality, mold sticking, meshing of slips during pouring in complex molds, and particle orientation. Over deflocculated slips can be a problem. So can scrap utilization.
cracking	drying	***Case hardening*** occurs in clay bodies on drying. This is a impervious surface layer that inhibits the removal of water from the interior of the body. In the first stage of drying, rapid water removal is allowed until the body particles touch. After that, water removal is ***diffusion controlled*** and the temperature and humidity of the dryer must be controlled until the piece is near completely dry. That means slower humidity controlled drying in the second stage. The last water in the piece is tightly held and may not be released until firing.

cracking	general	Due to stress buildup in the formed part. May be induced during extrusion, forming, and handling operations. Clay has a memory and tries to return to some original state. Uneven drying causes clay cracking (**see above**). Thick sections dry slower than thin sections so slow drying is required so part design is important. Cracks can be found by painting hot paraffin on the surface. Sometimes those areas can be repaired by ***pegging***. Edges should be wet sponged to remove cracks after cutting, fettling, and trimming to prevent opening of cracks during drying or firing.
cracking	edge	***Short*** clay. Too rapid or uneven drying. Too thin edges which can be corrected by design. Engobes can strain ware. Absorption of water by dry ware on standing which expands the part in certain areas producing strain which often show up after bisk firing as fine cracks. Improper trimming or fettling, especially on too dry ware or by using dull tools. Wet sponging can help. See ***chittered edge***.

cracking	handle	Stresses build during drying due to differences in shrinkage of the handle and the piece. Placing cast handles on plastic formed ware, if the handles have a higher moisture content than the piece, works because the shrinkage is the same over the cup handle placement distance. That is, a cast handle having 17% moisture on a cup having 15% moisture can result in the same shrinkage over the cup handle placing distance. That prevent strain. Putting a plastic formed handle on a plastic part does not always work because the required moisture in the handle is higher than the cup and the shrinkage of the handle is too high. Cast bodies usually shrink less than plastic bodies which has been a source of "good luck" for potters over the centuries. (I made a graph of this when I worked for Pfaltzgraff Company but I no longer have the data we obtained.) Handles also crack or pop off if the operator is unskilled. Also, the sticking slip, if used rather than just water, can be the problem. Too thick slip is not good. Also, if the cup handles are not trimmed properly resulting in improper fit, the handle will come off. A good fit and proper bonding are easily determined by impact testing. A good fit is observed if when the handle breaks during testing, the break is in the piece or in the handle but not at the join. Handles formed ***in situ*** on cast ware are usually reliable but handling can weaken the handle when it is removed from the mold. Finishing operations can also disrupt the handle.

cracking	spiral	Over extension of clay during forming operations. May show up on drying or firing. Can be confused with ***dunting***. The fracture surface is smoother and more shiny with ***dunting***.
cracking	surface	Improper moisture distribution. Water or slurry left standing in the base of thrown ware causes ***S-cracks***. Remove all excess water by sponge. Insufficient or nonuniform pressure during plastic forming can cause the clay to stay randomly mixed rather than in a close-packed playing card structure. This causes irregular shrinkage. Irregular drying caused by thick versus thin cross sections can produce surface cracks. Proper drying or part design is needed. Fine grained bodies tend to form a fine network of surface cracks numbers. Drying must be controlled. The body may need to be reformulated to reduce shrinkage. Grog additions may help. See Reference 3. REFERENCES
crawling	glazing	Crawling of glaze off ware can be caused by too much shrinkage of the glaze, too-thick glaze application, or incorrect binder system. Some areas of the body may not be taking up the glaze due to contamination by oil or particle orientation in some areas. Soluble salts from the body can be a problem. Tie them up chemically using barium carbonate.

crawling	glost firing	Crawling during the glost fire can be because of the glaze not wetting the body in certain areas. **See causes above.** Ware placed too close too each other may be a problem. Viscous glazes are prone to crawl. Crawling can occur because of handling. Controlled slower heat up of the glaze is sometimes required to correct the crawling problem. See reference 3 for more details. REFERENCES
crawling	underglaze colors	Crawling can occur on underglaze decorations due to improper adhesion of the glaze to the decoration. Binders and fluxes can improve adhesion. Too much underglaze medium. Fire slowly up to 500°C. See reference 3. REFERENCES

crazing	glazing, decorating, in field	Crazing occurs when the glaze is in tensile stress. That may because the glaze has too-high expansion or because of moisture expansion of the body. It often shows up in decorating fires. The cure is usually to lower the thermal expansion coefficient of the glaze. Silica added to the glaze or to the body often does the trick. Silica acts different in body and glaze (vitreous state versus crystalline state). Moisture expansion can be reduced by adding flux to the body or sealing the complete surface of the piece with glaze which requires pin firing. Various chemical elements usually in the frit form can reduce crazing. Low-expansion boron frits are often used. For a complete list of Chemical Elements and how they affect glazes it Table Form go to **CPDS 1-10**. This information can be extracted from the references (as I did). For calculating the thermal expansion coefficient (and other properties) of glazes from the elements see the tables in references 2, 3, and 4. Crazing can occur during ***dunting*** of ware. See the references and **CPDS 1-10** for other condition that may induce crazing such as too-thick glaze, underfiring body or glaze, overfiring porcelain glaze, improper grinding, etc. REFERENCES
cut glaze	glazing	***Crawling*** of glaze due to handling often in the dipping process. Scratches on the surface causes crawling along the mark. Oil or dirt from fingers or processing conditions can be factors that cause local crawling.

devitrification	glost firing	Crystallization of a non-crystalline glaze sometimes resulting in a pinkish or blueish discoloration. Zinc silicates and calcium borates are suspect. Calcium may come from the body. The longer a glaze is molten, the more chance it has of crystallizing so control the time/temperature during maturation and cooling. Additions of alumina perhaps as china clay can help as does lead bisilicate or lead frit.
dimples	glost firing	Also called ***orange peel***. Often a glaze application problem and can be recognized by looking at the surface of the glaze during application. Spray guns too close or spray pressure too high. Firing of higher viscosity glazes will not cure this defect. Glaze adjustment may be required if the application problem can not be cured.
discoloration (see also staining)	cast ware	A ***mold spot*** may appear at the point the slip first hits the mold possibly causing a local separation of body components. If the spot ends up on the bottom of the piece, it may not be important. Mica and iron particulate can concentrate and cause spotting. For a detailed analysis see ***Reference 3.*** REFERENCES

dropping, glaze	glost kilns	Called ***droppers*** by my friends in England. An Italian designed tile factory was put out of commission at Interpace® Corporation (before I worked there) when glaze dripped on the tile from the kiln roof. The factory was used to make tile grog after that fiasco. Also at Pfaltzgraff we purchased an old factory where fluorite was fired in a tunnel kiln. That kiln dripped but we could protect the ware with setters and by remodeling the kiln. Lead glazes can be a problem. Proper kiln design which allows the removal of glaze vapors is needed for some glazes. The vapors must be condensed outside the kiln chamber and collected as toxic waste. Have you tried zircon kiln washes?
dunting	glost fire	Cracking of ware due to thermal shock often associated with quartz inversions. The α **to** β inversions (which are shown incorrectly in my copy of reference 3) are crystobalite 225ºC, quartz 573ºC, and tridymite 870ºC. A smooth often shiny fracture surface indicates dunting.The first two inversions are often the problem. Controlling the cooling zone is required. You can cool rapidly to the inversion but then you must creep through the inversion *tippee toe*. Glazes too-high in compression are prone to dunt. Now if you open the kiln door letting cold air rush in over hot ware, the ware may suffer ***thermal shock.*** See reference 3 for a more comprehensive study of dunting. REFERENCES
dunting	decorating	See above. Fast cooling may be the problem. Keep ware above kiln shelf.

dunting	hot water	Pouring boiling or very hot water into a ceramic vessel may cause failure sometimes exhibited by the base breaking off a coffee pot or teapot. A lower expansion body, thinner glaze, and proper design avoiding non-uniform thickness may help. This is a serious problem in the field as someone could be scalded. Testing such ware in the factory is essential. See reference 3. REFERENCES
exploding	drying or firing	Too rapid drying or firing of damp ware resulting from steam pressure buildup. Often in flat or flaky pieces.
firing, fast	bisk, glost, decorating fires	Time temperature differences are important. Problems can be trapped gases, carbon compounds not oxidized, insufficient maturation of body or glaze, decorations not properly sunk. Keep working on it!
flaking	engobes	Usually due to shrinkage differences between the engobe and the body. Differences in drying shrinkage show up after drying. Differences in fired shrinkage show up after firing. Thinner coatings may improve adherence and fluxes can help. For a detailed analysis of this problem see ***Reference 3***. REFERENCES
flaking	decorations	
flaking, colors	underglaze	Too rapid application. Dirty surface. Binder problems. Not an industrial problem.
glaze, raw	glazing	

grit or other rough surface bits	glazing	Thin glaze reveals body surface and feels rough. Calcium has been dissolved from frit and reacts with carbonate in processing water forming small spheres. This occurs if glaze is stored in a too warm environment. Prepared glazes from supplier can be kept dry until needed. Less soluble frits can be used. Acid can be added but that flocculates the glaze slurry.
gloss, loss of	glazing	See ***crystallization***. Underfiring, improper or over grinding of the glaze, new batts or setters, thin glaze, kiln atmosphere or other kiln conditions. See reference 3. REFERENCES
handle fall-off	bisk ware	See Cracking, handle.
handle fall-off	green ware	See Cracking, handle
handle fall-off	gilded (or luster) ware decorating	Precious metals get into cup joint and hign expansion pops off the handle. Stay a way from the join.
ironing	decorating	Cobalt decorations have bronze streak above or in decoration. Add flux to color, apply color thinner, thicken glaze coating. Repair ware by applying flux or glaze over color and refiring. See reference 3. REFERENCES
laminating	cast ware	
laminating	dry pressing	Caused by poor material flow or air entrapment. Particle size distribution and particle fineness are to be suspected. Binders and lubricants can help. The flow of propane to displace air in die cavities helps too.

laminating	green ware	Ware formed by extrusion can laminate if the extrusion auger is worn or not functioning properly. Also if the extrusion is not de-aired laminations or blisters will result. Freezing a cross-section of extruded ware will reveal laminations. Ware formed on plate rollers and other plastic forming equipment may laminate because of problems in the initial extrusion. Improper programing of a plate roller can cause the clay not to knead properly. Particle orientation during forming operations should be considered a problem source.
lime popping	bisk fire	A white spot in a pock mark may be a lime particle. Test with acid. May occur during storage.
livering	casting slip	Thixotropic slip on standing or in under-deflocculated state. Slip surface look like jelly. Re-disperse the slip.
low strength	green ware	Increase percentage of fine-grained clay. Increase ball clay. Add small amounts of montmorillonite (bentonite). Use small amounts of organic binder such as gum arabic or dextrin. Decrease grog. Age the body before forming. Careful handling required.
low strength	bisk	Increase vitrification by adding fluxing minerals or increasing bisk firing time/temperature. Ball mill batch materials. Make sure body is properly mixed and de-aired during mixing and pugging operations. Make sure adequate pressure is applied during forming. Study the fired structure under a microscope or SEM.
matt, change in	glazing	

matt/glost changes in	overglaze colors	Shiny overglaze colors fire matt. Underfiring. Severe overfiring. **See Sulphuring**. Kiln condensation because of improper ventilation. Contaminates especially calcium compounds. Color substitution error. Lack of flux. See reference 3. REFERENCES
matt, change in	underglaze	
metal release	glazing and decorating	Usually refers to Pb and Cd. In glazes add lead as frit or lead bisilicate frit. Lower the lead content or eliminate it all together. Lead release in decorating is usually from the glaze but Cd is usually from the decorations. Underfiring. Too soluble glazes or decorations. Keep 4% moisture in final-fire (usually the gild fire) decorating kilns. Frit used in decorations can be a factor. See reference 3 for more details. REFERENCES
milky colors	underglaze	Glaze devitrification. Underfiring. Too rapid firing. Calcium borate formation. (Add Al to color and glaze.) Harden color before glazing using a hardening on fire. Glaze slurry contaminants. Hole in that sieve?
molds joints	casting	Tight mold joints are required because even though you fettle and sponge a protrusion caused by too open mold joints, the defect will appear again after drying and firing.
morted ware	cast ware	Caused by glazing partially dried ware by dipping. Stresses cause thin layers to sluff off. Morted ware in the sanitary ware industry is cracked ware due to incorrect pouring.

opacity, change in	glazing	Matt glaze becomes shiny. Use tin oxide (expensive) or zircon opacifiers. Titanium gives unwanted color. Insufficient dispersion can be corrected by using a zircon frit. Over firing.
overfiring	glost firing	See ***blistering*** and ***bloating***.
peeling	glaze application	Glaze not adhering to substrate or having too much shrinkage. Control particle size and binders as well as slip viscosity and specific gravity.
peeling	glost fire	Glaze ***shivering*** off when the glaze is in too much compression due to too low thermal expansion compared to the body. Easy to fix. What is harder to fix is when the glaze expansion is too high. See ***crazing***.
pinholes	cast ware	Dirty slip or reclaimed slip. Contaminated raw materials. Air entrapped by blunger blades whipping around above the slip level. Oil in blungers or dust. Improperly processed or excessive scrap. New molds can cause this. High density, high viscosity slips. Too fast pouring rate. Air or oil in casting lines. Improper screening or magnetic separation. Is there a hole in your screen? Check often.
pinholes	decorating	Pinholes that occur during glazing may show up in decorating fires. See below.

pinholes	glazing	Body contaminants from raw materials or reclaimed body, factory dust, coarse basalt, sponge, water contaminants, oil from machinery or air lines (use filters), fibers, lignite, air entrapped in pug mills, etc., past frozen clay, un-pugged clay, fast firing. Materials such as manganese dioxide in clay can give off oxygen in glost and decorating fires if they are not decomposed during bisk firing. REFERENCES
plasticity, lack off	plastic forming	Aging the body for 2-6 weeks can improve plasticity. Also make sure your body is flocculated. Plaster can be added to the slip to increase the degree of flocculation. Also, finer kaolins and ball clays can help plasticity. There are purer ball clays that can be added in small amounts to preserve whiteness. V-gum® or refined montmorillonite clays can help. Bodies containing alumina or nepheline syenite tend to deflocculate with time. If this occurs, the solution is to put the body back into slip form so it can be flocculated. Moisture control is important. A soil harness tester (clay hardness tester) is useful for control.
ring, loss off	glost fire	Look for minute cracks. Body underfired.
run off	cast ware pouring	See **wreathing**.

scumming	drying, firing, aging in field	From soluble salts migrating to surface or edges. Ware dried on the lip may show scumming on the foot. Filter pressing of body removes some salts. Salts can also be tied up by barium added as barium carbonate. Slower drying can diminish salt migration. Salts may come from the water source and sanitary ware plants often treat their process water. Vanadium and iron salts cause scumming in structural clay products. There is more information on this in **CPDS 1-10.** REFERENCES
spatter	glazing	See **Colemanite Splutter**

specking	glazing	Specking can be internal or on the surface which may help identify the source. If specking is on the surface it may not be in the batch but was deposited on the ware after forming. Harry Fraser says in his book that if specking is on both top and bottom surfaces it probably occurred early in the process. Processing equipment should be checked continuously especially storage tanks, mixers, screens, magnetic separators, extruders, etc. The factory must be kept clean. If overhead structures are a source of specking, they must be cleaned or at least body and glaze slip tanks must be covered and ware protected if stored in the open. Wind can bring in dust. Workmen can make dust, Vacuuming of machinery and kiln decks is a good idea. Kiln combustion systems at times create particulates. Filters in gas and air lines may be required. We had rust from old stagnant gas lines completely contaminate ware during the first firings at one factory I was managing. Colored specs may be attributed to compounds of Fe, Co (which goes a long way),Cu, Ni and other elements. Decorating materials should be held in suspect. See **CPDS 1-10** for other sources. REFERENCES
spit-out	decorating	
staining, brown	casting molds	From my experience it is caused by over deflocculation by sodium silicate which can release lignin from ball clays. Mold life is reduced as is casting efficiency.

staining, smoke	cast porcelain and stoneware reduction glost firing	Usually occurs on mold side surface. Use Dispex® from Allied Chemical instead of sodium silicate and soda ash as dispersant. Note: Dispex can also be used effectively with sodium silicate to improve casting of other bodies (which do not necessarily show smoking). Using sodium-sulphate-free clays also eliminates the problem. See Reference 3. REFERENCES
starved glaze	glazing	Contamination or improper glaze slip (slop) adjustment. Look for oil or handling marks.
starved glaze	glost firing	Too close setters or refractory, thin glaze, underfiring.
streaking	glazing	Called ***glaze run*** in the U.S. The glaze runs during application. Control glaze slurry (slop) specific gravity (pint weight) and viscosity. Glaze too thick. To much binder. Control grind of glaze so it doesn't settle out or separate during application. Correct dipping techniques (see reference 3). This problem in colored glazes can result is some pretty but off-colored streaks. REFERENCES
stuck ware	bisk fire	Overfiring. Contaminants on ware or setters or kiln slabs.
stuck ware	glost fire	Overfiring. Glaze on foot of ware. Glaze on setters or kiln slabs. Use setter wash and kiln slab wash.
stuck ware	slip casting molds	New molds. Dust molds with talc (now frowned upon). I have always preferred to wipe the mold with a damp cloth containing kerosene of fuel oil. Slip adjustments can help. Use Dispex®. See **casting**.

sulphuring	glost fire	Or ***feathering*** if frost-like on a window here in Idaho**.** Matt areas on a glossy surface that do not show crystallization. Usually calcium sulfate. This occurs with oil or coal firing.
twisting	glazing	Clay has a memory and hand-thrown pots may shift slightly during firing. This can displace the handle or spouts on teapots, etc. Clever potters put the spouts and handles on *crooked*. The twisting then puts them straight.
warping	bisk fire	**See below**. Overfiring or hot spots. Often ware must be supported by setters or props. For a discussion of shrinkage, drag, and slump see **CPDS 1-10.**
warping	glost fire	Warping occurs during drying or firing. Clay has a memory and stresses induced during making can cause warping. Even drying is required to prevent warping. Warping in kilns can be caused by hot spots in the kiln or flame impingement. Often ware must be supported by setters or props. Overfiring causes warping. ***Reference 3*** has a good section on how to prevent slump. To buy a new or used copy click on the reference link in REFERENCES.
white spot	glazing	Contaminants on the surface of a glaze, usually random and irregular shaped. Uniform shaped defects in the glaze may be due to opacifier, colorants, or other glaze constituents. Refiring can help. See **blistering**.
wreathing	cast ware	See **casting**. Use correct pouring procedures and adjust slip thixotropy and specific gravity. Use Dispex® (Allied Chemical)

REFERENCES

(references are linked to Amazon.com)

1. Ceramics: Processing & Testing, John T. Jones and M. F. Berard, Iowa State University Press, Second Edition, 1993

2. Ceramic Glazes, Cullen Parmalee and Cameron G. Harmon, Cahners 1973

3. Ceramic Faults and Their Remedies, Harry Fraser, A & C Black, London, 1986

4. Ceramic Glazes, Felix Singer and W. L. German, Borax Corporation 1960 (1964 printing)

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