1 Purpose and Scope

The purpose of this standard is to define and establish acceptance and rejection criteria for surface finish for incoming and outgoing inspections applicable at Customer, approved Supplier or Subcontractor and Viasat. The company uses similar inspection criteria as today's technology and market leader. Viasat can meet any surface finish on request; our finishing standard is common industrial finish described in Surface Categories Section.

Each finishing class stands for special manufacturing and handling processes, which are proportional to the related costs. Every customer has to decide if a special cosmetic finish is a requirement or "nice to have". Manufacturing processes of bare material (e.g. cold rolled steel, pre galvanized steel, extruded parts) as well from machining processes (e.g. punching, forming, and welding) may leave visible marks at the finished products, which are not avoidable. Anodized material is more scratch resistant than Alodine material.

This standard applies to Surface Finishes such as Paint, Chemical Conversion Coating (Alodine, Anodize), Plating, Molding and silk-screening.

Inspection Purpose

The inspection purpose is to determine any conditions for which the part or system will be rejected. The intent of inspection is

To ship a part or system that meets the finish standard of this specification.

It is **NOT** the intent of inspection to find all imperfections on a part or system.

2 Terms and Defect Definitions

Accept per approved engineering drawing

Some cosmetic imperfections are not avoidable in certain process and design circumstances. Approved engineering documents will point this out.

Abrasion

Surface imperfection that doesn't remove or displace material appears as a scuff or changes to the surface finish.

Bare Metal

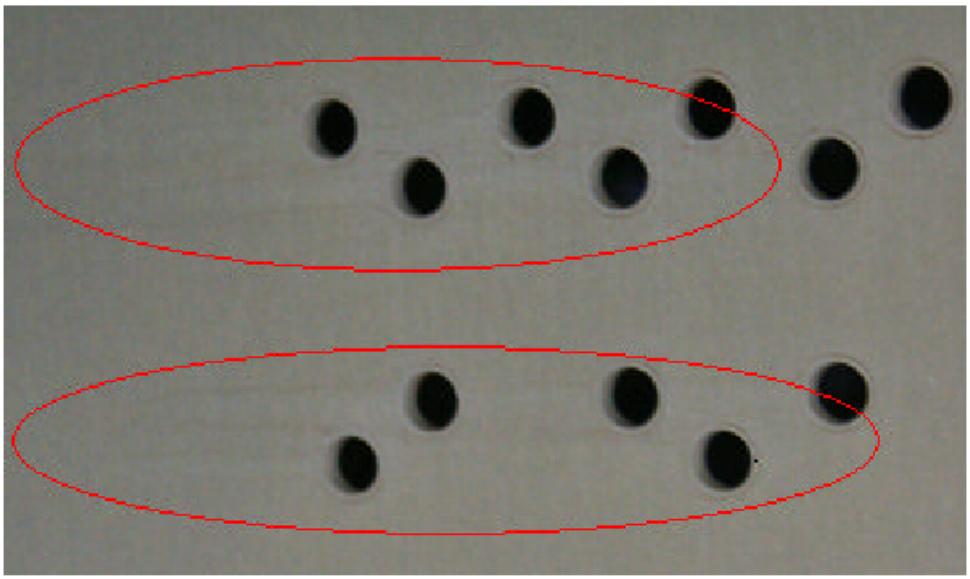
A metal surface that has an intact protective coating but no cosmetic finish.

Base Metal

A bare metal surface on which the protective coating has been compromised.

Bleed Out

A Substance that runs out of seams. Color can vary from brown, dark brown to gray white at plating.



Bleeding

Rough and not densely packed dull gray lines at plated material.

Blister

A bubbling in the surface of the finish. Non-adhesion or lack of proper sticking of the coating to the surface caused by trapped air, gas or moisture.

Blush

Discoloration or change in gloss.

Burns

Brown marks or streaks on a surface of the part caused by trapped gases burning the surface of the plastic during molding operation.

Bubble

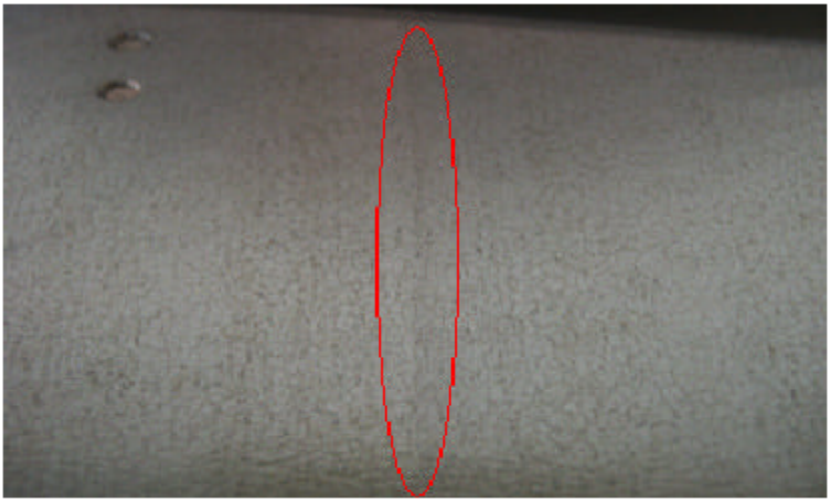
A bubbling in the surface of the finish. Non-adhesion or lack of proper sticking of the coating to the surface caused by trapped air, gas or moisture.

Bump

Protrusions caused by trapped air / gas or moisture usually seen in finished parts.

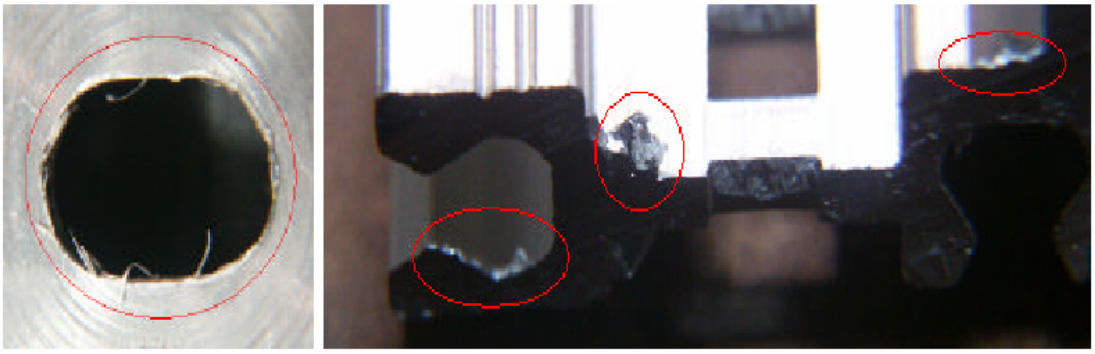
Burnish Marks

Marks or lines that cannot be felt usually caused by tooling dies most common on flattened cold rolled material e.g. Steel or aluminum sheets



Burrs

Sharp edges around part features caused by manufacturing process like punching, shearing, milling or drilling.



Caution: Sheet metal edges that are compliant to UL 1439 can still cut through protective gloves and/or human hands.

Chipping

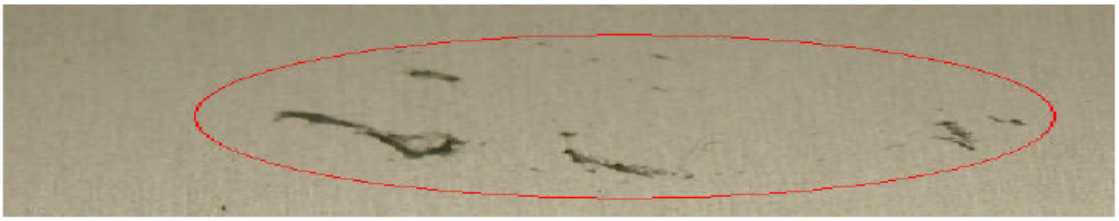
Areas in which the adhesion between the paint and the surface is poor, causing the paint to come off with light rubbing.

Cloudiness

A haziness or lack of clarity in otherwise transparent part.

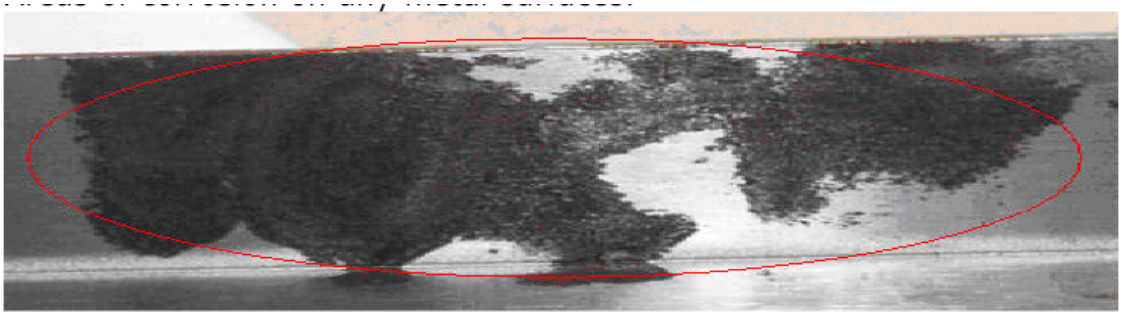
Contamination

Rough and not densely packed dull gray lines at plated material. Colored specks of foreign material embedded in or on the surface part.



Corrosion

Areas of corrosion on any metal surfaces.



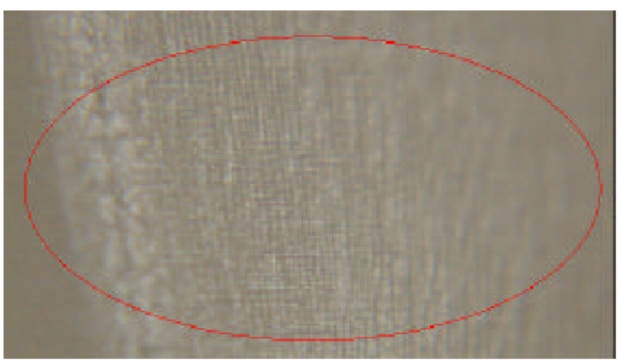
Caution: Small areas of rust are acceptable where plating is removed by a standard manufacturing or welding process, e.g. sheared (cut) edges.

Cracking

Crackled appearance due to poor adhesion usually from surface contamination before plating.

Hairline cracks of anodized material caused by bending, high temperature curing after silk screening of the aluminum or tool mark hair cracks on the opposite site of the aluminum.

Fine damages which may extend in a pattern on or beneath the surface or through a layer of material.



Crazing

A fine mesh of minute cracks on the surface of some plastics due mainly to the effects of UV light.

Delaminating

Separation, peeling of thin layer of material

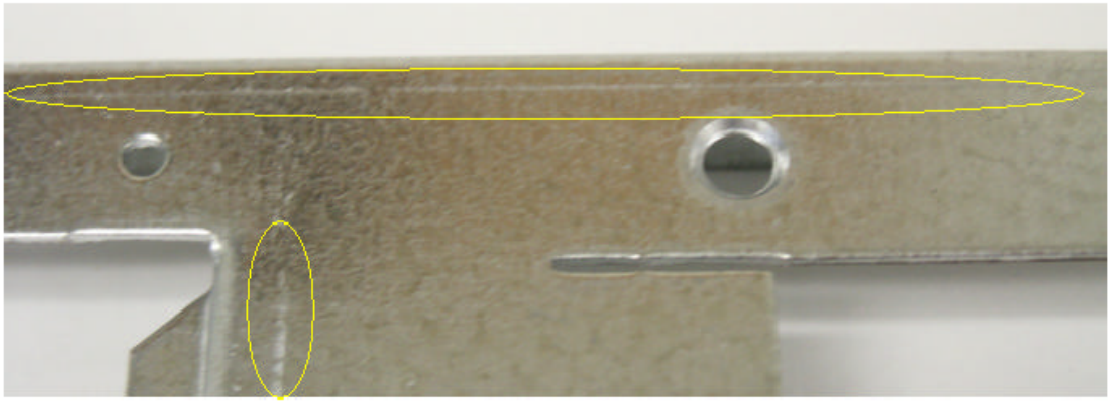
Dent

A surface depression caused by an impact.

Caution: Tooling marks are not dents.

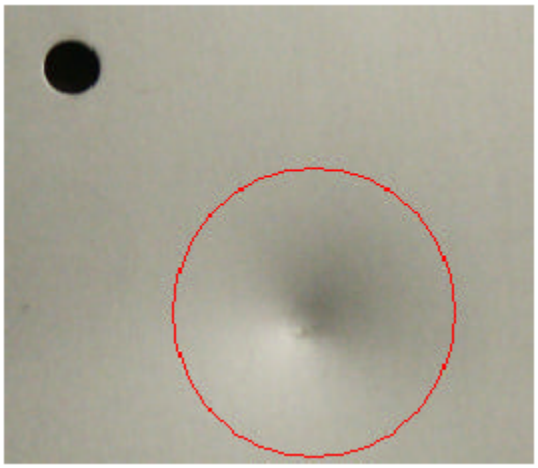
Die marks

Marks made on the metal's surface when it is formed, usually consist of long straight lines.



Ding

Roughly funnel shaped dent caused by an impact.

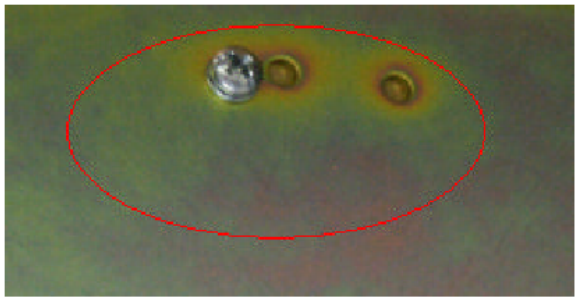


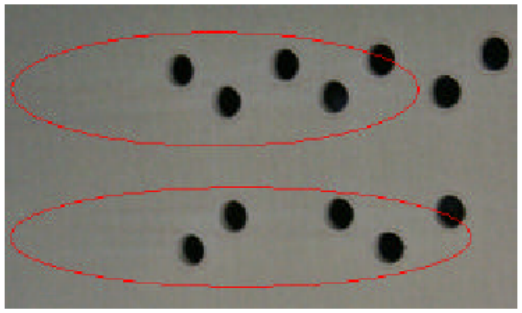
Dirt

Any particle of foreign material.

Discoloration

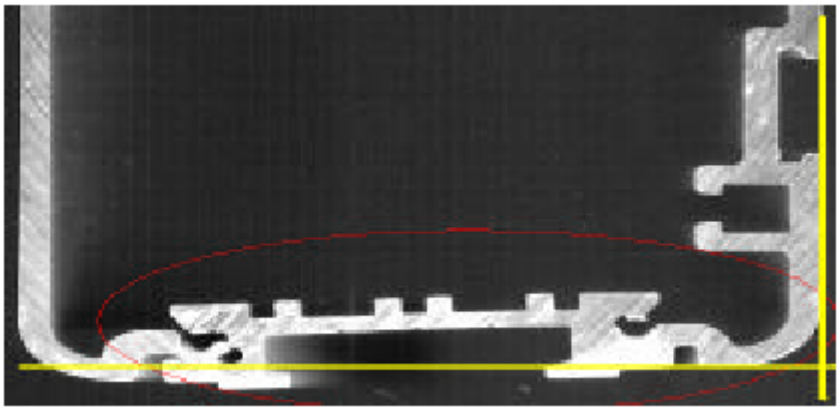
Any change from the original color or shade in the finish.





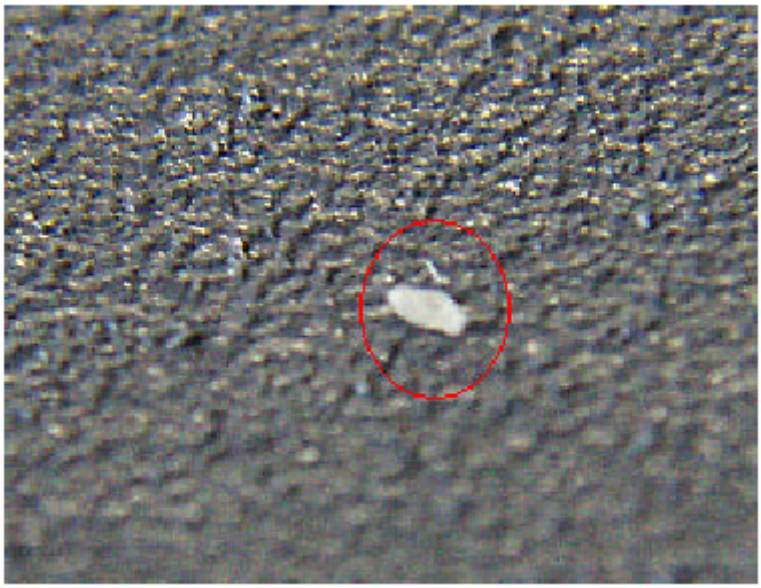
Distortion

A deformation of a diecasted part



Dust

Small particles.

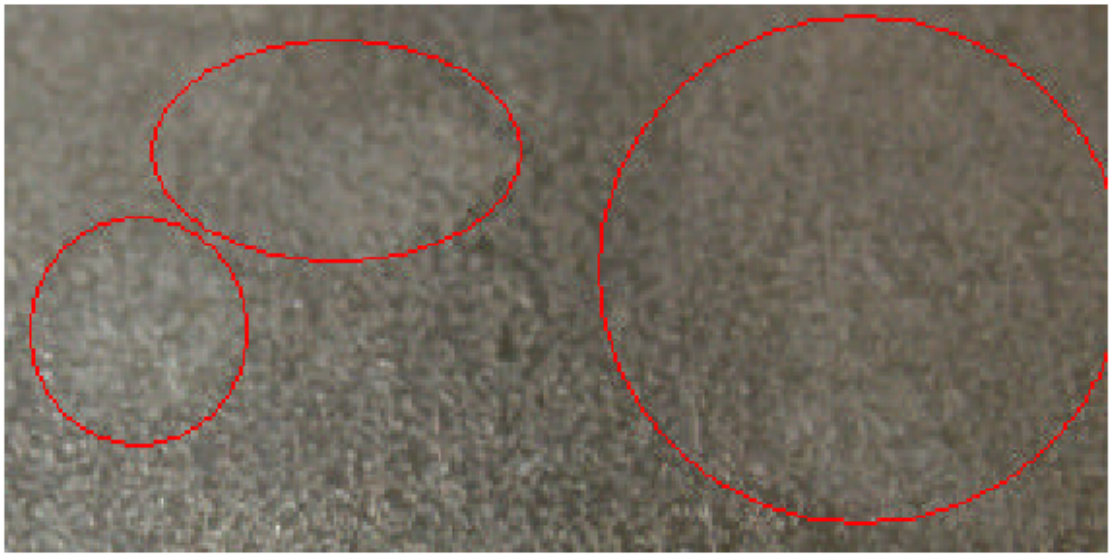


Fill In

An excess of ink that alters the form of a screened feature not affecting legibility.

Fingerprints

An impression left on the surface due to operator handling.



Finish

An area of smoother finish of molded plastic parts.

Flaking

Areas in which the adhesion between the paint and the surface is poor, causing the paint to come off with light rubbing.

Flash

Thin, excess material usually around the area of the mold parting line or internal shutoff areas.

Flow Marks

Waviness of edge or excess linear surface texture of silk-screened areas.

Fracture

Material splitting usually on the outside bend radius.

Gates

Point at which plastic is injected in cavity, usually on parting line.

Gloss

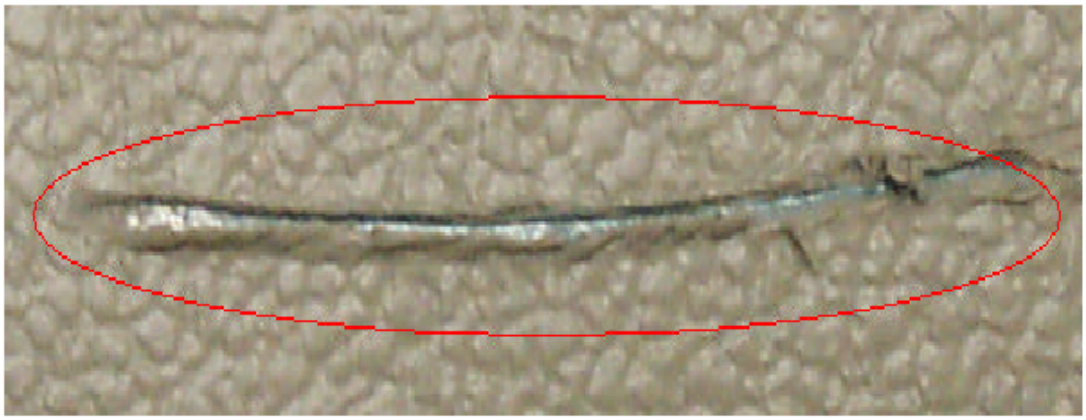
A uniform appearance of a painted or molded area. E.g. Shiny, matt

Glossiness

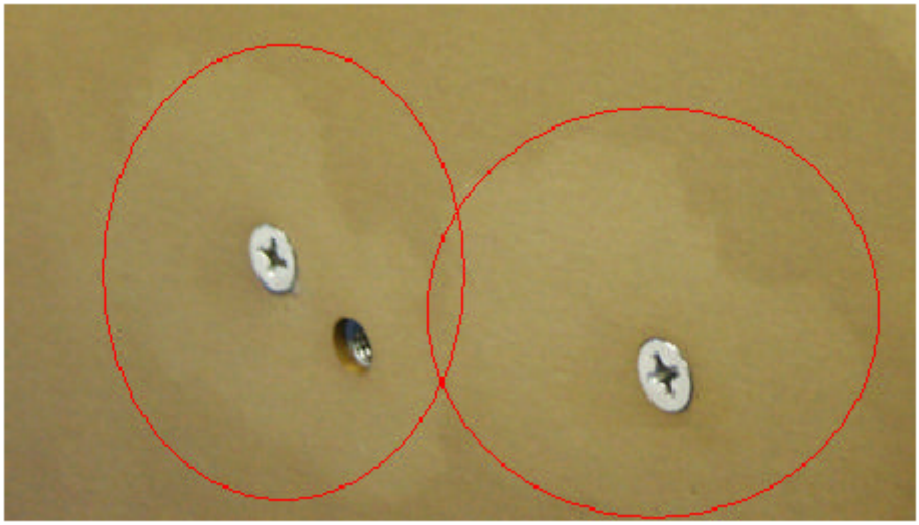
An area of either excessive or deficient gloss.

Gouge

A groove or scratch that extends through the finish and into the metal caused by a sharp object. A depth is measurable.



Grease
Any lubricant transferred to the part's surface, shiny or glossy patches on the surface of the part.



Haze
Cloudiness on an otherwise transparent part.

Inconsistency
Variation of gloss, thickness of line or surface texture.

Inclusions
Small craters on surface caused by dust or dirt.

Lint
Any unintended foreign substance in the coating or on the surface.

Marbling
Colored streaks on a surface caused by improper mixing of molten plastic.

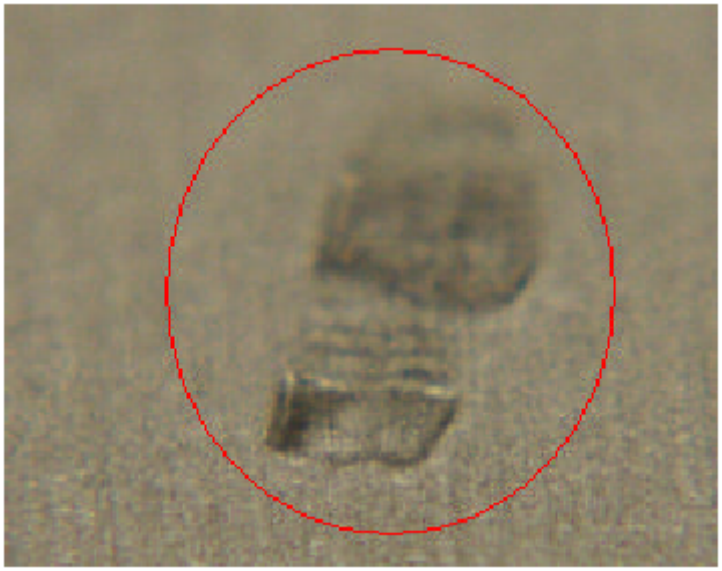
Marks
Pits, sanding, or other marks on base material that remains visible after coating.

Matt Finish
A less glossy finish of a surface area.

Metal Fuzz
Fine grit metal shavings that are clumped together may also be magnetic.

Nicks

Like gouges but short of length caused by impact.



Non-adhesion

Lack of proper sticking of the coating or a glued material to the surface.

Non-uniform Coverage

Areas that have an insufficient or excessive coating.

Oils

Oily material on the surface due to materials used in manufacturing processes. Oily looking spots caused by Loctite locking feature.

Orange Peel

Paint defect, rippled or mottled appearance viewable as concentric lines caused by under pressurizing not dried paint surfaces.

Orange Skin

Paint defect, rippled or mottled appearance.

Oxidation

Has a rough feel of appearance. Dull gray, dark gray, black, brown, dark cinnamon or possibly white colored substance.

Peeling

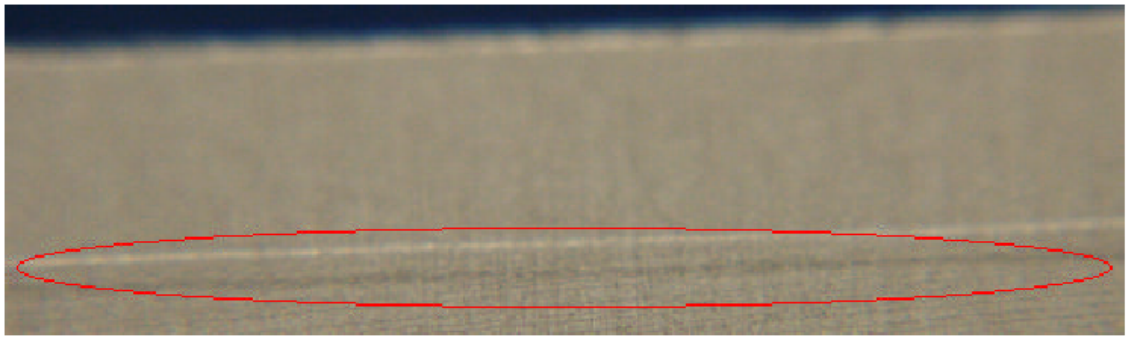
Areas in which the adhesion between the paint and the surface is poor, causing the paint to come off with light rubbing.

Pitting

Small craters on surface.

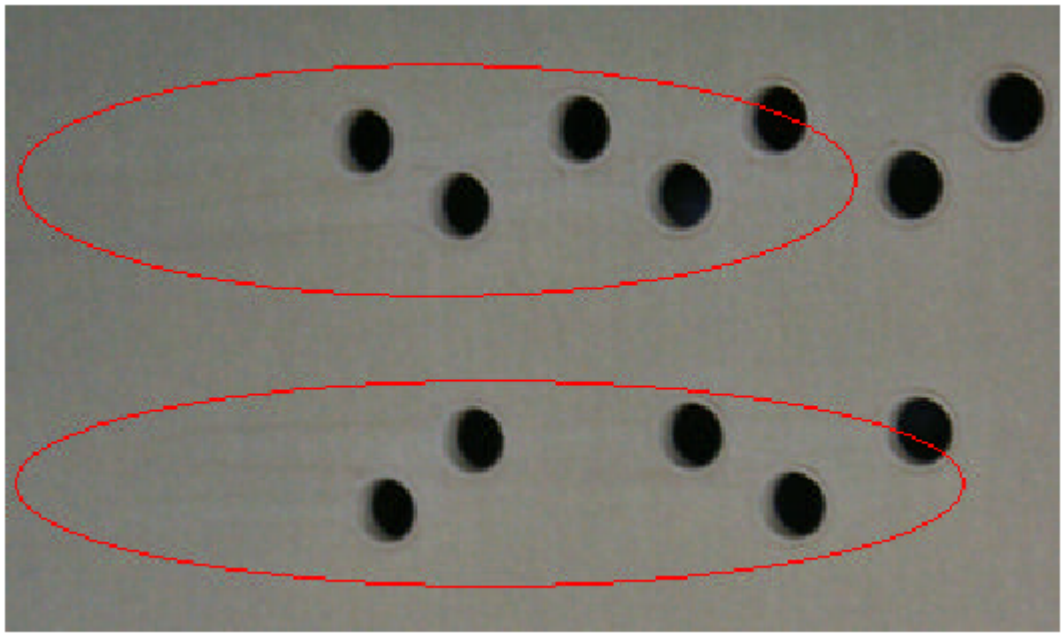
Punch mark

Mark on the surface of a material due to punch process.



Runs

Drips, bleeding, visible lines or raised areas of excessive paint or chemical coating similar to non-uniform coverage.



Rust

Areas of corrosion on any metal surfaces

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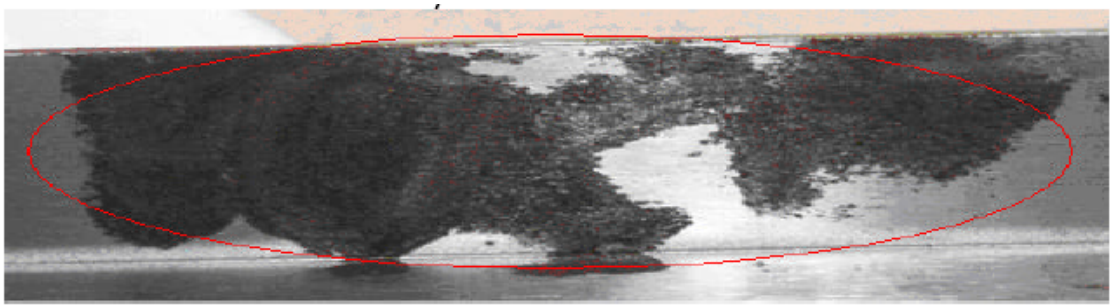
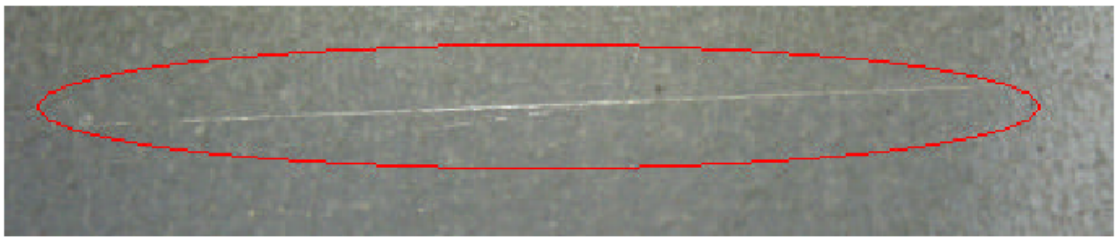


Caution: Small areas of rust are acceptable where plating is removed by a standard manufacturing or welding process, e.g. sheared (cut) edges.

Scratch

A shallow groove that can be seen but not felt.

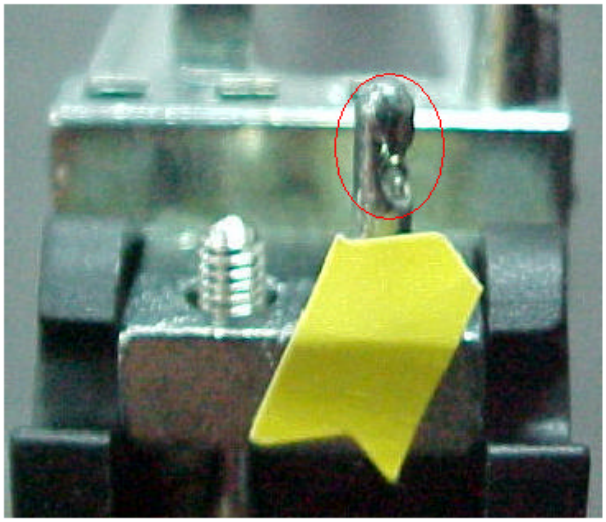


Scuff marks

A series of very light, concentrated scratches that can be seen but not felt.

Short-Shot

Incomplete molded feature.

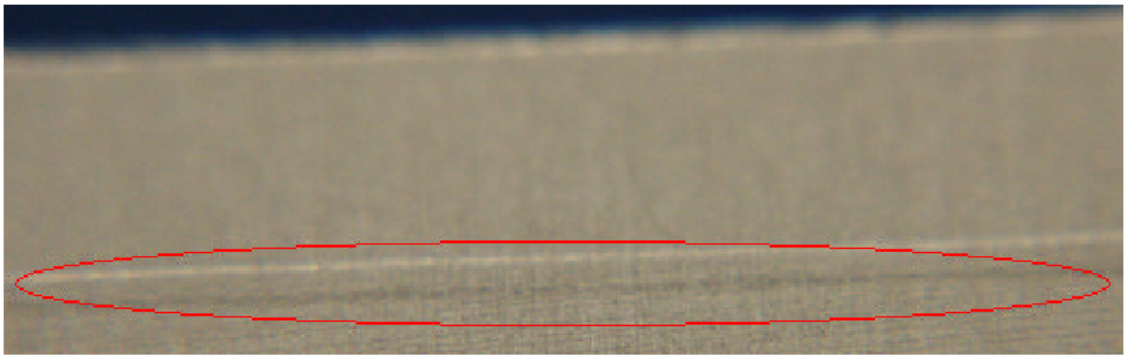


Sink

Depression or dimple caused by non-uniform material shrinkage.

Slug Mark

A surface deformity caused by the punching process.

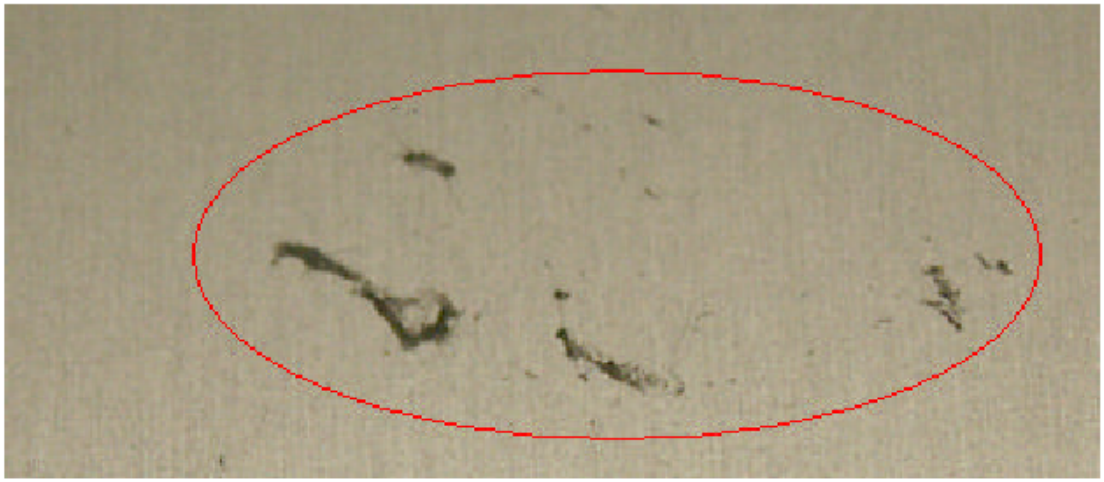


Smearing

The presence of ink on areas not called out in the master artwork.

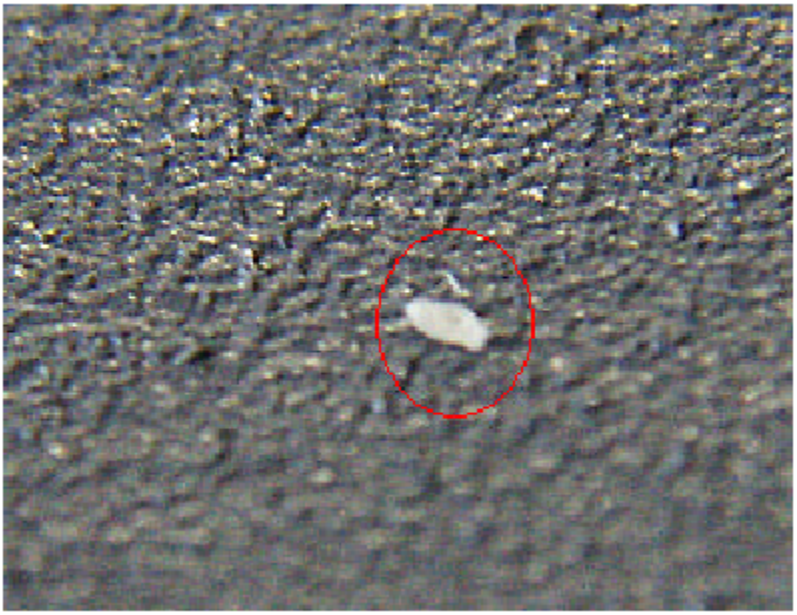
Smudge

Any dirt particle of foreign material.



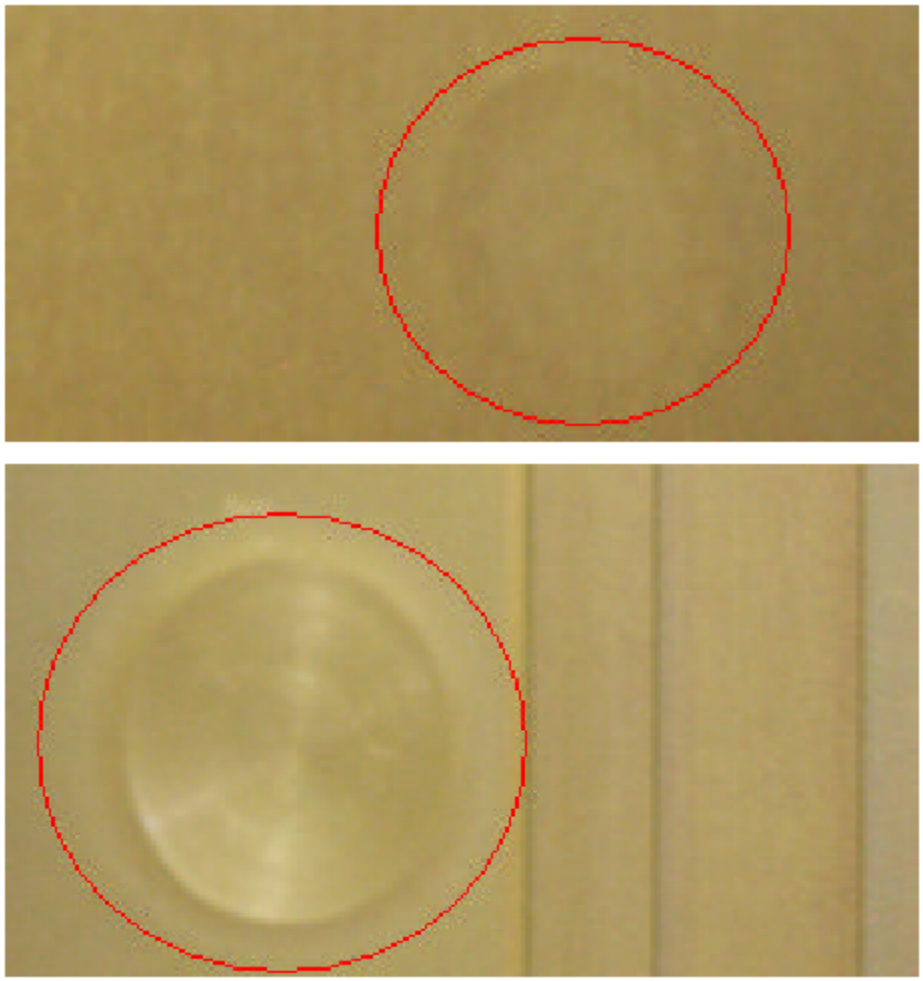
Specks

Small particles.



Spot Weld Mark

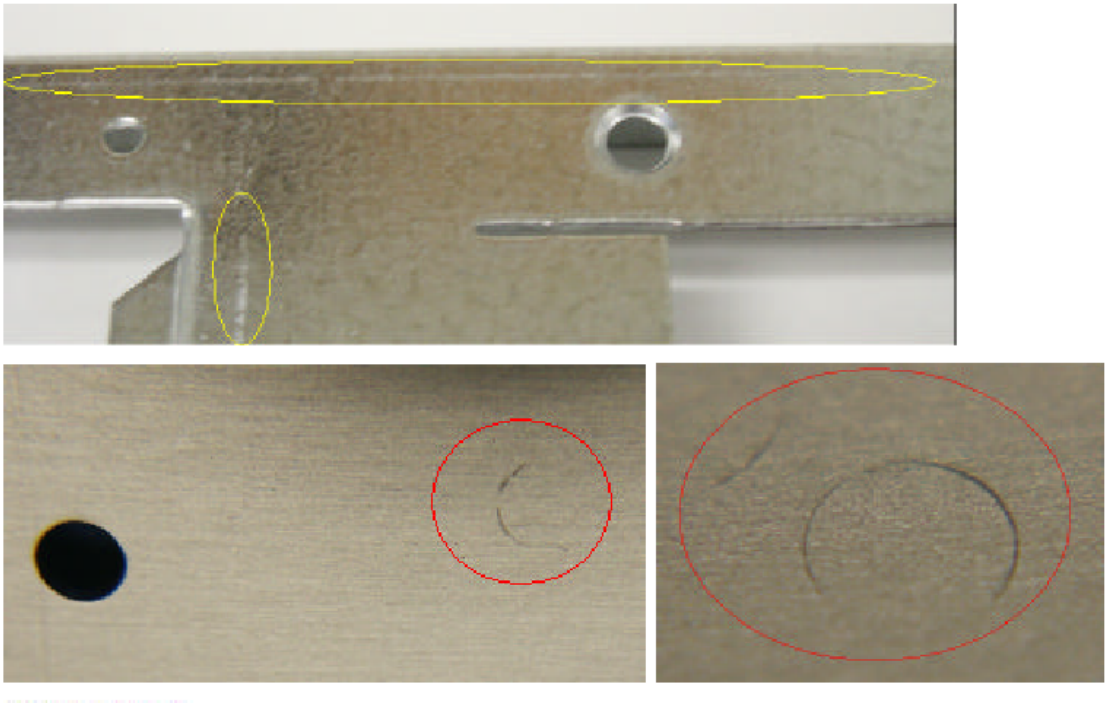
Dish shaped surface caused by spot welding process.



Tooling Marks

Very shallow lines which are parallel to bends in part.

Unwanted impact of a tool during punch process.



Caution: Some tooling marks are not avoidable in some process steps. E.g. punching, forming, and bending.

Texture

An area of rougher finish of plastic molded parts.

A rougher but uniform finish of painted parts.

Visible Surface

Surfaces those are visible when the enclosure or part is installed in a completed assembly.

Void

The failure of ink to define a graphic feature.

Warpage

Dimensional distortion in a part after molding, pressing or laminating. Twist or bows in the part.

Water Spots

Rough and not densely packed dull gray lines at plated material.

Weld lines

Line where molten plastic or metal joins form a part. A weld line usually appears as a noticeable line or gloss variation across the surface of the part.

3 Preferred Appearance Quality

PAINT

Preferred

- Painted surfaces should be defect free and the texture and color should be uniform throughout the entire surface.
- The finish on a continuous surface shall exhibit no gross imperfections such as gouges, large chips, runs, blisters, oil spots, flaking, or any defects that will affect the functional properties of the finish.
- Paint touch-up is acceptable.
- A touch-up is not acceptable if visible at the viewing distance for that class of surface.

SILK-SCREENING

Preferred

- Silk-screened logos or symbols should be defect free, and should withstand cleaning with mild solvents and the tape pull test.

PLATING

Preferred

- Visible outside surfaces should be defect free, and die and slug marks should not be visible.

CHEMICAL CONVERSION COATING (Alodine)

Preferred

- The finish shall have uniform appearance; be semi-bright, smooth, and clear to slightly yellow or iridescent in color. Visual appearance will vary between different alloys and between machined, milled, cast, and grained surfaces.
- Outside surface shall be free from scratches, dents, or gouges.

INSPECTION REQUIREMENTS

Viewing Conditions

- The inspector shall scan the surface in a continuous manner. All judgments shall be made from the specified lighting, viewing distance, angle and material classes as described below.

4 Surface Categories

Class A

- Is a **critical** cosmetic surface usually front exterior surface which is most often closely viewed by the user / customer
- Panels
- Instrument cases
- Desktop cases
- Customer specified

Class B

- Is a semi-critical cosmetic surface usually exterior surface which is adjacent to Class A, not viewed as often but easily seen.

Class C

- Is a non-critical cosmetic surface either exterior surface rarely viewed by the user / customer, such as back surface; or an internal surface that is visible but not normally viewed by the user / customer.

5 Light Source

Light Specification

- White, cool artificial office lighting (e.g. fluorescent light)
- Do not use direct sunlight.

Light Intensity

- Uniform intensity between 70 and 120 foot-candles. (750 and 1250 Lux)

Caution: At levels of greater light intensity caution should be used to not over inspect the parts in order of accentuate surface flaws.

Light position

- Reflection free, non-directional from the top.

Caution: No direct overhead light above inspection table.

6 Inspection Table Surface

The table surface should be made of a non-reflective dark color to avoid twilight conditions.

Preferred: Black rubber mat Acceptable: Dark blue or dark green rubber mat

Unacceptable: Light color table surfaces e.g. white, gray, yellow, metallic etc.

Caution: Reflective light-colored surfaces eliminate or accentuate surface flaws.

7 Viewing Time

Class A

- Systems: Ten (10) seconds per 200 square inches per part
- Front Panels: Five (5) seconds per 50 square inches per part

Class B

- Seven (7) seconds per 200 square inches per part

Class C

- Five (5) seconds per 200 square inches per part

8 Viewing Orientation

During inspection, view objects in an orientation perpendicular to each surface. During assembly, view objects in normal orientation of manufacturing process. In some cases inspection should be held prior to assembly. Any visible surface flaw has to be verified against the acceptable defect matrix.

Caution: Parts shall not be manipulated to reflect a single light source in order to accentuate surface flaws.

9 Magnification Tools

Magnification tools may be used to find root causes for defects or to verify correctness of special areas.

Caution: Magnification is not to be used when inspecting for cosmetic defects.

10 Viewing Distance

Viewing Distances from the surface being inspected

Class A

- 24 Inch (610 mm)

Class B

- 30 Inch (760 mm)

Class C

- 36 Inch (760 mm)

11 Acceptable Defects Matrix

Acceptable Defects For Class "A" Surfaces

Viewing time	Viewing distance
Ten (10) seconds per 200 square inches per part, Five (5) seconds per 50 square inches for front panels	24 Inch (610 mm)

DEFECT	ACCEPT	REJECT
Bleed out	Up to 5/16" away from seam. Touch up allowed.	Any greater than 5/16"
Blister	None	Any
Blush	Accept per approved engineering document.	
Bubble	None	Any
Burns	Accept per approved engineering document.	
Burrs	Less than 10% of material thickness	Any greater than 10%
Cloudiness	None	Any
Contamination	None	Any
Corrosion / Rust / Oxidation	None	Any
Cracks	None	Any
Dent / Ding / Pitting	None	Any
Discoloration color consistency	Accept per approved engineering document for 100% uniformity of surface.	Partial discoloration
Dirt / Lint / Specks / Smudge	Less than or equal to 0.02"	Any greater than 0.02"
Flash	Accept per approved engineering document.	
Flow Marks	None	Any
Fingerprints	None	Any
Flaking / Chipping / Peeling	None	Any
Metal Fuzz	None	Any
Paint Non-Adhesion / Non-Uniformity / Inconsistency	None	Any
Paint runs	None	Any
Scratches / Gouges	Qty. 3, less than or equal to 0.01" x 0.03"	More than qty. 3. Any bare metal or base metal on a painted surface
Scuff Marks	Accept per approved engineering document.	
Short-Shots	None	Any
Sink	Less than or equal to 0.003" deep	Any greater than 0.003"
Smearing	None	Any
Spot weld, Welding Lines	Accept per approved engineering document.	
Texture / Gloss / Finish	100% uniformity of surface, Accept per approved engineering document.	Partial variation
Tooling marks / Die marks / Slug mark / Punch mark / Burnish marks	Accept per approved engineering document.	
Voids	Less than or equal to 0.01"	Any greater than 0.01"
Water Spots	None	Any

Acceptable Defects For Class "B" Surfaces

Viewing time	Viewing distance
Seven (7) seconds per 200 square inches per part	30 Inch (760 mm)

DEFECT	ACCEPT	REJECT
Bleed out	Up to 3/8" away from seam. Touch up allowed.	Any greater than 3/8"
Blister	None	Any
Blush	Accept per approved engineering document.	
Bubble	None	Any
Burns	Accept per approved engineering document.	
Burrs	Less than 10% of material thickness	Any greater than 10%
Cloudiness	None	Any
Contamination	None	Any
Corrosion / Rust / Oxidation	None	Any
Cracks	None	Any
Dent / Ding / Pitting	None	Any
Discoloration color consistency	90% uniformity of surface.	More than 10% surface discoloration or consistency
Dirt / Lint / Specks / Smudge	Qty. 3, Less than or equal to 0.03"	More than qty. 3 per surface or any greater than 0.03"
Flash	Less than or equal to 0.005" in height	Any greater than 0.005" in height
Flow Marks	None	Any
Fingerprints	None	Any
Flaking / Chipping / Peeling	Less than or equal to 0.03"	Any bare metal greater than 0.03" or any exposed base metal
Metal Fuzz	None	Any
Paint Non-Adhesion / Non-Uniformity / Inconsistency	None	Any
Paint runs	None	Any
Scratches / Gouges	Qty. 2; Less than or equal to 0.02" x 0.09"; Qty. 1; Less than or equal to 0.01" x 0.25";	More than limit qty. per surface. Any exposed base metal on painted surfaces
Scuff Marks	Accept per approved engineering document.	
Short-Shots	None	Any
Sink	Less than or equal to 0.005" deep	Any greater than 0.005" deep
Smearing	None	Any
Spot weld, Welding Lines	Less than or equal to 0.005" in height or depth	Any greater than 0.005" in height or depth
Texture / Gloss / Finish	Less than or equal to 0.02" x 0.25"	Any greater than 0.02" x 0.25"
Tooling marks / Die marks / Slug mark / Punch mark / Burnish marks	Accept per approved engineering document.	
Voids	Less than or equal to 0.03"	Any greater than 0.03"
Water Spots	None	Any

Acceptable Defects For Class "C" Surfaces

Viewing time	Viewing distance
Five (5) seconds per 200 square inches per part	36 Inch (460 mm)

DEFECT	ACCEPT	REJECT
Bleed out	Up to 3/8" away from seam. Touch up allowed.	Any greater than 3/8"
Blister	None	Any
Blush	Accept per approved engineering document.	
Bubble	None	Any
Burns	Accept per approved engineering document.	
Burrs	Less than 10% of material thickness	Any greater than 10%
Cloudiness	None	Any
Contamination	None	Any
Corrosion / Rust / Oxidation	None	Any
Cracks	None	Any
Dent / Ding / Pitting	None	Any
Discoloration color consistency	80% uniformity of surface.	More than 20% surface discoloration or consistency
Dirt / Lint / Specks / Smudge	Qty. 3, Less than or equal to 0.06"	More than qty. 3 per surface or any greater than 0.06"
Flash	Less than or equal to 0.005" in height	Any greater than 0.005" in height
Flow Marks	None	Any
Fingerprints	None	Any
Flaking / Chipping / Peeling	Less than or equal to 0.09"	Any bare metal greater than 0.09" or any exposed base metal
Metal Fuzz	None	Any
Paint Non-Adhesion / Non-Uniformity / Inconsistency	None	Any
Paint runs	None	Any
Scratches / Gouges	Qty. 4; Less than or equal to 0.02" x 0.25"; Qty. 1; Less than or equal to 0.01" x 0.5";	More than limit qty. per surface. Any exposed base metal on painted surfaces
Scuff Marks	Accept per approved engineering document.	
Short-Shots	None	Any
Sink	Qty. 1, Less than or equal to 0.015" deep	Any greater than 0.015" deep
Smearing	None	Any
Spot weld, Welding Lines	Less than or equal to 0.005" in height or depth	Any greater than 0.005" in height or depth
Texture / Gloss / Finish	Less than or equal to 0.02" x 0.09"	Any greater than 0.02" x 0.09"
Tooling marks / Die marks / Slug mark / Punch mark / Burnish marks	Accept per approved engineering document.	
Voids	Less than or equal to 0.03"	Any greater than 0.03"
Water Spots	None	Any