Business Area(s)	Business Function	Document Type	Document ID	Release Date
Platform & Services (P&S)	Performance Management	**GUIDELINE**	093815	12/15/2025
Business Process Area	**Document Content Owner**	**Document Scope**	**Revision**	**Compliance**
Quality Management	Kenneth Sturm	Sector Wide	02a	**YES**

BAE SYSTEMS

Guideline for Supplier Workmanship Standard

Purpose / Scope

This Supplier Workmanship Standard (SWS) provides criteria for the visual inspection and evaluation of raw and finished components. The purpose of this document is to establish BAE Systems acceptance criteria, with respect to the workmanship of fabricated parts and assemblies. Herein, workmanship refers to the level of quality imparted onto a finished part/assembly both during and at the completion of the manufacturing process.
This workmanship standard is specific to Phoenix Suppliers and products. This document addresses visual aesthetic characteristics based on the component's intended use and is for use during the requirements definition, manufacture, and/or inspection operations of parts/assemblies designed and procured by/for BAE Systems.

- This workmanship standard is required to be used when Contract Deliverable Requirement (CDR) 087 – Material Workmanship Standard is applied on the purchase order.
- Suppliers are responsible for fabricating and delivering parts that meet all requirements defined by the applicable drawings, specifications, and/or as otherwise defined within the purchase order.
- This document provides a common reference for the workmanship of parts where they are unspecified through other superseding requirements.

This document does not address performance or durability characteristics.

Reference Related Support Data

- BAE Systems Forms/Standard Operating Procedures
  - 089725 - Vendor Information Request Form

Table Of Contents.

Document Maintenance

This document will be maintained by BAE Systems Quality with document stakeholders (Quality Engineering, Manufacturing Engineering, Project Engineering and Operations) as required to ensure the information contained herein remains relevant.

Standard Requirements

The standard workmanship requirements were developed by BAE Systems through common industry practices. The subjective nature of visual blemishes and defects mandates the use of visual inspection criteria for the acceptance of components and assemblies by BAE Systems and its Suppliers. The criteria in this document does not replace or modify BAE Systems drawings or material specifications. In the event of a conflict between this standard and any applicable document, the order of precedence will be as defined by the purchase order.

Surface Visual Requirements

All surfaces or areas on any part/component/assembly which are most prominent to the observer or are most likely noticed at first glance, shall have the highest quality finish requirements.

Procedure

The criterion in this document is to be used by Supplier inspection personnel in making an "accept/reject" or pass/fail decision. Visual inspection decisions shall rely on the judgment of Supplier trained inspectors on the requirements of this document.

Visual Inspection Method

- Lighting: Visual inspection areas shall be well lit, and illumination should be uniform overhead cool white florescent lighting, without shadow, with a minimum 70 foot-candles (753 lux) at the inspection surface. When judging colors the use of a light booth is recommended.

- Viewing Distance and Angle: Unless otherwise specified or required, inspections should be performed at normal viewing distances at “arm’s length” or about 18-24 inches (45 - 70 cm), “waist high” or about 26-30 inches (66 – 76 cm) from the floor, with the unaided eye. The part is often held at a 30° to 45° angle to the horizontal plane and rotated to allow light to reflect off the surface from different angles, which may help to reveal surface imperfections.

- Parts under inspected shall not be manipulated (twisted) to reflect a single light source to accentuate surface flaws. View without directly reflecting a light source. The parts shall be free of all dust, dirt, oil, water or any identified or unidentified FOD during the inspection. The part may be wiped with a clean cloth or with a suitable light duty cleaning solution before examination if required. Any inspection table surface should be made of a non-reflective color.

- Once a potential defect has been detected, closer examination should be used to appropriately determine the potential defect in question. The Supplier shall use the following determine what defect types should be looked for on any given surface area, and if this defect on the material cannot be reworked to the print requirements, the following section must be followed.

- Supplier Non-Conforming Materials

  - The Supplier shall document product non-conformances requiring BAE Systems Material Review Board (MRB) action on a Vendor Information Request Form, (VIR) 089725. The VIR form shall be submitted to the VIR submission mailbox ensuring that the cognizant BAE Systems Buyer and BAE Systems Supplier Quality is notified.

  - If BAE Systems' MRB requires a sample to evaluate the Supplier's VIR request the packing slip must state that these parts are nonconforming, and the parts must be bagged and identified, or individually marked, labeled or tagged as non-conforming per the VIR number. Sample parts, unless destroyed by test, shall be returned to the Supplier with the dispositioned VIR.

  - Suppliers shall be notified of the disposition of the VIR by the VIR Coordinator or cognizant BAE Systems Buyer. Upon receipt of an approved VIR, the Supplier shall respond according to the disposition instructions contained on the VIR Form. Upon receipt of an un-approved VIR, the Supplier shall re-work the product to full conforming status or submit proof of product destruction. For all complete or partial shipments of accepted material, the VIR number shall be recorded on the packing slip, and a legible copy of the VIR shall be attached to the packing slip. The actual quantity of shipped parts affected by the VIR shall be indicated on all partial shipments.

- Finishes

  - Plating Finishes
    - Plated and coated parts should be uniform, smooth, fine grained, adherent, and free from powdery areas, blisters, pits, nodules, voids, and other defects which could be detrimental to their utilization. The size and number of contact marks should be, at a minimum, consistent with good practice, and should not be conditions for rejection.

  - Chemical Conversion Coatings (Alodine) On Aluminum
    - Color levels may range from clear to iridescent yellow or brown. Uniformity of color may vary from alloy to alloy on aluminum welds, castings, and brazements. Clear (colorless) coating should only be used when specifically authorized by the procuring activity. Touch-up, if allowed by the drawing requirements or procurement activity, should be in accordance with the governing specification.

  - Acceptable Conditions
    - Variation in color, hue, or tint of the Alodine coating on a single part/assembly due to differences in surface finish (cast, grained, textured, etc.), welds, brazements, and machining features are acceptable as long as the finish meets the requirements of the governing specification. Requirements may include conductivity, thickness, no exposed base metal, etc.

  - Rejectable Conditions
    - Chips
    - Pits
    - Corrosion

- Loss of adhesion
- Incorrect plating
- Missing plating in required areas or Plating in areas not to be plated
- Uncoated areas, breaks, scratches, flaws, or other defects where the surface of the base metal has been exposed.

- Anodize Finishes – Acceptable Conditions
  - Non-Dyed (Ref MIL-A-8625 Class 1): Any natural coloration resulting from anodic treatment with the various alloy compositions should not be considered coloration.
  - Dyed (Ref MIL-A-8625 Class 2): The color on wrought alloys should be uniform. Cast alloys may exhibit dye bleed-out or lack of color associated with the inherent porosity of the casting.
  - Small holes and tapped holes under ¼ inch diameter may vary from no film to a full normal coating.

- Anodize Finishes – Rejectable Conditions
  - Powdery Areas
  - Incorrect Plating
  - Missing plating in required areas
  - Plating in areas not to be plated
  - Corrosion
  - Loss of Adhesions

- Passivated Finishes
  - Appearance should be free of etching, frosting, iron contamination and other foreign materials.

Marking

Unless otherwise specified ensure marking is correct and in accordance with the drawing or other governing documentation. Marking should be checked for proper location, legibility, adherence, as well as no damage. If Bar code and Unique Item Identification (UID) markings are required, it shall be scanned with an appropriate device to make sure it reads the required human readable text.

- Marking Methods

  Marking should be accomplished by one of the following methods as defined by the drawing/specification:

  - Labels – If specified on the drawing and per the Bill of Material.
  - Rubber Stamping - To make an impression using a stamp made of rubber.
  - Silk Screening - A method of stenciling using a flat piece of silk, fine cloth, or metal screen, on which all parts not to be printed have been stopped off by an impermeable film.
  - Etching - Marks consisting of letters or numbers formed by selective chemical etching of the surface.

- Engraving - Marks consisting of letters or numbers or other characters or lines formed by cutting the pattern into a surface by means of a mechanical tool or laser.
- Metal Stamping - The process of impressing marks of letters or numbers into a surface by means of a metal die.

o Character Style / Height / Locations

- Character style and height are governed by the applicable drawing requirements.
- Character location should be as specified on the drawing.
- "Approximately as shown" with no specified dimensions allows the marking to be within the general area and not necessarily at the location shown on the drawing pictorials, provided it does not interfere with or is not obscured by other features.

Note: Rules governing "Approximately as shown" are:

- The characters should be within the quadrant of the part shown in the drawing/pictorial.
- The characters should be in the same relative position to other features on the drawing.

o Character Orientation

Characters should read as depicted on the drawing.

o Marking Legibility

Marking should be sharp, well defined and easily readable. Blurring, smearing, or other imperfections that impair the legibility are unacceptable.

- Marking Legibility Accept / Reject Examples:
    - Examples of acceptable and rejectable marking legibility is as shown in Figures 1through Figures 7

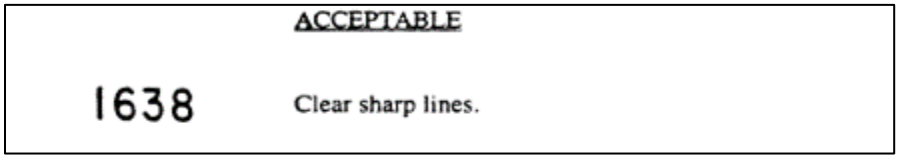

Figure 1 – Acceptable Legibility Example (1 of 2)

Figure 2 – Acceptable Legibility Examples (2 of 2)

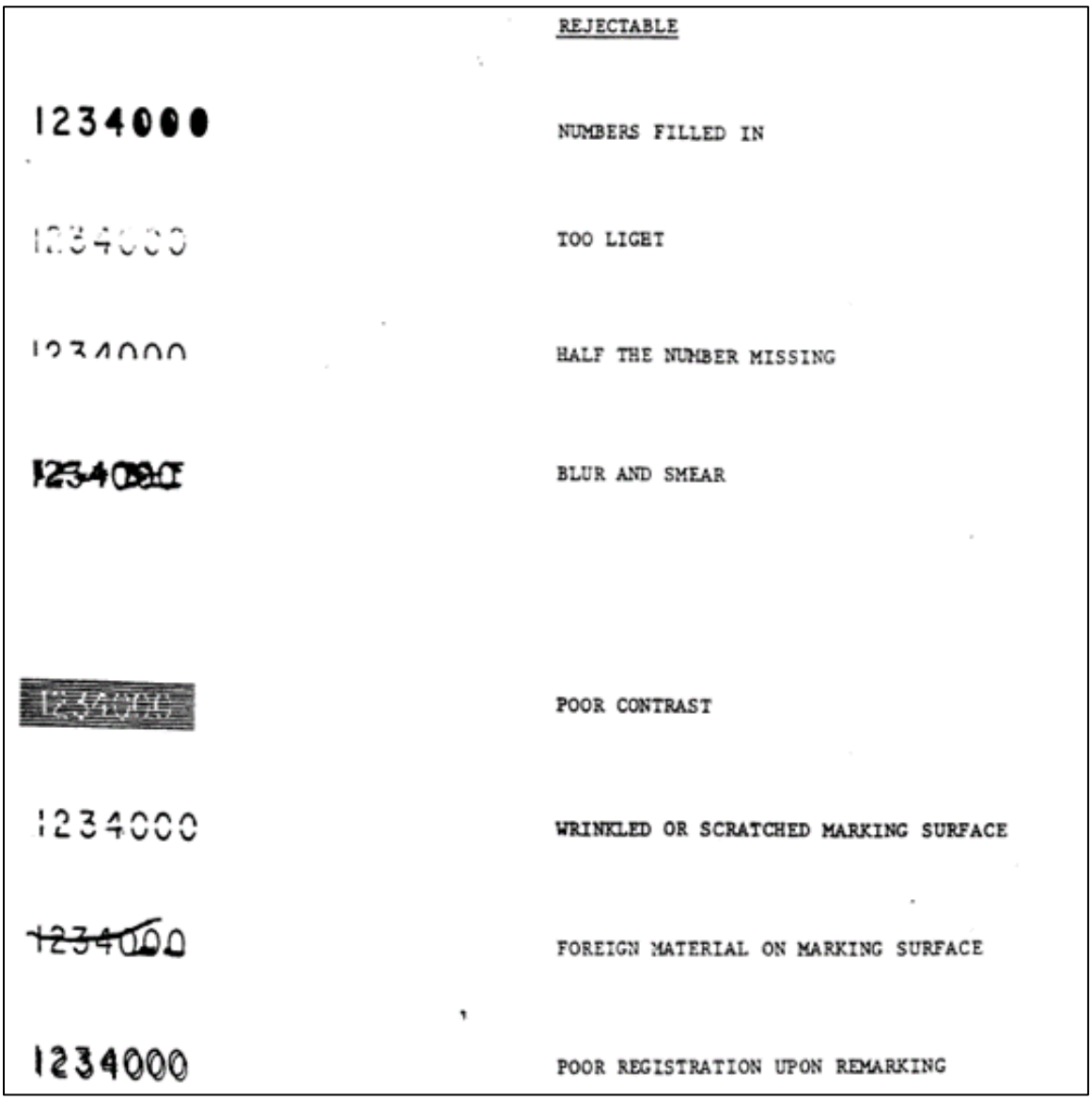

Figure 3 – Rejectable Legibility Examples (1 of 5)

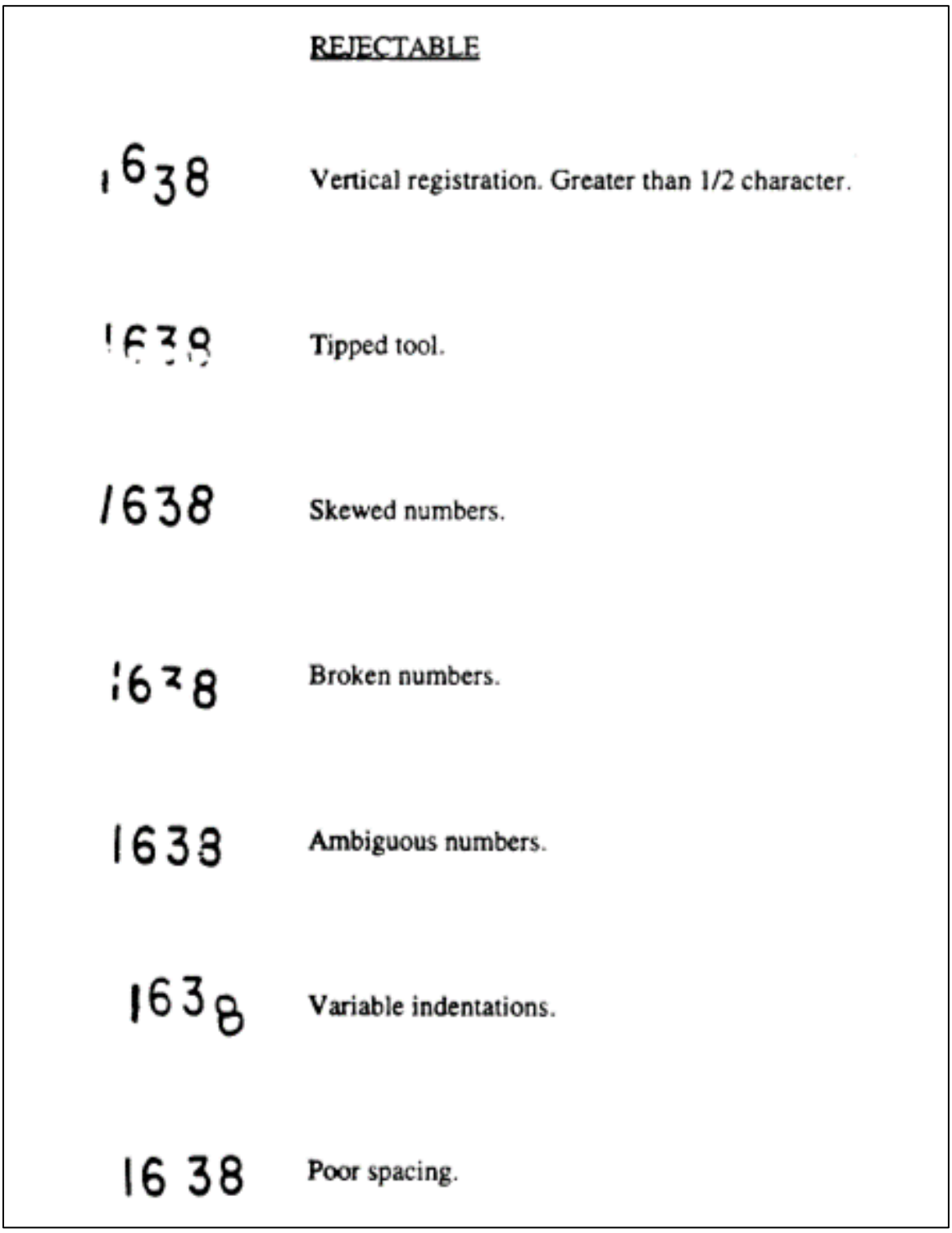

Figure 4 – Rejectable Legibility Examples (2 of 5)

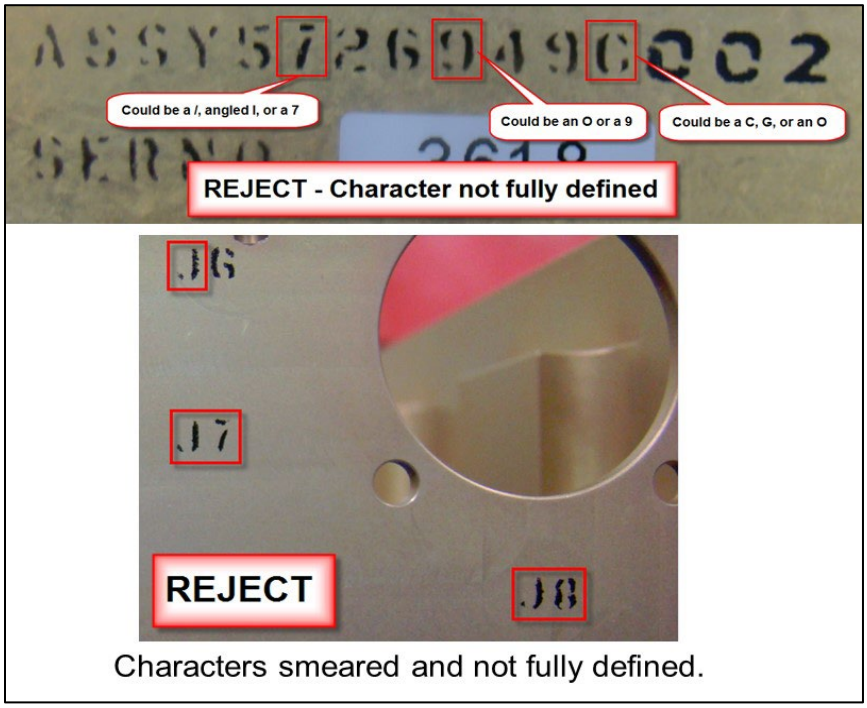

Figure 5 (Above) – Rejectable Legibility Examples (3 of 5)

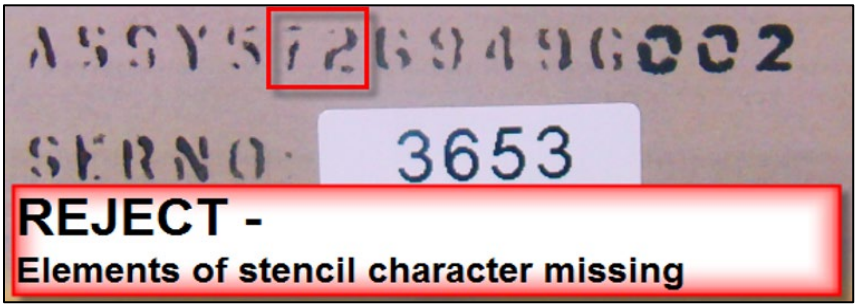

Figure 6 (Above) – Rejectable Legibility Example (4 of 5)

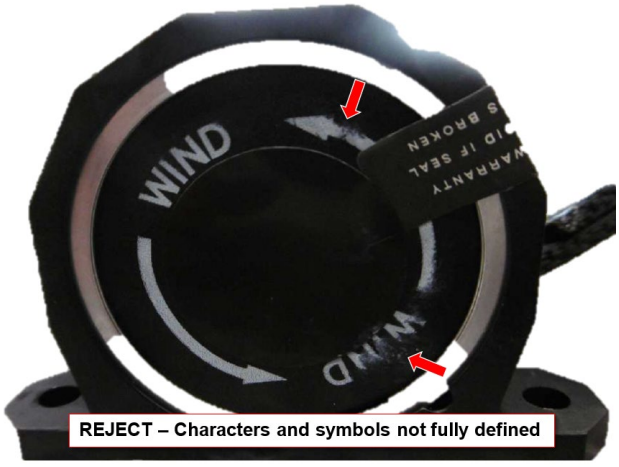

Figure 7 (Above) – Rejectable Legibility Example (5 of 5)

- Marking Color

The marking color should provide a contrast with the background for readability if the color is not specified on the drawing.

  - Testing of Epoxy Marking for Adhesion and Resistance to Solvents

    Unless otherwise defined by the drawing, recommendations for testing of marking on plated or painted surfaces for adhesion and resistance to solvents is as follows:

    - Dip cotton tip applicator into the solvent (isopropyl alcohol – American Chemical Society reagent grade or in accordance with TT-I-735, Grade A or B; or equivalent). Place applicator directly on marking to be tested. Apply pressure and draw the applicator across the marking, making three passes. In these passes, the applicator cannot be scrubbed.

- Acceptable Conditions

  - Marking is clear, and legible. Slight lightening of the color of marking is permissible.

- Rejectable Conditions

  - Marking exhibits blurring, fading, complete removal, or other imperfections that impair legibility

- Visual Appendix Figures

The figures below illustrate various common defects. These illustrations are not intended to define all possible, or all listed defects and are used as examples of some common ones.

Figure 1.
Example of Alodine scratch exposing base metal

Figure 2.
Example of impression of dent/ding

Figure 3.
Example of orange peel on a finished surface

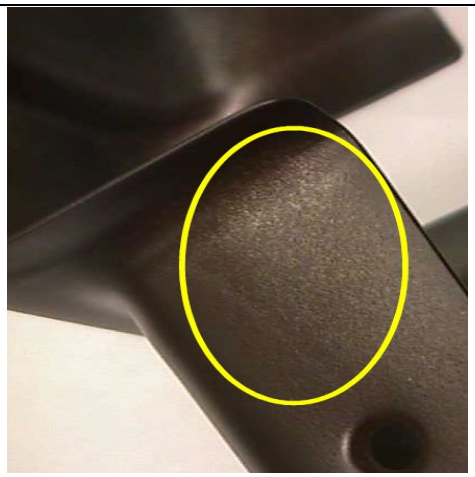

Figure 4.
Example of light paint coverage on finished part

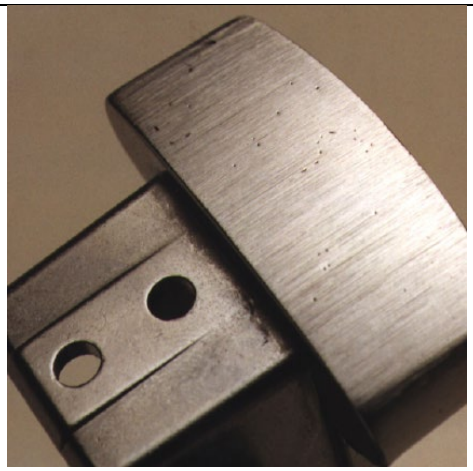

Figure 5.
Example of porosity clusters on finished surface

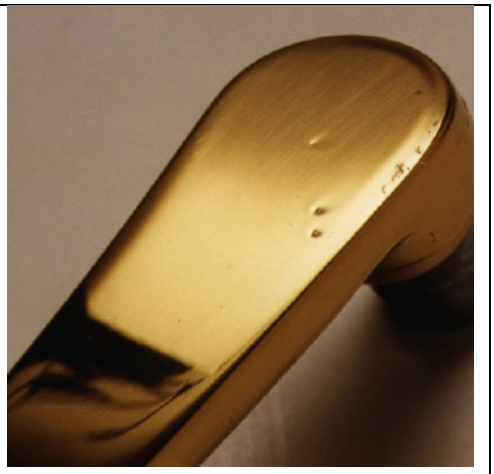

Figure 6.
Example of large pinholes on a finished surface

Figure 7.
Example of blistering on finished surface

Figure 8.
Example of excess flow paint on finished surface

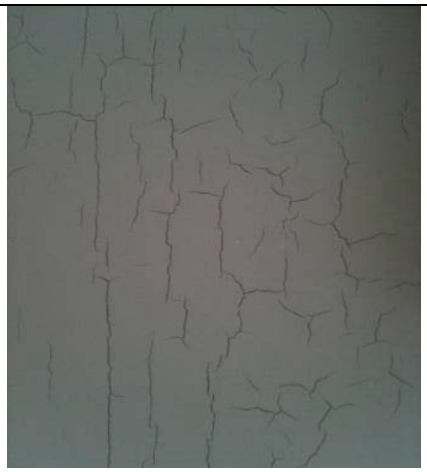

Figure 9.
Example of cracking on a finished surface

Figure 10.
Example of checking on a finished surface

Figure 11.
Example of Sharpie used on an anodized finish

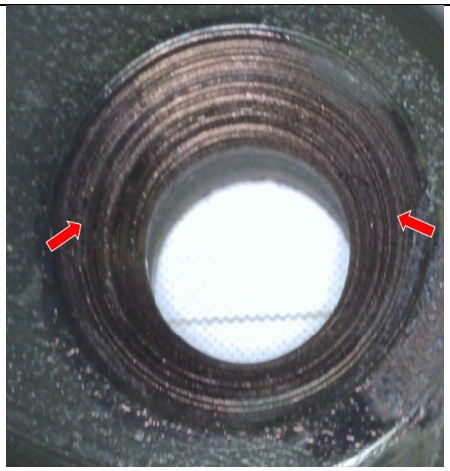

Figure 12.
Example of Sharpie used on a zinc coating finish

- Defect Definitions

The terms below are various common defects. These defects are not intended to define all possible, or all listed defects and are used as examples of some common ones.

- **ACID STAIN** – This defect is caused by residue of chromic acid and water spots and has a brownish-yellow streak appearance.
- **BEADING** – This defect is caused when paint, lacquer, or powder coating builds up along an edge, creating a heavy bead. Some beading is unavoidable; excessive beading is very noticeable.
- **BELTING LINES / POLISHING LINES** – This defect appears as small circular / linear scratches in the finished material resulting from some sort of polishing operation.
- **BLEED OUT / BLEEDING** – This defect is the discoloration created by the diffusion of coloring material through an applied coating from the substrate to the surface or under the surface of the top (clear) coating.
- **BLEND LINES** – These defects occur in areas where buffing or polishing surfaces in different directions merge. Sometimes they are unavoidable due to the part configuration; in these cases, it should be made as invisible as possible.
- **BLISTER, CASTING** – Although this defect may be very similar in appearance to plating blisters, the appearance of circular, dome-shaped, gas-filled projections of differing diameters is created from inclusions of gaseous materials and normally will not create a loss of adhesion of the coating films.
- **BLISTER, PLATING / BUBBLE** – These defects appear as circular, dome-shaped, and liquid- or gas-filled projections of differing diameters resulting from the localized loss of adhesion and the lifting of the film from a previously applied coating of the substrate. A blister should not be adherent to the basic material and/or underplate when subjected to adhesion testing. (ref. Figure 7)
- **BURNED AREA** - This defect is an area of plating that shows considerable discoloration or roughness due to excessive current during the plating process.
- **BURRS AND FLASH** – This defect consists of hanging material left over from the manufacturing process (casting, machining, forging, stamping, etc.).
- **CHIPS** – This defect is defined as the loss of adhesion and the removal, usually in small fragments, of the surface coating resulting from impact by hard objects.
- **CHROME BURN** – This defect manifests itself as areas that are dull, lusterless, and cast-iron gray in color. Chrome burn is usually found on corners or on the outer radii of plated surfaces.
- **CHROME STAIN** – This defect appears as a rust-colored stain that usually can be wiped off soon after the chrome-plating process.
- **CLOUDY CHROME / DULL FINISH / WHITEWASH** – This defect appears as areas where the shine or luster of the coating material is less than the rest of the part under inspection.
- **CONTACT MARKS** – This generally is not a defect since most specifications allow minimum contact marks due to the process however, it should be consistent with good

practice and if in doubt, the Supplier should be submitting a Vendor Information Request (VIR) if the locations are not specified on the drawing or purchase order.

- **CONTAMINATION / DIRT** – This defect often appears in the form of irregularly distributed dust particles, usually appearing burnt and black. These particles generally have no common shape or size and may appear long in shape, much like tiny hairs. This defect is also considered foreign material in or on the surface part.

- **CORROSION** – The visible manifestation of corrosion attacking the base metal is seen in the formation of oxidation that is a reddish-brown color for iron alloys, a white color for zinc alloys, and a green color for copper alloys.

- **CRACKS / CHECKING** (ref. Figures 9 & 10) – These defects include the following:
  - An irregular-type crack in which the breaks do not appear in any definite pattern, usually occurring only in the exposure of enamels.
  - A crackled appearance due to poor adhesion, usually from surface contamination before plating. Includes hairline cracks of plating material caused by bending or high-temperature curing.
  - A line-type crack in which the breaks are generally arranged in parallel lines in the surface coating, often following the lines of brush marks.
  - A crow's-foot-type crack where the breaks form definite three-pronged patterns with the breaks starting from a center forming an angle of about 120 degrees between the three prongs.

- **DENTS / NICKS / DINGS** – This defect is characterized by impressions or depressions in the metal beneath the finishing material caused by impact with some object. Dents have no characteristic size or shape and can be located on either the raw or the finished components. Nicks are similar to scratches, but short of length usually caused by impact. (ref. Figure 2)

- **DIE MARKS / TOOL MARKS / GATE MARKS** – This type of defect is an indentation, depression, or line that occurs in the same location of every part due to a damaged die, mold, tool, or ejector pin.

- **DIMENSIONAL VARIATION** – This defect occurs in areas of the part that have been dimensionally changed due to aggressive polishing or belting. Usually occurs on contours and may be flat spots or changing radii. May also be due to excessive build-up of plating or powder coating.

- **DISCOLORATION** – This defect is a change in color or loss of luster over entire surface. It includes any change from the original color or shade in the finish.

- **EXCESSIVE BUILD-UP PLATING / PAINT** – This defect is a condition where the thickness of the plating or paint is excessive in certain areas, such as: around holes, inside holes, along the edges and surfaces, etc., of the basis material.

- **FLOW LINES** – This defect consists of visible surface lines caused by improper die temperature, and they are not considered cracks or scratches.

- **FINGERPRINTS** – This defect is characterized by shallow grooves in a coated surface, which appear after applying the finishing material.

- **FRACTURE –** This defect is characterized by a tear, separation, or pulling apart of material. A clean fracture is generally found at corners or wherever sharp radii are located.

- **IRREGULAR COLOR –** This defect consists of larger spots or areas of a surface in which the color characteristics are different than those of the surrounding area.

- **IRREGULAR SURFACE** – This defect is indicated by dimensional or cosmetic change due to a process; for example, buffing or polishing.

- **LIGHT PAINT** – This defect is characterized by the base metal (substrate) showing through the paint. It may also cause the surface to appear rough or orange peel (ref. Figure 4).

- **MARKINGS** – This defect consists of marking legibility not being sharp, well defined and easily readable. It can also involve blurring, smearing, or other imperfections that impair the legibility are unacceptable. (ref. Figures 5.5.3.1-1 through Figures 5.5.3.1-7)

- **NICKEL SHOWING / LIGHT-CHROME** – This defect appears as a dull yellow-brown or beige spot-on plated surfaces and cannot be wiped or polished from the surface.

- **ORANGE PEEL** – This defect is a rippling of the cured finishing material and appears rough and uneven, much like the skin of an orange or the exterior of basketball. It is most commonly a paint defect (ref. Figure 3).

- **PEELING** – This defect involves the lifting of the coating from the substrate due to poor adhesion. It includes an area where the paint or plating has lifted from the material and has exposed the base metal through flaking.

- **PINHOLE / PITTING** – Pinholes defects are sharp, round, holes randomly distributed over a surface coating or base metal and may range in size from those barely visible to those the size of a pinhead. They can also be characterized as pits, i.e., small craters on the surface (ref. Figure 6).

- **PITS** – This defect involves small holes located commonly and randomly in the plating but not exposing base metal or under the plating.

- **PLATING SURFACE VARIATIONS** – This defect involves irregularities in the finish shine; it is either cloudy, dull, or gray in appearance.

- **PLATING VARIATIONS** – This defect involves little or no plating coverage in required areas that are either discolored or rippled in appearance.

- **POLISHING / BUFFING COMPOUND** – This defect consists of an organic / non-organic substance (rouge, Tripoli, or silicon) or residue left on the part as a result of poor cleaning after the polishing process. Shows as black spots on buffed brass and cloudiness on chrome-plated parts.

- **POROSITY** – This defect is a hole or cluster of holes, less than 1/16-in. in diameter, occurring in cast substrates. Porosity may cause blisters or bubbles in subsequent coating processes and may not be visible until coated. They are similar to pits, except that there are minute holes (holes that are not normally visible) allowing the passage of liquids to the underplate or basis material. Where the condition becomes severe enough to be visually evident, the holes are defined as voids (ref. Figure 5).

- **POWDERY AREAS** – This defect is a condition of anodized or chemical film (Alodine) coatings exhibiting a dull appearance and loose adherence to the base aluminum.

- **ROUGHNESS** – This defect is a finished area(s) exhibiting a coarse surface texture or embedded dirt, dust, etc., and that appear rough to the touch or can be felt.

- **ROUGH PLATING** – This defect is a condition where the plating is not continuous, smooth, and fine grained.
- **RUN / SAGGING** – A run defect is generally a long, narrow, linear band of discoloration on a finished surface. In many instances where the drop ceases to follow across the surface, it will dry in place, often forming, a bump, or drop-like defect, on the surface, the size of which depends on the amount of finishing material carried (ref. Figure 8).

- **SHIFTING / DIE MISMATCH** – This defect occurs when the two sides of a part, the drag and cope sides, are off-center. This occurs during forging / casting processes.

- **SCRATCHES / GOUGES** – This defect is a light to heavy grooving of the surface finish caused by contact with other objects during manufacture, handling, or packing and can usually be detected with a fingernail. This defect can also be defined as a line or lines disrupting the surface quality in plated or chemical-film surfaces exposing the primer and/or base metal (see Figure 1).

- **SCUFFS / MAR** – These are marks caused by contact with objects during manufacture, handling, or packing. Scuffs cannot be detected with a fingernail.

- **SHARP EDGES** – This defect is evident in an edge that, when pulled across the palm of hand with a moderate pressure, may cut the skin.

- **SMUTTY AREAS** – This defect is a condition where the coating has a dull appearance and can be removed by rubbing with a Kim-Wipe or Doe-Pac.

- **STOP MARKS** – These defects are obvious marks where the buffing or polishing process has stopped and started. They usually occur on larger pieces where the buffing operator does not buff the entire part in one stroke.

- **UNAUTHORIZED TOUCH-UP** – These defects are visual marks where a Sharpie or similar marking pen to touch-up areas using an unapproved material is used. This appearance usually occurs on material with no plating, paint or anodized coverage in the required areas and are considered to be unauthorized to be used. (ref. Figure 11 and Figure 12).

- **VOIDS** – This defect is the absence of plating or material on a specific area.

- **WAVINESS / WRINKLES** – These defects are areas of a part that exhibit changing elevations. They may be in base material due to poor polishing, or they may be in the coating also. Wrinkles are an excessive form of Waviness that occurs in stamped parts due to improper draw.

- Revision History

Rev	Release Date	Change Description	Approved By	Change Request #
-	11/06/2024	Initial release	James Dolan, Randy Fawver	BPMS-08939
01	10/14/2025	Corrected grammar, corrected added Systems to BAE per branding policy, reformatted to new template.	Roopnarine Sukhram, Kenneth Sturm	BMS-00093
02	1/9/2026	Updated Visual Inspection Method sections. Corrected and reformatted to the current template.	Roopnarine Sukhram, Kenneth Sturm	BMS-00254
02a	1/14/2026	Admin change- corrected error of values for the Viewing Distance and Angle section, reformatted and realigned document to post	Vincent Galindo Kenneth Sturm	BMS-00330