Protective Finishes

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PURPOSE & SCOPE

This Workmanship Standard details the workmanship acceptance criteria to be applied to L3 Communication Systems – West (CSW) products.

This Workmanship Standard applies to finishes applied to for CSW products. This standard applies specifically to conditions occurring due to the application of the protective finish. WS-022, Cosmetic Surface Conditions of Assemblies provides standards for conditions which may occur during assembly processing and allows some conditions which result from the manufacturing assembly processes.

WORKMANSHIP STANDARD

1. PAINT

This section gives criteria for paint conditions that occur as a result of the painting process. For the purposes of workmanship standards, powder coat finishes are considered paint and shall be evaluated to this document.

NOTE: WS-022 provides standards for finish conditions resulting from assembly, handling and transportation processes and allows some conditions which result from the manufacturing assembly process.

1.1. Viewing Distance/Angle

1.1.1. When viewing product, orient the item so that it is facing you perpendicular to your line of site. Repeat this process for all surfaces: top back, bottom, front, and sides.

1.1.2. Viewing distance/angle for small parts shall be viewed at approximately 24 inches from the object.

1.1.3. Magnification shall not be used when inspecting for cosmetics. However, tools may be used for root cause analysis.

1.1.4. Viewing distance/angle for moderately large parts shall be viewed at three feet.

1.2. Inspection Requirements

Viewing requirements shall be complete by scanning the surface in a slow continuous manner. When inspecting for cosmetics, all visual judgments shall be made using specified lighting, viewing distance,

angle of part as described. Color difference should be verified with a Spectrophotometer or color chips per AMS-STD-595.

For paint flaw limitations see Table 1.

Note: All visual outside surfaces such as doors, doorframes, holding panels, skins and covers shall not exceed the limitations of Table 1.

Table 1: Paint Flaw Limitations

	Pits up to .04 in. diameter X .005 Deep	**Foreign Particles up to .03 High X .03 Long**
User interface where systems are controlled or monitored while in use. Any surface with switches, buttons, or a display screen.	0 per square foot	2 per square foot
All surfaces, including egress panels and hour meters, which are not user interfaces as defined above.	2 per square foot	6 per square foot

1.3. Paint Gloss

It is required that components be painted with the specified color and gloss. Due to process variables semi-gloss paints can vary in gloss beyond the limits in the military specifications and AMS-STD-595. Gloss is not a critical feature on products finished with semi-gloss paint at CSW. Variation in gloss in semi-gloss paint colors shall not be cause for rejection.

1.4. Light Source

White, cool fluorescent office lighting that is uniform intensity between 70 and 120-foot candles.

Note: All photos in this document are examples and intended to provide visual directive and are not specific to any part or program.

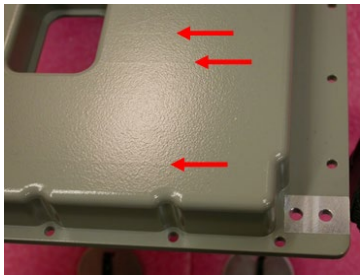
1.4.1. Target

- Smooth, uniform. Continuous film.
- Color matches applicable specification.

1.4.2. Acceptable

- Acceptable imperfections in the surface under the paint may be visible through the paint finish.

Note: The imperfections under the paint are not addressed in this document, only the fact that they are visible after paint. Surface imperfections under paint can be caused by machining marks, casting imperfections, etc. (see WS-004, Machining, Fabricated, & Additive Parts).

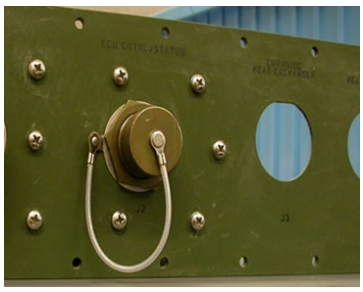


1.4.3. Acceptable

- A visible texture, with fully cured paint unlike wrinkling and orange peel.

1.4.4. Acceptable

- Marring and surface lighening due to handling is characteristic of Chemical Agent Resistant Coatings.

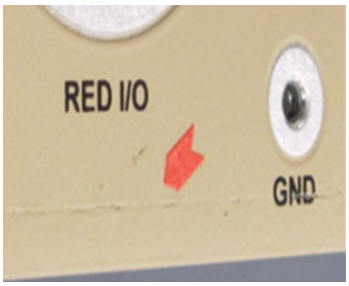


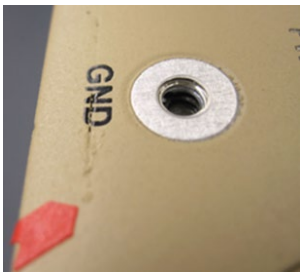
1.4.5. Acceptable

- Thick paint at the base of fins or deep cutouts where paint buildup is common.
- This type of buildup may look like a blister but will not be soft or easily punctured and removed.

1.4.6. Irregularities Under Coating

Irregularities such as nicks, dents, scratches, pits, grooves, and adhesive drips under the coating shall not be evaluated in this standard (see WS-004 and applicable print).





1.4.7. Acceptable

- Small discolorations and minor roughness, common on fins or deep recesses.

1.4.8. Acceptable

- Exposed substrate material of a through hole, threaded hole, and countersink. This condition occurs due to the powder coat masking process for the threaded holes.

1.4.9. Defect

- Paint peeled or chipped away from the substrate. Paint chipping away from base material or primer indicates adhesion failure.

1.4.10. Defect

- A raised area of paint that resembles a small bubble or blister. Blisters will move when prodded indicating adhesion failure.

1.4.11. Defect

- Where final paint film is required, primer or bare substrate material is exposed.

  Note: Areas which are specified as no-paint areas or overspray allowed areas may have uncoated surface showing on piece parts or assemblies.

1.4.12. Defect

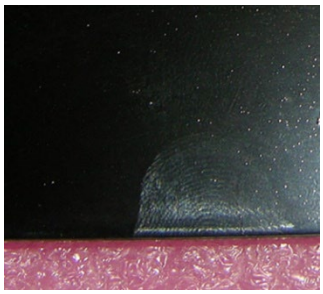
- Fisheyes or crater-like circular areas that may vary in size and sometimes expose the underlying substrate.

1.4.13. Defect

- Excessive inclusions, see criteria in Table 1.

1.4.14. Defect

- Fingerprints, bubble wrap marks, and other impressions due to handling or damage to paint during the cure cycle.

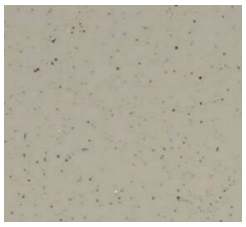


1.4.15. Defect

- A wrinkled appearance that resembles the peel of an orange. The paint is soft with pin holes or fisheyes. The paint is wrinkling and lifting leaving voids underneath.
- Pin holes appear as very small dots.

1.4.16. Defect

- Paint film is rough and uneven, possibly with tiny overspray specks of color.



1.4.17. Defect

- Runs that appear as drips.
- This requirement does not apply to sealant or adhesive from a joint which may have a similar appearance and has been painted over. Sealant or adhesive runs should be evaluated to the applicable workmanship standards document.

  Note: This is typically caused by applying too much paint to a vertical surface resulting in paint beginning to move.

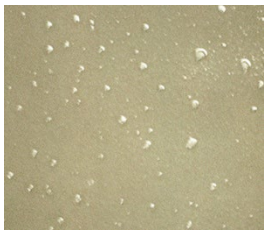
1.4.18. Defect

- A sag in the paint that appears draped onto the surface, like curtains.
- This requirement does not apply to sealant or adhesive from a joint which may have a similar appearance and has been painted over. Sealant or adhesive sags should be evaluated to the applicable workmanship standards document.

  Note: This is typically caused by applying too much paint to a vertical surface resulting in paint beginning to move

1.4.19. Defect

- Solvent popping or bubbles that are generally clear and appear on the surface of the paint film.

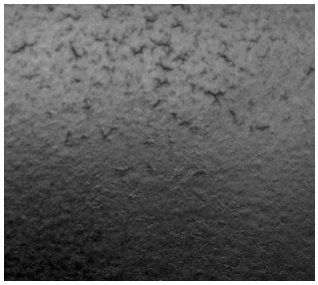


1.4.20. Defect

- Uncured paint which may be tacky and unusually soft and malleable and may contain impressions.

1.4.21. Defect

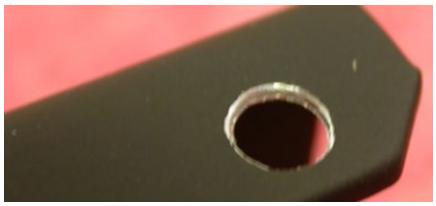
- Paint film appears wrinkled and cracked after drying.



1.5. Edges of Masking

1.5.1. Target

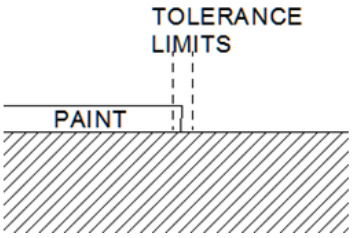
- Paint at the edge of masking should be smooth and even without any burrs.



1.5.2. Acceptable

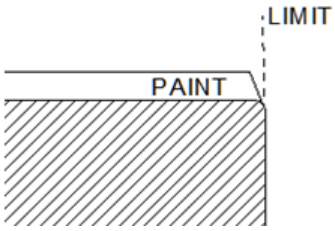
- Paint edge falls within tolerance.

  Note: See 60056954 or 1000383796 for tolerance interpretation.



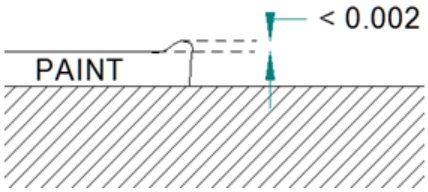
1.5.3. Acceptable

- When paint ends at a corner or edge, paint shall not extend past the corner as shown.



1.5.4. Acceptable

- Paint at edge of masking is less than 0.002” more than paint thickness.

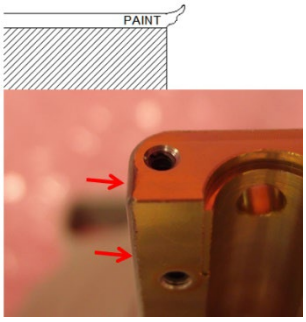


1.5.5. Defect

- Paint at edge of masking is more than 0.002” more than paint thickness.

1.5.6. Defect

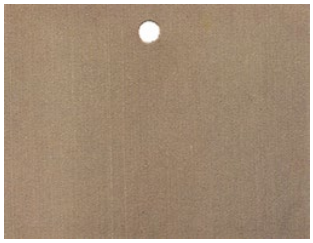
- Paint extends too high or past the corner or edge.



2. CHEMICAL FILM (CLASS 1A)

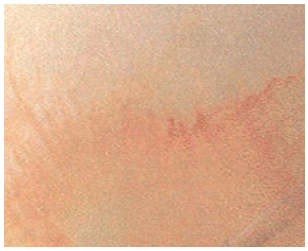
2.1. Target

- Uniform appearance.
- Continuous, smooth coating.
- Color: yellow



2.2. Acceptable

- Streaking.
- Discoloration or color variations.



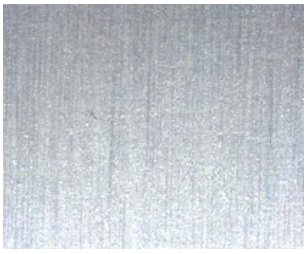
2.3. Defect

- Powdery, loose film.
- Contaminated film (oil residue, etc.).

2.4. Chemical Film (Class 3)

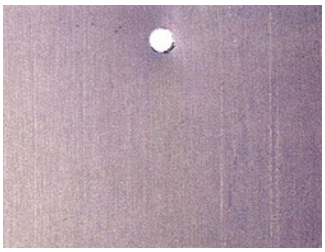
2.4.1. Target

- Uniform appearance.
- Continuous, smooth coating.
- Color: clear.



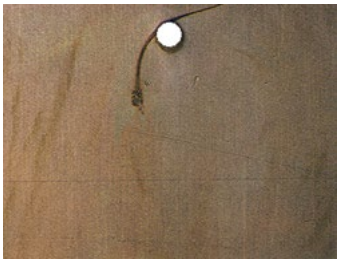
2.4.2. Acceptable

- Streaking.
- Discoloration or color variations.



2.4.3. Defect

- Powdery, loose film.
- Oily residue or contamination.
- Contaminated film.



3. ANODIZE – ALL TYPES AND CLASS

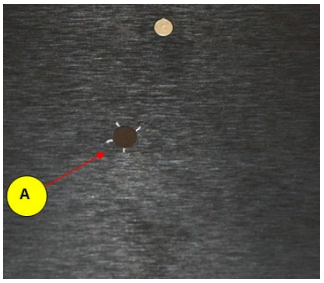
3.1. Target

- Continuous, smooth adherent plating.

3.2. Acceptable

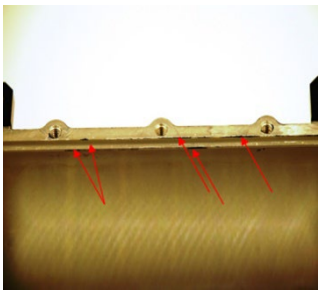
- Plating thickness within specified requirements.

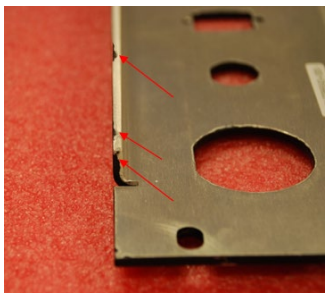
A. Small plating voids (not visible at next higher assembly).



3.3. Acceptable

- Minimal Plating Bleed out on uncoated surface.



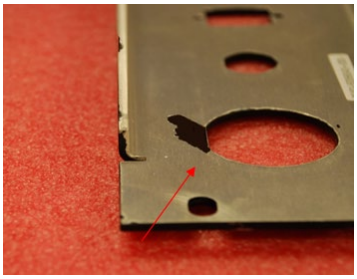


3.4. Acceptable

- Visible but smooth continuous touch up.

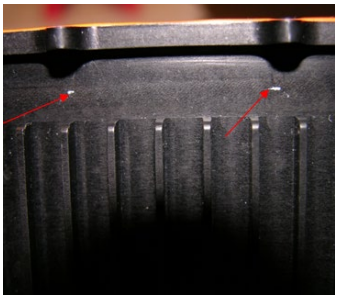
3.5. Defect

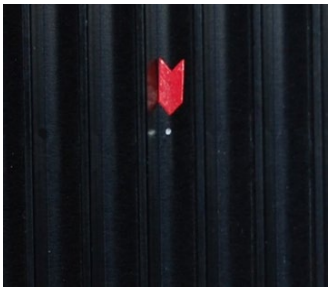
- Bleed out is excessive on uncoated surface.



3.6. Defect

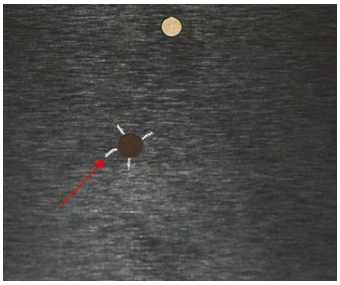
- Anodize surface has been scratched, marred and/or damaged (bare metal exposed).
- Plating thickness not within the specified requirements.
- Surface is rough or pitted.
- Small plating voids (visible at next higher assembly).





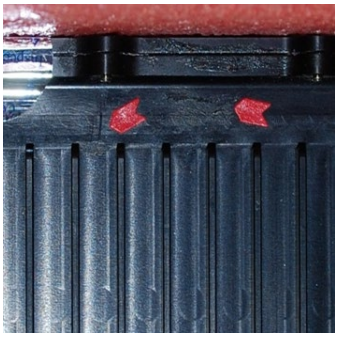
3.7. Defect

- Plating voids visible at next higher assembly.



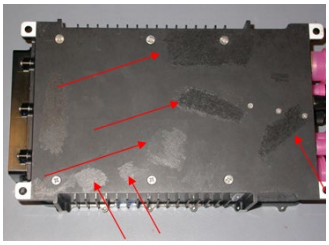
3.8. Defect

- Touched up area has excessive texture and brush marks.



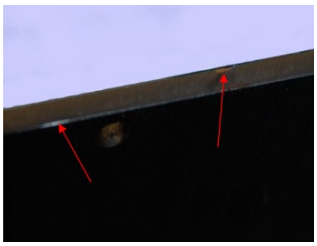
3.9. Defect

- Surface touchup has exceeded 5 percent of the total anodized surface.
- Color, gloss, and texture is different/mismatched between the part and the touchup surface and is clearly visible from a viewing distance of 24 inches.



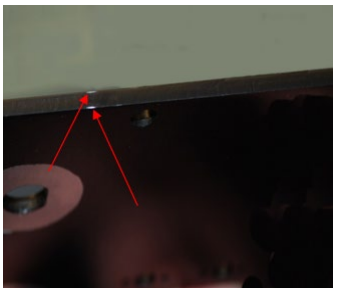
3.10. Defect

- Substrate has been touched up with sharpie or any unapproved marker.



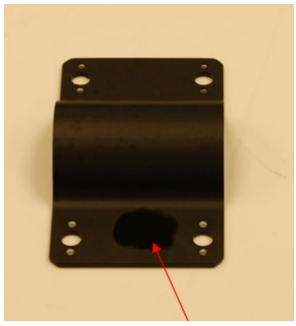
3.11. Defect

- Plating contact points visible at next higher assembly.



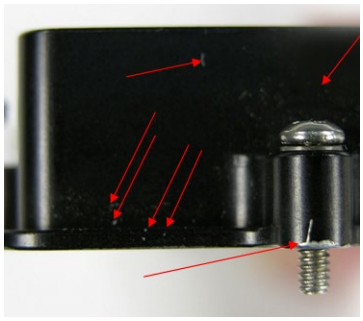
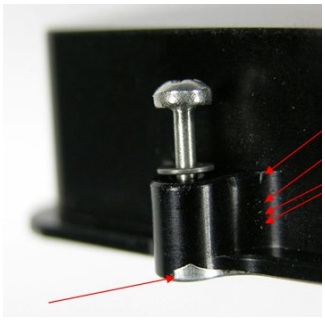
3.12. Defect

- Oily film or other contamination which cannot be removed by normal cleaning.



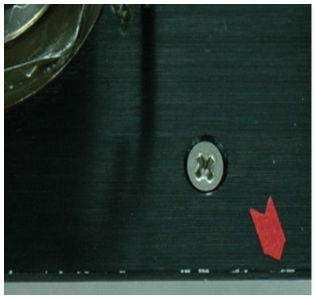
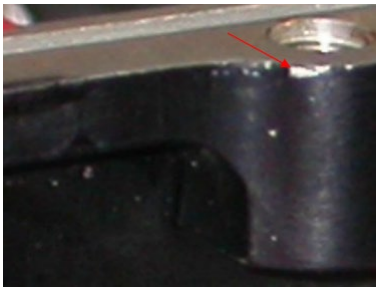
3.13. Defect

- Exposed bare material.

3.14. Defect

- Anodize surface scratched, marred and/or damaged (bare metal exposed).

4. OTHER PLATED SURFACE

This section addresses the visual properties of machined surfaces that have been plated. These surfaces shall be inspected using magnification no greater than 10X. When handling gold plated surfaces gloves shall be used to prevent contamination. The acceptance criteria for Metal Fabricated Parts and Assemblies are in WS-004.

In the case of a discrepancy, the description or written criteria always takes precedence over the illustrations.

4.1. Terms and Definitions:

Blister – An area where the plating covers but does not adhere to the metal. A mound shaped projection on a plated metal surface, caused by inclusion of gases or foreign material.

Burr – Raised or sharp edge which occurs because of a machine process such as milling or punching.

Burn - through/comet-tailing – Is a defect in the plated layer resulting from a base material inclusion that is highlighted during subsequent ultrasonic cleaning.

Flaking (Peeling) – An area where the plating covers but does not adhere to the substrate material.

Gold Nodules – Localized build-up of plating protruding from the surface.

Machine Mark – Marks that are made directly from a machine process such as milling or punching.

Major – A measurable condition or attribute.

Minor – A non-measurable condition or attribute

Pit – A measurable depression or cavity below the surrounding surface.

Scorch Mark – A burn that has discolored and/or changed the texture of a surface.

Scratch – A surface grove with a measurable depth.

Scuff – a surface abrasion with no measurable depth.

4.2. Target - Surface Appearance

- Uniform in appearance of color.
- No particulate matter adhering to the surface.
- Free of burrs or other protrusions.
- Free of blisters, pits, machining marks, scratches, and scuffs.
- Free of corrosion.
- Free of burn-through or comet-tailing.
- Free of flaking.
- Free of gold nodules.
- No exposed inner plating layers or exposed base metal.
- Free of oily bleed-thru or other contamination.
- Free of fingerprints.
- Threaded holes are completely plated.

4.3. Acceptable - Surface Appearance

- Minor pits, machining marks, or scuffs that do not expose basis metal (Figure 2-1).
- Discoloration or staining of gold (different sheens, tints, etc.) (Figure 2-2).
- Blister(s) on surfaces that will receive a post-plating milling operation (not shown).
- Scorch marks that do not expose base metal (not shown).
- Watermarks (Figure 2-3).
- Threaded holes are partially gold plated (Figure 2-4).

Note: Threaded holes used to fixture the part during processing are not required to be gold plated.

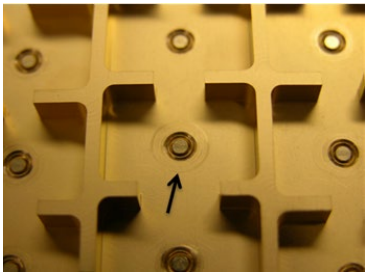


Figure 2-1

Figure 2-2

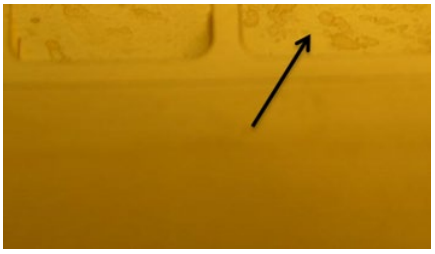


Figure 2-3

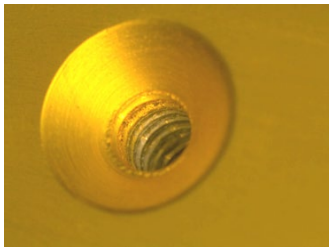


Figure 2-4

4.4. Defect – Surface Appearance

- Burrs or non-dimensioned (unexpected) protrusions (not shown).
- Nodules (Figure 2-5).
- Particulate/foreign matter (not shown).
- Plated inclusions (not shown).
- Oily bleed-thru (not shown) or other surface contamination (not shown).
- Flaking or peeling (Figure 2-6).
- Blisters (Figure 2-7).
- Exposed inner plating layer or base metal (Figure 2-8).
- Scratches (Figure 2-9).
- Corrosion (Figure 2-10).
- Burn-through/comet-tailing (Figures 2-11 and 2-12).
- Fingerprints (Figure 2-13).
- Major machine marks (not shown).
- Pits (Figure 2-14).

Figure 2-5

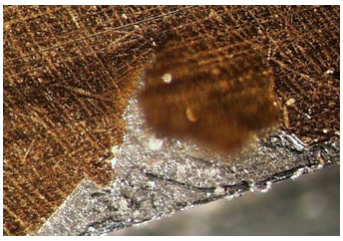


Figure 2-6

Figure 2-7

Figure 2-8

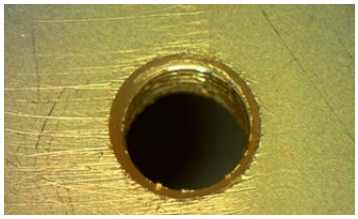


Figure 2-9

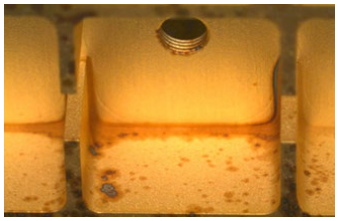


Figure 2-10

Figure 2-11

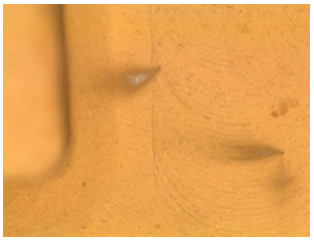


Figure 2-12

Figure 2-13

Figure 2-14

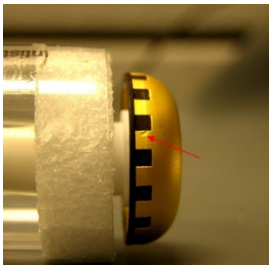
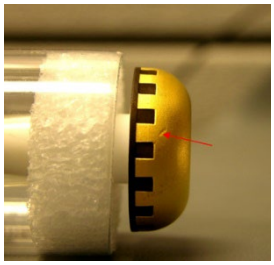
5. PLATED TEFLON PARTS

Note: Magnification is applicable to IPC 610, not to exceed 10X.

5.1. Acceptable

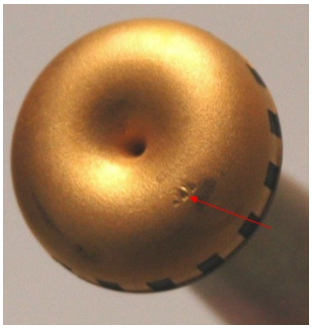
- Dent/ding does not exceed .020 in. depth.
- Dent/ding does not exceed .125 in. diameter zone.

Note: Reflector as shown is in carrying container.

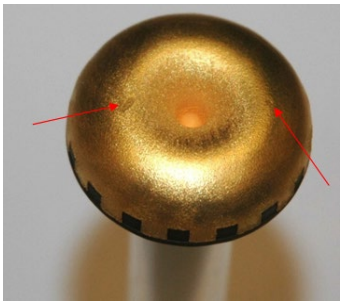
5.2. Acceptable

- Multiple dents/dings are allowed within a .125 in. diameter zone. This is considered as one diameter zone.



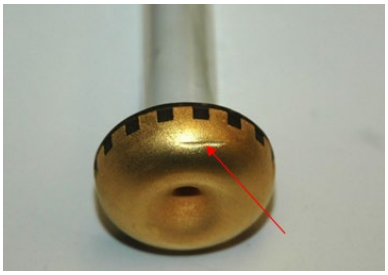
5.3. Acceptable

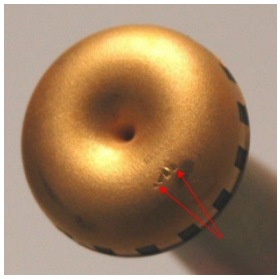
- Dent/ding does not exceed allowable diameter zone.
- Dent/ding no more than 2 places (diameter zones).
- Grainy appearance finish.



5.4. Defect

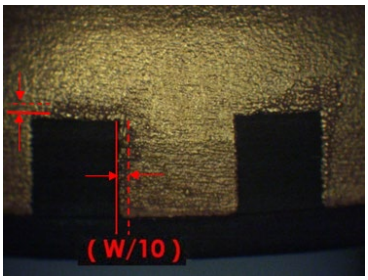
- Dent/ding exceed allowable diameter zone.
- Multiple dent/dings exceed the .125 in. diameter zone.





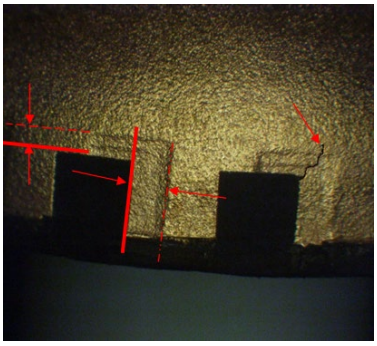
5.5. Acceptable

- Misregistration depression no greater than 10 percent of finger width.



5.6. Defect

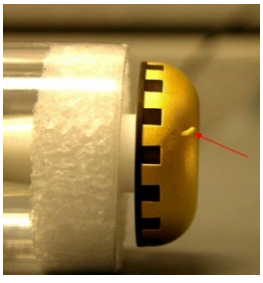
- Misregistration depression exceeds 10 percent of the finger width.
- Cracked plating.



5.7. Acceptable

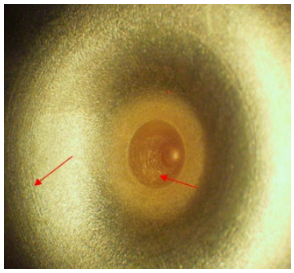
- Plating void touch-up, not to exceed .020 in. height x .125 in. diameter zone. Touch-up appears convex.
- Plating void touch-up, no more than 2 places.

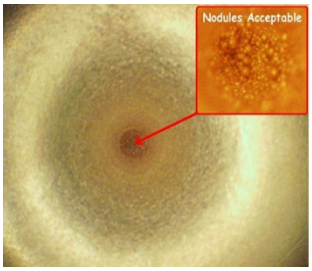
Note: Reflector as shown is in carrying container.



5.8. Acceptable

- Machine marks.
- Nodules in center.





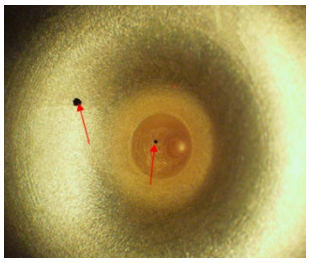
5.9. Acceptable

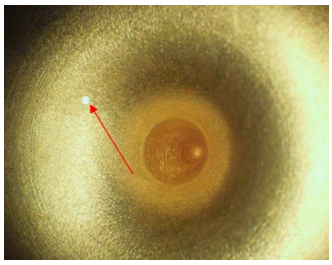
- Preferred Tetra Etch

Note: Commercial Etching for Teflon (Black in Color)

5.10. Acceptable

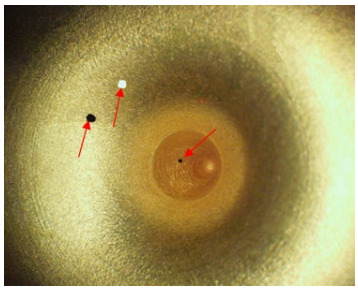
- Void(s) no more than 2 places (void is through gold and silver plating).
- Void is no greater than .030 in. diameter.
- Void(s) in gold plating, silver plating is visible, does not exceed .030 in. diameter.





5.11. Defect

- Void(s) in gold or silver plating more than 2 places.
- Void(s) exceed .030 in. diameter.

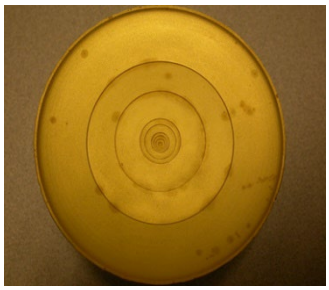


5.12. Defect

- Gold discoloration.

5.13. Defect

- Bleed out.



RECORDS

There are no records associated with this document.

END OF DOCUMENT

DOCUMENT INFORMATION

Responsible Organization:	Operations
Function/Sub-function:	Workmanship Standards
Governing Document(s):	Y-001 Quality Management System
Subordinate Document(s):	N/A
Related Document(s):	IS-003, Workmanship Acceptability of Electronic Assemblies P-047, Inspection W-018, Manufacturing Criteria WS-000, Workmanship Standards Introduction WS-002, IPC-A-610 Acceptance of Electronic Assemblies WS-022, Cosmetic Surface Conditions of Assemblies
Related Training:	N/A
Approval Requirements:	Manager, Engineering Management Manager, Manufacturing Engineering
Review Requirements:	Scientist, Mechanical Engineering Supervisors, Quality Management Associate Manager, Quality Management

Revision History Summary

Revision #	Description of Change	Date
New – 11	Initial Release through revision 11	VAROUS
12	Added to Purpose and Scope - "WS-022 provides standards for assemblies and allows some conditions which result from the manufacturing assembly processes." Deleted sub-sections for Cadmium Plating, Passivation, Powder Coated, and Cosmetic Imperfections of Systems, Trailers and Transit Cases. Updated sub-sections on Paint, Anodize, Other Plated Finishes and Plated Teflon Parts.	8/17/2016
NA	Added records section. No revision upgrade necessary.	03/07/2017
13	Updated Purpose and Scope. Major revision to 4.1 and 4.2. Added WS-022 to list of related documents.	12/12/2017
14	Update logo and proprietary	05/04/2021
NA	Updated point of contact. No revision upgrade necessary.	4/26/2022
15	Incorporated subsections (separate files) into this single document.	9/19/2022
16	Added "or color chips per AMS-STD-595" to section 1.2.	10/18/2023