

1. Document Owner – Quality Assurance
2. Scope: This document provides Acceptance Limits for imperfections permitted on all parts unless otherwise specified by an Engineering drawing or customer requirement, provides instructions to Inspectors for evaluation of indications of surface imperfections, and provides certain drawing interpretation guidance.
3. Policy – This Visual Inspection Standard (VIS) provides relaxations from the flawless surface condition implied by engineering drawings. Only these relaxations, called allowable imperfections, allowed by this Standard, the Engineering drawing or customer requirements are permitted on parts.
4. Application and Scope
  - 4.1. This Standard applies to all parts made by or for Cox and Company.
  - 4.2. This Standard applies to all areas of a part unless otherwise specified.
  - 4.3. Visual acceptance limits for assemblies shall take precedence over visual acceptance limits for detail parts comprising the assembly.
5. Order of Precedence of Requirements – Requirements of the following documents shall apply in decreasing order of precedence:
  - 5.1. Cox Purchase Order requirements
  - 5.2. Cox design engineering requirements
  - 5.3. This Standard
6. Instructions to Inspectors
  - 6.1. Any observed conditions not addressed by this Standard or engineering drawing shall be considered as nonconforming. Examples of nonconforming conditions not addressed by this Standard are cracks, chips, burrs and missed operations.
  - 6.2. Parts shall be cosmetically representative of quality workmanship based on such factors as inspection history with parts previously returned from customer(s) and/or unusual variations from normal appearance.
  - 6.3. Unless otherwise specified, parts shall be inspected without magnification. However, up to 4X magnification may be used as an aid to evaluate an observed condition.

6.4. Visual imperfections which will be removed by subsequent machining or processing shall be disregarded.

6.5. Visual inspection standard limits may be evaluated in-process, but all final products must be acceptable to the visual requirements of this Standard.

## 7. Stylus Definition and Use

7.1. A stylus having a nose radius ranging in size from .030 inch to .0365 inch may be used to evaluate imperfections which appear to penetrate the surface finish texture in accordance with the following paragraph of this Standard.

7.2. The stylus should be lightly held near the top, between the thumb and forefinger, inclined at 60 degrees toward the imperfection, and be pushed forward over the surface without applying pressure other than the weight of the stylus itself, in a direction approximately 90 degrees to the general lay of the imperfection.

7.2.1. If the point of the stylus hesitates (catches) in the surface imperfection being judged, the imperfection is deemed a scratch and shall be evaluated as such.

7.2.2. If the point of the stylus does not hesitate (catch) in the surface imperfection being judged, the imperfection is deemed not to be a scratch and shall be evaluated as such.

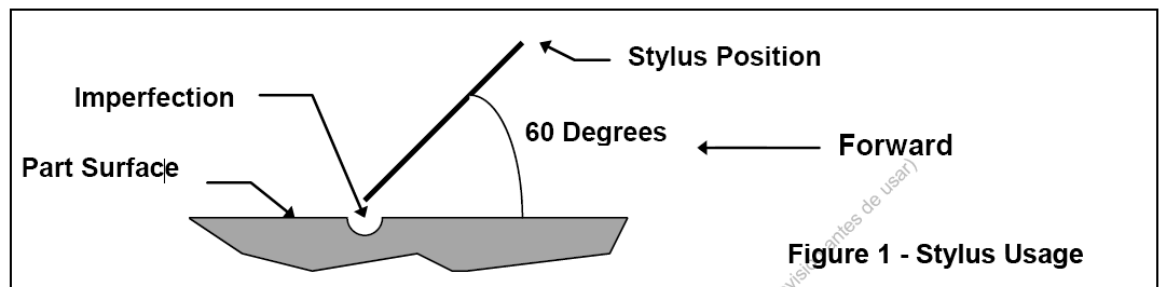


Figure 1

## 8. Uncoated Metallic and Composite Parts (Excluding Composite Connector Components)

8.1. Visual Inspection Method is per sections 6 and 7 above.

8.2. Allowable Imperfections are as follows. Parts containing imperfections other than those allowed herein are cause for rejection.

8.2.1. Superficial imperfections, burnish marks, and water discoloration light gray or light brown.

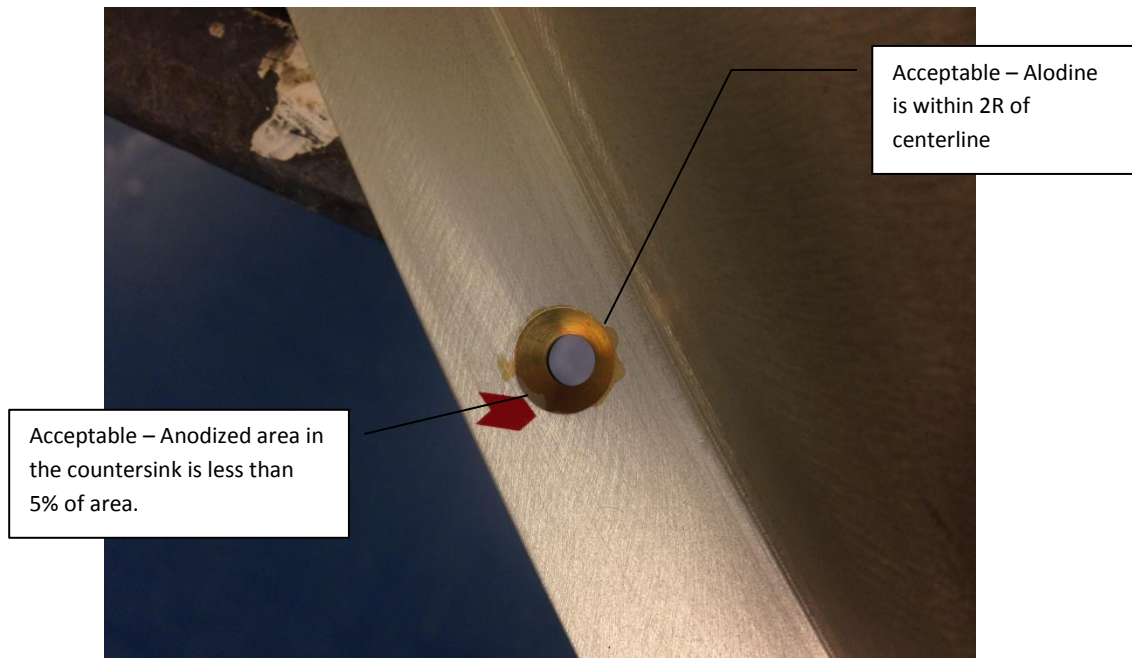
- 8.2.2. Any imperfection, which appears to penetrate the surface finish, does not have a dark bottom (i.e.: bottom not visible without magnification) and does not cause a stylus (per the above definition) to hesitate (catch) when passed over it.
- 8.2.3. Chatter marks, provided surface texture requirements are met.
- 8.2.4. Drilled Holes: Circumferential tool marks, up to .003 inch deep are permitted in the bore of drilled holes, provided they do not affect an area in excess of 10% of the part thickness (or hole depth), are free of raised metal, are not within 10% of part thickness dimension from either end of the hole and do not break into the radius at either end of the hole.
- 8.2.5. Counter bored Holes: Steps in the counter bore diameter up to .003 inch deep are acceptable provide they are smooth and do not affect an area in excess of 10% of the counter bored area.
- 8.2.6. Scallops: Circumferential tool marks, up to .003 inch deep, are permitted on the surfaces of scallops, provided they are free from raised material, do not break an edge and do not extend from one scallop to an adjacent scallop in a single line.
- 8.2.7. Surfaces containing drilled holes: False drill starts, up to .005 inch deep or 10% of thickness, whichever is less, are acceptable provided they are free from raised material or sharp edges and are at least .100 inch away from the nearest edge.

## 9. Chemical Conversion Coated, Metallic Parts

- 9.1. Visual Inspection Method is per sections 6 and 7 above.
- 9.2. Allowable Imperfections are as follows. Parts containing imperfections other than those allowed herein are cause for rejection
- 9.2.1. Acceptance criteria are per the coating specification defined on the engineering drawing.
- 9.2.2. Any indication that appears to penetrate the coated surface shall be cause for rejection.
- 9.2.3. Indications of scratches shall be evaluated using the stylus (see above), with the exception that any indication that appears to penetrate the coated surface shall be cause for rejection.
- 9.2.4. Allowances for localized overruns – Ref Figure 2
- 9.2.4.1. When drawings require “areas to be free of (anodic) coating”, those areas may exhibit up to a total of about 5% anodize coating. The 5% limit applies in total to

repeated features such as countersunk holes constituting electrical faying surfaces (e.g. bonding resistance paths).

- 9.2.4.2. Alodine coatings (e.g. MIL-DTL-5541) applied to holes and countersinks may overrun onto the base part provided (1) the part will be painted at a later operation and (2) the overrun does not extend beyond and  $2R$  from the centerline of the hole, where  $R$  is the radius of the hole at the surface, including the countersink diameter if applicable. (Figure 2)



**Figure 2 – Alodine Coatings**

## 10. Painted Parts

- 10.1. Visual Inspection Method shall be performed without magnification at a distance of approximately 5 feet for parts with maximum dimension greater than or equal to 2 feet and at a distance of approximately 2 feet for parts with maximum dimension less than 2 feet.
- 10.2. Allowable Imperfections are as follows. Parts containing imperfections other than those allowed herein are cause for rejection
- 10.2.1. Primer Coats - The primer film shall be uniform (continuous) and free of runs, wrinkles, and pinholes. Substrate source patterns (such as fabric pattern or core mark off) showing through the primer are acceptable. A reduction in uniform appearance due to irregular

fastener pattern is also acceptable.

10.2.2. Top (Finish) Coats - the paint shall appear even and be free from sags, pigment float, lint, dirt, craters and overspray. Substrate source patterns (such as fiberglass or core mark off) showing through the enamel are satisfactory. A reduction in uniform appearance due to irregular fastener patterns is also acceptable. In cases of rework within a color, it is acceptable to have a slight color variation if rework does not detract from overall appearance. High solids coatings may have an increased tendency to orange peel. An increased orange peel is inherent to these materials and is not cause for rejection.

#### 11. Composite Connector Components (Shells, Backshells, etc).

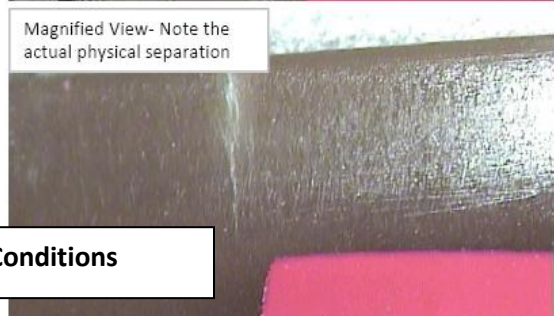
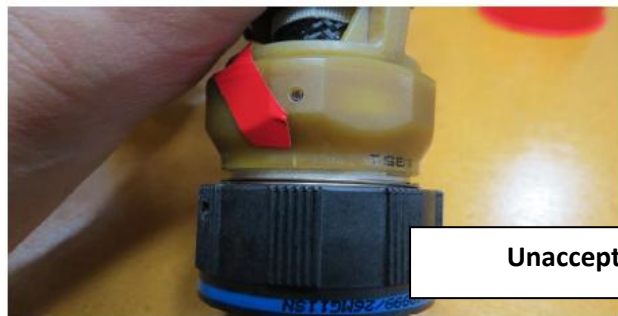
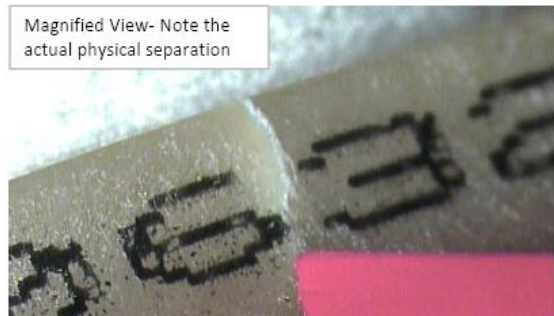
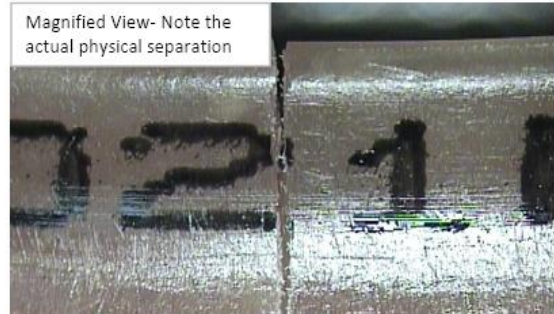
11.1. Molding marks, flow lines and other similar continuous blemishes are acceptable.

11.2. Cracks are not acceptable.

11.3. Note: Some of the following photographs contain highly magnified views for illustrative purposes only. The visual inspection technique for composite connector components including use of magnification is as defined in the "Instructions to Inspectors" section above.







**Unacceptable Conditions**

## 12. Heater and Heater Cores, Finned, End Views

Note: Limits provided on lengths and areas are to be interpreted as approximate and may be gauged by visual methods only unless otherwise specified.

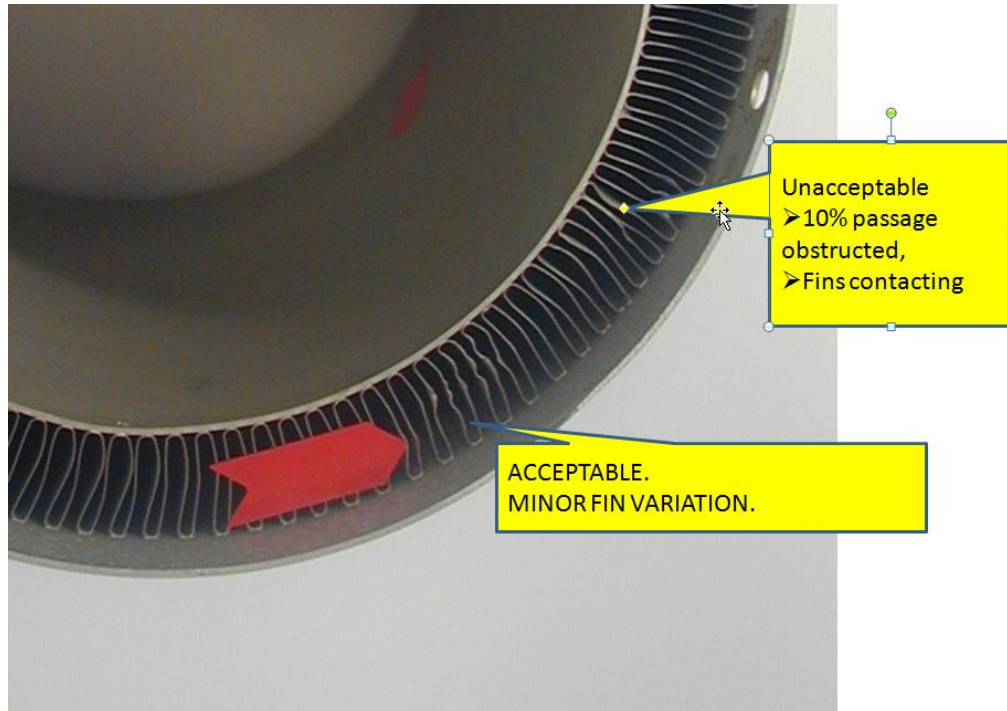
### 12.1. Distorted Fins – Cosmetic distortions are allowable provided:

12.1.1. No more than 10% of any one flow passage is obstructed and

12.1.2. No adjacent fins contact each other and

12.1.3. No more than 50% (one-half) of the fins within a 1.5" circumferential span exhibit visible distortion.

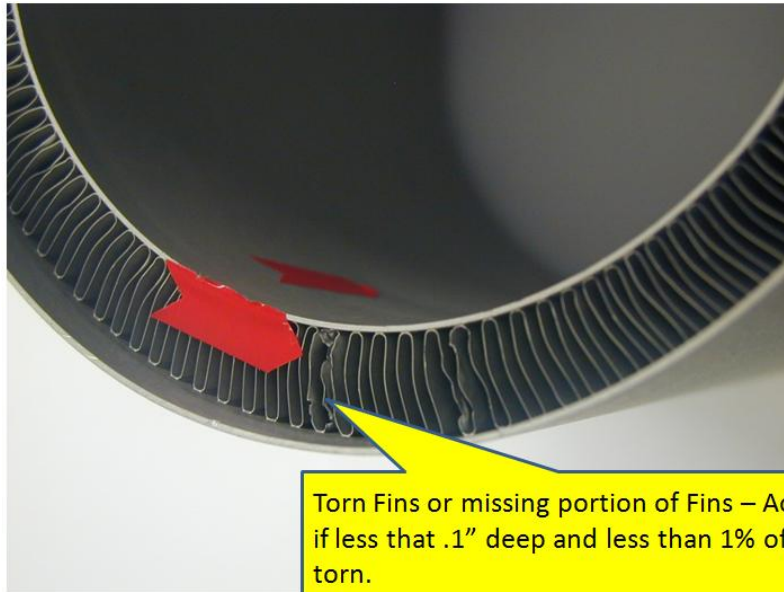




12.2. Torn or Partially Missing Fins – Minor tears in fins are acceptable provided:

12.2.1. Tears are not deeper than .1" and no more than 1% of fins exhibit tears and

12.2.2. each tear is removed by trimming to no more than .1" depth.



Torn Fins or missing portion of Fins – Acceptable if less that .1" deep and less than 1% of fins are torn.

12.3. Excess Braze – is allowable provided:

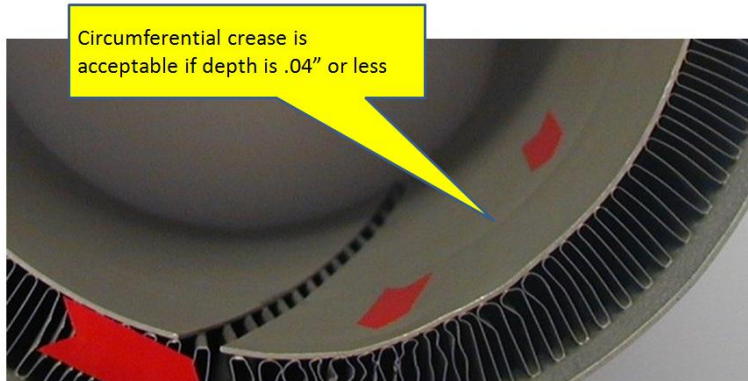
12.3.1. It blocks less that 10% of the fin column and

12.3.2. Blocks less than 20% of the columns in a 1.5" circumferential span, and

12.3.3. Is solid and adhered to the structure (e.g. no FOD risk)

12.4. Creased Cylinders

12.4.1. Circumferential creases in the cylinder walls are acceptable provided their depth is .04" or less.



## Glossary of Terms

**Bellmouth** – A Taper condition formed on ID of hole at the opposite end of the hole from which a punch or blanking die enters.

**Blending** - An operation which removes an irregularity from a surface, resulting in a shallow, smooth depression.

**Blister** - A localized lifting of coating, plating, fiberglass, or paint, appearing as a bulge that may break when probed.

**Bottomed Imperfection** – A pit, cavity or hole in which the bottom can be seen.

**Burnish** - A shiny area resulting from rubbing against a hard, smooth surface; may contain scratches of no apparent depth.

**Burr** - A fragment of metal which remains attached to the surface after a machining or riveting operation.

**Chatter Mark** - Recurring undulations or irregularities that result from vibratory interactions of the tool and a typical machined surface.

**Crack** - Linear imperfection in the form of a narrow break or fissure of the surface.

**Craters** - Small bowl-shaped depressions in a coating film that frequently have drops or bands of material at their centers and raised circular edges. Most often caused by the presence of grease, oil, silicone or other similar contaminants on the surface.

**Dent** - A surface depression normally having rounded edges, corners, and bottom, caused by the impact of some object.

Depressed Imperfection - One that is below the general surface of the part; may have either smooth or irregular (sharp) edges or bottom (see Dent or Pit)

Die Break (Breakaway or Fracture Marks) - A rough surface caused by breaking away of metal by a punch or blade during a blanking or shearing operation.

Draw Mark - Linear, trough-like grooves which result from the action of die imperfections or foreign material on the drawn material.

Drips – (see Runs)

Fisheyes – (see Craters)

Formed Depression - A change in surface level caused by mismatch of adjoining die segments.

Imperfection - An interruption (non-uniformity) in the normal surface condition of a part configuration which must be evaluated for acceptance to an assigned standard.

Nick - A small surface imperfection having sharp edges, corners or bottom caused by impact of a sharp object.

Non-bottomed Imperfection - A depressed imperfection in which the bottom cannot be seen.

Orange Peel - A dimpled or grainy surface texture resembling an orange peel.

Pit - Small irregular cavity in a surface, usually dark bottomed.

Printed Circuit Board (PCB) Artwork – Commonly referred to as “Gerber files”, a set of computer files generated by a PCB design program containing nondimensional data that defines the printed circuit board copper layers, solder mask, legend, drill holes, silk screens, etc. The Gerber file set is defined as a single data element carrying a single revision indication.

Raised Edge - A narrow ridge of material along an edge raised above the general contour of the part.

Raised Imperfection – An imperfection which is above the general surface of the part.

Runs - Heavy, U-shaped build-ups or horizontal lips on the surface of coatings. Conditions resulting from too much organic coating material or thinner applied to a surface area.

Sags – (see Runs)

Scratch - A linear depression with a sharp bottom caused by movement of a sharp object or particle across the surface.

Shallow Imperfection - An imperfection which appears to penetrate the surface finish, does not have a dark bottom and which would not cause a stylus (ref. paragraph 5.9) to hesitate (catch) when passed over it.

Shear Mark (Die Break) - A rough surface caused by breaking away of metal during die-forming operations.

Smooth - A surface that is continuously even, free of irregularities, presenting no resistance to the sliding of a finger or tool. Can be applicable to one plane surface or transition surfaces between planes.

Stain - Surface discoloration due to liquids drying on the part.

Substrate Source Pattern - The uniform crosshatched pattern visible on the exterior of the composite part due to the presence of the tape and fabric in the underlying piles.

Surface Texture (Finish) - The texture of a surface, be it forged, case or machined. Also, this term applies to the numerical value assigned to the surface roughness of machined surfaces.

Tool Mark - Imperfection, usually depressed, caused by machining tools.

Wrinkle - A ripple surface that occurs in areas of sharp contour changes (e.g. transition areas between circular and flat surfaces).

**Revisions**

Rev.	Description	Date	Appr.
-	Initial Release. Derived from WI-21-003	02-Nov-2016	PJR