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Standard for Workmanship and General Practices

REVISION RECORD

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Standard for Workmanship and General Practices

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Standard for Workmanship and General Practices

1. Purpose

To establish procedures and ensure consistency in requirements for general workmanship and standard practices for procured fabricated items or processes purchased by Sensor Systems Inc (SSI).

2. Scope

The documents referenced herein shall represent the minimum workmanship standards for all fabricated printed circuit boards, electronic sub-assemblies, and assemblies, as well as mechanical assemblies, which represent Sensor Systems' products. The requirements herein are applicable all suppliers/vendors to Sensor Systems Inc.

3. References

Documents

- ASTM D3951-18 – Standard Practice for Commercial Packaging
- AWS D17.1 – Specification for Fusion Welding for Aerospace
- IPC-A-600 – Acceptability of Printed Circuit Boards (PCB)
- IPC-A-610 – Workmanship Standards for electronic sub-assemblies
- IPC-A-612 - Qualification and Performance Specification for Rigid Printed Boards
- IPC J-STD-001 – Requirements for Soldered Electrical and Electronic Assemblies
- IPC/WHMA-A-620 – Requirements and Acceptance for Cable and Wire Harness Assemblies
- MIL-DTL-5541 – Chemical Conversion Coatings on Aluminum and Aluminum Alloys

4. General Procedure

Verify all workmanship attributes comply with drawing specifications as well as the appropriate reference standard Workmanship.

SSI, as the Buyer, reserves the right to review all Supplier procedures on workmanship practices during a process audit under the AS9100 / ISO 9001 Quality Management System or any Smart waste management and disposal.

5. Metal Fabrication Workmanship Requirements

The procurement procedure is crucial for ensuring that SSI's suppliers consistently provide products and services that meet quality requirements.

5.1 Surface Roughness

Unless otherwise specified, surface roughness shall be no greater than a 125 micro inch finish and be uniform across the entire surface.

5.2 Burrs (includes sharp edges)

A burr is defined as a rough or irregular piece of material that typically occurs at the edge of a part feature. The burr is usually the result of the part fabrication process.

Burrs are classified under the following types:

- **Tight Burr –** A burr that is strongly attached to the part. The burr cannot be moved or dislodged.
- **Rolled-Over Burr –** A burr that is curled over itself. Concern is that contaminants can be trapped in the burr.
- **Embedded Burr –** Any burr that has been pressed into the base metal. The burr cannot be moved or dislodged.
- **Loose Burr –** A bur that is not firmly attached to the part . The burr can be moved or dislodged.
- **Feather Burr –** A very thin or fine burr typically less than .001” thick. The burr can be moved or dislodged.

Burrs/sharp edges need to be removed for the following reasons:

a) Pose a cutting hazard to individuals handling the part

b) Foreign Object Damage (FOD)

c) Can cause acute damage to mating components. (Fasteners, O-Rings, gaskets, wiring)

d) Localized stress increases potentially causing cracks or part failure.

e) Increased possibility of corrosion failure

5.3 Deburring Requirements

Unless otherwise specified on the drawing, all fabricated items shall be completely deburred, and is applicable to all edges and corners.

Burr removal shall:

a) Not result in a chamfer or radius that exceeds .015 inches, or one-quarter of the material thickness, or the maximum edge break radius as specified on the drawing, whichever is smaller.

b) Be accomplished prior to any coatings or finish applied.

c) Not affect the parts dimensional tolerances specified on the drawing.

d) Not impact functionality or cosmetic appearance.

5.4 Thread Relief

Thread relief requirements are based on the following types:

- External
- Internal

Unless otherwise noted on the drawing, external thread reliefs shall be as follows:

- Minimum minor diameter +.000/-.010 inches for threads .25 inch diameter and under

- Minimum minor diameter +.000/-.020 inches for threads over .25 inch
- Length of thread relief shall not exceed 2-1/2 threads.

Unless otherwise noted on the drawing, internal thread reliefs shall be as follows:

- Minimum minor diameter +.020”/-.000 inches for threads .25 inch diameter and under
- Minimum minor diameter +.040”/-.000 inches for threads over .25 inch
- Length of thread relief shall not exceed 2-1/2 threads.

5.5 Concentricity

Unless otherwise specified, all diameters shown concentric to each other shall be concentric within .010 total indicator runout.

5.6 Perpendicularity of Holes

Unless otherwise specified, clearance holes shown perpendicular to a surface shall be perpendicular within 0.5 degrees. Unless otherwise specified, tapped holes shown perpendicular to a surface shall be perpendicular within 1.0 degree.

5.7 Parallelism of Plane Surfaces

Unless otherwise specified, all machined or sheared surfaces shown parallel shall be so within the tolerance zone for given length of the surface shown by Figure 1 and Table 1.

Figure 1. Parallelism for Plane Surfaces

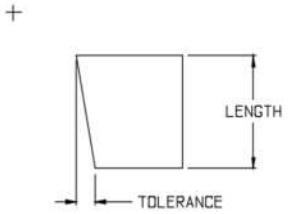

Table 1. Parallelism Length/Tolerance

Length (inches)	Tolerance (inches)
0.00 – 1.00	.003
1.00 – 3.00	.005
3.00 – 5.00	.010
5.00 – 25.00	.015
25.0 – 60.0	.050

If tolerance exceeds tolerance on the drawing, the drawing tolerance shall take precedence.

5.8 Flatness

Machined surfaces shall be flat within .002 inch/inch.

If tolerance exceeds tolerance on the drawing, the drawing tolerance shall take precedence.

5.9 Squareness of 90 Degree Bends

Sheet metal bends shown as 90^{O} on drawing shall be 90 +/- 1.0 degree. All formed parts shall have minimum bend reliefs where required.

5.10 Grain Direction

Unless otherwise specified on the drawing, grain direction in formed metal parts may run in any direction convenient to manufacturing, provided these parts do not fracture at bends.

5.11 Chamfering/Countersink – Through Hole

Unless otherwise specified on the drawing, when chamfering or countersinking a threaded hole, any raised burrs cause by this operation are to be removed.

5.12 Chamfering/Countersink - Threaded Holes

To prevent raised burrs, caused by this operation, following tool sequence is to be utilized:

- Drill
- Chamfer/Countersink
- Tap

Drill and Chamfer/Countersink maybe perform as a single process with use of step drills.

5.13 Counterbore and Spotface Fillet Radii

Counterbore and spotface fillet radii shown as sharp shall be sharp to:

- .010 maximum radius for bore sizes between 0.00 and 1.00 inches.
- 030 maximum radius for bore sizes between 1.00 and 2.00 inches.

If tolerance exceeds tolerance on the drawing, the drawing tolerance shall take precedence. Any raised burrs cause by this operation are to be removed.

5.14 Tangency of Fillets and Rounds

Fillets and rounds shown tangent to adjacent surfaces shall fair smoothly with tangent surfaces +/- .005 inches.

If tolerance exceeds tolerance on the drawing, the drawing tolerance shall take precedence.

5.15 Soldering

All solder joints shall be IAW IPC J-STD-001.

5.16 Welding

When not specified on the drawing welded assemblies will be based on the best practices identified in AWS D17.1/D17.1M:2010-AMD1.

Parts must be checked and verified that they are to print, before welding. Once welding begins selective welding techniques must be exercised, so that surface distortion is held to a minimum.

General weld requirements:

- **Butt Welds -** Unless otherwise specified, all butt weld joints shall have complete penetration.
- Joint Appearance –
- Welds shall be free from harmful defects (e.g., cracks, porosity, undercuts, voids, and gaps).
- All welds and brazes shall show no burn-through.
- Weld bead appearance, cross-section and ripples shall be uniform and smooth.
- **Welds Sizes -** Fillet weld sizes shall be at least 140% of the thickness of the thinner material unless the drawing specifies otherwise.

5.17 Grinding

Grinding shall affect the minimum area possible to satisfy the drawing requirements. Welds shall not be ground unless required by drawing.

6. Mechanical Assemblies

When mounting and installing parts and/or subassemblies, the following practices will be adhered to wherever applicable:

- Assembled parts and hardware should be secured or mounted in a manner that satisfactorily accomplishes the intended purpose without degrading or becoming damaged in the environment in which they are to be used.
- Electronic equipment comprised of missing, inoperative, defective, bent, broken, or otherwise damaged parts will be deemed unacceptable.
- Rework to damaged finishes will be considered successfully performed when the surfaces are touched-up with a continuous protective coating of identical composition as the original coating.
- The touch-up area should match the original finish such that the blended area is not visually noticeable.

6.1 Installation of Threaded Fasteners and Rivets

Threaded fasteners and rivets should be carefully selected and applied so as to produce a safe, noncorroding, functional and long-lived joining of materials.

Commonly practiced procedures, guidelines and requirements are:

- Screws, nuts and bolts should show no evidence of cross threading, mutilation, or detrimental or hazardous burrs.
- Fasteners/Rivets utilized shall meet the drawing requirements.
- Fasteners shall be securely torqued to the appropriate torque value.

- The riveting operation should be carefully performed such that the rivets are tight and satisfactorily headed with the rivet heads tightly seated against their bearing surface.

7. Wiring/Cable/Coax Workmanship

All wiring shall be IAW IPC/WHMA-A-620

8. Printed Circuit Boards (PCB) Workmanship

All PCBs shall be IAW IPC-A-600 and IPC-A 612.

9. Electronic Sub-Assemblies Workmanship

All electronic Sub-Assemblies shall be IAW IPC-A-610.

10. Chemical Conversion Coatings Appearance (MIL-DTL-5541)

Coatings appearance shall meet MIL-DTL-5541 when viewed with normal lighting.

The appearance shall free of:

- Powdery or loose coating
- Scratches
- Voids, pits or corrosion
- Variances in appearance continuity of coating
- Dark spots caused by conversion chemicals dripping or rundown

Suppliers are responsible for coordinating with their sub-contractors to determine the procedures/methods to comply with MIL-DTL-5541 and this document and sample shall be submitted to SSI for approval.

If a Touch-up is required on an area with a grain or smoothness requirement, and touch-up exceeds 5 percent of the surface, specific SSI approval must be requested and obtained.

11. Cleaning of Parts and Assemblies

The proper methods for cleaning parts and assemblies during the fabrication of product are essential in assuring the expected performance and long operational life. The subsequent procedures are offered as examples of acceptable cleanliness practices.

This requirement must be adhered to before:

- Application of any coatings or paint
- Prior to packaging of product for delivery

Product shall be cleaned of:

- Loose, spattered or excess solder
- Weld Metal
- Metal Chips
- Mold Release Agents

- Any contaminants which were used in the manufacturing processes:
- Lubricants
- Waxes
- Sand
- Corrosive products (fluxes, Cleaners, etc)
- Grinding Residue
- Dust/Dirt
- Smudges, fingerprints

12. Handling of Product

Proper handling of product must be exercised to preclude physical and/or electrical damage such as:

- Cracks, scratches
- Twists
- Fractures
- Prevent the possibility of hidden damage such as:
- Flexure of component leads
- Stressing of solder joints
- Over tightening of fasteners
- Electrostatic discharge (ESD)

13. Cosmetic Inspection Criteria

The purpose of this standard is to define and establish acceptance and rejection criteria for cosmetic finish for outgoing inspections applicable at the Supplier and/or Supplier's Subcontractor to ensure product delivered to SSI:

- Meet the finish standard required on the applicable drawing.
- Inspection to find and identify all imperfections prior to delivery.

13.1 Terms and Defect Definitions

Abrasion – Surface imperfection that doesn't remove or displace material (appears as a scuff or changes to the surface finish)

Bare Metal – 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.

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 or tint.

Break-Out – Tearing of metal, or other material away from a casted or molded edge because of a cutting/trimming process.

Burns – Marks or streaks on a surface reflecting over heating or burning.

Bubble – A bubbling in the surface 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 mixture 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.

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

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

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

Corrosion – Areas of corrosion on any metal surfaces.

Cracking –

- Crackled appearance due to poor adhesion usually from surface contamination before plating or coating.
- Hairline cracks of anodized material caused by bending, high temperature curing after silk screening of aluminum or tool mark hair cracks on the opposite site of aluminum.
- Fine damages which may extend in a pattern on or beneath the surface or through a layer of material.

Delaminating – Separation, peeling of thin layer of material.

Dent/Ding– A surface depression caused by an impact.

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

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

Distortion – A deformation of a casted or stamped part.

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.

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 which has a measurable depth.

Inconsistency – Variations of gloss, thickness of coatings or incomplete surface finish texture.

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

Nicks – Like gouges but short in length caused by impact.

Non-adhesion – Lack of proper sticking of a glued or bonded material surface.

Non-uniformity – Areas that have insufficient or excessive coating or surface finish.

Orange Peel/Skin -Paint defect, rippled or molted appearance viewable as cosmetic lines.

Oxidation – A rough feel or appearance due insufficient protection of the metal.

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 crates on a 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.

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

Tooling Marks –
Very shallow lines which are parallel to bends in parts.
Unwanted impact of a tool during punching process.

Warpage – Dimensional distortion in a part after molding, pressing or laminating.

13.2 Required Appearance Quality

Paint

- Painted Surfaces shall be defect free and texture and color should be uniform.

- The finish on a continuous surface shall exhibit no imperfections such as gouges, chips, runs, blisters, flaking, or any defect that will affect the functional properties of the finish.
- Touch-up is acceptable if not visible under normal lighting conditions.

Silk Screening

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

Plating

- Visible outside surfaces shall be defect free.
- Surface shall have a uniform appearance.

Chemical Conversion Coating (MIL-DTL-5541F)

- The finish shall be of the appropriate class, type and color per the drawing requirement. Certificate of Conformance (CoC) must be validated and provided.
- The finish shall have a uniform appearance; semi bright and smooth and have no defects.

Cleanliness

- Items shall be clean prior to packaging for shipment.

Packaging

Ensure packaging utilized IAW ASTM D3951-18 requirements and required Certificates of Conformance included with shipping documents.

14. Supplier Deviation Activities

Suppliers should fill out and submit SSI Form PUR003 Supplier Deviation Request Form for SSI's review and possible approval for the following instances:

- Any manufacturing/inspection requirements that cannot be fulfilled.

Shipment of product with a Supplier Deviation Request cannot be shipped to SSI until final determination of the deviation request is made and accepted. If SSI denies the deviation request, they will not be accepted.