Discrete components are the backbone of the electronics world, consisting of individually packaged, leaded devices, highly integrated circuits (IC), interconnects, terminators, switches, etc.

While discrete components are rapidly being displaced by the smaller-form surface mount technology (SMT) package, the discrete component is still widely in use, especially in extreme environmental applications where the SMT device will not perform reliably and/or is unavailable.

The solder joint surface is smooth, nonporous and undisturbed, with a finish varying from satin to bright. The fillet completely wets all elements of the connection and is concave.

Populated plated through holes (PTH) should exhibit a vertical solder fill of 100%, with a fully formed fillet on the solder side, and evidence of 100% wetting on the component side lead, barrel, and pad.

Best Workmanship Practice

Components are installed per engineering documentation, and are parallel to, and in contact with, the board surface. Component and board markings are clear and legible. Component leads exhibit proper bend radii, and stress relief. Solder fillets are smooth and shiny, with concave profiles.

The solder joint surfaces are smooth, nonporous and undisturbed, with a finish varying from satin to bright. The fillet completely wets all elements of the connection and is concave.

NASA-STD-8739.3 [13.6.1.1]
ACCEPTABLE EXPOSED BASE METAL (SPECIAL EXCEPTION)
Exposed base metal on the vertical edge of printed wiring conductors, lands, and pads is acceptable.
NASA-STD-8739.3 [ 13.6.2.e.5 ]

UNACCEPTABLE INSUFFICIENT LEAD PROTRUSION
Leads terminated straight through the PWB shall extend a minimum of 0.5 mm (0.020 in.) beyond the pad surface.
NASA-STD-8739.3 [ 8.5.3 ]

UNACCEPTABLE ADHESIVES
Adhesives may be used to temporarily hold discrete components in position during wave or reflow soldering. Adhesives shall not interfere with soldering, and residues shall be removed following soldering operations.
Best Workmanship Practice
NASA-STD-8739.3 [ 13.6.2.b.10 ]
ACCEPTABLE INTERFACIAL CONNECTIONS / VIAS (MULTILAYER PWBs)
Interfacial connections (vias) in multilayer PWBs do not require the use of filler wire, and shall not be solder filled.
NASA-STD-8739.3 [ 11.2.4.b ]

ACCEPTABLE MEASLING
Whitish, discrete spots or crosses below the laminate surface - usually induced by thermal shock / stress. Measling that bridges uncommon conductors is unacceptable.
NASA-STD-8739.3 [ 13.6.1.l ], [ 13.6.2.c.3 ]

UNACCEPTABLE MEASLING
Measling that bridges uncommon conductors is unacceptable.
NASA-STD-8739.3 [ 13.6.2.c.3 ]

UNACCEPTABLE NON-UNIFORM / UNEVEN FLOW (DEMARCATION LINES / FILLET SWIRLS)
A solder fillet exhibiting a nonuniform / uneven profile, demarcation lines, or swirls is acceptable, provided the fillet is shiny and there is evidence of complete wetting with smooth fillets at the swirls.
Best Workmanship Practice

ACCEPTABLE INTERFACIAL CONNECTIONS / VIAS (PTH / VIAS)
No dedicated effort shall be expended to remove solder from unpopulated plated through holes (PTH) and/or vias.
NASA-STD-8739.3 [ 11.2.4 ]

UNACCEPTABLE SOLDERED TEMPERED LEADS
Tempered / hardened leads (sometimes referred to as pins) shall not be bent or formed for mounting purposes since body seals and connections internal to the part may be damaged.
NASA-STD-8739.3 [ 8.1.6.e ]

UNACCEPTABLE BLOWHOLE
Blowholes are typically caused by trapped gases or flux during the formation of the solder fillet, and are unacceptable.
NASA-STD-8739.3 [ 13.6.2.b.5 ]

UNACCEPTABLE BRIDGING
Bridging is an indicator of poor process controls (i.e.: excess solder, smeared paste, improper placement, incorrect heat).
NASA-STD-8739.3 [ 13.6.2.c.4 ]

ACCEPTABLE SOLDER IN STRESS RELIEF BEND
Solder which extends into the stress relief bend of any leaded part shall not be cause for rejection if the topside bend radius is discernable, and if the solder does not extend within one (1) lead diameter of the part body or end seal.
NASA-STD-8739.3 [ 13.6.2.b.6 ]

UNACCEPTABLE SOLDER IN STRESS RELIEF BEND
Solder extends into the stress relief bend and contacts the part body end seal. The topside of the lead is not discernable.
NASA-STD-8739.3 [ 13.6.2.b.6 ]

UNACCEPTABLE BENT TEMPERED LEADS
Tempered / hardened leads (sometimes referred to as pins) shall not be bent or formed.
NASA-STD-8739.3 [ 8.1.6.e ]

ACCEPTABLE SOLDER-FILLED INTERFACIAL CONNECTIONS (PTH / VIAS)
No dedicated effort shall be expended to remove solder from unpopulated plated through holes (PTH) and/or vias.
NASA-STD-8739.3 [ 11.2.4 ]

UNACCEPTABLE SOLDER-FILLED INTERFACIAL CONNECTIONS (PTH / VIAS)
Solder which extends into the stress relief bend of any leaded part shall not be cause for rejection if the topside bend radius is discernable, and if the solder does not extend within one (1) lead diameter of the part body or end seal.
NASA-STD-8739.3 [ 13.6.2.b.6 ]

UNACCEPTABLE UNIFORM / UNEVEN FLOW / REFLOW
A solder fillet exhibiting nonuniform / uneven flow lines / swirls with hard demarcation lines (no fillet at swirl interfaces), and a dull finish are typically caused by an inadequate / uneven application of heat during the fillet formation.
Best Workmanship Practice

ACCEPTABLE INTERFACIAL CONNECTIONS / VIAS
Interfacial connections (vias) in multilayer PWBs do not require the use of filler wire, and shall not be solder filled.
NASA-STD-8739.3 [ 11.2.4.b ]

UNACCEPTABLE INTERFACIAL CONNECTIONS / VIAS
Solder extends into the stress relief bend and contacts the part body end seal. The topside of the lead is not discernable.
NASA-STD-8739.3 [ 13.6.2.b.6 ]

THROUGH-HOLE SOLDERING GENERAL REQUIREMENTS (cont.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER HOUSTON, TEXAS USA 77058

THROUGH-HOLE SOLDERING GENERAL REQUIREMENTS (cont.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER HOUSTON, TEXAS USA 77058

THROUGH-HOLE SOLDERING GENERAL REQUIREMENTS (cont.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER HOUSTON, TEXAS USA 77058

THROUGH-HOLE SOLDERING GENERAL REQUIREMENTS (cont.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER HOUSTON, TEXAS USA 77058
### THROUGH-HOLE SOLDERING

#### GENERAL REQUIREMENTS (cont.)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>Charring of components and/or laminate is an indicator of poor process control (i.e.: excessive heat).</td>
<td>NASA-STD-8739.3 [13.6.2.a.7]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>The use of parts with chips in the component body, termination area, or meniscus, is prohibited.</td>
<td>NASA-STD-8739.3 [13.6.2.a.7]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>A cold solder joint is an indicator of incorrect process control (i.e.: inadequate heat).</td>
<td>NASA-STD-8739.3 [13.6.2.b.1]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>Contamination is a reliability concern.</td>
<td>NASA-STD-8739.3 [13.6.2.b.10]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>Improper coplanarity of leaded parts will result in bridging, shorts, opens, and/or misalignment. Part leads shall be reworked (if allowed) prior to installation.</td>
<td>NASA-STD-8739.3 [13.6.2.a.5]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>Cracks (especially in ceramic components) are an indicator of poor process control (i.e.: improper preheat, thermal / mechanical shock, etc.).</td>
<td>NASA-STD-8739.3 [13.6.2.a.7]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>The component (capacitor C47) has been mounted with the identification marks on the underside of the component body (against the circuit board), preventing visual confirmation that the correct value part is installed.</td>
<td>NASA-STD-8739.3 [8.1.3]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>The component (capacitor C47) has been mounted with the identification marks on the underside of the component body (against the circuit board), preventing visual confirmation that the correct value part is installed.</td>
<td>NASA-STD-8739.3 [8.1.3]</td>
</tr>
<tr>
<td><strong>ACCEPTABLE</strong></td>
<td>Parts shall be mounted in such a manner that, at a minimum, the markings are visible in the following order of precedence: polarity, traceability / lot code (if applicable), part value, part number / type.</td>
<td>NASA-STD-8739.3 [8.1.3]</td>
</tr>
<tr>
<td><strong>UNACCEPTABLE</strong></td>
<td>The use of parts with chips in the component body, termination area, or meniscus, is prohibited.</td>
<td>NASA-STD-8739.3 [13.6.2.a.7]</td>
</tr>
<tr>
<td><strong>ACCEPTABLE</strong></td>
<td>A solder pit is acceptable, provided the bottom of the cavity can be seen from all angles of vision.</td>
<td>NASA-STD-8739.3 [8.1.4]</td>
</tr>
<tr>
<td><strong>ACCEPTABLE</strong></td>
<td>Smooth tool impression marks (slight cuts, nicks, scratches or scrapes) on the conductor surface, which do not expose base metal or reduce cross-sectional area are acceptable.</td>
<td>NASA-STD-8739.3 [8.1.6.d]</td>
</tr>
<tr>
<td><strong>ACCEPTABLE</strong></td>
<td>A slight recessing or shrinkback of the solder into the PTH below the solder pad is acceptable, providing the lead and pad exhibit wetting and the shrinkback is slight.</td>
<td>NASA-STD-8739.3 [13.6.1.12]</td>
</tr>
</tbody>
</table>

### NASA WORKMANSHIP STANDARDS

#### THROUGH-HOLE SOLDERING

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

JOHNSON SPACE CENTER

HOUSTON, TEXAS USA 77058

**Released:** 06.27.2002

**Revision:** 6.01

**Page:** 8
## UNACCEPTABLE CRACKS (LAMINATE)
Cracks in the laminate are cause for rejection.  
*Best Workmanship Practice*

## UNACCEPTABLE CRACKS (SOLDER FILLET)
Cracks or fractures in the solder fillet are an indication of mechanical / thermal shock, or temperature coefficient mismatch.  
*NASA-STD-8739.3 [ 13.6.2.b.3 ]*

## UNACCEPTABLE DAMAGED PART SEAL
Parts with damaged seals shall not be used.  
*NASA-STD-8739.3 [ 13.6.2.a.7 ]*

## UNACCEPTABLE DEWETTING
Dewetting is caused when molten solder coats a surface and then recedes, leaving irregularly-shaped solder deposits separated by areas covered by a thin solder film.  
*NASA-STD-8739.3 [ 13.6.2.b.11 ]*

## UNACCEPTABLE DISCOLORED LAMINATE (BURNS)
Burns that physically damage the laminate surface or the assembly are not allowed. Slight discoloration is allowable.  
*NASA-STD-8739.3 [ 13.6.2.c.2 ]*

## UNACCEPTABLE DISCOLORED LAMINATE (OVERHEATING)
A browning / darkening of the laminate because of excess heat; an indicator of improper process control / thermal design.  
*NASA-STD-8739.3 [ 13.6.2.e.3 ]*

## UNACCEPTABLE FRACTURED SOLDER
A fractured solder joint is an indication that the joint has been subjected to extreme mechanical shock. A crack in an “as-received” assembly is unusual and cause for concern.  
*NASA-STD-8739.3 [ 13.6.2.b.3 ]*

## UNACCEPTABLE FLUX RESIDUE
Flux residue indicates improper / incomplete cleaning.  
*NASA-STD-8739.3 [ 13.6.2.b.10 ]*

## UNACCEPTABLE FLUX SPLATTER
Flux splatter is an indication of an improper process parameter (heat / moisture).  
*NASA-STD-8739.3 [ 13.6.2.b.8 ]*

## UNACCEPTABLE GOLD INTERMETALLIC
Gold intermetallic is characterized by evidence of golden colored streaks in the solder fillets of gold plated leads that have not been properly tinned. Gold intermetallic can severely embrittle a solder joint.  
*Best Workmanship Practice*

## UNACCEPTABLE GOLD PLATING
Gold plated surfaces that will become a part of the finished solder connection shall be tinned prior to soldering to remove the gold plating.  
*NASA-STD-8739.3 [ 7.2.5.c. ] [ 13.6.2.a.3 ]*

## UNACCEPTABLE GOLD PLATING (HOLE OBSTRUCTION)
The mounting pad has been installed upside down. Parts shall not be mounted such that they obstruct solder flow to the component-side termination area (pad), or prevent cleaning and inspection.  
*NASA-STD-8739.3 [ 8.4.4 ]*

## UNACCEPTABLE HOLE OBSTRUCTION
The mounting pad has been installed upside down. Parts shall not be mounted such that they obstruct solder flow to the component-side termination area (pad), or prevent cleaning and inspection.  
*NASA-STD-8739.3 [ 8.4.4 ]*

## THROUGH-HOLE SOLDERING
### GENERAL REQUIREMENTS (cont.)

## NASA WORKMANSHIP STANDARDS

### THROUGH-HOLE SOLDERING
### GENERAL REQUIREMENTS (cont.)

### NASA WORKMANSHIP STANDARDS
UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]

UNACCEPTABLE
IMPROPER LEAD BENDING
The minimum distance from the part body / seal to the start of the bend shall be 2 lead diameters for round leads and 0.5 mm (0.020 in.) for ribbon leads. The bend radius shall not be less than one lead diameter (1d) or ribbon thickness (t). NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD CUTTING
Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations. NASA-STD-8739.3 [8.1.6.a]

UNACCEPTABLE
IMPROPER LEAD LENGTH
The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor. NASA-STD-8739.3 [13.6.2.a.20]

UNACCEPTABLE
IMPROPER ORIENTATION
Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications. NASA-STD-8739.3 [13.6.2.a.5]
THROUGH-HOLE SOLDERING
GENERAL REQUIREMENTS (cont.)

UNACCEPTABLE
INSUFFICIENT STRESS RELIEF / LEAD BEND
Lead is improperly bent, placing strain on the weld bead. Conductors and part leads shall have sufficient stress relief to prevent damage to the solder termination and/or part.
NASA-STD-8739.3 [13.6.2.a.10]

UNACCEPTABLE
MENISCUS CONTACT
Parts exhibiting contact with, or embedment of, the meniscus and the solder joint, shall be rejected.
NASA-STD-8739.3 [8.1.7], [13.6.2.b.13]

UNACCEPTABLE
POROUS SOLDER
Porous solder exhibits an uneven surface and a spongy appearance that may contain a concentration of small pinholes and voids.
Best Workmanship Practice
NASA-STD-8739.3 [13.6.2.b.7]

UNACCEPTABLE
NO SOLDER
The lack of solder is an indicator of poor process control.
NASA-STD-8739.3 [13.6.2.b.12]

UNACCEPTABLE
NONWETTING
Nonwetting results in the solder forming a ball or beading on the termination surface. The fillet is convex; no feathered edge is apparent.
NASA-STD-8739.3 [13.6.2.b.12]

UNACCEPTABLE
PINHOLE
Pinholes are typically small holes in the solder surface, leading to a void of indeterminate size within the solder termination.
NASA-STD-8739.3 [13.6.2.b.5]

UNACCEPTABLE
NICKS
The use of parts with nicks in the component body or termination area is prohibited.
NASA-STD-8739.3 [13.6.2.a.7]

UNACCEPTABLE
POPCORNING
Popcorning is caused by the release of entrapped moisture during the soldering process.
Best Workmanship Practice
NASA-STD-8739.3 [13.6.2.b.10]

UNACCEPTABLE
POOR WETTING
Poor wetting is an indicator of poor solderability, improper flux, or contamination.
NASA-STD-8739.3 [13.6.2.b.4]

UNACCEPTABLE
POOR FLOW / REFLOW
The lack of flow / reflow of solder is an indicator of poor process control or layout design (i.e.: inadequate heat, shadowing).
NASA-STD-8739.3 [13.6.2.b.1]

UNACCEPTABLE
POOR WETTING
Nonwetting results in the solder forming a ball or beading on the termination surface. The fillet is convex; no feathered edge is apparent.
NASA-STD-8739.3 [13.6.2.b.12]

UNACCEPTABLE
INSUFFICIENT STRESS RELIEF / LEAD BEND
Lead is improperly bent, placing strain on the weld bead. Conductors and part leads shall have sufficient stress relief to prevent damage to the solder termination and/or part.
NASA-STD-8739.3 [13.6.2.a.10]

UNACCEPTABLE
PIGGYBACKED PARTS
The piggybacking of parts not designed specifically for that configuration is prohibited.
Best Workmanship Practice
NASA-STD-8739.3 [13.6.2.b.9]

UNACCEPTABLE
POOR WETTING
Poor wetting is an indicator of poor solderability, improper flux, or contamination.
NASA-STD-8739.3 [13.6.2.b.4]

UNACCEPTABLE
POROUS SOLDER
A rosin solder joint is similar in appearance to a cold solder joint, but exhibits evidence of entrapped flux in the fillet and at the surfaces to be joined.
NASA-STD-8739.3 [13.6.2.b.9]

THROUGH-HOLE SOLDERING
GENERAL REQUIREMENTS (cont.)

NASA WORKMANSHIP STANDARDS
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS USA 77058

Released: 06.27.2002
Revision: 6
Section: 6.01
Page: 13
**UNACCEPTABLE SCRATCHES (SOLDER FILLET)**
Scratches in the solder are prohibited.

NASA-STD-8739.3 [13.6.2.b.3]

**UNACCEPTABLE SOLDER BALLS**
Solder balls are considered a contaminant, and are an indication of improper process control (inadequate preheat), and/or the use of outdated solder/flux.

NASA-STD-8739.3 [13.6.2.b.10]

**UNACCEPTABLE SOLDER PEAKS, ICICLES, SHARP EDGES**
Solder peaks, icicles, and/or sharp edges are an indicator of improper process parameter and are a reliability and short-circuit concern.

NASA-STD-8739.3 [13.6.2.c.4]

**UNACCEPTABLE SOLDER SKIPS**
Solder skip is the random non-formation of solder fillets, and is an indicator of poor process control. Solder skip may be caused by insufficient solder, contamination, non-solderability (oxide), improper flux, solder thieving, etc.

NASA-STD-8739.3 [13.6.2.b.7]

**UNACCEPTABLE SOLDER SLIVERS**
Solder slivers are an indication of improper process control.

NASA-STD-8739.3 [13.6.2.c.4]

**UNACCEPTABLE SOLDER SPLATTER**
Solder splatter is typically caused by moisture contamination and is an indicator of poor process control.

NASA-STD-8739.3 [13.6.2.b.8]

**UNACCEPTABLE OBSERVED SOLDER TERMINATIONS**
The placement of a part, which obscures the inspectability of another part's terminations, is unacceptable, unless interim inspection is performed (part depicted is mounted over previously installed surface mount components).

NASA-STD-8739.3 [13.6.2.a.22]

**UNACCEPTABLE SOLDER BALLS**
Solder balls are considered a contaminant, and are an indication of improper process control (inadequate preheat), and/or the use of outdated solder/flux.

NASA-STD-8739.3 [13.6.2.b.10]

**UNACCEPTABLE SOLDER SKIPS**
Solder skip is the random non-formation of solder fillets, and is an indicator of poor process control. Solder skip may be caused by insufficient solder, contamination, non-solderability (oxide), improper flux, solder thieving, etc.

NASA-STD-8739.3 [13.6.2.b.7]

**UNACCEPTABLE SOLDER SLIVERS**
Solder slivers are an indication of improper process control.

NASA-STD-8739.3 [13.6.2.c.4]

**UNACCEPTABLE SOLDER SPLATTER**
Solder splatter is typically caused by moisture contamination and is an indicator of poor process control.

NASA-STD-8739.3 [13.6.2.b.8]

**UNACCEPTABLE OVERHEATED SOLDER**
Overheated solder has a dull, gray, frosty, and/or crystallized appearance and is the result of excessive exposure to heat.

NASA-STD-8739.3 [13.6.2.b.2]

**UNACCEPTABLE PART LEADS USED AS TERMINALS**
Part leads shall not be used as terminals, unless the part lead is designed to function as a terminal.

NASA-STD-8739.3 [13.6.2.a.18]

**UNACCEPTABLE PART MISALIGNMENT**
Part misalignment is an indicator of improper process control.

NASA-STD-8739.3 [13.6.2.a.5]
A whisker is a slender needle-shaped metallic growth between a conductor and a land. Typically the result of mechanical stresses in high tin compounds, it is a reliability concern. **Best Workmanship Practice**

Voids are an indication of improper process control, and are typically caused by insufficient solder, solder wicking/thieving, or contamination. **NASA-STD-8739.3 [13.6.2.b.5]**

Splices shall not be used to repair broken or damaged conductors or part leads. **NASA-STD-8739.3 [8.1.8], [13.6.2.a.16]**

Webbing is an indication of improper process control. **NASA-STD-8739.3 [13.6.2.c.4]**
THIS PAGE IS INTENTIONALLY BLANK.