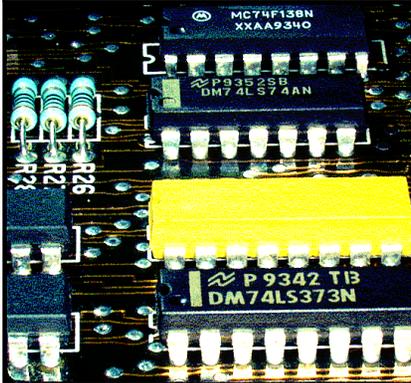


**THROUGH-HOLE SOLDERING
GENERAL REQUIREMENTS**



**THROUGH-HOLE SOLDERING
GENERAL REQUIREMENTS**

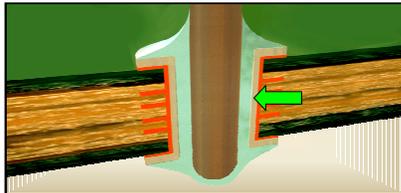
Discrete components are the backbone of the electronics world, consisting of individually packaged, leaded devices, highly integrated circuits (IC), interconnects, terminators, switches, etc.

While discretes 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.



GENERAL REQUIREMENTS

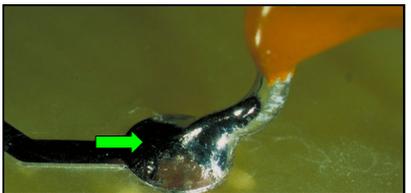
Components are installed per engineering documentation, and are parallel to, and in contact with, the board surface. Component and board markings are clear and legible. Component leads exhibit proper bend radii, and stress relief. Solder fillets are smooth and shiny, with concave profiles.



**PREFERRED
100% SOLDER FILL (PTH)**

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](#)



**PREFERRED
PWB COMPONENT SIDE FILLET (PTH)**

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

[NASA-STD-8739.3 \[13.6.1.f.2 \]](#)



**PREFERRED
SOLDER SIDE FILLETS (PTH / NPTH)**

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 \[13.6.1.f.1 \]](#)

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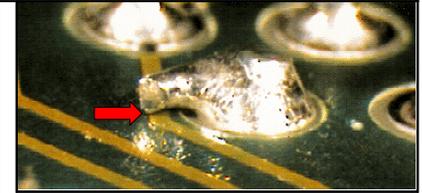
**THROUGH-HOLE SOLDERING
GENERAL REQUIREMENTS (cont.)**



**ACCEPTABLE
CLINCHED LEAD TERMINATION**

Conductor / lead ends may be clinched, with the clinched length at least 1/2 the largest solder pad dimension, bent in the direction of the longest pad dimension. Clinched leads shall not violate minimum electrical spacing requirements.

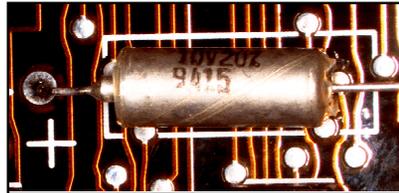
[NASA-STD-8739.3 \[8.5.2 \]](#)



**UNACCEPTABLE
IMPROPERLY CLINCHED LEAD**

Component leads shall not be clinched toward an electrically uncommon conductor.

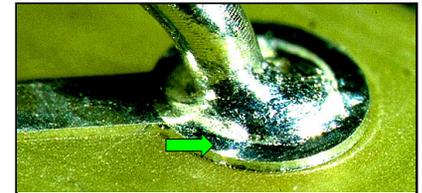
[NASA-STD-8739.3 \[13.6.2.a.20 \]](#)



**ACCEPTABLE
CONDUCTIVE CASE PARTS**

Parts having conductive cases, which are mounted over printed conductors or which are in close proximity to other conductive materials shall be separated by insulation of suitable thickness, or shall have an insulating jacket / sleeve.

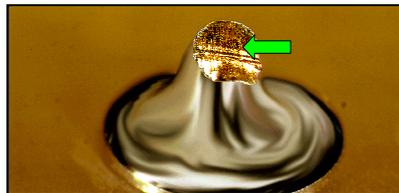
[NASA-STD-8739.3 \[8.1.2.b \]](#)



**ACCEPTABLE
DEWETTING**

Slight solder dewetting around the periphery of the component side termination pad shall not be cause for rejection, provided the termination exhibits flow-through and bonding of the lead / conductor to the termination pad.

[NASA-STD-8739.3 \[11.2.3.c \]](#)



**ACCEPTABLE
EXPOSED BASE METAL**

Exposed ends of leads on straight-through terminations shall not be cause for rejection if the PWA is to be conformally coated.

[NASA-STD-8739.3 \[13.6.1.k \]](#)



**UNACCEPTABLE
EXPOSED BASE METAL**

Defects or damage (cuts, nicks, gouges, scrapes, etc.) that result in exposed base metal (except for the vertical edges of circuit traces, lands, and pads) shall be rejectable.

[NASA-STD-8739.3 \[13.6.2.a.8 \], \[13.6.2.c.5 \]](#)

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

<p style="text-align: center;">ACCEPTABLE EXPOSED BASE METAL (SPECIAL EXCEPTION)</p> <p>Exposed base metal on the vertical edge of printed wiring conductors, lands, and pads is acceptable.</p> <p>NASA-STD-8739.3 [13.6.2.c.5]</p>	<p style="text-align: center;">ACCEPTABLE FILLER WIRE USE</p> <p>Interfacial connections in double-sided PWBs require the use of filler wire if the PWB coupon is not evaluated by construction analysis.</p> <p>NASA-STD-8739.3 [13.6.2.a.24]</p>

<p style="text-align: center;">ACCEPTABLE GLASS ENCASED PARTS</p> <p>Glass encased parts shall be covered with transparent / translucent resilient sleeving (or other approved material) when epoxy is used for staking, conformal coating, encapsulating, or where damage from other sources is likely.</p> <p>NASA-STD-8739.3 [8.1.4]</p>	<p style="text-align: center;">UNACCEPTABLE UNSLEEVED GLASS ENCASED PARTS</p> <p>Glass encased parts shall be covered with transparent / translucent resilient sleeving (or other approved material) when epoxy is used for staking, conformal coating, encapsulating, or where damage from other sources is likely.</p> <p>NASA-STD-8739.3 [8.1.4], [13.6.2.a.12]</p>

<p style="text-align: center;">ACCEPTABLE LEAD PROTRUSION LENGTH</p> <p>Leads terminated straight through the PWB shall extend 0.5 mm (0.020 in.) to 2.29mm (0.090 in.) beyond the pad surface. Leads may be bent up to 30° from the vertical plane to retain the part during soldering.</p> <p>NASA-STD-8739.3 [8.5.3]</p>	<p style="text-align: center;">UNACCEPTABLE INSUFFICIENT LEAD PROTRUSION</p> <p>Leads terminated straight through the PWB shall extend a minimum of 0.5 mm (0.020 in.) beyond the pad surface.</p> <p>NASA-STD-8739.3 [13.6.2.a.21]</p>

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

<p style="text-align: center;">PREFERRED HEAT PRODUCING PARTS</p> <p>Parts which dissipate heat in quantities of 1 Watt or greater, or in quantities sufficient to damage the laminate shall be mounted with sufficient standoff [$\geq 1.5\text{mm}$ (0.060 in.)] and shall be mechanically restrained.</p> <p>Best Workmanship Practice</p>	<p style="text-align: center;">PREFERRED HIGH-MASS COMPONENTS</p> <p>Components weighing in excess of 7g (0.25 oz.) total, or 3.5gm (0.12 oz.) per lead, shall be mechanically secured to the mounting surface by at least 4 evenly spaced bonds, when no other mechanical support is used.</p> <p>Best Workmanship Practice</p>

<p style="text-align: center;">PREFERRED WIRE / LEAD INSULATION GAP (MINIMUM)</p> <p>The insulation shall not be imbedded in the solder joint. The contour of the conductor shall not be obscured at the termination end of the insulation.</p> <p>NASA-STD-8739.3 [9.1.1]</p>	<p style="text-align: center;">PREFERRED WIRE / LEAD INSULATION GAP (MAXIMUM)</p> <p>The termination exhibits a gap of less than two (2) insulated wire diameters ($<2d$) between the end of the insulation and the first point of contact of the conductor to the termination / pad.</p> <p>NASA-STD-8739.3 [9.1.2]</p>

<p style="text-align: center;">ACCEPTABLE ADHESIVES</p> <p>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.</p> <p>Best Workmanship Practice</p>	<p style="text-align: center;">UNACCEPTABLE ADHESIVE INCLUSION</p> <p>Adhesive material in the solder joint shall be cause for rejection.</p> <p>NASA-STD-8739.3 [13.6.2.b.10]</p>

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

<p style="text-align: center;">ACCEPTABLE INTERFACIAL CONNECTIONS / VIAS (MULTILAYER PWBs)</p> <p>Interfacial connections (vias) in multilayer PWBs do not require the use of filler wire, and shall not be solder filled.</p> <p>NASA-STD-8739.3 [11.2.4.b]</p>	<p style="text-align: center;">ACCEPTABLE SOLDER-FILLED INTERFACIAL CONNECTIONS (PTH / VIAS)</p> <p>No dedicated effort shall be expended to remove solder from unpopulated plated through holes (PTH) and/or vias.</p> <p>NASA-STD-8739.3 [11.2.4]</p>

<p style="text-align: center;">ACCEPTABLE MEASLING</p> <p>Whitish, discrete spots or crosses below the laminate surface - usually induced by thermal shock / stress. Measling that bridges uncommon conductors is unacceptable.</p> <p>NASA-STD-8739.3 [13.6.1.1], [13.6.2.c.3]</p>	<p style="text-align: center;">UNACCEPTABLE MEASLING</p> <p>Measling that bridges uncommon conductors is unacceptable.</p> <p>NASA-STD-8739.3 [13.6.2.c.3]</p>

<p style="text-align: center;">ACCEPTABLE NON-UNIFORM / UNEVEN FLOW (DEMARICATION LINES / FILLET SWIRLS)</p> <p>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.</p> <p><i>Best Workmanship Practice</i></p>	<p style="text-align: center;">UNACCEPTABLE UNEVEN FLOW / REFLOW</p> <p>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.</p> <p><i>Best Workmanship Practice</i></p>

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

<p style="text-align: center;">ACCEPTABLE SOLDER IN STRESS RELIEF BEND</p> <p>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.</p> <p>NASA-STD-8739.3 [13.6.2.b.6]</p>	<p style="text-align: center;">UNACCEPTABLE SOLDER IN STRESS RELIEF BEND</p> <p>Solder extends into the stress relief bend and contacts the part body end seal. The topside of the lead is not discernable.</p> <p>NASA-STD-8739.3 [13.6.2.b.6]</p>

<p style="text-align: center;">ACCEPTABLE TEMPERED LEADS</p> <p>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.</p> <p>NASA-STD-8739.3 [8.1.6.e]</p>	<p style="text-align: center;">UNACCEPTABLE BENT TEMPERED LEADS</p> <p>Tempered / hardened leads (sometimes referred to as pins) shall not be bent or formed.</p> <p>NASA-STD-8739.3 [8.1.6.e]</p>

<p style="text-align: center;">UNACCEPTABLE BLOWHOLE</p> <p>Blowholes are typically caused by trapped gases or flux during the formation of the solder fillet, and are unacceptable.</p> <p>NASA-STD-8739.3 [13.6.2.b.5]</p>	<p style="text-align: center;">UNACCEPTABLE BRIDGING</p> <p>Bridging is an indicator of poor process controls (i.e.: excess solder, smeared paste, improper placement, incorrect heat).</p> <p>NASA-STD-8739.3 [13.6.2.c.4]</p>

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

<p style="text-align: center;">UNACCEPTABLE CHARRING</p> <p>Charring of components and/or laminate is an indicator of poor process control (i.e.: excessive heat).</p> <p>NASA-STD-8739.3 [13.6.2.a.7]</p>	<p style="text-align: center;">UNACCEPTABLE CHIP-OUTS (NICKS)</p> <p>The use of parts with chips in the component body, termination area, or meniscus, is prohibited.</p> <p>NASA-STD-8739.3 [13.6.2.a.7]</p>

<p style="text-align: center;">UNACCEPTABLE COLD SOLDER JOINT</p> <p>A cold solder joint is an indicator of incorrect process control (i.e.: inadequate heat).</p> <p>NASA-STD-8739.3 [13.6.2.b.1]</p>	<p style="text-align: center;">UNACCEPTABLE CONTAMINATION</p> <p>Contamination is a reliability concern.</p> <p>NASA-STD-8739.3 [13.6.2.b.10]</p>

<p style="text-align: center;">UNACCEPTABLE COPLANARITY</p> <p>Improper coplanarity of leaded parts will result in bridging, shorts, opens, and/or misalignment. Part leads shall be reworked (if allowed) prior to installation.</p> <p>NASA-STD-8739.3 [13.6.2.a.5]</p>	<p style="text-align: center;">UNACCEPTABLE CRACKS (COMPONENT)</p> <p>Cracks (especially in ceramic components) are an indicator of poor process control (i.e.: improper preheat, thermal / mechanical shock, etc.).</p> <p>NASA-STD-8739.3 [13.6.2.a.7]</p>

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

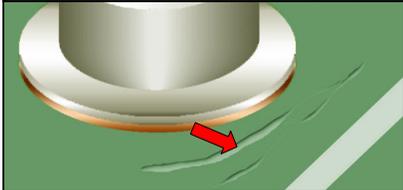
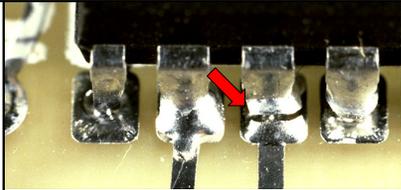
<p style="text-align: center;">ACCEPTABLE PART MARKINGS</p> <p>Parts shall be mounted in such a manner that, at a minimum, the markings are visible in the following order of precedence: polarity, traceability / lot code (if applicable), part value, part number / type.</p> <p>NASA-STD-8739.3 [8.1.3]</p>	<p style="text-align: center;">UNACCEPTABLE IDENTIFICATION MARKS MISSING</p> <p>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.</p> <p>NASA-STD-8739.3 [8.1.3]</p>

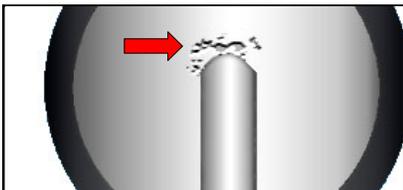
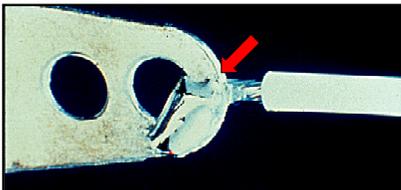
<p style="text-align: center;">ACCEPTABLE PITS</p> <p>A solder pit is acceptable, provided the bottom of the cavity can be seen from all angles of vision.</p> <p>Best Workmanship Practice</p>	<p style="text-align: center;">ACCEPTABLE SHRINK TUBING (TRANSLUCENT / TRANSPARENT)</p> <p>Shrink tubing installed over components and/or soldered terminations shall be transparent (or translucent) to allow visual inspection.</p> <p>NASA-STD-8739.3 [8.1.4]</p>

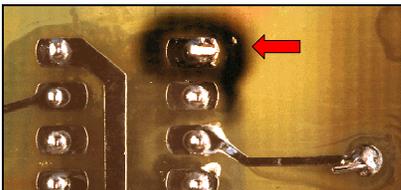
<p style="text-align: center;">ACCEPTABLE SMOOTH TOOL IMPRESSION MARKS</p> <p>Smooth tool impression marks (slight cuts, nicks, scratches or scrapes) on the conductor surface, which do not expose base metal or reduce cross-sectional area are acceptable.</p> <p>NASA-STD-8739.3 [8.1.6.d]</p>	<p style="text-align: center;">ACCEPTABLE SOLDER FILLET RECESS / SHRINKBACK</p> <p>A slight recessing or shrinkback of the solder into the PTH below the lead and pad exhibit wetting and the shrinkback is slight.</p> <p>NASA-STD-8739.3 [13.6.1.f.2]</p>

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

	
<p style="text-align: center;">UNACCEPTABLE CRACKS (LAMINATE)</p> <p>Cracks in the laminate are cause for rejection. Best Workmanship Practice</p>	<p style="text-align: center;">UNACCEPTABLE CRACKS (SOLDER FILLET)</p> <p>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]</p>

	
<p style="text-align: center;">UNACCEPTABLE DAMAGED PART SEAL</p> <p>Parts with damaged seals shall not be used. NASA-STD-8739.3 [13.6.2.a.7]</p>	<p style="text-align: center;">UNACCEPTABLE DEWETTING</p> <p>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]</p>

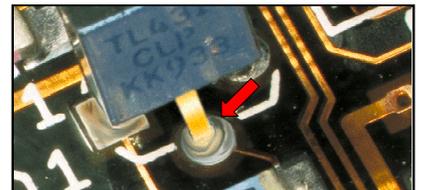
	
<p style="text-align: center;">UNACCEPTABLE DISCOLORED LAMINATE (BURNS)</p> <p>Burns that physically damage the laminate surface or the assembly are not allowed. Slight discoloration is allowable. NASA-STD-8739.3 [13.6.2.c.2]</p>	<p style="text-align: center;">UNACCEPTABLE DISCOLORED LAMINATE (OVERHEATING)</p> <p>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.c.3]</p>

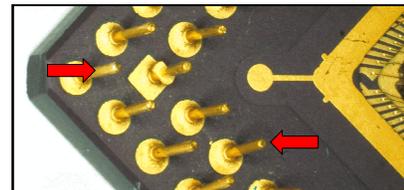
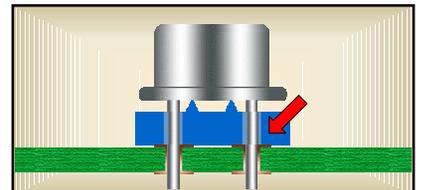
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**THROUGH-HOLE SOLDERING
GENERAL REQUIREMENTS (cont.)**

	
<p style="text-align: center;">UNACCEPTABLE FLUX RESIDUE</p> <p>Flux residue indicates improper / incomplete cleaning. NASA-STD-8739.3 [13.6.2.b.10]</p>	<p style="text-align: center;">UNACCEPTABLE FLUX SPLATTER</p> <p>Flux splatter is an indication of an improper process parameter (heat / moisture). NASA-STD-8739.3 [13.6.2.b.8]</p>

	
<p style="text-align: center;">UNACCEPTABLE FRACTURED SOLDER</p> <p>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]</p>	<p style="text-align: center;">UNACCEPTABLE GOLD INTERMETALLIC</p> <p>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</p>

	
<p style="text-align: center;">UNACCEPTABLE GOLD PLATING</p> <p>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]</p>	<p style="text-align: center;">UNACCEPTABLE HOLE OBSTRUCTION</p> <p>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]</p>

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**THROUGH-HOLE SOLDERING
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<p style="text-align: center;">UNACCEPTABLE IMPROPER LEAD BENDING</p> <p>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 (1 d) or ribbon thickness (1 t).</p> <p>NASA-STD-8739.3 [8.1.6.a]</p>	<p style="text-align: center;">UNACCEPTABLE IMPROPER LEAD CUTTING</p> <p>Leads shall be cut per engineering documentation and by methods, which do not impart stress to the lead seal or internal terminations.</p> <p>NASA-STD-8739.3 [8.1.6.a]</p>

<p style="text-align: center;">UNACCEPTABLE IMPROPER LEAD LENGTH</p> <p>The clinched lead extends beyond the pad edge in excess of allowed limits and is bent over an uncommon electrical conductor.</p> <p>NASA-STD-8739.3 [13.6.2.a.20]</p>	<p style="text-align: center;">UNACCEPTABLE IMPROPER ORIENTATION</p> <p>Parts shall be mounted parallel to the laminate surface, right side up, and aligned to the lands within design and engineering specifications.</p> <p>NASA-STD-8739.3 [13.6.2.a.5]</p>

<p style="text-align: center;">UNACCEPTABLE IMPROPER TINNING</p> <p>Tinned surfaces, which are to become part of the solder termination, shall exhibit 100% coverage.</p> <p>NASA-STD-8739.3 [7.2.6], [13.6.2.a.3]</p>	<p style="text-align: center;">UNACCEPTABLE INSUFFICIENT SOLDER</p> <p>Insufficient solder is an indicator of improper process control, and may result in reduced reliability.</p> <p>NASA-STD-8739.3 [13.6.2.b.7]</p>

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

<p style="text-align: center;">UNACCEPTABLE DISTURBED SOLDER</p> <p>A disturbed solder joint is characterized by the appearance that there was motion between the metals being joined while the molten solder was solidifying.</p> <p>NASA-STD-8739.3 [13.6.2.b.6]</p>	<p style="text-align: center;">UNACCEPTABLE EXCESS SOLDER</p> <p>The solder fillet shall exhibit a positive wetting angle and shall not contact the component body.</p> <p>NASA-STD-8739.3 [13.6.2.b.6]</p>

<p style="text-align: center;">UNACCEPTABLE EXCESS SOLDER / SOLDER FLOODING</p> <p>Excess solder / Solder flooding / is an indicator of improper / incorrect process controls, and is typically seen in wave soldering.</p> <p>NASA-STD-8739.3 [13.6.2.b.6]</p>	<p style="text-align: center;">UNACCEPTABLE EXCESSIVE LEAD PROTRUSION</p> <p>Leads terminated straight through the PWB shall extend a maximum of 2.29 mm (0.090 in.) beyond the pad surface. Leads may not violate minimum electrical spacing requirements.</p> <p>NASA-STD-8739.3 [13.6.2.a.21]</p>

<p style="text-align: center;">UNACCEPTABLE EXPOSED DIE / CIRCUIT ELEMENTS</p> <p>The unprotected exposure of die or circuit elements is not allowed unless specified in the engineering documentation.</p> <p>NASA-STD-8739.3 [13.6.2.a.7]</p>	<p style="text-align: center;">UNACCEPTABLE EYELETS</p> <p>Eyelets shall not be used for interfacial terminations.</p> <p>Best Workmanship Practice</p>

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

<p style="text-align: center;">UNACCEPTABLE INSUFFICIENT STRESS RELIEF / LEAD BEND</p> <p>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.</p> <p>NASA-STD-8739.3 [13.6.2.a.10]</p>	<p style="text-align: center;">UNACCEPTABLE MENISCUS CONTACT</p> <p>Parts exhibiting contact with, or embedment of, the meniscus and the solder joint, shall be rejected.</p> <p>NASA-STD-8739.3 [8.1.7], [13.6.2.b.13]</p>

<p style="text-align: center;">UNACCEPTABLE NICKS</p> <p>The use of parts with nicks in the component body or termination area is prohibited.</p> <p>NASA-STD-8739.3 [13.6.2.a.7]</p>	<p style="text-align: center;">UNACCEPTABLE NONWETTING</p> <p>Nonwetting results in the solder forming a ball or beading on the termination surface. The fillet is convex; no feathered edge is apparent.</p> <p>NASA-STD-8739.3 [13.6.2.b.12]</p>

<p style="text-align: center;">UNACCEPTABLE NO FLOW / REFLOW</p> <p>The lack of flow / reflow of solder is an indicator of poor process control or layout design (i.e.: inadequate heat, shadowing).</p> <p>NASA-STD-8739.3 [13.6.2.b.1]</p>	<p style="text-align: center;">UNACCEPTABLE NO SOLDER</p> <p>The lack of solder is an indicator of poor process control.</p> <p>NASA-STD-8739.3 [13.6.2.b.7]</p>

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

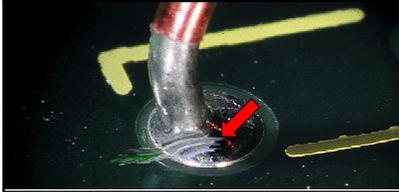
<p style="text-align: center;">UNACCEPTABLE PIGGYBACKED PARTS</p> <p>The piggybacking of parts not designed specifically for that configuration is prohibited.</p> <p>Best Workmanship Practice</p>	<p style="text-align: center;">UNACCEPTABLE PINHOLE</p> <p>Pinholes are typically small holes in the solder surface, leading to a void of indeterminate size within the solder termination.</p> <p>NASA-STD-8739.3 [13.6.2.b.5]</p>

<p style="text-align: center;">UNACCEPTABLE POOR WETTING</p> <p>Poor wetting is an indicator of poor solderability, improper flux, or contamination.</p> <p>NASA-STD-8739.3 [13.6.2.b.4]</p>	<p style="text-align: center;">UNACCEPTABLE POPCORNING</p> <p>Popcorning is caused by the release of entrapped moisture during the soldering process.</p> <p>Best Workmanship Practice</p>

<p style="text-align: center;">UNACCEPTABLE POROUS SOLDER</p> <p>Porous solder exhibits an uneven surface and a spongy appearance that may contain a concentration of small pinholes and voids.</p> <p>Best Workmanship Practice</p>	<p style="text-align: center;">UNACCEPTABLE ROSIN SOLDER JOINT</p> <p>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.</p> <p>NASA-STD-8739.3 [13.6.2.b.9]</p>

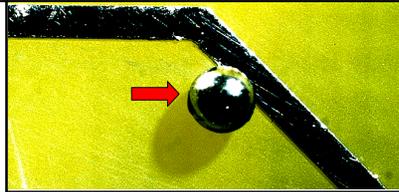
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**THROUGH-HOLE SOLDERING
GENERAL REQUIREMENTS (cont.)**



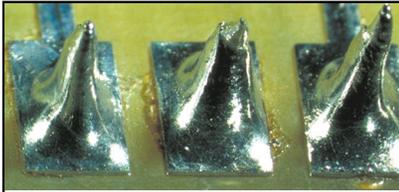
**UNACCEPTABLE
SCRATCHES (SOLDER FILLET)**

Scratches in the solder are prohibited.
[NASA-STD-8739.3 \[13.6.2.b.3 \]](#)



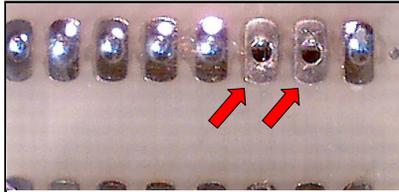
**UNACCEPTABLE
SOLDER BALLS**

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 \[13.6.2.b.10 \]](#)



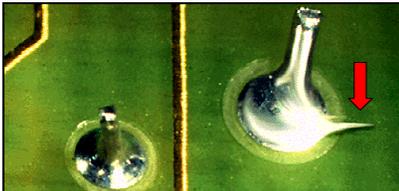
**UNACCEPTABLE
SOLDER PEAKS, ICICLES, SHARP EDGES**

Solder peaks, icicles, and/or sharp edges are an indicator of an improper process parameter and are a reliability and short-circuit concern.
[NASA-STD-8739.3 \[13.6.2.c.4 \]](#)



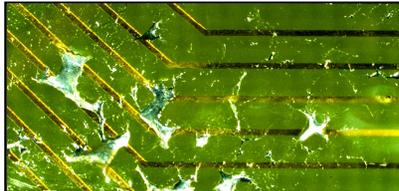
**UNACCEPTABLE
SOLDER SKIPS**

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 \[13.6.2.b.8 \]](#)

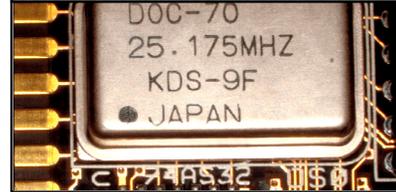
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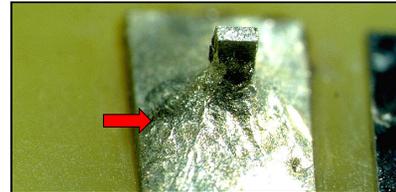
**UNACCEPTABLE
OBSCURED SOLDER TERMINATIONS**

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 \[13.6.2.a.23 \]](#)



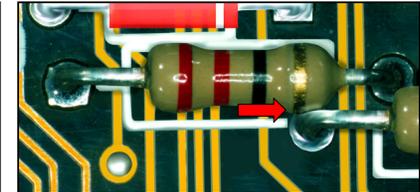
**UNACCEPTABLE
OPENS / VOIDS**

Cavities (opens / voids) reduce the circumferential wetting of lead and barrel, land coverage, and vertical solder fill below minimum acceptable requirements.
[NASA-STD-8739.3 \[13.6.2.b.5 \]](#)



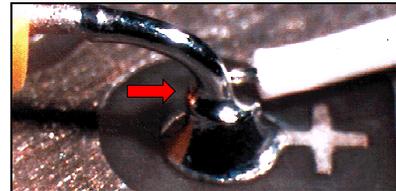
**UNACCEPTABLE
OVERHEATED SOLDER**

Overheated solder has a dull, gray, frosty, and/or crystallized appearance and is the result of excessive exposure to heat.
[NASA-STD-8739.3 \[13.6.2.b.2 \]](#)



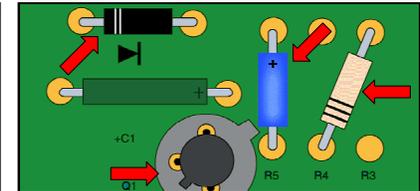
**UNACCEPTABLE
PART BODY CONTACT**

Part bodies shall not be in contact with soldered terminations. The spacing between components is below recommended values, resulting in contact between the resistor body and the lead, which may eventually result in a short circuit.
[NASA-STD-8739.3 \[8.1.7 \], \[13.6.2.b.13 \]](#)



**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 \[13.6.2.a.5 \]](#)

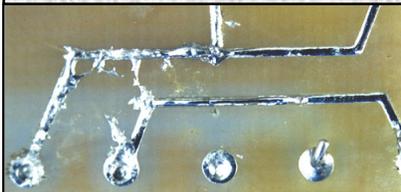
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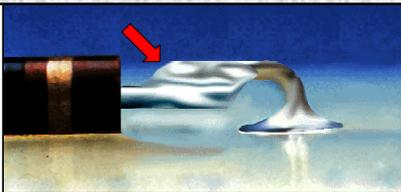
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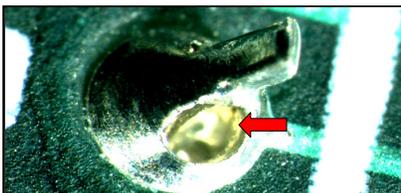
**UNACCEPTABLE
SOLDER WEBBING**

Webbing is an indication of improper process control.
[NASA-STD-8739.3 \[13.6.2.c.4 \]](#)



**UNACCEPTABLE
SPliced CONDUCTORS / LEADS**

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



**UNACCEPTABLE
VOIDS**

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



**UNACCEPTABLE
WHISKER**

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](#)

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