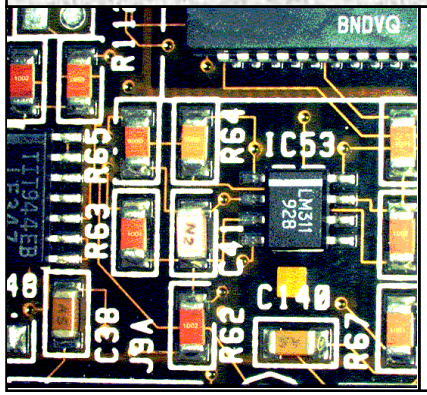
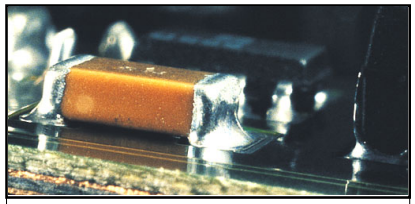


SURFACE MOUNT TECHNOLOGY (SMT)
GENERAL REQUIREMENTS

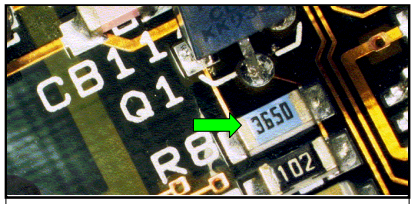
Surface mount technology (SMT) is used to mount electronic components on the metallized surface of printed wiring boards (PWB) or substrates. SMT makes it possible to mount components on one or both sides of the printed wiring assembly (PWA), producing more reliable electronic assemblies at greatly reduced weight, volume, and cost.



PREFERRED

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

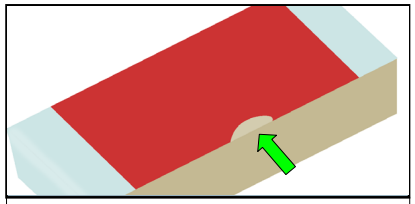
NASA-STD-8739.2 [12.8.1]



PREFERRED

Part markings are visible and oriented uniformly.

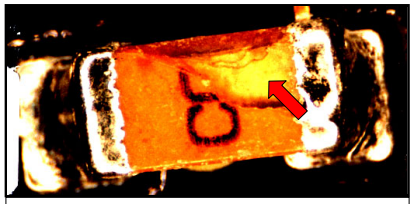
NASA-STD-8739.2 [8.7.4.a], [12.7.1.b], [12.8.1.f]



ACCEPTABLE
CHIP-OUTS (NICKS)

Chip-outs (nicks) of the top surface (adhesive coating), less than 0.25mm from the component edge are acceptable. Chips in the component body, element area, or termination area are unacceptable.

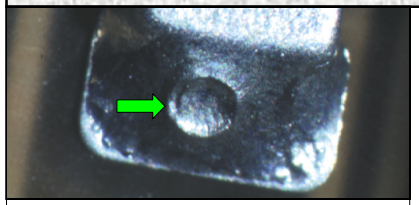
NASA-STD-8739.2 [8.7.4.b], [8.8.2]



UNACCEPTABLE
CHIP-OUTS (NICKS)

The use of chip-scale parts with chips in the component body or termination area, and any resistive elements with chip outs, is prohibited.

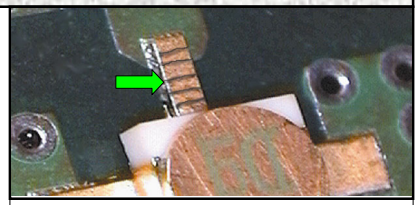
NASA-STD-8739.2 [12.8.2.a.3]



ACCEPTABLE
PITS

A solder pit is acceptable, provided the bottom of the cavity can be seen from all angles of vision.

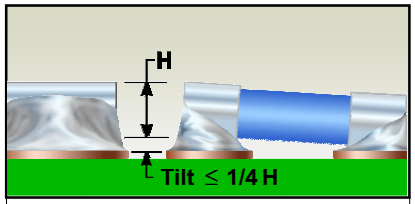
NASA-STD-8739.2 [3.1], [12.8.2.b.5]



ACCEPTABLE
SMOOTH TOOL IMPRESSION MARKS

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.

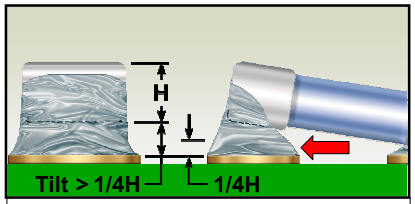
NASA-STD-8739.2 [12.8.2.a.4]



ACCEPTABLE
TILT

Part tilt shall not exceed 25% of component height (H) or diameter (i.e.: MELFs), and shall not interfere with the proper placement of adjacent parts.

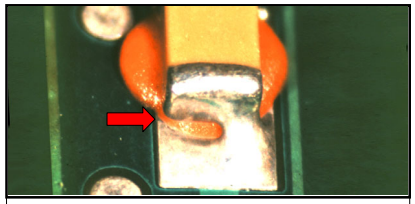
Best Workmanship Practice



UNACCEPTABLE
EXCESS TILT

Excessive tilting of a component may impact the long-term reliability and integrity of the solder termination, and may interfere with the proper placement and thermal profile of adjacent parts.

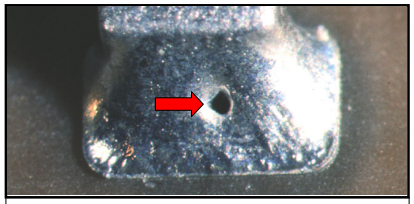
Best Workmanship Practice



UNACCEPTABLE
ADHESIVE INCLUSION

Adhesive material in the solder joint shall be cause for rejection.

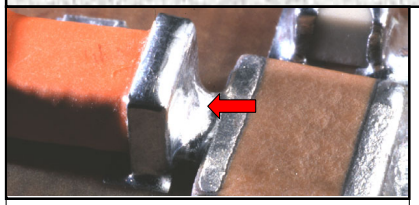
NASA-STD-8739.2 [8.10.3], [12.8.2.b.9]



UNACCEPTABLE
BLOWHOLE

Blowholes are typically caused by trapped gases or flux during the formation of the solder fillet, and are unacceptable.

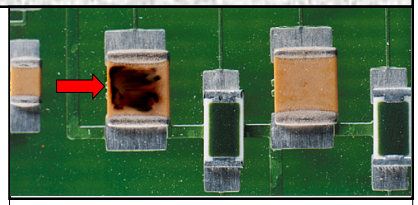
NASA-STD-8739.2 [12.8.2.b.5]



UNACCEPTABLE
BRIDGING

Bridging is an indicator of poor process controls (i.e.: excess solder, smeared paste, improper placement, incorrect heat).

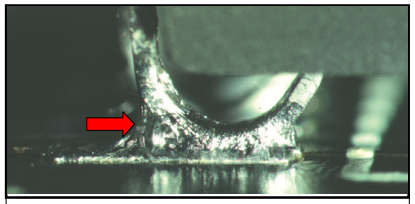
NASA-STD-8739.2 [12.8.2.c.4]



UNACCEPTABLE
CHARRING

Charring of components and/or laminate is an indicator of poor process control (i.e.: excessive heat).

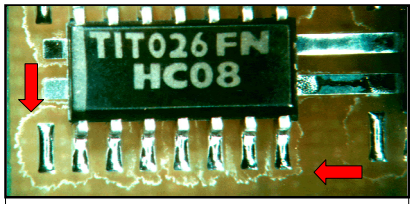
NASA-STD-8739.2 [12.8.2.a.3]



UNACCEPTABLE
COLD SOLDER JOINT

A cold solder joint is an indicator of incorrect process control (i.e.: inadequate heat).

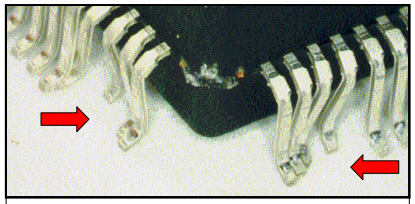
NASA-STD-8739.2 [12.8.2.b.1]



UNACCEPTABLE
CONTAMINATION

Contamination is a reliability concern. Residual flux and other contaminants can lead to corrosion and circuit failure.

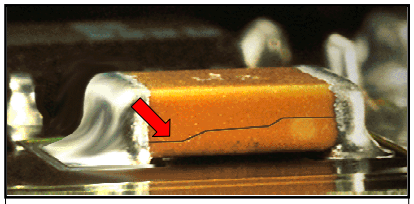
NASA-STD-8739.2 [12.8.2.b.9]



UNACCEPTABLE
COPLANARITY

Improper coplanarity of leaded parts will result in bridging, shorts, and misalignment. Parts shall be reworked prior to installation.

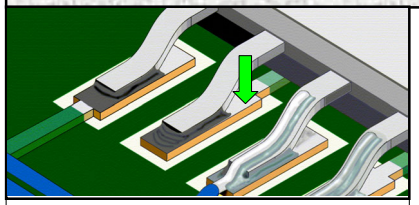
NASA-STD-8739.2 [7.1]



UNACCEPTABLE
CRACKS (COMPONENT)

Cracks (especially in ceramic components) are an indicator of poor process control (i.e.: improper preheat, thermal / mechanical shock, etc.).

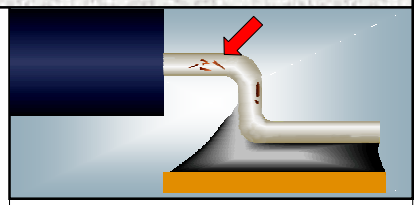
NASA-STD-8739.2 [12.8.2.a.3]



ACCEPTABLE
EXPOSED BASE METAL

Exposed base metal on the vertical edges of circuit traces, lands, and pads is acceptable.

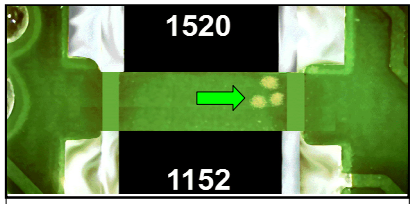
NASA-STD-8739.2 [12.8.2.c.5]



UNACCEPTABLE
EXPOSED BASE METAL

Exposed base metal is prohibited, except for the vertical edges of circuit traces, lands, and pads.

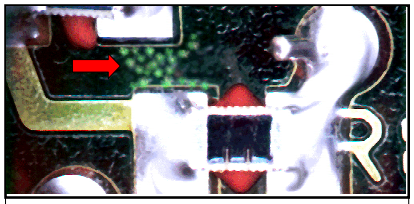
NASA-STD-8739.2 [12.8.2.c.5]



ACCEPTABLE
MEASLING

Whitish, discrete spots or crosses below the laminate surface - usually induced by thermal shock / stress. Measling that bridges uncommon conductors is unacceptable.

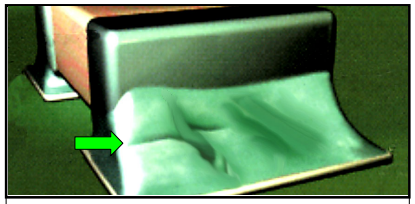
NASA-STD-8739.2 [12.8.2.c.3]



UNACCEPTABLE
MEASLING

Measling that bridges uncommon conductors is unacceptable.

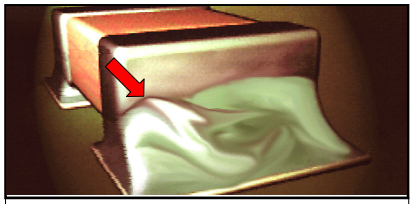
NASA-STD-8739.2 [12.8.2.c.3]



ACCEPTABLE
NONUNIFORM / UNEVEN FLOW / REFLOW

A solder filet exhibiting a nonuniform / uneven flow line is acceptable, provided there is evidence of good wetting.

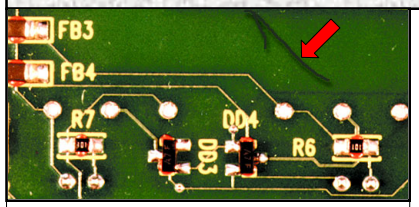
NASA-STD-8739.2 [12.8.1.g]



UNACCEPTABLE
NONUNIFORM / UNEVEN FLOW / REFLOW

The uneven flow / reflow of solder is typically caused by an inadequate / uneven application of heat. The condition is acceptable if good wetting is evident.

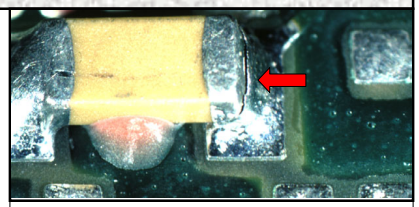
NASA-STD-8739.2 [12.8.1.g], [12.8.2.b.4]



UNACCEPTABLE
CRACKS (LAMINATE)

Cracks in the laminate are a reliability concern and are a cause for rejection.

Best Workmanship Practice



UNACCEPTABLE
CRACKS (SOLDER FILLET)

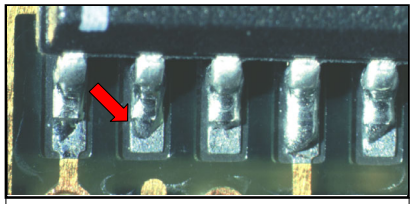
Cracks or fractures in the solder fillet are an indication of mechanical / thermal shock, or temperature coefficient mismatch.

NASA-STD-8739.2 [12.8.2.b.3]

UNACCEPTABLE
DAMAGED PART SEAL

Parts with damaged seals shall not be used.

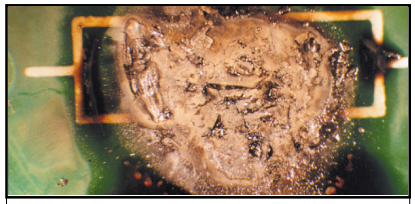
NASA-STD-8739.2 [12.7.2.b]



UNACCEPTABLE
DEWETTING

Dewetting is an indicator of poor process control (i.e.: excessive heat dwell following reflow).

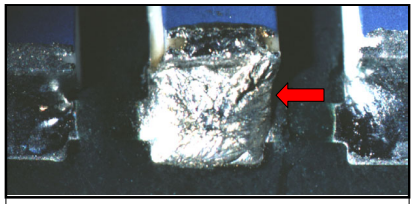
NASA-STD-8739.2 [12.8.2.b.10]



UNACCEPTABLE
DISCOLORED LAMINATE (BURNS)

Burns that physically damage the laminate surface or the assembly are not allowed. Slight discoloration is allowable.

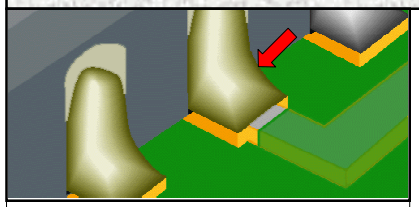
NASA-STD-8739.2 [12.8.2.c.2]



UNACCEPTABLE
DISTURBED SOLDER

A disturbed solder joint is an indicator of improper process control.

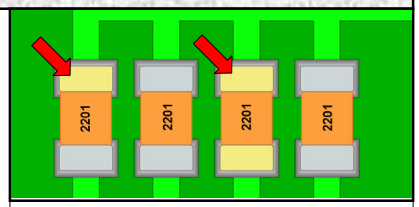
NASA-STD-8739.2 [12.8.2.b.3]



UNACCEPTABLE
GOLD INTERMETALLIC

Gold intermetallic can severely embrittle a solder joint.

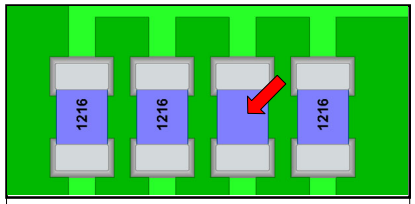
NASA-STD-8739.2 [12.8.2.b.22]



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.

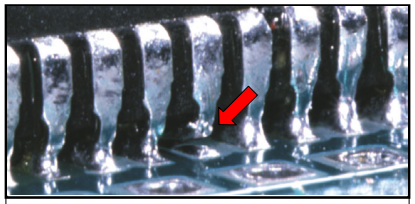
NASA-STD-8739.2 [7.2.1.b]



UNACCEPTABLE
IDENTIFICATION MARKS MISSING

Parts shall be mounted with the identification markings visible.

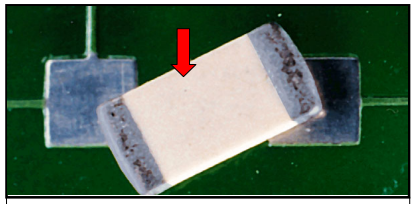
NASA-STD-8739.2 [8.7.4.a], [12.6.3.1]



UNACCEPTABLE
IMPROPER LEAD SPACING

Leads shall not exhibit spacing separation in excess of 0.26mm (0.010 inch) above the solder land.

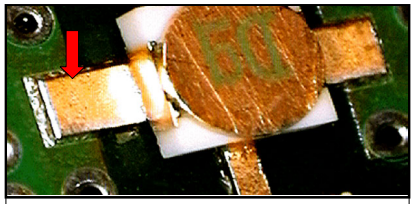
NASA-STD-8739.2 [12.8.2.a.10]



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.

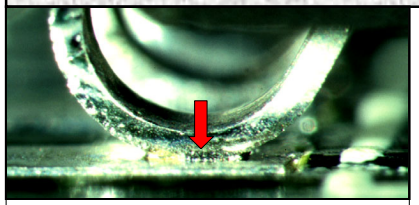
NASA-STD-8739.2 [8.7.4], [12.7.1.b]



UNACCEPTABLE
IMPROPER TINNING

Tinned surfaces shall exhibit at least 95% coverage.

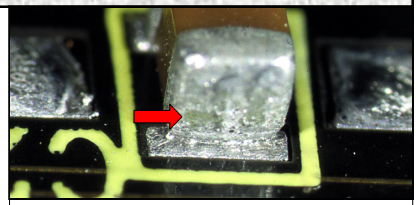
NASA-STD-8739.2 [7.2], [12.8.2.a.1]



UNACCEPTABLE
INSUFFICIENT SOLDER

Insufficient solder is an indicator of improper process control, and may result in reduced reliability. In this example, there is no side or heel fillet.

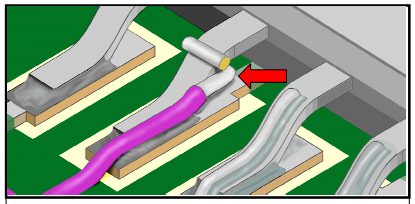
NASA-STD-8739.2 [12.8.2.b.6]



UNACCEPTABLE
LEACHING

Parts exhibiting leaching or loss of metallization in the termination area shall be rejected.

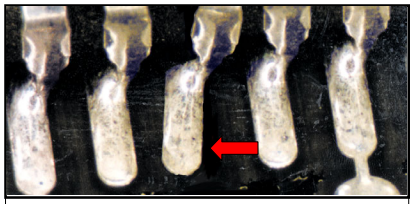
NASA-STD-8739.2 [12.9.1.b.6]



UNACCEPTABLE
LEADS USED AS TERMINALS

Part leads shall not be used as terminals, except when the part lead is used as a terminal.

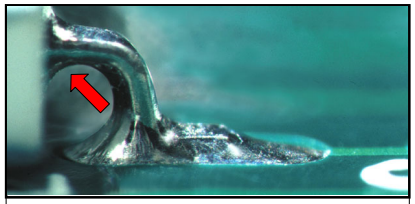
NASA-STD-8739.2 [12.8.2.a.9]



UNACCEPTABLE
LIFTED PAD / TRACE

Termination pads or traces exhibiting separation from the substrate shall be cause for rejection.

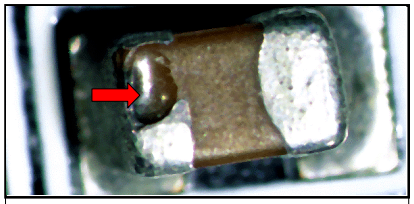
NASA-STD-8739.2 [12.8.2.c.1], [12.8.2.c.9]



UNACCEPTABLE
MENISCUS CONTACT

Parts exhibiting contact with, or embedment of, the meniscus and the solder joint, shall be rejected.

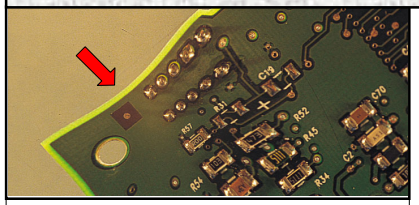
NASA-STD-8739.2 [12.8.2.b.12]



UNACCEPTABLE
NICKS

The use of parts with nicks in the component body or termination area is prohibited.

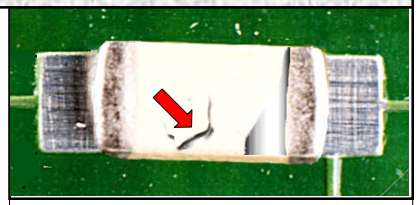
NASA-STD-8739.2 [12.6.3.2], [12.8.2.a.3]



UNACCEPTABLE
EXCESSIVE BOW / TWIST (PWB)

Excessive bow or twist may inhibit proper mounting and may result in mechanical interference or shorting to adjacent assemblies or chassis.

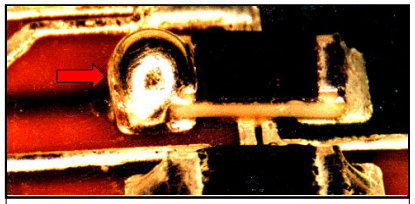
Best Workmanship Practice



UNACCEPTABLE
EXPOSED DIE / CIRCUIT ELEMENTS

The unprotected exposure of die or circuit elements is not allowed unless specified in the engineering documentation.

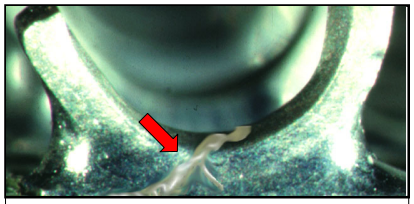
NASA-STD-8739.2 [8.8.2]



UNACCEPTABLE
EXCESS SOLDER

The solder fillet shall exhibit a positive wetting angle and shall not contact the component body.

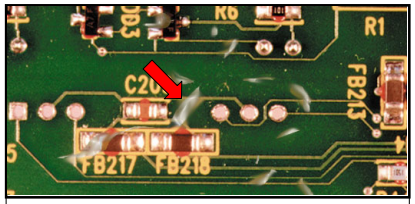
NASA-STD-8739.2 [12.8.2.b.12]



UNACCEPTABLE
FLUX RESIDUE

Flux residue indicates improper / incomplete cleaning.

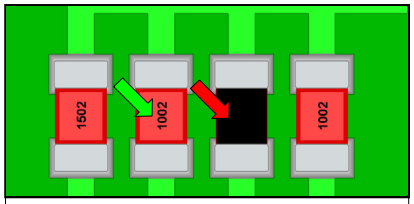
NASA-STD-8739.2 [12.8.2.a.5]



UNACCEPTABLE
FLUX SPLATTER

Flux splatter is an indication of an improper process parameter (heat / moisture).

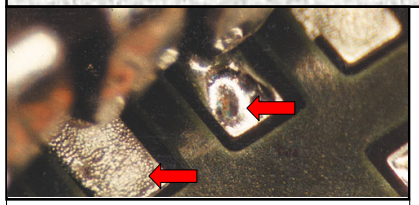
NASA-STD-8739.2 [12.8.2.b.7]



UNACCEPTABLE
GLASS SIDE DOWN

Thick film components shall be mounted with the protective glass film side in the up position.

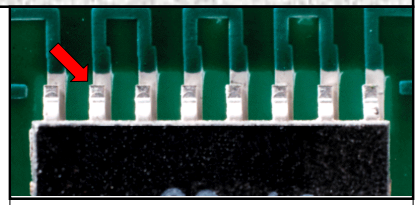
NASA-STD-8739.2 [8.8.3], [12.7.1]



UNACCEPTABLE
NO FLOW / REFLOW

The lack of proper flow / reflow of solder paste / preforms is an indicator of poor process control or layout design (i.e.: inadequate heat, shadowing).

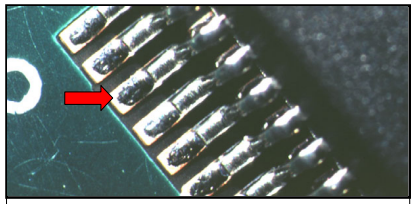
NASA-STD-8739.2 [12.8.1]



UNACCEPTABLE
NO SOLDER

The lack of solder is an indicator of poor process control.

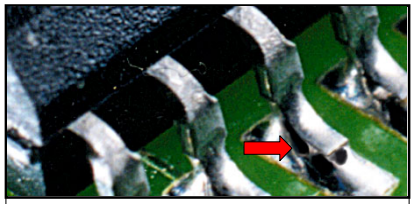
NASA-STD-8739.2 [12.6.1.a.4], [12.8.2.b.6]



UNACCEPTABLE
NONWETTING

Nonwetting is an indicator of poor solderability or contamination.

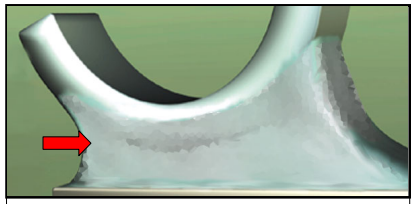
NASA-STD-8739.2 [12.8.2.b.11]



UNACCEPTABLE
OPENS / VOIDS

Opens / voids are an indicator of insufficient solder, solder wicking, and/or coplanarity problems.

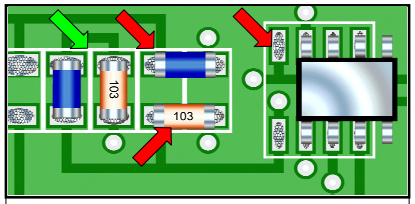
NASA-STD-8739.2 [12.8.2.b.5], [12.8.2.b.6]



UNACCEPTABLE
OVERHEATED SOLDER

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

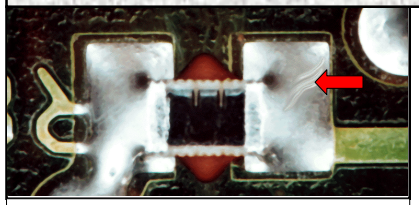
NASA-STD-8739.2 [12.8.2.b.2]



UNACCEPTABLE
PART MISALIGNMENT

Part misalignment is an indicator of improper process control.

NASA-STD-8739.2 [8.7.4], [12.8.2.a.2]



UNACCEPTABLE
SCRATCHES (SOLDER FILLET)

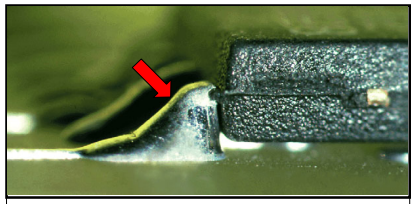
Scratches in the solder are prohibited.

NASA-STD-8739.2 [12.8.2.b.14]

UNACCEPTABLE
SOLDER BALLS / SOLDER FINES

Solder balls or fines are an indication of improper process control (inadequate preheat), and/or the use of outdated solder / flux.

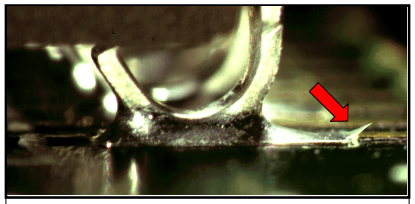
NASA-STD-8739.2 [12.8.2.b.19]



UNACCEPTABLE
SOLDER IN STRESS RELIEF BEND

Solder shall not extend into the stress relief bend of any leaded part. In this example, the solder is also in contact with the part body and the body seal.

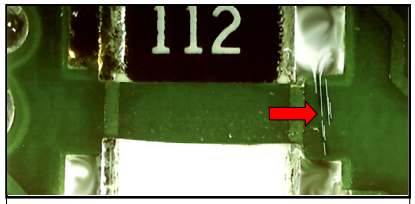
NASA-STD-8739.2 [12.8.2.b.16]



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.

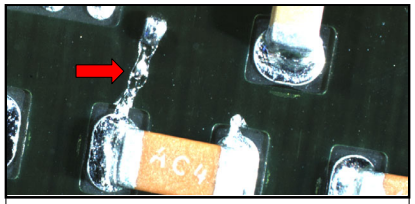
NASA-STD-8739.2 [12.8.2.c.4]



UNACCEPTABLE
SOLDER SLIVERS

Solder slivers are an indication of improper process control, and are a reliability and short-circuit concern.

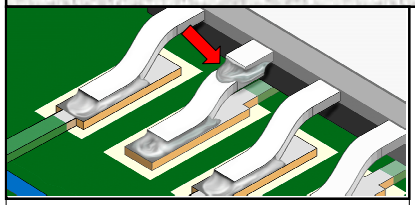
NASA-STD-8739.2 [12.8.2.b.20]



UNACCEPTABLE
SOLDER WEBBING

Webbing is an indication of improper process control, and is a reliability and short-circuit concern.

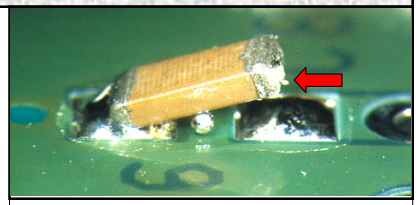
NASA-STD-8739.2 [12.8.2.b.18]



UNACCEPTABLE
SPLICED LEADS

Parts having spliced leads shall be rejected.

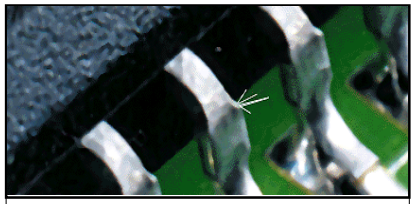
NASA-STD-8739.2 [12.8.2.a.8]



UNACCEPTABLE
TOMBSTONING

Tombstoning is an indicator of poor process control, primarily inadequate solder paste, or inadequate / uneven application of heat.

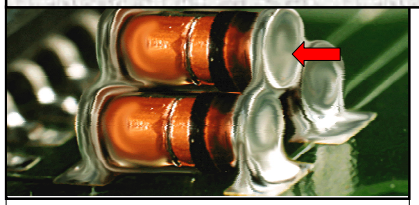
NASA-STD-8739.2 [12.8.2.a.2], [12.9.1.b.1]



UNACCEPTABLE
WHISKER

A whisker is a slender needle-shaped metallic growth, and is typically the result of mechanical stresses in high tin-alloy plating on component leads. Whiskers are mechanically stronger than dendrites, and are a “dead-short” reliability risk.

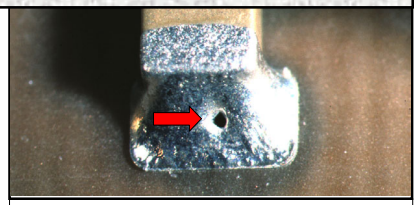
NASA-STD-8739.2 [12.8.2.b.21]



UNACCEPTABLE
PIGGYBACKED PARTS

Piggybacking, or stacking, of parts not designed specifically for that configuration is prohibited.

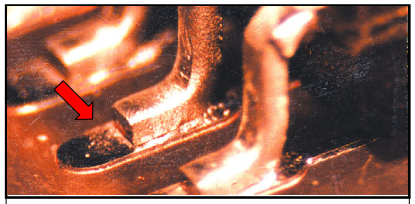
NASA-STD-8739.2 [8.7.4.e], [12.6.2.a.1]



UNACCEPTABLE
PINHOLE

Pinholes are typically small holes in the solder surface, leading to a void of indeterminate size within the solder termination.

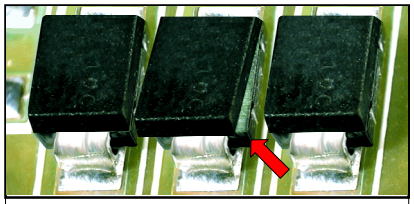
NASA-STD-8739.2 [12.8.2.b.5]



UNACCEPTABLE
POOR WETTING

Poor wetting is an indicator of poor solderability, improper flux, or contamination.

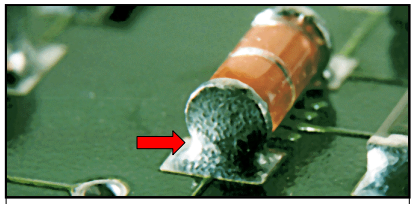
NASA-STD-8739.2 [12.8.2.b.4]



UNACCEPTABLE
POPCORNING

Popcorning is caused by the release of pressure entrapped in the component body during the soldering process. The effect can be relatively minor (body distortion), or destructive (seal breach or delidding).

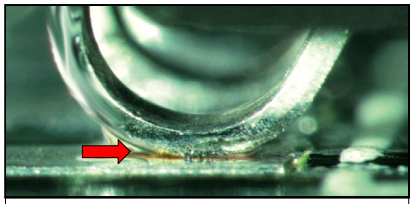
NASA-STD-8739.2 [12.7.2.b], [12.8.2.a.3]



UNACCEPTABLE
POROUS SOLDER

Porous solder is an indication of improper process control (i.e.: excessive flux, inadequate dwell time).

NASA-STD-8739.2 [12.8.2.b.17]



UNACCEPTABLE
ROSIN SOLDER JOINT

A rosin solder joint is an indication of improper process control (i.e.: excessive flux, inadequate dwell time).

NASA-STD-8739.2 [12.8.2.b.8]