This document provides guidance for manufacturers and quality assurance personnel who are interested in updating manufacturing procedures and documentation previously baselined to NASA-STD-8739.2 and NASA-STD-8739.3, in order to be current with and traceable to J-STD-001ES.

Comments and improvements are welcomed and will be added with an accompanying revision letter.

NASA Workmanship Standards Program
March 26, 2013, Revision -
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Process type requirement changes

Type	New Requirement	Requires "User" Approval Prior to Mfrg	Notes
Solder	Pb-free control plan required when Pb-free is used.	✓	
Lead Plating	A red plague control plan is required when silver-plated wire is used	✓	
Materials, general	Non-standard assemblies and materials do not require user approval.		Generic language requires all materials and processes to meet all other J-STD-001 requirements
Processes, general	Process changes shall be validated. The validation methods shall be documented.	✓	Bare boards included in this requirement
Cleaning	Aqueous cleaning methods are not prohibited		
Solder	Sn62Pb36Ag2 included in list of solders considered to be "pre-approved" [in addition to SN60 and SN63 baseline]		
Solder	Use of solders not listed as "pre-approved" is acceptable if all other requirements in J-STD-001 are met.	✓	
Flux	Use of flux not listed as "pre-approved" is acceptable shall be demonstrated through test to be compatible with parts and processes.	✓	

Type	New Requirement	Requires "User" Approval Prior to Mfrg	Notes
Flux	ORMx or ORHx flux is "pre-approved" for tinning leads or solid wire with "bonded" insulation (i.e. extruded, or varnish as is used for magnet wire)		
Solder	Solder paste slump and oxidation testing is not required.		
Process assurance	Chemical strippers are now "pre-approved"		
Part Prep	Moisture sensitive parts shall be shall be handled in "a manner consistent with" IPC/JEDEC J-STD-033 or equivalent		This concerns plastic encapsulated microcircuits (PEMs)
Thermal Shock Protection	Ceramic capacitors and stacked ceramic capacitors shall be considered heat-sensitive		
Thermal Shock Protection	If a heat sink can not be implemented or is insufficient for protecting heat-sensitive parts or assemblies during soldering, preheating shall be used.		
Thermal Shock Protection	For heat-sensitive parts heat up and cool down rates shall be controlled within the Manufacturers' recommendations.		

Type	New Requirement	Requires "User" Approval Prior to Mfrg	Notes
Package standoff	Parts shall be mounted with sufficient clearances between the body and the PCB to assure adequate cleaning and cleanliness testing.		LCC's no longer held to a quantitative stand-off height
Cleaning	Duration between soldering and cleaning is not specified.		
Process	At least one component lead shall have stress relief.		NASA looking at improving this wording because it is misplaced thus miscommunicates.
Process	If controlled cooling is used, the process shall be documented.		
Cleaning	Cleaning and cleanliness measurement is not required for bare printed circuit boards prior to soldering.		
Process	Duration between de-moisturization and soldering and cleaning is not specified.		
Soldered surfaces	Exposed base metal allowed unless material is Fe-based (e.g. Kovar) or solder joint formation is affected. Exposed OSP shall not prevent solder joint formation.		
Stranded wire	Birdcaging is allowed if it is limited to a dimension equal to one strand diameter.		

Type	New Requirement	Requires "User" Approval Prior to Mfrg	Notes
Tinning stranded wire	Solder used for tinning stranded wire shall be the same material used to form the solder joint with that wire.		
Tinning stranded wire	Tinning and solder wicking shall not extend into the region of the stranded wire that is to remain flexible.		
Tinning stranded wire	Wire strands shall be discernable after tinning		
Tinning stranded wire	Solder build up from the tinning process shall not inhibit subsequent assembly steps.		
Tinning stranded wire	The length of untinned strands from the end of the wire insulation shall not exceed 1 wire diameter		NASA standard used a 0.5 mm (0.020 inch) dimension.
Lead forming	The lead forming process shall not damage lead seals, welds, or connections internal to components.		
Lead forming	Leads shall not be re-formed except for minor adjustments to bend angles.		
Lead forming	Lead bending shall start no closer than 1 lead diameter or a minimum of 0.8 mm (0.031 in) to the package or lead-to-package weld.		NASA standard specified 2 lead diameters for round leads and no less than 0.5 mm (0.020 in) for ribbon leads

Type	New Requirement	Requires "User" Approval Prior to Mfrg	Notes
Lead forming, clinched end	The orientation of the clinched end of a clinched conductor is not controlled other than avoiding exceeding minimum electrical clearance.		
Lead protrusion in through hole	Minimum protrusion is no longer a dimensioned length but instead must be "discernable"		
Through hole solder fill	The vertical fill shall be a minimum of 75%. The unfilled portion (25% maximum) is a combination of unfilled heights on the solder application and solder destination sides. Unfilled portions do not include voids, blowholes, or pinholes.		This requirement does not intend that x-ray inspection methods are used to evaluate conditions internal to the solder fill, though they may be used to overcome line-of-sight obstructions of the solder joint's external surface.
Lead-pad overlap	Minimum defined as 2 lead widths or diameters. Maximum not defined as long as the length does not exceed the pad length.		NASA-STD used 3.5 widths
Fillet height, square chip package	Minimum fillet height on chip packages is the solder thickness under the package plus 25% of the height of the end termination or the solder thickness plus 0.5mm (0.02in) whichever is less.		

Type	New Requirement	Requires "User" Approval Prior to Mfrg	Notes
Fillet height, round chip packages (MELF)	Minimum fillet height on chip packages is the solder thickness under the package plus 25% of the height of the end termination or the solder thickness plus 1 mm (0.0394 in) whichever is less.		
Fillet height, round chip packages (MELF)	If via-in-pad is used the prescribed fillet height may be replaced by criteria agreed to between the manufacturer and the user.	✓	
Use of LCC packages	If parts with castellated terminations are chosen by design, their use shall be approved by the User.	✓	
LCC solder joints	Maximum side pad overhang: 25% No stand-off height (solder thickness) is defined though wetting shall be evident.		
Gull wing lead solder joint	Solder may extend into the top lead bend area. Solder may come in contact with the package body or end seal for plastic SOIC or SOT packages.		
SMT Area Array Packages (BGA, CGA, LGA)	Ball grid array, column grid array, and land grid array package types are now standard (preapproved) and have inspection criteria defined for them.		

Type	New Requirement	Requires "User" Approval Prior to Mfrg	Notes
Inspection of Area Array solder joints	X-ray inspection is required.		
Thermal plane connections	Criteria shall be defined in accordance with the design and agreed to between the manufacturer and the user.	✓	
Bottom terminated (no leads)	This package type is pre-approved. Solder joint geometry and quality criteria are defined.		
Lead Coplanarity	Coplanarity screening of each package is not a requirement.		
Ultrasonic cleaning	Ultrasonic cleaning is allowed if evidence is provided demonstrating that it is non-damaging.	✓	
Solder balls	Allowed if method, proven by evidence of effectiveness and approved by user, is used to secure each solder ball	✓	
Exposed glass fibers on PCB	Exposed glass fibers are allowed only on the board perimeter and around the diameter of unsupported holes a distance of 0.6 mm (0.0236 in) maximum.		
Reduction in pad	Widths of PCB traces and widths and lengths of PCB solder pads shall not be reduced from their intended dimensions more than 20%.		

Back Up – Requirements Comparison with Paragraph Numbers

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
1.	Lead Free Control	0.1.6 Use of Lead-Free Tin The use of components, assemblies, packaging technology, mechanical hardware, and materials meeting any of the following conditions shall be prohibited unless documented and controlled through a User approved Lead Free Control Plan (LFCP) incorporating either a replating or hot solder dip (HSD) process that completely replaces the lead-free tin finish, or a minimum of two mitigation measures.	Not addressed by NASA standards	J-STD-001ES defines requirements for Lead Free Control Plan
2.	Red Plague	0.1.7.1 Red Plague Control Plan – Minimum Requirements The use of silver-coated copper conductors shall require the implementation of a User-approved Red Plague Control Plan (RPCP) to reduce and control exposure to environmental conditions and contamination that promote the development of cuprous/cupric oxide corrosion (Red Plague) and latent damage. The minimum requirements are as outlined below:	Not addressed by NASA standards	J-STD-001ES defines requirements for Red Plague Control Plan
3.	**Materials**	**3.1 Materials** The materials and processes used to assemble/manufacture electronic assemblies shall be selected such that their use, in combination, produce products acceptable to this standard. When major elements of the proven processes are changed (e.g., flux, solder paste, cleaning media or system, solder alloy or soldering system), validation of the acceptability of the change(s) shall be performed and documented in accordance with approved tests agreed upon between the Manufacturer and User. The change shall be approved by the User prior to use. Major elements may also pertain to a change in bare boards (including supplier), solder resist, or metallization.	4.1.3 Nonstandard Processes, Materials, or Parts. When the supplier intends to use processes, materials, or parts not covered by this publication, the supplier shall document the details of fabrication and inspection, including acceptance and rejection criteria, and shall provide appropriate test data. Such documentation shall be approved by the procuring NASA Center prior to use (Requirement).	J-STD-001ES is not as prescriptive as the NASA standards in that it does not define all materials and processes to be used in the manufacturing process, only that their use in combination produce products acceptable to the standard. (Example: Aqueous Cleaning is allowed by J-STD-001ES provided the assembly meets the visual and ionic cleanliness requirements). J-STD-001ES specifies when major elements of the proven processes are changed (e.g., flux, solder paste, cleaning media or system, solder alloy or soldering system), validation of the acceptability of the change(s) shall be performed and documented in accordance with approved tests agreed upon between the Manufacturer and User. The change shall be approved by the User prior to use. Major elements may also pertain to a change in bare boards (including supplier), solder resist, or metallization

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
4.	**Solder**	**3.2 Solder** Solder alloys **shall** be Sn60Pb40, Sn62Pb36Ag2, Sn63Pb37, or Sn96.3Ag3.7 in accordance with J-STD-006 or an equivalent controlled specification. Other solder alloys that provide the service life, performance, and reliability required of the product may be used if all other conditions of this standard are met and objective evidence of such is reviewed and approved by the User prior to use. High temperature solder alloys, e.g., Sn96.3Ag3.7, **shall** only be used where specifically indicated by approved drawings. Flux that is part of flux cored solder wire or solder paste **shall** meet the requirements of 3.3. Flux percentage is optional.	6.11.1 Types and Usage. All solder used for tinning and solder connections shall conform to ANSI/J-STD-006 (Requirement). Flux-cored solder shall be either composition SN60 or SN63 containing flux types R or RMA, or equivalent (Requirement). For all soldering applications where adequate subsequent cleaning is not practical, only solder containing flux type R shall be used (Requirement). Solid solders (no flux) for use in solder pots shall be of the same composition (Requirement). 6.12.2 Solder paste shall be Sn63/Pb37, Sn60/Pb40, or Sn62/Pb36/Ag2 composition (Requirement). Solder paste shall be compatible with base metal and shall meet the following requirements:	J-STD-001ES allows the use of Sn96.3Ag3.7 and different types of solder other than SN60 and SN63 if reviewed and approved by User prior to use. J-STD-001ES specifies solder alloys **shall** be Sn60Pb40, Sn62Pb36Ag2, Sn63Pb37, or Sn96.3Ag3.7 in accordance with J-STD-006 or an equivalent controlled specification. Other solder alloys that provide the service life, performance, and reliability required of the product may be used if all other conditions of this standard are met and objective evidence of such is reviewed and approved by the User prior to use.
5.	**FLUX**	**3.3 Flux** Flux **shall** be in accordance with J-STD-004 or an equivalent controlled specification. Flux **shall** conform to flux activity levels L0 or L1 of flux materials rosin (RO) or resin (RE). Use of any other flux **shall** be approved by the User prior to use. When other activity levels or flux materials are used, data demonstrating material and process compatibility through testing agreed upon between the Manufacturer and User **shall** be provided. Type H or M fluxes may be used for tinning of solid wires with insulation bonded to the wire, e.g., magnet wire. For all fluxing applications where adequate cleaning is not practical, only flux types RO or RE of the L0 flux activity level, or equivalent, **shall** be used.	6.12.2 Rosin Flux. Flux types R, RMA, or equivalent shall be used (Requirement). For all fluxing applications where adequate subsequent cleaning is not practical, only type R, or equivalent, flux shall be used (Requirement). Liquid flux used with flux-cored solder shall be chemically compatible with the solder core flux and with the materials with which it will come in contact. 6.12.3 Variations. The use of any other flux compositions and forms (including type RA flux) shall require the approval of the procuring NASA Center prior to use (Requirement). The request for approval shall include detailed flux removal, cleaning processes, monitoring requirements, and cleanliness test methods.	J-STD-001ES uses the J-STD-004 classification of fluxes. Flux Classification changes from RMA and R to: Flux **shall** conform to flux activity levels L0 or L1 of flux materials rosin (RO) or resin (RE). Use of any other flux **shall** be approved by the User prior to use. When other activity levels or flux materials are used, data demonstrating material and process compatibility through testing agreed upon between the Manufacturer and User **shall** be provided. J-STD allows for Type H or M fluxes to be used for tinning of solid wires with insulation bonded to the wire, e.g., magnet wire.

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
6.	**Solder Paste**	**3.4 Solder Paste** Solder paste **shall** be in accordance with J-STD-005 or equivalent. Solder paste **shall** also meet the requirements of 3.2 and 3.3.	**7.3 Solder Paste Testing** 7.3.1 Oxidation/cohesion (solder ball) 7.3.2 Slump (spread)	Solder paste testing not required by J-STD-001
7.	**Chemical Strippers**	**3.7 Chemical Strippers** Chemical solutions, pastes, and creams **shall not [D1D2D3]** cause damage or degradation	6.6.2 Insulation stripping tools suitable for use include: c. Chemical Strippers. Chemical solutions, pastes, and creams used to strip wires shall be suitable for removal of the insulation to be stripped and shall not cause degradation to the wire (Requirement). In addition, wires must be neutralized and cleaned of contaminants in accordance with manufacturer's recommended instructions. Chemical stripping materials and methods require pre-approval from the procuring NASA center.	The use of chemical strippers does not require customer pre-approval before use
8.	**Moisture or Process Sensitive Components**	**3.8 Components** Moisture or process sensitive components (as classified by IPC/JEDEC J-STD-020, ECA/IPC/JEDEC J-STD-075 or other documented classification procedure) shall [D1D2D3] be handled in a manner consistent with IPC/JEDEC J-STD-033 or other documented procedure.	Moisture or process sensitive components not addressed by NASA standards.	J-STD-001 specifies special handling for Moisture or Process sensitive components
9.	**Thermal Protection**	4.6 **Thermal Protection** When hand soldering, tinning or reworking a component identified as heat sensitive, protective measures **shall** be taken to minimize component heating or prevent thermal shock, e.g., heat sink, thermal shunt, preheat. If it is not possible to implement an effective heat sink, the component **shall** be preheated. Multilayer Ceramic Chip Capacitors (MLCCs) and "stacked" capacitors containing these parts **shall** be handled as thermal shock sensitive. Heat up and cool down rates **shall** be controlled within the Manufacturers' recommendations. **Note:** Hand soldering with solder irons and tinning operations are particularly at risk. Consult your component manufacturer for heat sensitivity levels, and or hand soldering and pretinning recommendations or guidelines. See 0.1.5 at the beginning of this Addendum for additional requirements on retinning of components.	11.1.2 Thermal Shunts. Thermal shunts shall be used when heat applied during the soldering operation may degrade conductors, insulation, parts, or previously soldered connections (Requirement).	J-STD-001 adds additional protection for thermal requirements. If it is not possible to implement an effective heat sink, the component **shall** be preheated. Multilayer Ceramic Chip Capacitors (MLCCs) and "stacked" capacitors containing these parts **shall** be handled as thermal shock sensitive. Adds Note**:** Hand soldering with solder irons and tinning operations are particularly at risk

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
10.	**LLCC Part Mounting**	4.9 **General Part Mounting Requirements** When design restrictions mandate mounting components incapable of withstanding soldering temperatures incident to a particular process, such components **shall** be mounted and soldered to the assembly using a process compatible with the part to be soldered. Parts **shall** be mounted with sufficient clearances between the body and the PCB to assure adequate cleaning and cleanliness testing. Assemblies should be cleaned after each soldering operation so that subsequent placement and soldering operations are not impaired by contamination (see 8, Cleaning Process Requirements).	12.9.7 LLCC Parts a. Accept Criteria (1) Complete concave solder fillet in the castellation (See Figure B-16). (2) Visible evidence of solder reflow under the LLCC termination area (See Figure B-16). (3) After reflow, stand-off height above the PWB substrate is not less than 0.127 mm (0.005 inch).	J-STD-001 does not give a specific stand-off height above the PWB for LLCC parts. Parts **shall** be mounted with sufficient clearances between the body and the PCB to assure adequate cleaning and cleanliness testing.
11.	**PCB Cleaning**	**4.9 General Part Mounting Requirements** Parts shall be mounted with sufficient clearances between the body and the PCB to assure adequate cleaning and cleanliness testing. Assemblies should be cleaned after each soldering operation so that subsequent placement and soldering operations are not impaired by contamination (see 8, Cleaning Process Requirements).	10.4.1 Interim Cleaning. Residues shall be removed during interim cleaning within 1/2 hour after soldering by applying an approved solvent as specified in paragraph 6.13 (Requirement).	NASA standard required interim cleaning within ½ hour J-STD-001ES does not. Board assemblies are required to pass visual and ionic cleanliness requirements.
12.	**Stress Relief**	**4.9.1 Stress Relief** At least one component lead shall [D1D2D3] have stress relief (see Figure 5-7) provided the component is not clip or adhesive mounted, or otherwise constrained. All leads shall [D1D2D3] have stress relief when the component is clip or adhesive mounted or otherwise constrained. Wires connected to terminals shall [A1P2D3] have stress relief.	**8.1.1 Stress Relief**. Stress relief shall be incorporated, wherever possible, into all leads and conductors terminating in solder connections to provide freedom of movement of part leads or conductors between points of constraint (Requirement).	J-STD-001 only requires stress relief in one lead of thru-hole mounted component
13.	**Board Cooling**	**4.15.2 Controlled Cooling** Controlled cooling may be used. If used, controlled (accelerated or slowed ramp) cooling shall [N1D2D3] be in accordance with documented procedures.	11.1.7 Cooling. Pressurized air shall not be used to cool solder joints (Requirement). Connections shall be cooled at room temperature only (Requirement).	J-STD-001 allows controlled cooling if in accordance with documented procedures.
14.	**PWA Bakeout**	**4.15.3 Drying/Degassing** Prior to soldering, the assembly shall be treated to remove detrimental moisture and other volatiles using a documented process	12.2.3 PWB's shall be cleaned and demoisturized prior to wave soldering (Requirement). The bakeout time and temperature shall be established and defined in the supplier's process Documentation. Demoisturizing shall be performed within 8 hours prior to wave Soldering.	**J-STD-001ES** Requires bakeout prior to soldering but does not specify parameters such as (8 hrs prior to soldering).

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
15.	**Exposed Basis Metal**	**4.18.1 Exposed Surfaces** Except as noted below, exposed basis metal on end of leads or vertical edges of lands is acceptable. a. Iron based component material, e.g. Alloy 42, Kovar®, component leads, body, shall not be exposed. b. Exposed basis metal shall not prevent the formation of an acceptable solder connection. c. Exposed Organic Solderability Preservatives (OSP) shall not prevent the formation of an acceptable solder connection.	NASA standards do not allow any exposed basis metal.	J-STD-001 allows exposed basis metal as long as it does not prevent the formation of an acceptable solder joint.
16.	**Strand Damage**	**5.1.2 Strand Damage** Wire strands shall not have separation exceeding 1 strand diameter or extend beyond wire insulation outside diameter.	13.6.2 Rejection Criteria (4) Separation of wire strands (birdcaging).	J-STD-001 gives specific criteria for rejection of separation exceeding 1 strand diameter or extend beyond wire insulation outside diameter.
17.	**Tinning of Stranded Wire**	**5.1.3 Tinning of Stranded Wire** Solder used for tinning **shall** be the same alloy that will be used in subsequent soldering processes. Solder wicking **shall not** extend to a portion of the wire which is required to remain flexible. The solder **shall** wet the tinned portion of the wire and should penetrate to the inner strands of the wire. Wire strands **shall** be discernable after tinning. Solder build-up or icicles within the tinned wire area **shall** not affect subsequent assembly steps. The length of untinned strands from end of wire insulation **shall not** be greater than 1 wire diameter.	7.2.5 Tinning of Conductors a. Hot tinning of solid conductors and part leads should not extend closer than 0.5mm (0.020 inch) to part bodies, end seals, or insulation unless the part configuration and mounting configuration dictate. If closer tinning is required, the part body, end seals, or insulation shall be inspected for damage after tinning and the results recorded (see also paragraph 4.1-3) (Requirement).	J-STD-001 eliminates .020 minimum dimension requirement. The length of untinned strands from end of wire insulation **shall not** be greater than 1 wire diameter.
18.	**Lead and Wire extensions**	**5.4.1.7 Lead and Wire End Extensions** The lead and wire ends should not extend beyond the terminal more than one (1) lead diameter. Minimum electrical clearance requirements shall [D1D2D3] be met.	**9.2 Turret and Straight Pin Terminals** d. Conductors shall be maintained in contact with the post for the full curvature of the wrap and the conductor ends shall not extend beyond the base of the terminal (Requirement).	Lead or wire ends can extend beyond the terminal diameter but only for one lead diameter of length as long as minimum electrical clearance distances are not exceeded.
19.	**Lead Forming**	**6.11 Lead Forming** Part and component leads should be preformed to the final configuration excluding the final clinch or retention bend before assembly or installation. The lead forming process **shall not** damage lead seals, welds, or connections internal to components. Leads **shall not** be reformed except for minor adjustments to bend angles. Leads **shall** extend at least one lead diameter or thickness but not less than 0.8 mm [0.031 in] from the body or weld before the start of the bend radius (see J-STD-001E Figure 6–1).	8.1.6 Lead Bending and Cutting The minimum distance from the part body or seal to the start of the bend in a part lead shall be 2 lead diameters for round leads and 0.5mm (0.020 inch) for ribbon leads (Requirement).	Requirement changed from 2 lead diameters to at least one lead diameter or thickness but not less than 0.8 mm [0.031 in] from the body or weld before the start of the bend radius

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
20.	**Termination Requirements**	**6.1.3** The orientation of the clinch relative to any conductor is optional.	8.5.2 Clinched Lead Terminations The lead shall be bent in the direction of the longest dimension of the solder pad	No longer a requirement to bend in the direction of the longest dimension of the solder pad
21.	**Lead Protrusion**	**Table 6–2 Protrusion of Leads in Supported Holes** (L) min End is discernible in solder1 (L) max 2.25 mm [0.0885 in]	8.5.3 Straight-Through Lead Terminations. Part leads terminated straight through the PWB shall extend a minimum of 0.5mm (0.020 inch) and a maximum of 2.29mm (0.090 inch)	Requirement changes from min of.020 inch to end discernible in solder.
22.	**Through-Hole Component Lead Soldering**	6.2.2 Through-Hole Component Lead Soldering When soldering component leads into PTH connections, the goal of the process is to accomplish 100% fill of the PTH with solder and good wetting to the lands, lead, and barrel top and bottom. The solder connection shall meet the requirements of Table 6–4 of this addendum, regardless of the soldering process, e.g. hand soldering, wave soldering, intrusive soldering, etc. Table 6–4 Supported Holes with Component Leads, Minimum Acceptable Conditions A. Vertical fill of solder 75% Note 2. Applies to any side to which solder or solder paste was applied. The 25% unfilled height includes a sum of both source and destination side depressions.	11.2 Solder Application c. For the connection on the PTH side opposite from the solder application, the solder quantity shall, as a minimum, exhibit flow-through and bonding of the lead or conductor to the solder pad; but not necessarily wetting out to or around the entire periphery of the solder pad (Requirement). A slight recessing or shrinkback of the solder into the PTH below the solder pad shall be acceptable, providing the solder has obviously wetted the lead and solder pad and the shrinkback is slight enough that it cannot be construed to be a solder void or blow hole 13.6.2 Rejection Criteria 13.6.2 B(5) Blowholes, pinholes, and voids (except pits as defined in paragraph 3.1).	J-STD-001ES Requires minimum solder hole fill of 75%. Note 2. Applies to any side to which solder or solder paste was applied. The 25% unfilled height includes a sum of both source and destination side depressions. 8739.3 allowed only for a slight recessing or shrinkback of the solder into the PTH below the solder pad shall be acceptable Solder voids are no longer a requirement for acceptance or rejection.
23.	**Part Lead Termination**	Table 7–1 SMT Lead Forming Minimum Lead Length A. Two lead widths for flat leads. B. Two lead widths for coined leads. C. Two lead diameters for round leads.	8.5.1 Part Lead Terminations b. Lapped Round Leads. The round lead shall overlap the solder pad a minimum of 3.5 times the lead diameter to a maximum of 5.5 times the lead diameter, but in no case shall the length be less than 1.27mm (0.050 inch) c. Lapped Ribbon Leads. The ribbon lead shall overlap the solder pad a minimum of 3 lead widths to a maximum of 5.5 lead widths	Lapped requirements change from minimum overlap of 3.5 times the lead diameter to two lead widths for flat, coined, or round.
24.	**Chip Components**	7.5.4 Rectangular or Square End Chip Components - 1, 3 or 5 Side Termination Minimum Fillet Height: a minimum of the solder thickness dimension (G) + 25% of the termination height (H) or (G) + 0.5 mm [0.02 in], whichever is less.	12.9.1 Chip Parts Reject if solder fillet is less than 50 percent of the part thickness (See Figure B-3).	J-STD-001 requires a fillet height of 25 percent for chip components

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
25.	**Cylindrical End Cap Terminations or MELF (Metal Electrode Leadless Face).**	7.5.5 Cylindrical End Cap Terminations This component is sometimes referred to as MELF (Metal Electrode Leadless Face). Minimum Fillet Height: a minimum of the solder thickness dimension (G) + 25% of the termination height (H) or (G) + 1 mm [0.0394 in], whichever is less.	B-14 Reject if solder fillet is less than 50 percent of the part thickness	J-STD-001 requires a fillet height of 25 percent for MELF components
26.	**Castellated Terminations**	7.5.6 **Castellated Terminations** If parts with castellated terminations are chosen by design, their use **shall** be approved by the User. When used, the existing J-STD-001E Class 3 requirements apply.	NASA standard does not permit any side overhang of leadless chip parts NASA standard had requirement for standoff height above the PWB substrate shall not be less than 0.127mm (.005 in).	J-STD-001 allows a maximum Side Overhang of 25% of width No standoff height requirement in J-STD-001
27.	**Solder in Lead Bend**	**7.5.7 Flat Gull Wing Leads** Note 4. Solder fillet may extend through the top bend. Solder does not touch package body or end seal, except for plastic SOIC or SOT devices. Solder should not extend under the body of surface mount components whose leads are made of Alloy 42 or similar metals.	NASA standard did not allow solder to extend into the stress relief bend area or under the body of surface mount components.	J-STD permits solder to extend through the top lead bend of component lead.
28.	**Surface Mount Area Array Packages**	7.5.14 Surface Mount Area Array Packages Visual inspection requirements: • X-ray inspection shall be used. Limited visual inspection may also be used. • The solder terminations on the outside row (perimeter) of the area array component shall be visually inspected. • The area array component needs to align in both X & Y directions with the corner markers on the PCB (if present). • Absence of leads, e.g. solder ball or columns, are defects unless specified by design. Process development and control is essential for continued success of assembly methods and implementation of materials.	No criteria in NASA standards	J-STD-001 provides new visual inspection criteria for Surface Mount Area Array Packages

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
29.	**Ball Grid Array Column Grid Array**	Tables 7-14, 7-15 and 7-16 provide solder joint dimensional and quality requirements for BGAs with collapsing balls, BGAs non-collapsing balls, and CGAs	No criteria in NASA standards	J-STD-001 provides new visual inspection criteria for Ball Grid Array Components
31.	**Bottom Termination Components**	**7.5.15 Bottom Termination Components (BTC)** *Criteria for nonvisible part of thermal plane solder connections (including voids) are not described in this document and shall be established by agreement between the Manufacturer and the User*. The thermal transfer plane acceptance criteria are design and process related. Issues to consider include but are not limited to component manufacturer's application notes, solder coverage, voids, solder height, maximum junction temperature, etc. When soldering these types of components voiding in the thermal plane is common. Solder, when required, shall meet documented requirements. For solder connections which are not thermal, dimensional and quality requirements are defined in Table 7-17 of the space addendum	Not addressed by NASA standards	J-STD-001ES defers acceptance criteria to agreement between the Manufacturer and User.
32.	**Bottom Thermal Plane Terminations (D-Pak)**	**7.5.16 Components with Bottom Thermal Plane Terminations** (D-Pak) Criteria for nonvisible parts of thermal plane solder connections are not described in this document and will need to be established by agreement between the Manufacturer and the User.	Not addressed by NASA standards	J-STD-001ES defers acceptance criteria to agreement between the Manufacturer and User.
33.	**Coplanarity**	7.1.1 **Surface Mount Device Lead Deformation** There **shall be no** unintentional lead deformation. The limits applied to nicks and indentations are defined in Paragraph 6.1.2.	7.1 Coplanarity Parts shall be examined 100 percent for coplanarity from the lead to the surface to which the part is to be soldered	J-STD-001ES does not require coplanarity inspection prior to part mounting.
34.	**Ultrasonic Cleaning**	**8.2 Ultrasonic Cleaning** Ultrasonic cleaning is permissible: a. On bare boards or assemblies, provided only terminals or connectors without internal electronics are present. b. On electronic assemblies with electrical components, provided the manufacturer has documentation available for review showing that the use of ultrasonics does not damage the mechanical or electrical performance of the product or components being cleaned	NASA STD does not allow Ultrasonic cleaning for electronic parts.	J-STD-001 Allows the use of ultrasonic cleaning on electronic assemblies with electrical components provided the manufacturer has documentation available for review showing that the use of ultrasonics does not damage the mechanical or electrical performance of the product or components being cleaned

Item	SUBJECT	J-STD-001-E/ES REQUIREMENT	NASA Standards .2/.3	COMMENT
35.	**Particulate Matter Assemblies**	8.3.1 Particulate Matter Assemblies shall be free of dirt, lint, solder splash, dross, wire clippings, solder balls or other metal particles, etc. Solder balls are allowed if proven secured (i.e., will not come loose during transportation, storage, or operation of the system) with a documented specialized process. The specialized process and acceptance criteria shall be approved by the User prior to use. The approved process shall be applied to 100% of all solder balls. Data generated by the approved process shall be maintained and available for review. Any violation of minimum electrical clearance shall be a defect, see 4.9.	10.4.2 Final Cleaning After cleaning, there shall be no visible evidence of flux residue or other contamination when examined	J-STD-001ES allows solder balls if proven secured by a specialized process approved by the User prior to use.
36.	**Exposed Fibers**	**9.1.2 Weave Exposure/Cut Fibers** There shall be no non-wetted exposed glass fibers. There shall be no surface damage that cuts into laminate fibers. Exception: Exposed fibers may extend onto the top and bottom surfaces of the printed board a maximum of 0.6mm [0.0236 in] around the perimeter of the printed board or around unsupported holes without lands.	Printed Wiring Boards (6) Cut, nicked, gouged, or scraped substrate that exposes glass fibers	J-STD-001 allows for minimal exposed fibers around the perimeter of board or around unsupported holes without lands. Not addressed by NASA Standards
37.	**Land/Conductor Reduction in Size**	**9.1.5 Land/Conductor Reduction in Size** The minimum width of printed conductors or width/ length of lands shall not be reduced by more than 20%	NASA STD did not allow for any reduction in size of conductor pattern.	J-STD-001 allows for 20% reduction of width/length of conductor land