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AEC to MILSPEC Comparison

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AEC vs Mil Grade / Space Grade Overview Allyson Yarborough



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AEC vs Mil Grade / Space Grade Overview

ltem	COTs	AEC	Mil / Space Grade Parts
Application Suitability	Non-critical	Small Sats / Less Than 5 Year Missions / Low Orbit	All Applications / Durations (Depending Upon Level)
Typical Screening (lot by lot)	25C Electrical	3 Temp Electrical	Temp Cycle X-Ray 3 Temp Electrical Burn-In Lead / PIND (Hermetic Package)
Qual	One Time / Major Changes	One Time / Major Changes	Every Lot
Reliability Stress Testing	Non-sequential; Each Individual Failure Mode Assessed Separately	Non-sequential; Each Individual Failure Mode Assessed Separately	Periodic Reliability Monitor Tests on Product and Technology
Radiation Tolerance	No	No	Yes for Space
DPA Required	No	No	Yes for Space



AEC vs Mil Grade / Space Grade Overview

ltem	COTs	AEC	Mil / Space Grade Parts
Typical Package Type	Plastic / Non-Hermetic	Plastic / Non-Hermetic	Hermetic Plastic / Non-Hermetic (Limited)
Manufacturing Location Control	No	Yes	Yes (Lot by Lot and by Wafer for Radiation)
Lot Date Code Control	No	No	Yes - Homogeneous
PCN Control	No	Yes	Yes
SPC	Depends on Manufacturer	Extensive - PPAP Controlled	Extensive
Tin Whisker Mitigation	Lead Finish: Pure Tin	Lead Finish: Pure Tin	Lead Finish: Tin/Lead and Gold
Availability	Wide	Wide	Limited - Older Technologies Fade Out After Time. New Technology Devices Behind COTs/AEC
Lead Time	Off The Shelf	Some Times Off The Shelf	Typically Long Lead Times Compared to COTs/AEC
EOL	Longer	Longer	Longest
Cost	Inexpensive	Not so Expensive	Expensive



AEC vs Mil Grade / Space Grade – Some Comments Sultan Lilani



Automotive Grade Part is Getting The Most Attention

Most commonly heard terms:

- AEC-Q100 qualified
- AEC-Q100 certified
- AEC-Q100 compliant
- Automotive like

AEC Qualified

- One time qualification; no on-going Reliability monitoring tests
- No special screening except extended temperature testing
 - Most of them have no burn-in
- SPC controlled line
- Re-qualification only in case of process / material change
- No whisker mitigation (pure tin)
- Third party ISO certification
 - PPAP data package review Content quality varies by manufacturer
- AEC-Q100 compliant / Automotive like
 - Fuzzy definition
 - Likely to use same manufacturing line as AEC Qualified
 - Like to use same AEC-Q100 initial qual requirements but test methods may be substituted, changed or sample size is reduced



How Do We Mitigate Gate Risks Associated with Mid Grade EEE Parts



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A Step Approach To Use Mid Grade EEE Parts

- 1. Assess and Quantify The Risks The Project Can Tolerate
- 2. Devise Risk Mitigation Around Commonly Used Risk Mitigation Techniques by Users
 - Understand the device design and manufacturing technology
 - Use reputable manufacturers
 - Use manufacturer's available data for level Quality / Reliability assessment
 - Use statistical approach to assessing product reliability
 - More failure analysis for all failures across supply chain
 - Three temperature testing
- 3. Seeing is Believing
 - Audits
 - Have technical assessment with manufacturers



- Understand
 - Project application
 - Mission duration
 - Project design for risk aversion / redundancies
- Quantity Mission FIT and PPM requirements
- Look at BOMs And What Kinds of Parts Can Be Used
 - Define minimum level grade parts to be used to meet Quality / Reliability of the mission
 - Define minimum product screening flow required for the parts
 - Check to see what types of parts are readily available and see if these parts can be economically used in application
 - Define minimum product screening flow required for the parts



- More Construction Analysis (CA) instead of Mil Std 1580 DPAs
- Analyze all failures across supply chain. This will tell us more about OCM process controls and part reliability than any other validation testing. Use OCM for failure analysis whenever practical and possible
- Use manufacturer available data Quality and Reliability data. This will
 - Provide process maturity information
 - Tell you what kind of process controls manufacturer has
 - Tell you the screening flow manufacturer uses
 - Tell you how detail assessment manufacturer does to validate Quality and Reliability of the product
 - Tell you the screening flow manufacturer uses



- Three temperature testing
- Looks for delta change before and after burn-in and life test
 - Cost and lead times may not allow long term reliability assessment. Sample size may be small. Consider:
 - Delta change pre and post burn-in
 - Delta change pre and post life test

Delta changes are typically a good indicator of parametric value shift or potential reliability issue



➤ See

- On-site visit; even for a short time, will tell you a lot about the manufacturer; specially with small OCMs
- Take a walk into the manufacturing line and see equipment and process real time
- Engage in technical dialogue with manufacturer. This will:
 - Help understand the product Quality / Reliability / Performance
 - Help in mitigating issues when failures or questions come up
 - Understand the true parts capabilities





Thank You!



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U.S. Assembly and Test Solutions

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This is the instructions for filling out the matrix.

But first, some definitions:

- 1. Mission Duration: 6 months to 5 years max
- 2. Small Sat mass: 180kg (wet weight)
- 3. Orbit Altitude: 1200 miles (LEO) or below
- 4. Mission Type: All (communications, navigation, atmosphere, astronomy, remote sensing, reconaissance)
- 5. Other drivers to consider: schedule, obsolescence, availability

The Assessment column would contain one of four colors

Blue = AEC requirement fully meets or exceeds that of the MIL-PRF

Green = Meets Intent (for example, test might be different, but tests for same failure mechanism)

Yellow = Partially Meets Intent

Red = Fails to Meet Intent

Gray = Not applicable for short term mission payloads

Inspections	MIL-STD-883		AEC-Q100	тм	TM Description/Additional Requirements	Sample Lot	Sample Size	Assessment	Rationale
	Method (Class V)	Condition	Test #						
Wafer acceptance lot test	QM plan or TM 500								No formal WLAT done by AEC
		thermal stability, SEM, glassivation							
		thickness, gold backing thickness							
Non-destructive bond pull test	TM 2023	Reveal non-acceptable wire bonds, but							Destructive bond pull done during qual
		avoid damaging acceptable ones.							
Internal Visual Inspection	TM 2010, Cond A								2nd op and other visuals meet most items but not all and not lot by lot
Temp Cycling	TM 1010, Cond C	-65 to 150°C, 10 cycles min	A4	JESD22-A104 and	Grade 0: -55 to 150°C, 2000x; test before and	3	77		not done lot by lot; during qual or group testing
				Appendix 3	after TC at hot T				
Constant Acceleration	TM 2001, Cond E	minimum 1 min each in X1, X2, Y1, Y2, Z1	, G3	MIL-STD-883, TM20	0 Y1 only, 30000 Gs for <40 pin packages, 20000	1	15		Y1 plane only
		and Z2 orientations; 30000 Gs			Gs for >40 pins				
Visual Inspection	100%								not done lot by lot; during qual or group testing
PIND	TM 2020, Cond A	3 pre-test shocks and vibration 3±1 s –							Not performed
		repeat 4 times							
Serialization	Device Specification								Not performed
Pre Burn In (interim) electrical parameters test	Device Specification	1	E1	Supplier data sheet		All	All		
				or user specs					
Burn In test	TM 1015, Cond D	Parallel excitation; 240 hrs at 125°C	B2?	AEC-Q100-008	Early Life Failure Rate	3	800		only initial 3 lots and during qual/group testing; not on a lot by lot basis
Post Burn In (Interim) electrical parameters	Device Specification		A6	JESD22-A103	High Temperature Storage Life: Store at 175 for	1	45		
test					1000hrs or 150C for 2000 hrs for Grade 0				
Reverse Bias Burn In Test (Static Burn In)	TM 1015, Condition		A5	JESD22-A105	PTC: -40C to +150C for 1000 cycles for Grade 0	1	45		only initial 3 lots and during qual/group testing; not on a lot by lot basis
	A or C	reverse bias; 144 hours at +125°C, 72							
		hours at +150°C minimum							
Post Burn In (Interim reverse bias) electrical	Device Specification	1	A6	JESD22-A103	High Temperature Storage Life: Store at 175 for	1	45		
parameters test					1000hrs or 150C for 2000 hrs for Grade 0				
Percent defective allowable	5% PDA, 3% DPA for	r							PDA exists for lots during qual or group testing
	functional								
	parameters at 25°C								
	(all lots)								
Final Electrical Tests	Device Specification	1							
Static test :			Which test	s correspond to these	final electrical tests?				
(1) at 25°C									
(2) Maximum and Minimum									
operating temperature				1		-			
Dynamic or functional test :									
(1) at 25℃									
(2) Maximum and Minimum									
operating temperature Switching test :									
(1) at 25°C									
(2) Maximum and Minimum									
operated temperature									
Seal test: Fine leak and Gross Leak	TM 1014		G4	MIL-STD-883, TM	Fine leak test followed by gross test. For ceramic	c			not done lot by lot; during qual or group testing
Sear test. This leak and Gross Leak	1014		34	1014	packges, cavity devices only.	~	1		not done lot by lot, during quaror group testing
Radiograph or C-SAM	TM 2012 or TM 202	0 Non-destructive evaluation of devices	+	1917	parages, cavicy acvices offiy.		1		not done lot by lot; during qual or group testing
External Visual Inspection	TM 2009	Verify workmanship; use 1.5X to 10X	1				1		I don't see this in AEC
		magnification							
Qualification or QCI/TCI	1					1	1		Various group testing required periodically
Radiation dose rate induced latch up Test	Burn	1	E4	AEC-Q100-004	Latch Up		1		
		1	D1		Electromigration				performed by AEC and mil prf 38535 during gual or characterization
	1	1	D2		Time Dependent Dielectric Breakdown	1			performed by AEC and mil pri 38535 during qual or characterization
	1	1	D3		Hot Carrier Injection	1	1		performed by AEC and mil pri 38535 during qual or characterization
			D4		Negative Bias Temperature Instability				performed by AEC and mil prf 38535 during qual or characterization
	1	1	D5	1	Stress Migration		1		performed by AEC but not by mil prf 38535 during qual or characterization
			A1	JEDEC					
				JEDEC J-STD-020	Preconditioning				performed by AEC and mil prf 38535 during qual or characterization

Table 1A Screening procedure for hermetic classes Q, V, and non-hermetic class Y microcircuits

Table 1B. Tests/monitors for plastic packages

Inspections	MIL-S	5TD-883	AEC-Q100	ТМ	TM Description/Additional	Assessment	Rationale
	Method	Condition	Test #		Requirements		
Wafer Acceptance	TRB/ QM plan	Wafer thickness, metallization thickness, thermal stability, SEM, glassivation thickness,					
		gold backing thickness					
Internal Visual	TM 2010						
Temp Cycling/Thermal Shock	TM 1010/ TM 1011	-65 to 150°C, 10 cycles min	A4	JESD22-A104	Temperature Cycle		
Resistance to Solvents	TM 2015						
Bond Strength	TM 2011	Destructive bond pull test	C2	MIL-STD-883 - 2011	Wire Bond pull strength		
Ball Shear	ASTM F1269		C1	AEC Q100-001	Wire Bond shear		
Solderability	TM 2003	Evaluate solderability of terminations for tin-lead eutectic.	С3	JESD22-B102 or J- STD-002D	Solderability		
Die Shear or Stud Pull	TM 2019 or TM 2027		G7	MIL-STD-883 - 2019	Die Shear Strength		
Steady State life test (End point electricals)	TM 1005	Demonstrate quality or reliability of devices over extended time period. 1000 h minimum at 125°C.					
Physical Dimensions	TM 2016		C4	JESD22-B100/B108	Physical Dimension		
Lead Integrity	TM 2004	Determine integrity of leads, welds and seals. See TM for more details on various tests.	C6	JESD22-B105			Lead integrity
Inspection for delamination	TM 1034, cross section, C- SAM (TM 2030)	Dye penetrant test (1034).					
Highly accelerated stress testing (HAST)	JESD22-A118 (100 hrs, +130C, 85% RH)		A2	JEDEC JESD22-A101 or A110	Biased HAST		
Autoclave	JESD22-A102 (no bias) 2 atm, +121C		A3	JEDEC JESD22-A102, A118, or A101	Unbiased HAST or Autoclave		
Salt Atmosphere	TM 1009	Accelerated laboratory corrosion test					
Adhesion to lead finish	TM 2025	Bend stress applied to randomly selected leads from each device					
nterim pre burn in electricals	Device Specifications						
Burn In test	TM 1015	125°C, 160 h	B1	JESD22-A108	High temp operating life		
nterim post burn in electricals	Device Specifications						
PDA	1% PDA						
Switching Test	Device Specifications						
External Visual Inspection Test	TM 2009 or JESD22-B101						

AE-Q100 Notes:

Additonal testing include unbiased HAST, ESD, power temp cycle, high temp operating life, statisical binning, characterization, lead free, etc..

Goal of qual is zero defect. Qual is three lots for several of the stress tests, Generic data for family is encouraged to reduce qual test unless there is a failure, no time limit for generic data to be accepted. Supplier required to provide stress data and certificate of design and construction.

AE-Q100 calls out different grades of parts (0 through 3) based on temp range. Test temp at hot and cold should be equivalent to grade. Junction temp during stress should be equal to or higher than upper limit above. Table 1: Part Operating Temperature Grades which is different from Space level -55 to 125C

Grade Ambient Operating Temperature Range

0 -40°C to +150°C

1 -40°C to +125°C

2 -40°C to +105°C

3 -40°C to +85°C

Table II. Group B tests (Mechanical and environmental test)

											AEC-Q100		ТМ			
Insp	pections	5	MIL-STD-88	83			MIL-STD	-883	MIL-STD-883		Test #	ТМ	Description/Addition	n Assessmen	:	Rationale
		Me	thod (Class V and Y)	Cor	ndition	M	ethod (Class B)	Condition	Method (Class S)	Condition			al Requirements	vs. Class V and Y vs. Class	B vs. Class S	
	. Subaro	Resi	Basistan collo Sollo S	тм	∑01 ₿015				Romers Dringastions	TM 2016					Phy Dim: Yes	
Sut	orstipeno	up 1						-	Hteanbewystervystor	TM 1018						
																anoritiset treat test, vean use
																Hiaffuffetu fate Osta Skip skip
		Bond	Bond Strength -	тм	<u>5M</u> 2011	Res	Resistance to Rolvents	TM 2015	Besistance to Salvents	TM 2013	2	Wire Bood Budlui T	MRP20117E&E&90303			file test
			Ŭ													SAFEE ARES AVELS FINH I FEALTINE DPA; FAILS FREY LANGE AVELS FOR I FEALTINE STATISTICS I FRANCE AND AND A FAIL
		Die S	Ries Sheat Jorst ur studietrate Attach Strengt Studi Full Test Fills Fill Fall Test													test should be done or mil std
	Subgrou	Strer	Strength or Stud Pull Test	тм	IM 2019 or TM 2027				Internal Visual and Mechanical	TM 2013, TM 2014						DPA should be done
Sut	ogróup 2	Flip (Flip Chip Pull Off Test	тм	TM 2031 or TM 2011				Bond Strength	TM 2811						
		Flip (File Chip Die Shear Strength Test of Chip Die Shear Strength Test or Substrate Attach Strength Test trate Attach Strength Test						Jond Strength Direshear Lest or Substrate Attach Strength Jest Shear Lest or Substrate Attach Strength South Voll Test Fing Chur Pull Off Test Mic Chin Pull Off Test The Chin Pull Off Test Mic Chin Pull Off Test The Chin Pull Off Test Strength Test Strength Test or Substrate Hadroff Strength Test Sco	-						
		Subs	Substrate Attach Strength Test	TM	TM 2019 or TM 2027 2019 or TM 2027				or Stud Pull Test	IM 2019 or TM 2027						
		50.53			2015 01 111 2027				Flip Chip Pull Off Test	TM 2019 or TM 2027 TM 2019 or TM 2027 TM 2031 or TM 2011 TM 2031 or TM 2011 TM 2031 or TM 2011						test should be done This test should be done
				-					The Chip Die Shear Strength Test or Substrate	1101 2031 01 1101 2011						test should be done This test should be done
									Attach Strength Test	TM 2019 or TM 2027 TM 2019 or TM 2027 M 2003						This test should be done
6	Subgro	up 3	Solderability 245C ±5C		TM 2003	<u> </u>	Solderability 245C ±5C derability 245C ±5C	TM 2003	Solderability 245C ±5C	TM 2003 TM 2003 TM 2003	3	Solderability JI Solderability	SD22 B102, J STD 002D JESD22-B102, J-STD-002D			<u> </u>
Su	ogroup 3				2003	300	derability 245C ±5C	IN 2003	olderability 245C ±5C	TIVI 2003	C3	Solderability	JESD22-B102, J-STD-002D			
		Colu	Shear Test for BGA or Galder Column Pull Test for CGA (Note: Meeul Barst for Ghadoes for meet													
		Mee	ts Ball shear hit does not meet		JESD22-B117 or TM 2038					TM 2004			EC Q100-010, AEC-Q003			4
	Subgro	up <mark>sold</mark>	er column)	JESD	022-B117 or TM 2038				Sadilatestity	FM 2004	ශි		AF5-22100-010, AEC-Q003			
Sub	ogroup 4								Send Testaue	TM 2024	C6	Lead Integrity	JESD22-B102			
									Ballongue Test for BGA or Solder Column Pull	TM 2024						d to add solder column pull
									all streat cost for Bayer's alder Calumn Bull	JESD22-B117 or TM					tes	t လြင့်ကျွှော်မြန် solder column pull
									Asttfore Contract of Manager Ball shear bit does	15922-B117 or TM						test for CGA parts
							Bond Strength	TM 2011	Phanesine electrical warameters	A938ecified						
						Bor				As specified						
							SabearaTexttorch									
							Ssteniet AttaStud Pull									/ / /
	Subgro	un 5					€egth or Stud Pull	TM 2019 or TM 2027	Steady State Life Test	TM 1005						4
Su	ogroup 5						flip Chip Pull Off Test			At∕ s ⊉00i ≴ied						
54	58.00p 5						Flop Contra Pionshireaut	TM 2031 or TM 2011		As specified						
							StrangthesSubstrate			io specifica						
							Attach Stransth Jest	TM 2019 or TM 2027								
							ach Strength Test	TM 2019 or TM 2027	Temperature Cycling, test condition C, 100			<u> </u>				+
		_		-		1	ach strength rest		Exclose and the cycling, test condition C, 100	TM 1010						<u> </u>
	Subgro	un: 6	†			\square				TM 309ð						
_	0	-		+		Ħ		+		TM 1010		++				} ────┤ ┦
Su	ogroup 6			-		\vdash		+		Arispacified		+ +				<u> </u>
		-		+		\vdash						<u> </u> h	SD22-B100 and B108, AEC-			
		_				\vdash			nd Point Electrical Parameters	As specified	4	L	19022-0100 and 0108, ALC			┩ ────┤──┦
		+	<u> </u>			+			·		<u> </u>	1'	1		+	+
											C4	Physical Dimensions	Q003			<u> </u>

Inspections					AEC- Q100		тм				
mopeetions	MIL-STD-883	Minimu	m sample size qua	ntity	Test #	TM	Description/Additional	Sample Size			
	Method Condition	Class Q	Class V	Class Y			Requirements		Acceptance Criteria	Assessment	Rationale
Subgroup 1	TM 5005 Static tests at +25C	116 or 100 %/ 0 sample	116 or 100 %/ 0 samp	116 or 100 %/ 0 sample	E5						
Subgroup 2	TM 5005 Static tests at maximum rated operating temperature										
Subgroup 3	TM 5005 Static tests at minimum rated operating temperature										
Subgroup 4	TM 5005 Dynamic tests at +25C	116 or 100 %/ 0 sample	116 or 100 %/ 0 samp	116 or 100 %/ 0 sample							
Subgroup 5	TM 5005 Dynamic tests at maximum rated operating temperat	ure				Electrical					AEC-Q100 does not specify exact test
Subgroup 6	TM 5005 Dynamic tests at minimum ratedoperating temperatu	ire				Distributions - Test	AEC-Q100-009 and AECQ-003	PO complex 2 lots	Where applicable, Cpk		conditions. Only lists electrical
Subgroup 7	TM 5005 Functional tests at +25C	116 or 100 %/ 0 sample	116 or 100 %/ 0 samp	116 or 100 %/ 0 sample	e	at room, hot, and	AEC-Q100-009 and AECQ-003	so samples, s lots	>1.67		testing at room, hot, and cold
Subgroup 8A	TM 5005 Functional tests at maximum rated operating temperation	ature				cold					temperatures.
Subgroup 8B	TM 5005 Functional tests at minimum rated operating tempera	ature									
Subgroup 9	TM 5005 Switching tests at +25C	116 or 100 %/ 0 sample	116 or 100 %/ 0 samp	116 or 100 %/ 0 sample	e]					
Subgroup 10	TM 5005 Switching tests at maximum rated operating tempera	ture									
Subgroup 11	TM 5005 Switching tests at minimum rated operating temperat	ture									

One supplier - upfront construction analysis on the lot prior to testing. MIL STD 1580 with materials testing

Looking for variation in performance over Temp so not getting degradation over temp range

Burn In: look at before and after and see if it is changing over time which indicates smtg unstable or latent defect over time.

Performance - if part not performing then not insert into hardware. Not necessary just to check variation/degradation, but over the temp range make sure parameters are within specifications

Type of test is dependent on mission and environment/application and if it is more dependent on static or dynamic parameterrs. Test box over temp instead of testing part (b/c of costs).

If mission is -20C to 70C, then don't need to go to 125C. At times, ie ASIC, then probing is done at the die level, but enough data at the die level so package level testing is done at perhaps one temp

Linear part may be more concerned at offset vs Digital part may not be as affected. Dependent on what is important to you

100% testing/screening is not the spirit of AEC-Q100. Question is whether or not SPC data is sufficient for the mission life

Less expensive parts and more readily available, but have to add cost via additional upgraded testing.

Certain parts in PEMs that is not available in military grade. So have to use PEMs.

Electrical testing as part of 100% testing is costly. Environmental is not as big of a hurdle.

If a suppplier is willing to help with the electrical testing, that is the best scenario.

Increations	MIL-STD-883		Minimum sample	Accept	AEC-Q100		ТМ	Sample		
Inspections	Method (Class Q)	Condition	size quantity	number	Test #	ТМ	Description/Addition	Size	Assessment	Rationale
Steady-state life test	MIL-STD-883 TM 1005 J (K not available on DLA site)		45 – use actual devices for lots >200 units. 5 devices or 10% of the lot, whichever is greater (for large lot <200 units). Every 3 months, unless major assembly changes	0	В2	JESD22-A108	1000 h at 125°C for Grade 1; +150°C Ta for 1000 h for Grade 0	3 lots, 77 samples		 As noted in AEC- Q100, qualification is performed only once and maintained through SPC. An integral part of the Near Term Tech specification will need to identify all required SPC. SPC will need to be an integral part of the specification. This includes determining the independent variables such as wafer to wafer and onwafer location variablitity as well as assembly variability. These variables should be
Test Conditions		A. Reverse Bias (All) B. Forward Bias (A/D) C. Power & Reverse (D/Lin) D. Parallel E. Ring oscillator				Q100-008	Early Life Failure Rate SS=800; 3 lots (Can be used for production)			forced during sampling. Thermal Derating and Appropriate biasing will need to be determined
					Endurance data retention	Q100-005				Thermal Derating and Appropriate biasing will need to be determined
End-point electrical param	As specified in the applicable device procurement specification								data can include sufficient SPC	

*No fails in 231 devices (77 devices from 3 lots) are applied as pass criteria for the major environmental stress tests. This represents an LTPD (Lot Tolerance Percent Defective) = 1, meaning a maximum of 1% failures at 90% confidence level

*This sample size is NOT sufficient or intended for process control or PPM evaluation. Manufacturing variation failures (low ppm issues) are achieved through proper process controls and/or screens such as described in AEC-Q001 and AEC-Q002. TM=detailed specs for how to bias parts requirements for process control?

Table V. Group D Tests (Package related tests)

Subgroup Tests	Tests							AEC-				
		MIL- Method (Class Q)	STD-883 Condition	MIL- Method (Class V)	Condition	MIL-S Method (Class Y)	TD-883 Condition	Q100 Test #	тм	TM Description/Additional Requirements	Assessment vs. Class V and '	Rationale
	Physical Dimensions	TM 2016		(C4	Physical Dimensions	JESD22-B100 and B108 and		MIL-STD-883E TM 2016 requires measuring
Subgroup 1										AEC-Q003	Meets intent	the package IAW case outline drawing. No other requirements on equipment calibration, accuracy or repeatability. AEC Q: 100 C4 refers to JEDEC JESD22-B100B, a slightly more detailed drawing.
	Lead/Terminal Integrity	TM 2004	B2 (lead fatigue) or applicable for the package technology style	TM 2004	B2 (lead fatigue) or applicable for the package technology style	TM 2004	B2 (lead fatigue) or applicable for the package technology style	C6	Lead Integrity	JESD22-B105	TBD	AEC-Q-100 does not require this for SMD parts.
Subgroup 2	Seal Test - Fine and Gross	TM 1014	Test condition as appli	TM 1014	Test condition as app		Not applicable for class Y non- hermetic mocrocircuits devices		Gross/Fine Leak	TM1014	Meets intent	AEC-Q-100 refers to MIL-STD-883 TM 1014. Leak tests are not applicable to PEMS devices. Moisture resistance might be a more perceptive test.
	Ball Shear for BGA and Solder Column Pull Test for CGA package	BGA package: JESD22-B117 CGA package: TM 2038	BGA: 45 balls from 2 devices min.; CGA: 45 columns from 2 devices min.	BGA package: JESD22-B117 CGA package: TM 2038	BGA: 45 balls from 2 devices min.; CGA: 45 columns from 2 devices min.	BGA package: JESD22-B117 CGA package: TM 2038	BGA: 45 balls from 2 devices min.; CGA: 45 columns from 2 devices min.	C5	Solder Ball Shear	AEC-Q100-010 or AEC-Q003	Meets Intent	AEC-Q-100 specifies a Cpk and Ppk for overall ball shear and solder shear statistics for manufacturing line rather than lot by lot basis so fewer samples per lot is taken but overall line has more data points.
	Thermal shock, 15 cycles Temperature cycling, Test Condition C 100 cycles min	TM 1011 TM 1010	Test condition B, 15 cy Test condition C, 100 cycles min.	TM 1011 TM 1010	Test condition B, 15 c Test condition C, 100 cycles min.	TM 1011 TM 1010	Test condition B, 1 Test condition C, 100 cycles min.	A5	Power temperature cycling	AEC-Q-100	ails to meet inte Meets intent	These are two different tests and address different failure mechanisms. TM 1010 cycles in an electrically inactive state.
	Moisture resistance Visual examination	TM 1004 TM 1004 or TM	8/	TM 1004 TM 1004 or TM	8/	JESD22-A118 TM 1004 or TM	Condition B	A2, A3	Temperature/Humididty	AEC-Q-100	Vleets or exceed	AEC-Q-100 has more stringent flow including autoclave.
Subgroup 3	visual examination	1010 1004 or TM		1010 1004 or 1M		1010 1004 or 1M					ails to meet inte	No visual inspection TM in AEC-Q-100.
	Seal Test - Fine and Gross	TM 1014	Test condition as applicable	TM 1014	Test condition as applicable	TM 1014	Test condition as a	G4	Gross/Fine Leak	TM1014	Meets intent	AEC-Q-100 refers to MIL-STD-883 TM 1014. Leak tests are not applicable to PEMS devices. Moisture resistance might be a more perceptive test.
	End Point Electrical Parameters	As Specified		As Specified		As Specified			AEC-Q-100 Test Group E		Meets intent	Test group E includes pre and post stress parameters, electrical characteristics in
	Mechanical shock	TM 2002	Condition B minimum	TM 2002	Condition B minimun	TM 2002	Condition B minim	G1	Mechanical Shock	JESD22-B104	Meets intent	addition to others such as ESD and latch up. 1500g peak with. Sms pulse duration is the TM2002 default test condition. AECQ-100 refers to JESD22-8104, 5 shocks per orientation, total of 30 shocks. acceleration spec range is 100g to 2900g; pulse duration range is 0.3 – 2.0ms. JESD22-8104 does not have the 1500g/.5ms default test condition.
	Vibration, variable	TM 2007	Condition A minimum	TM 2007	Condition A minimun	TM 2007	Condition A minim	G2	Variable Frequency Vibration	JESD22-B103		
	frequency											20 Hz to 2 KHz to 20 Hz (logarithmic variation) in >4 minutes, 4X in each orientation, 50 g peak acceleration. TEST before and after at room temperature.
Subgroup 4	Constant acceleration	TM 2001	Test condition E, Y1 or	TM 2001	Test condition E, Y1 c	TM 2001	Test condition E, Y		Constant Acceleration	MIL STD 883, Method 2001		AEC-Q100 uses the same TM as MIL-STD- 883, so the difference will be in test conditions.
	Seal Test - Fine and Gross	TM 1014	Test condition as appli	TM 1014	Test condition as app		Not applicable for class Y non- hermetic mocrocircuits devices	G4	Gross/Fine Leak	TM1014		AEC-Q-100 refers to MIL-STD-883 TM 1014. Leak tests are not applicable to PEMS devices. Moisture resistance might be a more perceptive test.
	Visual examination End Point Electrical	TM 2007 As Specified		TM 2007 As Specified		TM 2007 As Specified			AEC-Q-100 Test Group E			This test does not exist in AEC Q-100.
	Parameters								ALC-Q-100 Test Gloup L			Test group E includes pre and post stress parameters, electrical characteristics in addition to others such as ESD and latch up.
	Salt atmosphere Visual examination	TM 1009 TM 1009	Test condition A, minimum	TM 1009 TM 1009	Test condition A, minimum	TM 1009 TM 1009	Test condition A, minimum					
Subgroup 5	Seal Test - Fine and Gross	TM 1014	Test condition as applicable	TM 1014	Test condition as applicable	1012003	Not applicable for class Y non- hermetic mocrocircuits devices		Gross/Fine Leak	TM1014		AEC-Q-100 refers to MIL-STD-883 TM 1014. Leak tests are not applicable to PEMS devices. Moisture resistance might be a more perceptive test.
Subgroup 6	Internal water vapor test (cavity packages) - 5000 ppm max at 100C	TM 1018	3 (0) samples, 5000 ppm max water content at 100°C	TM 1018	3 (0) samples, 5000 ppm max water content at 100°C		Not applicable for class Y non- hermetic mocrocircuits devices	G8	Internal Water Vapor	MIL STD 883, Method 1018		MIL-STD-883 TM 1018; AEC-Q-100 uses the same TM, no differences except those of detailed failure definitions.
Subgroup 7	Adhesion of lead finish Lid Torque	TM 2025 TM 2024	Where applicable Where applicable	TM 2025 TM 2024	Where applicable Where applicable	TM 2025 TM 2024	Where applicable Where applicable	G6	Lid Torque	MIL STD 883. Method 2024		No method in AEC-Q-100 MIL-STD-883 TM 2024: AEC-Q-100 uses the
Subgroup 8								υb	inin rorque	WIL STU 665, Method 2024		same TM, no differences except those of detailed failure definitions.
Suberoup 9	Soldering heat Seal Test - Fine and Gross	TM 2036 TM 1014	Where applicable Where applicable	TM 2036 TM 1014	Where applicable Where applicable	TM 2036 TM 1014	Where applicable Where applicable	G4	Gross/Fine Leak	TM1014		No method in AEC-Q-100 AEC-Q-100 refers to MIL-STD-883 TM 1014. Leak tests are not applicable to PEMS devices. Moisture resistance might be a more perceptive test.
	Visual examination End Point Electrical Parameters	TM 2009 As Specified		TM 2009 As Specified		TM 2009 As Specified			AEC-Q-100 Test Group E			No visual inspection TM in AEC-Q-100. Test group E includes pre and post stress parameters, electrical characteristics in addition to others such as ESD and latch up
Subgroup ?	Die shear	TM2019							Package Drop Die Shear	MIL STD 883, Method 2019		No package drop test in MIL-STD-883 AEC-Q100 uses the same TM as MIL-STD- 883, so the difference will be in test conditions.

The Assessment column would contain one of four colors Blue = AEC requirement fully meets or exceeds that of MIL-PRF-38535 Green = Meets Intent of MIL-PRF-38535 (test may be different, but tests for same failure mechanism) Yellow = Partially Meets Intent of MIL-PRF-38535. Red = Fails to Meet Intent of MIL-PRF-38535. Gray = Not applicable for short term mission payloads.

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Table E-IV. Screening Requirements

		MIL-STD-750				1	TM			
Inspection	Method		JANS	JANTXV	JANTX	TM	Description/Additional	Sample Size	Assessment	Rationale
Die visual for glass diodes	2073	Condition B, die form prior to assembly	100%	NA	NA		Not specified			No requirements in AEC-Q10
Internal visual (pre-cap) inspection: For diodes For power FETs For microwave transistors For transistors	2074 2069 2070 2072		100%	100%	NA		Not specified			No requirements in AEC-Q10
High Temp life (non operating life) (stabilization bake)	1032	Less than or equal to maximum rated storage temperature, t = as specified (340 h min, unless specified)	Optional	Optional	Optional		Not specified			No requirements in AEC-Q10
Temperature Cycling	1051	20 cycles. No dwell time is required at +25°C. Test condition C (-55 to 175°C) or maximum storage temperature, whichever is less.	100%	100%	100%	JESD22-A104	1000 cycles (-55°C to max rated junction T, not to exceed 150°C). Reduce to 400 cycles (25°C over part max rated junction T or 175°C if rated >150°C). No 100% Screening, Initial Qualification only	3 lots 77 samples each		Only performed for qual. Similar temperature ranges
Surge	4066	Condition A (sinusoidal current surge) or B (rectangular current phase), as specified	100%	100%	100%		Not specified			No requirements in AEC-Q10
Thermal Impedance Transistors, Power FETs Bipolar Diodes IGBT GaAs FET	3161 3131 3101 3103 3104	As specified	100%	100%	100%	JESD24-3 JESD24-4 JESD24-6	No 100% Screening, Initial Qualification only	1 lot 10 samples each for pre- and post-change		Test to assure specification compliance and provide process change comparison data
Constant acceleration. Not required for stud devices and metallugically bonded diodes.	2006	Y1 direction at 20,000 G minimum, except at 10,000 G minimum for devices with power rating of ≥10 watts at TC = +25°C. The 1 minute hold time requirement shall not apply.	100%	Optional	Optional	MIL-STD-750, Method 2006	Y1 plane only, 15K g- force. Test before and after CA. No 100% Screening, Initial Qualification only	1 lot 30 samples		Lower g-force. Only perrformed for qual.
PIND	2052	Condition A (20 g's peak at 40- 250 Hz) or B (10 g's peak at 60 Hz minimum), as specified	100%	NA	NA		Not specified			No requirements in AEC-Q10
Instability shock test (axial lead diodes only) FIST BIST	2081		100%	NA	NA		Not specified			No requirements in AEC-Q10
Hermetic Seal Fine	1071	Fine leak not required for double plug diodes.	Optional	Optional	Optional	JESD22 A-109	Fine and gross leak test per individual user	1 Lot 30 parts		
Gross Serialization			100%	100%	100%		specification Not specified			No requirements in AEC-Q10
Interim electrical parameters		As specified	100% (read and record)	For case mounted	For case mounted	User specification or supplier's	As needed for pre- and	All qualification parts submitted		No requirements in Acc Q20
High temperature reverse bias (HTRB):				rectifiers as specified	rectifiers as specified	standard specification	post-stress electrical test	for testing		
For Transistors For power FETs For diodes and rectifiers	1039 1042 1038	Test condition A (steady-state everse bias). Sovercent (minimum) of rated VCB (bjobaly, VGS(FT), or VDS(FT), as application B: Bopercent (minimum) of rated VGS Test condition A: Diodes (not required for LEDs, Zeners, and case mounted vRo TWWM when DC conditions ar seguefied: 95 - 100% of VWM, when half sine conditions are seguefied: 95 - 100% of VWMM, when half sine conditions are seguefied.	100%	100%	100%	MIL-STD-750, Method 1038	1000 h at max DC Reverse Voltage rated Junction T. No 100% Screening, Initial Qualification only	3 lots 77 samples each		Method 1038 is only for diodes, rectifiers, and zeners Testing methods for Transitors and power FETs not specified in AEC.
Interim electrical and delta parameter for PDA		As specified but including all delta parameters as a minimum. When HTRB is performed leakage current shall be measured on each device before any other specified parametric test is made.	100-percent (Measure all specified parameters. Measure leakage current within 16 hours after removal of applied voltage in HTRB. Record those parameters which have a delta limit.) (See screen 13 of table EIV.)	100-percent (Measure all specified parameters. Measure leakage current within 24 hours after removal of applied voltage in HTRB. Record those Parameters which have a delta limit.) (See screen 13 of table EIV.)	100-percent (Measure all specified parameters. Measure leakage current within 24 hours after removal of applied voltage in HTRB. Record those Parameters which have a delta limit.) (See screen 13 of table E-IV.)	User specification or supplier's standard specification	As needed for pre- and post-stress electrical test (no PDA)	All qualification parts submitted for testing		
Burn In for: Bipolar Transistors Power FETs Diodes, Zeners, and rectifiers Case mount rectifiers Thyristors Bipolar small die transistors Bipolar power transistors	1039 1042 1038 1040 1039 1039	Test condition B Test condition A Condition A (HTRB), JANTX and JANTX only Condition B, for JANS Condition B Condition B	100-percent 240 hours (minimum) 240 hours (minimum) 240 hours (minimum) Not applicable 240 hours (minimum) 240 hours (minimum) 240 hours (minimum) 240 hours (minimum)	100-percent 160 hours (minimum) 160 hours (minimum) 96 hours (minimum) 48 hours (minimum) Not applicable 96 hours (minimum) 160 hours (minimum)	100-percent 160 hours (minimum) 160 hours (minimum) 96 hours (minimum) 48 hours (minimum) Not applicable 96 hours (minimum) 160 hours (minimum)	MIL-STD-750, Method 1038 Method 1040	1000 h at max DC Reverse Voltage rated junction T. 1000 h at max AC blocking voltage and junction T. No 100% Screening, Initial Qualification only	3 lots - 77 samples each		
Final electrical test Interim electrical and delta parameters for PDA Other electrical parameters		As specified	100-percent Group A, subgroup 2, interim electrical and delta parameters. (read and record) Group A subgroup 3	100-percent Group A, subgroup 2. Read and record interim electrical and delta parameters Not applicable	100-percent Group A, subgroup 2. Read and record interim electrical and delta parameters (see Not applicable	User specification or supplier's standard specification	As needed for pre- and post-stress electrical test (no PDA)	All qualification parts submitted for testing		
Hermetic Seal Fine	1071	Omit for double plug diodes	Group A, subgroup 3 100%	100%	Not applicable 100%	JESD22 A-109	Fine and gross leak test per individual user	1 Lot 30 parts		
Gross Radiography	2076	Detect defects within sealed cases	100%	Not Applicable	Not Applicable	M-109	specification Not specified			No requirements in AEC-Q10
Radiography External visual examination	2076	To be performed after complete marking and prior to lot	100%	Not Applicable	Not Applicable Not Applicable	JESD22-B101	Not specified No 100% Screening, Initial Qualification only	All qualification parts submitted		into requirements in AEC-Q10.
		acceptance. To be performed on all case						for testing		
Case Isolation	1081	to be performed on all case isolated packages, as specified.	100%	100%	100%	l	Not specified			No requirements in AEC-Q10

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Table E-VIA Group B Inspections for JANS devices

to an address a		MIL-STD-750	Qualification and Large Lot	Small Lot Conformance		TM Description/Additional			
Inspections Subgroup 1	Method	Condition	Conformance	Inspection	TM	Requirements	Sample Size	Assessment	Rationale
Physical dimensions	2066	Dimensions in accordance with case outline specified in specification sheets.	22 devices, c = 0	8 devices, c = 0	JESD22 B-100	Part of Initial Qualification	1 lot, 30 samples		
Subgroup 2	Separate sam	ples may be used for each test. The sample plan applies to the number of					1		
Solderability	2026	leads inspected. A minimum of three	15 leads, c = 0	6 leads, c = 0	J-STD-002 JESD22-B102	Part of Initial Qualification	1 lot, 10 samples		Lower quantity in AEC
Resistance to Solvents	1022	devices shall be tested. Ink marked devices only. Not required if	15 devices, c = 0	6 devices, c = 0	JESD22-B107	Part of Initial Qualification	1 lot. 30 samples		
		marking is etched into the device. Salt atmosphere at +35°C passed thru							
Salt Atmosphere (corrosion)	1041	chamber for 24 +2/-0 h at rates of 10 - 50 g/m^2 per 24 h; examine post test. Laser	6 devices, c = 0	6 devices, c = 0		Not specified			No requirements in AEC-Q101
		marked devices only. Not required for non corrrosive base metals.							
Subgroup 3		correstive base metals.		1		-			
Thermal shock (liquid-to-liquid)	1056	25 cycles, condition B (glass diodes only)				Not specified			No requirements in AEC-Q101
Temperature cycling (air-to-air)	1051	Test condition C, or maximum storage temperature, whichever is less. (100			JESD22-A104	Part of Initial Qualification	3 lots, 77 samples each		
Surge	4066	cycles). As specified.				Not specified	cuci		No requirements in AEC-Q101
Hermetic seal Fine	1071	Fine leak not required for double plug	22 devices, c = 0	6 devices, c = 0	JESD22	Fine and gross leak test per	1 Lot 30 parts		•
Gross		diodes.			A-109	individual user specification			
Electrical Measurements		Group A, subgroup 2			User specification or supplier's	As needed for pre- and post-	All qualification parts submitted		
					standard specification	stress electrical test	for testing		
Decap-internal visual (design	2075	Visual criteria in accordance with qualified	6 devices, c = 0	6 devices, c = 0		Not specified			No requirements in AEC-Q101
verification)		design and internal visual precap criteria.				500 h, T A = max rated T j			
Bond strength (wire or clip bonded devices	2037	Condition D: testing for internal bonds at the die or substrate and the lead frame.	22 wires or 11 devices, c = 0, (whichever requires the	12 wires or 6 devices, c=0 (whichever requires the	MIL-STD-750,	for bonding of dissimilar metals, decap and wire	10 bonds from		Same as wire bond integrity in AEC?
(wire or clip bonded devices only)	2037	Similar to Condition C, but uses a hook under the lead wire.	(whichever requires the smaller number of devices.)	smaller number of devices.)	Method 2037	pull/bond inspection after	min of 5 parts		sume as write bond integrity in AEC?
SEM for applicable	2077		See MIL-STD-750 TM			WBI on all wires. Not specified			No requirements in AEC-Q101
designs)	-317		The same number of devices						10 - Equilibrium (101
Die shear (excluding axial	2017		used for bond strength will also be		MIL-STD-750,	Not specified	1 lot, 5 samples		Lower quantity in AEC
leaded devices)			used for die shear (minimum of six die).		Method 2017				
Subgroup 4			of six die).	1					
Intermittent operation life	1037 or 1042	2,000 cycles, Condition D. Devices with .008 inch or larger bond wires, 6,000			MIL-STD-750, Method 1037	Part of Initial Qualification	3 lots, 77 samples each		
Hermetic seal		cycles. Fine leak not required for double plug			JESD22	Fine and gross leak test per			
Fine Gross	1071	diodes.	22 devices, c = 0	12 devices c = 0	A-109	individual user specification	1 Lot 30 parts		
Electrical					User specification or supplier's	As needed for pre- and post-	All qualification		
measurements		Group A, subgroup 2 and as specified.			standard	stress electrical test	parts submitted for testing		
Bond strength		Condition D. The sample shall include a			specification				
(wire or clip bonded	2037	minimum of three devices and shall include all wire sizes.	11 wires, c = 0	11 wires, c = 0	MIL-STD-750, Method 2037	Part of Qualification	10 bonds from min of 5 parts		Same as wire bond integrity in AEC?
devices only) Subgroup 5		include all wire sizes.							
2000/00/22		Bias conditions as specified.							
Accelerated steady-state	1027	TJ = +275°C minimum (for 96 hours				Not specified			No requirements in AEC-Q101
operation life		minimum) or TJ = +225°C minimum (for 216 hours minimum) or TJ = rated °C							
		minimum (for 1,000 hours minimum).			User specification		All qualification		
Electrical measurements		Group A, subgroup 2 and 3			or supplier's standard	As needed for pre- and post- stress electrical test	parts submitted		
Schottky diodes, Case		TJ = rated TJ maximum			specification MIL-STD-750,		for testing 3 lots		
mount rectifiers	1038	(for 1,000 hours minimum).			Method 1038	Part of Qualification	77 samples each		
Electrical		Group A, subgroup 2 and 3.			User specification or supplier's	As needed for pre- and post-	All qualification parts submitted		
measurements				12 devices	standard specification	stress electrical test	for testing		
Accelerated steadystate		Condition B, VGS = rated, TA = +175°C,	22 devices, c = 0	c = 0			3 lots		
gate stress power MOSFETS	1042	t = 24 hours or TA = 150°C, t = 48 hours.			JESD22-A108	Part of Qualification	77 samples each		
			1		User specification		All qualification		
Electrical measurements		Group A, subgroup 2 and 3.			or supplier's standard	As needed for pre- and post- stress electrical test	parts submitted for testing		
		Condition A,			specification				
Accelerated steady-state reverse bias	1042	VDS = rated, TA = +175°C, t = 120 hours or TA = 150°C,			JESD22-A108	Part of Qualification	3 lots		
power MOSFETS		t = 240 hours and as specified.					77 samples each		
Electrical			1		User specification or supplier's	As needed for pre- and post-	All qualification		
measurements		Group A, subgroup 2 and 3.			standard	stress electrical test	parts submitted for testing		
Bond strength		As specified. Bond strength samples shall			specification MIL-STD-750,		10 bonds from		
(wire or clip bonded devices only)	2037	have passed accelerated steady-state operation life.	20 wires, c = 0	20 wires, c = 0	Method 2037	Part of Qualification	min of 5 parts		Same as wire bond integrity in AEC?
Subgroup 6 Thermal resistance				1					
Diodes Transistors (bipolar)	3101 or 4081 3131	As specified. Thermal resistance may be performed on a group C frequency			JESD24-4	Not specified Part of Qualification	1 lot, 10 samples		No requirements in AEC-Q101 Lower quantity in AEC
Transistors (POWER FETS)	3161	whenever 100% thermal impedance is	22 devices, c = 0	8 devices c = 0	JESD24-3	Part of Qualification	1 lot, 10 samples		Lower quantity in AEC
Thyristors IGBT	3181 3103	performed, except for power and case mounted devices			JESD24-6	Not specified Part of Qualification	1 lot, 10 samples		No requirements in AEC-Q101 Lower quantity in AEC
GaAs FET Subgroup 7	3104	l		l		Not specified			No requirements in AEC-Q101
High temperature life (non- operating)		340 hours minimum, T_STG(max) = T_A				Not specified			No requirements in AEC-Q101
	1032		32 devices, c = 0	12 devices	User specification		All qualification		
Electrical Measurements		Group A, subgroup 2		c = 0	or supplier's standard	As needed for pre- and post- stress electrical test	parts submitted for testing		
		l		l	specification	1			

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Table E-VIB Group B Inspections for JAN, JANTX, and JANTXV devices

Image:			MIL-STD-750	Qualification and	Small Lot Conformance		TM			
shift-raining is any plane show is any plane show were shall be shown in the support of the support o	Inspection	Method	Condition	Large Lot			Description/Additiona	Sample Size	Assessment	Rationale
space-billing 2014 - Description of a manual a manual a scale of a manual b manual a scale of a manual b ma	Subgroup 1		Separate samples n	nay be used for each te	est					
objectnorme object $i = 0$ $i = $			The sample plan applies to the							
IndexInterpretation statution statution statutionInterpretation statution statution statution statution statution statutionInterpretation statution statution statution statution statution statution statutionInterpretation statution statution statution statution statution statution statution statution statution statution statutionInterpretation statution statution statution statution statution statution statution statutionInterpretation statution statution statution statutionInterpretation statution statution statution statutionInterpretation statution statution statution statutionInterpretation statution statution statutionInterpretation statution statutionInterpretation st	Solderability	2026					Part of Qualification			Lower quantity in AEC
base base base base base base base base	soluciosinty	2020		c = 0	c = 0	JESD22-B102		10 samples		concil qualitaty invice
Index out 2 Under specified Under specifie	Resistance to Solvents	1022				JESD22-B107	Part of Qualification			
Internal Stack (qual to logis) 150 of excession 150 o	Subgroup 2		etched into the device.	C = U	C = U			30 samples		
Andrem 3.8.00 (pigue 6 space) Abs Goode anyly Abs Abs<			10 cycles condition B (glass							
Rest control correlation properties (spring is not provide and provide an	Thermal Shock (liquid to liquid)	1056					Not specified			No requirements in AEC-Q101
endingendue (condition (or end) (non- transfer ends) (no- transfer ends)										
Link Mathematics	Tomporature Cucling (air to air)	1051	storage temperature,			155022 4104	Part of Qualification	3 lots		
targe 400 Augenite No requirements in AEC QBD shift amoughers (corrosion) 20 Shift amoughers (corrosion) 20 Shift amoughers (corrosion) 20 Restruct amoughers (corrosion) No No requirements in AEC QBD shift amoughers (corrosion) 20 Shift amoughers (corrosion) 20 Restruct amoughers (corrosion) No No requirements in AEC QBD shift amoughers (corrosion) 20 Shift amoughers (corrosion) No	remperature cycling (an to an)	1051	whichever is less. (45 cycles			JE3D22-A104	Part of Qualification	77 samples each		
Set at an significant (correction) Satis at manufactor (relation of problem) Satis at manufactor (relation) Satis at manufactor (relation of pr										
Sist atmogher (corrosion) 201 association constrained by the chamber for 3-2 (corr 2-1), example of the chamber for 3-2 (corr 2-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example of the last norrequired for chamber for 3-2 (corr 3-1), example for a state state for indication for a state for chamber for 3-2 (corr 3-1), example for a state for chamber 3-2 (corr 3-1), example for a state for chamber 3-	Surge	4066					Not specified			No requirements in AEC-Q101
said atmosphere (corresion) 101 2/2 devices (more performance of low) 2/2 devices (construction performance of low) 2/2 devices (construction performance of low) Not specified Not speci										
silt drospiter (corroson) 104 /mr 2 pr 2 h, pamile post entrust is an article devices entry. e = 0 Mot specified										
image: space of the space o	Salt atmosphere (corrosion)	1041					Not specified			No requirements in AEC-Q101
def methodis only riseis only should be plog dode.is only shoul				C = 0	C=0					
Intermetics call File Gross 107 File law host regreted for double plug dode. Not specified for upplie? Not specified and post stress or upplie? All qualification and post stress or upplie? Not specified for upplie? Not specifie										
The Gots101Not specifiedNot specified <td>Hermetic seal</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Hermetic seal									
grossConstruction <th< td=""><td></td><td>1071</td><td></td><td></td><td></td><td></td><td>Not specified</td><td></td><td></td><td>No requirements in AEC-Q101</td></th<>		1071					Not specified			No requirements in AEC-Q101
Group A, subgroup 2 Image: Control of the subgroup 2 As A Recent of the subgroup 3 As A Recent of the subgroup 3 As A Recent of the subgroup 3 Subgroup 3			double plug diode.							
Circuit A Measurements Group A, subgroup 2 Image: Construction of the specification of the specific						User specification	As peeded for pre-	All qualification		
Subgroup 3Image: Subgroup 3Subgroup	Electrical Measurements		Group A subgroup 2			or supplier's				
Subgroup 1 Specification Specification Not specified Not specifi			Group A, Subgroup 2							
state operation life 102 Bias conditions as specified, 3db bours (mimum) Provide (mimum) Provid						specification				
$\frac{1}{1020} = \frac{1}{300} + \frac{1}{300} = \frac{1}{300} + \frac{1}{3000} + \frac{1}{30000} + \frac{1}{300000} + \frac{1}{300000} + \frac{1}{30000000} + \frac{1}{300000000000000000000000000000000000$	Subgroup 3				1		1			
Lifetrical measurements or metermitted geration life 1037 Group A, subgroup 2 2.000 cycles (min) Condition D, 2.000	Steady-state operation life	1027					Not specified			No requirements in AEC-Q101
Electrical measurements or remetication operation like1037 2000 cycles (min) cycles			S40 fiburs (filininun)				T 1>100°C			
decked and measurements ADS anota y subgroup 2 anota y subgroup 2<										
or merrinternitient operation life 104 2000 cycles (mn) christing (min) christing (min) (min) 0,2000 cycles (mn) fine laak not required for gross 45 devices c = 0 45 devices c = 0 45 devices (c = 0) 1071 (min)		1037				MIL-STD-750,		3 lots		
def der 45 devices c = 0 45 devices, c = 0 30000(r,y), 500 (r,y), 500 30000(r,y), 500 termetic seal fine gross 1071 fine leak not required for double plug diodes. 45 devices, c = 0 165022 fine and gross leak table 1 lot 30 parts Lower quantity in AEC gross Group A, subgroup 2 Group A, subgroup 2 Fine and gross leak table 1 lot 30 parts 1 lot 30 parts Lower quantity in AEC Bond strength (wire or clip bonded levices only) 2037 Group A, subgroup 2 111 wires c = 0 111 wires c = 0 111 wires c = 0 1 device c = 0 Part of Qualification aparts submitted 10 bonds from min of 5 parts Subgroup 4	or	1010								
Construction C	Intermittent operation life	1042	Condition D, 2,000 cycles (min)	AT devices			30000/(x+y), 7500	-		
Fine Gross 1071 Fine lask notrequired for double plug diodes. Fine lask notrequired for double plug diodes. Lower quantity in AEC Electrical measurements Image: specification of supplier's standard As needed for pre- and post-standard Image: specification of supplier's standard As needed for pre- and post-standard Image: specification of supplier's standard Image: specification of					45 devices, c = 0		cycles			
Infe 10/1 double plug diodes. A:10 test per individual user specification Lower quantity in AEC Gross Gross Group A, subgroup 2 Ser specification As needed for pre- and post-stress All qualification parts submitted All qualification and post-stress All qualification parts submitted Bond strength (wire or clip bonded leters only) 2037 Condition D. The sample shall include a minimum of three divers sizes 11 wires c = 0 11 wires c = 0 MIL STD-750, c = 0 Part of Qualification before and shall include all specification 10 bonds from min of 5 parts Subgroup 4	Hermetic seal		Fine leak not required for	0-0		IESD22				
Gross Image: constraint of the second se		1071						1 Lot 30 parts		Lower quantity in AEC
Electrical measurements As needed for pre- standard specification All qualification parts submitted specification All qualification pression All qualification pression Bond strength (wire or clip bonded devices only) 2037 Condition D. The sample shall include a minimum of three device and shall include all wire sizes. 11 wires c = 0 11 wires c = 0 MIL-STD-750, Method 2037 Part of Qualification 10 bonds from min of specification Subgroup 4	Gross						user specification			
Electrical measurements Group A, suggroup 2 standard specification standard specification and possiversa electrical test part of Qualification for testing part of Qualification Bond strength (wire or clip bonded devices only) 2037 Condition D. The sample shall include a minimum of three device and shall include all wire sizes. 11 wires c = 0 MILSTD-750, Method 2037 Part of Qualification 10 bonds from min of 5 parts 10 bonds from min of 5 parts Subgroup 4 Visual criteria in accordance with qualified design. 11 device c = 0 1 device c = 0 Not specified No requirements in AEC-Q101 Subgroup 5							As needed for pre-	All qualification		
condentconditionconditionspecificationelectrical testfor testingconditionBond strength (wire or clip bonded devices only)2037Condition D. The sample shall include a minimum of three device and shall include all11 wires c = 011 wires c = 0MIL-STD-750, Method 2037Part of Qualification10 bonds form min of S partsSubgroup 4	Electrical measurements		Group A, subgroup 2				and post-stress	parts submitted		
Bond strength (wire or clip bonded devices only) 2037 Condition D. The sample shall include a minimum of three device and shall include all device and shall include all wire sizes. 11 wires c = 0 11 wires c = 0 MIL-STD-750, Method 2037 Part of Qualification 10 bonds from min of 5 parts Subgroup 4							electrical test	for testing		
Bond strength (wire or clip bonded devices only) 2037 Induce a minimum of three device and shall include all wire sizes. 11 wires c = 0 ML-STD-750, c = 0 Part of Qualification Internation of 5 parts Subgroup 4			Condition D. The sample shall			specification				
devices only 2037 device and shall include all wire sizes. c = 0 Method 2037 Part of Qualification Trom mon of 5 parts Subgroup 4	Bond strength (wire or clip bonded			11 wires	11 wires	MIL-STD-750,				
Subgroup 4 Visual criteria in accordance with qualified design. 1 device c = 0 1 device c = 0 Not specified Not specified No requirements in AEC-Q101 Subgroup 5	devices only)	2037		c = 0	c = 0		Part of Qualification			
Decap internal visual (design verification) 2075 Visual criteria in accordance with c = 0 1 device c = 0 Not specified Not specified No requirements in AEC-Q101 Subgroup 5			wire sizes.					5 parts		
Decay internal visual (design) 2075 with 1 device 0 more quirements in AEC-Q101 Subgroup 5	Subgroup 4				1		1			
20/5 with qualified design. c = 0 c = 0 Not specified Not specified No requirements in AEC-Q101 Subgroup 5	Decap internal visual (design	ac		1 device	1 device					
Subgroup 5 Image: Subgroup 6 Image: Su	verification)	2075					Not specified			No requirements in AEC-Q101
Internal resistance Image: Additional synthesistance As specified. Thermal resistance maybe performed or group C frequency on port C frequency of the port C freq			quaimed design.		1		1	I		
Diodes 4081 As specified. Thermal resistance maybe performed on group C frequency whenever 100% thermal resistance maybe performed on group C frequency whenever 100% thermal method is angles in the scept for power and case mounted devices. 15 devices c = 0 6 devices c = 0 Not specified 1 lot 10 samples 1 lot 10 samples Lower quantity in AEC Q101 GBT 3101 impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is performed except for power and case mounted devices. impedance is per										
As specified. Inermal Transistors (bipolar) 3131 as specified. Inermal resistance maybe performed on group C frequency whenever 100% thermal impedance is performed except for power and case mounted devices. 15 devices c = 0 6 devices c = 0 JESD24-4 Part of Qualification 1 lot 10 samples Lower quantity in AEC IGBT 3103 3103 mounted devices. 15 devices c = 0 6 devices c = 0 Part of Qualification 1 lot 10 samples Lower quantity in AEC IGBT 3103 3104 Not specified Not specified No requirements in AEC-Q101 Subgroup 6 Not specified Not specified No requirements in AEC-Q101 Inon-operating] 1032 340 hours minimum, TSTG(max) = TA Group A, subgroup 2 32 devices, c = 0 12 devices, c = 0 Not specified Not specified No requirements in AEC-Q101 User specification or supplier's standard As needed for pre- and post-stress or supplier's standard As needed for pre- and post-stress or supplier's standard All qualification perticipal tori Part submitted perticipal tori Part submitted perticipal tori		4081					Not specified			No requirements in AFC-0101
Irransitors (bipolar) 3131 resistance maybe performed on group C frequency whenever 100% thermal impedance is performed except for power and case mounted devices. 15 devices c = 0 15 devices c = 0 15 devices c = 0 15 devices c = 0 16 devices performed c = 0 10 samples 10 to 10 samples 10 cover quantity in AEC IGBT 3103 impedance is performed except for power and case mounted devices. 15 devices c = 0 16 devices c = 0 Part of Qualification 11 lot 10 samples Lower quantity in AEC GBAT 3103 impedance is performed except for power and case mounted devices. 15 devices c = 0 16 devices c = 0 Part of Qualification 11 lot 10 samples Lower quantity in AEC GBAT 3104 3104 Vert performed except for power and case mounted devices. 15 devices c = 0 12 devices c = 0 Part of Qualification intervert 10 lot 10 samples 10 cover quantity in AEC GaAs FET 3104 10 cover quantity in AEC 10 cover quantity in AEC 10 cover quantity in AEC Subgroup 6 Vert of Qualification (non-operating) Not specified No requirements in AEC-Q101 1032 340 hours minimum, TSTG(max) = TA Group A, subgroup 2 32 devices, c = 0 12 devices, c = 0 Not specification or supplier's standard As needed for pre- and post-stress or particular total All qualification part submitted								1 lot		
Subgroup 6 (non-operating) 3161 on group Crequency (whenever 100% thermal (mpedance is performed except for power and case mounted devices. 15 devices c = 0 6 devices c = 0 JESD24-3 Part of Qualification (a) 1 lot 10 samples Lower quantity in AEC GBT 3103 impedance is performed except for power and case mounted devices. 15 devices c = 0 impedance is performed except for power and case mounted devices. 16 devices c = 0 Not specified 1 lot 10 samples No requirements in AEC-Q101 GBT 3104 10 1 lot 10 samples 1 lot 10 samples No requirements in AEC-Q101 Subgroup 6 V Not specified Not specified No requirements in AEC-Q101 Independence Subgroup 6 V No requirements in AEC-Q101 Subgroup 6 V Not specified No requirements in AEC-Q101 Independence Subgroup 6 V No requirements in AEC-Q101 Independence Subgroup 6 V No requirements in AEC-Q101 Independence Subgroup 6 Subgroup 6 V No requirements in AEC-Q101 Independence Subgroup 6 Subgroup 6 Subgroup 6 Not specified No requirements in AEC-Q101 Independence Subgroup 7 Subgroup 7 Subgroup 6 Subgroup 6 Subgroup 6 Subgroup 6<	i ransistors (bipolar)	3131				JESD24-4	Part of Qualification			Lower quantity in AEC
Impedance is performed tryristors Impedance is performed except for power and case mounted devices. C = 0 C = 0 C = 0 Impedance is performed and case Not specified Not specified Not specified No requirements in AEC-0101 IGBT 3103 impedance is performed except for power and case mounted devices. Impedance is performed except for power and case mounted devices. Impedance is performed impedance is performed intervention in AEC-0101 Impedance is performed intervention in AEC-0101 SaAs FET 3104 Impedance is performed intervention in AEC-0101 Impedance is performed intervention in AEC-0101 Impedance is performed intervention in AEC-0101 Subgroup 6 Impedance is performed intervention intervention in AEC-0101 Impedance is performed intervention intervention in AEC-0101 Impedance is performed intervention intervention in AEC-0101 Subgroup 6 Impedance is performed intervention intervention interventintervention intervention intervention intervention intervention i	Transistors (POWER FETS)	2161		15 devices	6 devices	IESD24-2	Part of Qualification			Lower quantity in AEC
Infristors 3181 (GBT except for power and case mounted devices. Not specified Not specified No requirements in AEC-0101 10 samples GBT 3103 mounted devices. JESD24-6 Part of Qualification 1 lot 10 samples Lower quantity in AEC GBAS FET 3104 Not specified Not specified No requirements in AEC-0101 Subgroup 6 (non-operating) 340 hours minimum, TSTG(max) = TA Group A, subgroup 2 32 devices, c = 0 12 devices, c = 0 User specification or supplier's standard As needed for pre- and post-stress or supplier's standard All qualification parts submitted No requirements in AEC-0101		2101		c = 0	c = 0	15024-2		10 samples		
IGBT 3103 mounted devices. JESD24-6 Part of Qualification 1 lot 10 samples Lower quantity in AEC GaAs FET 3104 Not specified Not specified No requirements in AEC-Q101 Subgroup 6 (non-operating) 340 hours minimum, TSTG(max) = TA Group A, subgroup 2 32 devices, c = 0 12 devices, c = 0 Not specified User specification or supplier's standard As needed for pre- and post-stress endertical tori for the stress of post-stress All qualification parts submitted All qualification parts submitted	Thyristors	3181					Not specified			No requirements in AEC-Q101
GaAs FET 3104 Not specified 10 samples Subgroup 6 Not specified Not specified High-temperature life (non-operating) 340 hours minimum, TSTG(max) = TA Group A, subgroup 2 32 devices, c = 0 12 devices, c = 0 Not specified User specification or supplier's standard Not specified and post-stress electrical tort All qualification parts submitted	IGBT	3103				JESD24-6	Part of Qualification			Lower guantity in AEC
Subgroup 6 Not specified High-temperature life (non-operating) 340 hours minimum, TSTG(max) = TA 32 devices, c = 0 12 devices, c = 0 Not specification or supplier's standard As needed for pre- and post-stress All qualification parts submitted Not requirements in AEC-Q101								10 samples		
High-temperature life (non-operating) Electrical measurements High-temperature life (non-operating) Electrical measurements High-temperature life (non-operating) State of the state of the st		3104					Not specified			No requirements in AEC-Q101
Incon-operating) Electrical measurements 1032 103 10 10										
Electrical measurements TSTG(max) = TA 32 devices, c = 0 12 devices, c = 0 User specification or supplier's and post-stress parts submitted standard electrical text for texting							Not specified			No requirements in AEC-Q101
Electrical measurements Group A, subgroup 2		·				User specification				
Electrical measurements Group A, subgroup 2 and post-stress parts submitted standard electrical text		1032		32 devices, c = 0	12 devices, c = 0					
	Electrical measurements		Group A, subgroup 2							
		I					electrical test	for testing		

MIL-PRF-19500 vs. AEC-Q101 Semiconductor Devices Bill Captorini (HiBal Components Engineering & Ma

Bill Cantarini (HiRel Components Engineering & Manufacturing)

Group A Inspection

		MIL-STD-750			тм	TM Description/Additional Requirements	Sample		
Subgroups	Method	Condition	JANS sample plan	JAN, JANTX, JANTX sample plan				Assessment	Rationale
Subgroup 1 (all devices except small die flow)									
		Verify workmanship of		116 devices, c = 0					Qty higher than JANS,
Visual and mechanical inspection	2071	hermetically packaged	15 devices c = 0	(JANTXV) 45 devices, c = 0	JESD22 B-101	inspect part construction, marking and workmanship	1 lot 30 samples		JANS devices are manufactured to hig
inspection		semiconductor devices	C = 0	(JAN, JANTX)		and workmanship	30 samples		standards.
Subgroup 1 (for small die									
flow only 2/ 3/)		Verif		116 devices, c = 0					
Visual and mechanical	2071	Verify workmanship of hermetically packaged		(JANTXV)	JESD22 B-101	inspect part construction, marking	1 lot		Lower quantity in A
inspection 4/		semiconductor devices		45 devices, c = 0 (JAN, JANTX)		and workmanship	30 samples		
	2026		1	(1.1.1)		Magnification 50x. Reference solder			
Solderability 4/	(J-STD-			15 leads, c = 0	J-STD-002 JESD22B102	conditions in Table 2B. Apply test method A for through-hole, or both	1 lot 10 samples		Lower quantity in A
	002)				3030228102	test methods B and D for SMD.	10 samples		
		Verify that the markings				Verify marking permanency (not			
Resistance to solvents 4/ 5/	1022	will not become illegible		15 devices, c = 0	JESD22-B107	required for laser etched parts or	1 lot		
		on devices when subjected to solvents.				parts with no marking)	30 samples		
		Salt atmosphere at	-						
Salt Atmosphere corrosion), (Laser marked		+35°C passed thru							Salt not listed but Auto
levices only. Not required	1041	chamber for 24 +2/-0 h		6 devices, c = 0					and Corrosion are
for non-corrosive base		at rates of 10 - 50 g/m^2 per 24 h;							referenced
metals)		examine post test.							
						1000 cycles (Ta = minimum range of 55°C to maximum rated junction			
						temperature, not to exceed 150°C).			
		Default test conditions:		Test condition C, or maximum		Can reduce duration to 400 cycles	3 lots		
Temperature cycling (air to air)	1051	minimum of 20 cycles using test condition C (-		storage temperature, whichever is	JESD22 A-104, Appendix 6	using Ta (max) = 25°C over part maximum rated junction	77 samples		
()		55 to 175°C).		less, 25 cycles. 22 devices, c = 0		tempreature or using Ta(max) =	each		
						175°C if the maximum rated junction			
						tempreature is above 150*C. Test before and after TC			
			1		User				
Electrical measurements	Group A, subgroup				specification or supplier's		All qualification parts submitted		
(group A, subgroup 2)	2				standard		for testing		
			-		specification				
Hermetic seal 6/		Fine leak not required			JESD22	Fine and gross leak test per			
Fine leak	1071	for double plug diodes.		22 devices, c = 0	A-109	individual user specification	1 Lot 30 parts		Refer to page 12
Gross leak			+	Precondition: Ta = +250°C at t = 24		Pre- & post-process change	10 bonds		
Bond strength 4/	2037			h or Ta = +300°C at t = 2 h; 11	MIL-STD-750 Method 2037	comparison to evaluate process	from min of		
			4	wires, c = 0	wethod 2057	change robustness	5 parts		
		Verify that design and construction of dvice				Random sample of parts that have			
Decap internal visual (design verification)	2075	are the same as those		4 devices, c = 0	AEC-Q101-004, Section 4 (DPA)	successfully completed H3TRB or	2 samples, 1 lot		Only DPA specified
(,8,		documented in qualified design report.				HAST, and TC			
Subgroup 2		488							
					User specification or	Test is performed as specified in the			
DC (static) test		+25°C ± 3°C	116 devices c = 0 7/9/	116 devices c = 0 7/	supplier's	applicable stress reference at room	3 Qual lots		
					standard	temperature	77parts/lot		
Subgroup 3					specification				
					User				
DC (static) test		High (-0°C, +10°C) and low (+0°C, -10°C)	116 devices c = 0 7/9/	116 devices c = 0 7/8/	specification or supplier's	Test is performed as specified in the applicable stress reference at room	All qualification parts submitted		No temperature test
De (Sube) test		specified temperatures	110 devices e = 0 77 57	110 0000000 - 0 77 07	standard	temperature	for testing		stated in specification
Subgroup 4					specification				
Subgroup 4					User				
					specification or	Test is performed as specified in the	All qualification		
Dynamic tests		+25°C ± 3°C	116 devices c = 0 7/9/	116 devices c = 0 7/8/	supplier's standard	applicable stress reference at room temperature	parts submitted for testing		Note 1
					specification				
Subgroup 5 Safe operating area test		1	1						
(for transistors only):									
a. DC									
 Clamped inductive (only when applicable) 				45 devices c = 0					Note 2
End-point electrical measurements			45 devices c = 0 10/						
Safe operating area test			1			Pre- & Post-process change			
c. Unclamped inductive					AEC-0101-004	comparison to evaluate			
(only when applicable)				45 devices c = 0	AEC-Q101-004 Section 2	process change robustness (Power MOS and internally clamped IGBTs	1 lot 5 samples		See Table 2 Item 2
End-point electrical						only).			
measurements Subgroup 6		1	1	I		I	I		
Surge current (for					User				
diodes/rectifiers only)				22 davi	specification or	former and and an and and and	All qualification		
				22 devices c = 0	supplier's standard	Surge not referenced in AEC100	parts submitted for testing		Note 2
End-point electrical	1	1			specification				
End-point electrical measurements									
End-point electrical		•			licer				
End-point electrical measurements <u>Subgroup 7</u>					User specification or		All qualification		MIL-PRF does not spi
End-point electrical measurements			45 devices c = 0 10/	22 devices c = 0		As needed for pre- and post-stress electrical test (no PDA)	All qualification parts submitted for testing		MIL-PRF does not sp tests and is assignable customer similar to a

 As noted in AEC- Q100, qualifiation is performed only once and maintained through SPC. An integral part of the Near Term Tech specification will need to identify all required SPC.
 SPC will need to be an integral part of the specification. This includes determining the independent variables such as wafer to wafer and onwafer location variablitity as well as assembly variability. These variables should be forced during sampling.

Note 1 - Under AEC101 Apendix 5 "Minimum Parametric Test" there is no listing for SOA tests Note 2- Under AEC101 Apendix 5 "Minimum Parametric Test" there is no listing for Surge tests MIL-PRF-19500 vs. AEC-Q101 Semiconductor Devices Sultan Lilani (Integra Technologies)

Group C Periodic Inspections (all quality levels)

Tab: Table E-VII

Inspections	Method	MIL-STD-750	Sample Plan	conformance	TM	TM Description/Additional	Sample Size	Assessment	Rationale
Subgroup 1	Method		7 1911			negarementa			
Physical dimensions	2066	Dimensions in accordance with case outline specified in specification	15 devices	6 devices c=0	JESD22 B-100	Verify physical dimensions to the applicable user part			Note 1: For AEC; performed
1/(not required for IANS)	2066	outline specified in specification sheets	c=0	6 devices c=0	JESD22 B-100	packaging specification for dimensions and tolerances			during initial qual or when process change is made
Subgroup 2									
Thermal Shock (liquid to liquid)	1056	25 cycles, condition B							Not stated in AEC-Q101
to liquid)						1000 cycles (TA = minimum			
Temperature cycling (air to-air)	1051	Test condition C (-55 to +173*C), or maximum storage temperature, whichever is test, 67 cycle including screening)	22	6 devices c=0	JESD22 A- 104, Appendix 6	range of -55°C to maximum rated junction temperature, not to exceed 130°C). Can educe duration to 400 cycles using TA (max) = 25°C coerci- tion and the state of the transmum and the temperature or using TA (max) = 17°C of the maximum rated junction temperature is above 150°C. TST before and the TC. Note: At Caddinoval req°L is posit temp cycle: 125°C decar pand wire poil on al invest find a Source pant internal bond wire sizes 5 mail tameter and the sizes 5 mail tameter and the sizes in addition.	77 samples from 3 lots for each test		AEC requires more cycles, along with pre- and post-test inspections.
						there is 100% CSAM req't post TC. Evaluate lead integrity of			
Terminal strength	2036	As specified			MIL-STD-750, Method 2036	leaded parts only Guideline for opening plastic			
Surface mount end cap bond integrity	2038	As specified (Condition B for US devices)			AEC-Q101, Appendix 6	Guideline for opening plastic packaged devices for reliable wire pull or bond shear testing.			AEC-Q101 Appendix 6 refers to plastic parts only. No specifics o end cap bond integrity testing.
Hermetic seal 2/									
a. Fine leak b. Gross leak	1071	Fine leak not required for double plug diodes.			JESD22 A-109	Fine and gross leak test per individual user specification	1 Lot 30 parts		AFC has no provision free
Moisture resistance	1021	Omit initial conditioning							AEC has no provision for moisture resistance testing for hermetic package but does perform HAST with
Electrical		Group A, subgroup 2	1						preconditioning for plastic
measurements	Notren-4	red for disc packages or metallurgically	/ bonded 4	ouble plug devicer					
Subgroup 3	or stud pa	ickaged devices		and the second second					
Shock	2016	Nonoperating, 1,500 G's, 0.5 ms, 5 blows in each orientation, X1, Y1, and Z1 (Y1 only for axial glass diodes)			JESD22 B-104	1500 G's for 0.5 ms, 5 blows, 3 orientations. Test before and after mechanical shock Use a constant displacement			
Vibration, variable frequency	2056	Peak-to-peak amplitude of 0.06° or peak accleereation of 20 g's over 20 to 2000 Hz; Cycle performed 4 times in each x, y, and z orientations.	22 devices c=0	6 devices c=0	JESD22 B-103	Use a constant displacement of 0.06" (double amplitude) over the range of 20 Hz to 100 Hz and a 50 G constant peak acceleration over the range of 100 Hz to 2 KHz. Test before			
Constant accleration 3/	2006	1 minute minimum in each orientation. X1, Y1, and Z1 at 20,000 G's minimum, except at 10,000 G's minimum for devices with power	devices c=0		MIL-STD-750, Method 2006	and after VVF Y1 plane only, 15K G-force. Test before and after constant acceleration	30 samples, 1 lot		AEC requires Y1 plane only, 15K force
Electrical		rating of ≥ 10 watts. Tc = +25°C Group A, subgroup 2							
measurements Subgroup 4									
Salt atmosphere (corrosion) 1/	1041	Salt atmosphere at +35°C passed thru chamber for 24 +2/-0 h at rates of 10 - 50 g/m^2 per 24 h; examine	15 devices c=0	6 devices c=0					Not stated in AEC-Q101
Subgroup 5		post test	C=0						
Thermal resistance 4/	4081								
Transistors (bipolar)	3131		15			Measure TR to assure			
Transistors (power FETs)	3161	As specified	devices c=0	6 devices c=0	JESD24-3, 24-4, 24-6 as appropriate	specification compliance and provice process change			Sample size not specified in AEC
Thyristors	3181 3103		C=0			comparison data			
CaAs FET	3103	Nete							
Subgroup 6 5/6/		Not required for disc pa	ucages		Test methods as follows				
Steady-state operation life	1026	1,000 hours minimum, bias conditions as specified. 7/ 8/			corresponding to each test in column F: HTRB: -STD-750-1 M1038 Method A, AC blocking voltage: MIL-STD-750-1 M1040 Test condition A, HTFB: JESD22 A-108, Steady state: MIL-STD- 750-1 M1038 Condition B (Zeners), HTGB: JESD22 A-108	1000 hours for each of the following tests are performed with testing before and after each hrs of each of the following: HTRB (reverse bias) AC blocking voltage, HTFB (forward bias), Steady state operational, HTGB (gate bias)	77 samples from 3 lots for each test		
Electrical measurements or Intermittent operation life	1037	6,000 cycles minimum	22 devices c=0	12 devices c=0	MIL-STD-750, Method 1037	Intermittent operational life: Tested per duration_indicated in Table 2A. Ta+25°C: Parts powered to insure Tj ≥ 100°C (not to exceed absolute maximum ratings). Test before and after IOL as a minimum			Sample size not specified in AEC
Hermetic seal 2/ a. Fine leak	1071	Fine leak not required for double plug diodes			IFSD22 8-109	Fine and gross leak test per			Sample size not specified in AEC
b. Gross leak Electrical			1			individual user specification			gree and appearing all AEC
Electrical measurements		Group A, subgroup 2	L						
Bond strength 9/	2037	Condition D, .008 inch or larger wire or clip bonded devices only. The sample shall include a minimum of three devices and shall include all wire sizes			MIL-STD-750, Method 2037	Pre- and post-process change comparison to evaluate process change robustness			
or Blocking life 8/	1048	wire sizes Perform with primary blocking junction reverse biased at elevated T for time period in accordance with life test requirements. Typically +150°C and at 80-85% of rated voltage.	11 wires, c=0	11 wires, c=0					This test methodology is not addressed in AEC document. Alternative method (steady stat or intermittent life; may be used with revised biasing scheme)
Electrical measurements		Group A, subgroup 2			Additional AEC-Q101 test include : Unbiased HAST, biased HAST, High humidity High temp forward bias, High humidity, high temp reverse bias,				
Subgroup 7 10/							-		
Internal gas analysis	1018	To be performed on each structurally identical package family	3 devices c=0	3 devices c=0					This test methodology is not addressed in AEC document. Th is an important test and should
L		l	I	I	I		1		be performed

1/ Electrical reject devices, from the same inspection lot, may be used for all subgroups when electrical end-point measurements are not required. Other non-catastrophic rejected devices (i.e., PIND, X-ray) may be utilized for all subgroups. For subgroups with end-point measurements, the devices shall be screened to table E-IV through screen 13. Salt atmosphere not required for Laser marked devices when devices from group A for small die flow, salt atmosphere have been selected to satisfy group C inspection requirements.

2/ Non-transparent glass encased double plug noncavity diodes only may use test method 2068 of MIL-STD-750, in lieu of 1071. This test may be performed after electrical measurements.

3/ Not applicable to any devices with external and internal pressure contacts (die to electrical contacts), optical coupled isolators, and double plug diodes.

4/ Not required when performed in group B.

5/If a given inspection lot undergoing group B inspection has been selected to satisfy group C inspection requirements, the 340 hour or 2,000 cycles life tests may be continued on test to 1,000 hours or 6,000 cycles, as applicable, in order to satisfy the group C life test requirements. End-point measurements shall be performed on either table E-VIA, group B, subgroup 4, or table E-VIB group B, subgroup 3 (340 hours or 2,000 cycles, as applicable) to satisfy group B (table E-VIA or table E-VIB) lot acceptance or group C, subgroup 6 (1,000 hours or 6,000 cycles, as applicable) to astisfy group B and C lot acceptance.

6/ Intermittent operation life shall be performed on all case mounted devices.

 $7/\,\text{TJ}$ = 150°C (min) or rated TJ whichever is less (except schottky and power mosfets) for operation life.

8/ The sample size may be increased and the test time decreased so long as the devices are stressed for a total of 22,000 device hours minimum, and the actual time of test is at least 340 hours.

9/ Required for JANS devices with .008 inch or larger bond wires only. Not required when JANS devices from group B bond pull inspection have been selected to satisfy group C inspection requirements.

10/ Internal gas analysis shall be performed on hermetic devices. An engineering evaluation shall be performed if there is a device failure to determine the moisture source (e.g. sealing environment, non hermetic device). The entire lot shall be rescreened in accordance with screen 14 herein (and resubmitted at 5/0.) Corrective action shall be taken as necessary. Subgroup 7 is not required for noncavity double plug devices.

"- I had some time today so I took a look at the MII-PRF-19500 table comparison. It looks like someone started working on it so I didn't add to the already filled columns. However, I added a column next to automotive test method with sample size. Hope It is okay. I figured it gives an idea on automotive sampling required since their qual methodology is very different from Mil standard.

 ladded some req'ts to Table E-VII for steady state life, constant acceleration sample and Temp cycle.
 AEC-Q101 adds several types of 1000 hr life testing (not just one per MiI-PRF-19500). See table above.
 AEC-Q101 adds several biased HAST and CSAM following temp cycle (I noted them in table).

Some general notes are same as notes on Mil-PRF-38535.

o Group A and Group B of Mil-PRF-19500 do not have an equivalent AEC-Q101.

o Qualification is performed initially with no repeats unless a process changes.

o A couple of tests, ie. ESD and parametric are required for each new part but other tests called out in AEC-Q101 can be applied to part family.

Thanks

Lilian"

MIL-PRF-123 vs. AEC-Q200 Capacitors, fixed, ceramic dielectric

Table IX. Qualification Inspection

Gen ::: 1	тм	TM Description	Number of sample units to be inspected	Number of failures 1/	IM	TM Description/Additional Requirements	Sample Size per Lot	Number of lots	Assessment	Rationale
Group I Radiographic inspection (leaded devices only)	4.6.5		All	N/A						No requirements in AEC-Q2
Thermal shock	4.6.6.1 (MIL-STD- 202, method 107)	a. Test condition A (except step 3): tested at +125°C b. Qual tests: 100 cycles c. Group A: 20 cycles d. Group B: 100 cycles		See table XVI			30	1		No test descriptions in AEC- Q200
Voltage conditioning	4.6.6.2	All parts to be exposed to test voltage ±5%, for defined time and temperature.				Electrical characterization – show Mila, Max, Mean, and Sider at RT, Min and Max operating temperatures.	User spec	User spec		Applied voltage depends o user spec. Mostly intended measure capacitance and C factor.
Dielectric withstanding voltage	4.6.9 (MIL-STD-202, method 301)	a. 250 – 400% of direct current rated voltage. b. 521 seconds; ramp up within 1 second, max. C. Between capacitor-element terminals. d. Surge current 30 – 50 mA e. Examined for evidence of damage and breakdown.	e 186 min 2/		User spec					Dielectric withstanding voltage test may be part of electrical characterization. Test conditions set by user spec.
insulation resistance +25°C	4.6.10 (MIL-STD- 202, method 302)	 c. Between mutually insulated points. a. 1 MHz ± 100 kHz when 100 pF or less for BX and BR and 1000 pF or less for BP and BG. 1 kHz ± 100 Hz when capacitance is greater than above. b. RMS voltage of 1.0 ± 0.2 V. 								Room temperature testing rated voltage. Sample size determined by user spec.
Insulation resistance +125°C										Max operating temperatur testing to rated voltage ma be included. Grades 0 and have maximum temperatu rating of +150°C and +125° respectively. Sample size is determined by user spec.
Capacitance	4.6.7 (MIL-STD-202, method 305)									Capacitance is measured a min/room/max temperatu at a minimum. Dissipation factor is measu
Dissipation factor	4.6.8	Measured with a capacitance bridge or other suitable method at the frequency and voltage in 4.6.7								at min/room/max temperatures at a minimu
Visual and mechanical examination; material, design, construction, and workmanship	4.6.3	magnification. Use Appendix B for non-leaded capacitors.		1	MIL-STD- 883, method 2009	 to 10x magnification. Inspect device construction, marking, and workmanship. 	all qual part	s submitted		Sample size undefined.
Destructive physical analysis 3/	4.6.11	See 4.6.11 for details on Group 1 and Group 2 requirements			EIA-469	Only applies to SMD ceramics. Electrical test not required.	10	1		10 samples required vs. 15 MIL-PRF.
Group IIIa – Leaded devices Terminal strength	4.6.12.1 (MIL-STD- 202, method 211)	Leaded capcitors: apply 2±.1 kg on terminal			MIL-STD- 202, method 211	Leaded device only. Ceramics: A (454 g), C (227 g), E (1.45 kg-mm); Tantalums: A (2.27 kg), C (227 g), E (1.45 kg-mm)	30	1		Ceramic load requirement than that required in MIL-F
Solderability	4.6.13.1 (MIL-STD- 202, method 208)	Test two terminals	12	1	J-STD-002	S0x magnification. Leaded method A: @235°C, cat 3. SMD method B, 4 h @155°C dry heat @235°C; method B @215°C cat 3; method D cat 3 @260°C.	15 each condition	1		
Resistance to soldering heat	4.6.14.1 (MIL-STD- 202, method 210)				MIL-STD- 202, method 210	Test condition D for SMD and condition B for leaded. Pre-heat @150°C for 60-120 s allowed for ceramics	30	1		
Group IIIb - Nonleaded devices				I		ceraniics	1	I		
Terminal strength	4.6.12.2 (MIL-STD- 202, method 211)	Attach nail head, apply 1±.1 kg on CKS51 and CSK52; 2±.2 kg on CKS53 and CKS54.				Terminal strength on leaded devices only 50x magnification. Leaded method				Not required for non-leade devices
Solderability	4.6.13.2 (MIL-STD- 202, method 208)	Immerse in molten solder to a depth of .020 +.010/000" or the entire capacitor	12	1	J-STD-002	A: @235°C, cat 3. SMD method B, 4 h @155°C dry heat @235°C; method B @215°C cat 3; method D cat 3 @260°C.	15 each condition	1		
Resistance to soldering heat	4.6.14.2 (MIL-STD- 202, method 210)	Immersed in molten solder. See 4.6.14 for details.			MIL-STD- 202, method 210	Test condition D for SMD and condition B for leaded. Pre-heat @150°C for 60-120 s allowed for ceramics	30	1		
Group IV 4/	4.6.15	See Table XVIII for voltage and temperature ranges. Temperature range: -55 to +125°C; rated voltage applied.	12	1	User spec	Electrical characterization – show Min, Max, Mean, and Stdev at RT, Min and Max operating temperatures.	User spec	User spec		User spec may not require voltage-temperature limit measurements.
Moisture resistance	4.6.16.2 (MIL-STD- 202, method 106)	20 cycles; first 10 cycles, apply 50V; after final cycle, condition at 25±5°C and 30-60% RH for 18-24 h. See 4.6.16.2 for details.	**	-	Not listed	Not listed	77	1		No details listed in Q200. May accept generic data.
<u>Group V</u> Humidity, steady state, low voltage	4.6.16.1 (MIL-STD- 202, method 103)	+85°C, 85% RH for 240 h, 1.3±0.25 VDC applied through 100 kohm resistance; after testing, dry for 3±0.5 h at +25°C and perform insulation resistance test through 100 kohm resistor at 1.3±0.25 VDC and capacitance. Visual inspection.		0	Not listed	Humidity bias	77			No details listed in Q200. May accept generic data.
/ibration, high frequency (leaded capacitors only)	4.6.17 (MIL-STD- 202, method 204)	Apply 125% of voltage rating. Test condition E (max 50 g's), except freq range of 10 – 3000 Hz.	12	1	MIL-STD- 202, method 204	z	30	1; when generic family data is provided in lieu of component specific data, 3 lots are required.		No requirements for elect measurements during vibi test.
Resistance to solvents	4.6.18 (MIL-STD- 202, method 215)	Marked portion of body brushed			MIL-STD- 202, method 215	Add aqueous wash chemical OKEMCLEAN (6% concentrated Oakite cleaner) or equivalent.	5	1		Less number of samples tested.
Group VI	4.6.19 (MIL-STD- 202, method 108)	See Table XIX for accept/reject criteria; test at 125 +4/-0°C; 4000 h for qual and 1000 h for group B.	123	1						No requirements. May be unnecessary for short-term missions.

1/ A sample unit having one or more defects will be charged as a single defective.

2/ Additional samples over the 186 minimum should be included, based on Table XVI to allow for the percent defective allowable. Twelve additional samples shall be required for nonleaded devices 3/ DPA samples shall be divided with 10 samples subjected to group 1 (see 4.6.11.1) and 5 samples to group 2 (see 4.6.11.2) 4/ Leads may be soldered to chip capacitor to facilitate the tests required in group IV.

Each production lot of parts to be inspected in accordance with Table X.

Table X. In-process Inspection

Inspection	Requirement paragraph	Description	ТМ	TM Description	Sample Size
Nondestructive internal				Ultrasonic exmination or other non-	
examination	3.5		4.6.1	destructive tests	100%
Pre-termination destructive					
physical analysis	3.6	5	4.6.2	See Table XIV	Table XIV
Visual examination	3.7	7	4.6.3	Leaded devices: use 10x visual inspect	ic 100%
Pre-encapsulation terminal					
strength (leaded capacitors only)	3.8	3	4.6.4		Table XV
Post termination, unencapsulated					
destructive physical analysis	3.15	; 	4.6.11		Table XVII, group 1
Table XIV. Pre-termination DPA sa					
	Minimum	A	D. i		
Lot Size	sample size	Accept	Reject		
1-500	14	0	1		
501-10000	32	1	2		
10001-35000	50	2	3		
35001-500000	80	3	4		
Table XV. Pre-encapsulation termi	nal strength				
	Lead pull				
Lead configuration	minimum	Sample size			
Radial per lead	1.8 kg (4.0 lbs)	5			
	All styles except				
	CKS11 and CKS12				
	– 1.8 kg (4.0 lbs)				
Axial per lead	CKS11 and CKS12	5			
	styles – 0.9 kg				
	(2.0 lbs)				
Dual in-line package	2.14 kg (4.7 lbs)	5			
Table XVII. Destructive physical an					
Lot size		Ainimum sample size <u>1</u> /			
1 500	Group 1 <u>2</u> /	Group 2 <u>3</u> /			
1-500	5	3			
501-10000	10	4			
10001-35000	25	7			
35001-500000	40	10			

1/ No failures allowed

2/ Leaded capacitors: After lead attachment and before encapsulation, or after removing encapsulation. Group 1 inspected for lead attachment, other assembly-related defects. 3/ Non-leaded capacitors: Performed after final termination coating application. See Appendix B.