

Comparison of Quality levels for EEE Parts

S/No	Tests	Space Grade	MIL Grade
1.	Application	Certified for Space Application	Certified for Defence/Military Application
2.	Process Control	✓	X
3.	Precap Visual Inspection	✓	X
4.	Screening Tests		
4a.	PIND	✓	X
4b.	Radiography	✓	X
4c.	Burn in Duration	240 hrs	Varies
4d.	PDA Criteria	✓ (<5%)	X

Comparison of Quality levels for EEE Parts

S/No	Tests	Space Grade	MIL Grade
6.	Lot traceability	✓	X
7	Radiation Test	✓ (if applicable)	X
8	Reliability Data	Defined FIT rate available. Space Grade < 10FITs	X
9.	Datapack	✓	X
10.	Schedule	Can be used readily.	Upscreening Required

Differences in Components Quality

Process	Grade 1 Class S QML V	Grade 2, Jan Class B, QML Q	Grade 3 883B	Grade 4 Commercial	Comments
Certification of Plant and Operators	Yes	Yes	No	No	
Baselined Process Flow	Yes	Yes	No	No	Vendor's 883B flow may change as frequently as they want/need. No control.
Traceability of Baseline Changes	Yes	Yes	No	No	883B = As long as meets data sheet, no explanation required; and Data sheet can change at will.
Number of Wafer Runs in lot	1	No longer controlled (but only from certified fab)			883B may use as many as they want, from different fabrication facilities, domestic or foreign - and mix together, change at will. Major radiation and DPA concern!
Wafer Lot Acceptance	Yes	No	No	No	wafer thickness, metal thickness, glass thickness, gold backing thickness, and thermal stability not monitored. These were "early" indicators of ionic contamination, latent failures, etc.

Differences in Parts Classes

Process	Grade 1 Class S QML V	Grade 2, Jan Class B, QML Q	Grade 3 883B	Grade 4 Commercial	Comments
Wafer Rework Control	Yes	Yes	Not control ed	No	A concern for homogeneity and radiation hardness assurance
Wafer Bonusing Controlled	Yes	No	No	No	A concern for homogeneity and radiation hardness assurance
Certification of Plant and Operators	Yes	Yes	No	No	883B Assembles to internal controls, changes when they desire, contracts assembly out to cost effective sources, worldwide and mixes lots
Internal Visual Inspection	Yes Cond. A	Yes Cond. B	No=Mil Spec Yes=Int ernal Vendor Spec	Not done	Rejects to Grade 2 (Cond B) Parts are acceptable to 883B flow.

Qualification	Grade 1 Class S QML V	Grade 2, Jan Class B, QML Q	Grade 3 883B	Grade 4 Commercial	Comments
Agency Team Certification of Plant and Operators	Yes	Yes	No	No	883B Qualification can be conducted by foreign or domestic contract house, to published or changed electricals, vendor's life test burn in boards.
Frequency of 1000 hour Life test	Yes (every lot)	12 months	12 months	None	S = on every lot, Class B & 883B = may be completed by outside contractor, and may be completed on a "similar device". May be several years between actual qualification.
Frequency of Package Qual	6 months	12 months	12 months	None	883B = May be completed by outside contractor.

Screening	Grade 1 Class S QML V	Grade 2, Jan Class B, QML Q	Grade 3 883B	Grade 4 Commercial	Comments
Agency Team Certification of Plant and Operators	Yes	Yes	No	No	883B may change electricals, burn-in boards, testers, handlers, etc. at will. Screening can be contracted out to lower cost outside and foreign screening house and mixed.
Electrical Subgroup 1- 12 Tested	Yes	No	No	No	S only includes read and record, Slash Sheet vs. advertised data sheet
Extended Burn-In (Dynamic, 240 hours)	Yes	No	No	None	883B = Control of BI Board configuration may be changed at will.
100% PIND Test	Yes	No	No	No	Particles are a concern in Space hardware.
PDA	5%	10%	Some	No	Reject lots from Class S are acceptable for B.
Attributes Data	Yes	Yes	Yes	No	
Variable Data (Read/Record)	Yes	No	No	No	S only
Failure Analysis Requirements	Yes	No	No	No	S only

Assembly	Grade 1 Class S QML V	Grade 2, Jan Class B, QML Q	Grade 3 883B	Grade 4 Commerc ial	Comments
Agency Team Certification of Plant and Operators	Yes	Yes	No	No	883B Assembles to internal controls, changes when they desire, contracts assembly out to cost effective sources, worldwide and mixes lots
Internal Visual Inspection	Yes Cond. A	Yes Cond. B	No=Mil Spec Yes=Internal Vendor Spec	Not done	Rejects to Grade 2 (Cond B) Parts are acceptable to 883B flow.
Tightened Lot Control	Yes	No	No	No	883B allows for multiple operators/ machines, contract to outside assembly houses [uncertified: foreign or domestic]
Non Destructive Bond Pull	Yes	No	No	No	Early indicator of bonding problems prior to seal/burn-in temperatures. (Commercial product uses gold wire on aluminum metalization). New bonders have NDBP built in.

GRADE	SUMMARY	LEVEL OF IN-PROCESS CONTROLS AND SCREENING	COST/ PART	POTENTIAL UPSCREEN COST	TYPICAL USE
1	Space quality class qualified parts or equivalent.	Highest	Highest	Low	Space flight.
2	Full Military quality class qualified parts or equivalent.	High	High	Medium	Space flight or critical ground support equipment.
3	Low Military quality class parts and Vendor Hi-Rel or equivalent. Screened automotive grade EEE parts.	Medium	Moderate	High	Space flight experiments, cube-sats noncritical space flight, critical ground support equipment, test demonstrations and ground support systems.
4	“Commercial” quality class parts. Qualification data at manufacturer’s discretion. No government process monitors incorporated during manufacturing.	Variable	Lowest	Highest	Cube-sats, noncritical space flight, noncritical ground support equipment, ground support systems, test demonstrations and prototypes. Limited critical GSE.

Grade 1

- Equipment supporting functions of critical mission objectives and safety such as life support or launch abort systems, requiring maximum feasible reliability.
- Project having very high visibility both within and outside of NASA.
- Projects involving objectives which may be difficult to repeat in another mission.

Grade 2

- Equipment that requires high reliability, but for which a low risk of failure can be tolerated to meet cost or schedule constraints.
- Multiple or single purpose, with a repeat mission possible.
- Critical ground support equipment.

Grade 3

- Equipment where high reliability is desired, but is not mandatory.
- Single purpose or routine mission with repeat missions possible.
- Application is usually space flight experiments or ground support equipment.

MIL-PRF-19500 Screening Requirements

Test/Inspection	Screening Level			MIL-STD-750 Method
	JANTX	JANTXV	JANS	
Internal visual inspection (precap)	-	100%	100%	2073, 2074, 2072
Temperature cycling (temp. cycle) 20 cycles > 10 minutes @ temperature extremes	100%	100%	100%	1051
Thermal impedance	100%	100%	100%	3161, 3101, 3103
Constant acceleration 20kG or 10kG > 10W	-	-	100%	2006
Particle impact noise detection (PIND - devices with internal cav.)	-	-	100%	2052 Condition A
Serialization of devices	-	-	100%	
Interim electrical parameters	-	-	100% R&R	
High temperature gate bias (within x hrs) MOSFETs/IGBTs:	100% (48 hrs)	100% (48 hrs)	100% (48 hrs)	1042 Condition B

MIL-PRF-19500 Screening Requirements

Test/Inspection	Screening Level			MIL-STD-750 Method
	JANTX	JANTXV	JANS	
Interim electrical and delta parameters (within x hrs)	100% (24 hrs)	100% (24 hrs)	100% (16 hrs)	
High temperature reverse bias (hours minimum) MOSFETs/IGBTs: Diodes:	100% (160 hrs) 100% (96 hrs)	100% (160 hrs) 100% (96 hrs)	100% (240 hrs) 100% (240 hrs)	1042 Condition A 1038 Condition A
Final electrical test and delta parameters	100%	100%	100%	
Hermetic seal (fine and gross leak)	100%	100%	100%	1071
Radiography	-	-	100%	2076
External visual exam (after complete marking)	-	-	100%	2071

MIL-PRF-19500 Quality Conformance Inspection
MIL-PRF-19500 Group A Inspection
Electrical Verification

Sub Group	Parameters	JANS Quantity (accept number)	JANTX, JANTXV Quantity (accept number)
1	Visual and mechanical inspection	15 (0)	45 (0)
2	DC (static) test at +25°C	116 (0)	116 (0)
3	DC (static) tests at max. and min. temps.		
4	Dynamic tests at +25°C		
5	Safe operating area test (power trans.): a. DC b. Clamped inductive c. Unclamped inductive End point electrical measurements	45 (0)	45 (0)
6	Surge current (diodes and rectifiers) End point electrical measurements		22 (0)
7	Selected static and dynamic tests		

MIL-PRF-19500 Group B Inspection

Mechanical Verification

Sub Group	Parameters	JANS (accept number)	JANTX, JANTXV
1	Physical dimensions	22 (0)	-
2	Solderability	15 leads (0)	15 leads (0)
	Resistance to solvents	15 (0)	15 (0)
3	Temperature cycling (100 cycles)	22 (0)	22 (0)
	Surge (diodes only)		
	Hermetic seal (fine and gross leak)		
	Electrical measurements		
	Decap internal visual	6 (0)	-
	Bond strength	22 wires (0) or 11 (0)	11(0)
	SEM (when specified)*	6 (0)	-
	Die shear	11 (0)	-
4	Intermittent op. life Electrical measurements	22 (0)	45(0)
5	Accelerated HTRB (120 hours)	22 (0)	-
	Electrical measurements		
	Accelerated HTGB (24 hrs)		
	Electrical measurements		
	Bond strength	22 wires (0)	-
6	Thermal resistance	22 (0)	15(0)
7	High Temp Life (340 Hours Non-Operating)	32 (0)	32(0)
	Electrical		

MIL-PRF-19500 Group C Inspection

Long-term Reliability Verification

Sub Group	Parameters	All Quality Levels (accept number)
1	Physical dimensions	15 (0)
2	Thermal shock	22 (0)
	Terminal strength	
	Hermetic seal (fine and gross leak)	
	Moisture resistance	
	Electrical measurements	
3	Shock	22 (0)
	Vibration, variable frequency	
	Constant acceleration	
	Electrical measurements	
4	Salt atmosphere (corrosion)	15 (0)
5	N/A	
6	Steady state op. life or intermittent op. life or blocking life	22 (0)
	Electrical measurements	
7	Internal water vapor	3 (0)

MIL-PRF-19500 Group D Inspection
Radiation Hardness Assurance Program

Sub Group	Parameters	JANTXV Inspection Lot Quantity (accept number)	JANS Wafer Inspection Lot Quantity (accept number)
2	Steady-state total dose irradiation		
	Qualification	11 (0)	4 (0) See note 1. 2 (0) See note 2. 1 (0) See note 3.
	CI	11 (0)	4 (0) See note 1. 2 (0) See note 2. 1 (0) See note 3.

- 1. For device types ≥ 4,000 die per wafer
- 2. For device types > 500 and < 4,000 die per wafer
- 3. For device types ≤ 500 die per wafer

MIL-PRF-19500 Group E Inspection
Package Qualification

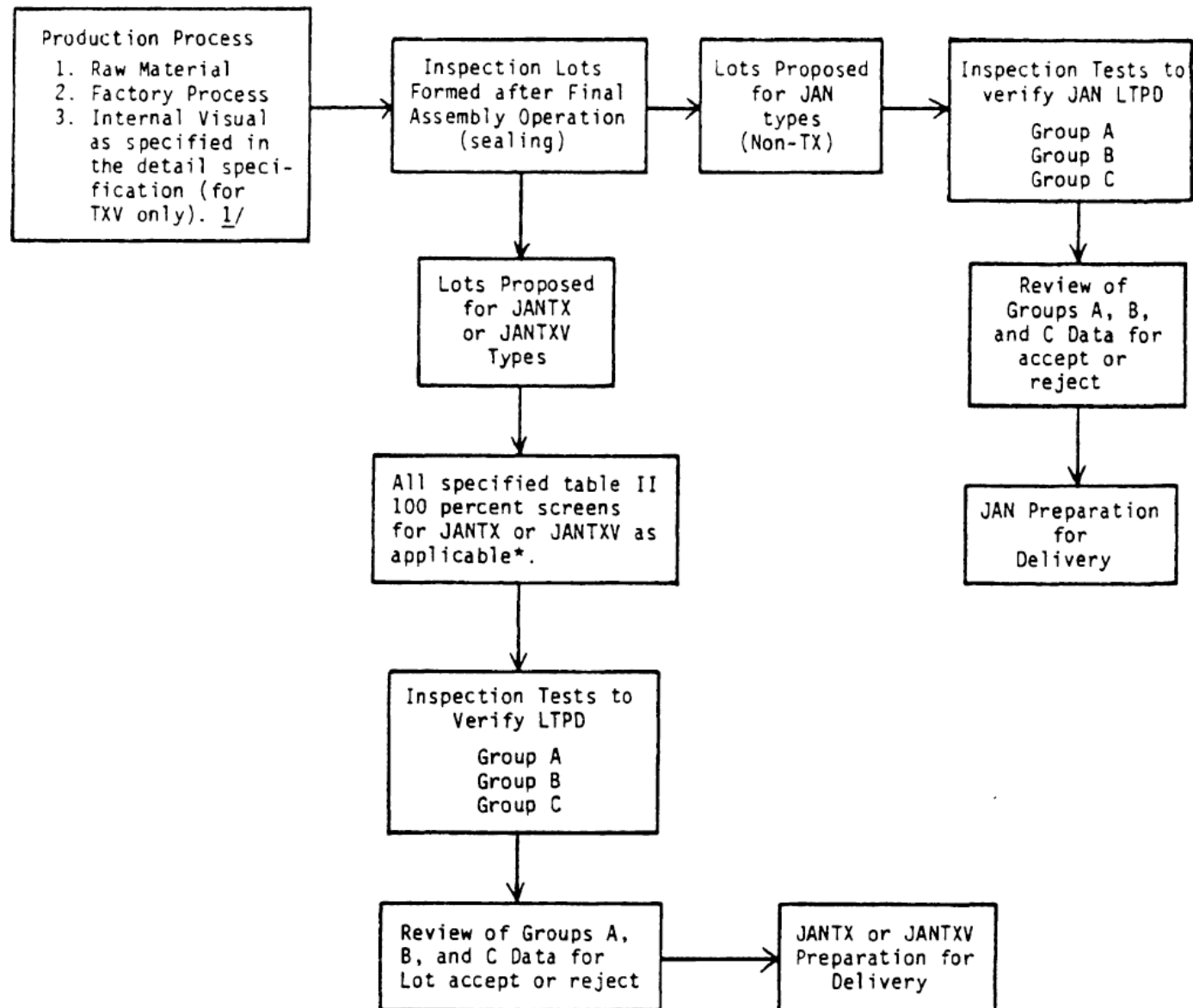
Sub Group	Parameters	All Quality Levels Quantity (accept number)
1	Thermal shock (100 cycles) or Temp. cycling (500 cycles min.) Electrical Measurements	per MIL-PRF-19500
2	Steady state op. life Electrical measurements	per MIL-PRF-19500
4	Thermal resistance	22 (0)
5	Barometric pressure (derives with rated voltage > 200V	15 (0)
6	ESD	3 (0)

TABLE 7.1.2.2-1: RELATIVE FAILURE RATE DIFFERENCES

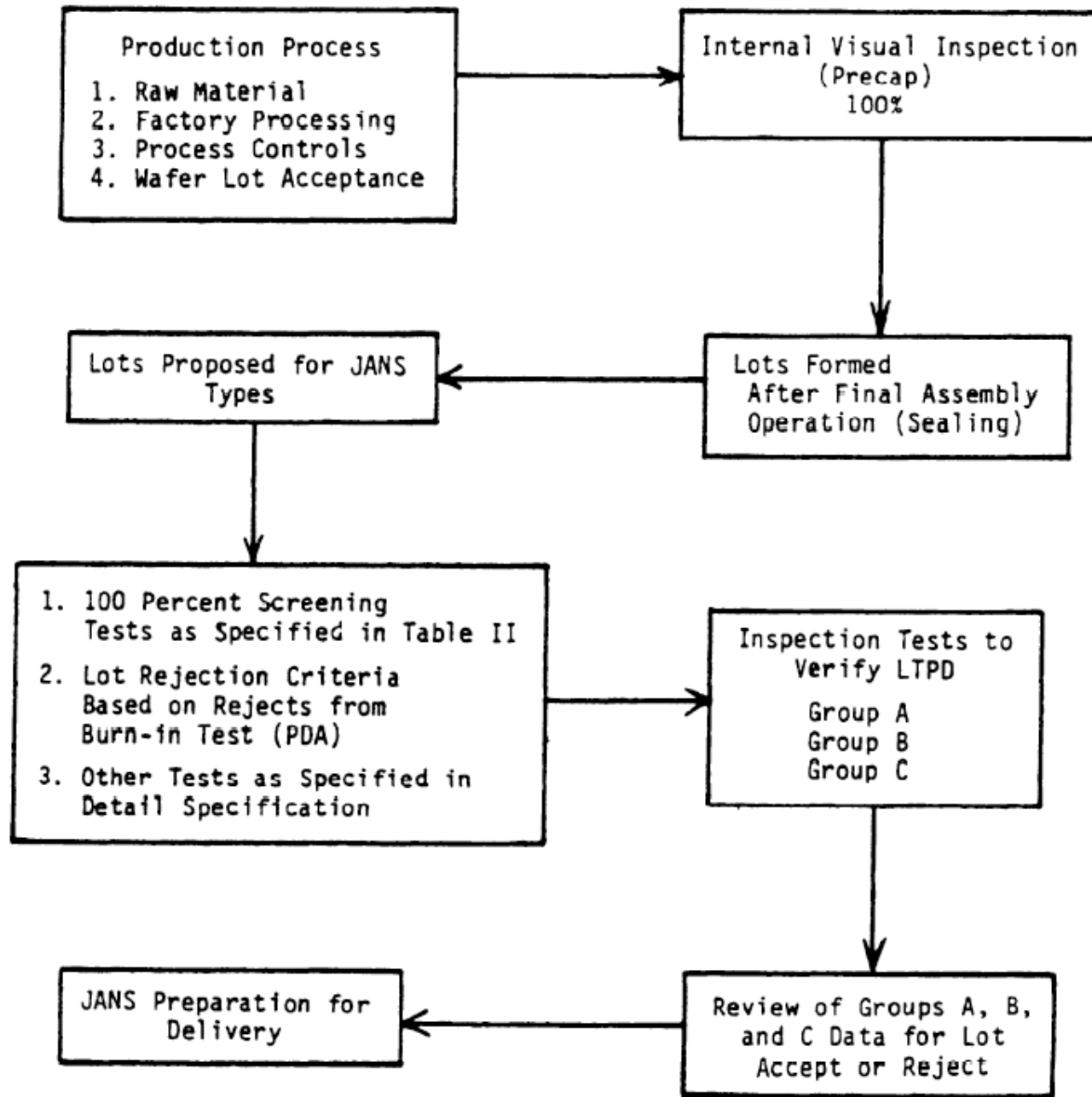
Screening Level	All Semiconductors Except Microwave	Microwave Detectors and Mixers (Si & Ge)
JANS	.05	.05
JANTXV	.1	.1
JANTX	.2	.3
JAN	1.0	1.0
Lower*	5.0	5.0

*Hermetic packaged devices

MIL-HDBK-338
15 OCTOBER 1984



JANS



	Commercial	AEC-Q100	EP	QMLQ	Space EP	QMLV QMLV	QMLV-RHA
Packaging	Plastic	Plastic	Plastic	Ceramic	Plastic	Ceramic	Ceramic
Single Controlled Baseline	No	No	Yes	Yes	Yes	Yes	Yes
Bond Wires	Au/Cu	Au/Cu	Au	Al	Au	Al	Al
Can be Pure Tin (Sn)	Yes	Yes	No	No	No	No	No
Production Burn-in	No	No	No	No	No	Yes	Yes
Radiation Tested	No	No	No	No	Yes	Yes	Yes
Radiation Assured	No	No	No	No	Yes	No	Yes
Typical Temperature Range	-40°C - 85°C	-40°C - 125°C	-55°C - 125°C*	-55°C - 125°C	-55°C - 125°C*	-55°C - 125°C	-55°C - 125°C
Extra Qualification and Process Monitors	None	X-Ray & Reflow, Outlier Control	Extended HAST, X-ray & Reflow, Outlier	MIL-Std-38535 Group A, B, D	MIL-STD-38535 "like" A, D, E	MIL-STD-38535 Group A, B, C, D	MIL-STD-38535 Group A, B, C, D, E
Life Test Per Wafer Lot	No	No	No	No	No	Yes	Yes
Description	Tailored for high-volume commercial applications and flexible supply	High reliability for automotive applications with flexible supply. Packages can use matte Sn and Cu bond wires.	Controlled baseline ensures more homogenous performance across lots. No Sn or Cu bond wire permitted. Uses increased reliability material set homogenous performance across lots. No Sn or Cu bond wire permitted. Uses increased reliability material set	Ceramic military grade parts released to a MIL spec. Intended for extreme environments and long term dormant storage	Space grade parts meant for low orbit missions. Screening for TID (Radiation Assured) High-reliability material set, similar to EP	Space grade parts release to a MIL spec. Meant for long lifetime, high reliability missions	Same as QMLV but additional lot testing and screening for TID (Radiation Assured)