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Quality, Reliability, and Process Flows

Corporate Views on Quality and Reliability

Cypress believes in product excellence. Excellence can only be defined by how the users perceive both our product quality and reliability. If you, the user, are not satisfied with every device that is shipped, then product excellence has not been achieved.

Product excellence does not occur by following the industry norms. It begins by being better than one's competitors, with better designs, processes, controls and materials. Therefore, product quality and reliability are built into every Cypress product from the start.

Some of the techniques used to insure product excellence are the following:

- Product Reliability is built into every product design, starting from the initial design conception.
- Product Quality is built into every step of the manufacturing process through stringent inspections of incoming materials and conformance checks after critical process steps.
- Stringent inspections and reliability conformance checks are done on finished product to insure the finished product quality requirements are met.
- Field data test results are encouraged and tracked so that accelerated testing can be correlated to actual use experiences.

Product Assurance Documents

Cypress Semiconductor uses MIL-STD-883 and MIL-I- 38535 as baseline documents to determine our Test Methods, Procedures and General Specifications for Semiconductors.

Customers using our commercial and industrial grade product receive the benefit of a military patterned process flow at no additional charge.

Product Testing Categories

Five different testing categories are offered by Cypress:

1. Commercial operating range product: 0°C to +70°C.
2. Industrial operating range product: − 40°C to +85°C.
3. Military Grade product processed to MIL-STD-883; Military operating range: − 55°C to +125°C.
4. QML (Qualified Manufacturers Line), JAN (Joint Army Navy), and SMD (Standardized Military Drawing) approved product: Military operating range: − 55°C to +125°C, electrically tested per the applicable Military Drawing.

Categories 1, 2, and 3 are available on all products offered by Cypress Semiconductor. Category 4 is offered on a more limited basis, dependent upon the specific part type in question.

Commercial Product Assurance Categories

Commercial grade devices are offered with two different classes of product assurance. Every device shipped, as a minimum, meets the processing and screening requirements of level 1.

Level 1: For commercial or industrial systems where the demand for quality and reliability is high, but where field service and device replacement can be reasonably accomplished.

Level 2: For enhanced reliability applications and commercial or industrial systems where maintenance is difficult and/or expensive and reliability is paramount.

Devices are upgraded from Level 1 to Level 2 by additional testing and a burn-in of 12 hours at 150°C.

Tables 1 and *2* list the 100% screening and quality conformance testing performed by Cypress Semiconductor in order to meet requirements of these programs.

Military Product Assurance Categories

Cypress's Military Grade components and SMD products are processed per MIL-STD-883 using methods 5004 and 5005 to define our screening and quality conformance procedures. The processing performed by Cypress results in a product that meets the class B screening requirements as called out by these methods. Every device shipped, as a minimum, meets these requirements.

QML, JAN, SMD, and Military Grade devices supplied by Cypress are processed for applications where maintenance is difficult or expensive and reliability is paramount. *Tables 3* through *7* list the screening and quality conformance testing that is performed in order to meet the processing requirements required by MIL-STD-883 and MIL-I-38535.

Quality, Reliability, and Process Flows

Table 1. Cypress Commercial and Industrial Product Screening Flows—Components

Screen	MIL-STD-883 Method	Product Temperature Ranges: Commercial 0°C to +70°C; Industrial −40°C to +85°C — Level 1 Plastic	Level 1 Hermetic	Level 2 Plastic	Level 2 Hermetic
Visual/Mechanical					
• Internal Visual	2010	0.4% AQL	100%	0.4% AQL	100%
• Hermeticity					
− Fine Leak	1014, Cond A or B (sample)	Does Not Apply	LTPD = 5	Does Not Apply	LTPD = 5
− Gross Leak	1014, Cond C	Does Not Apply	100%	Does Not Apply	100%
Burn-in					
• Pre-Burn-in Electrical	Per Device Specification	Does Not Apply	Does Not Apply	100%	100%
• Burn-in	Per Cypress Specification	Does Not Apply	Does Not Apply	100%[1]	100%[1]
• Post-Burn-in Electrical	Per Device Specification	Does Not Apply	Does Not Apply	100%	100%
• Percent Defective Allowable (PDA)		Does Not Apply	Does Not Apply	5% (max)[2]	5% (max)[2]
Final Electrical	Per Device Specification				
• Static (DC), Functional, and Switching (AC) Tests	1. At 25°C and Power Supplies Extremes	Not Performed	Not Performed	100%[1]	100%[1]
	2. At Hot Temperature and Power Supply Extremes	100%	100%	100%	100%
Cypress Quality Lot Acceptance					
• External Visual	2009	Note 3	Note 3	Note 3	Note 3
• Final Electrical Conformance	Cypress Method 17-00064	Note 3	Note 3	Note 3	Note 3

Table 2. Cypress Commercial and Industrial Product Screening Flows—Modules

Screen	MIL-STD-883 Method	Product Temperature Ranges: Commercial 0°C to +70°C; Industrial −40°C to +85°C — Level 1	Level 2
Burn-in			
• Pre-Burn-in Electrical	Per Device Specification	Does Not Apply	100%
• Burn-in	1015	Does Not Apply	100%
• Post-Burn-in Electrical	Per Device Specification	Does Not Apply	100%
• Percent Defective Allowable (PDA)		Does Not Apply	15%
Final Electrical	Per Device Specification		
• Static (DC), Functional, and Switching (AC) Tests	1. At 25°C and Power Supply Extremes	Not Performed	100%
	2. At Hot Temperature and Power Supply Extremes	100%	100%
Cypress Quality Lot Acceptance			
• External Visual	2009	Per Cypress Module Specification	Per Cypress Module Specification
• Final Electrical Conformance	Cypress Method 17-00064	Note 3	Note 3

Notes:
1. Burn-in is performed as a standard for 12 hours at 150°C.
2. Electrical Test is performed after burn-in. Results of this are used to determine PDA percentage.
3. Lot acceptance testing is performed on every lot. AOQL (the Average Outgoing Quality Level) for 1994 was <100 PPM.

Table 3. Cypress QML/JAN/SMD/Military Grade Product Screening Flows for Class B

Screen	Screening Per Method 5004 of MIL-STD-883	Product Temperature Ranges −55°C to +125°C	
		QML/JAN/SMD/Military Grade Product[4]	Military Grade Module
Visual/Mechanical			
• Internal Visual	Method 2010, Cond B	100%	N/A
• Temperature Cycling	Method 1010, Cond C, (10 cycles)	100%	Optional
• Constant Acceleration	Method 2001, Cond E (Min.), Y1 Orientation Only	100%	N/A
• Hermeticity:			
— Fine Leak	Method 1014, Cond A or B	100%	N/A
— Gross Leak	Method 1014, Cond C	100%	N/A
Burn-in			
• Pre-Burn-in Electrical Parameters	Per Applicable Device Specification	100%	100%
• Burn-in Test	Method 1015, Cond D, 160 Hrs at 125°C Min. or 80 Hrs at 150°C	100%	100% (48 Hours at 125°C)
• Post-Burn-in Electrical Parameters	Per Applicable Device Specification	100%	100%
• Percent Defective Allowable (PDA)	Maximum PDA, for All Lots	5%	10%
Final Electrical Tests			
• Static Tests	Method 5005 Subgroups 1, 2, and 3	100% Test to Applicable Device Specification	100% Test to Applicable Specification
• Functional Tests	Method 5005 Subgroups 7, 8A, and 8B	100% Test to Applicable Device Specification	100% Test to Applicable Specification
• Switching	Method 5005 Subgroups 9, 10, and 11	100% Test to Applicable Device Specification	100% Test to Applicable Specification
Quality Conformance Tests			
• Group A[5]	Method 5005, see Tables 4 − 7 for details	Sample	Sample
• Group B		Sample	Sample
• Group C[6]		Sample	Sample
• Group D[6]		Sample	Sample
External Visual	Method 2009	100%	100%

Notes:

4. QML product is allowed a reduction in screening requirements with DESC approval per MIL-I-38535.
5. Group A subgroups tested for QML/SMD/Military Grade products are 1, 2, 3, 7, 8A, 8B, 9, 10, 11, or per JAN Slash Sheet.
6. Group C and D end-point electrical tests for QML/SMD/Military Grade products are performed to Group A subgroups 1, 2, 3, 7, 8A, 8B, 9, 10, 11, or per JAN Slash Sheet.

Table 4. Group A Test Descriptions

Sub-group	Description	Sample Size/Accept No.	
		Components	Modules[7]
1	Static Tests at 25°C	116/0	116/0
2	Static Tests at Maximum Rated Operating Temperature	116/0	116/0
3	Static Tests at Minimum Rated Operating Temperature	116/0	116/0
4	Dynamic Tests at 25°C	116/0	116/0
5	Dynamic Tests at Maximum Rated Operating Temperature	116/0	116/0
6	Dynamic Tests at Minimum Rated Operating Temperature	116/0	116/0
7	Functional Tests at 25°C	116/0	116/0
8A	Functional Tests at Maximum Temperature	116/0	116/0
8B	Functional Tests at Minimum Temperature	116/0	116/0
9	Switching Tests at 25°C	116/0	116/0
10	Switching Tests at Maximum Temperature	116/0	116/0
11	Switching Tests at Minimum Temperature	116/0	116/0

Cypress uses an LTPD sampling plan that was developed by the Military to assure product quality. Testing is performed to the subgroups found to be appropriate for the particular device type. All Military Grade component products have a Group A sample test performed on each inspection lot per MIL-I-38535/MIL-STD-883 and the applicable device specification.

Table 5. Group B Quality Tests

Sub-group	Description	Quantity/Accept # or LTPD	
		Components	Modules[7]
2	Resistance to Solvents, Method 2015	3/0	3/0
3	Solderability, Method 2003[8]	22/0	10
5	Bond Strength, Method 2011[9]	15/0	NA

Notes:
7. Military Grade Modules are processed to proposed JEDEC standard flows for MIL-STD-883 compliant modules.
8. Sample size is based upon leads taken from a minimum of 3 devices.
9. Sample size is based upon leads taken from a minimum of 4 devices.

Group B testing is performed for each inspection lot. An inspection lot is defined as a group of material of the same device type, package type and lead finish built within a six week seal period and submitted to Group B testing at the same time.

Table 6. Group C Quality Tests

Sub-group	Description	LTPD	
		Components	Modules[7]
1	Steady State Life Test, End-Point Electricals, Method 1005, Cond D	45/0	15/0

Group C tests for all Military Grade products are performed on one device type from one inspection lot representing each technology. Sample tests are performed per MIL-I-38535/MIL-STD-883 from each four calendar quarters production of devices, which is based upon the die fabrication date code.

End-point electrical tests and parameters are performed per the applicable device specification.

Table 7. Group D Quality Tests (Package Related)

Sub-group	Description	Quantity/Accept # or LTPD	
		Components	Modules[7]
1	Physical Dimensions, Method 2016	15/0	15/0
2	Lead Integrity, Seal: Fine and Gross Leak, Method 2004 and 1014	45/0[8]	15/0
3	Thermal Shock, Temp Cycling, Moisture Resistance, Seal: Fine and Gross Leak, Visual Examination, End-Point, Electricals, Methods 1011, 1010, 1004 and 1014	15/0	15/0
4	Mechanical Shock, Vibration - Variable Frequency, Constant Acceleration, Seal: Fine and Gross Leak, Visual Examination, End-Point Electricals, Methods 2002, 2007, 2001 and 1014	15/0	15/0

Table 7. Group D Quality Tests (Package Related) (continued)

Sub-group	Description	Quantity/Accept # or LTPD	
		Components	Modules [10]
5	Salt Atmosphere, Seal: Fine & Gross Leak, Visual Examination, Methods 1009 & 1014	15/0	15/0
6	Internal Water-Vapor Content; 5000 ppm maximum @ 100°C. Method 1018	3(0) or 5(1)	N/A
7	Adhesion of Lead Finish,[11] Method 2025	15/0	15/0
8	Lid Torque, Method 2024[12]	5(0)	N/A

Notes:
10. Does not apply to leadless chip carriers.
11. Based on the number of leads.
12. Applies only to packages with glass seals.

Group D tests for all Military Grade products are performed per MIL-I-38535/MIL-STD-883 on each package type from each six months of production, based on the lot inspection identification (or date) codes.

End-point electrical tests and parameters are performed per the applicable device specification.

Product Screening Summary

Commercial and Industrial Product

- Screened to either Level 1 or Level 2 product assurance flows
- Hermetic and molded packages available
- Incoming mechanical and electrical performance guaranteed:
  - 0.02% AQL Electrical Sample test performed on every lot prior to shipment
  - 0.01% AQL External Visual Sample inspection
- Electrically tested to Cypress data sheet

Ordering Information

Product Assurance Grade: Level 1

- Order Standard Cypress part number
- Parts marked the same as ordered part number
  Ex: CY7C122-15PC, PALC22V10-25PI

Product Assurance Grade: Level 2

- Burn-in performed on all devices to Cypress detailed circuit specification
- Add 'B' Suffix to Cypress standard part number when ordering to designate burn-in option
- Parts marked the same as ordered part number
  Ex: CY7C122-15PCB, PALC22V10-25PIB

Military Grade Product

- SMD and Military Grade components are manufactured in compliance with paragraph 1.2.1 of MIL-STD-883. Compliant products are identified by an 'MB' suffix on the part number (CY7C122-25DMB) and the letter "C"
- QML/JAN devices are manufactured in accordance with MIL-I-38535. Compliant products are identified with the letter "Q."
- Military grade devices electrically tested to:
  - Cypress data sheet specifications

    OR
  - SMD devices electrically tested to military drawing specifications

    OR
  - JAN devices electrically tested to slash sheet specifications
- All devices supplied in hermetic packages
- Quality conformance inspection: Method 5005, Groups A, B, C, and D performed as part of the standard process flow
- Burn-in performed on all devices
  - Cypress detailed circuit specification for non-Jan devices

    OR
  - Slash sheet requirements for JAN products
- Static functional and switching tests performed at 25°C as well as temperature and power supply extremes on 100% of the product in every lot
- JAN product manufactured in a DESC certified facility

Ordering Information

JAN/QML Product:

- Order per military document
- Marked per military document
  Ex: JM38510/28901BVA

SMD Product:

- Order per military document
- Marked per military document
  Ex: 5962-8867001LA

Military Grade Product:

- Order per Cypress standard military part number
- Marked the same as ordered part number
  Ex: CY7C122-25DMB

Military Modules

- Military Temperature Grade Modules are designated with an 'M' suffix only. These modules are screened to standard combined flows and tested at both military temperature extremes.
- MIL-STD-883 Equivalent Modules are processed to proposed JEDEC standard flows for MIL-STD-883 compliant modules. All MIL-STD-883 equivalent modules are assembled with fully compliant MIL-STD-883 components.

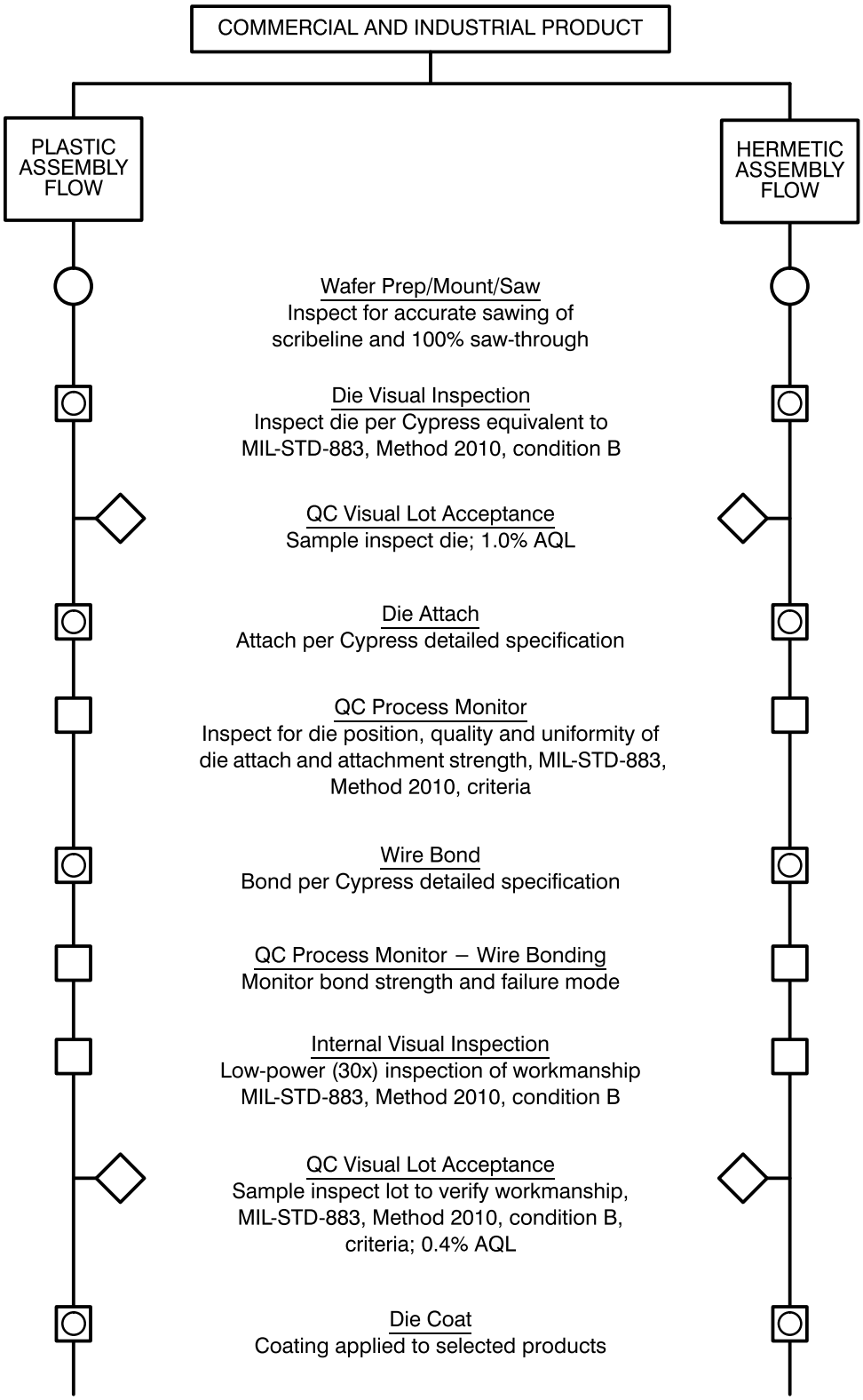
Product Quality Assurance Flow—Components

Area	PROCESS	Process Details
QC	INCOMING MATERIALS INSPECTION	All incoming materials are inspected to documented procedures covering the handling, inspection, storage, and release of raw materials used in the manufacture of Cypress products. Materials inspected are: wafers, masks, leadframes, ceramic packages and/or piece parts, molding compounds, gases, chemicals, etc.
FAB	DIFFUSION/ION IMPLANTATION	Sheet resistance, implant dose, species and CV characteristics are measured for all critical implants on every product run. Test wafers may be used to collect this data instead of actual production wafers. If this is done, they are processed with the standard product prior to collecting specific data. This insures accurate correlation between the actual product and the wafers used to monitor implantation.
FAB	OXIDATION	Sample wafers and sample sites are inspected on each run from various positions of the furnace load to inspect for oxide thickness. Automated equipment is used to monitor pinhole counts for various oxidations in the process. In addition, an appearance inspection is performed by the opeartor to further monitor the oxidation process.
FAB	PHOTOLITHOGRAPHY /ETCHING	Appearance of resist is checked by the operator after the spin operation. Also, after the film is developed, both dimensions and appearance are checked by the operator on a sample of wafers and locations upon each wafer. Final CDs and alignment are also sample inspected on several wafers and sites on each wafer on every product run.
FAB	METALIZATION	Film thickness is monitored on every run. Step coverage cross-sections are performed on a periodic basis to insure coverage.
FAB	PASSIVATION	An outgoing visual inspection is performed on 100% of the wafers in a lot to inspect for scratches, particles, bubbles, etc. Film thickness is verified on a sample of wafers and locations within each given wafer on each run. Pinholes are monitored on a sample basis weekly.
FAB	QC VISUAL OF WAFERS	
FAB	E-TEST	Electrical test is performed for final process electrical characteristics on every wafer.
FAB	QC MONITOR OF E-TEST DATA	Weekly review of all data trends; running averages, minimums, maximums, etc. are reviewed with the process control manager.
TEST	WAFER PROBE/SORT	Verify functionality, electrical characteristics, stress test devices.
TEST	QC CHECK PROBING AND ELECTRICAL TEST RESULTS	Pass/fail lot based on yield and correct probe placement.

TO ASSEMBLY AND TEST

(continued)

Product Quality Assurance Flow—Components (continued)
Commercial and Industrial Product



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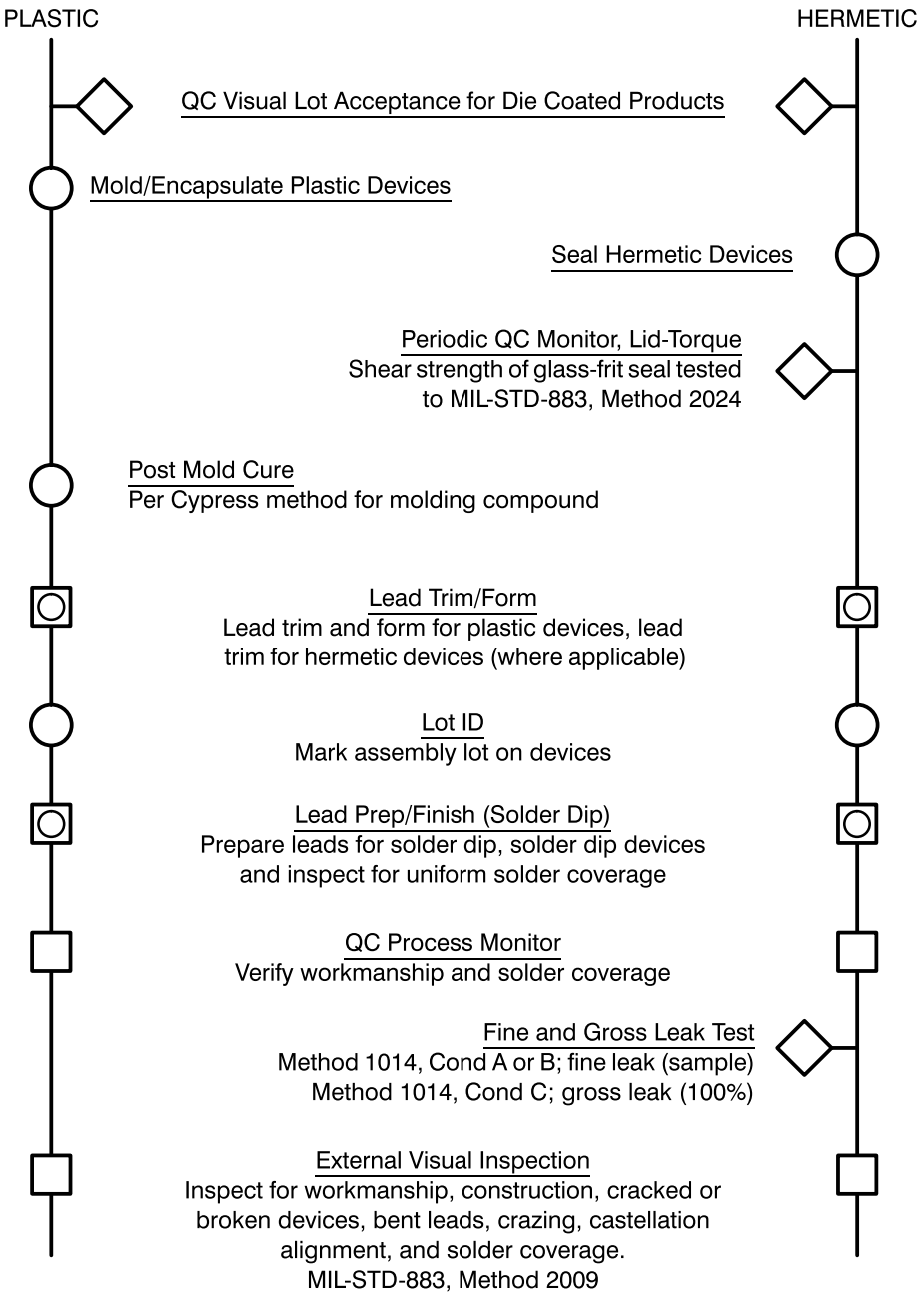
Product Quality Assurance Flow—Components (continued)
Commercial and Industrial Product



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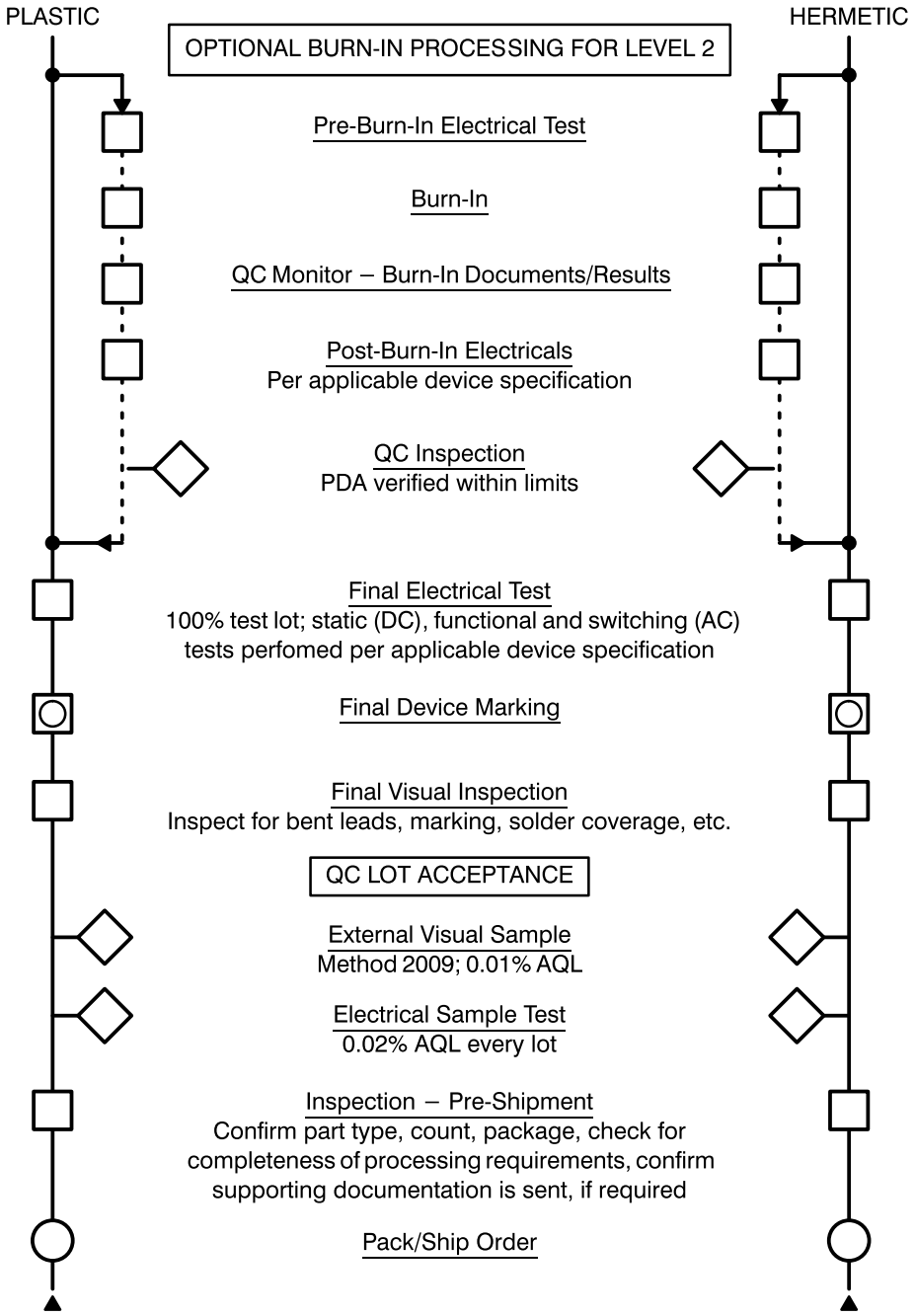
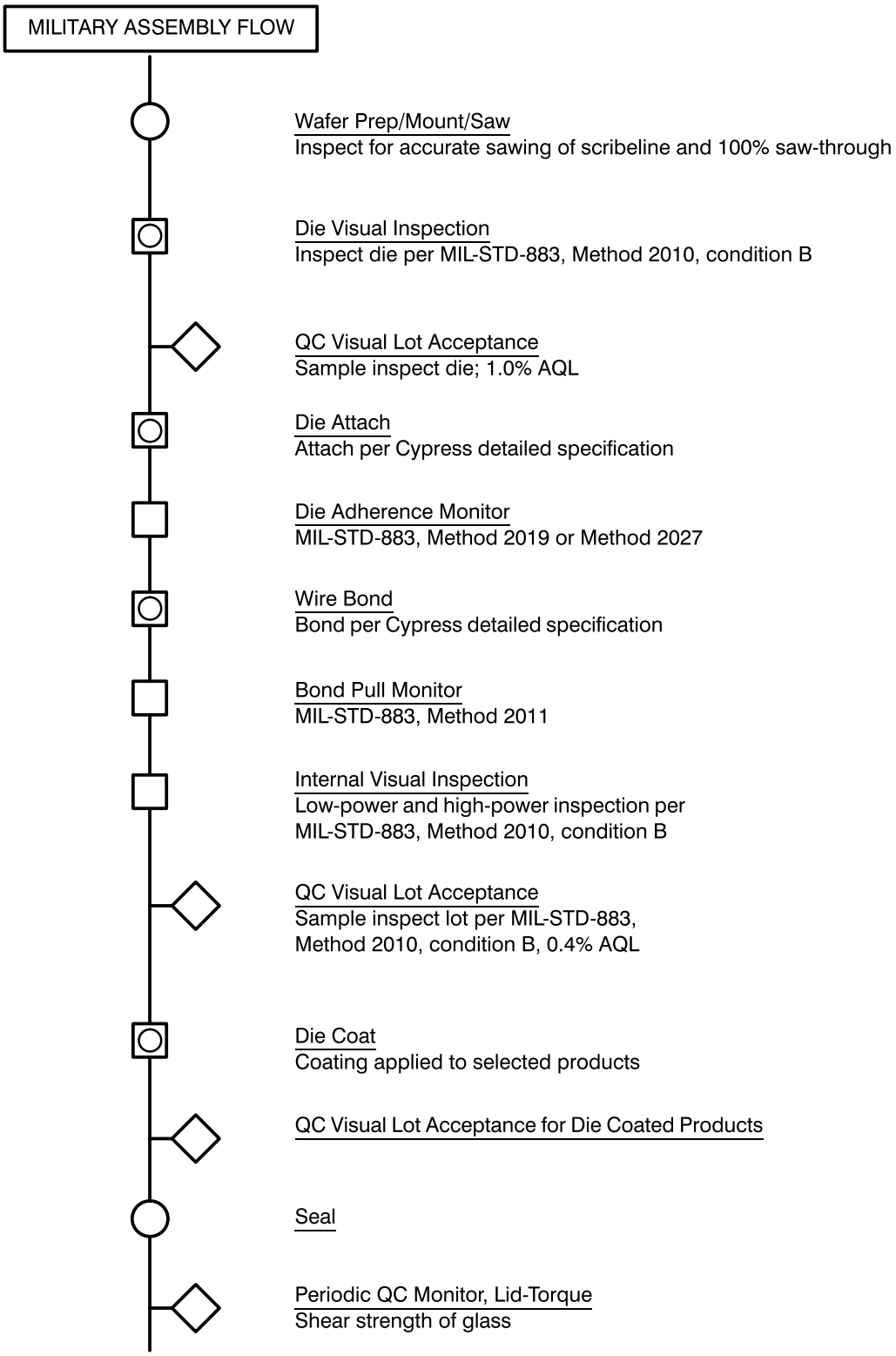
Product Quality Assurance Flow—Components (continued)
Commercial and Industrial Product



Key

- Production Process
- Test/Inspection
- Production Process and Test Inspection
- QC Sample Gate and Inspection

Product Quality Assurance Flow—Components
Military Components



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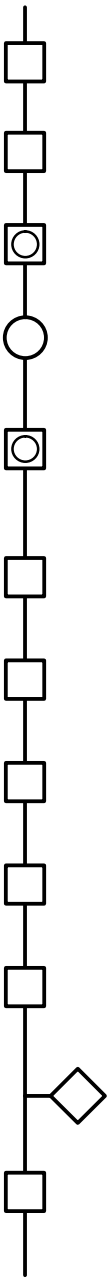
Product Quality Assurance Flow—Components (continued)
Military Components



Temperature Cycle
Method 1010, Cond C, 10 cycles

Constant Acceleration
Method 2001, Cond E, Y1 Orientation

Lead Trim
Lead trim when applicable

Lot ID
Mark assembly lot on devices

Lead Finish
Solder dip or matte tin plate applicable devices and inspect

QC Process Monitor
Verify workmanship and lead finish coverage

External Visual Inspection
Method 2009

Pre-Burn-In Electrical Test
Method 5004, per applicable device specification

Burn-In
Method 1015, condition D

Post-Burn-In Electricals
Method 5004, per applicable device specification

PDA Calculation
Method 5004, 5%

Final Electrical Test
Method 5004; Static, functional and switching tests per applicable device specification

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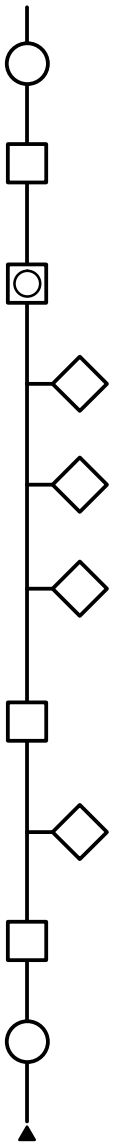
Product Quality Assurance Flow—Components (continued)
Military Components



Lead Finish – Solder Dip
Solder dip applicable devices

Fine and Gross Leak Test
Method 1014, condition A or B, fine leak; condition C, gross leak

Final Device Marking
MIL-STD-883 or applicable device specification

Group B
Method 5005

Group A
Method 5005, per applicable device specification

Group C and D
Method 5005, in accordance with
1.2.1 of MIL-STD-883; JAN devices
in accordance with MIL-I-38535

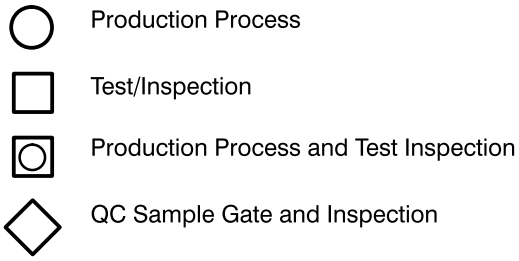
External Visual
Method 2009, 100% inspection

External Visual Sample
Method 2009, 0.01% AQL

Plant Clearance

Pack/Ship Order

Key



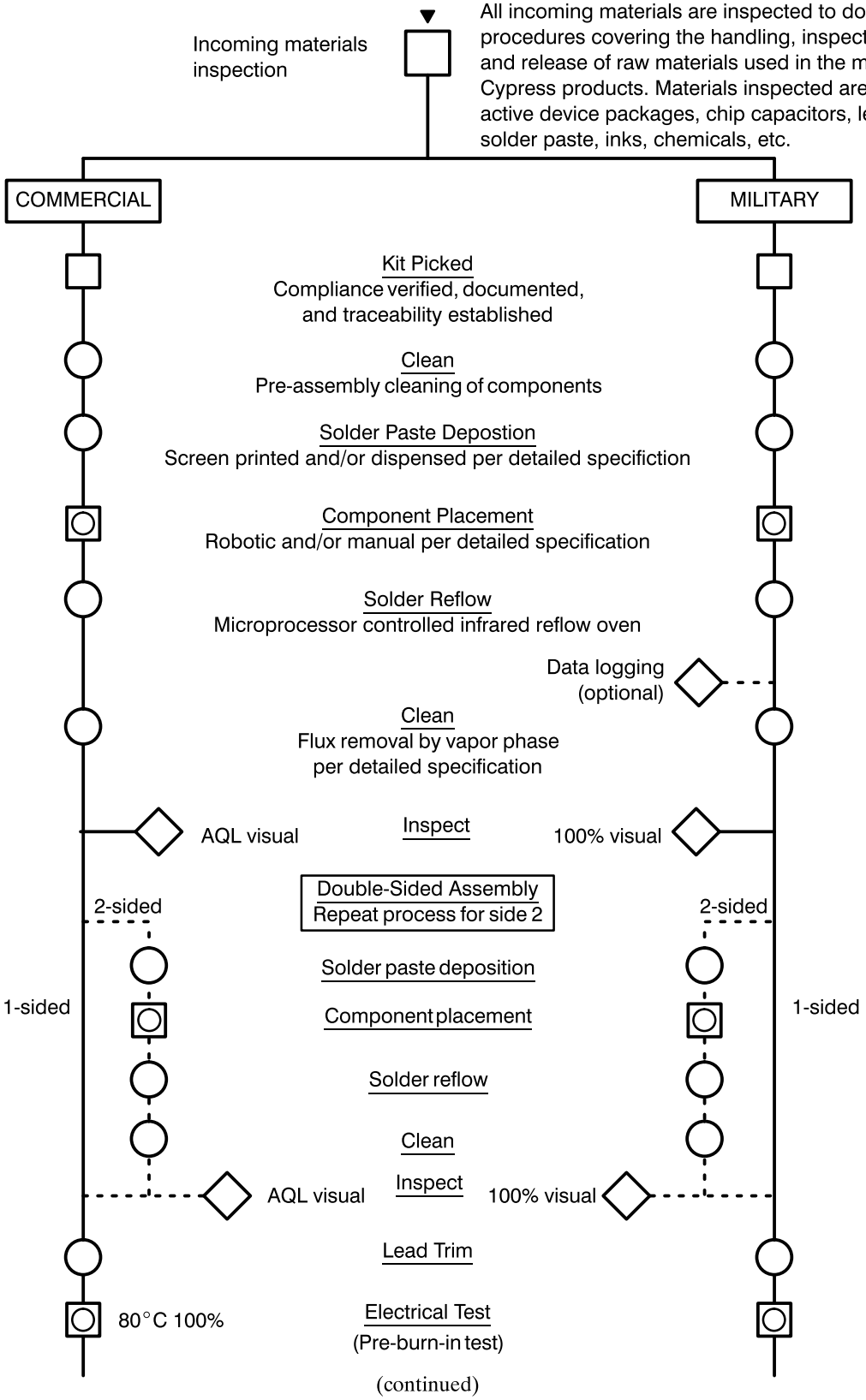
Production Process

Test/Inspection

Production Process and Test Inspection

QC Sample Gate and Inspection

Product Quality Assurance Flow—Modules



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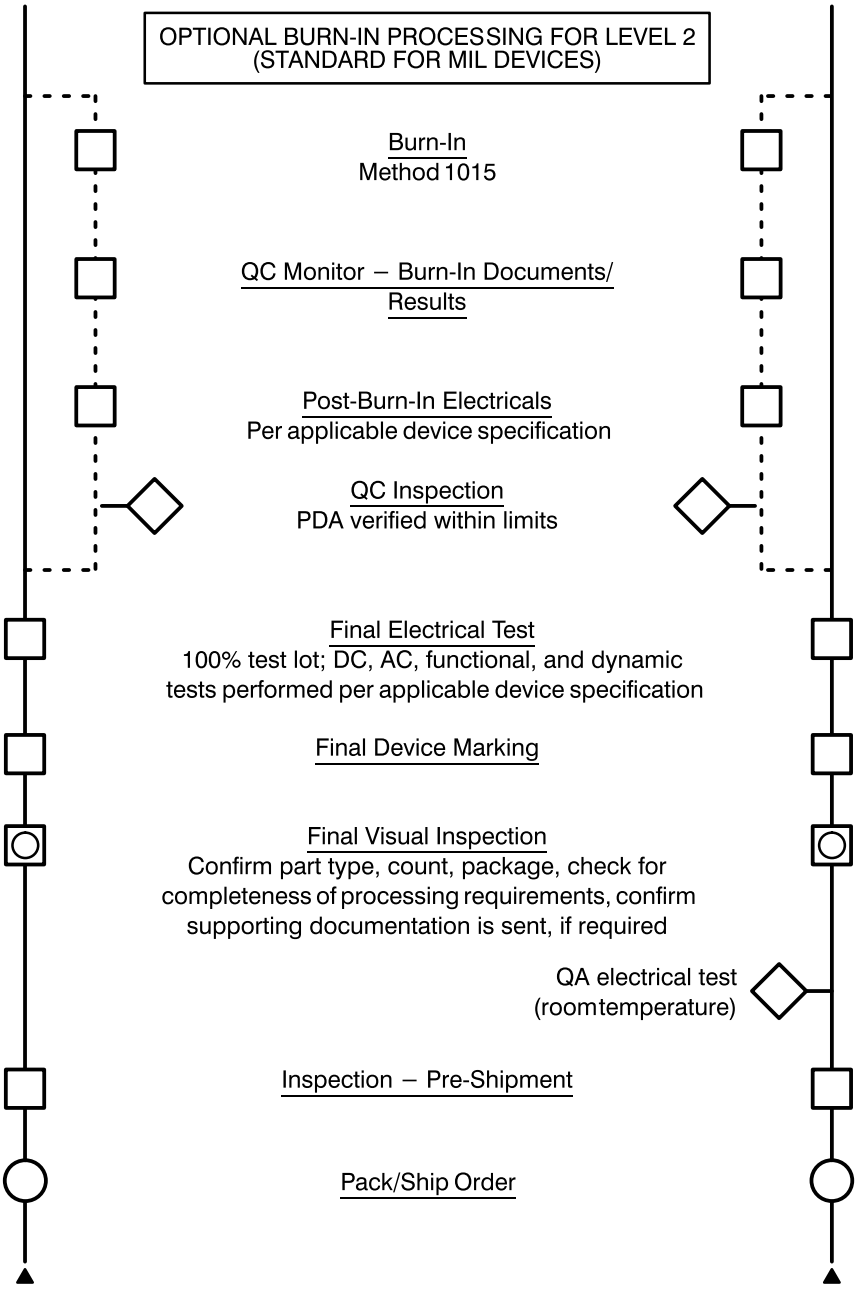
Product Quality Assurance Flow—Modules (continued)



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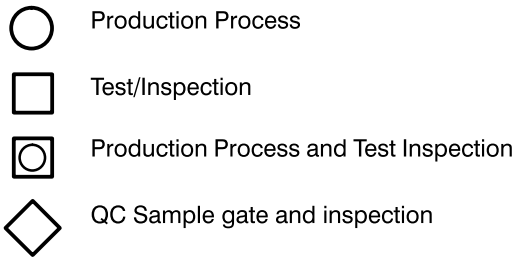

Quality, Reliability, and Process Flows

Reliability Monitor Program

The Reliability Monitor Program is a documented Cypress procedure that is described in Cypress specification #25-00008, which is available to Cypress customers upon request. This specification describes a procedure that provides for periodic reliability monitors to insure that all Cypress products comply with established goals for reliability improvement and to minimize reliability risks for Cypress customers. The Reliability Monitor Program monitors our most advanced technologies and packages. Every technology produced at a given fabrication site (Tech. − Fab.) and all assembly houses are monitored at least quarterly. If failures occur, detailed failure analyses are performed and corrective actions are implemented. A summary of the Reliability Monitor Program test and sampling plan is shown below.

Quarterly Reliability Monitor Test Matrix

Stress	Devices Tested	# per Quarter
HTOL	Tech. − Fab.	6
	All High Volume	2
HAST	Tech. − Fab.	6
	All High Volume	2
PCT	Plastic Packages	4
TC	Tech. − Fab.	6
	Plastic Packages	3
	Ceramic Packages	5
	All High Volume	2
DRET	FAMOS − San Jose and Texas	2
HTSSL	All Technologies	4
TEV	All Technologies	4
Total		46

Reliability Monitor Test Conditions

Test	Abbrev.	Temp. (°C)	R.H. (%)	Bias	Sample Size	LTPD	Read Points (hrs.)
High-Temperature Operating Life	HTOL	+150	N/A	5.75V Dynamic	116	2	48, 168, 500, 1000
High-Temperature Steady-State Life	HTSSL	+150	N/A	5.75V Static	116	2	48, 168, 500, 1000
Data Retention for Plastic Packages	DRET	+165	N/A	N/A	76	3	168, 1000
Data Retention for Ceramic Packages	DRET2	+250	N/A	N/A	76	3	168, 1000
Pressure Cooker	PCT	+121	100	N/A	76	3	96, 168
Highly Accelerated Stress Test	HAST	+140	85	5.5V Static	76	3	128
Temperature Cycling 1	TC	−40 to +125°C	N/A	N/A	76	3	500, 1000 Cycles
Temperature Cycling 2	TC2	−65 to +150°C	N/A	N/A	45	5	300, 1000 Cycles
Temperature Extreme Verification	TEV	Commercial Hot & Cold 0 to +70°C	N/A	N/A	116	2	N/A