



High Reliability Optoelectronic Devices

Sensors and Specialist Components BI Technologies and OPTEK Technology

Hi-Rel products, Hi-Rel service from OPTEK Technology

TT Electronics' OPTEK Technology solves your toughest high-reliability optoelectronics and magnetic sensor challenges with a commitment to quality and customer service. Since 1978, OPTEK has delivered standard and custom sensor products for military commercial and aerospace applications; and we now have the capability to offer COTS (Commercial Off The Shelf) level products from our world-class manufacturing and test facility. Along with high-reliability optoelectronics and magnetics sensors, OPTEK offers the highest level of customer service and engineering support.

- 100% in-house screening and QCI testing (Group A, B, C & D) per MIL-PRF 19500 Method of MIL-STD-750 and MIL-STD-883 method 5005.
- TX, TXV, B, S, and ESA level process capabilities to meet any requirements
- NASA-certified soldering operations
- Comprehensive in-house failure analysis including SEM capability



High-Reliability - Product

High-reliability requirements demand that products be able to function under abnormally severe levels of mechanical, environmental, and electrical stress. OPTEK has met this challenge with product designs and process control techniques that ensure high reliability and, thus, long life.

CAPABILITY

OPTEK maintains a well equipped high-reliability lab for conducting electrical, mechanical, and environmental test. OPTEK's Calibration system complies with the requirements of ANSI/NCSL Z 540-1. High reliability hall effect, and transistor devices from OPTEK are currently in use in a wide variety of space and defense programs.

CERTIFICATIONS

OPTEK is fully certified for commercial off the shelf (COTS) products as well as BS EN ISO 9001:2000 and ISO/TS16949:2002. Electrical, environmental and mechanical testing is based on MIL-PRF-19500, MIL-STD-883 and ESA 5000 test method and procedures.

GENERIC SCREENING AND QCI TESTING

Screening and Quality Conformance Testing can be provided on almost any hermetic product that OPTEK builds or quotes. OPTEK generic processing and QCI testing is explained in the "Generic OPTEK Processing" table. Specific details such as burn-in conditions or delta measurements performed can be obtained from the devices Data sheet.

One of the key advantages of purchasing part types to a generic high-reliability screening program is that Group testing lot charges may be avoided, since OPTEK frequently spreads these costs over large groups of orders. Customers requiring Group testing on their individual orders can also be accommodated, but these orders have to be run under a special part number for control purposes.

HIGH-RELIABILITY COUPLERS

OPTEK offers high-reliability, optically coupled isolators to MIL-PRF-19500, and components processed to OPTEK's own military screening program.

HIGH-RELIABILITY SENSORS AND EMITTERS

A large selection of discrete emitter and sensor are offered that are processed to OPTEK's own military screening program patterned after MIL-PRF-19500 and MIL-STD-883. These devices are identified by "TX", "TXV", "B" and "S" suffixes. Although not military qualified devices, they receive 100% screening and are fully processed to the appropriate levels.

For discrete sensors, the 100% screening includes both a 48-hour, high temperature reverse bias at $T_A=125\text{ }^\circ\text{C}$, and a 160 or 240-hour power burn-in at ambient temperature ($T_A=25\text{ }^\circ\text{C}$). For emitters, the 100% screening includes a burn-in in the forward direction for 96, 160 or 240 hours depending on the series.

HIGH-RELIABILITY HALL EFFECT SENSOR

OPTEK offers unipolar and bipolar (latching) hall effect magnetic sensing product in hermetic ceramic packages. These sensors are processed to OPTEK's screening procedure patterned after MIL-STD-883 Class B or Class S quality levels. These products operate from a 4.5 to 24 volt power supply and have an open collector logic level output capable of providing 25mA of sink current.

HIGH-RELIABILITY TRANSISTOR PRODUCTS

A line of standard transistor product in hermetic surface mount packages are offered to support the defense, space and high reliability industries. Single, dual, and quad package transistor chips are designed to conserve board space in high-density applications.

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HIGH-RELIABILITY ASSEMBLIES

OPTEK manufactures a wide variety of standard (commercial-off-the-shelf) and custom (built-to-print) assemblies. Most assemblies can be classified into one of two groups: slotted optical switches or reflective Assemblies.

Slotted optical switches are designed to provide non-contact sensing of linear or rotary motion.

Reflective assemblies are designed to provide non-contact sensing of reflective surfaces, or a change in surface reflectivity of an object.

High reliability assemblies are generally made with plastic housing and hermetically sealed discrete sensors and emitters. Before being placed in the housing the discrete components are subjected to high-reliability processing. Frequently, this processing on the discrete device is similar to what is specified on the individual high-reliability sensor and emitter data sheets.

CUSTOMER SPECIFIC DESIGNS

Sometimes, it is necessary to have special electrical selections, screening requirements, or package configuration that is different from the standard offerings shown in the data sheets. OPTEK's custom capability is extensive. Assembly and test areas were designed with a great deal of flexibility, which allows the product to be built and tested on an order-to-order basis. The Quality Control Department's Environmental testing areas are set up similarly, allowing many orders to be handled, each requiring different tests, screens, and conditions.

Group A:	Consists of electrical tests and external visual done on a sample basis by Q.C. Prior to submittal to Q.C for Group A inspection, all devices in the lot are 100% electrically tested in manufacturing.
Group B:	Consists of tests conducted on a sample basis to verify production lot conformance to package integrity, environmental extremes, and long-term reliability. The Group B samples are normally selected from the lots that are manufactured within a six-week time period, based on the date of final package sealing
Group C:	Is further environmental testing similar to Group B, but sample testing is performed on a periodic basis (typically at six month intervals.)
High Temperature Reverse Bias (HTRB):	Devices are reverse biased in a non-conduction mode at high temperature for a period of time in this test. This test is used primarily to screen out those devices with inferior semiconductor die characteristics, such as poor voltage breakdown or leakage current. Ambient temperature is usually specified somewhere between +100°C to +175°C.
MIL-PRF-19500:	Military document that establishes the general requirements for semiconductor devices for a particular series (e.g., 4N22A military series is spelled out in MIL-PRF-19500/486.)
MIL-STD-750:	Military specification that depicts electrical, mechanical, and environmental test procedures and methods for discrete semiconductors.
MIL-STD-883:	Military specification that establishes uniform methods, controls and procedures for testing microelectronic devices.
Level TX:	All TX units receive process conditioning prior to quality conformance inspection. (See Fig 1)
Level TXV:	All TXV units receive process conditioning prior to quality conformance inspection as well as 100% visual inspection. (See Fig 2)
Level B:	All B units receive process conditioning prior to quality conformance inspection. (See Fig 3)
Level S:	An ultra-high-reliability device with very strict quality assurance and manufacturing controls imposed. Level S devices are designed with space applications in mind with the highest product assurance reliability test. (See Fig 4)
Level ESA/SCC/5000:	European Space Agency specification that defines the general requirements for the qualification approval, procurement, including lot acceptance testing and delivery of discrete semiconductor components for space applications. (See Fig 5)

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OPERATING LIFE

Also known as burn-in, life testing, and power age. Operating the device in a conduction mode (turn on) to simulate what the part will encounter in actual service. As a very common test in process conditioning, operating life is used to screen out those parts with potential short service life.

QUALITY CONFORMANCE INSPECTION (QCI):

Those tests performed to verify a given lot's conformance to a military document or a customer's specification. Quality conformance inspection consists of Group A, but may include Group B or C, depending on the requirements for the formulation of these groups of tests.

QUALIFICATION (QUAL):

All testing performed to qualify a new product, traditionally consists of Groups A, B and C. Individual test or requirements are sometimes added or deleted for qualification.

PROCESS CONDITIONING:

Test (sometimes referred to as screens) that are performed on 100% of the devices in the lot to assure long-term reliability characteristics.

SIMPLIFIED PRODUCT FLOWS

TX	TXV	B Per 883	S Per 883	ESA
Commercial Product	100%: Pre-Cap, Visual	Commercial Product	SEM—Inspection 100%: Pre-Cap, Visual	100%: Pre-Cap, Visual
High Temperature Storage	High Temperature Storage	High Temperature Storage	100%: Non-Destruct Bond Pull	High Temperature Storage
Temperature Cycle	Temperature Cycle	Temperature Cycle	High Temperature Storage	Temperature Cycle
Constant Acceleration	Constant Acceleration	Constant Acceleration	Temperature Cycle	Constant Acceleration
Hermetic Seal Test	Hermetic Seal Test	Hermetic Seal Test	Constant Acceleration	Hermetic Seal Test
HTRB	HTRB	HTRB	Hermetic Seal Test	HTRB
Power Burn-In	Power Burn-In	Power Burn-In	HTRB	Power Burn-In
QCI LAT A B C	QCI LAT A B C	QCI LAT A B C	Power Burn-In X-Ray QCI LAT A B D	QCI LAT LAT 3 LAT 2 LAT 1
Ship	Ship	Ship	Ship	Ship

(Fig. 1)

(Fig. 2)

(Fig. 3)

(Fig. 4)

(Fig. 5)

GENERIC OPTEK PROCESSING

Screening	TX & TXV per MIL-PRF-19500	S-Level per MIL-PRF-19500	B-Level per M5004 of MIL-STD-883 ²	S-Level per M5004 of MIL-STD-883 ²	B-Level per ESA 5000 ⁷		
Operation Description	MIL-STD-750 Method	MIL-STD-750 Method	MIL-STD-883 Method	MIL-STD-883 Method	MIL-STD-750 Method		
Bond Pull, Ball Shear, Die Shear Test: In process monitors in the form of SPC. (Ball shear applies to gold ball bonded devices only)	(Per MIL-PRF-19500 App D for S Level plus ball shear)						
Non-Destruct Bond Pull	N/A	N/A	N/A	2023	N/A		
Internal Precap Inspection Performed on all OPTEK Hi-Rel Products	2072 ³	2072	2010	2010	2072		
RGA Monitors Periodic monitors. Not performed on every lot.	1018						
100% Post Seal Electrical Test Selected DC tests only.	Per OPTEK published data sheet						
Permanent Serialization	No	Yes	No	Yes	Yes		
High Temperature Storage	N/A	Optional			48 hrs. Max T _j		
Temperature Cycle ⁴ -55°C to +175°C	1051 Condition C, 20 Cycles	1051 Condition C, 20 Cycles					
-65°C to +150°C						1010 Condition C, 10 Cycles	1010 Condition C, 10 Cycles
-65°C to +125°C						(MIL-STD-202) M 102, 20 Cycles	
Acceleration	2006, 20 KG, Y1	2006, 20 KG, Y1	2001, 30 KG, Y1	2001, 30 KG, Y1	2006, 20 KG, Y1		
Visual Inspection/Dimension Check	No	No	For Catastrophic visual defects	For Catastrophic visual defects	All dimensions on 5 pieces		
Particle Impact Noise Detection	N/A	2052 Cond. A	N/A	2020 Cond. A	2052 Cond. A		
Fine Leak Test ⁵	1071 Cond. H 5X10 ⁻⁸	1071 Cond. H 5X10 ⁻⁸	1014 Cond. A, 5X10 ⁻⁸	1014 Cond. A, 5X10 ⁻⁸	1071 Cond. H 5X10 ⁻⁸		
Gross Leak Test ⁵	1071 Cond. C	1071 Cond. C	1014 Cond. C	1014 Cond. C	1071 Cond. C		
Thermal Response Test ⁶	3101 or 3131	3101 or 3131	N/A	N/A	N/A		
Pre HTRB Electrical Measurements Recorded parameters for delta data	N/A	N/A	N/A	N/A	Yes		
HTRB	1038 or 1039 Cond. A	1038 or 1039 Cond. A	N/A	N/A	1038 or 1039 Cond. A		
Post HTRB/Pre Burn-In Testing Record parameters for delta calculations	Yes						

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GENERIC OPTEK PROCESSING (Continued)

Screening	TX & TXV per MIL-PRF-19500	S-Level per MIL-PRF-19500	B-Level per M5004 of MIL-STD-883 ²	S-Level per M5004 of MIL-STD-883 ²	B-Level per ESA 5000 ⁷
Operation Description	MIL-STD-750 Method	MIL-STD-750 Method	MIL-STD-883 Method	MIL-STD-883 Method	MIL-STD-750 Method
Burn-In	1038 or 1039 Cond. B Diodes 96 hrs., Transistors 160 hrs.	1038 or 1039 Cond. B 240 hrs.	1015, 160 hrs	1015, 240 hrs	1038 or 1039 Cond. B Diodes 96 hrs., Transistors 160 hrs.
Post Burn-In Testing Read & Record, and Delta Calculations	Yes				
PDA Limit	10%	5%	5%	5%	5%
ALL other specified electrical test Perform 100% Read & Record	No No	Yes No	Yes No	Yes No	Yes Yes
Calculate PDA on all tests	No	No	No	No	Yes
X-Ray	No	2076	No	2012	2076
External Visual	No	2071	2009	2009	2071
Produce a Failure Accountability Sheet	No	Yes	No	No	Yes
Lot Acceptance Testing	MIL-PRF-19500 See Table provided for TX and TXV Group A, B, C testing	MIL-PRF-19500 See Table provided for S level Group A, B, C testing	5005 See Table provided for Group A, B, C testing	5005 See Table provided for Group A, B, D testing	ESA 5000 See Table provided for Group level 1, 2 and 3 testing

Notes:

1. Revision K
2. OPTEK is a compliant COTS supplier per MIL-STD 750 and MIL-PRF-19500. OPTEK does not claim to be a supplier as defined in MIL-STD-883D, paragraph 1.2.1. MIL-STD-883 requirements are based on Revision D, Notice 2.
3. TX products receives only 30X inspection. TXV product receives those magnifications called out in Method 2072.
4. This temperature or the maximum device rating (whichever is less) will be used.
5. Hermeticity testing will be performed at this point or after Burn-In electrical test.
6. Performed routinely on select transistor and diodes only but available on any bi-polar or PN junction device.
7. European Space Agency (ESA) 5000 Revision D.
8. The sample sizes given are for lot sizes of 2,500 pieces or less, the definition for "small lot" size per MIL-PRF-19500.

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LOT ACCEPTANCE TESTING — MIL-PRF-19500

Per MIL-PRF-19500, lot acceptance testing is performed by sampling each date code lot following all 100% screening operations and performing a series of tests. Tests are divided into groups. Group A for electrical, Group B & C for Environmental and life test. Group A & B is performed on every lot while Group C is performed on one lot for each package and chip combination every 12 months. Standard OPTEK products that have a TX or TXV suffix typically follow the generic MIL-PRF-10500 lot acceptance test outline and rules. Products with a B or S suffix are usually MIL-STD-883, M5005 controlled. Special circumstances may warrant a deviation on some products.

The following tables reflect MIL-PRF-19500 Revision M as they affect OPTEK standard products. OPTEK attempts to maintain standard TX, TXV, S, B & ESA specifications up to the most current revision.

LOT ACCEPTANCE TESTING — Group A

Per MIL-PRF-19500 and MIL-STD-883 Method 5005

Subgroup	MIL-PRF-19500 TX, TXV, & S Level			MIL-STD-883 ² Method 5005	
	Operation	Sample Quantity ⁸		B & S Level samples size for All Sub-groups = 116/0	
		TX & TXV	S-Level		
Subgroup 1	Visual & Mechanical	45	15		25 ° C DC Test
Subgroup 2	25°C DC Test	45	116		High Temp. DC Test
Subgroup 3	High & Low Temp Test	45	116		Low Temp. DC Test
Subgroup 4	25°C Dynamic Test	45	116		25 ° C Dynamic Test
Subgroup 5	Safe Operating Area	45	45		High Temp. Dynamic Test
Subgroup 6	Surge Current	22	45		Low Temp. Dynamic Test
Subgroup 7	Misc.	22	45		25°C Functional Test
Subgroup 8A	N/A	0	0		High Temp. Functional Test
Subgroup 8B	N/A	0	0		Low Temp. Functional Test
Subgroup 9	N/A	0	0	25°C Switching Time Test	
Subgroup 10	N/A	0	0	High Temp Switching Time Test	
Subgroup 11	N/A	0	0	Low Temp Switching Time Test	

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LOT ACCEPTANCE TESTING — Group B

Subgroup	MIL-PRF-19500		MIL-STD-883 Method 5005	
	TX & TXV	S-Level	B-Level	S-Level
Subgroup 1	Solderability Resistance to Solvents	Physical Dimensions	N/A	Physical Dimensions Internal Water Vapor
Subgroup 2	Temp Cycling, Surge, Hermetic Seal, Electrical End Points	Solderability Resistance to Solvents	Resistance to Solvents	Resistance to Solvents, Internal Visual, Bond Strength, Die Shear
Subgroup 3	Steady State Operation Life (340 hrs) Electrical End Points, Bond Strength	Temp cycling, Thermal Shock, Surge (when applicable), Hermetic Seal, Electrical End Points, Bond Strength, SEM, Die Shear	Solderability	Solderability
Subgroup 4	De-Cap Internal Visual	Intermittent Operating Life Test, Electrical End Points	N/A	Lead Integrity, Hermeticity, Lid Torque
Subgroup 5	Thermal Resistance	Accelerated Steady State, Operating Life Test, Electrical End Points, Bond Strength	Bond Strength	Electrical R&R, Steady State Life Test, Electrical End Points
Subgroup 6	High Temp. Storage (340 hrs)	Thermal Resistance	N/A	Electrical R&R, Temp. Cycling, Constant Acceleration, Hermeticity, Electrical End Points

LOT ACCEPTANCE TESTING — Group C

Subgroup	MIL-PRF-19500	MIL-STD-883 Method 5005	
	All Levels	B-Level	S-Level
Subgroup 1	Physical Dimensions (Not required for S-Level)	Electrical Test, 1,000 hr Life Test, Electrical Test	N/A
Subgroup 2	Thermal Shock, Terminal Strength, Hermetic Seal, Moisture Resistance, Electrical End Points	N/A	N/A
Subgroup 3	Shock, Vibration, Variable Frequency, Constant Acceleration, Electrical End Points	N/A	N/A
Subgroup 4	Salt Atmosphere	N/A	N/A
Subgroup 5	N/A	N/A	N/A
Subgroup 6	Electrical Test, Operational Life, Electrical Test	N/A	N/A

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LOT ACCEPTANCE TESTING — Group D

Subgroup	MIL-STD-883 Method 5005 only (All quality levels)
Subgroup 1	Physical Dimensions
Subgroup 2	Lead Integrity, Seal Test
Subgroup 3	Thermal Shock, Temperature Cycle, Moisture Resistance, Visual Inspect, Seal Test, Electrical End Points
Subgroup 4	Mechanical Shock, Variable Frequency Vibration, Constant Acceleration, Seal Test, Visual Inspect, Electrical End Points
Subgroup 5	Salt Atmosphere, Visual Inspection, Seal Test
Subgroup 6	Internal Water Vapor Content (RGA)
Subgroup 7	Adhesion of Lead Finish
Subgroup 8	Lid Torque (For Glass Only)

OPTEK supports process flow and lot acceptance test requirements of European Space Agency (ESA) documents with some limitations. OPTEK high reliability manufacturing procedures reflect United States (US) military documents. Therefore, some referenced ESA documents must default to similar US documents. Test limits, conditions, sequence and sample size specified in the ESA documents are maintained. A document cross reference list is provided in the following table.

ESA Specification	Description	Substitute Specification
20400	Internal Visual Inspection	MIL-STD-750 Method 2072
20500	External Visual Inspection	MIL-STD-750 Method 2071
20900	Radiographic Inspection	MIL-STD-750 Method 2076
24800	Resistance to Solvents	MIL-STD-750 Method 1022
23500	Lead Materials and Finish	MIL-PRF-19500
20100	Qualification Requirements	MIL-PRF-19500
20600	Preservation and Packaging	MIL-PRF-19500
21300	Terms and Definitions	MIL-PRF-19500
22800	Non-Conformance Control	MIL-PRF-19500
21500	Calibration System	MIL-PRF-19500

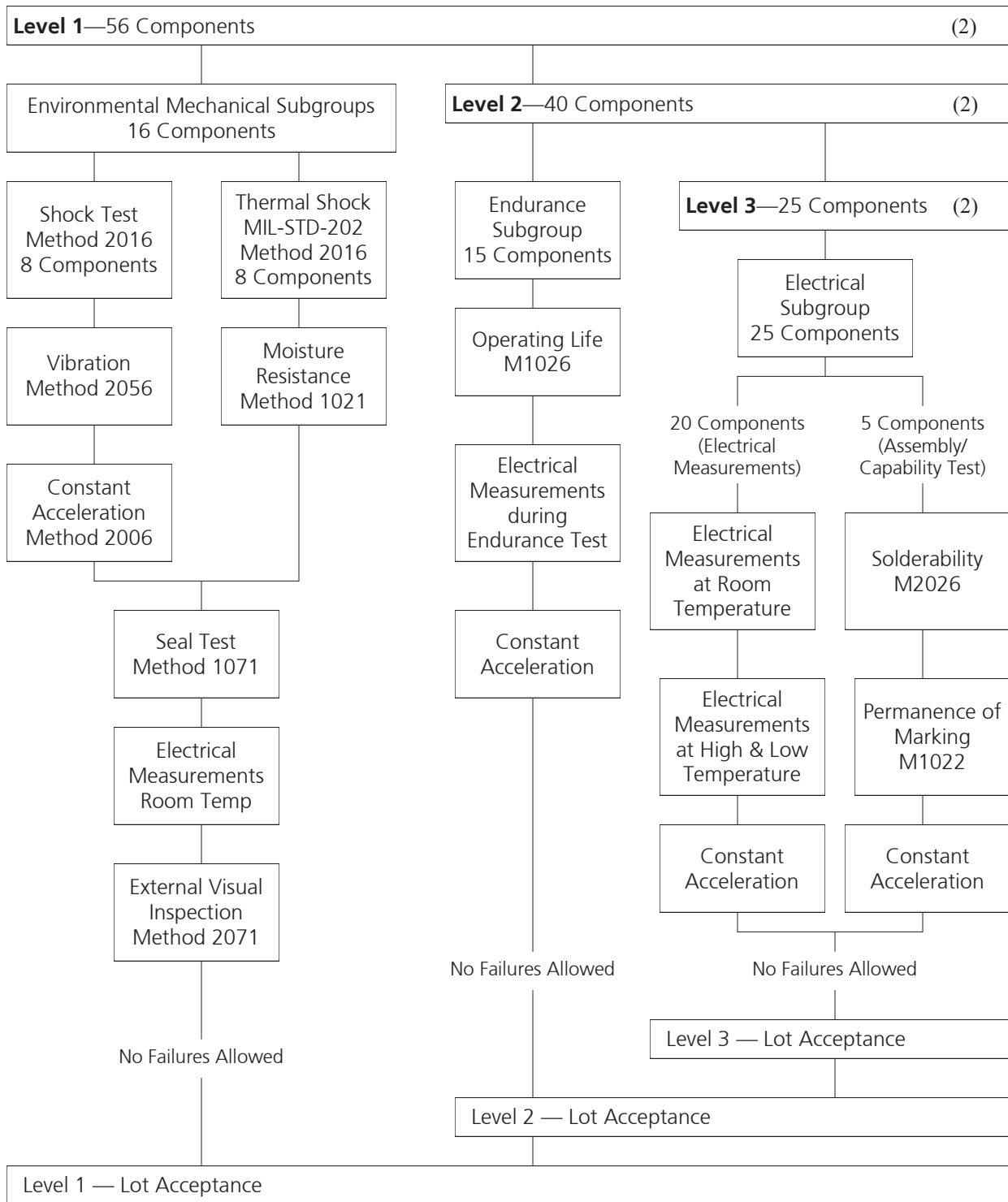
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Lot Acceptance Test for ESA Devices



Note: Test methods referenced are from MIL-STD-750 unless otherwise specified. Diagram reflects ESA5000 Rev. D