“ Component Risk Mitigation Strategies “

April, 10 2011

Dynamic Research and Testing Laboratories, LLC (DRTL)

Authors :

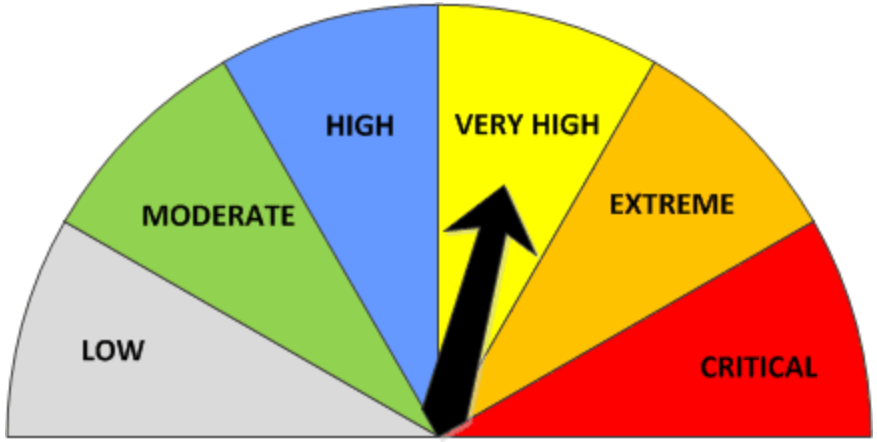
Mark Northrup

Clifton Aldridge

Risk Mitigation ?

What is the definition of Risk Mitigation ?

A systematic reduction in the extent of exposure to a risk and/or the likelihood of its occurrence.



COMPONENTS

Risk Mitigation Testing Strategies Examples

Testing Plan Strategies

- BASIC
- IDEA 1010
- AS5553C
- MIL-STD-1580
- Custom

COMPONENTS

Risk Mitigation Testing Strategies Examples

Testing Laboratory Certifications

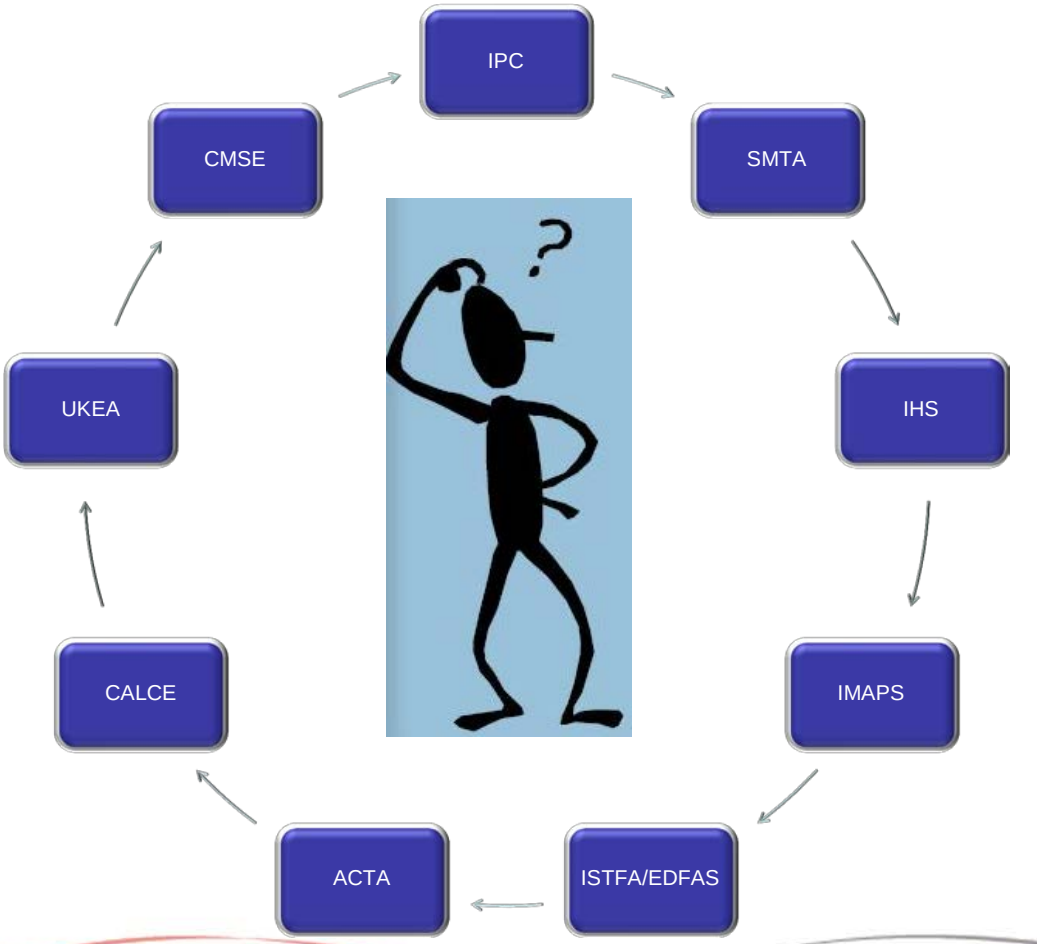
- ISO/IEC 9000
- ISO/IEC 17025
- AS9100
- AS6171
- NADCAP
- DLA/QML

COMPONENTS

Risk Mitigation Testing Affiliations

Affiliations

- Industry
- Government
- Academia



COMPONENTS

IDEA – 1010 Risk Mitigation Testing Strategies

IDEA – STD – 1010 ACCEPTABILITY OF ELECTRONIC COMPONENTS DISTRIBUTED IN THE OPEN MARKET

1.1 Scope : The Standard sets forth practices and requirements for visual examination and acceptability criteria of electronic components purchased and sold in the open market . Practices are generally accepted industry methods and are provided in the Standard for guidance only; they are not mandatory. Requirements are mandatory conditions essential for indicating acceptable products in accordance with the Standard.

COMPONENTS

IDEA – 1010 Risk Mitigation Testing Strategies

COMPONENTS

AS5553 Risk Mitigation Testing Strategies

SAE AS5553 COUNTERFEIT ELECTRONICS PARTS; AVOIDANCE DETECTION, MITIGATION, AND DISPOSITION

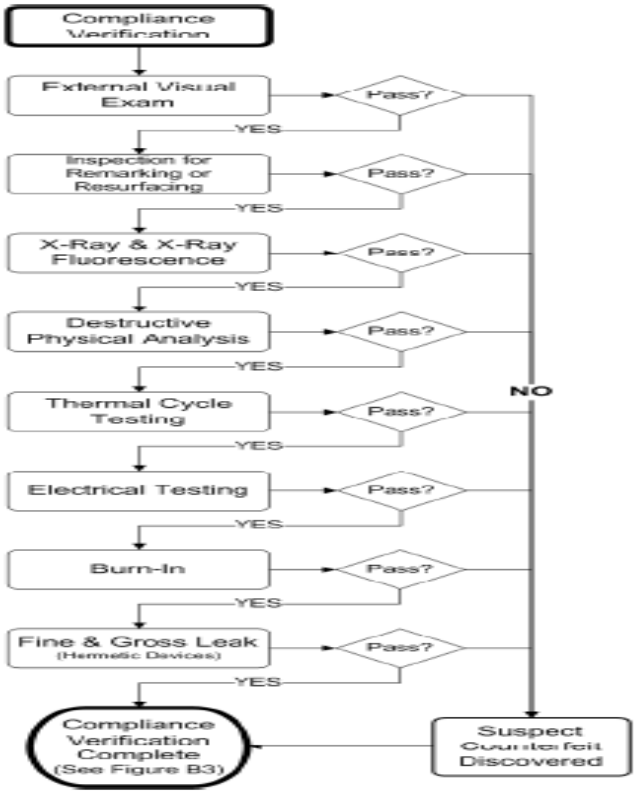
1.1 Scope. This SAE Aerospace Standard standardizes practices to:

a. Maximize availability of authentic parts
b. Procure parts from reliable sources
c. Assure authenticity and conformance of procured parts
d. Control parts identified as counterfeit
e. And report counterfeit parts to other potential users and Government investigative authorities.

G-19 Counterfeit Electronic Parts Committee

COMPONENTS

AS5553 Risk Mitigation Testing Strategies



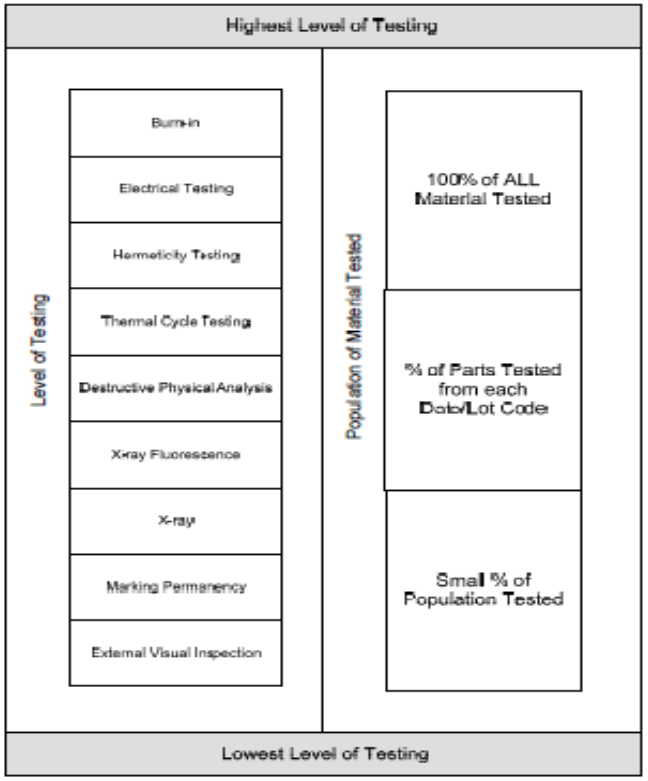


FIGURE E2 - TEST EVALUATION RISK STACK CHART

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies

MIL-STD-1580 DEPARTMENT OF DEFENSE TEST METHOD STANDARD DESTRUCTIVE PHYSICAL ANALYSIS FOR ELECTRONIC, ELECTROMAGNETIC, AND ELECTROMECHANICAL PARTS

1.1 Scope. This standard describes the general requirements for performance of destructive physical analysis (DPA) on samples of parts. In addition to the requirements for the analysis procedures, the general criteria for interpreting results, such as for the acceptance or rejection of associated production lots, is included for typical electronic, electromagnetic, and electromechanical parts.

1.2 Application of the standard. This standard; is intended to be referenced, in detailed part specifications; or in other documents where DPA requirements are imposed, to assure that the practices, procedures, and criteria contained herein are uniformly applied. The requirements are intended to provide the general framework and basis for detailed DPA procedures for specific part types.

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies(883)

1.1 Scope. This standard describes the general requirements for performance of destructive physical analysis (DPA) on samples of parts. In addition to the requirements for

1.1 Purpose. This standard establishes uniform methods, controls, and procedures for testing microelectronic devices suitable for use within Military and Aerospace electronic systems including basic environmental tests to determine resistance to deleterious effects of natural elements and conditions surrounding military and space operations; mechanical and electrical tests; workmanship and training procedures; and such other controls and constraints as have been deemed necessary to ensure a uniform level of quality and reliability suitable to the intended applications of those devices. For the purpose of this standard, the term "devices" includes such items as monolithic, multichip, film and hybrid microcircuits, microcircuit arrays, and the elements from which the circuits and arrays are formed. This standard is intended to apply only to microelectronic devices. The test methods, controls, and procedures described herein have been prepared to serve several purposes:

a. To specify suitable conditions obtainable in the laboratory and at the device level which give test results equivalent to the actual service conditions existing in the field, and to obtain reproducibility of the results of tests. The tests described herein are not to be interpreted as an exact and conclusive representation of actual service operation in any one geographic or outer space location, since it is known that the only true test for operation in a specific application and location is an actual service test under the same conditions.

b. To describe in one standard all of the test methods of a similar character which now appear in the various joint-services and NASA microelectronic device specifications, so that these methods may be kept uniform and thus result in conservation of equipment, manhours, and testing facilities. In achieving this objective, it is necessary to make each of the general tests adaptable to a broad range of devices.

c. To provide for a level of uniformity of physical, electrical and environmental testing; manufacturing controls and workmanship; and materials to ensure consistent quality and reliability among all devices screened in accordance with this standard.

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies(202)

MIL-STD-202 DEPARTMENT OF DEFENSE TEST METHOD STANDARD ELECTRONIC AND ELECTRICAL COMPONENT PARTS

1.1 Purpose. This standard establishes uniform methods for testing electronic and electrical component parts, including basic environmental tests to determine resistance to deleterious effects of natural elements and conditions surrounding military operations, and physical and electrical tests. For the purpose of this standard, the term "component parts" includes such items as capacitors, resistors, switches, relays, transformers, inductors, and others. This standard is intended to apply only to small component parts, weighing up to 300 pounds or having a root mean square test voltage up to 50,000 volts unless otherwise specifically invoked. The test methods described herein have been prepared to serve several purposes:

a. To specify suitable conditions obtainable in the laboratory that give test results equivalent to the actual service conditions existing in the field, and to obtain reproducibility of the results of tests. The tests described herein are not to be interpreted as an exact and conclusive representation of actual service operation in any one geographic location, since the only true test for operation in a specific location is an actual service test at that point.

b. To describe in one standard (1) all of the test methods of a similar character which appeared in the various joint or single-service electronic and electrical component parts specifications, (2) those test methods which are feasible for use in several specifications, and (3), the recognized extreme environments, particularly temperatures, barometric pressures, etc., at which component parts will be tested under some of the presently standardized testing procedures. By so consolidating, these methods may be kept uniform and thus result in conservation of equipment, man-hours, and testing facilities. In achieving these objectives, it is necessary to make each of the general tests adaptable to a broad range of electronic and electrical component parts.

c. The test methods described herein for environmental, physical, and electrical tests shall also apply, when applicable, to parts not covered by an approved military specification, military sheet form standard, specification sheet, or drawing.

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies(750)

MIL-STD-750 DEPARTMENT OF DEFENSE TEST METHOD STANDARD TEST METHODS FOR SEMICONDUCTOR DEVICES

1.1 Purpose. This standard establishes uniform methods for testing semiconductor devices, including basic environmental tests to determine resistance to deleterious effects of natural elements and conditions surrounding military operations, and physical and electrical tests. For the purpose of this standard, the term "devices" includes such items as transistors, diodes, voltage regulators, rectifiers, tunnel diodes, and other related parts. This standard is intended to apply only to semiconductor devices. The test methods described herein have been prepared to serve several purposes:

a. To specify suitable conditions obtainable in the laboratory that give test results equivalent to the actual service conditions existing in the field, and to obtain reproducibility of the results of tests. The tests described herein are not to be interpreted as an exact and conclusive representation of actual service operation in any one geographic location, since it is known that the only true test for operation in a specific location is an actual service test at that point.

b. To describe in one standard all of the test methods of a similar character which now appear in the various joint-services semiconductor device specifications, so that these methods may be kept uniform and thus result in conservation of equipment, man-hours, and testing facilities. In achieving this objective, it is necessary to make each of the general tests adaptable to a broad range of devices.

c. The test methods described herein for environmental, physical, and electrical testing of devices shall also apply, when applicable, to parts not covered by an approved military sheet-form standard, specification sheet, or drawing.

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies

MIL-STD-883 DEPARTMENT OF DEFENSE TEST METHOD STANDARD MICROCIRCUITS

METHOD NO. ENVIRONMENTAL TESTS

1001 Barometric pressure, reduced (altitude operation)
1002 Immersion
1003 Insulation resistance
1004.7 Moisture resistance
1005.9 Steady state life
1006 Intermittent life
1007 Agree life
1008.2 Stabilization bake
1009.8 Salt atmosphere (corrosion)
1010.8 Temperature cycling
1011.9 Thermal shock
1012.1 Thermal characteristics
1013 Dew point
1014.13 Seal
1015.10 Burn-in test
1016.2 Life/reliability characterization tests
1017.2 Neutron irradiation
1018.6 Internal gas analysis
1019.8 Ionizing radiation (total dose) test procedure
1020.1 Dose rate induced latchup test procedure
1021.3 Dose rate upset testing of digital microcircuits
1022 Mosfet threshold voltage
1023.3 Dose rate response of linear microcircuits
1030.2 Preseal burn-in
1031 Thin film corrosion test
1032.1 Package induced soft error test procedure (due to alpha particles)
1033 Endurance life test
1034.1 Die penetrant test (for plastic devices)

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies

MECHANICAL TESTS

2001.3 Constant acceleration
2002.5 Mechanical shock
2003.9 Solderability
2004.6 Lead integrity
2005.2 Vibration fatigue
2006.1 Vibration noise
2007.3 Vibration, variable frequency
2008.1 Visual and mechanical
2009.10 External visual
2010.12 Internal visual (monolithic)
2011.8 Bond strength (destructive bond pull test)
2012.8 Radiography
2013.1 Internal visual inspection for DPA
2014 Internal visual and mechanical
2015.13 Resistance to solvents
2016 Physical dimensions
2017.9 Internal visual (hybrid)
2018.5 Scanning electron microscope (SEM) inspection of metallization
2019.8 Die shear strength
2020.9 Particule impact noise détection test(PIND)
2021.3 Glassivation layer integrity
2022.2 Wetting balance solderability
2023.6 Nondestructive bond pull
2024.2 Lid torque for glass-frit-sealed packages
2025.4 Adhesion of lead finish
2026 Random vibration
2027.2 Substrate attach strength
2028.4 Pin grid package destructive lead pull test
2029 Ceramic chip carrier bond strength
2030.1 Ultrasonic inspection of die attach
2031.1 Flip chip pull-off test
2032.2 Visual inspection of passive elements
2035 Ultrasonic inspection of TAB bonds
2036 Resistance to soldering heat

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies

ELECTRICAL TESTS (DIGITAL)

3001.1 Drive source, dynamic
3002.1 Load conditions
3003.1 Delay measurements
3004.1 Transition time measurements
3005.1 Power supply current
3006.1 High level output voltage
3007.1 Low level output voltage
3008.1 Breakdown voltage, input or output
3009.1 Input current, low level
3010.1 Input current, high level
3011.1 Output short circuit current
3012.1 Terminal capacitance
3013.1 Noise margin measurements for digital microelectronic devices
3014 Functional testing
3015.8 Electrostatic discharge sensitivity classification
3016 Activation time verification
3017 Microelectronics package digital signal transmission
3018 Crosstalk measurements for digital microelectronic device packages
3019.1 Ground and power supply impedance measurements for digital microelectronics device packages
3020 High impedance (off-state) low-level output leakage current
3021 High impedance (off-state) high-level output leakage current

ELECTRICAL TESTS (LINEAR)

4001.1 Input offset voltage and current and bias current
4002.1 Phase margin and slew rate measurements
4003.1 Common mode input voltage range
Common mode rejection ratio/Supply voltage rejection ratio
4004.2 Open loop performance
4005.1 Output performance
4006.1 Power gain and noise figure
4007 Automatic gain control range

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies

METHOD NO. TEST PROCEDURES

5001 Parameter mean value control
5002.1 Parameter distribution control
5003 Failure analysis procedures for microcircuits
5004.11 Screening procedures
5005.15 Qualification and quality conformance procedures
5006 Limit testing
5007.7 Wafer lot acceptance
5008.9 Test procedures for hybrid and multichip microcircuits
5009.1 Destructive physical analysis
5010.4 Test procedures for custom monolithic microcircuits
5011.5 Evaluation and acceptance procedures for polymeric adhesives.
5012.1 Fault coverage measurement for digital microcircuits.
5013 Wafer fabrication control and wafer acceptance procedures for processed GaAs wafers

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies

Environmental tests (1000 series).

1001.2 Barometric pressure (reduced).
1011.1 Immersion.
1015.1 Steady-state primary photocurrent irradiation procedure (electron beam).
1016 Insulation resistance.
1017.1 Neutron irradiation.
1018.3 Internal gas analysis.
1019.5 Steady-state total dose irradiation procedure.
1020.2 Electrostatic discharge sensitivity (ESDS) classification.
1021.3 Moisture resistance.
1022.5 Resistance to solvents.
1026.5 Steady-state operation life.
1027.3 Steady-state operation life (sample plan).
1031.5 High-temperature life (non-operating).
1032.2 High-temperature (non-operating) life (sample plan).
1033 Reverse voltage leakage stability
1036.3 Intermittent operation life.
1037.2 Intermittent operation life (sample plan).
1038.4 Burn-in (for diodes, rectifiers, and zeners).
1039.4 Burn-in (for transistors).
1040 Burn-in (for thyristors (controlled rectifiers)).
1041.3 Salt atmosphere (corrosion).
1042.3 Burn-in and life test for power MOSFET's or insulated gate bipolar transistors (IGBT).

MIL-STD-750
DEPARTMENT OF DEFENSE
TEST METHOD STANDARD
TEST METHODS FOR
SEMICONDUCTOR DEVICES

1049 Blocking life (sample plan).
1051.6 Temperature cycling (air to air).
1054.1 Potted environment stress test.
1055.1 Monitored mission temperature cycle.
1056.7 Thermal shock (liquid to liquid).
1057.1 Resistance to glass cracking.
1061.1 Temperature measurement, case and stud.
1066.1 Dew point.
1071.8 Hermetic seal.
1080 Single event burnout and single event gate rupture test.

COMPONENTS

Mil-Std-1580 Risk Mitigation Testing Strategies

Environmental tests (100 class)

101E	Salt atmosphere (corrosion) (formerly called salt spray)
102A	Superseded by Method 107 (see note on Method 102)
103B	Humidity (steady state)
104A	Immersion
105C	Barometric pressure (reduced)
106G	Moisture resistance
107G	Thermal shock
108A	Life (at elevated ambient temperature)
109C	Explosion
110A	Sand and dust
111A	Flammability (external flame)
112E	Seal

MIL-STD-202
DEPARTMENT OF DEFENSE
TEST METHOD STANDARD
ELECTRONIC AND
ELECTRICAL COMPONENT
PARTS

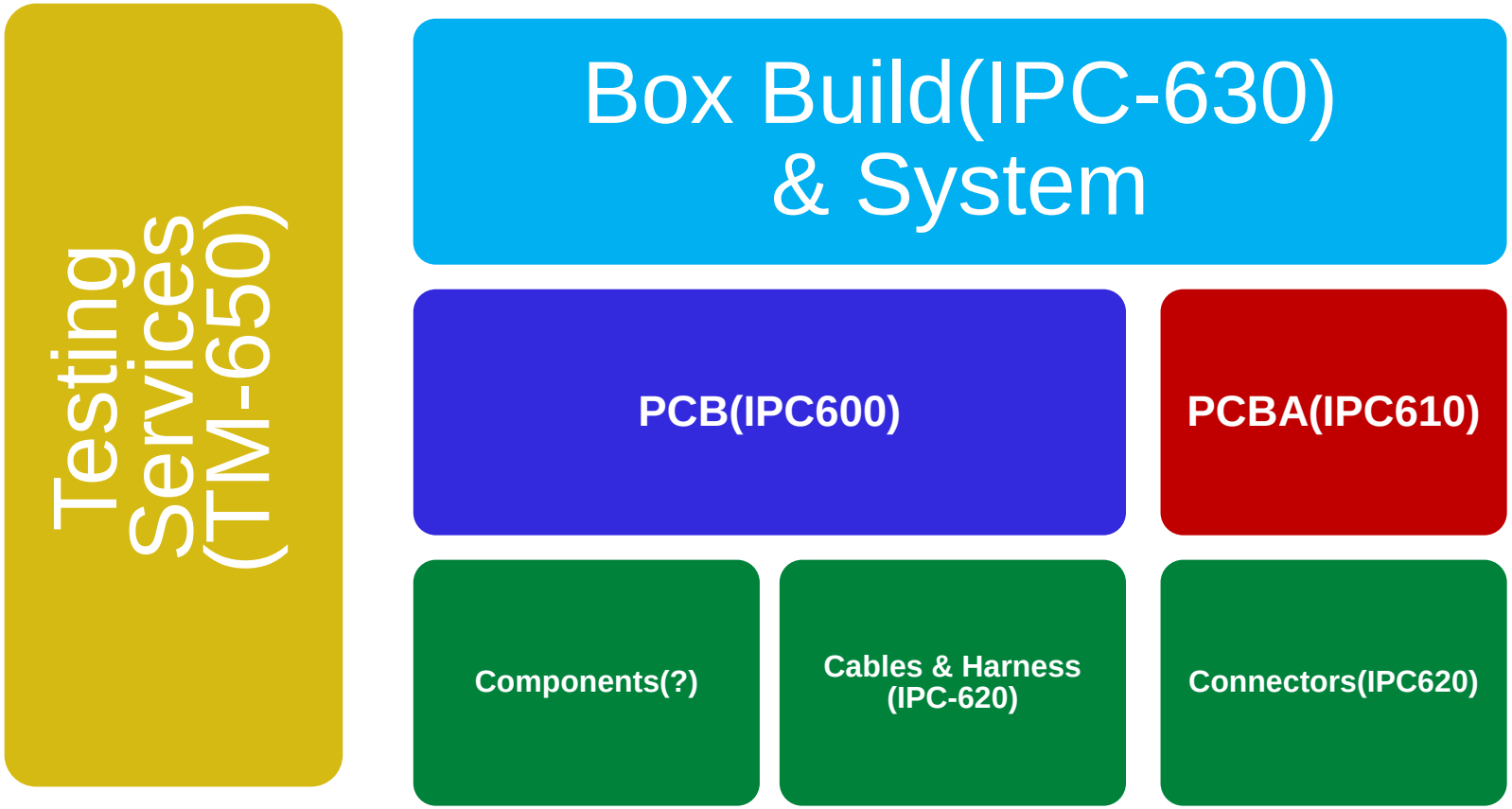
Physical characteristics tests (200 class)

208H	Solderability
209	Radiographic inspection
210F	Resistance to soldering heat
211A	Terminal strength
212A	Acceleration
213B	Shock (specified pulse)
214A	Random vibration
215K	Resistance to solvents
217A	Particle impact noise detection (PIND)

Electrical characteristics tests (300 class)

301	Dielectric withstanding voltage
302	Insulation resistance
303A	DC resistance
304	Resistance temperature characteristic
305A	Capacitance
306	Quality factor (Q)
307	Contact resistance

IPC BOX BUILD GUIDELINE BLOCKS



COMPONENTS

Risk Mitigation Testing Strategies

Three Step Component Risk Mitigation Procedure

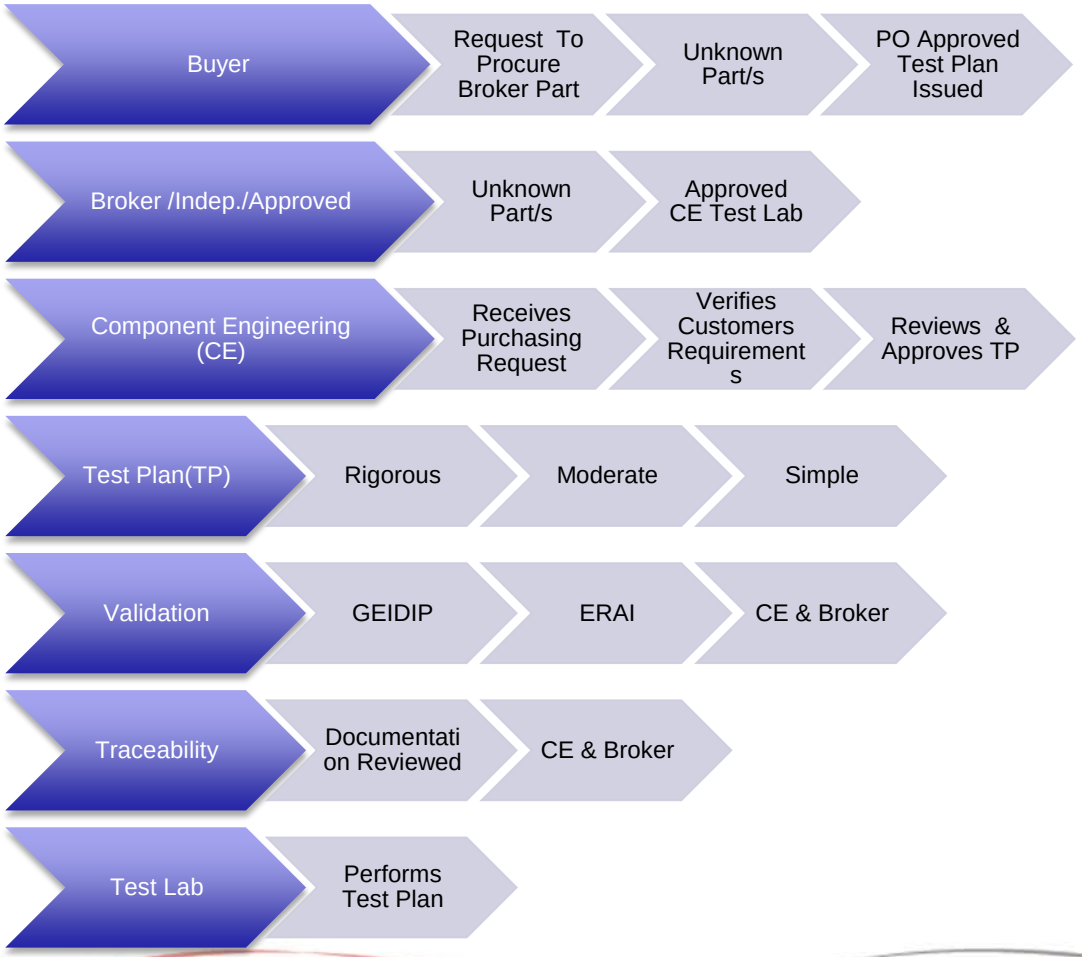
COMPONENTS

Risk Mitigation Testing Strategies

Step 1 – Customer Identifies The Application

Typical Procurement Structure

Step 2 – Component Test Plan Defined



COMPONENTS

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

Step 2 – Component Test Plan Defined

HIGH	MEDIUM	LOW
• DPA (MIL-STD-1580) • External Visual(2009.10) • Internal Visual(2013.1) • X-ray(2012.8) • XRF(1580B 5.1) • CSAM(2030.1) • Solderability(2013.9) • Environmental Stress Test • Thermal Shock(1011.9) • SEM(2018.5) • EDX/EDS(1580B 9) • FTIR/TGA • Electrical Test • Burn-in(1015.10) • Fine & Gross Leak(1014.13) • RGA(1018.6) • PIND(2020.9)	• AS5553C • DPA • External Visual • Internal Visual • Marking Permanency • Inspection Remarking/Resurface • X-ray • XRF(JESD 213) • Thermal Cycle • Electrical Test • Burn-in • Fine & Gross Leak	• IDEA 1010 • Photograph Parts • Co-planarity • Damaged Leads and Terminations • Contamination and Oxidation • Evidence of Poor Handling, Storage or Prior Use • Rework or Refurbishment • Remarked and Suspect Counterfeit/Fraud

COMPONENTS

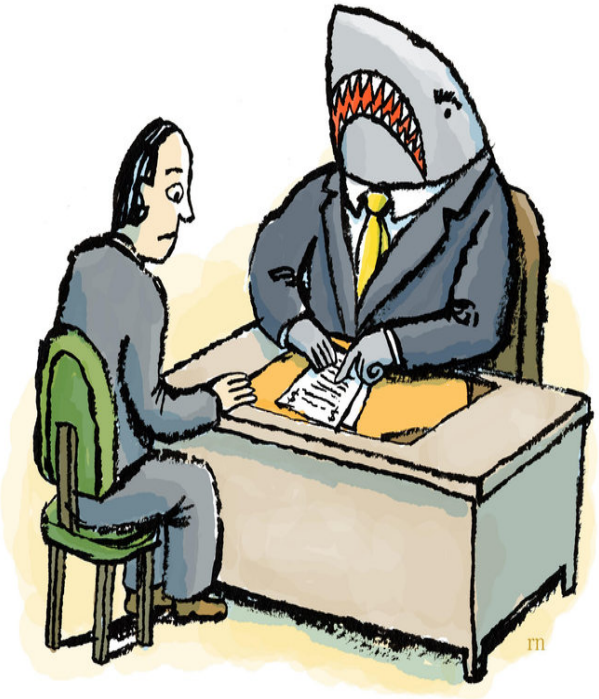
Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

Step 3 – Customer Acknowledges Risk

The Only True Component Risk Mitigation Solution

Risk Mitigation Testing Strategies
(IDEA -1010, AS5553, Mil-Std-1580, Custom)

Design Out Obsolescence ?



Customer Submission Request Form

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

Optical Microscopy
MIL-STD-883, Method 2010
Method 2013, Method 2017
MIL-STD-750, Internal Visual

X-Ray Fluorescence (XRF)
JESD213
MIL-STD-1580, Reqmt. 9

Real-Time X-Ray Inspection
MIL-STD-883, Method 2012
MIL-STD-750, Method 2076
MIL-STD-202, Method 209

Seal Testing
MIL-STD-883, Method 1014
MIL-STD-750, Method 1071
MIL-STD-202, Method 112

Fluorescent Microscopy
MIL-STD-883, Method 1014

FTIR/TGA
ASTM E1252, E2105

Chemical Decapsulation
Industry Accepted Standards

Cross-Sectioning
DPA MIL-STD-1580

Temperature Cycling
MIL-STD-883, Method 1010
MIL-STD-750, Method 1051
MIL-STD-202, Method 107

Particle Impact Noise Detection (PIND)
MIL-STD-883, Method 2020
MIL-STD-750, Method 2052
MIL-STD-202, Method 217

Wire-Pull
MIL-STD-883, Method 2011
MIL-STD-750, Method 2037

Die Shear
MIL-STD-883, Method 2019
MIL-STD-750, Method 2017

Scanning Electron Microscopy (SEM)
MIL-STD-750, Method 2077
MIL-STD-883, Method 2018

Energy Dispersive X-Ray Spectroscopy (EDS)
ASTM E1508

C-Mode Scanning Acoustic Microscopy (CSAM)
IPC/JEDEC
J-STD-035

Electrical Testing/Screening
MIL-STD-883
MIL-STD-750
MIL-STD-202

HAST
JESD22-A110D
JESD22-A118A

Customer Submission Request Form

Risk Mitigation Testing Strategies

(IDEA-1010, AS5553, Mil-Std-1580, Custom)

DRTL REPORT

REVISION TABLE

REV	DATE	ENG APPROVAL	NOTES
-	03-04-11	CLIFTON ALDRIDGE	Initial Release

INTERNAL PROGRAM/CUSTOMER:		ADDITIONAL INFORMATION:
SO#:		
DATE RECEIVED:	03/02/11	
PART NUMBER:	935101-1 (MS75089-11)	
SERIAL NUMBER:	NONE	CUSTOMER I
MANUFACTURER:	Delevan	NONE

Incoming Complaint:
Incoming compliant was customer had reported intermittent series resista
to the nigh higher assemble.

Detail:
The following parts were supplied for testing.
Lot # 207111, D/C 1049 = 233, D/C 1032 = 22, D/C 1035 = 45
Lot # 205790, D/C 1035 = 300
Lot # 202407, D/C 1035 = 3
The 205790 and 202407 lots (both of date code 1035) were electrical test

Dynamic Research and Testing Laboratories, LLC

Dynamic Research and Testing Laboratories LLC
1450 Mission Ave NE
Albuquerque, NM 87101

(505)263-0398
caldridge@DRTLOnline.com

Invoice

DATE	INVOICE #
03/06/2011	1009
TERMS	DUE DATE
Net 30	04/05/2011

BILL TO
XYZ4 XYZ4 XYZ4, NY

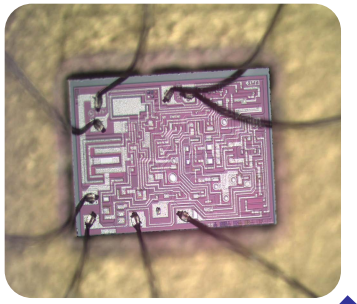
AMOUNT DUE	ENCLOSED
$1,550.00	

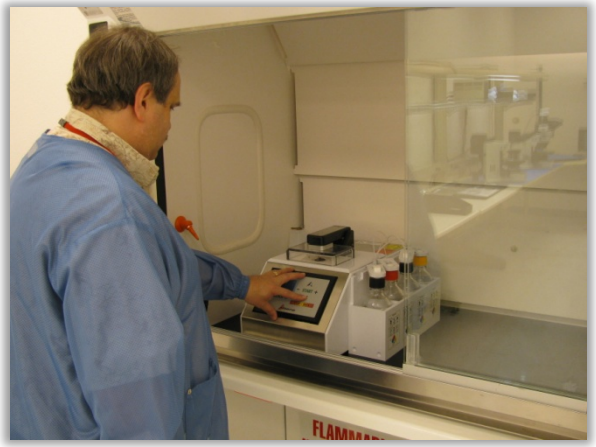
Please detach top portion and return with your payment

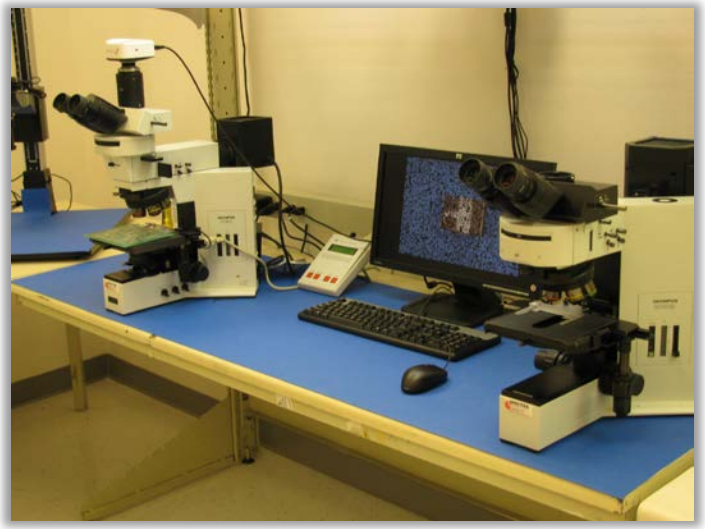
Activity	Quantity	Rate	Amount
• Standard DPA per MIL-STD-1580 Requirement 10 for Capacitors	1	550.00	550.00
• Standard Level 2 Destructive Physical Analysis	1	1,000.00	1,000.00

SERVICES – Optical Microscopy

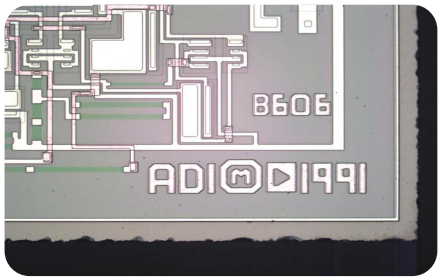
Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)







Internal Visual
Mil-Std-750/883



SERVICES – Real Time X-ray Inspection

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

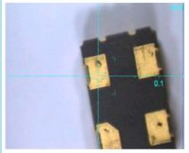
Radiographic Inspection per Mil-Std- 202, 750, 883?

SERVICES – XRF (X-ray Fluorescence)

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

HELMUT FISCHER GmbH + Co. KG
industriestrasse 21
71069 Sindelfingen

Fischerscope® XRAY XDAL
Product: 1 / ENIG Dir.: PCB Rigid Block: 9
Application: 24 / ENIG



XRF

Calibration: Standard free
n= 1 Au 1 = 27.6 µ" NiP 2= 297.0 µ" Cu 3 = 2.35 µ"

Mean	27.61 µ"	297.0 µ"	2.347 µ"
Standard deviation	-------- µ"	-------- µ"	-------- µ"
C.O.V. (%)	0.00	0.00	0.00
Range	0.000 µ"	0.000 µ"	0.000 µ"
Number of readings	1	1	1
Min. reading	27.6 µ"	297.0 µ"	2.35 µ"
Max. reading	27.6 µ"	297.0 µ"	2.35 µ"
Measuring time	30 sec		
Operator: CCA	SMT Osc	na	

Date: 7/23/2010 Time: 9:24:13 AM

MIL-STD-1580

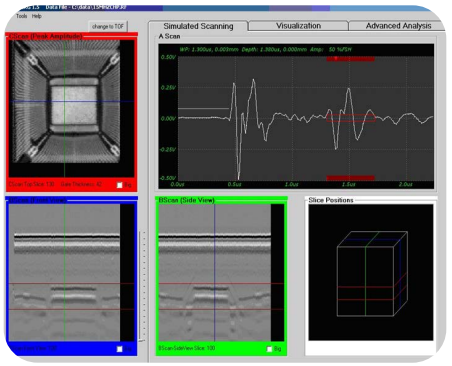
JESD213

SERVICES - CSAM

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

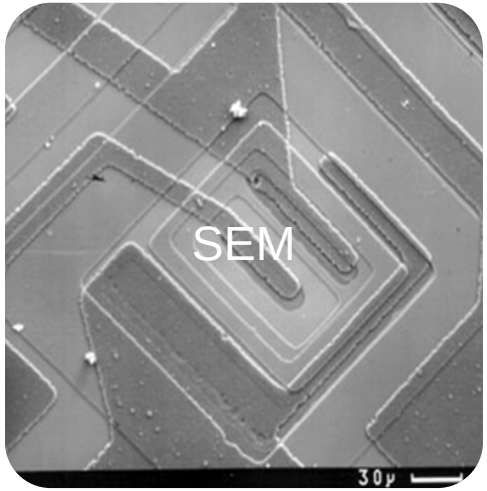
CSAM

J-Std-035



SERVICES – SEM/EDX

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)



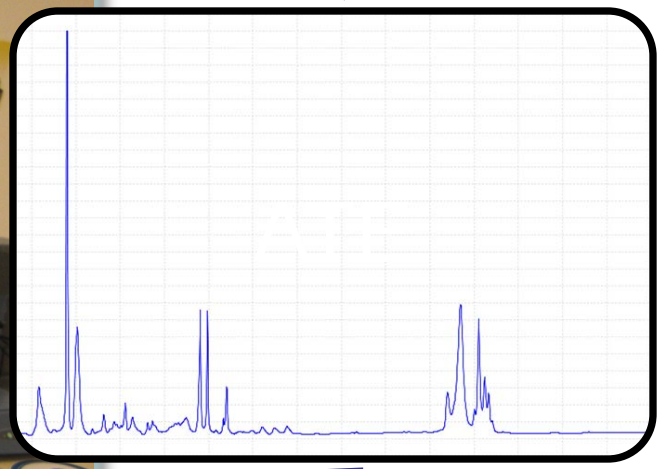
Mil-Std -750

Mil –Std-883

SERVICES – uFTIR/TGA

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

FTIR

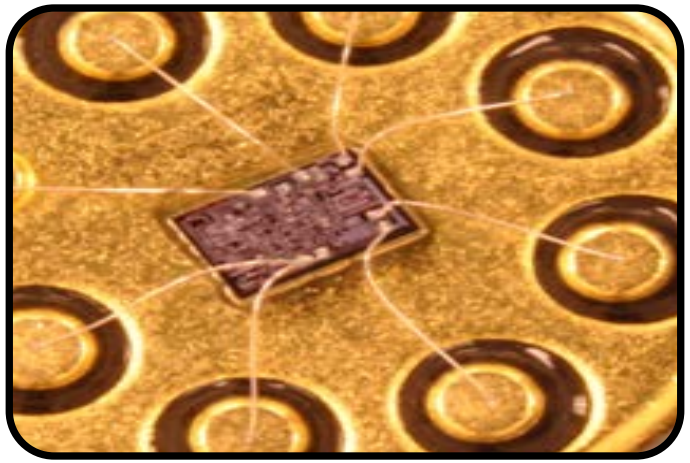


TGA

SERVICES – Wire-pull/Die Shear

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

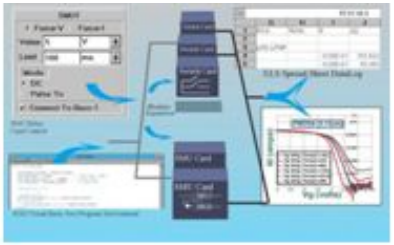
Wire-Pull
Mil-Std-883 / 2011



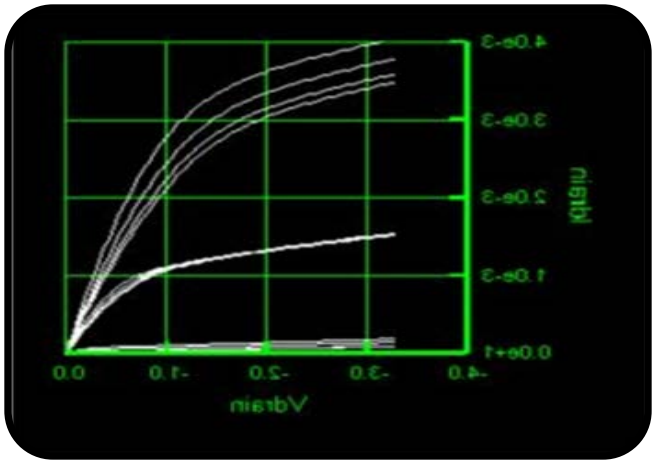
Die Shear
Mil –Std – 883/2019

SERVICES – Electrical

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)



HFE

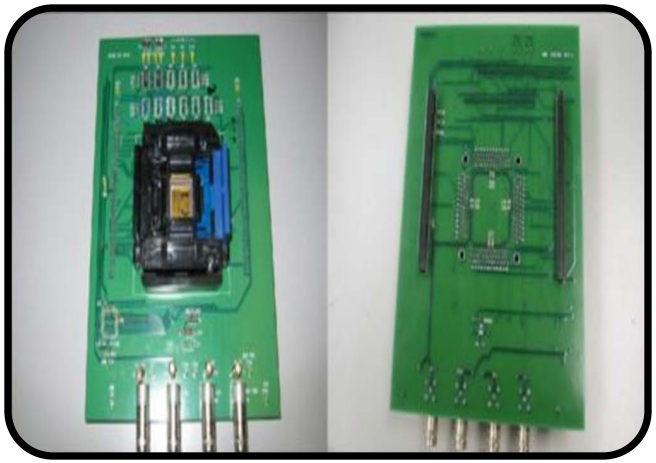


Idss

SERVICES – Environmental

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)

HAST



THERMAL CYCLE

Questions- *Thank you*

Risk Mitigation Testing Strategies
(IDEA-1010, AS5553, Mil-Std-1580, Custom)