REVISIONS			
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SHEET REVISION STATUS

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SH	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

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DESTRUCTIVE PHYSICAL ANALYSIS (DPA) OF EEE PARTS

GSFC S-311-M-70

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SECTION 1

SCOPE

1.1 PURPOSE

The purpose of this document is to describe the general requirements for performance of destructive physical analysis (DPA) on samples of parts. This specification will identify the tests to be performed and the appropriate acceptance/rejection criteria to be used in the testing of electronic, electromagnetic, and electromechanical parts. The appendices in the back of this document are provided to give further guidance in the performance of destructive physical analysis.

1.2 APPLICATION

This standard is intended to be referenced in detailed part specifications, or other documents where DPA requirements are imposed, to assure that the practices, procedures, and criteria contained herein are uniformly applied.

Section 2

APPLICABLE DOCUMENTS

2.1 GOVERNMENT DOCUMENTS

The following documents, of the issue in effect on the date of the invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

2.2 STANDARDS

MILITARY:

MIL-STD-105	SAMPLING PROCEDURES AND TABLES FOR INSPECTION BY ATTRIBUTES
MIL-STD-202	TEST METHODS FOR ELECTRONIC AND ELECTRICAL COMPONENT PARTS
MIL-STD-750	TEST METHODS FOR SEMICONDUCTOR DEVICES
MIL-STD-883	TEST METHODS AND PROCEDURES FOR MICROELECTRONICS
MIL-STD-1580	DESTRUCTIVE PHYSICAL ANALYSIS FOR ELECTRONIC, ELECTROMAGNETIC, AND ELECTROMECHANICAL PARTS
DOD-STD-1686	ELECTROSTATIC DISCHARGE CONTROL PROGRAM FOR PROTECTION OF ELECTRICAL AND ELECTRONIC PARTS ASSEMBLIES AND EQUIPMENT.

2.3 OTHER DOCUMENTS

NASA:

SPAR	GUIDELINES FOR STANDARD PAYLOAD ASSURANCE REQUIREMENTS FOR GSFC ORBITAL PROJECTS
GSFC PPL	GSFC PREFERRED PARTS LIST

NATIONAL BUREAU OF STANDARDS:

NBS SPECIAL PUBLICATION 400-35 NOTES ON SEM EXAMINATION OF MICROELECTRONIC DEVICES

2.4 ORDER OF PRECEDENCE

In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence. In the event of a conflict between this standard and a procurement specification, the procurement specification shall take precedence. However, nothing in this standard shall supersede applicable laws and regulations unless a specific exemption has been obtained.

SECTION 3

DEFINITIONS

3.1 DEFECT

A defect is any nonconformance from specified requirements which affects form, fit, or function.

3.2 DESTRUCTIVE PHYSICAL ANALYSIS

A destructive physical analysis (DPA) is a systematic, logical, detailed examination of parts during various stages of physical disassembly, conducted on a sample of completed parts of a given lot, wherein parts are examined for a wide variety of design, workmanship, and processing problems that may not show up during normal screening tests. The purpose of these analyses is to determine those lots of parts, delivered by a vendor, which have anomalies or defects such that they could, at some later date, cause a degradation or catastrophic failure of a system.

3.3 LOT RELATED DEFECT

A lot related defect is an anomaly attributable to a variance in the design, manufacturing, test, or inspection process that is repetitive throughout a production lot.

3.4 PRODUCTION LOT

A production lot is a group of parts defined by the part specification or drawing, and identified with a lot date code.

3.5 SCREENABLE DEFECT

A screenable defect is one for which an effective, nondestructive screening test or inspection can be reasonably developed and applied to eliminate, with confidence, the nonconforming items from the lot.

SECTION 4

GENERAL REQUIREMENTS

The general requirements of this specification are the same as those requirements outlined in MIL-STD-1580(USAF) Section 4.

In determining the level of testing and inspection methods, refer to the procurement document to verify the class of the part purchased. If no class has been specified in the procurement document then class B or equivalent class is to be assumed and parts are to be subjected to class B level of testing and inspection methods.

Change in the order in which tests are performed is permitted with prior approval from the governing activity.

Sampling is to be performed in accordance with paragraph 4.1 of MIL-STD-1580(USAF) or with the sampling plan specified in the applicable procurement document; the plan specified in the procurement document shall take precidence over other plans. Lots of 200 or less shall be sampled as outline in Table 1. Table 1 indicates the required number of samples to be subjected to destructive physical analysis per lot date code (LDC). If identical parts are received with different lot date codes, the parts will be separated by lot date codes and subjected to the sampling plan of Table 1.

Small Lot Sampling Plan

Lot Size per LDC	Sample Size
<5	1
5-15	2
16-50	3
>50	5

Table 1. Sample size for number of parts per lot date code.

SECTION 5

DETAILED REQUIREMENTS

This section calls out the detailed requirements for destructive physical analysis of commonly used components. These requirements supplement the general requirements of section 4. Pre-DPA tests, such as functional tests and solderability tests, are assumed to have been satisfied by normal inspection and testing.

5.1 CAPACITORS

5.1.1 Capacitors, fixed ceramic
type: MIL-C-20
MIL-C-123
MIL-C-39014
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.1.

5.1.2 Capacitors, fixed, ceramic chip
type: MIL-C-123
MIL-C-55681
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.2.

5.1.3 Capacitors, fixed mica
type: MIL-C-87164
MIL-C-39001
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.3.

5.1.4 Capacitors, fixed, solid tantalum
type: MIL-C-39003
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.4.

5.1.5 Capacitors, fixed, tantalum foil
type: MIL-C-39006
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.5.

5.1.6 Capacitors, fixed, paper or plastic film
type: MIL-C-19978

Follow procedure outlined in MIL-STD-1580(USAF) Section 5.6.

5.1.7 Capacitors, fixed, metallized film
type: MIL-C-87217
MIL-C-83421
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.7.

5.1.8 Capacitors, fixed, tantalum slug, wet electrolyte
type: MIL-C-39006/22
MIL-C-83500/01
Follow procedure outlined in MIL-STD 1580(USAF) Section 5.8.

5.1.9 Capacitor, fixed, glass
type: MIL-C-23269
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.9.

5.1.10 Capacitor, variable, piston type, sealed and unsealed
type: MIL-C-14409
Follow procedure outlined in MIL-STD-1580(USAF) Section 5.10

5.2 MAGNETIC DEVICES

5.2.1 INDUCTORS and TRANSFORMERS
type: MIL-STD-981
Follow procedure outlined in MIL-STD-1580(USAF) Section 10.1

5.2.2 RF COILS
Follow procedure outlined in MIL-STD-1580(USAF) Section 10.2.

5.3 RESISTORS

5.3.1 Resistors, variable, wire wound
type: MIL-R-39015
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.1

5.3.2 Resistors, variable, nonwirewound
type: MIL-R-39035
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.2

5.3.3 Resistors, metallized film
type: MIL-R-55182
MIL-R-39017
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.3.

5.3.4 Resistors, fixed, metal foil
type: MIL-R-55182 (RNC90)
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.4.

5.3.5 Resistors, fixed, chip
type: MIL-R-55342 (RM)
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.5.

5.3.6 Resistor networks
type: MIL-R-83401
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.6.

5.3.7 Resistors, wirewound, accurate
type: MIL-R-39005
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.7.

5.3.8 Resistors, fixed, wirewound, power
type: MIL-R-39007
MIL-R-39009
Follow procedure outlined in MIL-STD-1580(USAF) Section 13.8.

5.3.9 Resistors, carbon composition
type: MIL-R-39008 (RCR)
DPA not Required

5.4 SWITCHES

5.4.1 Switch, snap, action
Follow procedure outlined in MIL-STD-1580(USAF) Section 14.1.

4.4.2 Switch, Thermal
Follow procedure outline in MIL-STD-1580(USAF) Section 14.2.

5.5 THERMISTORS

5.5.1 Thermistor, glass bodied, hermetic
type: MIL-T-23648
Follow procedure outline in MIL-STD-1580(USAF) Section 15.1.

5.5.2 Thermistor, disc and bead encapsulated
type: MIL-T-23648
Follow procedure outlined in MIL-STD-1580(USAF) Section 15.2

5.6 CRYSTALS

5.6.1 Crystal units, Quartz
type: MIL-C-3098
Follow procedure outlined in MIL-STD-1580(USAF) Section 7.1.

5.7 CONNECTORS

5.7.1 Connectors, multipin, excluding contacts
Follow procedure outlined in MIL-STD-1580(USAF) Section 6.1.

5.7.2 Connectors, multipin, with contacts
Follow procedure outlined in MIL-STD-1580(USAF) Section 6.2

5.7.3 Connectors, RF
Follow procedure outlined in MIL-STD-1580(USAF) Section 6.3.

5.7.4 Connector, contacts
Follow procedure outlined in MIL-STD-1580(USAF) Section 6.4.

5.8 FILTERS

5.8.1 Filters, EMI, low pass, feed through
type: MIL-F-28861
MIL-F-15733
Follow procedure outlined in MIL-STD-1580(USAF) Section 9.1.

5.9 RELAYS

5.9.1 Relays
type: MIL-R-6106
MIL-R-39016
Follow procedure outlined in MIL-STD-1580(USAF) Section 12.1.

5.10 DIODES

5.10.1 Diodes
type: MIL-S-19500
Follow procedure outlined in MIL-STD-1580(USAF) Section 8.1. After electrical testing, devices constructed with an internal cavity shall be subjected to PIND testing in accordance with MIL-STD-883 method 2020.

5.11 TRANSISTORS

5.11.1 Transistors
type: MIL-S-19500
Follow procedure outlined in MIL-STD-1580(USAF) Section 16.1. After electrical testing, devices constructed with an internal cavity shall be subjected to PIND testing in accordance with MIL-STD-883 method 2020.

5.12 MICROCIRCUITS

5.12.1 Microcircuits, hybrid
Follow procedure outlined in MIL-STD-883
Method 5009.1 para. 3.5

5.12.2 Microcircuits, multichip
Follow procedure outlined in MIL-STD-883
Method 5009.1 para. 3.5

5.12.3 Microcircuits, monolithic
Follow procedure outlined in MIL-STD-883
Method 5009.1 para. 3.4.
Additional testing for non-standard parts
to be done in accordance with GSFC PPL Table 10:
PIND MIL-STD-883 method 2020

APPENDIX A

RADIOGRAPHIC EXAMINATIONS

1. Radiographic examinations may be performed as an extension to normal DPA procedures for the purpose of determining defects which may be present within a component prior to opening that component. The following specifications or approved equivalent shall be used when performing radiographic examinations:

Integrated circuits	MIL-STD-883	method 2012
Transistors, Diodes	MIL-STD-750	method 2076
Passive Devices	MIL-STD-202	method 209

APPENDIX B

ENERGY DISPERSIVE X-RAY ANALYSIS

The purpose of this test is to help in the identification of certain defects or anomalies which may be present in a component. Energy dispersive X-ray analysis (EDXA) is used to determine the elemental makeup of a selected particle or item within a component. EDXA may be performed at the same time that SEM examinations are being performed. Actual operation of the EDXA unit shall be in accordance with manufacturer instructions and shall be performed by a properly trained operator. Results of this analysis shall be recorded and maintained with the results of SEM examination.

APPENDIX C

SCANNING ELECTRON MICROSCOPE (SEM) EXAMINATION

The SEM examination is used as a compliment to the optical microscope during the internal examination process of a DPA procedure. It is used to look at wire bonds, metallization integrity, chip bonds, particles, oxide faults, or laser trim faults. The following Military Standards or approved equivalent procedures may be used to perform SEM examinations:

Semiconductors	MIL-STD-750	method 2077
Integrated circuits	MIL-STD-883	method 2018