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ELECTROSTATIC DISCHARGE CONTROL REQUIREMENTS FOR THE PROTECTION OF ELECTRONIC COMPONENTS AND ASSEMBLIES

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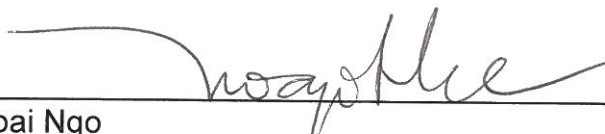
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ELECTROSTATIC DISCHARGE CONTROL REQUIREMENTS FOR THE PROTECTION OF ELECTRONIC COMPONENTS AND ASSEMBLIES

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TABLE OF CONTENTS

CHANGE HISTORY LOG	6	
1.0 SCOPE 7		
1.1 PURPOSE	7	
1.2 APPLICABILITY	7	
1.3 CONVENTIONS	8	
1.4 MEASUREMENT / VERIFICATION.....	8	
1.5 CANCELLATION / RESCISSION	8	
2.0 REFERENCES	8	
2.1 APPLICABLE DOCS	8	
2.2 RESOLVING CONFLICTS.....	9	
2.3 REFERENCE DOCS.....	9	
3.0 ACRONYMS, TERMS, AND DEFINITIONS	9	
4.0 RESPONSIBILITY	10	
4.1 SAFETY AND MISSION ASSURANCE	10	
4.2 ESD TESTING AND VERIFICATION OFFICER	10	
4.3 JSC LABS AND FACILITIES	10	
4.4 CONTRACTOR LABS AND FACILITIES.....	10	
4.5 DESIGN ENGINEERING.....	11	
4.6 JSC SUPPORT FOR ESD ISSUES	11	
5.0 TOOLS AND TASKS REQUIRED TO MAINTAIN AN ESD CONTROL PROGRAM	11	
5.1 TRAINING	11	
5.2 PERSONNEL CERTIFICATION	13	
5.3 RE-CERTIFICATION	13	
5.4 CLASS 1, 2, AND 3 FACILITY EPA CERTIFICATION.....	13	
5.5 FACILITY ESD MONITORS.....	16	
5.6 ESD CONTROL PLAN	16	
5.7 MATERIAL CERTIFICATION AND QUALITY INSPECTION REQUIREMENTS.....	17	
5.7.1 Reusing ESD Protective Materials.....	17	
5.8 ESD EQUIPMENT CONTROL.....	17	
6.0 ESD CONTROL PROGRAM TECHNICAL REQUIREMENTS:.....	18	
6.1 GENERAL	18	
6.2 IDENTIFICATION AND ACCESS.....	19	
6.3 STORAGE AND LOCKER FACILITIES.....	19	
6.4 PROHIBITED ACTIVITIES AND ITEMS	19	
6.5 ESD PROTECTIVE WORK SURFACES	19	
6.6 ESD PROTECTIVE FLOOR MATS AND CONDUCTIVE FLOORS	21	
6.7 PERSONNEL GROUNDING DEVICES	22	
6.7.1 Wrist Straps.....	22	
6.7.2 Leg Straps, Heel Straps, and Conductive Shoes	22	
6.8 EQUIPMENT AND FACILITIES GROUNDING	23	
6.8.1 Stools and Chairs	24	
6.9 RELATIVE HUMIDITY CONTROL.....	24	
6.10 AIR IONIZERS.....	24	

6.11	HAND TOOLS, EQUIPMENT, AND FIXTURES	25
6.11.1	Soldering Equipment	25
6.11.2	Desoldering Equipment	25
6.11.3	Common Ground at the Workstation	25
6.12	ESD PROTECTIVE PACKAGING	25
6.13	CARTS, WAGONS, AND TRAMS.....	27
6.14	TEMPERATURE CHAMBERS AND COOLING AGENTS	27
6.15	CLEANING ESD PROTECTIVE AREAS.....	28
6.16	CLEANING ESD SENSITIVE ITEMS	28
6.17	ELECTROSTATIC DETECTORS, MONITORS, AND VOLTMETERS.....	28
6.18	CONTAMINATION CONTROL.....	28
6.19	CLOTHING REQUIREMENTS.....	29
6.19.1	Recommended Resistance Range	29
6.19.2	Clean Room Considerations.....	29
6.19.3	Cleaning	29
7.0	OPERATING PROCEDURES:	29
7.1	DRAWING REQUIREMENTS AND IDENTIFICATION OF ESD SENSITIVE ITEMS	29
7.2	MARKING OF ASSEMBLIES, SUBASSEMBLIES AND LRUS	30
7.3	CLASSIFICATION OF PART ESD SENSITIVITY	30
7.3.1	ESD-Sensitivity Classification	30
7.3.2	ESD-Sensitivity Markings	31
7.4	PACKAGING IDENTIFICATION OF ESD SENSITIVE ITEMS	31
7.5	SHIPPING AND RECEIVING	31
7.6	USER RECEIVING INSPECTION	32
7.7	PRINTED CIRCUIT BOARD LEVEL ESD PROTECTION.....	32
7.8	STORAGE OF ESDS HARDWARE.....	33
8.0	LINE REPLACEABLE UNIT ESD REQUIREMENTS:	33
8.1	INTERCONNECTING CABLES.....	33
8.2	MOUNTING AND UNMOUNTING LINE REPLACEABLE UNITS.....	33
8.3	DETERMINATION OF AN LRU'S ESD SENSITIVITY	34
8.4	BOX LEVEL TESTING TO DETERMINE THE ESD SENSITIVITY OF FLIGHT HARDWARE	34
8.5	ANALYSIS TO DETERMINE THE ESD SENSITIVITY OF FLIGHT HARDWARE	35
9.0	ELECTROSTATIC DISCHARGE DESIGN GUIDE FOR PROTECTION OF ELECTRONIC EQUIPMENT AND CIRCUITS.....	35
9.1	INTRODUCTION	35
9.2	CHARACTERISTIC OF THE ESD WAVEFORMS	35
9.3	ESD PROTECTION CIRCUITRY	37
9.4	PROTECTION CIRCUIT ELEMENTS.....	37
9.5	DIODES	37
9.6	RESISTORS.....	37
9.7	ESD PCB DESIGN	38
9.8	PROTECTION NETWORK	38
9.9	ESD TESTING.....	38
9.10	TEST SETUP	39
9.11	ESD TEST SIMULATOR.....	39
9.12	DC POWER SOURCE.....	39
9.13	TEST LEVELS.....	40



9.14	SELECTION OF TEST POINTS.....	40
9.15	TEST PLANNING	41
APPENDIX A ACRONYMS, TERMS, AND DEFINITIONS		43
	TERMS AND DEFINITIONS.....	43
	ACRONYMS.....	48
APPENDIX B INFORMATIVE REFERENCES.....		49

LIST OF TABLES

Table 5.1-1	ESD Training Guidelines	11
Table 5.4-1	ESD Requirements for Workstations Handling ESD Sensitive Components.....	15
Table 6.1-1	ESD Certification and Periodic Inspection	18
Table 7.3-1	ESD Sensitivity Classification	30
Table 9.14-1:	ESD – Contact Discharge	42
Table 9.14-2:	ESD – Contact Discharge	42
Table 9.14-3:	ESD – Contact Discharge	43

LIST OF FIGURES

Figure 6.5.1	Typical ESD Protective Station Grounding Systems	20
Figure 6.5.2	Typical Barrier Strip Common Ground Point	21
Figure 7.2.1	ESDS8-1-2001 ESD Susceptibility Symbol	30
Figure 9.2.1:	IEC 61000-4-2 schematic as shown in specification	36
Figure 9.2.2:	Schematic diagram of the IEC waveform	36
Figure 9.2.3:	Basic circuit diagram for HBM	37
Figure 9.13.1:	Typical Test Setup for Table Top Equipment	41

Change History Log

Revision	Date	Originator	Description of Changes
Baseline	March	Stephen Trifilo	Initial Release (was formerly JPR 8730.1)

1.0 SCOPE

This document defines the process, roles, responsibilities, and technical requirements for ESD control. Based on the requirements and guidelines found in this document, the responsible party for each facility or laboratory shall identify each ESD control work area. The responsible parties shall then develop an ESD Control Plan for each work area. This document provides guidance on how to comply with NASA Policy Directive 8730.5 (NPD-8730.5) that imposes ESD standard ANSI/ESD S20.20-2007.

1.1 Purpose

The purpose of this document is to establish the standards for an Electrostatic Discharge (ESD) control program designed to protect Electrostatic Discharge Sensitive (ESDS) components, sub-assemblies, and assemblies that are susceptible to ESD damage at voltage levels equal to or above 250 volts. For handling ultra-sensitive devices that can be damaged at voltage levels below 250 volts, Table 5-2 ESD Requirements for Workstations Handling ESD Sensitive Components, Class 1 and Table 6.1-1 ESD Certification and Periodic Inspection requirements become mandatory.

1.2 Applicability

This document is applicable to any Johnson Space Center (JSC) organizational element or contractor facility that:

1. Handles ESDS space flight components for storage, test, evaluation, or analysis of these components; and /or
2. Performs construction, test, repair, rework, or modification of any electrical or electronic Line Replaceable Unit (LRU), module, assembly, or sub-assembly that contains or may contain ESDS sensitive components.

The standards defined in this document are applicable to all JSC organizations and contractors, both on-site and off-site that handle flight hardware and components or mission-essential ground support equipment. For the purposes of this document, the following definitions are used:

Flight hardware includes spacecraft, launch vehicles, payloads, experiments, and any element of these components where invoked contractually in procurements.

Mission-essential ground support equipment may include ground data processing hardware, unique payload support hardware for installation and functional checkout, and related equipment.

This document does not include controls for pyrotechnics, flammables, or explosives.

Measures for controlling electrostatic discharge shall be implemented during all phases of hardware handling including the receiving, inspection, assembly, testing, modification, repair, storage, and shipping of all items designated as ESDS. ESD sensitive items that are properly protected as described in this document do not require special precautions, such as use of a wrist strap, when they are being handled.

Facilities that handle ESDS hardware at the orbital replacement unit (ORU) level exclusively shall comply with Table 5.4-1 ESD Requirements for Workstations Handling ESD Sensitive Components, Class 3 requirements.

1.3 Conventions

Requirements are indicated by the word "shall".

1.4 Measurement / Verification

Verification of the requirements contained within this standard is primarily accomplished through the identification, inspection and certification of JSC facilities handling Electrostatic Discharge Sensitive material. These inspections are performed to the requirements contained in this document.

1.5 Cancellation / Rescission

Upon issuance of this standard, the following documents are cancelled:

Doc. No.	Rev.	Document Title
JPR 8730.1		Electrostatic Discharge Control Requirements for the Protection of Electronic Components and Assemblies (April 2008).

2.0 REFERENCES

The latest issuances of cited documents shall apply unless specific versions are designated.

2.1 Applicable Docs

The documents listed in this section contain provisions that constitute requirements of this standard as cited in the text.

Doc. No.	Document Title
ANSI/ESD S20.20-2007	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
ANSI C63.16-1993	American National Standard Guide for Electrostatic Discharge Test Methodologies and Criteria for Electronic Equipment
ESD TR20.20-2008	Handbook for the development of an Electrostatic Discharge Control Program for the Protection of Electronic Parts, Assemblies and Equipment
IEC 61000-4-2	Electromagnetic Compatibility (EMC) – Part 4.2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test
IEEE STD C62.38-1994	IEEE Guide on Electrostatic Discharge (ESD): ESD Withstand Capability Evaluation Methods (for Electronic Equipment Subassemblies)
MIL-STD-129P	Change 3, Marking for Shipment and Storage
MIL-STD-1686C	Protection of Electrical and Electronic Parts, Electrostatic Discharge Control Program for Assemblies and Equipment (Excluding Electrically

	Initiated Explosive Devices)
MIL-E-17555	Packaging of Electronic and Electrical Equipment, Accessories, and Provisioned Items
MIL-PRF-19500	Semiconductor Devices, General Specification for
MIL-PRF-38510	Performance Specification, General Specification for Integrated Circuits Manufacturing

2.2 Resolving Conflicts

In the event of a conflict between this standard and any applicable or reference documents, this standard takes precedence. In the event of a conflict between this standard and a NASA Policy Directive (NPD) the NPD takes precedence.

2.3 Reference Docs

Additional informative references are located in Appendix C.

3.0 ACRONYMS, TERMS, AND DEFINITIONS

Specialized terms, acronyms, and definitions used in this document are defined in Section 3.0.

4.0 RESPONSIBILITY

4.1 Safety and Mission Assurance

The JSC Safety and Mission Assurance (S&MA) Office shall be responsible for identification, inspection, and certification of JSC facilities handling Electrostatic Discharge Sensitive (ESDS) materials. S&MA shall monitor conformance to the requirements of this document via the work area Electrostatic Discharge (ESD) Control Plan for all locations handling ESDS parts and assemblies. These control measures shall be implemented during all phases of design, procurement, assembly, disassembly, troubleshooting, testing, maintenance, modification, handling, inspections, storage, shipping, and receiving.

4.2 ESD Testing and Verification Officer

An ESD Testing and Verification (ET&V) Officer who is an ESD Association Certified Engineer or Inspector shall lead the S&MA function for identification, inspection, and certification of JSC facilities handling Electrostatic Discharge Sensitive (ESDS) materials.

All ESD Testing and Verification (ET&V) employees shall be formally trained by attending one or more sessions of training offered by the ESD Association.

Rationale: The requirements for this section derive from ESD TR20.20-2008, Section 4.3 – Developing a Compliance Verification Plan. Refer to that source for further information.

4.3 JSC Labs and Facilities

The ET&V Officer shall ensure the following tasks are performed:

Identification of all JSC labs and facilities handling ESD sensitive items.

Initial audit/certification and recertification of all JSC labs and facilities handling ESD sensitive items.

Qualification and periodic verification testing of ESD protective materials.

Periodic re-inspection of all certified labs.

Conformance and compliance audits of labs and facilities using a JSC approved alternative ESD Control Requirement. Compliance audits may be performed by the contractor. An independent certified third party may perform compliance audits when this requirement is imposed by the procurement contract and/or engineering documentation and when this arrangement has been approved by the JSC ET&V Officer.

4.4 Contractor Labs and Facilities

Inspection and certification of contractor ESD-protected labs and facilities shall be performed. This audit may be performed by either the contractor or the ET&V officer, depending on prior agreement. An independent certified third party may inspect and certify contractor ESD-protected labs and facilities when this requirement is imposed by the procurement contract and/or

engineering documentation and when this arrangement has been approved by the JSC ET&V Officer.

The contractor or independent certified third party shall maintain records of inspections, certifications, and compliance audits performed by the contractor or independent certified third party. These records shall be available to the ET&V Officer upon request and delivered to NASA/JSC as part of the procurement.

Periodic verification of compliance shall be at the discretion of the JSC S&MA.

4.5 Design Engineering

The organization performing the design engineering function shall select components that provide the greatest immunity from ESD damage consistent with the performance requirements of the design. The design engineering organization shall ensure that all drawings document ESDS components as detailed in Section 7.1 of this standard.

4.6 JSC Support for ESD Issues

JSC Avionics Systems Division (EV), JSC Safety and Mission Assurance (NT), and the ET&V Officer shall assist NASA JSC and contractor organizations in determining ESD sensitivity of a device or hardware interface. They will also help in determining ESD protective equipment requirements and facility ESD test planning. Additionally, these groups will provide technical expertise for ESD related problems and questions.

5.0 TOOLS AND TASKS REQUIRED TO MAINTAIN AN ESD CONTROL PROGRAM

5.1 Training

The S&MA Directorate shall provide ESD training for required NASA and contractor personnel. Personnel subject to training shall include, but are not limited to, those personnel listed in Table 5.1-1 ESD Training Guidelines. All contractor training courses and instructors shall be approved by S&MA and EV and conform to the requirements of this document.

ESD training shall be oriented to the functional needs of the personnel being trained. Table 5.1-1 outlines the ESD training needs for various job functions. Temporary or transient personnel who have not been trained and who enter an ESD protected area:

shall conform to the local protective equipment requirements when entering a controlled work area;

shall be briefed on ESD precautions for the area;

shall maintain a 1-meter minimum distance from ESDS items unless wearing a grounded wrist strap and accompanied by an ESD certified attendant.

Table 5.1-1 ESD Training Guidelines

LEVEL	TYPE OF PERSONNEL	FREQUENCY	TRAINING COURSE OUTLINE
1	Program Managers Purchasing Personnel Janitorial Personnel	Once	A general ESD overview class with specifics about the particular issues associated with the trainees' job function and ESD protection of hardware.
2	Engineering Personnel Quality Assurance Personnel Field Engineer and Maintenance Production Operators and Assemblers Material Handlers and Stockroom Personnel Test Personnel Inspection Personnel	Every 24 Months	Training must cover all aspects of ESD protection of sensitive parts and hardware.
3	Personnel responsible for a facility ESD control plan and internal auditing of the facility (Facility ESD Monitors).	Every 5 years	Hands-on training in the use of inspection equipment required to perform a facility ESD audit, sufficient knowledge to write a facility ESD control plan and perform the tasks of a Facility ESD Monitor. Prerequisite: Level 2 Certification must be repeated every 2 years.

Rationale: This requirement derives from ESD TR20.20-2008, Section 4.2 – Developing a Training Plan. Refer to that source for further information.

5.2 Personnel Certification

S&MA shall provide ESD training and periodic re-certification to all required personnel as defined in Table 5.1-1 of this document. As a minimum, all ESD training courses used for certification shall, be approved by EV and NT. The S&MA Directorate has the authority to certify personnel for handling ESDS hardware and components. This authority may be delegated to another NASA organization or contractor who has been approved to perform certification.

Upon completion of training, all personnel shall take a written test on the applicable training materials. Upon successful completion of ESD training, they shall be issued a "Certificate of Completion" that lists the training modules completed, expiration date of certification, and each individual's organization name.

Each organization shall maintain a record of all ESD certified operators assigned to them and ensure that these certified operators are notified when retraining is due. The Facility ESD Monitor shall maintain a record of the ESD training status for all employees working in each location and have it readily available.

5.3 Re-Certification

S&MA shall provide periodic re-certification to all personnel certified at course levels 2 and 3 of Table 5.1-1. All personnel involved in the direct assembly, disassembly, inspection, testing, handling, training, or storage of ESDS items shall be required to be re-certified every 24 months. The procedure for re-certification shall include sufficient training or retraining to enable the candidate to demonstrate proficiency in protecting ESDS items. Certified S&MA personnel will periodically verify all ESD certification and re-certification testing content.

5.4 Class 1, 2, and 3 Facility EPA Certification

(Reference ESD TR20.20-2008, Section 4.3 – Developing a Compliance Verification Plan)

An auditor from the ET&V Office or designated representative shall perform initial certification of each JSC Electrostatic Protected Area (EPA) and the Compliance Verification Plan for that area.

The three classes of certification for an EPA are:

Class 1: A class 1 work area has the highest level of certification and will allow handling of all ESDS items.

Class 2: A Class 2 work area provides protection to devices and hardware that will not be damaged by a voltage level below 250 volts.

Class 3: Class 3 certification is for work areas that only handle items at the LRU level with no exposed ESD sensitive parts other than connector pins and sockets during inspection and/or the cable mate and demate process. Hardware with exposed connector pins or sockets not certified to prevent hardware damage when exposed to a voltage below 1,999 volts shall not be handled in a Class 3 facility.

An EPA certification report shall address compliance to Table 5.4-1 ESD Requirements for Workstations Handling ESD Sensitive Components, and shall include the following:

Level of certification (Class 1, 2 or 3),

Date of the audit,

Names of the personnel performing the audit,

Specific ESD requirements audited,

Documented results of the audit and any corrective actions taken and completed.

The ET&V Officer shall grant EPA certification in writing and shall maintain records of all audits performed. The responsible party for each EPA shall have on file the findings from the periodic verification audits performed by the Facility ESD Monitor referenced in Table 6.1-1 ESD Certification and Periodic Inspection. Recertification of all work areas:

shall be done by the ET&V Officer upon request by the lab owner or S&MA or

shall be done within 5 years from the last facility certification

The following table is a summary of the applicable requirements for Class 1, 2, or 3 workstations that handle ESD sensitive components. In this table, "M" signifies that the equipment is mandatory, and "O" signifies that the equipment is optional.

Table 5.4-1 ESD Requirements for Workstations Handling ESD Sensitive Components

STAND ARD Section	Subject	Class 1	Class 2	Class 3
3.2	Identification and Access	M	M	M
3.3	Storage and Locker Facilities	M	M	O
3.4	Prohibited Activities and Items	M	M	O
3.5	ESD Protective Work Surface	M	M	M
3.6	ESD-Protective Floors Mats and Conductive Floors	M	O	O
3.7.1	Wrist Straps	M	M	M
3.7.2	Leg Straps, Heel Straps, and Conductive Shoes	O	O	O
3.8	Equipment and Facilities Grounding	M	M	M
3.8.1	Stool and Chairs	M	O	O
3.9	Relative Humidity Control	M	M	O
3.10	Air Ionizers	M	M	O
3.11	Hand Tools, Equipment and Fixtures	M	M	O
3.12	ESD Protective Packaging	M	M	M
3.13	Grounded Carts, Wagons, and Trams	M	M	M
3.14	Temperature Chambers and Cooling Agents	M	M	M
3.15	Cleaning ESDP Areas	M	M	M
3.17	Electrostatic Detectors, Monitors and Voltmeters	M	M	O
3.18	Contamination Control	M	M	M
3.19	Clothing Requirements	M	M	O
4.1	Drawing Requirements and Identifications of ESDS Items	M	M	O
4.4	Packaging Identification of ESDS Items	M	M	M
4.5	Shipping and Receiving	M	M	M
4.5	User Receiving Inspection	M	M	M
4.7	Packaging and Shipment of ESDS Items	M	M	M
4.8	Printed Circuit Board Level ESD Protection	M	M	N/A
4.9	Storage of ESDS Hardware	M	M	M
5.0	Orbital Replaceable Unit	M	M	M

O = Optional, M = Mandatory