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ICE, CLOUD, and Land Elevation Satellite-2 (ICESat-2)

ATLAS Electrical Systems Requirements

ICESat-2-SYS-REQ-0189

Effective Date: November 4, 2010

Revision A

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CM FOREWORD

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All reviews and approvals are captured electronically on the MIS.

Revision	Date Released	Description	Approved by	Date Approved
Revision -	9/20/2010	Baseline release per Score-0043	G. Jackson	9/20/2010
Revision A	11/4/2010	Name changes and clarifications to Electrical Systems Rqmts	G. Jackson	11/4/2010

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ID	Section	Title	TBD	Baseline	Verif Method	Alloc
ESR1		Primary Power		Distributed power architecture shall be used to supply over-current protected primary and/or secondary power to all the loads.	T-Component	PDU
ESR2		Primary Power		In the spacecraft flight configuration, no +31V power returns shall be switched.	A-Component	MEB,PDU,HVPC,LRS,laser,SPD,OFA,DAA,BSM
ESR3		Primary Power		The bus voltage of the ATLAS PDU primary power outputs shall have a nominal +31 volts direct current (VDC) output voltage with a range from +27 VDC to +35 VDC at the spacecraft / ATLAS electrical interface connector.	T-Instrument	PDU
ESR4		Primary Power		ATLAS heaters shall provide adequate heating over the voltage range of +27 VDC to +35 VDC at the spacecraft / ATLAS electrical interface connector.	A-Instrument	thermal
ESR5		Primary Power		Powered components shall provide the capability for redundant wires (more than required for current carrying for each service).	A-Component	MEB,HVPC,PDU,harness,LRS,Laser,SPD,OFA,DAA,TAMS,BSM
ESR6		Primary Power		The peak current shall not exceed 80% of the SSPC maximum sustainable current for the given service.	A-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,thermal

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ESR7		Primary Power		The bus ripple contributed by PDU shall be less than 0.3V peak-to-peak (p-p).	T-Component	PDU
ESR8		Primary Power		No component shall be damaged by the unannounced removal of power.	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,thermal
ESR9		Primary Power		Any operations required on a routine basis prior to power turn off shall be listed in that individual subsystem ICD.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR10		Primary Power		Any minimum time following power turn-off that the component must remain off prior to power turn-on shall be listed in that individual component ICD.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR11		Primary Power		The ATLAS power distribution unit (PDU) shall supply switched and unswitched unregulated power services.	A-Component	PDU
ESR12		Fusing		Critical unswitched power services shall use fuses as over-current protection devices during integration and test only.	I-Instrument	harness
ESR13		Fusing		In the flight configuration, fuses may only be used on redundant or non-critical loads.	I-Instrument	harness

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ESR14		Fusing		The use of non-resetting over-current protection (i.e., fuses) within the user subsystems shall be prohibited.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR15		Primary Power Anomalies		All subsystems shall be designed to not be damaged by any voltage in the range of 0 to +40 VDC for an indefinite time period applied to the power input.	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR16		Primary Power Anomalies		All subsystems shall not be damaged by polarity reversal of the input power.	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR17		Power Switching		When a service is switched off or trips off due to a fault condition, the voltage shall fall to 0 V no faster than 20 µs.	T-Component	PDU
ESR18		Primary Power Inrush	yes	The ATLAS component transient in-rush current shall be within the limits as provided for the SSPCs (TBD).	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS
ESR19		Primary Power Inrush		The inrush current of a subsystem shall not to exceed a rate of change of 1 amp per microsecond (A/µs) in the first 10 µs when measured with an electromechanical device (such as a relay) as the input power switching device.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS

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ESR20		Primary Power Inrush		The inrush current of a subsystem shall have a maximum rate of change of less than or equal to 20 mA/µs after the initial 10 µs surge when the inrush current is measured with an electromechanical device (such as a relay) as the input power switching device.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS
ESR21		Primary Power Inrush		The subsystem transient current shall not exceed 300% of the maximum steady-state current in the first 10 ms when the inrush current is measured with an electromechanical device (such as a relay) as the input power switching device.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS
ESR22		Primary Power Inrush		The inrush current of a subsystem shall not exceed a rate of change of 200 milliamp per microsecond (mA/µs) until the voltage reaches the steady-state level when the inrush current is measured with an SSPC as the input power switching device	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TMAS

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ESR23		Primary Power Inrush		The inrush current of a subsystem shall not exceed a rate of change of 20 mA/µs after the voltage reaches the steady-state level when the inrush current is measured with an SSPC as the input power switching device.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS
ESR24		Primary Power Inrush		The transient current shall never exceed 300% of the rated output current of the SSPC in the first 70 ms when the inrush current is measured with an SSPC as the input power switching device.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS
ESR25		Primary Power Inrush		In-rush current shall be reduced to steady-state value at 100 ms after turn-on.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS
ESR26		Primary Power Redundancy		Any subsystem or component that includes redundant power supply inputs shall not be damaged by the simultaneous application of power to both interfaces.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,Thermal
ESR28		Primary Power Ripple		Single-event power bus transients superimposed on the power buses due to normal subsystem load switching shall be limited to +/-3.0V from the steady-state bus value.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA

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ESR31		Primary Power Transients		The rate of change of any operational current transients shall not exceed 20 mA/µs.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA
ESR32		Primary Power Transients		When the power service is switched off, the peak voltage transients induced on the power service shall not exceed +40V, nor fall below -1V.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS
ESR33		Single Point (Primary Power) Ground		ICESat-2 components shall implement a single-point grounding scheme for the primary power bus.	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR36		Single Point (Primary Power) Ground		At the component primary power interfaces, primary power (31 VDC) and primary power returns shall be isolated from the component chassis by greater than or equal to 1 Megohms (Mohms) direct current (DC).	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,BSM
ESR37		Single Point (Primary Power) Ground		The ICESat-2 structure shall not be used to carry DC current or common mode current.	T-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR39		Distributed Secondary Ground		ATLAS components shall implement distributed signal grounding scheme for secondary power returns and/or signal grounds.	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM

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ESR40		Distributed Secondary Ground		The secondary return (power, signal, analog, or digital grounds) shall be locally connected to the component chassis with low impedance paths (<= 2.5 milliohms DC per joint) to minimize stray current.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR41		Distributed Secondary Ground		All secondary power (or signal) inputs and returns shall be isolated from primary power by equal to or greater than 1 Mohms DC.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,BSM
ESR42		Distributed Secondary Ground		Common mode noise for the primary and secondary power, as well as digital, analog and signal grounds, shall be less than 100 millivolts (mV) p-p.	T-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR43		Distributed Secondary Ground		The electrical DC resistance of a mechanical contact between two conductive mating surfaces shall not exceed 5 milliohms DC.	T-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,structures,thermal
ESR44		Distributed Secondary Ground		The electrical grounding method for a powered component shall be the metal-to-metal contact between component mounting surface or ground strap and the ATLAS structure.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,BSM,TAMS,thermal

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ESR45		Distributed Secondary Ground		Mating (electrically bonding) surfaces should be free from nonconductive finishes and should establish sufficient conductive contact surface area to satisfy electrical grounding requirements.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,structures,thermal
ESR46		Distributed Secondary Ground		The electrical DC resistance between any two mated powered components on the ATLAS structure, measured at the foot of each component, shall not exceed 10 milliohms DC.	T-Instrument	harness
ESR47		MIL-STD-1553		All ATLAS Remote Terminal (RT), and coupling transformer devices shall comply with MIL-STD-1553B requirements.	A-Component	MEB
ESR48		MIL-STD-1553		The transformer-coupled (long stub) interface shall be implemented for the ICESat-2 1553 data bus, as specified in MIL-STD-1553B.	I-Spacecraft	MEB
ESR50		MIL-STD-1553		The ICESat-2 1553 bus shall be a dual, standby-redundant bus as defined in MIL-STD-1553B shall be used.	I-Spacecraft	MEB,harness
ESR51		MIL-STD-1553		All ATLAS 1553 Remote Terminals (RTs) shall utilize a connector compatible with the ATLAS 1553 harness which uses a Trompeter PL3155AC connector.	I-Component	MEB

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ESR52		MIL-STD-1553		The ATLAS 1553 data bus shall use M17/176-00002 cable.	I-Instrument	harness
ESR53		MIL-STD-1553		The ATLAS 1553 bus shall use transformer coupling as defined in Section 4.5.1.5.1 of MIL-STD-1553B.	I-Spacecraft	harness,MEB
ESR54				Deleted		
ESR55				Deleted		
ESR56				Deleted		
ESR57		MIL-STD-1553		The ATLAS 1553B bus cabling and couplers shall have 100% shielding coverage.	I-Instrument	harness
ESR58		MIL-STD-1553		All ATLAS 1553 RT isolation transformers shall be designed to provide an output signal level of 18 to 27V p-p at the component output interface.	T-Instrument	MEB
ESR59		SpaceWire		ATLAS components using SpaceWire shall use four twisted pair wires (100+2% ohm cable) with a separate shield around each twisted pair and an overall shield per ESA SpaceWire Specification (ECSS-E-50-12).	I-Instrument	Harness
ESR62		Signals		The presence or absence of any combination of the input signals applied in any sequence shall not cause damage to a component, reduce its life expectancy, or cause any malfunction, whether the component is powered or not.	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,thermal

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ESR64		Telemetry	yes	The specific thermistor part number utilized to generate the passive analog telemetry that is read by the ATLAS MEB shall be identified in the ATLAS TBD thermal document.	I-Instrument	thermal
ESR66		Telemetry		The active analog signal ground or reference shall not be shared with the passive analog returns.	I-Component	MEB
ESR67		LVDS		Subsystems connected using LVDS signals shall adhere to the electrical terminations as given in the Electrical Characteristics of Low Voltage Digital Signaling (LVDS) Circuits (TIA/EIA-644).	I-Component	LRS,MEB,DAA
ESR68		RS-422		ATLAS components using RS-422 differential signals shall adhere to the electrical terminations as given in the Electrical Characteristics of Balanced Voltage Digital Interface Circuits (ANSI/TIA/EIA-422) with a 100 ohm termination resistor between the terminals on the receiving end.	I-Component	MEB,HVPC,PDU,LRS,laser
ESR69		RS-422		All discrete pulses between components shall be transmitted using RS-422 differential signals.	I-Component	MEB,HVPC,PDU,LRS,laser

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ESR70		Ground Straps		If a powered component is mounted on a composite or other low conductive material, a grounding strap shall be attached from the component chassis to an instrument conductive structure.	I-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,structures,thermal,harness
ESR71		Ground Straps		The electrical DC resistance of the grounding strap as measured at the component chassis tie-point and the instrument structure tie-point shall not exceed 5 milliohms DC.	T-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,structures,thermal,harness
ESR72		Ground Straps		All ground straps for powered components or subsystems shall have at most a length-to-width ratio of 5 to 1 (width is at least 1/5 of length), be made of copper at least 0.001" thick, and still be flexible enough to allow for bending to occur.	I-Instrument	harness
ESR73		Ground Straps		The grounding lug location on the powered component chassis or the tie points in contact with the ground strap shall have a minimum contact area of 80 millimeters squared (mm2).	I-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,structures,thermal,harness

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ESR74		GSE		GSE cable connectors that mate with flight test connectors shall be flight-approved connectors.	I-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,harness
ESR75		Harness		EMI backshells shall be required for all harness connectors.	I-Component	harness
ESR76		Harness		All component input/output (I/O) connector interfaces shall be designed to accommodate an EMI backshell.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR77		Harness Design		Harnesses shall be developed using Design and Development Guidelines for Spaceflight Electrical Harnesses (565-PG-8700.2.1).	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,harness
ESR78		Harness Design		Qualified wire, cable, and connectors specified in the Instructions for EEE Parts Selection, Screening, Qualification, and Derating (EEE-INST-002) shall be used for the SC flight harness or any of the component harnesses.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,harness
ESR79		Harness Design		Wire gauge, connectors, connector contacts, and other harness piece parts shall be derated per the Instructions for EEE Parts Selection, Screening, Qualification, and Derating (EEE-INST-002).	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,harness

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ESR80		Harness Design		Harnesses shall be grouped by common electrical characteristics of the signals carried in the harness.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,harness
ESR81		Harness Design		All power lines and power return lines to a particular component shall be twisted together in a single bundle.	I-Component	harness
ESR82		Harness Design		Length of wire twist shall be between 8 and 16 times the outer diameter of the Harness, in accordance with the Section 7.3 (20) of Crimping, Interconnecting Cables, Harness, and Wiring (NASA-STD-8739.4)	I-Component	harness
ESR83		Harness Design		Wherever two or more power conductors are used to increase the current carrying capability, or provide redundant wires, the component interfaces to the two conductors shall be of the same design	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,harness
ESR84		Harness Design		Wherever two or more power conductors are used to increase the current carrying capability, or provide redundant wires, the wires shall be routed in the same harness to keep path length the same for both.	I-Component	harness

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ESR85		Harness Design		Wherever two or more power conductors are used to increase the current carrying capability, or provide redundant wires, there shall be the same number of power and return lines, and each return wires shall be twisted with a power wire.	I-Component	harness
ESR86		Harness Design		Power and signal shall not share the same component interface and harness connectors.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,BSM
ESR87		Harness Design		The connector half that sources power to another component shall be female (socketed) to protect against inadvertent grounding prior to mating.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR88		Harness Design		The component connectors, on each box, shall be spaced far enough apart to access the harness connector with EMI backshells by a hand or with an extraction tool.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR89		Harness Design		Mechanical support for harnesses shall be designed in accordance with the Crimping, Interconnecting Cables, Harness, and Wiring (NASA-STD-8739.4).	I-Component	harness
ESR90		Harness Design		Harness splices (except for heaters) shall not be allowed.	I-Component	harness

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ESR91		Harness Design		Wires that have tin coating shall not be used.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR92		Harness Design		Harness shields shall be terminated at the connector backshell or another connection to chassis at both ends of each harness.	I-Component	harness
ESR93		Harness Design		All shields shall be grounded to the ATLAS structure.	I-Component	harness
ESR94		Harness Design		Wire harness shields shall not carry current by design.	I-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR95		Harness Design		Outer shields shall not be tied to component connector pins or wires in the cable bundle.	I-Component	harness
ESR96		Harness Design		Shield termination pig-tails shall be grounded to the connector backshell.	I-Component	harness
ESR97		Harness Design		All external harnesses shall be shielded with an overall outer bundle shield and terminated with 360° outer shield connected to the backshell.	I-Component	harness
ESR98		Harness Design		Aluminum tape (LG-1055 or equivalent) at least 0.001" thick, wrapped with 50% overlap on each 360-degree wrap over the previous wrap shall be used as harness bundle shield.	I-Component	harness

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ESR99		Harness Design		All internal interconnections and cables between components of the same subsystem shall be bundle shielded and terminated.	I-Component	LRS
ESR100		Harness Design		All electrical connectors shall be covered such that they are not exposed to the low earth orbit environment.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR101		Harness Design		All connectors on a component shall be different sizes, pin counts and/or genders to prevent any mismating of harness to component connectors.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR102		Harness Design		All subsystems shall provide a list of connectors to the SC electrical systems engineer prior to connector part procurement.	I-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR103		Harness Shielding		Component connector shells shall be electrically mated to the component chassis through an electrical resistance not exceeding 5 milliohms DC.	T-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR104		Harness Shielding		Electrical harness backshells shall be electrically mated to the chassis through an electrical resistance not exceeding 5 milliohms DC.	T-Instrument	harness

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ESR105		Harness Shielding		Shield grounds associated with cables (twisted shielded pairs, coaxial cables, etc.) shall be terminated to chassis.	T-Instrument	harness
ESR106		High Voltage		Components with high-voltage circuits shall be immune to corona and arcing while in a nominal orbital vacuum environment.	T-Component	HVPC,DAA
ESR107		Hinges		A ground strap shall carry the ground across any hinged joints.	I-Component	harness
ESR108		I&T		Power harnesses shall use break-out-boxes (BOB) for fuses to permit the interruption of the unswitched power bus to a faulty component or harness during I&T.	I-Instrument	harness
ESR111		Laser Safety		Safing and arming plugs shall be incorporated in the cable or harness that control laser power.	I-Component	harness
ESR112		Materials		All subsystem materials list shall be reviewed for their electrical properties and assessed for its compatibility with electrical systems requirement defined in this specification.	I-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,thermal

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ESR113		Radiation		ATLAS components shall meet their performance requirements with acceptable degradation due to radiation induced effects as documented in the ICESat-2 Radiation Specifications (ICESat-2-SMA-REQ-0037).	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR116		Test Connectors		All test signals shall be protected within components from ESD, handling, facility-induced noise, and GSE malfunction of a 10 A pulse with a 300 MHz frequency (3 ns rise time).	A-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR117		Test Connectors		Test connectors shall be capped with flight-approved RF and static control covers when not in use, including in orbit.	I-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR118		Test Connectors		Component power shall not be applied or accessed at or through a test connector.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR120		Charge Control		All layers of thermal blankets shall be redundantly grounded to the SC structure (<10 kilohms) with one grounding tab for every Multilayer Insulation Blanket (MLI) < 30 cm x 30 cm (900 cm**2 / 139.5 in**2).	I-Component	thermal,structures

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ESR121		Charge Control		All layers of thermal blankets shall be redundantly grounded to the SC structure (<10 kilohms) with two grounding tabs for every Multilayer Insulation Blanket (MLI) > 30 cm x 30 cm (900 cm**2 / 139.5 in**2).	I-Component	thermal,structures
ESR122		Charge Control		All layers of thermal blankets shall be redundantly grounded to the SC structure (<10 kilohms) with one additional ground assembly for each additional square meter of MLI.	I-Component	thermal,structures
ESR123		Charge Control		Any point on the blanket shall be less than 1 meter from the nearest grounding point.	I-Component	thermal
ESR124		Charge Control		Insulating films in blankets such as Kapton and other dielectric materials shall be less than 0.005" thick, assembled to minimize surface charge build-up, and grounded (<10 kilohms) to bleed surface charge.	I-Component	thermal

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ESR126		Charge Control		The electrical system shall be designed to carry discharge currents and to shield from the electric field from the discharge without any permanent damage to ATLAS.	A-Instrument	elec systems
ESR128		Charge Control		Internal charging effects shall be controlled by shielding all electronics elements with sufficient aluminum equivalent thickness (0.1" Al for bulk dielectrics).	A-Instrument	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM
ESR129		Charge Control		Internal dielectrics materials with bulk resistivity of >10**12 ohm-cm that do not meet the shielding requirement shall be controlled.	A-Component	elec systems
ESR130		Charge Control		If none of the control techniques described in ESR-120 through ESR-132 can be applied to minimize charging of internal dielectrics, the impacts of the discharge from the dielectrics material shall be assessed for an approval.	A-Instrument	elec systems
ESR131		Charge Control		All internal floating conductors greater than 6.5 cm^2 (1 in^2) in surface area shall be connected to the ground with less than 10^11 ohms resistance.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,structures,thermal,harness

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ESR132		Charge Control		Leakage impedance of conductive internal parts shall be less than 200,000 ohms.	I-Component	MEB,HVPC,PDU,LRS,laser,SPD,OFA,DAA,TAMS,BSM,structures,thermal,harness

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