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MAVEN Project
Mission Requirement Document (MRD)
Spacecraft Requirements Only

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MRD dated June 23, 2008
All TCMs shall be within view of the DSN.
When in normal operation mode, i.e., not safe hold, the spacecraft shall lose no more than 1% of the ancillary and the Electra and science data in the Mapping phases.
Nominal Science: The nominal science orbit shall be an elliptical orbit, with an inclination of 75 +/-1.5 degrees, and a period of 4.5 +/- .05 hours, targeted to a periapsis density corridor of 0.05 to 0.15 km/kg3 and an apoapsis altitude of 6200 km.
Deep Dips: During the five deep dips the periapsis orbit shall be lowered to target a density of approximately 2kg/km3 (roughly 125 km altitude) for five days.
Extended Mission: The extended mission orbit requirements shall be the same as the requirements for the nominal science mission. At the end of the extended phase, the periapsis shall be raised to ≥ 250 km.
The orbiter launch wet mass shall be ≤ 2720 kg.
The orbiter Dry Mass shall be less than or equal to 1036.1 kg.
The total instrument mass shall be less than or equal to 83kg
The orbiter center of mass shall be located as indicated in the Launch Vehicle ICD while in the launch configuration
The MAVEN mission shall make [TBD products] available to the [TBD users] within [TBD timeframe] of observation, minimally [TBD]% of the time over an annualized basis
The MAVEN mission shall be capable of making [TBD products] available to the [TBD users] for at least [TBD]% of all observations taken over an annualized basis.
MAVEN shall make the orbiter health and safety real-time (RT) telemetry available to the ground during critical events. Critical events shall include launch, launch vehicle separation, solar array deployment, boom deployments and Mars Orbit insertion.
All orbiter subsystems shall meet the system performance margins specified in GSFC-STD-1000. All unallocated systems reserves shall be held by the Mission System Engineer.
All EEE parts shall be capable of withstanding a Total Ionizing Dose (TID) ≥ 20 krads for the mission lifetime defined above. This requirement assumes that all enclosures have a minimum of 100 mils of aluminum shielding.
All EEE parts shall be latch-up immune with a LETth requirement for single event latch-up > 100 (TBR) MeV*cm2/mg or shall employ external latch-up protection circuitry. All EEE parts shall have a LETth requirement for single event upset > 37 MeV*cm2/mg. Use of parts not meeting these requirements shall require prior approval from the Project.
All orbiter external surfaces shall meet the conductance and grounding requirements in the MAVEN Electrostatic Cleanliness (ESC) specification. All waivers to these requirements will need concurrence from the MAVEN ESC board.
The spacecraft, including the solar arrays, and the instruments will be built with magnetic cleanliness controls designed and optimized by the MAG team as described in the MAVEN Magnetic Cleanliness Document (MAVEN-SYS-SPEC-0001).
The flight segment shall interface with the launch site, Kennedy Space Center (KSC) as specified in the Launch Operations Plan.
The Flight Segment shall interface with the NASA Deep Space Network (DSN) as specified in the Ground Segment to Flight Segment ICD [MAVEN-SYS-ICD-0004].
The spacecraft shall be capable of operating spacecraft subsystems, the NGIMS, the Remote Sensing (IUVS) package, and the Particles and Fields package (LPW, STATIC, SWEA, SWIA, MAG, SEP) in their normal modes simultaneously and continuously as defined in the Operations Concept.

The spacecraft shall provide an indication of altitude (atmospheric pressure) during the mapping orbit and deep dip campaigns to the instruments. The accuracy and frequency of update of this indication are TBD.
The Spacecraft shall comply with instrument contamination requirements as defined in the instrument to spacecraft ICDs.
The spacecraft shall supply all instrument required actuator power in accordance with the instrument ICDs.
The spacecraft structure shall be compatible with EELV requirements as defined in the MAVEN Launch Vehicle ICD.
The structure shall accommodate instrument mass, mounting, field of view, thermal field of view and envelope requirements as defined in the spacecraft to instrument ICDs
The deployed solar array shall have a minimum first mode natural frequency ≥ 1.0 Hz
The deployed APP shall have a minimum first mode natural frequency ≥ 1.0 Hz.
The deployed SWEA and boom assembly shall have a minimum first mode natural frequency ≥ 1.0 Hz.
Booms, solar arrays, and HGA shall be mounted so that they remain clear of the modeled thruster plumes.
The orbiter shall provide separate single fault tolerant switches for the survival heater power circuits per the instrument ICDs.
The orbiter shall provide separate single fault tolerant latching switches when required per the instrument ICDs.
The Ultra Stable Oscillators (USOs) shall be separately switched as well as the Electra receivers
Each low speed serial data interface shall be capable of supporting variable bi-directional data clock rates of up to 921.6 kbps
Each high speed serial data interface shall be capable of supporting variable data clock rates of up to 15 Mbps
All serial interfaces from the orbiter to payload users shall be electrically isolated
The spacecraft shall support simultaneous real time data transfers from all payload elements to mass memory for those payload elements that send data directly to the mass memory
The total effective composite data transfer rate from all payloads to mass memory shall be at least 100 Mbps (TBR).
The mechanisms shall provide for the retention and release, including any deployments, of all spacecraft and instrument appendages.
The mechanisms shall meet all instrument pointing requirements as defined in the spacecraft to instrument ICDs.
The EPS shall provide unregulated 28 VDC power at the payload connectors as defined in the spacecraft to instrument ICDs
The EPS shall provide separate single fault tolerant switches as defined in the spacecraft to instrument ICDs.
The EPS shall be designed for a maximum battery depth of discharge ≤ 30% (TBR) at the maximum solar eclipse period of 75 minutes assuming continuous operation of the TWTA.
After achieving the primary science orbit, the spacecraft shall be capable of providing 95 W Average per orbit to the instruments, including all margins while providing energy for Electra Sleep Mode as allocated in the Electra ICD
After achieving the primary science orbit, the spacecraft shall be capable of providing the Electra Payload with the energy necessary for Electra relay passes by reducing the energy allocated to the instruments.
The energy allocated per Electra relay pass shall be as documented in the Electra ICD.
While in cruise to Mars, the orbiter shall be capable of providing 130 W including all margins for the instruments.
In addition, the spacecraft shall also provide power for Electra as allocated in the Electra ICD for the Electra Sleep Mode including calibrations.
The orbiter shall provide unregulated 28Vdc (+8Vdc, -6Vdc) power at the payload connectors.

The C&DH shall provide interfaces for command transmission to the instruments as defined in the spacecraft to instrument ICDs.
The C&DH shall provide telemetry interfaces to the instruments as defined in the spacecraft to instrument ICDs.
The C&DH shall be capable of storing on-board at least 7 days of Orbitor housekeeping and science data assuming an aggregate instrument orbit average data range of 3.1 kbps.
For critical events, the C&DH shall store S/C engineering and health data for subsequent playback.
The C&DH shall supply time code data to the instruments as defined in the spacecraft to instrument ICDs.
The C&DH shall time tag payload packets with and accuracy of 10 msec relative to the spacecraft clock as defined in the spacecraft to instrument ICDs.
The C&DH shall correlate on-board time to Universal Time Coordinated (UTC) to within 1 millisecond (TBR).
The spacecraft on-board time reference (spacecraft clock) shall drift by no more than +/-100 milliseconds (3-sigma) over seven days.
The spacecraft contribution to the uncertainty in reconstructing the correlation between the spacecraft clock and the ground clock shall be less than 15 msec (3-sigma).
All digital interfaces from the orbiter to payload users shall be electrically isolated
The spacecraft shall maintain all instrument interfaces at temperature levels defined in the spacecraft to instrument ICDs.
The spacecraft shall provide passive temperature monitoring for the instruments as defined in the spacecraft to instrument ICDs.
The propulsion subsystem shall provide a total delta-V of at least 2030 m/sec
The propulsion subsystem shall provide for reaction wheel desaturation
During wheel desturation the orbiter will not meet pointing requirements.
The Spacecraft shall be capable of simultaneously transmitting stored spacecraft housekeeping telemetry and stored science data/housekeeping in X-Band.
The telecommunications subsystem shall be capable of receiving commands for any attitude from LV separation through the end of the mission.
The telecommunications subsystem X-band uplink frequency shall be channel TBD
The telecommunications subsystem shall be capable of receiving commands at ≥ 2000 bps with an HGA off-point of 2 mrad at maximum Earth range.
The telecommunications subsystem X-band downlink frequency shall be channel TBD
The telecommunications subsystem shall provide the capability to transmit data at ≥ 40 bps with an LGA off-point of 65 degrees at maximum Earth range with Reed-Solomon and 7 ½ convolution encoding
The telecommunications subsystem shall provide the capability to transmit data at ≥ 165 kbps with an HGA off-point of 2 mrad degrees at maximum Earth range with Reed-Solomon and 7 ½ convolution encoding.
The telecommunications subsystem shall be capable of meeting it's uplink and downlink data rate requirements with ≥ 3 dB of link margin, with 2σ statistics.
The orbiter to DSN link shall be capable of a maximum bit error rate (BER) of 1 x 10-5 for uplink and 1 x 10-6 for downlink.
The telecommunications subsystem shall accommodate BPSK and QPSK modulation for the X-band downlink
The telecommunications subsystem shall have capability for Reed-Solomon encoded telemetry per CCSDS 101.0-B-5.
The telecommunications subsystem shall provide capability to transmit turbo-coded telemetry (rate 1/2, 1/3, and 1/6) per CCSDS 101.0-B-5 with no additional coding.
The orbiter shall have capability for 7 1/2 convolutional coding per CCSDS 101.0-B-5.
The orbiter shall be capable of providing Reed Solomon and convolutional encoding separately or simultaneously

The orbiter shall be compatible with the Deep Space Network (DSN) at X-band as described in the DSN Interface Document JPL 810-005.
The orbiter shall support the DOR tone capability in the SDST.
The telecommunications subsystem shall include an Electra UHF transceiver for relay operations
The telecommunications subsystem shall be capable of transmitting simultaneously at X-band (LGA) and Electra UHF
The spacecraft shall be capable of acquiring a maximum data volume of 1 Gbit (TBR) of critical Electra relay return data once per week during the Mapping Phase
The spacecraft shall be capable of accepting Mars Exploration Program forward link relay data and delivering that data to the Electra payload.
In the event of a instrument safing event, the orbiter shall collect and retain enough information to determine the proximate cause of the event.
In the event of a spacecraft safing event, there is no requirement to maintain data from the instruments as a result of responding to on-board faults except to determine if the instrument was the reason for the anomaly
During normal mapping operations, the orbiter shall provide the Ultra Stable Oscillator [USO] in the Electra package with a temperature environment that changes no faster than 3° C/Hr in either direction.
The spacecraft shall provide three-axis stabilized attitude control during all mission phases following launch vehicle separation
The spacecraft shall provide sufficient time tagged engineering telemetry to define an unambiguous orbiter state at all times including nominal and off nominal conditions and in the presence of any single fault and within 30 minutes of DSN lockup at the minimum telemetry data rate.
The uplink data rate capable of being received by the orbiter shall be part of the engineering telemetry.
The spacecraft shall be capable of telemetering all health and status (engineering) data generated from the payload and spacecraft in less than 1.5 hours (TBR) from the time the data is available to the spacecraft for health and status data that is sent directly to the Command and Data subsystem. Note: The 1.5 hours "stop watch" stops when the data is ready for telemetering even if the data remains on the orbiter awaiting telemetering.
The orbiter shall provide the capability to autonomously manage/perform the following functions. 1) Ephemeris relative commanding 2) Orbiter momentum 3) Data storage , retrieval and deletion 4) Accommodate sun time-of-travel requirements from the payload during attitude maneuvers 5) Launch 6) Mars Orbit Insertion 7) Unattended operations for 28 days during normal operations
Once separated from the launch vehicle, the orbiter shall be capable of continuously receiving commands and transmitting real time and stored telemetry.
The spacecraft shall provide by ground command the capability to retransmit previously transmitted data in data units of 1 Mbit or less if that data has not been overwritten by ground command or onboard storage.
The spacecraft shall lose no more than 1% of the ancillary and the Electra and science data in the Mapping phases as the result of an onboard hardware or software failure.
The spacecraft unmodeled contribution to the X-band 2-way doppler noise, exclusive of center of mass motion, shall not be greater than 0.1 mm/sec (1 sigma) sampling every 10 seconds, with the following exceptions: a.) during momentum management periods, slews, TCM start up transients, and wobble during drag pass, when no allocation shall apply, and for 180 seconds after these events b.) during a 500 second period following return to sun point, when the allocation shall be 0.15 mm/sec (1-sigma). Note: The unmodeled contribution from the spacecraft consists of the mechanical and electrical noise (e.g., unmodeled motion of antenna phase center relative to the spacecraft center of mass and thermal noise).
The orbiter shall produce downlink telemetry frame lengths as short as allowed by CCSDS when the downlink rate is 40 bps or lower.

The spacecraft shall be capable of ensuring integrity of commands and software loads including patches prior to execution and capable of reporting sufficient information to the ground operators to assess verification of command and software load receipt and execution.
The Orbiter shall provide 3 axis inertial pointing accuracy with respect to the space vehicle alignment axes (SVAA) as follows (excluding reaction wheel desaturation and navigation errors): Accuracy (3 sigma) < 0.7 mrad Roll <1.0 mrad Pitch <1.0 mrad Yaw
The spacecraft shall provide an attitude control and knowledge for pointing the payloads as follows: Instrument□Pointing Accuracy (deg, 3-Sigma)□Reconstruction Knowledge (deg, 3-Sigma)□Reference□Comment□ NGIMS□2.0□0.15□RAM□For Altitudes Below 400km□ IUVS Disk Maps□3.0□1.0□Inertial□For 80 Min centered on Apoapsis□ IUVS Limb Scans□2.0□0.3□Nadir□For Altitudes Below 400km□ IUVS Inertial□0.6□-□Star□□ EUV Monitor□1.0□0.05□Sun□Off for Deep-Dips□ LPW□None□None□None□□ STATIC□5.0□1.0□Orbit Normal□Off for Deep-Dips□ SWEA□5.0□1.0□Sun□Off for Deep-Dips□ SWIA□5.0□1.0□Sun□Off for Deep-Dips□ SEP□None□1.0□Nadir□Off for Deep-Dips□ MAG□None□0.25□□Off for Deep-Dips□
The Orbiter shall provide the following pointing stability at the instrument mounting interface, per axis, 3 sigma (except during reaction wheel de-saturation, slews, and entering and exit solar eclipse): Instrument□Pointing Stability □ NGIMS□0.1 deg over 20 sec□ IUVS□0.06 deg over 10 sec□ EUVM□None□ LPW□None□ STATIC□None□ SWEA□None□ SWIA□None□ SEP□None□ MAG□None□
The spacecraft shall have a power-positive control mode to be entered in spacecraft emergencies
SafeHold shall not be compromised by the same fault that led to SafeHold activation
Spacecraft safehold shall be capable of being maintained for at least 28 days without ground intervention
Entry into SafeHold shall be ground-commandable as well as automatic upon detection of pre-defined anomalous conditions
The spacecraft shall provide the capability to receive the command uplink, and to transmit real-time and stored telemetry, during SafeHold operations

The spacecraft shall exit SafeHold only by ground command except during MOI.
The FSW shall validate, process, and execute commands and data loads.
The FSW shall provide the capability to store and retrieve commands for delayed timed execution for the spacecraft and instruments
The FSW shall be capable of supporting absolute time commands and relative time commands
The FSW shall provide the capability to accommodate spacecraft and Instrument flight processor software uploads
The FSW shall provide the capability to accommodate spacecraft and instrument flight table uplinks
The FSW shall provide the capability to collect science data packets from the instruments, and engineering health and safety packets from the spacecraft and instruments
The FSW shall be capable of transferring software and instrument flight table uploads to the NGIMs instrument and the PF and RS DPUs.
The FSW architecture shall be architected to provide the capability for in-flight software updates. It shall be possible to both patch selected FSW tasks and to upload an entire image.
The FSW shall be capable of maintaining Spacecraft and instrument health and safety without ground support for 7 days.
The FSW shall continually monitor the health and safety of the spacecraft and instruments.
The FSW shall be capable of detecting out-of-limit conditions while monitoring spacecraft health and safety.
The spacecraft shall implement a boot memory segment that is non-writable on-orbit.
The boot code shall implement a memory loader to allow memory loads in the event that the flight code is compromised.
The spacecraft design shall provide the capability to verify all file uploads, copies and deletions to all forms of orbiter memory.
The spacecraft shall be capable of running a maximum of twenty (TBR) concurrent sequences. Note: this does not specify the number of sequences that must be run concurrently at any specific time. That will be determined by the operations being performed.
The orbiter shall be capable of terminating a command file if a fault is encountered or by ground command
The spacecraft shall be capable of preventing the execution of invalid and restricted commands, and safety critical commands without proper enables.
The spacecraft shall provide the following encoding schemes as input to the SDST: Reed-Solomon encoding and turbo (rate 1/2, 1/3, and 1/6) encoding
The orbiter shall be capable of accepting the emergency uplink signal following detection of a fault condition
The orbiter shall transmit the emergency downlink signal with Reed-Solomon and convolutional coding following detection of a fault condition.
The orbiter shall provide for autonomous initiation of emergency telemetry in the event that no commands are received within a ground-selectable time period
The spacecraft shall be capable of issuing a safing command to the payload and disable the payload upon entering safe mode
Within 24 (TBR) hours of being commanded out of safe mode, the orbiter shall be capable of returning to an operational state that allows the orbiter to resume planned activities
The LSS shall provide LV telemetry during all portions of the LV powered flight and during orbiter separation
The orbiter shall be capable of supporting either: a 2-hour continuous launch window or 2 instantaneous windows separated by a minimum of 30 minutes.
The orbiter shall be compatible with a NASA provided intermediate class EELV.
The orbiter shall integrate with the launch vehicle at the Cape Canaveral Air Station per the approved Launch Site Support Plan.

While at the launch site, the orbiter shall comply with the requirements of the Range Safety Document (EWR-127) and KHB-1710.2.
The orbiter shall be capable of performing the first trajectory correction maneuver (TCM) anytime after launch plus 8 days.
The orbiter shall be capable of performing at least 5 TCMs.
The orbiter shall have the ability to include a TCM 6 hours prior to a MOI.
The orbiter shall be capable of executing a TCM in any inertial direction, subject to the accommodation of payload sun, time-of-travel requirements as stated in the payload ICDs.
The LSS shall interface with the Flight Segment as specified in the MAVEN Launch Vehicle Interface Control Document
The orbiter shall be designed to support a Northern approach Trajectory to Mars for the MOI maneuver.
The spacecraft shall be compatible with a Mars Capture orbit with the following parameters: Periapsis altitude: 550 km +/- 50 km (3 sigma) with respect to surface of Mars as defined by a sphere with a radius of 3397.2 km. Inclination: 75 +/- 1.5 degrees (3 sigma) Period: 35 hours +/- 1 hour.
The spacecraft shall be capable of performing up to five "deep-dips" to a periapsis altitude defined by a maximum mass density of 2 kg/km^3 .
Each deep-dip shall last up to 5 days.
The spacecraft shall be designed such that the delta-V uncertainty due to momentum management shall be less than 0.4 mm/s (3-sigma) per axis per event. This requirement applies to predicted values up to 10 days in advance.
The orbiter shall be designed such that the momentum management events shall occur no more frequently than once every 12 hours
The spacecraft pressurant leaks shall be less than the mission elapsed time dependant curve shown below. It is not required to meet the orbiter-generated acceleration requirements during the first 30 days of flight, emergency momentum events, aerobraking, planned or unplanned thruster slew events, or while the orbiter is in safe hold.
The position of the orbiter shall be predicted to within the following: Position Error Radial: 0.5 km Downtrack: 84 km Crosstrack: 0.5 km
Positional knowledge of the orbiter shall be reconstructed to with 1 km (3D).
The spacecraft shall be capable of operating with an ephemeris which is updated as frequently as twice per week
The orbiter shall be capable of performing orbit trim maneuvers (OTMs) as frequently as every 3.5 days
The orbiter shall be capable of executing an OTM velocity increment in any inertial direction.
The Ground Segment shall interface with the Flight Segment as specified in the Ground Segment to Flight Segment ICD
The Ground Segment shall interface with the DSMS as specified in the Ground Segment to DSMS ICD
The spacecraft shall maintain an operational availability of > 0.95 over the mission life.
The MOC shall provide mission management, orbiter operations, and data routing for the life of the MAVEN mission
The MOC shall be capable of providing contact to the Orbiter at least every orbit for twice a week for a 5 hour period.
The MOC shall maintain an operational availability of 0.95
The MOC shall interface with the Flight Segment as specified in the Ground Segment to Flight Segment ICD
The MOC shall interface with the DSMS as specified in the GSFC MSA to DSMS ICD and the LM MSA to DSMS ICD
The MOC shall interface with the SOC as specified in the LM MSA to LASP ICD

The MOC shall have no single point of failure for the orbiter operations functions required for real-time orbiter operations
The MOC shall assemble commands into a command stream according to the CCSDS Recommendation for Telecommand Part 1 - Channel Service and Part 2 - Data Routing Service
The MOC shall provide an orbiter simulator capable of generating mode-dependent orbiter telemetry in response to command sequences
The MOC shall be capable of maintaining the spacecraft flight software, that is, uploading upgraded, verified versions of spacecraft flight software provided by the software maintainers

TBD	Verif Method	Level
No	A - Spacecraft	Move to Spacecraft
No	A - Spacecraft	Move to Electra
Yes	A - Spacecraft, Mission Design	
No	A - Spacecraft, Mission Design	
No	A - Spacecraft, Mission Design	
No	T - Spacecraft	
No	T- Spacecraft	
No	T - Spacecraft, Instrument	
No	T - Spacecraft	
Yes	A - Availability T - Orbitor Level, Spacecraft, Instrument	
Yes	A - T - Orbitor Level, Spacecraft, Instrument	
No	A T - Orbitor Level, Spacecraft Sims/Solar Array Deploy	
No	A T - Orbitor Level, Spacecraft, Instrument	
No	A - Orbitor Level, Spacecraft, Instrument T - Orbitor Level - Component Tests	
Yes	A - Orbitor Level, Spacecraft, Instrument T - Orbitor Level, Spacecraft, Instrument	
No	A - Orbitor, Spacecraft, Instrument T - Orbitor, Spacecraft, Instrument	
No	A -Oribitor, Spacecraft, Instrument T - Orbitor, Spacecraft, Instrument	CCR - Added Document Number to remove TBD
No	I - Spacecraft	
Yes	I - Orbitor T - Spacecraft	CCR to add document number
No	T - Mapping SVT - Spacecraft	CCR to add "as defined in the Operations Concept."

Yes	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A- Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	Rewrite for more detail and telemetry. Include Electra.
Yes	T. Spacecraft	
No	T - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	I - Spacecraft T - Spacecraft	
Yes	CSR Number A - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	

No	T - Spacecraft	
No	A - Analysis T - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
Yes	T - Spacecraft	
No	A, T - Spacecraft	
No	A, T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	I - harness drawing - Spacecraft T - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	A - Spacecraft	
Yes	T - Spacecraft	
No	A - Spacecraft	
Yes	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft T - Spacecraft Total Data/Air Rate	
No	A - Spacecraft T - Spacecraft	
No	A - Spacecraft T - Spacecraft	
No	T- Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	

No	T - Spacecraft	
No	T - Spacecraft	
No	I - Spacecraft	
No	T - Spacecraft	
Yes	T- Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	A, T - Spacecraft	
No	I - Design - Spacecraft T - Spacecraft	
Yes	I, T Spacecraft	
No	A, T - Spacecraft	
No	A, T - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A, T - Spacecraft	

No	A, T - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	Gold Rule A - Spacecraft T - Spacecraft	
No	Gold Rule A - Spacecraft	
No	Gold Rule A - Spacecraft	CCR need for addition of 28 day unattended
No	Gold Rule A - Spacecraft	
No	Gold Rule A - Spacecraft T - Spacecraft	

No	Gold Rule T - Spacecraft	CCR Needed to add "except during MOI."
No	T-Spacecraft	
No	T - Spacecraft	
No	I - Spacecraft T - Spacecraft	
No	I - Spacecraft T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	A - Spacecraft	CCR to add "7 days."
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T- Spacecraft	
No	t- Spacecraft	
Yes	T - Spacecraft	
No	T - Spacecraft	
No	T- Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
No	T - Spacecraft	
Yes	T - Spacecraft, All Instruments	
No	T - Spacecraft	
No	A - Spacecraft	Added from 2.5
No	I - Spacecraft (ICD)	
No	A - Spacecraft	

No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	I - Spacecraft	Deliverable
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	A - Spacecraft	
No	I, T - Spacecraft	
No	I, T - Spacecraft	
No	A - Spacecraft	
No	A, T - Spacecraft	
No	A - Spacecraft	CCR to remove TBD and add "for twice a week for a 5 hour period."
No	A - Spacecraft	CCR to remove TBD
No	I - Spacecraft	
No	I - Spacecraft	
No	I - Spacecraft	

No	T - Spacecraft	
No	I, T - Spacecraft	CCR - deleted prior to encryption
No	A, T - Spacecraft	
No	T - Spacecraft	

Comments
4.5 +/-.05 - CCR 75 to 1.5
Derived from MAVEN1 TBD - prior to SRR
Derived from MAVEN1
Gold Rule Wording needed
TBR - Assign to Bowser
Dave Curtis specification - Tim T to find
Mario document
Launch Operations Plan - Spacecraft
GSFC Drawing Number

1 x 10-5 torr (TBR) - CCR needed.
Contamination Control Plan
Deliverables
CCR to add TBR TBR by SRR

CCR to change days to 7. 3 kilobits for science and telemetry
TBR - due at SRR
Ai - Spacecraft
Ai - Spacecraft

NNG09EK34C
Attachment H

Mars Atmosphere and Volatile Evolution (MAVEN) Mission

Applicable/Reference Documents List For Risk Reduction Phase and Phase B

March 27, 2009
Revision 1

Goddard Space Flight Center
Greenbelt, Maryland

MAVEN Applicable and Reference Documents List

DOCUMENT	DOCUMENT TITLE
AFSCM 91-710	Range Safety Users Requirements Manual
ANSI/ASQC Q9000-3	Quality Management and Quality Assurance Standards – Part 3: Guidelines for the Application of ISO 9001 to the Development, Supply and Maintenance of Computer Software
ANSI/ESD S20.20	ESD Association Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)
ANSI-IEEE STD 828	IEEE Standard for Software Configuration Management Plans
ANSI-IEEE STD 1042	Guide to Software Configuration Management
ANSI/ISO/ASQ Q9001:2000	Quality Management Systems - Requirements
ANSI/ISO/IEC 17025:2000	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI/NCSL Z540.1-1994	Calibration Laboratories and Measuring and Test Equipment – General Requirements (R2002)
ASTM E-595	Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
CCSDS 133.0-B-1	CCSDS, Space Packet Protocol, Blue Book September 2003
CCSDS 732.0-B-1	CCSDS, Advanced Orbiting Space Data Link Protocol, Blue Book September 2003
CCSDS 132.0-B-1	CCSDS, TM Space Data Link Protocol, Blue Book, September 2003
CCSDS 131.0-B-1	CCSDS, TM Synchronization and Channel Coding, , Blue Book September 2003
CCSDS 301.0-B-3	CCSDS, Time Code Formats, Blue Book, January 2002
CCSDS 232.0-B-1	CCSDS, TC Space Data Link Protocol, Blue Book, September 2003

CCSDS 232.1-B-1	CCSDS, Communications Operations Procedure-1, Blue Book, September 2003
CCSDS 231.0-B-1	CCSDS, TC Synchronization and Channel Coding, Blue Book, September 2003
CCSDS 727.0-B-3	CCSDS File Delivery Protocol (CFDP), Recommendation for Space Data System Standards, Blue Book, June 2005
CCSDS 720.2-G-1	CCSDS File Delivery Protocol—Part 1: Introduction and Overview. Report Concerning Space Data Systems Standards, , Green Book, September 2003
CCSDS 720.2-G-2	CCSDS File Delivery Protocol—Part 2: Implementers Guide. Report Concerning Space Data Systems Standards, , Green Book, September 2003
CR 5320.9	Payload and Experiment Failure Mode Effects Analysis and Critical Items List Ground Rules
FAP P-302-720	Performing a Failure Mode Effects Analysis
GIDEP S0300-BT-PRO-010	GIDEP Operations Manual
GIDEP S0300-BU-GYD-010	Government-Industry Data Exchange Program Requirements Guide
GP-1098	KSC Ground Operations Safety Plan, Volume 1
GPR 1060.2	Management Review and Reporting for Programs and Projects
GPR 7120.4	Risk Management
GPR 8621.3	Mishap, Incident, Hazard, and Close Call Investigation
GPR 8700.4	Integrated Independent Reviews
GPR 8700.6	Engineering Peer Reviews
GSFC EEE-INST-002	Instructions for EEE Parts Selection, Screening, and Qualification and Derating
GFSC-STD-1000	Rules for Design, Development, Verification, and Operation of Flight Systems
GSFC-STD-7000	General Environmental Verification Standards (GEVS) for Flight Programs and Projects
GSFC S-311-M-70	Destructive Physical Analysis

IEEE 1413.1	Guide for Selecting and Using Reliability Predictions Based on IEEE 1413
IEEE STD 730	IEEE Standard for Software Quality Assurance Plans
IEEE STD 1058	Software Project Management Plans
IPC A-600	Acceptability of Printed Boards
IPC-A-610	Acceptability of Electronic Assemblies
IPC/EIA J-STD-001	Requirements for Soldered Electrical and Electronic Assemblies
IPC-2221	Generic Standard on Printed Board Design
IPC-2222	Sectional Design Standard for Rigid Organic Printed Boards
IPC-2223	Sectional Design Standard for Flexible Printed Boards
IPC-6011	Generic Performance Specifications for Printed Boards
IPC-6012	Qualification and Performance Specification for Rigid Printed Boards
IPC-6013	Qualification and Performance Specification for Flexible Printed Boards
IPC-6018	Microwave End Product Board Inspection and Test
ISO 10013	Guidelines for Quality Management System
KHB 1860.1	KSC Ionizing Radiation Protection Program
KHB 1860.2	KSC Non-Ionizing Radiation Protection Program
KNPR 1710.2	Kennedy Space Center Safety Practices Procedure Requirements
KNPR 8715.3	KSC Safety Practices Procedural Requirements
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-338	Electronic Reliability Design Handbook
MIL-STD-461	Requirement for Control of Electromagnetic Interference Characteristics of Subsystem and Equipment
MIL-STD-882	Standard Practice for Systems Safety
MSFC-STD-3029	Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments

NASA-STD-6001	Flammability, Odor, Off-Gassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion
NASA-STD 8719.8	Expendable Launch Vehicle Payloads Safety Review Process Standard
NASA-STD 8719.9	NASA Standard for Lifting Devices and Equipment
NASA-STD 8719.13	NASA Software Safety Standard
NASA-STD-8719.17	NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems
NASA-STD-8729.1	Planning, Developing, and Managing an Effective and Maintainability Program
NASA-STD 8739.1	Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies
NASA-STD 8739.2	Workmanship Standard for Surface Mount Technology
NASA-STD 8739.3	Workmanship Standard for Soldered Electrical Connections
NASA-STD 8739.4	Workmanship Standard for Crimping, Interconnecting Cables, Harnesses and Wiring
NASA-STD-8739.5	Workmanship Standard for Fiber Optic Terminations, Cable Assemblies and Installation
NASA-STD-8739.8	NASA Standard for Software Assurance
NPD 7120.4	Program and Project Management
NPD 8700.1	NASA Policy for Safety & Mission Success
NPD 8720.1	NASA Reliability and Maintainability (R&M) Program Policy
NPD 8730.2	NASA Parts Policy
NPR 7120.5	NASA Space Flight Program and Project Management Processes and Requirements
NPR 7123.1	Systems Engineering Processes and Requirements
NPR 7150.2	Software Engineering Requirements
NPR 8000.4	Risk Management Procedural Requirements
NPR8020.12C	Planetary Protection Provisions for Robotic Extraterrestrial Missions

NPD8020.7G	Biological Contamination Control for Outbound and Inbound Planetary Spacecraft
NPR 8621.1	NASA Procedures and Guidelines for Mishap Reporting, Investigating, and Record Keeping
NPR 8705.4	Risk Classification for NASA Payloads
NPR 8705.5	Probabilistic Risk Assessment (PRA) Procedures for NASA Programs and Projects
NPR 8715.3	NASA General Safety Program Requirements
NPR 8735.1	Procedures for Exchanging Parts, Materials, and Safety Problem Data Utilizing the Government-Industry Data Exchange Program and NASA Advisories
NPR 8735.2	Management of Government Quality Assurance Functions for NASA Contracts
NSS 1740.12	Safety Standard for Explosives, Propellants, and Pyrotechnics
NSS 1740.14	Guidelines and Assessment Procedures for Limiting Orbital Debris
RADC-TR-85-229	Reliability Prediction for Spacecraft
SAE AS9100	Quality Management System, Aerospace Requirements
300-PG-7120.2.1	Systems Safety and Mission Assurance Program (SSMAP) Development
302-PG-7120.2.1	System Safety Support to GSFC Missions and Other Organizations
541-PG-8072.1.2	GSFC Fastener Integrity Requirements