HARLAN

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FINAL
FLIGHT MISSION RULES

APOLLO 9

(AS-504 /104 /LM-3)

REV A
DATED 2/15/69

DECEMBER 15, 1968

PREPARED BY

FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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INCLUDING APPROPRIATE CONTRACTORS

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APOLLO

FINAL FLIGHT MISSION RULES

AS-504/104/LM-3

APOLLO 9

PREFACE

THIS DOCUMENT CONTAINS THE FLIGHT MISSION RULES FOR APOLLO 9 AND CONSTITUTES THE FINAL DOCUMENTATION. THESE RULES WILL RECEIVE AN EXTENSIVE EVALUATION DURING THE SIMULATIONS PRIOR TO THE APOLLO 9 MISSION. SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON DIFFERENT COLORED PAGES FOR EASY RECOGNITION. INFORMATION CONTAINED WITHIN THIS DOCUMENT REPRESENTS THE FINAL FLIGHT MISSION RULES FOR THE APOLLO 9 MISSION AS OF DECEMBER 15, 1968.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. CHARLES R. LEWIS, FLIGHT CONTROL OPERATIONS BRANCH, BUILDING 45, ROOM 633, PHONE 483-3918.

ANY REQUESTS FOR ADDITIONAL COPIES OR CHANGES TO THE DISTRIBUTION LIST IN APPENDIX B OF THIS DOCUMENT MUST BE MADE IN WRITING TO MR. CHRISTOPHER C. KRAFT, JR., DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

THIS IS A CONTROL DOCUMENT AND ANY CHANGES ARE SUBJECT TO THE CHANGE CONTROL PROCEDURES DELINEATED IN APPENDIX C. THIS DOCUMENT IS NOT TO BE REPRODUCED WITHOUT THE WRITTEN APPROVAL OF THE CHIEF, FLIGHT CONTROL DIVISION, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

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FC021
2/15/69

APOLLO 9

FINAL FLIGHT MISSION RULES

REVISION A

PREFACE

THIS DOCUMENT CONTAINS REVISION A TO THE FLIGHT MISSION RULES FOR APOLLO 9 AS OF FEBRUARY 15, 1969. REVISION A IS A PAGE CHANGE REVISION AND THE PAGES SHOULD BE INSERTED IN ACCORDANCE WITH THE REVISION INSTRUCTION SHEET WHICH FOLLOWS THIS PAGE. THIS AND ALL SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON DIFFERENT COLORED PAGES FOR EASY RECOGNITION.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. CHARLES R. LEWIS, FLIGHT CONTROL OPERATIONS BRANCH, BUILDING 45, ROOM 643A, PHONE 483-3918.

ANY REQUESTS FOR ADDITIONAL COPIES OR CHANGES TO THE DISTRIBUTION LIST IN APPENDIX B OF THIS DOCUMENT MUST BE MADE IN WRITING TO MR. CHRISTOPHER C. KRAFT, JR., DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

THIS IS A CONTROL DOCUMENT AND ANY CHANGES ARE SUBJECT TO THE CHANGE CONTROL PROCEDURES DELINEATED IN APPENDIX C. THIS DOCUMENT IS NOT TO BE REPRODUCED WITHOUT THE WRITTEN APPROVAL OF THE CHIEF, FLIGHT CONTROL DIVISION, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

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CHRISTOPHER C. KRAFT, JR.
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APOLLO 9

FINAL FLIGHT MISSION RULES

REVISION A

REVISION INSTRUCTION SHEET

UPDATE THIS DOCUMENT IN ACCORDANCE WITH THE FOLLOWING INSTRUCTIONS

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PART I
INTRODUCTION AND GEN GUIDELINES

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INTRODUCTION & PURPOSE

MISSION RULES ARE PROCEDURAL STATEMENTS WHICH PROVIDE FLIGHT CONTROL PERSONNEL WITH GUIDELINES TO EXPEDITE THE DECISION-MAKING PROCESS. THE RULES ARE BASED ON AN ANALYSIS OF MISSION EQUIPMENT CONFIGURATION, SYSTEMS OPERATIONS AND CONSTRAINTS, FLIGHT CREW PROCEDURES, AND MISSION OBJECTIVES. THE DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS, HAS THE OVERALL RESPONSIBILITY FOR THE PREPARATION, CONTENTS, AND CONTROL OF THE FLIGHT MISSION RULES.

MISSION RULES CAN BE CATEGORIZED AS GENERAL AND SPECIFIC. GENERAL MISSION RULES CONTAIN THE BASIC PHILOSOPHIES USED IN THE DEVELOPMENT OF THE FLIGHT MISSION RULES. SPECIFIC MISSION RULES PROVIDE THE BASIC CRITERIA FROM WHICH REAL-TIME DECISIONS ARE MADE AND WILL BE FORMATTED AS FOLLOWS:

A. THE CONDITION/MALFUNCTION COLUMN DEFINES THE FAILURE.

B. THE PHASE COLUMN IDENTIFIES THE TIME INTERVAL IN WHICH THE CONDITION/MALFUNCTION OCCURS.

C. THE RULING COLUMN DEFINES FLIGHT CONTROLLER ACTION AND/OR PROCEDURES THAT MUST BE ACCOMPLISHED AS A RESULT OF THE CONDITION.

D. THE CUES/NOTES/COMMENTS COLUMN PROVIDES THE FLIGHT CONTROLLER WITH ADDITIONAL INFORMATION CONCERNING THE CONDITION/MALFUNCTION AND/OR RULING.

REV	ITEM	
		OMSF GENERAL RULES
	I-1	MISSION RULES ARE EFFECTIVE DURING THE LAUNCH COUNTDOWN, FLIGHT AND RECOVERY OPERATIONS, AND DURING PRELAUNCH TESTS WHEN APPLICABLE. THEY ARE BASED ON PRIMARY OBJECTIVES AS STATED IN THE APOLLO FLIGHT MISSION ASSIGNMENTS DOCUMENT M-D MA 500-11. PROPOSED CHANGES TO THE PRIMARY OBJECTIVES STATED IN THE MISSION ASSIGNMENTS DOCUMENT SHALL REQUIRE AA/MSF APPROVAL.
	I-2	THE DIRECTOR OF FLIGHT OPERATIONS AND THE DIRECTOR OF LAUNCH OPERATIONS OR THEIR DESIGNATED REPRESENTATIVE WILL INSURE COORDINATION OF THEIR RESPECTIVE MISSION RULE CHANGES WITH THE MISSION DIRECTOR AND OTHER APPROPRIATE ORGANIZATIONS.
	I-3	FOLLOWING THE CDDT OR FRT, WHICHEVER OCCURS FIRST, MISSION DIRECTOR APPROVAL AND CONCURRENCE WILL BE REQUIRED ON ALL RULES CHANGES AFFECTING SAFETY, ACCOMPLISHMENT OF TEST OBJECTIVES, DEVIATIONS FROM THE NOMINAL MISSION AND PRELAUNCH CONSTRAINTS. CONCURRENCE MAY BE OBTAINED VERBALLY IF TIME CONSIDERATIONS SO DICTATE.
	I-4	DURING THE CONDUCT OF THE MISSION, THE MISSION DIRECTOR WILL BE ADVISED OF ALL RECOMMENDATIONS THAT INVOLVE CHANGES TO: MISSION OBJECTIVES, MISSION RULES, FLIGHT PLAN CONTENT, OR LAUNCH/FLIGHT SAFETY.
	I-5	WITHIN THEIR RESPECTIVE AREAS OF RESPONSIBILITY, THE COMMAND PILOT, THE LAUNCH DIRECTOR, FLIGHT DIRECTOR, DOD MANAGER FOR MSF SUPPORT OPERATIONS, AND THE MISSION DIRECTOR MAY TAKE OR RECOMMEND ANY ACTION REQUIRED FOR OPTIMUM CONDUCT OF THE MISSION.
	I-6	THE COMMAND PILOT, SPACECRAFT TEST CONDUCTOR, LAUNCH VEHICLE TEST CONDUCTOR, SPACE VEHICLE TEST SUPERVISOR, LAUNCH OPERATIONS MANAGER, LAUNCH DIRECTOR, FLIGHT DIRECTOR, DOD MANAGER FOR MANNED SPACE FLIGHT SUPPORT OPERATIONS, OR THE MISSION DIRECTOR MAY REQUEST A HOLD FOR CONDITIONS WITHIN THEIR RESPECTIVE AREAS OF RESPONSIBILITY.
	I-7	DURING THE COUNTDOWN, THE LAUNCH VEHICLE AND SPACECRAFT PROGRAM MANAGERS AND RESPECTIVE CENTER OPERATIONS MANAGERS SHALL PROVIDE TECHNICAL ADVICE AND SUPPORT DIRECTLY TO THE LAUNCH OPERATIONS MANAGER AND LAUNCH DIRECTOR. THE LATTER TWO WILL KEEP THE MISSION DIRECTOR FULLY INFORMED OF PROBLEMS AND PROPOSED SOLUTIONS. DURING THE FLIGHT PHASE OF OPERATIONS, SIMILAR SUPPORT AS REQUIRED WILL BE PROVIDED TO THE FLIGHT DIRECTOR AND THE MSC DIRECTOR OF FLIGHT OPERATIONS. THE MISSION DIRECTOR WILL BE KEPT FULLY INFORMED BY THESE INDIVIDUALS OF PROBLEMS AND PROPOSED SOLUTIONS DURING THE APPLICABLE PHASES OF THE MISSION.
	I-8	WHEN TIME PERMITS, THE FAILURE OF A MANDATORY OR HIGHLY DESIRABLE ITEM WILL BE REPORTED TO THE MISSION DIRECTOR BY THE LAUNCH DIRECTOR OR THE FLIGHT DIRECTOR. THE INITIAL REPORT WILL INCLUDE THE POSITION OR FACILITY THAT DETECTED THE MALFUNCTION. SUBSEQUENTLY, THE MISSION DIRECTOR WILL BE INFORMED OF ESTIMATED TIME TO REPAIR AND RECOMMENDED PROCEED, HOLD, RECYCLE, OR SCRUB ACTION AS IT DEVELOPS.

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MISSION RULES

REV	ITEM	
	I-9	IF A MANDATORY ITEM FAILS DURING THE COUNTDOWN, IT WILL BE CORRECTED PRIOR TO LAUNCH, HOLDING OR RECYCLING THE COUNTDOWN AS NECESSARY. IF A MANDATORY ITEM CANNOT BE CORRECTED TO PERMIT LIFTOFF WITHIN THE LAUNCH WINDOW, THE MISSION DIRECTOR MAY PROCEED WITH THE LAUNCH AFTER APPROPRIATE COORDINATION WITH THE APPROPRIATE OPERATIONS AND PROGRAM MANAGERS. GENERALLY THE LOSS OF A MANDATORY ITEM WILL RESULT IN A SCRUB.
	I-10	AS THE DESIGNATED REPRESENTATIVE OF THE PROGRAM DIRECTOR, ONLY THE MISSION DIRECTOR MAY SCRUB THE MISSION. FURTHER, THE MISSION DIRECTOR RETAINS THE PRIMARY AUTHORITY TO DOWNGRADE A MANDATORY ITEM. THIS AUTHORITY SHALL BE EXERCISED AS CIRCUMSTANCES DICTATE AND AFTER APPROPRIATE RECOMMENDATIONS FROM THE PROGRAM MANAGERS, LAUNCH DIRECTOR, AND FLIGHT DIRECTOR.
	I-11	CONSIDERATION WILL BE GIVEN TO THE REPAIR OF ANY HIGHLY DESIRABLE ITEM, BUT IN NO CASE WILL THE LAUNCH BE SCRUBBED FOR ANY SINGLE HIGHLY DESIRABLE ITEM. IF TWO OR MORE HIGHLY DESIRABLE ITEMS FAIL AND/OR OTHER AGGRAVATING CIRCUMSTANCES OCCUR, THE MISSION DIRECTOR MAY SCRUB THE MISSION AFTER COORDINATION WITH THE APPROPRIATE OPERATIONS AND PROGRAM MANAGERS.
	I-12	THE COUNTDOWN WILL NOT BE HELD NOR THE LAUNCH SCRUBBED FOR FAILURE OF DESIRABLE ITEMS.
	I-13	WHENEVER POSSIBLE, THE LAUNCH SITE AND MCC WILL VERIFY TELEMETRY READOUT DISCREPANCIES OCCURRING PRIOR TO LIFTOFF. IF THE MCC LOSES A PARAMETER BUT THE LAUNCH SITE HAS A VALID READOUT, THE MCC WILL CONTINUE ON THE LAUNCH SITE READOUT. THIS IS TRUE EXCEPT FOR THOSE MANDATORY PARAMETERS (LISTED IN THE FLIGHT MISSION RULES) UPON WHICH MISSION RULES ACTION IS TAKEN. IN THIS CASE, A HOLD MAY BE CALLED TO EVALUATE THE PROBLEM.
	I-14	THE COUNTDOWN WILL CONTINUE WHERE POSSIBLE CONCURRENTLY WITH CORRECTION OF AN EXISTING PROBLEM.
	I-15	WHERE POSSIBLE, ALL MANUAL ABORT REQUESTS FROM THE GROUND DURING FLIGHT WILL BE BASED ON TWO INDEPENDENT INDICATIONS OF THE FAILURE. CREW ABORT ACTION WILL NORMALLY BE BASED UPON TWO CUES.
	I-16	PRIOR TO LIFTOFF, THE DIRECTOR OF LAUNCH OPERATIONS WILL BE RESPONSIBLE FOR ALL ACTIONS IN THE EVENT OF LAUNCH SITE EMERGENCIES, EXCEPT FOR RECOVERY OPERATIONS OF SPACECRAFT AND CREW RESULTING FROM A PAD ABORT.
	I-17	THE LAUNCH OPERATIONS MANAGER MAY SEND AN ABORT REQUEST FROM THE TIME THE LAUNCH ESCAPE SYSTEM IS ARMED UNTIL THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER. THE CRITERIA FOR SENDING AN ABORT REQUEST WILL BE ESTABLISHED IN THE LAUNCH RULES.

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MISSION RULES

REV	ITEM	
	I-18	FROM LIFTOFF TO TOWER CLEAR, THE LAUNCH DIRECTOR AND FLIGHT DIRECTOR WILL HAVE CONCURRENT RESPONSIBILITY FOR SENDING AN ABORT REQUEST. THE CRITERIA FOR SENDING AN ABORT REQUEST DURING THIS PERIOD WILL BE ESTABLISHED IN THE LAUNCH AND FLIGHT RULES RESPECTIVELY.
	I-19	THE LAUNCH OPERATIONS MANAGER WILL INFORM MCC WHEN THE SPACE VEHICLE CLEARS THE UMBILICAL TOWER BY SAYING "CLEAR TOWER" OVER ONE OF THE LOOPS FROM KSC TO MCC.
	I-20	IN THE EVENT OF NON-CATASTROPHIC SPACE VEHICLE COLLISION WITH THE UMBILICAL TOWER OR OTHER CONTINGENCIES WHICH DO NOT REQUIRE IMMEDIATE ACTION, THE LAUNCH OPERATIONS MANAGER WILL CONTINUE TO EVALUATE THE EXTENT OF THE DAMAGE AND PROVIDE INFORMATION TO THE FLIGHT DIRECTOR FOR ANY ACTION NECESSARY AFTER UMBILICAL TOWER CLEARANCE.
	I-21	COMPLETE GROUND CONTROL OF THE SPACE VEHICLE PASSES TO THE FLIGHT DIRECTOR WHEN THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER.
	I-22	IN THE MCC, THE FLIGHT DIRECTOR, FLIGHT DYNAMICS OFFICER AND BOOSTER SYSTEMS ENGINEER WILL HAVE THE CAPABILITY TO SEND AN ABORT REQUEST SIGNAL. THE CRITERIA FOR SENDING AN ABORT REQUEST WILL BE ESTABLISHED IN THE FLIGHT RULES.
	I-23	THE COMMAND PILOT MAY INITIATE SUCH INFLIGHT ACTION AS HE DEEMS ESSENTIAL FOR CREW SAFETY.
	I-24	FLIGHT CREW SAFETY SHALL TAKE PRECEDENCE OVER THE ACCOMPLISHMENT OF MISSION OBJECTIVES.
	I-25	IN THE EVENT OF COMMUNICATIONS LOSS BETWEEN THE MANNED SPACE FLIGHT NETWORK AND THE SPACECRAFT, THE COMMAND PILOT WILL ASSUME RESPONSIBILITY FOR MISSION CONDUCT AS DESCRIBED WITHIN THE FLIGHT RULES.
	I-26	THE FLIGHT DIRECTOR, THROUGH THE RECOVERY COORDINATOR, WILL PROVIDE THE DOD MANAGER FOR MANNED SPACE FLIGHT SUPPORT OPERATIONS THE PREDICTED LOCATION AND TIME OF SPLASHDOWN.
	I-27	THE DOD MANAGER FOR MANNED SPACEFLIGHT SUPPORT OPERATIONS IS RESPONSIBLE FOR RECOVERY AND COMMAND AND CONTROL OF DOD RECOVERY FORCES. RECOMMENDATIONS, GUIDELINES AND REQUIREMENTS, AS SET FORTH BY NASA, WILL BE CONSIDERED TO EFFECT SAFE AND EXPEDITIOUS RECOVERY OF THE FLIGHT CREW AND SPACECRAFT.
		RULE NUMBERS 1-28 THROUGH 1-35 ARE RESERVED

REV	ITEM	DEFINITIONS
	I-36	REDLINE: A REDLINE VALUE IS A MAXIMUM AND/OR MINIMUM LIMIT OF A CRITICAL PARAMETER NECESSARY TO IDENTIFY VEHICLE, SYSTEM, AND COMPONENT PERFORMANCE AND OPERATION. REDLINE VALUES WILL BE ESTABLISHED SUCH THAT FURTHER DEGRADATIONS OF THE SYSTEM OR COMPONENT COULD LEAD TO A FAILURE TO ACCOMPLISH THE PRIMARY MISSION.
	I-37	REDLINE FUNCTION: A REDLINE FUNCTION IS A PARAMETER THAT HAS BEEN IDENTIFIED TO MONITOR THE FUNCTIONING OF A UNIT TO INSURE THE OPERATIONAL PERFORMANCE OF THAT UNIT IS ACCEPTABLE TO MEET THE PRIMARY MISSION. REDLINE FUNCTIONS ARE MANDATORY.
	I-38	PRIMARY OBJECTIVE: A STATEMENT OF THE PRIMARY PURPOSE OF FLIGHT. WHEN USED IN CENTER CONTROL DOCUMENTATION THE PRIMARY OBJECTIVE MAY BE AMPLIFIED BUT NOT MODIFIED. DETAILED TEST OBJECTIVES WILL BE GENERATED AND AMPLIFIED TO FULFILL EACH MISSION OBJECTIVE.
	I-39	PRINCIPAL DETAILED TEST OBJECTIVE: A DETAILED TEST OBJECTIVE WHICH MUST BE ACCOMPLISHED PRIOR TO THE LUNAR LANDING MISSION. ANY PRINCIPAL DETAILED TEST OBJECTIVE NOT SATISFACTORILY COMPLETED ON THE ASSIGNED MISSION CAN BE ATTEMPTED ON A SUBSEQUENT MISSION WITHOUT MAJOR IMPACT.
	I-40	MANDATORY DETAILED TEST OBJECTIVE: A PRINCIPAL DETAILED TEST OBJECTIVE WHICH MUST BE SATISFACTORILY COMPLETED ON THE ASSIGNED MISSION. FAILURE TO DO SO WOULD UNDULY COMPROMISE SUBSEQUENT FLIGHT SCHEDULES AND/OR REQUIRE SUBSEQUENT SPACE VEHICLE RECONFIGURATION.
	I-41	SECONDARY DETAILED TEST OBJECTIVE: A DETAILED TEST OBJECTIVE WHICH WOULD PROVIDE SIGNIFICANT DATA OR EXPERIENCE BUT WHICH IS NOT A PREREQUISITE TO THE LUNAR LANDING MISSION.
	I-42	MANDATORY (M): A MANDATORY ITEM IS A SPACE VEHICLE OR OPERATIONAL SUPPORT ELEMENT THAT IS ESSENTIAL FOR ACCOMPLISHMENT OF THE PRIMARY MISSION, WHICH INCLUDES PRELAUNCH, FLIGHT, AND RECOVERY OPERATIONS THAT INSURE CREW SAFETY AND EFFECTIVE OPERATIONAL CONTROL AS WELL AS THE ATTAINMENT OF THE MANDATORY DETAILED TEST OBJECTIVES.
A	I-43	HIGHLY DESIRABLE (HD): A HIGHLY DESIRABLE ITEM IS A SPACE VEHICLE OR OPERATIONAL SUPPORT ELEMENT THAT SUPPORTS AND ENHANCES THE ACCOMPLISHMENT OF THE PRIMARY MISSION AND IS ESSENTIAL FOR THE ACCOMPLISHMENT OF THE PRINCIPAL DETAILED TEST OBJECTIVES.
	I-44	DESIRABLE (D): A DESIRABLE ITEM IS A SPACE VEHICLE ELEMENT OR OPERATIONAL SUPPORT ELEMENT THAT IS NOT ESSENTIAL FOR THE ACCOMPLISHMENT OF THE PRIMARY MISSION.
	I-45	PROCEED: CONTINUE IN ACCORDANCE WITH PRESCRIBED COUNTDOWN PROCEDURES.
	I-46	HOLD: INTERRUPTION OF THE COUNTDOWN FOR UNFAVORABLE WEATHER, REPAIR OF HARDWARE, OR CORRECTION OF CONDITIONS UNSATISFACTORY FOR LAUNCH OR FLIGHT.

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MISSION RULES

REV	ITEM	
	I-47	COUNTDOWN: THE PERIOD OF TIME STARTING WITH LAUNCH VEHICLE POWER UP FOR THE LAUNCH (OR SIMULATED LAUNCH) WHICH INCLUDES SERVICE STRUCTURE REMOVAL, LAUNCH VEHICLE CRYOGENIC TANKING, SPACECRAFT CLOSEOUT, AND THE TERMINAL COUNT.
	I-48	HOLD-POINT: A PREDETERMINED POINT WHERE THE COUNTDOWN MAY BE CONVENIENTLY INTERRUPTED.
	I-49	RECYCLE: THE COUNTDOWN IS STOPPED AND RETURNED TO A DESIGNATED POINT OR AS SPECIFIED IN THE LAUNCH MISSION RULES.
	I-50	SCRUB: THE LAUNCH IS POSTPONED.
	I-51	CUTOFF: THE AUTOMATIC OR MANUAL COMMAND TO STOP THE LAUNCH SEQUENCE AFTER INITIATION OF THE "AUTOMATIC LAUNCH SEQUENCE START."
	I-52	LIFTOFF: THE EVENT DETERMINED BY THE INSTRUMENTATION UNIT UMBILICAL DISCONNECT SIGNAL AND IS THE POINT IN TIME WHEN PLUS TIME COMMENCES.
	I-53	ABORT: MISSION TERMINATION BY UNSCHEDULED INTENTIONAL SEPARATION OF THE SPACECRAFT FROM THE LAUNCH VEHICLE PRIOR TO ORBITAL INSERTION.
	I-54	EARLY MISSION TERMINATION: UNSCHEDULED INTENTIONAL MISSION TERMINATION AT OR AFTER ORBITAL INSERTION.
	I-55	MEASUREMENT: A MEASUREMENT IS A SPECIFIC DATA CHANNEL OF INSTRUMENTATION MONITORING A SINGLE FUNCTION.
	I-56	INSTRUMENTATION: INSTRUMENTATION IS THE EQUIPMENT THAT ACQUIRES, TRANSMITS AND MONITORS DATA FOR PERFORMANCE EVALUATION OF SPACE VEHICLE AND OPERATIONAL SUPPORT ITEMS.

PART II
1 GENERAL RULES
AND SOP'S

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MISSION RULES

REV	ITEM	
		GENERAL
	1-1	THE FLIGHT MISSION RULES OUTLINE PREPLANNED DECISIONS DESIGNED TO MINIMIZE THE AMOUNT OF REAL-TIME RATIONALIZATION REQUIRED WHEN NON-NOMINAL SITUATIONS OCCUR DURING THE TERMINAL COUNTDOWN, THE FLIGHT PHASE, AND RECOVERY OPERATIONS.
	1-2	WHENEVER POSSIBLE, THE CREW AND GROUND WILL VERIFY ALL MALFUNCTIONS. WHENEVER THERE IS A CONFLICT BETWEEN SPACECRAFT AND GROUND TELEMETRY READOUTS, THE SPACECRAFT READOUTS ARE PRIME (ASSUMING THE SPACECRAFT HAS ADEQUATE INSTRUMENTATION AND THAT APPLICABLE SPACECRAFT COCKPIT READOUTS ARE OPERATIONAL).
	1-3	IF AN ALTERNATE MISSION IS REQUIRED, MISSION OBJECTIVES WILL BE DELETED IN ACCORDANCE WITH THE PRIORITY OF OBJECTIVES STATED IN THE FLIGHT OPERATIONS RULES. LOWER ORDER OBJECTIVES WILL NOT BE ATTEMPTED IF DOING SO MAY COMPROMISE THE ACCOMPLISHMENT OF OBJECTIVES OF A HIGHER PRIORITY.
A	1-4	SPACECRAFT LAUNCH WILL NOT BE ATTEMPTED IF KNOWN SPACECRAFT SYSTEMS MALFUNCTIONS WILL LIMIT THE MISSION DURATION SUCH THAT ACCOMPLISHMENT OF THE MANDATORY PRINCIPAL DETAILED TEST OBJECTIVES WILL BE COMPROMISED.
	1-5	WHEN A CONFLICT OF FLIGHT PLAN ACTIVITIES OCCURS, THE FLIGHT DIRECTOR WILL DETERMINE THE PRIORITY OF ACTIVITIES.
	1-6	IN SOME INSTANCES, THE SPECIFIC MISSION RULES MAY DEVIATE FROM THE GENERAL GUIDELINES CONTAINED IN PART I OR FROM THESE GENERAL RULES. THE SPECIFIC MISSION RULE WILL APPLY IN ALL CASES, AND THE DEVIATIONS FROM THE GENERAL GUIDELINES WILL BE NOTED.
	1-7	THE AUTOMATIC EDS (TWO ENGINE OUT AND OVERRATE CAPABILITY) WILL BE FLOWN CLOSED LOOP.
	1-8	THE FLIGHT DIRECTOR MAY, AFTER ANALYSIS OF THE FLIGHT, CHOOSE TO TAKE ANY NECESSARY ACTION REQUIRED FOR THE SUCCESSFUL COMPLETION OF THE MISSION.
	1-9	MISSION RULE LIMITS THAT ARE CONSIDERED TO BE INTERIM OR UNCONFIRMED NUMBERS WILL BE UNDERLINED IN THIS PUBLICATION AND ALL SUBSEQUENT REVISIONS UNTIL THE NUMBERS ARE CONFIRMED BY THE RESPONSIBLE NASA AGENCY.

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MISSION RULES

REV	ITEM	
	1-10	THE SYSTEMS LIMITS LISTED IN THESE RULES ARE THE ACTUAL VEHICLE LIMITS AS WELL AS THEY ARE KNOWN AND UNDERSTOOD AND ARE NOT BIASED TO COMPENSATE FOR TIME DELAYS OR KNOWN INSTRUMENTATION ERRORS IN THE OVERALL DATA SYSTEM.
	1-11	UNLESS STATED OTHERWISE, MANDATORY AND HIGHLY DESIRABLE INSTRUMENTATION REQUIREMENTS ARE SATISFIED BY EITHER ONBOARD OR PCM CAPABILITY.
	1-12	MANDATORY SPACE VEHICLE INSTRUMENTATION FOR THE PURPOSES OF FLIGHT MISSION RULES MUST BE IN CONSONANCE WITH THE FOLLOWING CRITERIA: (REFERENCE OMSF GENERAL RULE I-42). A. REQUIRED TO INSURE FLIGHT CREW SAFETY. B. REQUIRED TO IMPLEMENT RULES RESULTING IN LAUNCH ABORTS. C. REQUIRED TO IMPLEMENT RULES RESULTING IN EARLY MISSION TERMINATION. D. REQUIRED TO MAKE DECISION TO CONTINUE TO THE NEXT MISSION PHASE. THE MANDATORY INSTRUMENTATION LISTINGS IN THIS DOCUMENT WILL BE CROSS-REFERENCED TO THE APPROPRIATE MISSION RULE MEETING THE ABOVE CRITERIA.
	1-13	THE CRITERION FOR CATEGORIZING INSTRUMENTATION AS HIGHLY DESIRABLE IN THE FLIGHT MISSION RULES IS ANY INSTRUMENTATION REQUIRED FOR NORMAL SYSTEMS MANAGEMENT OR REQUIRED FOR FLIGHT CONTROL DECISIONS NOT IN THE MANDATORY CATEGORY.
	1-14	RF COMMANDS WILL NOT BE TRANSMITTED TO THE SPACECRAFT OR LAUNCH VEHICLE DURING THE LAUNCH PHASE UNLESS SPECIFIC MISSION RULES ARE INVOKED WHICH REQUIRE COMMAND ACTIVITY.
	1-15	THE LAUNCH OPERATIONS MANAGER WILL INFORM THE FLIGHT DIRECTOR WHEN THE SPACE VEHICLE HAS CLEARED THE UNBILICAL TOWER BY STATING "CLEAR TOWER" OVER CHANNEL 111.
		RULE NUMBERS 1-16 THROUGH 1-25 ARE RESERVED.

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MISSION RULES

REV	ITEM	
		DEFINITIONS
	1-26	ASAP: AS SOON AS PRACTICABLE (I.E., AS SOON AS POSSIBLE AND REASONABLE).
	1-27	PTP: A PREFERRED TARGET POINT IS A STRATEGICALLY LOCATED SET OF COORDINATES FOR WHICH THE SPACECRAFT SHOULD BE TARGETED IF IT BECOMES NECESSARY TO LAND ON THAT REVOLUTION.
	1-28	ATP: AN "ALTERNATE TARGET POINT" IS A STRATEGICALLY LOCATED SET OF COORDINATES CHOSEN TO PROVIDE A SPACECRAFT TARGET POINT MIDWAY BETWEEN PTP'S.
	1-29	NEXT BEST PTP: A PREFERRED TARGET POINT WHICH CAN BE REACHED BY THE SPACECRAFT WITHIN THE CONSTRAINTS IMPOSED BY THE SPACECRAFT PROBLEM CAUSING AN EARLY MISSION TERMINATION AND ALLOWING THE BEST POSSIBLE REENTRY AND LANDING AREA CONDITIONS.
	1-30	CRITICAL BURN: A BURN WHICH MUST BE ACCOMPLISHED TO MAINTAIN AN ACCEPTABLE LEVEL OF CREW SAFETY. FOR THE PURPOSE OF MISSION RULES, THE FOLLOWING ARE THE PLANNED CRITICAL BURNS: A. MODE III ABORT BURNS B. MODE IV CONTINGENCY ORBIT INSERTION BURNS C. APOGEE KICK BURNS D. DEORBIT BURNS E. RESCUE BURNS F. CSI, CDH AND TPI (LM VEHICLE)
	1-31	NON-CRITICAL BURN: A BURN WHICH NEED NOT BE ACCOMPLISHED TO MAINTAIN AN ACCEPTABLE LEVEL OF CREW SAFETY.
	1-32	EARLY STAGING: UNSCHEDULED INTENTIONAL SEPARATION OF THE S-IVB STAGE FROM THE S-II STAGE.
	1-33	CONTINGENCY ORBIT INSERTION (COI): A SPS PROPULSIVE MANEUVER WHICH WILL PROVIDE CSM INSERTION INTO A SAFE ORBIT ($H_p \geq 75$ NM) IN THE EVENT OF AN SLV FAILURE OCCURRING IMMEDICATELY PRIOR TO INSERTION, OR IN THE EVENT OF DEGRADED SLV PERFORMANCE.

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MISSION RULES

REV	ITEM	
	1-34	S-IVB DESTRUCT PACKAGE SAFING: THE EMERGENCY DESTRUCT PACKAGE IS SAFED BY THE RSO TRANSMITTING A COMMAND WHICH PERMANENTLY REMOVES POWER FROM THE RANGE SAFETY RECEIVERS.
	1-35	S-IVB ORBITAL SAFING: A PASSIVATION SEQUENCE IN WHICH S-IVB LOX, LH_2, AND HIGH PRESSURE SPHERES ARE DEPLETED.
	1-36	PRELAUNCH PHASE (PRELN): THE TIME INTERVAL FROM THE COMPLETION OF THE FLIGHT READINESS REVIEW TO LIFTOFF.
	1-37	FLIGHT PHASE: THE TIME INTERVAL FROM LIFTOFF TO SPLASHDOWN. LISTED BELOW ARE THE MISSION PHASES WHICH COMPRISE THE FLIGHT PHASE. THE PHASES ARE LISTED BY VEHICLE AND WILL BE USED IN THE PHASE COLUMN OF FEC/TSG FORM 291 TO IDENTIFY THE MISSION PERIOD OF ACTIVITY FOR WHICH A SPECIFIC RULING IS APPLICABLE. A. S-IVB 1. LAUNCH PHASE : FROM LIFTOFF THROUGH INSERTION. (TB1 THROUGH TB4) 2. ORBIT PHASE: FROM INSERTION TO CSM/S-IVB SEPARATION FOR TD&E. (TB5) 3. TD&E PHASE: FROM CSM/S-IVB SEPARATION THROUGH LM EJECTION FROM SLA. (TB5) 4. TRANSLUNAR INJECTION (TLI) PHASE: FROM LM EJECTION TO COMPLETION OF S-IVB SUPPORT. THIS PHASE INCLUDES S-IVB RESTARTS AND ORBITAL SAFING. (TB5 THROUGH TB9) B. LM 1. DOCKED PHASE: THE TIME INTERVALS DURING WHICH THE LM AND CSM ARE DOCKED. 2. UNDOCKED PHASE: THE TIME INTERVAL DURING WHICH A MANNED LM IS SEPARATED FROM CSM FOR STATION KEEPING (MAXIMUM SEPARATION DISTANCE OF ≈ 500 FT). 3. EVA PHASE: THE TIME INTERVAL DURING WHICH THE EVA CREWMAN IS INDEPENDENT OF THE LM ECS AND REQUIRES EMU FOR LIFE SUPPORT. 4. RENDEZVOUS PHASE: THE TIME INTERVAL FROM THE CSM SEPARATION MANEUVER FOR MINI-FOOTBALL TO LM/CSM DOCKING AT END OF RENDEZVOUS. 5. UNMANNED PHASE: FROM FINAL LM SEPARATION OR JETTISON TO COMPLETION OF LM ACTIVITIES. C. CSM 1. LAUNCH PHASE: FROM LIFTOFF THROUGH INSERTION. 2. ORBIT (S-IVB) PHASE: FROM INSERTION TO CSM/S-IVB SEPARATION FOR TD&E. 3. TD&E PHASE: FROM CSM/S-IVB SEPARATION THROUGH LM EJECTION FROM SLA. 4. DOCKED PHASE: THE TIME INTERVALS DURING WHICH THE LM AND CSM ARE DOCKED. 5. EVA PHASE: THE TIME INTERVAL DURING WHICH THE EVA CREWMAN IS INDEPENDENT OF THE LM ECS AND REQUIRES THE EMU FOR LIFE SUPPORT. 6. UNDOCKED PHASE: THE TIME INTERVAL DURING WHICH A MANNED LM IS SEPARATED FROM CSM FOR STATION KEEPING (MAXIMUM SEPARATION DISTANCE OF ≈ 500 FT). 7. RENDEZVOUS PHASE: THE TIME INTERVAL FROM THE CSM SEPARATION MANEUVER FOR MINI-FOOTBALL TO LM/CSM DOCKING AT END OF RENDEZVOUS. 8. ORBIT (SOLO) PHASE: CSM ACTIVITIES FROM LM SEPARATION TO DEORBIT BURN CUTOFF. 9. ENTRY PHASE: FROM DEORBIT BURN CUTOFF TO SPLASHDOWN.
	1-38	RECOVERY PHASE: THE TIME INTERVAL FROM SPLASHDOWN TO DELIVERY OF THE FLIGHT CREW AND SPACECRAFT TO DESIGNATED LANDBASED INSTALLATIONS.

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MISSION RULES

REV	ITEM	
	1-39	REENTRY DEFINITIONS: A. AUTOMATIC - REENTRY CONTROLLED BY CMC WHICH OUTPUTS BANK ANGLE COMMANDS TO THE RCS. B. CLOSED LOOP - REENTRY CONTROLLED BY THE CREW MANUALLY FLYING BANK ANGLE MODULATION USING CMC ENTRY PROGRAM OUTPUTS. C. OPEN LOOP REENTRY - REENTRY CONTROLLED BY THE CREW USING SPACECRAFT DISPLAYS AND FLYING: 1. BANK ANGLE (RL 0-90) AND RETRB (RR 0-90). 2. CONSTANT BANK ANGLE - CONSTANT BANK ANGLES >90 DEGREES WILL NOT BE FLOWN EXCEPT WHEN SKIPOUT RULE IS VIOLATED. 3. ROLLING ENTRY - MAINTAIN CONSTANT 18 DEGREES PER SECOND ROLL RATE. 4. EMS RANGING - CONSTANT BANK ANGLE IS HELD TO .2G THEN THE RANGE TO GO DISPLAY AND THE RANGE POTENTIAL LINES ARE COMPARED TO MODULATE THE BANK ANGLE. AT RETRB THE PRESENT BANK ANGLE IS REVERSED.
	1-40	ALTERNATE MISSION: ANY DEVIATION FROM THE NOMINAL MISSION TIMELINE WHERE FURTHER MISSION OBJECTIVES ARE CONSIDERED BEFORE THE END OF THE MISSION.
	1-41	CONTINUE MISSION: THE CONTINUE MISSION RULING FOR MALFUNCTIONS INDICATES THAT THE MISSION WILL BE CONTINUED IN ACCORDANCE WITH PRESENT PLANS UNLESS OVERRIDING FACTORS ARE PRESENT WHICH WOULD CAUSE SELECTION OF AN ALTERNATE MISSION CHOICE.
		RULE NUMBERS 1-42 THROUGH 1-45 ARE RESERVED.

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MISSION RULES

REV	ITEM	
		CRITERIA FOR TARGET POINT SELECTION
	1-46	THE CRITERIA LISTED BELOW WILL BE USED WHEN CHOOSING BETWEEN TWO OR MORE TARGET POINTS. THE CRITICALITY OF THE MISSION SITUATION WILL AFFECT THE APPLICATION OF THESE CRITERIA.

	PRIORITY
ACCEPTABLE WEATHER CONDITIONS FOR RECOVERY OPERATIONS	1
CAPABILITY OF RECOVERY FORCES	2
COMMUNICATION WITH THE SPACECRAFT FROM A GROUND STATION AT LEAST 40 MINUTES PRIOR TO DEORBIT BURN	3
SUFFICIENT DAYLIGHT FOR RECOVERY OPERATIONS	4
A GROUND STATION FOR POST-DEORBIT BURN TRACKING	5
VOICE CONTACT PRIOR TO AND DURING DEORBIT BURN	6
POST-BLACKOUT TRACKING DATA AVAILABLE FOR REENTY (ASSUMES PRE-BLACKOUT ACQUISITION)	7
GROUND STATIONS AVAILABLE TO OBTAIN DELTA V_C READOUTS AND TO PASS CREW BACKUP GUIDANCE QUANTITIES.	8

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MISSION RULES

REV	ITEM	
		PRELAUNCH RULES
	1-47	MANDATORY - THE COGNIZANT FLIGHT CONTROLLER WILL REQUEST A HOLD OR A CUTOFF FROM THE FLIGHT DIRECTOR IN CASE OF A LOSS OR FAILURE OF A MANDATORY ITEM. PRIOR TO T-1 MIN., FAILURES OF MANDATORY ITEMS WILL BE CONFIRMED PRIOR TO REQUESTING A HOLD OR A CUTOFF. AFTER T-1 MIN., CUTOFF WILL BE REQUESTED FOR MANDATORY ITEMS WITHOUT VERIFICATION DUE TO THE LIMITED TIME REMAINING. AT T-20 SEC., ALL MANDATORY ITEMS WILL REVERT TO HIGHLY DESIRABLE UNLESS SPECIFICALLY DESIGNATED AS MANDATORY TO L/O. REFERENCE LAUNCH MISSION RULES DOCUMENT, ITEM TBD FOR SPECIFIC PROCEDURES.
	1-48	HIGHLY DESIRABLE - THE COGNIZANT FLIGHT CONTROLLER WILL NOTIFY THE FLIGHT DIRECTOR IN CASE OF A LOSS OR A FAILURE OF A HIGHLY DESIRABLE ITEM(S). A HOLD MAY BE CALLED BY THE FLIGHT DIRECTOR TO REPAIR THIS ITEM(S) WHEN IT IS CONVENIENT AND IF THE ESTIMATED TIME TO REPAIR OR REPLACE THE ITEM(S) IS ACCEPTABLE. ALL HIGHLY DESIRABLE ITEMS REVERT TO DESIRABLE AFTER AUTO SEQUENCE START.
	1-49	DESIRABLE - FLIGHT CONTROLLERS WILL NOT CALL HOLDS FOR THE LOSS OF DESIRABLE ITEMS AS THEY ARE PLACED IN THIS CATEGORY BECAUSE THEY ARE ITEMS OF SUPPORT WHICH ARE OF MINOR IMPORTANCE TO FLIGHT OPERATIONS.
	1-50	MANUAL CUTOFF WILL NOT BE ATTEMPTED FROM T-11 SECONDS (ENGINE IGNITION) TO T-0.
		RULE NUMBERS 1-51 THROUGH 1-60 ARE RESERVED.

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MISSION RULES

REV	ITEM	
		LAUNCH ABORTS
	1-61	ABORT REQUEST COMMANDS ARE COMMANDS TRANSMITTED FROM THE MCC OR LCC WHICH ILLUMINATE THE ABORT REQUEST LIGHT ON THE COMMAND PILOT'S PANEL. THE "ABORT LIGHT" AND A VOICE REPORT "ABORT" OVER A/G ARE CONSIDERED TWO CUES FOR THE CREW TO TAKE THE NECESSARY ACTION TO ABORT THE MISSION. THE GROUND WILL USE TWO INDEPENDENT CUES PRIOR TO TRANSMITTING "ABORT REQUEST." ADDITIONAL CUES FOR THE CREW WILL COME FROM ONBOARD INDICATIONS.
	1-62	WHENEVER POSSIBLE, ALL ABORTS AND EARLY MISSION TERMINATIONS WILL BE TIMED FOR A WATER LANDING.
	1-63	THE FLIGHT DIRECTOR WILL INITIATE THE ABORT REQUEST COMMAND FOR SPACECRAFT SYSTEMS MALFUNCTIONS, TRAJECTORY DEVIATIONS, AND LAUNCH VEHICLE MALFUNCTIONS IF TIME PERMITS.
	1-64	THE FLIGHT DYNAMICS OFFICER WILL INITIATE THE ABORT REQUEST COMMAND DURING THE FLIGHT PHASE IF THE SPACE VEHICLE EXCEEDS THE FLIGHT DYNAMICS ENVELOPE.
	1-65	THE BOOSTER SYSTEMS ENGINEER WILL INITIATE THE ABORT REQUEST COMMAND BASED UPON LAUNCH VEHICLE TIME-CRITICAL SYSTEMS MALFUNCTIONS THAT WOULD NOT ALLOW A SAFE INSERTION FOR FAILURES OCCURRING FROM LIFTOFF TO S-IVB CUTOFF.
	1-66	THE ONLY KSC POSITION THAT WILL HAVE ABORT REQUEST CAPABILITY IS THE LAUNCH OPERATIONS MANAGER. THE LAUNCH OPERATIONS MANAGER MAY SEND AN ABORT REQUEST FROM THE TIME THE LAUNCH ESCAPE SYSTEM IS ARMED UNTIL THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER. PRIOR TO TRANSFER OF CONTROL TO THE FLIGHT DIRECTOR, THE LAUNCH OPERATIONS MANAGER WILL INITIATE THE ABORT REQUEST COMMAND FROM KSC BASED ON THE FOLLOWING CRITERIA: A. MAJOR STRUCTURAL FAILURE OR EXPLOSION. B. LOSS OF POSITIVE VERTICAL MOTION. C. UNCONTROLLABLE VEHICLE TILTING. D. TOWER COLLISION RESULTING IN DAMAGE NECESSITATING IMMEDIATE ABORT ACTION.
	1-67	THE RSO CAN SHUTDOWN THE SLV BY TRANSMITTING THE MFCO COMMAND WHICH ALSO LIGHTS THE ABORT REQUEST LIGHT IN THE SPACECRAFT. THE MFCO WILL INITIATE AN AUTO-ABORT IF TRANSMITTED PRIOR TO EDS DISABLE. THE MFCO COMMAND INITIATES A 4.0 SEC TIMER ON THE GROUND WHICH IN TURN ENABLES DESTRUCT CAPABILITY IF TRANSMITTED. THE RSO DESTRUCT COMMAND CAN THEN DESTROY THE SLV. THE RSO WILL ALWAYS SAFE THE S-IVB AFTER TRANSMITTING MFCO UPON VERIFICATION OF CUTOFF IF THE DESTRUCT COMMAND IS NOT TO BE TRANSMITTED.

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MISSION RULES

REV	ITEM	
A	1-68	FIXED TIME ABORTS ARE IMPLEMENTED FOR NON-TIME-CRITICAL FAILURES WHICH PRECLUDE CONTINUING LAUNCH TO INSERTION. FIXED TIME ABORTS ARE SCHEDULED AT THE FOLLOWING GET: 1 + 45 MODE IB 3 + 00 MODE IC 4 + 30 MODE II 9 + 10 MODE II
1	1-69	THE FIXED TIME ABORT PROCEDURE IS AS FOLLOWS: A. APPROPRIATE FLIGHT CONTROLLER GIVES RED STATUS AND VOICE REPORT OF FAILURE TO FLIGHT DIRECTOR. B. CREW CONFIRM FAILURE. C. FLIGHT DETERMINE ABORT TIME TO BE USED. D. RETRO BEGIN COUNTDOWN AT ABORT TIME MINUS 10 SECONDS. E. CAPCOM RELAY COUNTDOWN TO CREW. F. CREW INITIATE ABORT ON "MARK". G. FLIGHT DIRECTOR WILL REQUEST "RSO SEND MFCO" IF THE CREW IS UNABLE TO SHUT DOWN WITHIN 5 SECONDS AFTER "MARK".
	1-70	THE RSO WILL SAFE THE S-IVB DESTRUCT SYSTEM AFTER CONFIRMATION OF S-IVB C/O FROM THE FLIGHT DYNAMICS OFFICER. IF COMMUNICATIONS ARE LOST WITH THE FIDO, THE S-IVB DESTRUCT SYSTEM WILL BE SAFED BASED ON THE RSO'S VERIFICATION OF S-IVB CUTOFF. ONCE SAFED, THE S-IVB DESTRUCT SYSTEM CANNOT BE REINITIATED. IF THE RSO INITIATES MFCO, THE RSO WILL INITIATE SAFING AFTER VERIFICATION OF S-IVB CUTOFF.
	1-71	ABORTS ARE INITIATED BY: A. CREW B. EMERGENCY DETECTION SYSTEM (EDS) ABORTS MAY BE REQUESTED BY: A. LAUNCH OPERATIONS MANAGER B. FLIGHT DIRECTOR C. FLIGHT DYNAMICS OFFICER (FDO) D. BOOSTER SYSTEMS ENGINEER (BSE) ABORT AFTER TOWER CLEARANCE IS REQUESTED BY THE FLIGHT DIRECTOR IF TIME PERMITS. THE RESPONSIBLE FLIGHT CONTROLLER (FDO OR BSE) WILL REQUEST ABORT IN TIME-CRITICAL SITUATIONS.

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MISSION RULES

REV	ITEM	
	1-72	EMERGENCY ENGINE SHUTDOWN METHODS.

INITIATOR	METHOD	STAGE	TIME FRAME
ASTRONAUT	CCW ON THC	S-IC, S-II, S-IVB	T + 30 SEC TO SECO
ASTRONAUT	S-II/S-IVB L/V STAGE SWITCH	S-II, S-IVB	T + 2:33 TO SECO
RSO	RF CMD (MFCO)	S-IC, S-II, S-IVB	T-0 TO INSERTION
EDS	2 OF 3 VOTING LOGIC	S-IC	T + 30 SEC TO EDS AUTO OFF AT T + 2:00 MIN NOTE: EDS WILL INITIATE ABORT FROM T-0 TO T + 30 SEC; HOWEVER, S-IC ENGINES WILL NOT BE SHUTDOWN

A 1-73 THE EDS AUTO ABORT LOGIC WILL BE DISABLED EARLY FOR LOSS OF ANY ENTRY BATTERY.

A 1-74 ABORT MODES:

MODE I	BOUNDARY OF APPLICATION	PROCEDURES
1A	LES ABORT ENABLE (≈T-30 MIN) TO GET 42 SEC. (10 K FEET)	REFERENCE AOH 5.1.1.1
1B	GET 42 SEC TO 100K FEET ALTITIDE (GET ≈1 + 50)	REFERENCE AOH 5.1.1.2
1C	100K FEET ALTITIDE TO TOWER JETTISON (GET ≈ 3 + 07)	REFERENCE AOH 5.1.1.3

A 1-75

MODE II	BOUNDARY OF APPLICATION	PROCEDURES
	TOWER JETTISON (GET ≈ 3 + 07) UNTIL FULL LIFT SPLASHPOINT IS 3350 N.M. DOWNRANGE	A. REFERENCE AOH 5.1.2.1 B. MCC PROVIDES 1. GET 400K AND PITCH AT .05 G'S. 2. GET DROGUE C. ENTRY IS FULL LIFT

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MISSION RULES

REV	ITEM			
A	1-76	MODE III	BOUNDARY OF APPLICATION	PROCEDURES
			FULL LIFT SPLASHPOINT BETWEEN 3350 N.M. AND INSERTION.	A. REFERENCE AOH 5.1.2.2 B. MCC PROVIDES: 1. GETI AT S-IVB CUTOFF PLUS 2:05 2. DELTA V FOR 3350 N.M. SPLASH-POINT 3. BURN DURATION 4. GET AND PITCH ATT AT 400K FT. 5. GET DROGUE 6. GET MAIN C. MANEUVER IS SCS AUTO. D. ENTRY IS ROLL LEFT 55 DEGREES.
A	1-77	MODE IV	BOUNDARY OF APPLICATION	PROCEDURES
			CONTINGENCY ORBIT INSERTION CAPABILITY TO INSERTION (BASED ON COI LINE ON γ VS V PLOT FOR NEAR NOMINAL ALTITUDE)	A. REFERENCE AOH 5.1.2.3 B. MCC PROVIDES: 1. GETI AT S-IVB CUTOFF PLUS 2:05 2. DELTA V REQUIRED TO ACHIEVE PERIGEE $\geq$75 N.M. 3. BURN DURATION 4. PITCH AT GETI C. MANEUVER IS SCS AUTO
A	1-78	MODE	BOUNDARY OF APPLICATION	PROCEDURES
		APOGEE KICK	PRE-APOGEE CUTOFFS, OUTSIDE THE COI BOUNDARY, CORRECTABLE TO SAFE ORBITAL CONDITIONS BY A MANEUVER AT APOGEE.	A. B. MCC PROVIDES: 1. GETI FOR BURN AT APOGEE 2. DELTA V REQUIRED TO ACHIEVE $\geq$75 N.M. 3. BURN DURATION 4. PITCH ATTITUDE C. MANEUVER IS SCS AUTO
A	1-79	CREW ABORT LIMITS		
		MAX Q REGION (00:50 TO 01:40)		PROCEDURES
		A. AOA $\geq$100 PCT AND PITCH, YAW AND ROLL ERROR >5 DEGREES (DISREGARD FOR S-IC CONTROL ENGINE OUT PRIOR TO 50 SECONDS)		ABORT MODE I (ACTION ONLY AFTER BOTH HAVE REACHED THRESHOLD) ABORT MODE I
		B. CUES 1. LV GUID LT-ON 2. LV RATE LT-ON		

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MISSION RULES

REV	ITEM		
	1-80	RATES AND ATTITUDE	PROCEDURES
		A. PITCH AND YAW	
		1. L/O TO S-IC/S-II STAGING - 4 DEG/SEC	ABORT MODE I
		2. S-IC/S-II STAGING TO SECO- 9 DEG/SEC	ABORT MODE I, MODE II, MODE III, OR MODE IV
		B. ROLL	
		1. L/O TO SECO - 20 DEG/SEC	ABORT MODE I, MODE II, MODE III, OR MODE IV
	1-81	EDS AUTOMATIC ABORT LIMITS (UNTIL MANUAL DEACTIVATION OF TWO ENGINES OUT AUTO AND LV RATES AT 2:00 MIN)	
		BOUNDARY OF APPLICATION	
		A. RATES PITCH AND YAW 4.0 ± .5 DEG/SEC ROLL 20.0 ± .5 DEG/SEC	
		B. ANY TWO ENGINES OUT	
		C. CM TO IU BREAKUP	
	1-82	S-IVB TANK PRESSURE LIMITS (L/O TO CSM/LV SEP)	
		A. BULKHEAD ΔP FUEL > OXID = 26 PSID OXID > FUEL = 36 PSID	
A	1-83	ENGINE FAILURES	PROCEDURES
		A. SIMULTANEOUS LOSS OF TWO OR MORE ENGINES (S-IC)	ABORT MODE I
		B. SIMULTANEOUS LOSS OF TWO OR MORE ENGINES (S-II)	ABORT OR EARLY STAGE REF MR 6-17
		C. S-II INBOARD ENGINE HARDOVER	ABORT PRIOR TO S-IVB TO ORBIT CAPABILITY, AFTER S-IVB TO ORBIT CAPABILITY, EARLY STAGE

2 FLIGHT OPERATIONS RULES

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MISSION RULES

REV	ITEM	
A	2-1	MISSION GO/NO-GO SUMMARY

A. COMBINED FLIGHT CONTROL/FLIGHT CREW GO/NO-GO'S WILL BE MADE FOR EACH OF THE FOLLOWING:

1. LAUNCH GO/NO-GO FOR ORBIT INSERTION (9 + 00)
2. S-IVB ORBIT COAST (POST CUTOFF)
3. CONTINUE PAST 2-1 TO 6-4 PTP (CRO)
4. TD&E
5. S-IVB ORBITAL MANEUVERS
6. SPS MANEUVERS
7. CONTINUE THE MISSION PAST PTP 6-4 AND DAILY PTP GO/NO-GO
8. IVT
9. DOCKED DPS BURN
10. EVA
11. CSM/LM UNDOCKING
12. SEPARATION MANEUVER
13. PHASING MANEUVER
14. INSERTION MANEUVER
15. LM STAGING
16. LM UNMANNED APS BURN GO/NO-GO

REFERENCE RULES 3-1 THROUGH 3-17 AND 3-20 THROUGH 3-41 FOR GO/NO-GO CRITERIA.

B. FAILURE TO SATISFY THE GO/NO-GO CRITERIA IS SUFFICIENT CAUSE TO ALTER THE NOMINAL MISSION ACTIVITIES. THE COURSE OF ACTION REQUIRED WILL BE BASED UPON THE SPECIFIC CRITERIA NOT SATISFIED AND ASSOCIATED SPECIFIC MISSION RULES.

C. THE LIFETIME REQUIREMENTS AND CONSUMABLES ESTABLISHED FOR THE GO/NO-GO CRITERIA MUST ACCOUNT FOR THE NOMINAL ACTIVITIES PLANNED FOR COMPLETION, OPERATIONAL RESERVES, SUFFICIENT TIME AND CONSUMABLES TO PREPARE AND CONDUCT A CSM REENTRY FROM ANY POINT IN THE NOMINAL ACTIVITIES, AND A CSM PAD OF THREE HOURS IF ENTRY IS DELAYED.

D. THE SYSTEMS GO/NO-GO PHILOSOPHY UTILIZED IN THE FORMULATION OF THE MISSION RULES IS AS FOLLOWS:

1. REDUNDANT SYSTEMS: MISSION OR MISSION PHASE TERMINATION WILL BE PLANNED ASAP FOR FAILURE OF A REDUNDANT SYSTEM IF THE FAILURE OF THE REMAINING SYSTEM WOULD CAUSE LOSS OF THE CREW.

2. TRIPLE REDUNDANT SYSTEMS: CONSIDERATION WILL BE GIVEN FOR MISSION CONTINUATION FOR LOSS OF ONE OF THREE SYSTEMS PROVIDING THAT THE FOLLOWING CONDITIONS ARE MET.

   (A) EACH OF THE REMAINING SYSTEMS HAS SUFFICIENT CAPABILITY OR CAPACITY TO SUPPORT THE PLANNED MISSION PROFILE.

   (B) SUFFICIENT TIME PRIOR TO THE GO/NO-GO EXISTS FOR DETAILED MONITORING OF THE OPERATION OF THE REMAINING SYSTEMS IN ORDER TO DETERMINE IF CONDITION 2(A) ABOVE IS SATISFIED.

   (C) THE FAILURE MODE IS UNDERSTOOD, AND AS FAR AS CAN BE DETERMINED, THE FAILURE WILL NOT AFFECT THE REMAINING SYSTEMS.

   (D) IF CRITERIA A, B, AND C ARE NOT SATISFIED, THE MISSION WILL NORMALLY BE TERMINATED.

3. SYSTEMS WITH INTEGRAL BACKUP MODES: THERE ARE SEVERAL SPACECRAFT SYSTEMS THAT HAVE MORE THAN ONE WAY (MODE) TO ACCOMPLISH THEIR DESIGN FUNCTION. FOR THESE SYSTEMS, THE FOLLOWING GUIDELINES WILL APPLY:

   (A) SINGLE SYSTEM WITH BACKUP MODES: IF THE REDUNDANT MODES HAVE EQUAL CAPABILITY, GUIDELINE 1 WILL APPLY.

   (B) DUAL SYSTEMS, EACH WITH BACKUP MODES: FOR THIS CASE, THE S/C HAS FOUR MODES IN WHICH TO ACCOMPLISH ITS DESIGN FUNCTION. THE MISSION WILL NORMALLY CONTINUE WITH LOSS OF ONE OF THE ABOVE MODES. FOR THE CASE WHERE TWO OF THE FOUR MODES ARE LOST, EACH OF THE REMAINING SYSTEMS HAS SUFFICIENT CAPABILITY TO SUPPORT THE MISSION PROFILE; HOWEVER, MISSION TERMINATION WILL BE PLANNED BECAUSE MULTIPLE SIMILAR FAILURES HAVE OCCURRED AND CONFIDENCE HAS BEEN LOST IN THE SYSTEM.

4. THE ABOVE GUIDELINES MAY BE INVOKED DURING THE CONDUCT OF THE MISSION BY EITHER THE FLIGHT DIRECTOR OR FLIGHT CREW IN ORDER TO MAXIMIZE THE CHANCE OF MISSION SUCCESS AND STILL MAINTAIN AN ADEQUATE MARGIN OF CREW SAFETY.

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MISSION RULES

REV	ITEM		
	2-2	PRELAUNCH	A. LAUNCH WINDOW OPENS AT 1600 GMT, BASED ON ACHIEVING PROPER RENDEZVOUS LIGHTING AND MSFN COVERAGE, AND CLOSES AT 1900 GMT, BASED ON IRRETRIEVABLE LOSS OF RENDEZVOUS LIGHTING CONDITIONS. B. THE LAUNCH WINDOW WAS EXTENDED BY UTILIZING THE ΔV BUDGETS OF SPS BURNS 2, 3, 4, AND 5 AND THE DOCKED DPS BURN TO MAINTAIN REQUIRED RENDEZVOUS LIGHTING AND MSFN COVERAGE CONSTRAINTS. FAILURE TO COMPLETE THESE BURNS MAY RESULT IN AN ALTERNATE RENDEZVOUS MISSION. C. WIND CONSTRAINTS - THE FLIGHT DIRECTOR WILL EVALUATE THE MODE I (TOWER) ABORT IP TRACK WIND SIMULATIONS PRIOR TO THE START OF CRITICAL COUNTDOWN ACTIVITIES AND WILL ADVISE THE LAUNCH DIRECTOR OF ANY PREDICTED PERIODS OF LAND LANDING. IF THE FLIGHT DIRECTOR IS UNABLE TO PROVIDE THIS EVALUATION, A LAND LANDING WILL BE ASSUMED AND THE SPACECRAFT WIND CONSTRAINTS FOR LAND IP'S WILL BE APPLIED. THESE CONSTRAINTS (REF LMRD) REQUIRE THAT THE SPACECRAFT NOT BE LAUNCHED OR REMAIN IN A TOWER ABORT MODE IF A TOWER ABORT WOULD RESULT IN A LAND LANDING WITH A HORIZONTAL VELOCITY COMPONENT OF GREATER THAN 54 FEET PER SECOND AT IMPACT. IN ALL CASES, THE LAUNCH DIRECTOR WILL BE PRIME FOR CALLING HOLDS FOR LAND LANDING LAUNCH WIND VIOLATIONS.
	2-3	LAUNCH	IT IS PREFERABLE TO GO INTO ORBIT AND REENTER INTO THE WEST ATLANTIC RATHER THAN PERFORM A LAUNCH ABORT. THEREFORE, THE LAUNCH WILL BE CONTINUED AS LONG AS THE CREW CONDITION IS SATISFACTORY, NO S/C OR SLV PROBLEMS EXIST WHICH JEOPARDIZE CREW SAFETY, AND SUFFICIENT CONSUMABLES, COOLANT, AND ELECTRICAL ENERGY REMAIN FOR AT LEAST ONE REVOLUTION PLUS ENTRY. FOR CASES WHERE THE ABOVE ANOMOLIES EXIST AND ALSO LAUNCH TRAJECTORY DEVIATIONS ARE EVIDENT, THE MISSION MAY BE ABORTED DURING LAUNCH PHASE.
	2-4	EARLY STAGING	IF REQUIRED, EARLY S-IVB STAGING MAY BE INITIATED BY THE FLIGHT CREW ONLY AFTER S-IVB-TO-ORBIT CAPABILITY IS OBTAINED.
	2-5	ORBIT GO/NO-GO	A GO/NO-GO DECISION WILL BE MADE AT CRO ON REV 1 TO CONTINUE FROM THE 2-1 TO THE 6-4 PTP. PRIOR TO REACHING THE 6-4 PTP, A GO/NO-GO DECISION WILL BE MADE TO CONTINUE TO THE 18-1 PTP. AFTER THE 18-1 PTP, A GO/NO-GO DECISION WILL BE MADE ON A DAY-BY-DAY BASIS FOR CONTINUATION TO THE NEXT GO/NO-GO PTP.
A	2-6	EARLY CSM/S-IVB SEPARATION (NO LM EXTRACTION) (CONTINUED)	A. A S-IVB FAILURE OR SYSTEMS TREND THAT WILL RESULT IN A HAZARDOUS SITUATION FOR THE FLIGHT CREW IS CAUSE FOR AN IMMEDIATE CSM/S-IVB SEPARATION. THE FLIGHT CREW WILL PERFORM A SEPARATION MANEUVER ASAP. B. IF THE RANGE SAFETY SYSTEM IS NOT SAFED AND EBW IS ARMED, THE CSM WILL PERFORM A SEPARATION MANEUVER ASAP.

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MISSION RULES

REV	ITEM		
A	2-6 (CONT'D)	EARLY CSM/S-IVB SEPARATION (NO LM EXTRATION)	C. IF THE CSM SEPARATES EARLY AND MANEUVERS TO ACHIEVE SAFE SEPARATION DISTANCE (7000 FT), THE CSM WILL BE PREPARED TO IMPLEMENT A S-IVB/LM RENDEZVOUS AND POSSIBLE DOCKING IN THE EVENT THE REASON FOR EARLY SEPARATION HAS BEEN CORRECTED. IN THIS CASE, THE NOMINAL S-IVB ACTIVITIES WILL BE DELETED.
	2-7	TRANSPOSITION, DOCKING, AND EXTRATION (TD&E)	A. EARLY TD&E WILL BE ATTEMPTED ONLY FOR S-IVB LIFETIME PROBLEMS WHICH WOULD RESULT IN PREDICTED STAGE FAILURES PRIOR TO THE END OF THE NOMINAL LM EXTRATION TIME. TD&E SHALL NOT BE ATTEMPTED EARLIER THAN SUNRISE ON REV 1. B. TD&E MAY BE DELAYED IF S-IVB AND/OR CSM SYSTEMS PROBLEMS EXIST WHICH DO NOT IMPACT CREW SAFETY BUT REQUIRE EXTENSIVE PARTICIPATION BY THE FLIGHT CREW AND/OR FLIGHT CONTROL FOR MONITORING AND CORRECTIVE ACTION. C. IF TD&E IS DELAYED BUT THERE IS A REASONABLE CHANCE OF COMPLETION, THE LM EXTRACTION WILL BE THE PRIORITY OBJECTIVE AND THE S-IVB RESTARTS WILL REMAIN INHIBITED UNTIL SEPARATION. D. A CSM MALFUNCTION REQUIRING ENTRY INTO 6-4 PTP SHALL NOT PRECLUDE ATTEMPTING THE TD&E ACTIVITY IF THE TD&E ACTIVITIES WOULD NOT FURTHER AGGRAVATE THE MALFUNCTION CONDITION. E. IF NORMAL LM EXTRACTION (CSM/LM UMBILICAL) IS NOT SUCCESSFUL, NO ATTEMPT WILL BE MADE TO MAN THE LM AND "STAGE" TO RECOVER THE ASCENT STAGE. F. IN THE EVENT OF ADVERSE LIGHTING, ATTITUDES OR RATES, THE FLIGHT CREW WILL MAKE THE FINAL DECISION TO ATTEMPT DOCKING AND EXTRACTION. G. IF ADVERSE ATTITUDE RATES OCCUR AFTER CSM DOCKING TO THE S-IVB/LM, THE CSM WILL PERFORM SEPARATION. SEPARATION SHOULD BE ATTEMPTED BY THE PROBE EXTEND RELEASE. IF THIS FAILS, A FINAL SEPARATION (PYROTECHNIC) WILL BE PERFORMED. H. THE SM-RCS MANEUVER PERFORMED IMMEDIATELY AFTER LM EXTRACTION WILL PROVIDE A SAFE DISTANCE (500 FT) BETWEEN THE CSM/LM AND S-IVB AT THE TIME OF S-IVB RESTART. I. THE NORMAL MINIMUM CABIN PRESSURE REDLINE OF 4.0 PSIA FOR TUNNEL/LM PRESSURIZATION SEQUENCES WILL BE WAIVED DURING TD&E. FOR TUNNEL OR LM LEAKS WHICH PREVENT NORMAL PRESSURIZATION, THE CM WILL BE DEPRESSURIZED AS REQUIRED FOR HATCH REMOVAL AND UMBILICAL HOOKUP. J. FOR SLA JETTISON ANOMALIES, THE FLIGHT CREW WILL MAKE THE FINAL DECISION TO ATTEMPT LM EXTRACTION.

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MISSION RULES

REV	ITEM		
A	2-8	S-IVB RESTARTS	A. THE S-IVB RESTARTS WILL REMAIN INHIBITED UNTIL THE CSM OR CSM/LM SEPARATES FROM THE S-IVB AND THE PROJECTED SEPARATION DISTANCE AT S-IVB RESTART TIME IS GREATER THAN 500 FEET WITH NO RECONTACT PROBLEM. B. THE FIRST S-IVB RESTART MAY BE INHIBITED IF DATA INDICATES A RESTART WOULD RESULT IN A CATASTROPHIC VEHICLE SPINUP. SPINUP COULD RESULT FROM: 1. A LOSS OF THE S-IVB HYDRAULIC SYSTEM. 2. AN S-IVB ACTUATOR HARDOVER WITH NOMINAL HYDRAULIC SYSTEM OPERATION. C. THE FIRST S-IVB RESTART MAY BE INHIBITED IF IT IS DETERMINED THAT A RETROGRADE COMPONENT OF VELOCITY WILL BE ACHIEVED DURING THE BURN.
	2-9	INTRAVEHICULAR TRANSFER	ONE HARDSUIT IVT FROM THE CSM TO THE LM WILL BE ACCOMPLISHED IF A REASONABLE CHANCE EXISTS THAT CORRECTIVE ACTION CAN BE TAKEN FOR A LM/TUNNEL PRESSURIZATION PROBLEM.
A	2-10	DOCKED LM OPERATION	A. LIMITED EVALUATION OF LM SYSTEMS PERFORMANCE WILL CONTINUE AS LONG AS LIFE SUPPORT CAN BE PROVIDED (EXCLUDING HARDSUIT OPERATION) TO AT LEAST ONE CREWMAN (VIA CM OR LM) AND AS LONG AS LM/CSM VOICE COMMUNICATIONS ARE AVAILABLE AND NO HAZARDOUS CREW SAFETY SITUATIONS EXIST. B. FOR AN IMPENDING HAZARDOUS SITUATION RESULTING FROM A DESCENT STAGE PROBLEM, THE LM WILL BE "STAGED" AND ASC STAGE OPERATIONS WILL CONTINUE. C. FOR MANNED LM OPERATIONS, A MINIMUM OF TWO EVA SUPPORT UNITS (PLSS + OPS OR 2 OPS) MUST BE VERIFIED OPERATIONAL PRIOR TO INSTALLATION OF TUNNEL HARDWARE. D. THE LOSS OF CM GNCS ABILITY TO MONITOR THE DOCKED DPS BURN SHALL NOT PRECLUDE EXECUTION OF THIS MANEUVER.
A	2-11	EXTRAVEHICULAR ACTIVITY (CONTINUED)	A. IF EVT IS ATTEMPTED AND NOT COMPLETED SATISFACTORILY WITHIN THE OPS LIFETIME, NO MANNED UNDOCKED ACTIVITIES SHALL BE PERFORMED. B. FOR MISSION LIFETIME PROBLEMS WHICH REDUCE LM SYSTEMS EVALUATION TIME, THE UNDOCKED ACTIVITIES SHALL TAKE PRIORITY OVER EVA. IN THIS CASE, CSM/LM UNDOCKING WILL BE PERFORMED WITHOUT AN EVT DEMONSTRATION IF TWO OF THREE EVA LIFE SUPPORT UNITS (PLSS AND OPS OR 2 OPS) ARE OPERATIONAL. C. EVA WILL BE RESTRICTED TO THE LM FORWARD LEG OR THE NOMINAL EVT TR PATH BETWEEN THE LM FORWARD HATCH AND CM SIDE HATCH EXCEPT FOR RETRIEVAL OF LM AND SM THERMAL SAMPLES.

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MISSION RULES

REV	ITEM		
A	2-11 (CONT'D)	EXTRAVEHICULAR ACTIVITY	D. INABILITY TO ISOLATE CSM AND/OR LM-RCS THRUSTERS WHICH IMPINGE ON THE EVT TRANSFER PATH IS SUFFICIENT CAUSE NOT TO ATTEMPT EVT. HOWEVER AN ALTERNATE OR ABBREVIATED EVA MAY BE CONDUCTED. IN EITHER CASE, THE EVT OR AN ALTERNATE EVA IS NOT A PREREQUISITE FOR MANNED UNDOCKED ACTIVITIES. E. VOICE COMMUNICATIONS BETWEEN THE EVA CREWMAN AND THE LM AND CM CREWMEN ARE REQUIRED TO INITIATE EVA. F. CM OR LM RECORDING OF EVA VOICE COMMUNICATIONS SHALL NOT CONSTRAIN SELECTION OF THE OPTIMUM EVA/LM/CM/MSFN VOICE COMMUNICATIONS CONFIGURATION. G. MSFN VOICE AND/OR DATA ARE NOT REQUIRED FROM THE EVA CREWMAN IN ORDER TO GIVE A GO FOR EVA.
	2-12	CSM/LM UNDOCKING	A. A MANNED LM WILL NOT BE SEPARATED FROM THE CSM WITHOUT INDEPENDENT MANEUVER CAPABILITY OF BOTH VEHICLES TO TERMINATE SEPARATED ACTIVITIES AND TO ACCOMPLISH DOCKING. B. VHF VOICE COMMUNICATIONS BETWEEN THE LM AND CSM ARE MANDATORY FOR UN-DOCKING. C. CM AND LM SUIT LOOP INTEGRITY IS REQUIRED FOR MANNED UNDOCKING. D. A LM-RCS REDLINE WILL BE ESTABLISHED BASED ON LM AS THE ACTIVE DOCKING VEHICLE. E. PRIOR TO UNDOCKING THE GO/NO-GO WILL BE INCLUSIVE OF THE CHOICE TO CON-TINUE WITH THE NOMINAL RENDEZVOUS PLAN OR AN APPROPRIATE ALTERNATE MISSION. ALTERATION OF ACTIVITIES AFTER UNDOCKING WILL BE BASED ON: 1. CHANGE IN CSM OR LM SYSTEMS STATUS AFTER UNDOCKING. 2. VIOLATION OR PREDICTED VIOLATION OF CONSUMABLE REDLINES. F. SELECTION OF THE ACTIVE VEHICLE FOR DOCKING WILL BE DETERMINED BY FLIGHT CONTROL AND THE FLIGHT CREW BASED UPON CONSUMABLES AND SYSTEMS PERFORMANCE. G. A MINIMUM OF TWO EVA SUPPORT UNITS MUST BE VERIFIED OPERATIONAL PRIOR TO UNDOCKING; HOWEVER, A SINGLE MANNED LM OPERATION AND UNDOCKING WILL BE PLANNED IF ONLY ONE EVA SUPPORT UNIT IS AVAILABLE.

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MISSION RULES

REV	ITEM		
A	2-13	RENDEZVOUS	A. FOR SYSTEM FAILURES IN EITHER SPACECRAFT THAT WOULD RESULT IN EARLY TERMINATION, THE TOTAL LM CAPABILITY (WITHIN ESTABLISHED REDLINES AND NO VIOLATION OF DETAILED SYSTEMS RULES) WILL BE DEDICATED TO COMPLETION OF THE RENDEZVOUS IN PROGRESS. B. CSM GO/NO-GO CRITERIA WILL INCLUDE THE CAPABILITY (SINGLE CREWMAN) TO EXECUTE A LM RESCUE FROM ANY POINT IN THE RENDEZVOUS SEQUENCE AND PERFORM DOCKING TO THE LM. C. SATISFACTORY PERFORMANCE OF THE CSM SPS MUST BE DEMONSTRATED PRIOR TO RENDEZVOUS. CRITICAL BURN CAPABILITY MUST EXIST FOR RENDEZVOUS. D. LM STAGING MAY BE DELAYED, POSSIBLY UNTIL AFTER DOCKING, IF NECESSARY TO MAINTAIN SUFFICIENT ELECTRICAL POWER, LIFE SUPPORT AND/OR PROPULSION CAPABILITY FOR COMPLETION OF THE RENDEZVOUS IN PROGRESS AND DOCKING. E. FITH STAGING FROM EITHER AN INACTIVE DPS OR AN ACTIVE DPS WILL NOT BE PERFORMED. F. A LM CONSUMABLES RESERVE OF THREE HOURS IS REQUIRED TO COMMIT TO THE NOMINAL RENDEZVOUS. G. TWO-WAY A/G MSFN VOICE COMMUNICATIONS ARE REQUIRED TO BOTH VEHICLES IN ORDER TO CONTINUE THE RENDEZVOUS.

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REV	ITEM		
	2-14	UNMANNED APS BURN	A. THE APS BURN WILL NOT BE INITIATED IF ATTITUDE CONTROL IS NOT AVAILABLE OR IF IGNITION COULD RESULT IN STAGE DESTRUCTION BASED ON NON-NOMINAL SYSTEM STATUS. B. THE APS BURN WILL BE TERMINATED VIA RF COMMAND IF INDICATIONS ARE THAT ATTITUDE CONTROL HAS BEEN LOST PRIOR TO THE PLANNED DURATION. MSFN WILL CONTINUE MONITORING LM SYSTEMS PERFORMANCE FOR THE REMAINING LM LIFETIME. C. MSFN COVERAGE MUST BE PROVIDED TO ALLOW FOR A NOMINAL COMMAND PREPARATION TIME OF 4 MINUTES FOR INITIATION OF THE BURN AND APPROXIMATELY 6 MINUTES OF BURN DURATION. THIS BURN IS TIME CRITICAL, AND DUE TO THE MSFN COVERAGE ANTICIPATED, THIS OBJECTIVE MAY NOT BE SATISFIED.
A	2-15	CSM DEORBIT	A. TWO METHODS OF DEORBIT ARE REQUIRED TO CONTINUE PAST THE NEXT BEST PTP. B. IF A SUBSEQUENT SINGLE FAILURE WOULD PRECLUDE DEORBIT BY BOTH METHODS REMAINING, THE CSM WILL DEORBIT THE NEXT BEST PTP. C. SPS DEORBIT IS PRIME. SUFFICIENT ΔV WILL BE RESERVED FOR SPS DEORBIT FROM ANY POINT IN THE MISSION. D. SM-RCS (4 QUAD) AND SM-CM/RCS HYBRID WILL BE CONSIDERED AS INDEPENDENT DEORBIT METHODS AS LONG AS INDIVIDUAL SM-RCS QUAD AND GNCS OR SCS INTEGRITY IS MAINTAINED AND SUFFICIENT RCS PROPELLANT IS AVAILABLE. E. THE LM PROPULSION SYSTEMS (DPS OR RCS) MAY BE USED TO PLACE THE CSM IN AN ORBIT ($H_p \geq 80$ NM) FROM WHICH A SM-RCS OR SM-CM/RCS HYBRID DEORBIT CAN BE CONDUCTED. F. UTILIZATION OF BACKUP DEORBIT METHODS WILL BE BASED ON THE FOLLOWING PRIORITIES: 1. SM-RCS 2. LM PROPULSION PLUS SM-RCS (LM PROPULSION FOR ORBIT SHAPING) 3. SM-CM/RCS HYBRID 4. LM PROPULSION PLUS SM-CM/RCS HYBRID G. DEORBIT BURN AND ENTRY MODE PRIORITIES ARE: DEORBIT BURN MODES. 1. G&N 2. SCS AUTO 3. HORIZON MONITOR MANUAL TVC. ENTRY MODES. 1. G&N 2. EMS 3. BRB 4. ROLLING

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MISSION RULES

REV	ITEM		
	2-16	MANEUVER PREPARATION TIME	A. SCS MANEUVER PREPARATION TIME IS: 1. VALID IMU TO INITIALIZE GDC - PAD DATA PLUS 15 MINUTES. 2. VERIFICATION OF GDC REQUIRED - PAD DATA PLUS ONE FULL NIGHT PASS FOR OPTICS CHECK, OR HORIZON CHECK, FOR RETROFIRE. 3. GDC INITIALIZATION WITH OPTICS - PAD DATA PLUS ONE FULL NIGHT PASS. 4. GDC INITIALIZATION WITH HORIZON - PAD DATA PLUS 30 MINUTES. B. AGS MANEUVER PREPARATION TIME IS: 1. VALID IMU TO INITIALIZE AGS - PAD DATA +7 MINUTES. 2. VERIFICATION OF AGS - REQUIRES 20 MIN AND THE FOLLOWING: (A) PAD DATA (B) INITIALIZED ORDEAL (C) LIT HORIZON CHECK AT TIG -5 MIN. 3. AGS INITIALIZATION WITH OPTICS (A) ONE NIGHT PASS AND CREW READOUT OF STARS UTILIZED, AOT ANGLES A_1 AND A_2 AND AOT DETENT FOR BODY AXIS ALIGN. (B) GROUND COMPUTATION OF REQUIRED PAD DATA. (C) PAD DATA +25 MIN. C. CMC AND LGC MANEUVER PREPARATION TIME IS: 1. IMU OFF OR UNKNOWN - ONE FULL NIGHT PASS AFTER IMU WARMUP. 2. IMU KNOWN AND UNACCEPTABLE - COARSE ALIGNMENT TO PREFERRED ALIGNMENT PLUS ONE FULL NIGHT PASS. 3. IMU KNOWN AND ACCEPTABLE - PAD DATA PLUS: (A) 10 MINUTES FOR RENDEZVOUS MANEUVERS. (B) 30 MINUTES FOR ALL OTHER MANEUVERS.
A	2-17	DATA PRIORITY GUIDELINES (CONTINUED)	A. LAUNCH 1. "EARLY STAGING TO ORBIT" SHOULD ONLY INVOLVE THE S-IVB. 2. MANUAL ABORTS WILL BE INITIATED UPON THE RECEIPT OF TWO RELATED ABORT CUES. 3. DATA PASSED TO THE CREW IN THE EVENT OF AN ABORT ARE AS FOLLOWS: (A) MODE II (1) "FULL LIFT" (2) GET 400,000 FT (3) PITCH AT ENTRY (4) BLACKOUT TIMES (B) MODE III (1) LIFT (2) GET OF IGNITION* (3) ΔV OF BURN* (4) ΔT OF BURN* (5) PITCH AT IGNITION* (6) GET 400,000 FT (7) PITCH AT .05G (8) GET OF DROGUE

*OMITTED IF A BURN IS NOT REQUIRED.

REV	ITEM		
A	2-17 (CONTD)	DATA PRIORITY GUIDELINES	(C) MODE IV (1) GET OF IGNITION (2) ΔV OF BURN (3) ΔT OF BURN (4) PITCH ANGLE AT IGNITION (D) APOGEE KICK (1) GET OF IGNITION (2) ΔV OF BURN (3) ΔT OF BURN (4) PITCH ANGLE AT IGNITION B. ORBIT/DEORBIT 1. CSM OR LM BURNS INDEPENDENT OF RENDEZVOUS WILL NOT TRIM RESIDUALS. THE DEORBIT BURN IS AN EXCEPTION AND SHOULD BE TRIMMED TO 0.2 FPS IN ALL AXES. 2. A DESIRED REFSMMAT WILL BE UPDATED PRIOR TO THE DEORBIT BURN. 3. A STATE VECTOR WILL NOMINALLY BE UPLINKED AT ONE HOUR PRIOR TO DEORBIT. C. RENDEZVOUS 1. THE BODY AXIS RESIDUALS, RESULTING FROM LM MANEUVERS, WILL BE TRIMMED AS FOLLOWS: (A) PHASING $\Delta V_X = \pm 2.0$ FPS $\Delta V_Y = \pm 0$ FPS $\Delta V_Z = \pm 0$ FPS (B) ALL OTHER MANEUVERS, EXCEPT TPI, WILL BE TRIMMED TO 0 FPS IN ALL AXES 2. THE BODY AXES RESIDUALS, RESULTING FROM ANY CSM MANEUVERS REQUIRED DURING THE RENDEZVOUS, WILL BE TRIMMED TO 0.2 FPS IN ALL AXES. 3. A "NOMINAL" DESIRED REFSMMAT WILL BE UPLINKED TO THE CSM AND LM PRIOR TO THE RENDEZVOUS. 4. PRIOR TO RENDEZVOUS, THE CMC AND LGC CLOCKS WILL BE "SYNCHRONIZED" AS CLOSE AS POSSIBLE TO GROUND GET. 5. ONLY ONE STATE VECTOR UPDATE IS PLANNED. THIS WILL BE TO BOTH VEHICLES AND WILL OCCUR PRIOR TO THE RCS SEPARATION BURN. 6. FAILURE OF THE LM TO PERFORM CSI OR CDH WILL RESULT IN THE CSM PERFORMING AN EQUAL AND OPPOSITE BURN, BIASED FOR EXECUTION 60 SECONDS LATER (MIRROR IMAGE). IF, HOWEVER, IT IS KNOWN 20 MINUTES PRIOR TO A LM BURN, THAT THE LM CANNOT PERFORM THE REQUIRED MANEUVER, THE CSM WILL BE TARGETED TO EXECUTE THE PROPER ONTIME CSM MANEUVER. 7. IN THE EVENT THE TPI_O MANEUVER MUST BE PERFORMED IT IS DESIRABLE TO DO SO ON THE FIRST TPI_O OPPORTUNITY. 8. AGS ALIGNMENTS AND STATE VECTOR UPDATES (FROM THE PNGCS) ARE TO BE PERFORMED EACH TIME THE PNGS IS DETERMINED TO BE OPERATING PROPERLY. 9. TPI SHOULD ALWAYS BE TARGETED WITH RESPECT TO DARKNESS SUCH THAT BRAKING MAY BE INITIATED AND COMPLETED IN DAYLIGHT. 10. PARTIAL INSERTION BURNS ARE UNACCEPTABLE. INSERTION MUST EITHER BE COMPLETED, OR THE EQUIPERIOD FOOTBALL GEOMETRY MUST BE MAINTAINED. IF $\Delta V_{INS} \leq 20$ FPS THE ΔV CAN BE "BACKED OUT". IF THE ΔV REMAINING IS ≤ 8 FPS THEN RCS MAY BE USED TO COMPLETE THE MANEUVER. ΔVELOCITY ERRORS FALLING BETWEEN THESE LIMITS MAY BE ADDED BY "STAGING" THE DESCENT STAGE AND UTILIZING THE RCS.
		RULES 2-18 THROUGH 2-29 ARE RESERVED.	

REV	ITEM	
A	2-30	ALTERNATE MISSION GUIDELINES

A. MAJOR ACTIVITIES WILL BE SCHEDULED FOR ALTERNATE MISSIONS IN ACCORDANCE WITH THE FOLLOWING PRIORITY:

1. SUFFICIENT LM EVALUATION TO PERMIT RENDEZVOUS ACTIVITY
2. RENDEZVOUS
   - NOMINAL (6 HRS)
   - FOOTBALL (4 1/2 HRS - 2 REVS)
   - FOOTBALL (3 HRS - 1 REV)
3. DOCKED DPS BURN
4. STATION KEEPING
5. UNMANNED APS BURN
6. EVA
7. DOCKED SPS BURNS

B. IF THE SPS FAILS, THE MISSION WILL BE CONTINUED AND ALL DOCKED LM ACTIVITIES, STATION KEEPING AND THE UNMANNED APS BURN WILL BE CONDUCTED.

C. IF THE CSM GNCS FAILS, THE SPS BURNS, DOCKED LM ACTIVITIES, STATION KEEPING AND THE UNMANNED APS BURN WILL BE CONDUCTED.

D. IF THE CSM PRIMARY COOLANT LOOP FAILS, THE LM RENDEZVOUS WILL BE TERMINATED; ALL OTHER ACTIVITIES WILL CONTINUE.

E. IF THE LM DPS FAILS PRIOR TO RENDEZVOUS AN ALTERNATE RENDEZVOUS PLAN WILL BE EXECUTED. ALL OTHER LM AND CSM ACTIVITIES OF THE NOMINAL MISSION WILL BE CONDUCTED WITHIN SYSTEMS CAPABILITIES.

F. IF A LM APS PRESSURIZATION FAILURE IS DETECTED PRIOR TO RENDEZVOUS, THE NOMINAL RENDEZVOUS WILL BE DELETED; HOWEVER, AN ALTERNATE RENDEZVOUS (FOOTBALL) MAY BE CONDUCTED.

G. IF THE LM PGNCS FAILS PRIOR TO RENDEZVOUS ALL DPS AND APS MANEUVERS AND THE RENDEZVOUS WILL BE DELETED. LM-ACTIVE STATION KEEPING MINI-BALL WILL BE CONDUCTED.

H. IN THE EVENT AN ALTERNATE MISSION IS EXECUTED, AS MANY DTO'S WILL BE ACCOMPLISHED AS POSSIBLE. REF TABLE 2-I, PAGE 2-11, FOR MISSION ACTIVITIES DTO POSSIBILITIES.

A

TABLE 2-I.- MISSION ACTIVITY/DTO ACCOMPLISHMENTS

PRIORITY				LAUNCH	CSM/S-IVB LM INACTIVE	UNMANNED LM DOCKED	MANNED LM DOCKED	DOCKED DPS BURN	STATION KEEPING	RENDEZVOUS	APS BURN UNMANNED UNDOCKED	CSM SOLO
1	M13.12	GROUP 1 HIGHEST PRIORITY	DPS BURN DURATION EFFECTS AND PRIMARY PROPULSION/ VEHICLE INTERACTIONS					P		C		
2	M17.17		LM ENVIRONMENTAL AND PROPULSION THERMAL EFFECTS				P	P		P	C	
3	M17.18		LM STRUCTURAL INTEGRITY	P	P[1]			P	P[1]	P[1]	C	
4	M11.6		LM PGNCS/DAP PERFORMANCE AND DPS THRUST PERFORMANCE					P		C		
5	M13.11		LONG DURATION APS BURN								C	
6	M14		LM ECS PERFORMANCE				C					
7	M17.9		LANDING GEAR DEPLOYMENT/THERMAL				P	P	P[1]	C		
8	M15.3		LM EPS PERFORMANCE DETERMINATION			P	P			C		
9	M16.7		LANDING RADAR/STRUCTURE/PLUME					P	P	C		
10	P12.4	GROUP 2 HIGH PRIORITY	AGS ΔV CAPABILITY USING DPS							C		
11	P11.14		PGNCS CONTROLLED APS BURN								C	
12	P11.7		PGNCS ATTITUDE/TRANSLATION CONTROL							C		
13	P20.22		LM/CSM/MSFN/EVA S-BAND/VHF COMPATIBILITY				P			C		
14	P12.3		AGS/CES ATTITUDE/TRANSLATION CONTROL						P	C		
15	P1.23		CSM AUTOPILOT STABILITY MARGIN			C						
16	P20.28		LM ACTIVE DOCKING							C		
17	P20.25		LM EJECTION FROM SLA			P	P[1]		P[1]	C		
18	P20.24		CSM ACTIVE DOCKING		C							
19	P20.26		LM/CSM UNDOCKING						C			
20	P11.10		PGNCS AND GNCS IMU PERFORMANCE	P		P	P	P		P	P	C
21	P2.9		GNCS/MTVC TAKEOVER									
22	P16.4		RENDEZVOUS RADAR TRACKING PERFORMANCE							C		
23	P20.21		LM/MSFN S-BAND COMMUNICATION PERFORMANCE				C					
24	P20.34	GROUP 3 LOW PRIORITY	INTRAVEHICULAR CREW TRANSFER			P	C					
25	P12.2		AGS INFLIGHT CALIBRATION AND PERFORMANCE				P	P		C		
26	P11.5		LM IMU INFLIGHT ALIGNMENT				P		P	C		
27	P20.29		LM JETTISON								C	
28	P16.19		RENDEZVOUS RADAR/RCS PLUME IMPINGEMENT/CORONA EFFECT							P		
29	P20.31		SUPPORT FACILITIES PERFORMANCE	P	P	P	P	P	P	P	P	C
30	P1.25		IMU ORIENTATION DETERMINATION/VISIBILITY			P						C
31	P1.24		CSM IMU ALIGNMENT ACCURACY			P	C					
32	P20.33		CSM SINGLE CREWMAN RENDEZVOUS CAPABILITY							C		
33	P16.6		LANDING RADAR SELF TEST				P		P	C		
34	S7.29	GROUP 4 LOWEST PRIORITY	EXHAUST EFFECTS/CSM		P	P	P			C[1]		
35	S20.32		CREW ACTIVITIES EVALUATION (CSM/LM)	P	P	P	P	P	P	P	P	C
36	S1.26		ORBITAL NAVIGATION/LANDMARK TRACKING			P						C
37	S13.10		APS BURN TO DEPLETION								C	
38	S20.37		DPS PLUME EFFECT					P		C		
39	S20.120		CSM/LM ELECTROMAGNETIC COMPATIBILITY				P				C	

P = PARTIALLY COMPLETE
C = COMPLETED

[1]CSM ECS/EPS RADIATOR HEAT REJECTION
[2]DOCKED SPS
[3]BEFORE AND AFTER DPS BURN
[4]IF STAGED

REV	ITEM
A	2-31

ALTERNATE MISSION DESCRIPTIONS

ALL OR PARTS OF THE FOLLOWING ALTERNATE MISSIONS MAY BE COMPLETED DEPENDING UPON THE ANOMALY, WHEN THE ANOMALY OCCURS AND/OR THE LIFETIME REMAINING. EXCEPTIONS TO AN ALTERNATE MISSION WILL BE INCLUDED IN THE RULING COLUMN OF THE SPECIFIC MISSION RULE. IN APPLICABLE CASES, THE NOMINAL S-IVB ACTIVITIES WILL BE CONTINUED IF NOT IN VIOLATION OF SPECIFIC MISSION RULES.

DETAILED TIMELINES OF THE FOLLOWING ALTERNATE MISSIONS LISTED BELOW CAN BE LOCATED IN THE APOLLO 9 SPACECRAFT OPERATIONAL ALTERNATE MISSION PLAN MSC INTERNAL NOTE NO. 69-FM-3.

NOMINAL MISSION PERIOD OF ENTRY		TYPICAL FUNCTIONAL FAILURE PRECIPITATING ALTERNATE MISSION
	ALTERNATE MISSION A	
1	COI SPS 1	NO LM
1 OR 2	SPS 2 SPS 3 SPS 4	
3	SPS 5	
6	SPS 6 SPS 7 SPS 8	
	ALTERNATE MISSION B	
1	TD&E	CSM LIFETIME, NO SPS LM LIFETIME
2 OR 3	LM SYSTEMS EVALUATION EXECUTE DOCKED DPS BURN	
3 OR 4	PERFORM EVA	
4 OR 5	STATION KEEPING (STAGE LM PRIOR TO DOCKING)	
4 OR 5	LONG APS BURN	
5 OR 6	DEORBIT	
	ALTERNATE MISSION C	
3 OR 4	PERFORM EVA LONG APS BURN CONTINUE MISSION	UNSAFE DESCENT STAGE (DESCENT STAGE SEPARATED PRIOR TO ALTERNATE MISSION). EVT GREATER THAN 15 MINUTES.
	ALTERNATE MISSION D	
1	TD&E	CSM LIFETIME, LM LIFETIME, EITHER CSM COOLANT LOOP FAILURE
2 OR 3	LM SYSTEMS EVALUATION EXECUTE DOCKED DPS BURN	
3 - 5	STAGE DESCENT STAGE LONG APS BURN	
3 - 6	DEORBIT	

REV	ITEM	NOMINAL MISSION PERIOD OF ENTRY		TYPICAL FUNCTIONAL FAILURE PRECIPITATING ALTERNATE MISSION
A	2-31 (CONT'D)		ALTERNATE MISSION E	
		5	E-5A STATION KEEPING. CONTINUE NOMINAL MISSION TIMELINE	UNSAFE DESCENT STAGE DPS FAILURE, LM PRIMARY COOLANT LOOP FAILURE, DESCENT OR ASCENT STAGE ELECTRICAL POWER PROBLEMS. PGNCS FAILURE, RENDEZVOUS RADAR FAILURE. AGS LOST.
			E-5B MINI-FOOTBALL RENDEZVOUS. CONTINUE NOMINAL MISSION TIMELINE	
			E-5C FOOTBALL RENDEZVOUS. CONTINUE NOMINAL MISSION TIMELINE	
			E-5D CSM ACTIVE RENDEZVOUS. CONTINUE NOMINAL MISSION TIMELINE	
			ALTERNATE MISSION F	
		3	DELETE DOCKED DPS BURN PERFORM SPS 5	PGNCS FAILURE
		4	PERFORM EVA	
		5	STATION KEEP, STAGE LM AND DOCK. EXECUTE CSM ACTIVE RENDEZVOUS (E-5D) DELETE LONG DURATION APS BURN CONTINUE MISSION	
			ALTERNATE MISSION G	
		3	DELETE DOCKED DPS BURN	LM PRIMARY COOLANT LOOP FAILURE OR DPS NON-OPERABLE
		4	PERFORM EVA	
		5	STATION KEEPING (E-5A) LONG APS BURN CONTINUE MISSION	

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MISSION RULES

REV	ITEM	
A	2-32	LIFETIME CASES

CASE	SUMMARY PLAN
1. MISSION MUST BE TERMINATED IN 6 - 4.	1. COMPLETE TD&E IF POSSIBLE. CONTINUE S-IVB ACTIVITIES.
2. MISSION MUST BE TERMINATED IN 18 - 1.	2. COMPLETE TD&E IF POSSIBLE. CONTINUE S-IVB ACTIVITIES PLUS FIRST DOCKED SPS BURN, LM POWER UP AND FINAL SEPARATION.
3. SPACECRAFT PROBLEM DETECTED WHICH WILL CAUSE MISSION TO BE TERMINATED AT END OF SECOND DAY.	3. PERFORM LM CHECKOUT, DOCKED DPS BURN AND UNMANNED APS BURN. DELETE DOCKED SPS BURNS.
4. MISSION MUST BE TERMINATED AT END OF THIRD DAY.	4. PERFORM LM CHECKOUT, DOCKED DPS BURN, LM SEPARATION AND ALTERNATE RENDEZVOUS, STAGING AND UNMANNED APS BURN. DELETE DOCKED SPS BURNS UNLESS ALREADY PERFORMED.
5. MISSION MUST BE TERMINATED AT END OF FOURTH DAY.	5. PERFORM SPS BURNS TO SET UP ALTERNATE RENDEZVOUS, LM CHECKOUT AND DOCKED SPS BURN, LM RENDEZVOUS AND UNMANNED APS BURN.
6. MISSION MUST BE TERMINATED AT END OF FIFTH DAY.	6. PERFORM NOMINAL LM ACTIVITIES.
7. REDUCED LM ASCENT OR DESCENT STAGE LIFETIME.	7. PERFORM AS MUCH AS POSSIBLE, IN THE FOLLOWING ORDER OF PRIORITY: (1) LM CHECKOUT (2) RENDEZVOUS (3) DOCKED DPS BURN (4) STATION KEEPING (5) UNMANNED APS BURN (6) EVA.

RULE NUMBERS 2-33 THROUGH 2-39 ARE RESERVED.

3 MISSION RULE SUMMARY

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MISSION RULES

REV	ITEM	GO/NO-GO SUMMARY
A	3-1	A FORMAL GO/NO-GO WILL BE GIVEN FOR THE CSM AT EACH DAILY PTP. REFERENCE MISSION RULES 3-20 THROUGH 3-41 FOR CONSUMABLE RULES AND TABLE 3-I, PAGE 3-21A, FOR GO/NO-GO SUMMARY.
	3-2	THE LAUNCH PHASE WILL BE ABORTED FOR: A. S-IC LOSS OF THRUST B. LAUNCH VEHICLE INERTIAL PLATFORM FAILURE C. S-II GIMBAL SYSTEM FAILURE - ACTUATOR HARDOVER INBOARD (PRIOR TO S-IVB TO ORBIT CAPABILITY) D. S-II TOTAL LOSS OF THRUST (PRIOR TO S-IVB TO ORBIT CAPABILITY) E. S-II SECOND PLANE SEPARATION FAILS TO OCCUR F. S-IVB LOSS OF HYDRAULIC FLUID (PRIOR TO S-IVB IGNITION) G. S-IVB FAILURE TO ATTAIN THRUST H. VIOLATION OF EDS LIMITS (AUTO/MANUAL) I. VIOLATION OF TRAJECTORY LIMIT LINES J. FIRE/SMOKE IN CM K. MALFUNCTION OF: 1. LOSS OF BOTH CM-RCS SYSTEMS DURING MODE I 2. CABIN AND SUIT PRESSURE 3. CABIN PRESSURE AND O_2 MANIFOLD LEAKS 4. THREE FUEL CELLS AND 1 BATTERY 5. UNCONTROLLABLE SHORTED MAIN BUS 6. BOTH AC BUSES DURING MODE I OR MODE III L. TEAM DISCRETION WILL BE USED FOR: 1. SUIT/CABIN CONTAMINATION 2. MEDICAL PROBLEMS
A	3-3	<u>POST INSERTION GO/NO-GO</u> A. THE S-IVB WILL BE <u>NO-GO</u> AFTER INSERTION OR DURING ORBIT IF ANY OF THE FOLLOWING CONDITIONS EXIST: 1. IMPENDING S-IVB BULKHEAD ΔP PROBLEM 2. S-IVB COLD HE SHUTOFF VALVES FAIL TO CLOSE 3. S-IVB RANGE SAFETY DESTRUCT SYSTEM ARMED 4. S-IVB IN WRONG TIME BASE 5. LOSS OF ATTITUDE CONTROL B. THE CSM WILL BE <u>NO-GO</u> IF ANY OF THE FOLLOWING CONDITIONS EXIST: 1. ECS (A) LOSS OF CABIN AND SUIT INTEGRITY.

FEC/TSS Form 292 (AUG 68)

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MISSION RULES

REV	ITEM
A	3-4

CONTINUE PAST 2-1 GO/NO-GO'S

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS

   (A) LOSS OF CABIN INTEGRITY AND LOSS OF SUIT INTEGRITY, LOSS OF SUIT LOOP INTEGRITY, LOSS OF O_2 MANIFOLD, OR LOSS OF ENTRY O_2 SUPPLIES.

   (B) LOSS OF ALL COOLING

2. CRYO

   (A) LOSS OF BOTH H_2 OR BOTH O_2 CRYOGENIC STORAGE TANKS

3. EPS

   (A) LOSS OF THREE FUEL CELLS

   (B) LOSS OF TWO ENTRY BATTERIES

   (C) LOSS OF BOTH AC BUSES

4. SPS

   (A) SUSTAINED PRESSURE DECAY IN FUEL OR OXIDIZER TANKS

5. CM-RCS

   (A) LOSS OF BOTH CM-RCS RINGS

6. UNSATISFACTORY CREW CONDITION

7. PERIGEE <75 NM

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MISSION RULES

REV	ITEM
A	3-5

TD&E GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF SUIT INTEGRITY
   - (F) LOSS OF ALL COOLING
   - (G) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)

3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS

4. COMM/INSTRUMENTATION
   - (A) LOSS OF INSTRUMENTATION (TM OR ONBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.

5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B

6. G&C
   - (A) LOSS OF TRANSLATION CAPABILITY (X-AXIS)
   - (B) LOSS OF DIRECT RCS (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS

7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE AND:
     - (1) LOSS OF CAPABILITY TO PERFORM CRITICAL MANEUVERS
     - (2) ΔV REMAINING LESS THAN SPS DEORBIT REQUIREMENT

8. SM-RCS
   - (A) LOSS OF TWO QUADS
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT.

9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

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MISSION RULES

REV	ITEM	
A	3-6	CONTINUE MISSION PAST 6-4 AND DAILY PTP GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) POTABLE WATER TANK QUANTITY PLUS FUEL CELL PRODUCTION TO THE NEXT PTP WILL TOTAL <20 LBS
   - (G)
   - (H) LOSS OF URINE DUMP CAPABILITY FOR PTP'S SUBSEQUENT TO LM JETTISON
   - (I) LOSS OF ALL COOLING
   - (J) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT
2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)
3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS
4. COMM/INSTRUMENTATION
   - (A) LOSS OF INSTRUMENTATION (TM OR ONBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION AFTER LM JETTISON (CSM/MSFN)
5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B
6. G&C
   - (A) LOSS OF DIRECT RCS (ANY AXIS)
   - (B) LOSS OF RATE DAMPING (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS
7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE AND:
     - (1) LOSS OF CAPABILITY TO PERFORM CRITICAL MANEUVERS
     - (2) ΔV REMAINING LESS THAN SPS DEORBIT REQUIREMENT
8. SM-RCS
   - (A) LOSS OF TWO QUADS
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT.
9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED
10. UNSATISFACTORY CREW CONDITION
11. TWO METHODS OF DEORBIT ARE AVAILABLE
12. A SUBSEQUENT SINGLE FAILURE WOULD NOT REQUIRE ENTRY IN ONE REV OR LESS.

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MISSION RULES

REV	ITEM
A	3-7

NON-CRITICAL SPS MANEUVER GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF SUIT INTEGRITY (FOR DOCKED SPS BURNS)
   - (G) LOSS OF ALL COOLING
   - (H) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)

3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS

4. COMM/INSTRUMENTATION
   - (A) LOSS OF INSTRUMENTATION (TM OR ONBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)

5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B

6. G&C
   - (A) LOSS OF TWO TVC SERVO LOOPS
   - (B) LOSS OF THREE TVC CONTROL MODES (G&N, SCS AUTO, AND MTVC RATE CMD)

7. SPS
   - (A) LOSS OF BOTH GN_2 BOTTLES (<400 PSI)
   - (B) FUEL OR OXIDIZER FEEDLINE TEMP <27°F
   - (C) FLANGE TEMP >480°F ON PREVIOUS BURN
   - (D) CHAMBER PRESSURE <70 PSI ON PREVIOUS BURN
   - (E) FUEL/OXIDIZER ΔP >20 PSI
   - (F) LOSS OF ULLAGE CAPABILITY FOR FIRST BURN SUBSEQUENT TO DOCKED DPS BURN, OR AFTER STORAGE TANKS EMPTY
   - (G) FIRST BURN SUBSEQUENT TO DOCKED DPS WAS <40 SEC, CONTINUOUS
   - (H) PRESSURE IN EITHER FUEL OR OXIDIZER TANK <140 PSI
   - (I) ΔV REMAINING LESS THAN MANEUVER PLUS DEORBIT REQUIREMENT

B. THE NON-CRITICAL DOCKED SPS BURNS WILL BE NO-GO IF THE FOLLOWING INTERFACE CONDITION EXISTS:

1. DOCKING SYSTEM
   - (A) LESS THAN NINE GOOD DOCKING RING LATCHES

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MISSION RULES

REV	ITEM	
A	3-8	CRITICAL SPS MANEUVER GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. G&C
   - (A) LOSS OF TWO TVC SERVO LOOPS
   - (B) LOSS OF THREE TVC CONTROL MODES (G&N, SCS AUTO, AND MTVC - RATE CMD)
2. SPS
   - (A) PRESSURE IN EITHER FUEL OR OXIDIZER TANK <115 PSI
   - (B) LOSS OF BOTH GN_2 BOTTLES (<400 PSI)
   - (C) FUEL OR OXIDIZER FEEDLINE TEMP <27°F
   - (D) FLANGE TEMP >480°F ON PREVIOUS BURN
   - (E) CHAMBER PRESSURE <70 PSI ON PREVIOUS BURN
   - (F) FUEL/OXIDIZER ΔP >20 PSI
   - (G) FIRST BURN SUBSEQUENT TO DOCKED DPS WAS <40 SEC

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MISSION RULES

REV	ITEM	
A	3-9	IVT (CSM TO LM) GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF SUIT INTEGRITY
   - (G) LOSS OF ALL COOLING
   - (H) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT
2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)
3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS
4. COMM/INSTRUMENTATION
   - (A) LOSS OF INSTRUMENTATION (TM OR ONBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO FOR CRITERIA EITHER IN S/C OR ON GROUND.
5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B
6. G&C
   - (A) LOSS OF DIRECT RCS (ANY AXIS)
   - (B) LOSS OF RATE DAMPING (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS
7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE AND:
     - (1) LOSS OF CAPABILITY TO PERFORM CRITICAL MANEUVERS
     - (2) ΔV REMAINING LESS THAN SPS DEORBIT REQUIREMENT
8. SM-RCS
   - (A) LOSS OF TWO QUADS
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT.
9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

B. THE IVT FROM THE CSM TO THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING INTERFACE CONDITIONS EXIST:

1. DOCKING SYSTEM
   - (A) LESS THAN THREE GOOD DOCKING RING LATCHES 120 DEGREES APART
   - (B) FAILURE OF CSM FORWARD HATCH PRIMARY LOCK/UNLOCK MECHANISM

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MISSION RULES

REV	ITEM	
A	3-10	DOCKED DPS BURN GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF SUIT INTEGRITY
   - (G) LOSS OF ALL COOLING
   - (H) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT
2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)
3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS
4. COMM/INSTRUMENTATION
   - (A) LOSS OF INSTRUMENTATION (TM OR ONBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)
5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B
6. G&C
   - (A) LOSS OF DIRECT RCS (ANY AXIS)
   - (B) LOSS OF RATE DAMPING (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS
7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE AND:
     - (1) LOSS OF CAPABILITY TO PERFORM CRITICAL MANEUVERS
     - (2) ΔV REMAINING LESS THAN SPS DEORBIT REQUIREMENT
8. SM-RCS
   - (A) LOSS OF TWO QUADS
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT
9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

B. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. SEQUENTIAL AND PYRO
   - (A) LOSS OF BOTH PYRO SYSTEMS A AND B

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MISSION RULES

REV	ITEM
A	3-10 (CONT'D)

2. EPS
   - (A) LOSS OF EITHER CDR OR LM BUS
   - (B) LOSS OF THREE OR MORE DESCENT BATTERIES
   - (C) LOSS OF TWO OR MORE DESCENT BATTERIES IF EITHER ASCENT BATTERY IS LOST
   - (D) LOSS OF BOTH ASCENT BATTERIES
   - (E) LOSS OF BOTH INVERTERS 1 AND 2
   - (F) LOSS OF AC BUS A
   - (G) LOSS OF INTEGRAL AND FLOOD LIGHTS

3. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT LOOP INTEGRITY
   - (C) LOSS OF BOTH SUIT FANS
   - (D) LOSS OF BOTH DEMAND REGULATORS
   - (E) LOSS OF BOTH PRIMARY AND SECONDARY COOLANT LOOPS
   - (F) LOSS OF ALL O_2 TANKS
   - (G) LOSS OF ALL H_2O TANKS

4. COMMUNICATIONS/INSTRUMENTATION
   - (A) LOSS OF CRITICAL ONBOARD DISPLAYS
   - (B) LOSS OF ALL VHF COMMUNICATIONS

5. GUIDANCE AND CONTROL
   - (A) LOSS OF PGNS AND MANUAL AGS TTCA ATTITUDE CONTROL CAPABILITY
   - (B) LOSS OF DPS GIMBAL TRIM CONTROL
   - (C)
   - (D) LOSS OF +X ULLAGE CAPABILITY
   - (E) LOSS OF DPS ENG ON/OFF CAPABILITY
   - (F) LOSS OF OPERATIONAL THROTTLE CONTROL

6. DPS
   - (A) PROPELLANT LEAK
   - (B) LOSS OF OPERATIONAL DPS

7. APS
   - (A) PROPELLANT LEAK

8. RCS
   - (A) RCS +X ULLAGE CAPABILITY
   - (B) THREE AXIS ATTITUDE CONTROL
   - (C) PROPELLANT LEAKS

C. THE DOCKED DPS BURN WILL BE NO-GO IF ANY OF THE FOLLOWING INTERFACE CONDITIONS EXIST:

1. DOCKING SYSTEM
   - (A) LESS THAN NINE GOOD DOCKING RING LATCHES
   - (B) FAILURE OF CSM FORWARD HATCH PRIMARY LOCK/UNLOCK MECHANISM.
   - (C) FAILURE OF LM DEMAND REGULATORS TO MAINTAIN CABIN PRESSURE $\geq$ (TBD) PSIA

2. COMMUNICATIONS
   - (A) LOSS OF TWO-WAY VHF VOICE COMMUNICATIONS BETWEEN CSM AND LM
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATIONS BETWEEN MSFN AND BOTH CSM AND LM
   - (C) LOSS OF CRITICAL ONBOARD DISPLAYS

D. THE DOCKED DPS BURN WILL BE NO-GO IF ANY OF THE FOLLOWING EMU CONDITIONS EXIST:

1. OPS CHECKOUT
   - (A) OPS SOURCE PRESSURE < 5380 PSIA
   - (B) OPS REG PRESSURE >4.0 PSID OR <3.4 PSID AT 0.3 LBS/HR
   - (C) LOSS OF ILLUMINATION OF BOTH GREEN HEATER STATUS LIGHTS

2. PLSS POS PRESSURE <850 PSIA

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MISSION RULES

REV	ITEM
A	3-11

EVA GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D) LOSS OF SURGE TANK OR REPRESS PACK
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF SUIT INTEGRITY
   - (G) LOSS OF ALL COOLING
   - (H) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT
2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)
3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS
4. COMM/INSTRUMENTATION
   - (A) LOSS OF INSTRUMENTATION (TM OR ONBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)
   - (C) LOSS OF TWO-WAY VOICE COMMUNICATIONS (CSM/LM)
5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B
6. G&C
   - (A) LOSS OF DIRECT RCS (ANY AXIS)
   - (B) LOSS OF RATE DAMPING (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS
7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE AND:
     - (1) LOSS OF CAPABILITY TO PERFORM CRITICAL MANEUVERS
     - (2) ΔV REMAINING LESS THAN SPS DEORBIT REQUIREMENT
8. SM-RCS
   - (A) LOSS OF TWO QUADS
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT
   - (D) LEAK IN ANY FUEL OR OXIDIZER TANK
9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

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MISSION RULES

REV	ITEM
A	3-11 (CONT'D)

B. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. EPS

(A) LOSS OF EITHER CDR OR LMP BUS
(B) LOSS OF THREE OR MORE DESCENT BATTERIES
(C) LOSS OF TWO OR MORE DESCENT BATTERIES IF EITHER ASCENT BATTERY IS LOST
(D) LOSS OF BOTH ASCENT BATTERIES
(E) LOSS OF INTEGRAL AND FLOOD LIGHTS

2. ECS

(A) LOSS OF CABIN INTEGRITY
(B) LOSS OF SUIT LOOP INTEGRITY
(C) LOSS OF BOTH SUIT FANS
(D) LOSS OF BOTH DEMAND REGULATORS
(E) LOSS OF PRIMARY AND SECONDARY COOLANT LOOPS
(F) LOSS OF DESCENT O_2 TANK
(G) LOSS OF BOTH ASCENT TANKS
(H) LOSS OF ALL H_2O TANKS

3. COMMUNICATIONS/INSTRUMENTATION

(A) LOSS OF CRITICAL ONBOARD DISPLAYS
(B) LOSS OF VHF DUPLEX CAPABILITY

4. PROPULSION (APS/DPS)

(A) PROPELLANT LEAKS
(B) IMPENDING DPS PROPELLANT VENTING

5. RCS

(A) PROPELLANT LEAK

C. THE EVA WILL BE NO-GO IF ANY OF THE FOLLOWING INTERFACE CONDITIONS EXIST:

1. ECS

(A) FAILURE OF CM OR LM TO MAINTAIN SEPARATE PRESSURE INTEGIRTY
(B) FAILURE OF LM DEMAND REGULATORS TO MAINTAIN CABIN PRESSURE ≥ (TBD) PSIA

2. COMMUNICATIONS

(A) LOSS OF TWO-WAY VHF VOICE COMMUNICATIONS BETWEEN THREE CREWMAN (CONFERENCE)
(B) LOSS OF TWO-WAY VOICE BETWEEN MCC AND BOTH CMP AND CDR
(C)

D. THE EVA WILL BE NO-GO IF ANY OF THE FOLLOWING EMU CONDITIONS EXIST:

1. OPS CHECKOUT

(A) OPS SOURCE PRESSURE <5380 PSIA
(B) OPS REG PRESSURE >4.0 PSID OR <3.4 PSID AT 0.3 LBS/HR
(C) LOSS OF ILLUMINATION OF BOTH GREEN HEATER STATUS LIGHTS

2. PGA/PLSS CHECKOUT

(A) POS <850 PSIA
(B) PGA PRESSURE >4.0 PSID OR <3.7 PSID, OR EMU PRESSURE DECAY >0.40 PSID/MIN
(C) BAT VOLTAGE <16 VDC
(D) FAILURE TO ACTIVATE PUMP OR FAN
(E) PGA PRESSURE <4.3 PSID DURING LM CABIN DEPRESS
(F) LOSS OF CRITICAL INSTRUMENTATION

3. SUBLIMATOR CHECKOUT

INADEQUATE LCG/LTV COOLING

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MISSION RULES

REV	ITEM
A	3-12

CSM/LM UNDOCKING GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF SUIT INTEGRITY
   - (G) LOSS OF ALL COOLING
   - (H) POTABLE WATER TANK QUANTITY PLUS FUEL CELL PRODUCTION TO THE COMPLETION OF RENDEZVOUS WILL TOTAL <10 LBS
   - (I)
   - (J) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT.
2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)
3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS
4. COMM/INSTRUMENTATION
   - (A) LOSS OF INSTRUMENTATION (TM OR ONBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)
   - (C) LOSS OF TWO-WAY VOICE COMMUNICATIONS (CSM/LM)
5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B
6. G&C
   - (A) LOSS OF TRANSLATION CAPABILITY (X-AXIS)
   - (B) LOSS OF DIRECT RCS (ANY AXIS)
   - (C) LOSS OF RATE DAMPING (ANY AXIS)
   - (D) LOSS OF TWO DEORBIT METHODS
7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE AND:
     - (1) LOSS OF CAPABILITY TO PERFORM CRITICAL MANEUVERS
     - (2) ΔV REMAINING LESS THAN SPS DEORBIT REQUIREMENT
8. SM-RCS
   - (A) LOSS OF TWO QUADS
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT
9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

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MISSION RULES

REV	ITEM	
A	3-12 (CONT'D)	B. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. EPS

   (A) LOSS OF EITHER CDR OR LM BUS
   (B) LOSS OF THREE OR MORE DESCENT BATTERIES
   (C) LOSS OF TWO OR MORE DESCENT BATTERIES IF EITHER ASCENT BATTERY IS LOST
   (D) LOSS OF BOTH ASCENT BATTERIES

2. ECS

   (A) LOSS OF CABIN PRESSURE INTEGRITY
   (B) LOSS OF SUIT CIRCUIT INTEGRITY
   (C) LOSS OF BOTH SUIT FANS
   (D) LOSS OF BOTH DEMAND REGULATORS
   (E) LOSS OF PRIMARY AND SECONDARY COOLANT LOOPS
   (F) LOSS OF TWO OR MORE O_2 TANKS
   (G) LOSS OF ALL H_2O TANKS

3. COMMUNICATIONS/INSTRUMENTATION

   (A) LOSS OF CRITICAL ONBOARD DISPLAYS

4. GUIDANCE AND CONTROL

   (A) LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL
   (B) LOSS OF 3-AXIS TRANSLATION CAPABILITY

5. DPS

   (A) PROPELLANT LEAKS

6. APS

   (A) PROPELLANT LEAKS

7. RCS

   (A) REDUNDANT 3-AXIS ATTITUDE CONTROL
   (B) 3-AXIS TRANSLATION CONTROL
   (C) PROPELLANT LEAK

C. THE CSM/LM UNDOCKING WILL BE NO-GO IF ANY OF THE FOLLOWING INTERFACE CONDITIONS EXIST:

1. DOCKING SYSTEM

   (A) THREE DOCKING RETRACT SQUIBS HAVE FIRED OR MISFIRED.
   (B) FAILURE TO REINSTALL OR CLOSE DOCKING PROBE, DROGUE, LM UPPER HATCH

2. COMMUNICATION

   (A) LOSS OF TWO-WAY VOICE COMMUNICATION BETWEEN CSM AND LM
   (B) LOSS OF MSFN VOICE COMMUNICATION WITH EITHER CSM OR LM

D. THE CSM/LM UNDOCKING WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. LOSS OF TWO OR MORE EVA LIFE SUPPORT UNITS

   (A) OPS O_2 SOURCE PRESSURE <5380 PSIA
   (B) OPS REG PRESSURE >4.0 PSID OR <3.4 PSID AT 0.3 LBS/HR
   (C) LOSS OF ILLUMINATION OF BOTH GREEN HEATER STATUS LIGHTS
   (D) PLSS POS PRESSURE <850 PSIA
   (E) PLSS POS PRESSURE <400 PSIA POST EVA (INITIAL CHECKOUT LEAK RATE <0.4 PSIA PER MIN)

2. EVT HAS BEEN ATTEMPTED AND NOT COMPLETED SATISFACTORILY WITHIN THE OPS LIFETIME.

ITEM	
3-13	SEPARATION MANEUVER GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF PRIMARY GLYCOL LOOP COOLING
   - (G) POTABLE WATER TANK QUANTITY PLUS FUEL CELL PRODUCTION TO THE COMPLETION OF RENDEZVOUS WILL TOTAL <10 LBS
   - (H)
   - (I) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT
2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS 2 REVS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)
3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES, OR LOSS OF ONE ENTRY BATTERY AND THE BATTERY CHARGER
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS
4. COMM/INSTRUMENTATION
   - (A) LOSS OF TELEMETRY SUCH THAT IS IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)
   - (C) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/LM)
5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B
6. G&C
   - (A) LOSS OF DIRECT RCS (ANY AXIS)
   - (B) LOSS OF RATE DAMPING (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS
   - (D) LOSS OF CAPABILITY TO PERFORM CRITICAL SPS MANEUVER
   - (E) LOSS OF IMU, CMC, BOTH DSKY'S, OPTICS, OR BOTH FDAI'S
   - (F) LOSS OF TRANSLATION CAPABILITY (ANY AXIS)
7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE AND:
     - (1) LOSS OF CAPABILITY TO PERFORM CRITICAL MANEUVERS
     - (2) ΔV REMAINING LESS THAN SPS DEORBIT REQUIREMENT
8. SM-RCS
   - (A) LOSS OF ONE QUAD
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT.
9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

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MISSION RULES

REV	ITEM	
	3-13 (CONT'D)	B. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. EPS
   - (A) LOSS OF EITHER CDR OR LMP BUS
   - (B) LOSS OF THREE OR MORE DESCENT BATTERIES
   - (C) LOSS OF TWO OR MORE DESCENT BATTERIES IF EITHER ASCENT BATTERY LOST
   - (D) LOSS OF BOTH ASCENT BATTERIES
   - (E) LOSS OF BOTH INVERTERS
   - (F) LOSS OF AC BUS A
2. ECS
   - (A) LOSS OF CABIN PRESSURE INTEGRITY
   - (B) LOSS OF SUIT LOOP INTEGRITY
   - (C) LOSS OF BOTH SUIT FANS
   - (D) LOSS OF BOTH DEMAND REGULATORS
   - (E) LOSS OF EITHER PRIMARY OR SECONDARY COOLANT LOOP
   - (F) LOSS OF PRIMARY H_2O FEEDPATH CAPABILITY
   - (G) LOSS OF ALL H_2O TANKS
   - (H) LOSS OF TWO OR MORE O_2 TANKS
3. COMMUNICATIONS/INSTRUMENTATION
   - (A) LOSS OF ONBOARD CRITICAL DISPLAYS
4. GUIDANCE AND CONTROL
   - (A) LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL
   - (B) LOSS OF PGNS
   - (C) LOSS OF 3-AXIS TRANSLATION CAPABILITY
   - (D) LOSS OF BOTH FDAI'S
   - (E) LOSS OF DSKY
5. DPS
   - (A) NO PROPELLANT LEAKS
6. APS
   - (A) NO PROPELLANT LEAKS
7. RCS
   - (A) 3-AXIS TRANSLATION CONTROL
   - (B) REDUNDANT 3-AXIS ATTITUDE CONTROL

C. THE SEPARATION MANEUVER WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. COMMUNICATIONS
   - (A) LOSS OF TWO-WAY VOICE COMMUNICATION BETWEEN VEHICLES WITH BACKUP
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATIONS BETWEEN MSFN AND EITHER CSM OR LM
   - (C) LOSS OF LM TELEMETRY OR CSM TELEMETRY

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MISSION RULES

REV	ITEM	
A	3-14	PHASING MANEUVER GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF PRIMARY GLYCOL LOOP COOLING
   - (G) POTABLE WATER TANK QUANTITY PLUS FUEL CELL PRODUCTION TO THE COMPLETION OF RENDEZVOUS WILL TOTAL <10 LBS
   - (H)
   - (I) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS 2 REVS (DRIFITING FLIGHT PLUS GUIDED ENTRY MANEUVER)

3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES, OR LOSS OF ONE ENTRY BATTERY AND THE BATTERY CHARGER
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS

4. COMM/INSTRUMENTATION
   - (A) LOSS OF TELEMETRY SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)
   - (C) LOSS OF TWO-WAY VOICE COMMUNICATIONS (CSM/LM)
   - (D) LOSS OF RR TRANSPONDER

5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B

6. G&C
   - (A) LOSS OF DIRECT RCS (ANY AXIS)
   - (B) LOSS OF RATE DAMPING (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS
   - (D) LOSS OF CAPABILITY TO PERFORM CRITICAL SPS MANEUVER
   - (E) LOSS OF IMU, CMC, BOTH DSKY'S, OPTICS OR BOTH FDAI'S
   - (F) LOSS OF TRANSLATION CAPABILITY (ANY AXIS)

7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) LOSS OF CAPABILITY TO PERFORM NON-CRITICAL MANEUVER

8. SM-RCS
   - (A) LOSS OF ONE QUAD
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT.

9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

REV	ITEM	
A	3-14 (CONT'D)	B. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. SEQUENTIAL AND PYROTECHNICS
   - (A) LOSS OF EITHER PYRO SYSTEM A OR B
2. EPS
   - (A) LOSS OF EITHER CDR OR LMP BUS
   - (B) LOSS OF THREE OR MORE DESCENT BATTERIES
   - (C) LOSS OF TWO OR MORE DESCENT BATTERIES IF EITHER ASCENT BATTERY LOST
   - (D) LOSS OF BOTH ASCENT BATTERIES
   - (E) LOSS OF BOTH INVERTERS
   - (F) LOSS OF AC BUS A
3. ECS
   - (A) LOSS OF CABIN PRESSURE INTEGRITY
   - (B) LOSS OF SUIT LOOP INTEGRITY
   - (C) LOSS OF BOTH SUIT FANS
   - (D) LOSS OF BOTH H_2O SEPARATORS
   - (E) LOSS OF BOTH DEMAND REGULATORS
   - (F) LOSS OF EITHER PRIMARY OR SECONDARY COOLANT LOOPS
   - (G) LOSS OF PRIMARY H_2O FEEDPATH CAPABILITY
   - (H) LOSS OF TWO OR MORE O_2 TANKS
   - (I) LOSS OF ALL H_2O TANKS
4. COMMUNICATIONS/INSTRUMENTATION
   - (A) LOSS OF CRITICAL ONBOARD DISPLAYS
5. GUIDANCE AND CONTROL
   - (A) LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL
   - (B) LOSS OF PGNS
   - (C) LOSS OF 3-AXIS TRANSLATION CAPABILITY
   - (D) LOSS OF RR/TRANSPONDER
   - (E) LOSS OF BOTH FDAI'S
   - (F) LOSS OF DSKY
   - (G) LOSS OF ENG ON/OFF CAPABILITY
   - (H) LOSS OF OPERATIONAL THROTTLE CONTROL CAPABILITY
   - (I) LOSS OF BOTH AOT AND COAS
6. DPS
   - (A) PROPELLANT LEAKS
   - (B) LOSS OF OPERATIONAL DPS
   - (C) LESS THAN 245 FPS ΔV
7. APS
   - (A) APS PROPELLANT LEAK
   - (B)
   - (C) PROPELLANT LEAK
8. RCS
   - (A) REDUNDANT 3-AXIS ATTITUDE CONTROL
   - (B) 3-AXIS TRANSLATION CONTROL

C. THE PHASING MANEUVER WILL BE NO-GO IF ANY OF THE FOLLOWING INTERFACE CONDITIONS EXIST:

1. COMMUNICATIONS
   - (A) LOSS OF TWO-WAY VOICE COMMUNICATION BETWEEN VEHICLES WITH BACKUP
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATIONS BETWEEN MSFN AND EITHER CSM OR LM
   - (C) LOSS OF LM TELEMETRY OR CSM TELEMETRY

REV	ITEM
A	3-15

INSERTION MANEUVER GO/NO-GO

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. ECS
   - (A) LOSS OF CABIN INTEGRITY
   - (B) LOSS OF SUIT CIRCUIT
   - (C) LOSS OF O_2 MANIFOLD
   - (D)
   - (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (F) LOSS OF PRIMARY GLYCOL LOOP COOLING
   - (G) POTABLE WATER TANK QUANTITY PLUS FUEL CELL PRODUCTION TO THE COMPLETION OF RENDEZVOUS WILL TOTAL <10 LBS
   - (H)
   - (I) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT
2. CRYO
   - (A) INSUFFICIENT O_2 AND H_2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS 2 REVS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER)
3. EPS
   - (A) LOSS OF TWO FUEL CELLS
   - (B) LOSS OF TWO ENTRY BATTERIES, OR LOSS OF ONE ENTRY BATTERY AND THE BATTERY CHARGER
   - (C) LOSS OF ONE MAIN BUS, ONE BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
   - (D) LOSS OF TWO INVERTERS
4. COMM/INSTRUMENTATION
   - (A) LOSS OF TELEMETRY SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)
   - (C) LOSS OF TWO-WAY VOICE COMMUNICATIONS (CSM/LM)
   - (D)
5. SEQUENTIAL
   - (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
   - (B) LOSS OF PYRO BUS A OR B
6. G&C
   - (A) LOSS OF DIRECT RCS (ANY AXIS)
   - (B) LOSS OF RATE DAMPING (ANY AXIS)
   - (C) LOSS OF TWO DEORBIT METHODS
   - (D) LOSS OF CAPABILITY TO PERFORM CRITICAL SPS MANEUVERS
   - (E) LOSS OF IMU, CMC, BOTH DSKY'S, OPTICS OR BOTH FDAI'S
   - (F) LOSS OF TRANSLATION CAPABILITY (ANY AXIS)
7. SPS
   - (A) PRESSURE DECAY IN EITHER FUEL OR OXIDIZER TANK
   - (B) LOSS OF CAPABILITY TO PERFORM NON-CRITICAL MANEUVER
8. SM-RCS
   - (A) LOSS OF ONE QUAD
   - (B) LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES
   - (C) PROPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT.
9. CM-RCS
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CM-RCS ARMED

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MISSION RULES

REV	ITEM
A	3-15 (CONT'D)

B. THE LM WILL NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. SEQUENTIAL AND PYROTECHNICS
   - (A) LOSS OF EITHER PYRO SYSTEM A OR B
2. EPS
   - (A) LOSS OF EITHER CDR OR LMP BUS
   - (B) LOSS OF TWO OR MORE DESCENT BATTERIES
   - (C) LOSS OF EITHER ASCENT BATTERY
   - (D) LOSS OF EITHER INVERTER 1 OR 2
   - (E) LOSS OF EITHER AC BUS A OR B
3. ECS
   - (A) LOSS OF CABIN PRESSURE INTEGRITY
   - (B) LOSS OF SUIT LOOP INTEGRITY
   - (C) LOSS OF BOTH SUIT FANS
   - (D) LOSS OF BOTH H_2O SEPARATORS
   - (E) LOSS OF BOTH DEMAND REGULATORS
   - (F) LOSS OF EITHER PRIMARY OR SECONDARY COOLANT LOOPS
   - (G) LOSS OF PRIMARY H_2O FEED PATH CAPABILITY
   - (H) LOSS OF DESCENT O_2 TANK
   - (I) LOSS OF BOTH ASCENT O_2 TANKS
   - (J) LOSS OF TWO OR MORE H_2O TANKS
4. COMMUNICATIONS/INSTRUMENTATION
   - (A) LOSS OF CRITICAL ONBOARD DISPLAYS
5. GUIDANCE AND CONTROL
   - (A) LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL CAPABILITY
   - (B) LOSS OF PGNS
   - (C) LOSS OF +X-AXIS TRANSLATION CAPABILITY
   - (D)
   - (E) LOSS OF BOTH FDAI'S
   - (F) LOSS OF DSKY
   - (G) LOSS OF ENG ON/OFF CAPABILITY
   - (H) LOSS OF OPERATIONAL THROTTLE CONTROL
   - (I) LOSS OF AOT AND COAS
6. DPS/APS
   - (A) LOSS OF OPERATIONAL DPS AND APS
   - (B) APS PROPELLANT LEAK
   - (C) LESS THAN 160 FPS DPS ΔV CAPABILITY IF APS IS NOT OPERATIONAL
7. RCS
   - (A) LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL
   - (B) LOSS OF +X AXIS TRANSLATION CAPABILITY
   - (C) RCS PROPELLANT LEAK

C. THE INSERTION WILL BE NO-GO IF ANY OF THE FOLLOWING INTERFACE CONDITIONS EXIST:

1. COMMUNICATIONS
   - (A) LOSS OF TWO-WAY VOICE COMMUNICATION BETWEEN VEHICLES WITH BACKUP
   - (B) LOSS OF TWO-WAY VOICE COMMUNICATIONS BETWEEN MSFN AND EITHER CSM OR LM
   - (C) LOSS OF LM TELEMETRY OR CSM TELEMETRY

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MISSION RULES

REV	ITEM
A	3-16

LM STAGING GO/NO-GO

A. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

1. SEQUENTIAL AND PYROTECHNICS
   - (A) LOSS OF EITHER SYSTEM A OR B
2. EPS
   - (A) LOSS OF EITHER CDR OR LMP BUS
   - (B) LOSS OF EITHER ASCENT BATTERY
3. ECS
   - (A) LOSS OF CABIN PRESSURE INTEGRITY
   - (B) LOSS OF SUIT LOOP INTEGRITY
   - (C) LOSS OF BOTH SUIT FANS
   - (D) LOSS OF BOTH H_2O SEPARATORS
   - (E) LOSS OF BOTH DEMAND REGULATORS
   - (F) LOSS OF EITHER ASCENT O_2 TANK
   - (G) LOSS OF BOTH ASCENT H_2O TANKS
4. COMMUNICATIONS/INSTRUMENTATION
   - (A) INSUFFICIENT INFORMATION TO ASSESS THE STATUS OF THE ASCENT STAGE SYSTEMS
   - (B) INSUFFICIENT INFORMATION TO ASSESS THE STATUS OF THE ASCENT STAGE SYSTEMS
5. GUIDANCE AND CONTROL
   - (A) LOSS OF PGNS
   - (B) LOSS OF +X TRANSLATION CAPABILITY
6. APS
   - (A) PROPELLANT LEAK
   - (B)
7. RCS
   - (A) LOSS OF +X TRANSLATION CAPABILITY
   - (B) LOSS OF 3-AXIS ATTITUDE CONTROL CAPABILITY

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MISSION RULES

REV	ITEM	
A	3-17	LM UNMANNED APS BURN GO/NO-GO

A. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:

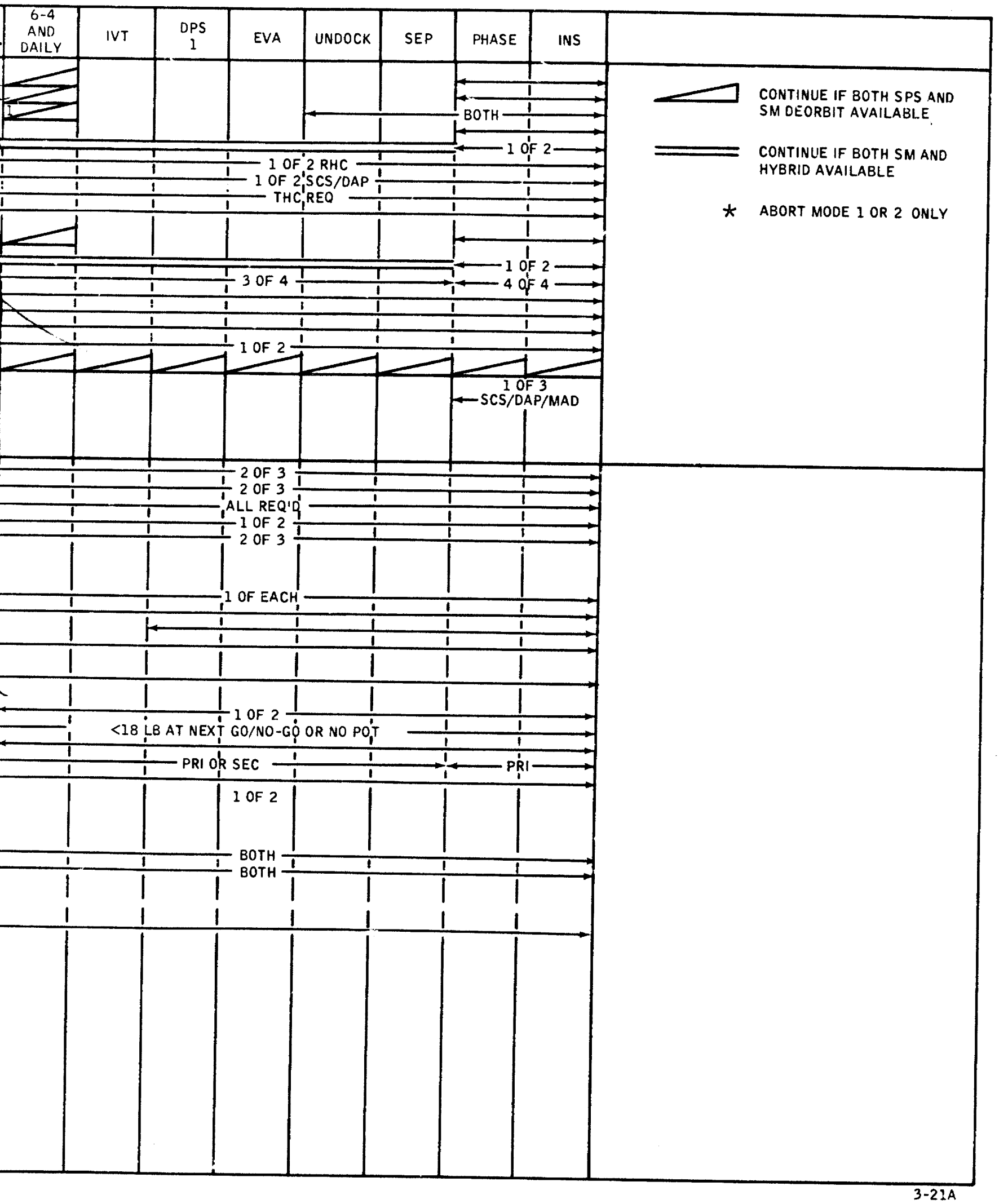
1. EPS
   - (A) LOSS OF CDR BUS
   - (B) LOSS OF BOTH ASCENT BATTERIES
2. GUIDANCE AND CONTROL
   - (A) LOSS OF PGNS
   - (B) LOSS OF APS ARM-DEARM/ON-OFF CONTROL
3. APS
   - NON-OPERATIONAL APS (REF MR 27-3)
4. RCS
   - (A) LOSS OF 3-AXIS ATTITUDE CONTROL

RULE NUMBERS 3-18 THROUGH
3-19 ARE RESERVED.

LM	DPS 1	EVA	UNDOCK	ROM	SEP	ROM	PHASE	ROM	INS	ROM	STAGE	APS DEP
GUIDANCE AND CONTROL												
PGNS OR DSKY	USE / TTCA				MINI							
DPS GIMBAL TRIM												
ULLAGE CAPABILITY												
NON OPN'L DPS- PRESS / ON/OFF						FOOTBALL			STAGE			
THROTTLE								10% >OK < 60% STAGE				
REDUNDANT 3 AXIS ATT			PGNS AND AGS OR									
3 AXIS X1A +C +1			AGS AND SEC COILS									
RR/XPONDER								+X REQ'D				
FDAI'S (2)												
AGS GUIDANCE						1 OF 2						
NO APS ENG PRESS / ON/OFF					N/R		N/R		N/R			
AOT OR COAS												
NO PGNS OR AGS						1 OF 2						
PROPELLANT LEAK												
IMPENDING PROP VENT		MAN VENT										
ELECTRICAL												
NO CDR OR LMP BUS							BOTH					CDR
DESCENT BAT 1-4	2 OF 6	2 DES + 2 ASC OR	3 DES + 1 ASC	3	2D/2A OR 3D/1A	3	2D/2A OR 3D/1A		3 OF 4			
ASC BATTERY 5-6				2		2			BOTH			1
INVERTERS (2)	1 A			2 BOTH	1 A	2 BOTH	1 A		BOTH			
AC BUS A/B									BOTH			
TRACKING LT												
PYRO												
PYRO A/B	1			BOTH					BOTH			
ECS												
CABIN INTEGRITY												
SUIT LOOP INTEGRITY												
SUIT FANS (2)							1 OF 2					
H_2O SEP (2)				1 OF 2	CREW OPT				1 OF 2			
DEMAND REGS (2)								1 OF 2				
PRI-SEC COOLANT LOOP		1 OF 2		BOTH	PRI				BOTH		1 OF 2	1 OF 2
DESCENT O_2	1 OF 3		2 OF 3		2 OF 3		2 OF 3					
ASCENT O_2 1		1 OF 2		BOTH		BOTH		BOTH	1 OF 2	BOTH	BOTH	
ASCENT O_2 2												
DES H_2O												
ASC H_2O 1		1 OF 3		2 OF 3	1 OF 3	2 OF 3	1 OF 3		2 OF 3			
ASC H_2O 2											1 OF 2	
COMM/INSTR												
CRITICAL ONB'D DISP												
OPS TM												
VOICE COMM - S BAND						N/R	SEE BELOW					
VHF DUP (A OR B) SIM (A OR B)	1 OF 2											
VHF DUP A AND B												
VHF SIM A AND B												
S-BAND +VHF DOP A OR B							1 OF 4					
S-BAND +VHF SIM A OR B												

TABLE 3-I. - GO/NO-GO SUMMARY

STAGE	APS DEP	CSM GUIDANCE / PROP	LAUNCH	TD AND E	6-4 AND DAILY	IVT	DPS 1	EVA	UNDOCK	SEP	PHASE	INS
		NO IMU										
		NO CMC OR DSKY (2)										
		FDAI'S									BOTH	
		NO OPTICS										
		TVC LOOP (2 P-Y)									1 OF 2	
		DIRECT RCS (ANY AXIS)						1 OF 2 RHC				
		RATE DAMP (ANY AXIS)						1 OF 2 SCS/DAP				
		TRANS CONTROL (ANY AXIS)						THC REQ				
		SPS - FUEL/OX DECAY										
		SPS - NON OPN'L TEMPS / TC P, ΔP										
		BALL VALVES A/B (GN_2)									1 OF 2	
		SM-RCS QUADS (4)						3 OF 4			4 OF 4	
		NO 3 AXIS ATT C+1										
		CM-RCS HE SOURCE/MAN A										
		-RCS ARMED										
		BMAG 1 AND 2 POR YAW						1 OF 2				
		BMAG 1 OF 2 ROLL										
		ULLAGE CAPABILITY									1 OF 3 SCS/DAP/MAD	
		ELECTRICAL										
	CDR	FUEL CELLS (3)	0					2 OF 3				
		ENTRY BAT (3)	1 OF 3					2 OF 3				
		BUS MAIN (2), BAT (2), BRB						ALL REQ'D				
	1	BUS AC (2)	*					1 OF 2				
		INVERTERS (3)	1 OF 3					2 OF 3				
		ECS										
		CRYO O_2/H_2						1 OF EACH				
		CABIN INTEGRITY	E/O									
		SUIT INTEGRITY	E/O									
		SUIT LOOP/1 OF 2 FANS										
		O_2 MANIFOLD	WITH CABIN LOSS									
		CYCLIC ACCUM (2)						1 OF 2				
		POTABLE/WASTE H_2O						<18 LB AT NEXT GO/NO-GO OR NO POT				
		LOSS OF H_2O/URINE DUMP										
		PRI OR SEC GLY LOOP						PRI OR SEC				PRI
1 OF 2	1 OF 2	GLYCOL LEAK/SUIT CABIN										
		SURGE TANK/REPRESS PK						1 OF 2				
		SEQUENTIAL										
BOTH		SEQ LOGIC BUS A/B						BOTH				
		PYRO BUS A/B						BOTH				
		COMM/INSTR										
1 OF 2		CRITICAL ONB'D DISP										
		VOICE COMM - S-BAND (SEE LM REQ)										


6-4 AND DAILY
IVT
DPS 1
EVA
UNDOCK
SEP
PHASE
INS
BOTH
1 OF 2
1 OF 2 RHC
1 OF 2 SCS/DAP
THC REQ
1 OF 2
3 OF 4
4 OF 4
1 OF 2
1 OF 3 SCS/DAP/MAD
2 OF 3
2 OF 3
ALL REQ'D
1 OF 2
2 OF 3
1 OF EACH
1 OF 2
<18 LB AT NEXT GO/NO-GO OR NO POT
PRI OR SEC
PRI
1 OF 2
BOTH
BOTH
CONTINUE IF BOTH SPS AND SM DEORBIT AVAILABLE
CONTINUE IF BOTH SM AND HYBRID AVAILABLE
* ABORT MODE 1 OR 2 ONLY

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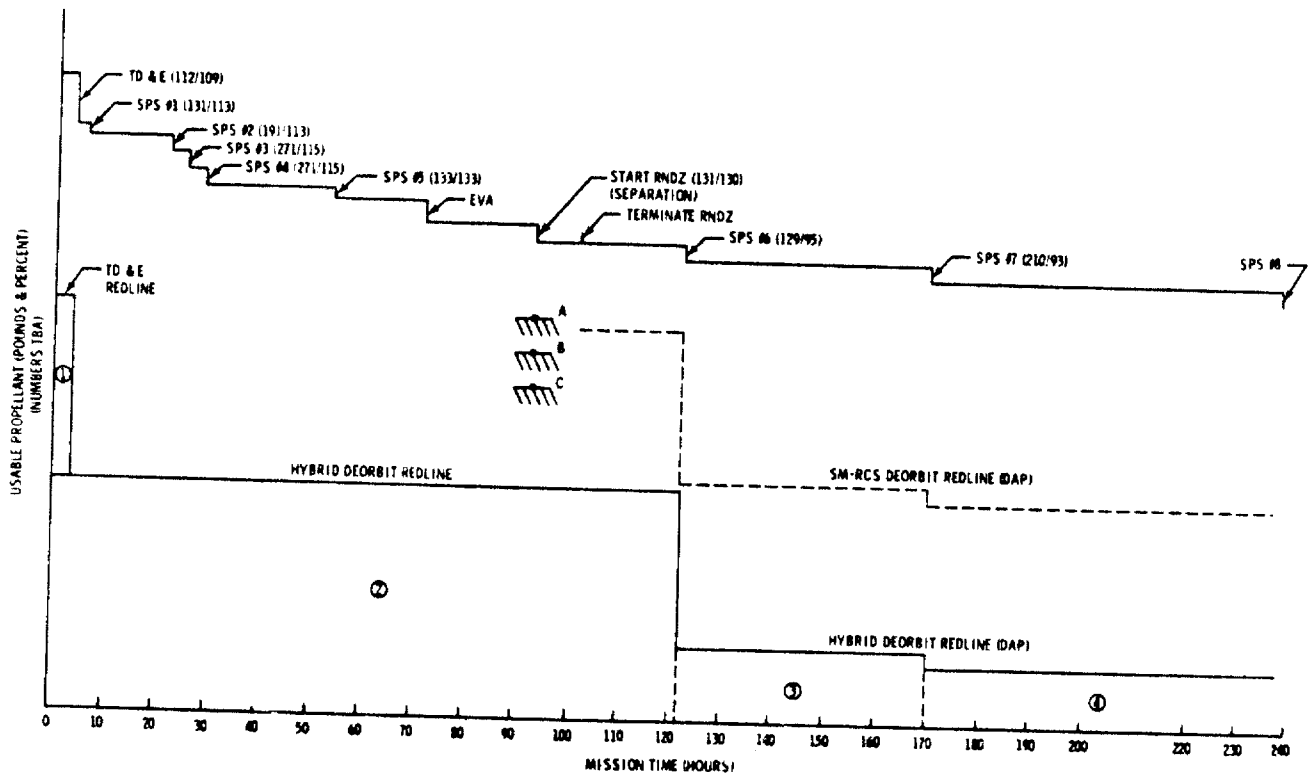
MISSION RULES

REV	ITEM
	3-20

SM-RCS



ASSUMPTIONS

A. TRAPPED PROPELLANT - 28 LBS

GAGING UNCERTAINTY - 80 LBS

108 LBS - (UNUSABLE AND NOT SHOWN ON GRAPH)

B. NO OPS RESERVE

GO/NO-GO (TBM)

1. RENDEZVOUS:

   A. PROPELLANT REQUIRED FOR SEPARATION MANEUVER PLUS CSM RESCUE OF LM AFTER LM INSERTION. INCLUDES ULLAGE FOR CSI AND CDH MANEUVERS, TPI, MIDCOURSES, BRAKING, DOCKING AND THE HYBRID DEORBIT REDLINE.

   B. PROPELLANT REQUIRED FOR SEPARATION MANEUVER PLUS SEPARATION MANEUVER PLUS CSM RESCUE OF LM AFTER PHASING BUT PRIOR TO INSERTION. INCLUDES TPI, MIDCOURSES, BRAKING, DOCKING, AND THE HYBRID DEORBIT REDLINE.

   C. PROPELLANT REQUIRED FOR SEPARATION MANEUVER PLUS CSM RESCUE OF LM AFTER SEPARATION BUT PRIOR TO PHASING. INCLUDES LOS CONTROL, BRAKING, DOCKING, AND THE HYBRID DEORBIT REDLINE.

2. THE EVA WILL BE CONSIDERED FOR DELETION IN ORDER TO MEET THE GO/NO-GO POINT (B) FOR THE FOOTBALL RENDEZVOUS.

REDLINES

1. ORBIT INSERTION TO LM EXTRACTION

   (1) THE TD&E WILL BE TERMINATED AT THE TD&E REDLINE. THE PROPELLANT IN 1 WILL ALLOW A CSM ACTIVE RENDEZVOUS WITH THE S-IVB/LM AND ALLOWS ____ LBS FOR DTO ACCOMPLISHMENT. REF ALTERNATE MISSION _____.

   (2) THE HYBRID DEORBIT REDLINE THROUGHOUT THIS PERIOD IS THE PROPELLANT REQUIRED FOR A HYBRID DEORBIT FROM THE RENDEZVOUS ORBIT ≈(130/130) AT THE END OF RENDEZVOUS CSM WEIGHT. IF THE CSM MUST SEPARATE EARLY FROM THE S-IVB/LM FOR SAFETY REASONS AND IT IS SUBSEQUENTLY DECIDED TO RENDEZVOUS AND ATTEMPT EXTRACTION, THE ONLY APPLICABLE REDLINE IS THE HYBRID DEORBIT REDLINE.

2. LM EXTRACTION TO SPS #6:

   (2) SAME AS (2) ABOVE

3. SPS #6 TO SPS #7:

   (3) PROPELLANT REQUIRED FOR A HYBRID DEORBIT FROM A ≈ 129/93 NM ORBIT.

4. SPS #7 TO SPS #8:

   (4) PROPELLANT REQUIRED FOR A HYBRID DEORBIT FROM A ≈ 210/93 NM ORBIT.

IN THE EVENT OF THE LOSS OF ONE SPS TVC SERVO LOOP, THE DEORBIT REDLINES WILL BE INCREASED BY 40 LBS IN THE AFFECTED AXIS TO ALLOW FOR RCS RECOVERY OF A SUBSEQUENT SPS HARDOVER.

AFTER RENDEZVOUS EVERY ATTEMPT WILL BE MADE TO STAY ABOVE THE SM RCS REDLINE (DAP). SPS #6 WILL BE CONSIDERED FOR EARLY EXECUTION TO MEET THIS OBJECTIVE.

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MISSION RULES

REV	ITEM	
		CSM SPS
	3-21	THE NOMINAL END OF MISSION SPS PROPELLANT MARGIN IS APPROXIMATELY 2100 LBS.
	3-22	THE SPS PROPELLANT REDLINE TO PROVIDE A MINIMUM 40-SECOND POST-DOCKED DPS BURN, LM RESCUE, AND DEORBIT CAPABILITY FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT IS 14.1 PERCENT INDICATED PROPELLANT REMAINING.
	3-23	THE SPS PROPELLANT REDLINE TO PROVIDE 21 SECONDS OF BURN FOR LM RESCUE PLUS DEORBIT CAPABILITY FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT IS 7.3 PERCENT INDICATED PROPELLANT REMAINING.
	3-24	THE SPS PROPELLANT REDLINE TO PROVIDE A DEORBIT CAPABILITY OF 620 FPS IS 3.6 PERCENT INDICATED PROPELLANT REMAINING AND IS SUFFICIENT TO ACCOMPLISH DEORBIT FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT.
		CSM CRYOGENICS AND WATER
A	3-25	THE NOMINAL END OF MISSION MARGINS FOR CSM CRYOGENICS ARE: H_2 - 10.15 LBS, AND O_2 - 150.3 LBS
	3-26	THE MINIMUM REQUIREMENT TO CONTINUE PAST A DAILY GO/NO-GO PTP IS SUFFICIENT CRYOGENICS AND WATER TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT DAILY GO/NO-GO PTP PLUS TWO REVOLUTIONS.
	3-27	THE MINIMUM REQUIREMENT TO INITIATE A MISSION PHASE IS (1) SUFFICIENT CRYOGENICS AND WATER TO SUPPLY FUEL CELL AND ECS DEMANDS FOR THAT PHASE, (2) THE SUBSEQUENT DEMANDS TO THE NEXT BEST PTP AFTER COMPLETION OF THE PHASE, AND (3) TWO EXTRA REVOLUTIONS.
	3-28	IF THE CRYOGENICS OR WATER ARE PREDICTED TO BE INSUFFICIENT FOR THE TOTAL MISSION, AN ALTERNATE MISSION MAY BE SELECTED IMMEDIATELY EVEN THOUGH THE DAILY GO/NO-GO PTP REQUIREMENTS ARE SATISFIED.
		RULE NUMBERS 3-29 THROUGH 3-30 ARE RESERVED.

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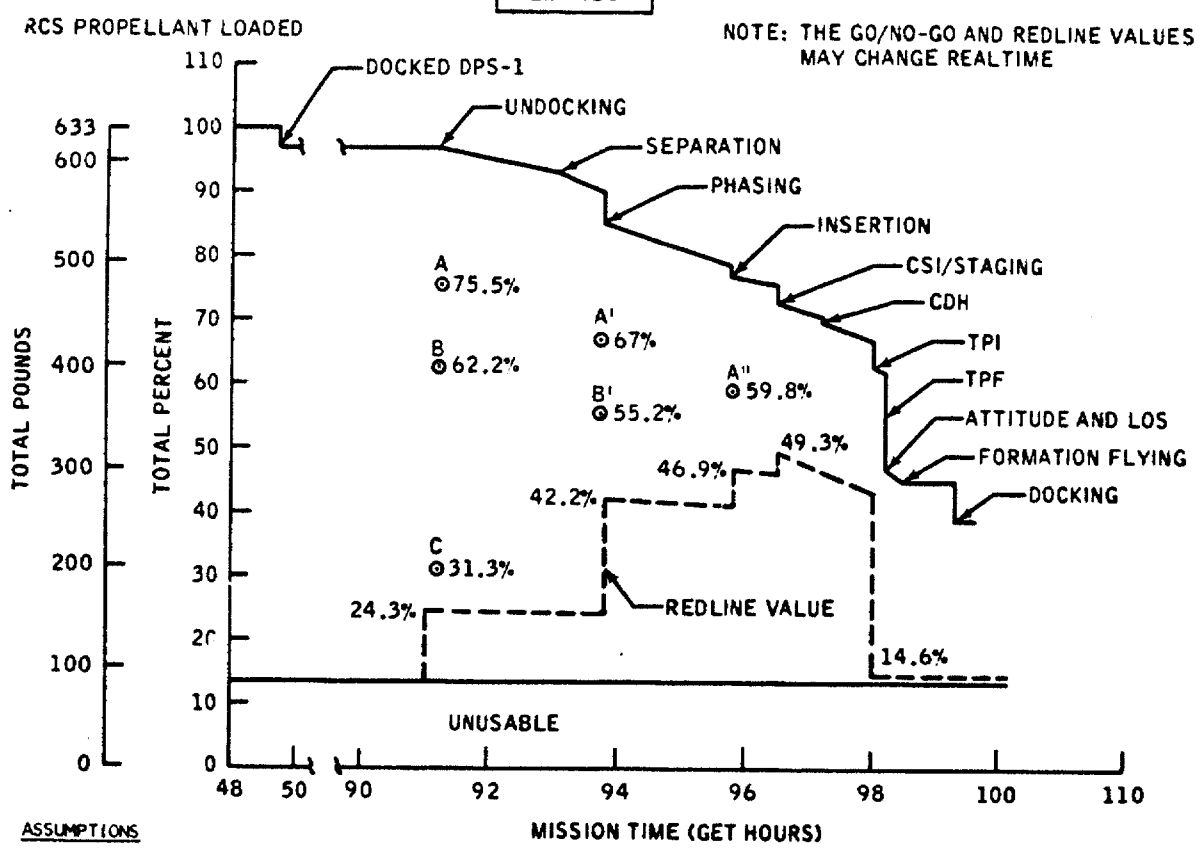
MISSION RULES

REV	ITEM
A	3-31

LM RCS



ASSUMPTIONS

A. TRAPPED PROPELLANT - 42.1 LBS
GAGING UNCERTAINTY - 44.3 LBS

86.4 LBS (UNUSABLE AND NOT SHOWN ON GRAPH)

B. OPS RESERVE = 1 REV OF LM ACTIVE STATION KEEPING (27 LBS). AFTER TPI, OPS RESERVE = 6 LBS

GO/NO-GO'S ( )

UNDOCKING/SEPARATION:

A. PROPELLANT REQUIRED FOR UNDOCKING AND NOMINAL RENDEZVOUS PLUS OPS RESERVE

B. PROPELLANT REQUIRED FOR UNDOCKING AND FOOTBALL RENDEZVOUS PLUS OPS RESERVE

C. PROPELLANT REQUIRED FOR UNDOCKING AND MINI-FOOTBALL RENDEZVOUS PLUS OPS RESERVE

PHASING:

A'. PROPELLANT REQUIRED FOR PHASING AND NOMINAL RENDEZVOUS PLUS OPS RESERVE

B'. PROPELLANT REQUIRED FOR PHASING AND FOOTBALL RENDEZVOUS PLUS OPS RESERVE

INSERTION:

A". PROPELLANT REQUIRED FOR INSERTION AND NOMINAL RENDEZVOUS PLUS OPS RESERVE

REDLINES

UNDOCKING-TO-PHASING:

(1) PROPELLANT REQUIRED FOR DOCKING PLUS OPS RESERVE.

PHASING-TO-INSERTION:

(2) PROPELLANT REQUIRED IN THE FOOTBALL RENDEZVOUS FOR NARROW DEADBAND ATTITUDE HOLD TO BRAKING, TPI, BRAKING, DOCKING, PLUS OPS RESERVE

INSERTION-TO-TPI:

(3) PROPELLANT REQUIRED IN THE NOMINAL RENDEZVOUS FOR NARROW DEADBAND ATTITUDE HOLD TO BRAKING, TPI, BRAKING, DOCKING, PLUS OPS RESERVE

TPI-TO-DOCKING:

(4) PROPELLANT REQUIRED FOR OPS RESERVE.

FEC/TSG Form 292 (AUG 68)

REV	ITEM	
		LM DPS
	3-32	THE NOMINAL DPS PROPELLANT MARGIN IS APPROXIMATELY 7000 LBS. THERE ARE NO REDLINES OR GO/NO-GO'S PLANNED.
		LM APS
	3-33	THE NOMINAL APS PROPELLANT MARGIN AT THE BEGINNING OF THE APS DEPLETION BURN IS APPROXIMATELY 4200 LBS. THERE ARE NO REDLINES OR GO/NO-GO'S PLANNED.
		LM EPS
	3-34	LM DESCENT STAGE BATTERIES: A. ALL DESCENT STAGE BATTERY LIFETIME WILL BE AVAILABLE TO ASSURE SUCCESSFUL ACCOMPLISHMENT OF THE DOCKED LM EVALUATION. B. EVA WILL BE DELETED OR TERMINATED EARLY IN ORDER TO MAINTAIN SUFFICIENT LIFETIME TO PERFORM THE RENDEZVOUS. C. FOLLOWING MANNED LM UNDOCKING, ALL REMAINING DESCENT POWER WILL BE COMMITTED TO SUCCESSFUL COMPLETION OF UNDOCKED ACTIVITIES. D. IF THE AMP HOUR USAGE EXTRAPOLATION INDICATES THE DESCENT BATTERIES WILL BE DEPLETED PRIOR TO THE NOMINAL TIME OF STAGING, THE RENDEZVOUS INSERTION BURN WILL NOT BE PERFORMED. E. ONLY THAT PORTION OF THE RENDEZVOUS WILL BE ATTEMPTED WHICH WILL GUARANTEE SUFFICIENT AMP HOURS REMAINING TO PERFORM THE APS DEPLETION BURN. F. REFERENCE FIGURE 3-1
	3-35	LM ASCENT STAGE BATTERIES: A. LM ASCENT BATTERIES MAY BE USED IF NECESSARY TO SUCCESSFULLY ACCOMPLISH DOCKED LM EVALUATION. LM ASCENT AMP HOURS WILL NOT BE AVAILABLE FOR EVA, BUT WILL BE RESERVED FOR UNDOCKED ACTIVITIES. B. BEFORE COMMITTING TO A RENDEZVOUS, SUFFICIENT COMBINED ASCENT AND DESCENT BATTERY POWER MUST BE AVAILABLE TO ACCOMPLISH THE RENDEZVOUS with 150 AH Reserves AND THE APS DEPLETION BURN. C. THE INSERTION BURN WILL NOT BE PERFORMED IF EXTRAPOLATION OF ASCENT BATTERY PROFILE INDICATES THAT A DELAYED STAGING WILL BE NECESSARY IN ORDER TO MEET THE LIFETIME REQUIRED FOR RENDEZVOUS AND DOCKING PLUS TWO REVOLUTIONS. D. REF FIGURE 3-1
	3-36	AFTER COMMITTING TO RENDEZVOUS, THE LM WILL PERFORM THE RENDEZVOUS MANEUVERS AS LONG AS THERE IS POWER ENOUGH TO COMPLETE THAT MANEUVER AND POWERED DOWN FLIGHT THROUGH CSM RESCUE.
		LM O_2/WATER
	3-37	THE LM O_2 AND H_2O MINIMUM REQUIREMENTS TO INITIATE AN ACTIVE LM MISSION PHASE IS SUFFICIENT O_2/WATER TO MEET ECS DEMANDS FOR THAT PHASE PLUS TWO REVOLUTIONS.
	3-38	THE INSERTION BURN WILL NOT BE PERFORMED IF EXTRAPOLATION OF TRENDS INDICATE THAT A DELAYED STAGING WILL BE NECESSARY IN ORDER TO MEET THE REQUIRED ECS DEMANDS FOR RENDEZVOUS AND DOCKING PLUS TWO REVOLUTIONS.

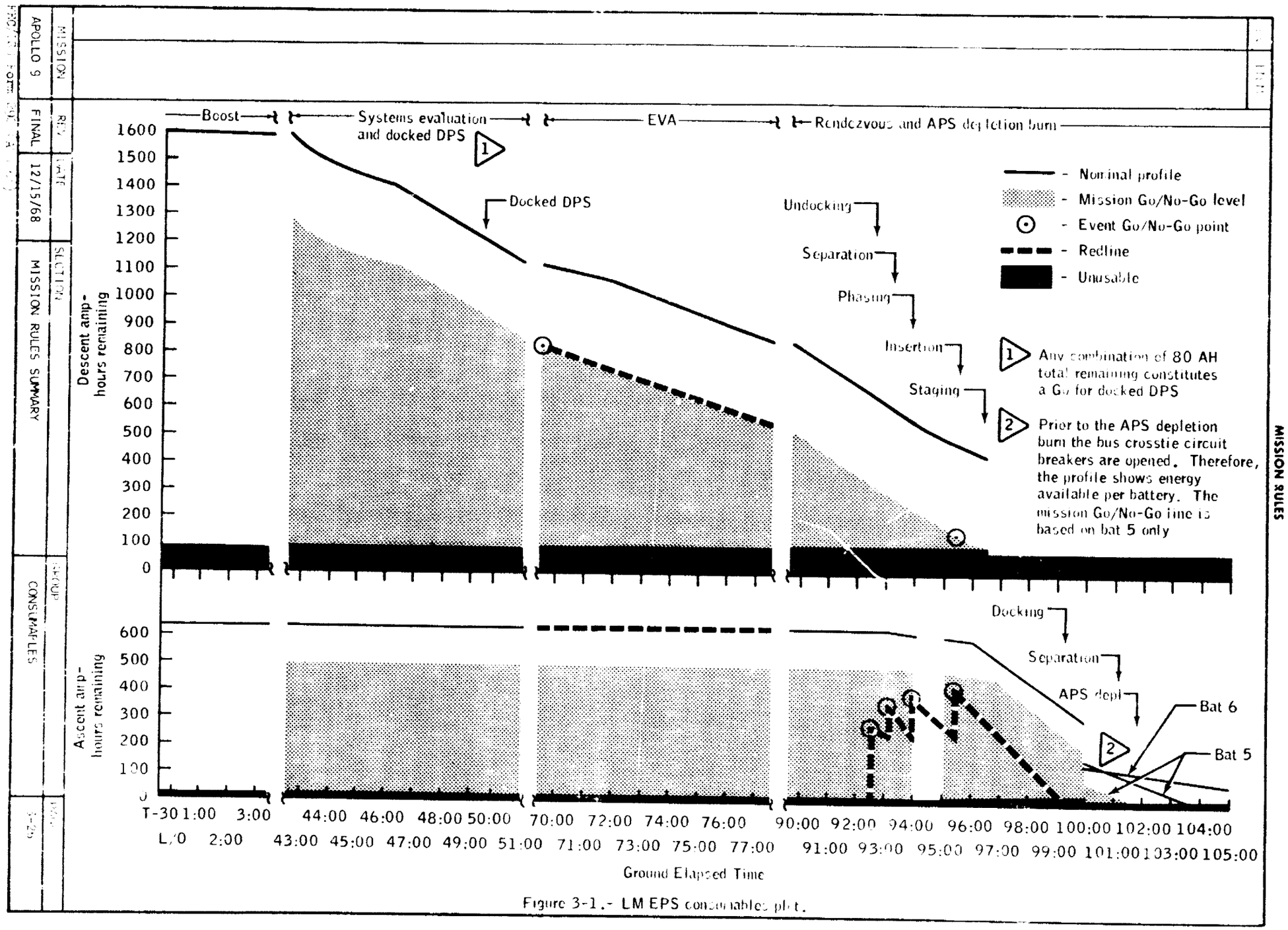


Figure 3-1.- LM EPS consumables plot.

REV	ITEM

PLSS

3-39 THE PLSS PRIMARY OXYGEN SUBSYSTEM (POS) IS CONSIDERED TO HAVE NOMINAL SOURCE PRESSURE OF 850 PSIA. THE CONSUMABLE PROFILE TO SUPPORT THE EVA PHASE IS DEFINED AS FOLLOWS:

ALLOWANCES	PRESSURE PSIA	QUANTITY (LBS MASS)
A. USABLE		
(1) PLANNING ALLOWANCE***	660	.811
(2) OPERATIONAL RESERVE	60	0.076
B. UNUSABLE		
(1) MEASUREMENT INACCURACIES	45	0.056
(2) RESIDUAL	85	0.105
C. TOTAL	850	1.048

***BASED ON WORSE CASE LEAK RATE .4 PSID/MIN AT 8.85 PSIA.

*ALL PRESSURES ARE TAKEN AT THE NOMINAL OF 70°F.

3-40 THE PRIMARY OXYGEN SUBSYSTEM (POS) CONSUMABLE PROFILE TO SUPPORT A CONTINGENCY TRANSFER IS DEFINED AS FOLLOWS:

ALLOWANCES	PRESSURE PSIA	QUANTITY LBS. MASS
A. USABLE		
PLANNING ALLOWANCE*	270	0.325
B. UNUSABLE		
(1) MEASUREMENT INACCURACIES	45	0.056
(2) RESIDUAL	85	0.105
C. TOTAL	400	.486

*THE PLANNING ALLOWANCE INCLUDES DEPRESS AND REPRESS ALLOWANCES, C/O, METABOLIC EXPENDITURE AND WORSE CASE LEAK RATE OF 0.4 PSID/MIN AT 8.85 PSIA.

3-41 THE PLSS BATTERY IS CONSIDERED TO HAVE A MINIMUM OF 14.3 AMP-HR CAPABILITY. THE CONSUMABLE PROFILE TO SUPPORT THE EVA PHASE IS DEFINED AS FOLLOWS:

	POWER (AMP-HRS)
1. USABLE	
(A) PLANNING ALLOWANCE	10.00
(B) OPERATIONAL RESERVE	2.90***
2. UNUSABLE	
MEASUREMENT INACCURACY	1.40*
3. TOTAL CHARGE	14.30

***THE 2.90 + 1.40 (4.3) AMP-HRS OPERATIONAL RESERVE IS REQUIRED FOR CONTINGENCY TRANSFER.

*10 PERCENT MEASUREMENT INACCURACY IS DUE TO INSTRUMENTATION ERROR AND THE UNCERTAINTIES OF THE POWER PROFILE DURING ABSENCE OF STATION COVERAGE.

4 GROUND INSTRUMENTATION REQUIREMENTS

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MISSION RULES

REV	ITEM	
A	4-1	GENERAL

A. THE FOLLOWING PRELAUNCH REQUIREMENTS DEFINE THE MCC/MSFN REQUIREMENTS WHICH MUST BE MET BEFORE A "GO" IS GIVEN FOR LAUNCH.

B. WHEN A SPECIFIC HARDWARE ITEM OR OPERATIONAL CAPABILITY IS DEFINED AS A MANDATORY ITEM, THE HARDWARE AND/OR SOFTWARE INTERFACE REQUIRED TO PROVIDE THE MANDATORY FUNCTIONS OF THAT HARDWARE ITEM OR OPERATIONAL CAPABILITY ARE TO ASSUME A MANDATORY STATUS ALSO.

C. WHERE REDUNDANCY EXISTS FOR MANDATORY ITEMS, A BACKUP CAPABILITY IS CONSIDERED HIGHLY DESIRABLE.

NOTE 1

THE VARIOUS EQUIPMENT LISTINGS IN THIS SECTION ARE TO BE UTILIZED AS A GUIDE ONLY. IT IS MANDATORY, PRIOR TO COMMITTING THE MISSION TO LAUNCH, TO BE ABLE TO:

A. RECEIVE AND DISPLAY TELEMETRY AND TRACKING DATA.
B. MAINTAIN VOICE COMMUNICATIONS WITH THE CREW.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-2	COMPUTER			
		A. MOC (IBM 360/75)	PRE LN	MANDATORY	TO PROCESS MANDATORY S/V PARAMETERS AND TRAJECTORY DATA.
		B. DSC (IBM 360/75)	PRE LN	HIGHLY DESIRABLE	AN SSC (IBM 360/75) IS AVAILABLE AS BACKUP TO THE MOC OR DSC.
		C. CCATS (UNIVAC 494) - ONLINE D. CCATS (UNIVAC 494) - STANDBY	PRE LN	1 MANDATORY AND 1 HIGHLY DESIRABLE	ALL DATA ENTERING OR LEAVING MCC MUST BE ROUTED BY CCATS.
		E. RTACF - 2	PRE LN	1 HIGHLY DESIRABLE	
A	4-3	COMMAND			
		A. MOCR TOGGLE SWITCHES (BOTH A AND B)			
		1. BSE ABORT REQUEST	PRE LN	HIGHLY DESIRABLE	FOR LAUNCH PHASE ABORT REQUEST
		2. FIDO ABORT REQUEST	PRE LN	HIGHLY DESIRABLE	
		3. FD ABORT REQUEST	PRE LN	HIGHLY DESIRABLE	
		B. MOCR COMMAND PANELS: EECOM, GUIDO, BSE, TELCOM, CONTROL	PRE LN	1 OF 5 MANDATORY	REQUIRED TO SATISFY RULE 4-21
		C. MOCR CONSOLE/SITE SELECT CAPABILITY			
		1. RTC CONSOLE (CCATS) 2. CCATS CMD CONSOLE MED	PRE LN	1 OF 2 MANDATORY	REQUIRED TO SITE SELECT A CONSOLE SO THAT COMMANDING CAN BE ACCOMPLISHED
		D. FC/M&O SWITCHING CAPABILITY		HIGHLY DESIRABLE	
		1. FLIGHT DIRECTOR 2. CCATS CMD MED	PRE LN	1 OF 2 MANDATORY	REQUIRED TO ENABLE MCC OUTPUT COMMANDING

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-4	TELEMETRY			
		A. CONSOLE DISPLAY (D/TV, EVENTS, ANALOGS)	PRE LN	MANDATORY	FOR DISPLAY OF MANDATORY S/V PARAMETERS.
		B. PCM GROUND STATIONS (4)	PRE LN	1 OF 4 MANDATORY, 1 HIGHLY DESIRABLE	FOR DISPLAY OF MANDATORY S/V EVENTS AND ANALOGS.
		C. RECORDING AND PLAYBACK			
		ALDS } MSFN }	PRE LN	BOTH DESIRABLE	
		D. FM - GROUND STATION	PRE LN	1 OF 2 MANDATORY	TO PROVIDE MANDATORY DISPLAY DATA FOR THE MCC SURGEON.
A	4-5	TRAJECTORY			
		A. TRAJECTORY DATA PROCESSING			THE TRAJECTORY DATA SOURCES ARE UTILIZED AS FOLLOWS:
		1. AVAILABILITY OF ONE INDEPENDENT TRACKING SOURCE (IP_R, USB) FROM LIFTOFF TO T+10 MINUTES.	PRE LN	1 MANDATORY	1. INDEPENDENT VERIFICATION OF L/V NAVIGATION. 2. PROTECT AGAINST VIOLATION OF LAUNCH ENVELOPE.
		2. IU AND CMC TLM VECTORS FROM LIFTOFF TO INSERTION PLUS 60 SECONDS.	PRE LN	BOTH MANDATORY	REQUIRED FOR MAKING ORBIT GO/NO-GO DECISION
		B. RTCC - DATA SELECT CAPABILITY	PRE LN	MANDATORY	REQUIRED TO SELECT BEST AVAILABLE TRACKING SOURCE FOR INPUT TO RTCC FOR ORBITAL DETERMINATION.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-6	MCC POWER			
		A. BUS A_1	PRE LN	MANDATORY	UNINTERRUPTABLE POWER FOR: WIDE BAND CROSSBAR SWITCH
		B. BUS A_2	PRE LN	MANDATORY	UNINTERRUPTABLE POWER FOR: D/TV DATA DISTRIBUTORS
		C. BUS B_1	PRE LN	MANDATORY	20 SECONDS INTERRUPTABLE POWER FOR: PLOTBOARDS
		D. BUS B_2	PRE LN	MANDATORY	20 SECONDS INTERRUPTABLE POWER FOR: VIDEO SWITCHING MATRIX (VSM)

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-7	DISPLAY			
		A. MOCR D/TV CHANNELS	PRE LN/LN	22 OF 36 MANDATORY TO T-10 MIN. 20 OF 36 MANDATORY AFTER T-10 MIN TO T-20 SEC	GNC - 3, EECOM - 3, RTCC - 1, FIDO/GUIDO/RETRO - 4, BSE - 8, SURGEON - 2, TELCOM - 1, CONTROL - 1.
		MSK NUMBER			
		GNC (3 CHANNELS)			
		1. 0683		GNC PRIMARY	
		2. 0966		CMC COMMON	
		3. EXTRA		ONE EXTRA CHANNEL IS REQUIRED TO OBSERVE VARIOUS OTHER DISPLAYS WHICH WHILE THEY MAY HAVE NO MANDATORY MEASUREMENTS, HAVE GROUPS OF PARAMETERS THAT ARE MANDATORY IN TOTAL.	
		EECOM (3 CHANNELS)			
		4. 0443		EPS COMMUNICATIONS	
		5. 0613		ECS CRYO	
		6. 0518		EPS HIGH DENSITY	
		RTCC (1 CHANNEL)			
		7. ONE CHANNEL TO BE SHARED BY THE FOLLOWING DISPLAYS:		GAMMA VS VELOCITY (BEST SOURCE) GAMMA VS VELOCITY (RAW)	DATA SELECT IS DISPLAYING 4 TRACKING DATA SOURCES (2 PER CHANNEL) FOR RTCC TRAJECTORY PROCESSING.
		1613 1614 2001		(IBM) TM STATUS NO. 1 - DISPLAYS COMPUTER EVENTS, TIMING, INPUT/OUTPUT COMPUTER STATUS.	
		FIDO, GUIDO, RETRO (4 CHANNELS)			
		8. 0043		FIDO LAUNCH DIGITALS	ONLY DISPLAY SOURCE FOR MODE 4 ABORTS.
		9. 0330		RFO LAUNCH DIGITAL	ONLY DISPLAY SOURCE FOR MODE 3 ABORTS.
		10. ONE CHANNEL		GUIDANCE INSERTION/INJECTION DIGITALS	REQUIRED FOR G&N GO/NO-GO DECISIONS.
		BOOSTER (8 CHANNELS)			
		12. 1402		BSE NO. 1	ALL IC/S-II
		13. 1403		BSE NO. 2 S-IVB/IU	MOST ALL S-IVB PROPELLANT DATA.
		14. 1404		BSE NO. 3	GUIDANCE/NAVIGATION DATA.
		15. 1400, 1401, 1411 } 1 OF 3		GND NO. 1	GUIDANCE/NAVIGATION DATA.
				GND NO. 2	DIGITAL SYSTEMS DATA.
				GND NO. 3	DIGITAL SYSTEMS DATA.
		16. 1416		ACS NO. 1	ATTITUDE CONTROL DATA.
		17. 1405		PSS NO. 1/LAUNCH	PROPULSION DATA.
		18. 1407		ENS NO. 1	ELECTRICAL ALL STAGES AND IU/ECS.
		19. 0231		SWITCH SELECTOR COMMAND TABLES	
		SURGEON (2 CHANNELS)			
		20. 1700, 1703, 1706 } 1 OF 3		CSM/CDR BIO ENVMTL CSM/CMP BIO ENVMTL CSM/LMP BIO ENVMTL	
		21. 1709		ALL ASTROS ENVMTL	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-7 (CONT)	TELCOM (1 CHANNEL)			
		22. 1091 } 1 OF 2		ELEC/COM · R/T	LM DISPLAYS WILL BE RELEASED AT T-10 MINUTES.
		1051 }		LM ECS · R/T	
		CONTROL (1 CHANNEL)			
		23. 1123 } 1 OF 4		GNC/PROP · CONTROL R/T	
		1125 }		PROP · R/T	
		1127 }		AGS · R/T	
		1137 }		GNC · R/T	
		B. TRAJECTORY DISPLAY			
		1. FDO LAUNCH DIGITALS	PRE LN	MANDATORY ON D/TV	FOR CONTINGENCY ORBIT INSERTION MANEUVER DATA AND T_{FF} LIMITS.
		2. γ VS V	PRE LN	MANDATORY 1 OF 4: A. 10 X 20 SCRIBER PLOTTER B. D/TV C. RTCC PLOTBOARD D. SSR PLOTBOARD	FROM SELECTED TRACKING DATA SOURCE. THE PLOT PROVIDES A MONITOR OF L/V PERFORMANCE.
		3. RFO LAUNCH DIGITALS	PRE LN	MANDATORY ON D/TV	MONITOR FOR MODES III AND 1B MANEUVER DATA.
		4. γ_{EI} VS V_{EI}	PRE LN	MANDATORY OF 1 OF 2 A. D/TV B. SSR PLOTBOARD	MONITOR FOR C-LIMIT VIOLATION
		5. ϕ VS λ	PRE LN	MANDATORY ON 1 OF 2: A. RTCC PLOTBOARD B. SSR PLOTBOARD	MONITOR FOR CROSS-RANGE LIMITS
		6. T_{FF} VS R_{IP}	PRE LN	HIGHLY DESIRABLE ON 1 OF 2: A. D/TV B. SSR PLOTBOARD	MONITOR FOR ABORT MODES II, III, AND IB.
		7. h VS d	PRE LN	MANDATORY ON 10 X 20 SCRIBER PLOTTER	MONITOR FOR VEHICLE BREAKUP LIMIT
		8. γ_i VS V_i (CMC DYNAMIC STATUS)	PRE LN	HIGHLY DESIRABLE ON 10 X 10 SCRIBER PLOTTER	MONITOR FOR L/V AND S/C NAVIGATION PERFORMANCE (GUIDANCE SYSTEM ANALYSIS - COMPARES CMC WITH TRACKING)
		9. WEDGE ANGLE MONITOR	PRE LN	HIGHLY DESIRABLE ON D/TV	MONITOR FOR L/V AND S/C NAVIGATION PERFORMANCE
		10. GUIDO ANALOG CHART RECORDERS ONE AND TWO	PRE LN	HIGHLY DESIRABLE VIA SSR OPAQUE TV	
		11. GUIDANCE INSERTION/INJECTION DIGITALS	PRE LN	MANDATORY ON D/TV	REQUIRED TO MAKE G&N GO/NO-GO DECISIONS.
		C. ADEG CHANNELS 90-93	PRE LN	HIGHLY DESIRABLE	FOR DSC DISPLAYS
		D. VIDEO SWITCHING MATRIX	PRE LN	MANDATORY	REQUIRED FOR DISPLAYING MANDATORY DISPLAYS
		E. AUX VSM	PRE LN	HIGHLY DESIRABLE	
		F. EIDOPHORS (3)	PRE LN	2 HIGHLY DESIRABLE	
		NOTE: INDIVIDUAL FLIGHT CONTROLLERS WILL BE RESPONSIBLE FOR REPORTING LOSS OF DISPLAY CAPABILITY OF MANDATORY PARAMETERS TO THE FLIGHT DIRECTOR.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-8	TIMING			
		A. MITE (2)	PRE LN	1 MANDATORY	MCC TIMING STANDARD TO SUPPORT MANDATORY RTCC/CCATS COMPUTERS
	4-9	COMMUNICATIONS			
		A. MOCR			
		FD LOOP AFD CONF LOOP	PRE LN	1 OF 2 MANDATORY	FOR MISSION CONTROL
		MOCR SYS 1 & 2 MOCR DYN A/G 1 LOOP A/G 2 LOOP	PRE LN	ALL HIGHLY DESIRABLE	
		B. MCC/LAUNCH COMPLEX			
		121 CLTC 111 CVTS 212 MSTC	PRE LN	1 OF 3 MANDATORY	FOR TERMINAL COUNT COORDINATION OF MCC - PAD ACTIVITIES
		C. MCC/RSO			
		FD LINE TO RSO RSO PRIVATE LINE CAPE 111 RSO LOOP	PRE LN	2 OF 3 MANDATORY	FOR TRAJECTORY VERIFICATION AND BOOSTER SAFING
		D. MISCELLANEOUS			
		BSE TM MONITOR LOOP CIF/USB LOOP	PRE LN	BOTH HIGHLY DESIRABLE	USED FOR MONITORING SPACE VEHICLES SUBSYSTEM CHECKOUT
		E. MCC/REMOTED SITES SEE A/G COMMUNICATIONS RULES 4-18 AND 4-19	PRE LN		
		RULE NUMBERS 4-10 THROUGH 4-15 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-16	GSFC			
		A. GSFC UNIVAC - 494 (2) COMMUNICATIONS PROCESSOR	PRE LN	1 MANDATORY	A. ONE UNIVAC - 494 CAN PERFROM ALL NECESSARY FUNCTIONS, THE SECOND ONE IS BACKUP.
		B. WBD (50.0 KBPS) LINES (2) BETWEEN MCC AND GSFC	PRE LN	1 MANDATORY	B. EITHER LINE CAN BE SWITCHED TO EITHER UNIVAC - 494.
		C. TTY CIRCUITS BETWEEN MCC AND GSFC			
		1. TEXT CIRCUITS (TRANSMIT ONLY)	PRE LN	1 OF 6 HIGHLY DESIRABLE	C.1. FOR ACQ MSG, LS CMD
		2. SIX LOW-SPEED (JJ) CIRCUITS	PRE LN	1 OF 6 MANDATORY	2. FOR RECEPTION OF LOW-SPEED RADAR DATA.
	4-17	KSC			
		TELEMETRY:			
		A. DATA CORE (2)	PRE LN	HIGHLY DESIRABLE	A. EITHER DATA CORE CAN BE SWITCHED TO EITHER ALDS COMPUTER. ONLY SIC SOURCE TO MCC.
		B. SDS - 930 (2) ALDS COMPUTER	PRE LN	HIGHLY DESIRABLE	B. EITHER SDS - 930 CAN RECEIVE INPUTS FROM EITHER DATA CORE AND CAN OUTPUT ON EITHER WBD (50.0 KBPS) LINE.
		C. WBD (40.8 KBPS) LINES BETWEEN MCC AND KSC (2)	PRE LN	HIGHLY DESIRABLE	C. EITHER CAN BE SWITCHED TO EITHER ALDS COMPUTER.
		D. VHF TM FROM THE FOLLOWING: 1. TEL IV - 30-FT DISH, 2. CIF ANTENNA, OR 3. MILA VHF ANTENNA	PRE LN	1 MANDATORY	D. ALTHOUGH THE MILA VHF ANTENNA IS PRIME, THE OTHER ANTENNAS CAN ALSO BE SWITCHED TO EITHER DATA CORE. DATA FROM THESE ANTENNAS CAN BE SENT TO THE MILA USB SITE PCM GROUND STATIONS VIA HARD-LINE TO BACKUP THE MILA VHF ANTENNA. VHF IS THE S-II'S ONLY SOURCE OF DATA
		E. USB TM FROM THE FOLLOWING: 1. MILA USB, OR 2. MANDY USB		1 MANDATORY	E. USB IS THE CSM'S ONLY SOURCE OF DATA.
		COMMAND:			
		THIS CAPABILITY IS DEFINED UNDER GSFC/KSC/MSFN COMMAND RULE 4-18A FOR LAUNCH COVERAGE.			
		TRACKING:			
		THAT CAPABILITY REQUIRED TO SATISFY RULE 4-5 (TRAJECTORY) IS MANDATORY.			
		VOICE COMMUNICATIONS:			
		THAT CAPABILITY REQUIRED TO SATISFY MCC RULE 4-9 (COMMUNICATIONS) IS MANDATORY.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-18	LAUNCH COVERAGE			
		KSC/MSFN SITES MUST PROVIDE THE FOLLOWING CAPABILITIES:			
		A. CMD			
		CCS	PRE LN	HIGHLY DESIRABLE AT BDA OR VAN	TO BACKUP CRITICAL SLV FUNCTIONS.
		B. TELEMETRY S-IC (VHF)	PRE LN	HIGHLY DESIRABLE	S-IC DATA IS ONLY HIGHLY DESIRABLE SINCE THE MCC IS NOT PRIME FOR REQUESTING AN ABORT FOR S-IC MALFUNCTIONS.
		S-II(VHF)	PRE LN	MANDATORY FROM LIFTOFF TO S-II CUTOFF (APPROX: 8 + 36 SEC)	MCC IS PRIME FOR REQUESTING AN ABORT FOR S-II MALFUNCTIONS.
		S-IVB VHF (CP-1) IU CCS (DP-1B)	PRE LN PRE LN	1 OF 2 MANDATORY FROM LIFTOFF TO S-IVB CUTOFF PLUS 60 SEC.	MCC IS PRIME FOR REQUESTING AN ABORT FOR S-IVB MALFUNCTIONS.
		IU VHF (DP-1) IU S-BAND (DP-1A)	PRE LN PRE LN	1 OF 2 MANDATORY FROM LIFTOFF TO S-IVB CUTOFF PLUS 60 SEC.	
		CSM (USB)	PRE LN	MANDATORY FROM LIFTOFF THROUGH S-IVB CUTOFF PLUS 60 SEC.	FOR ABORT CUES FROM MCC
		C. TRACKING			
		THAT CAPABILITY REQUIRED TO SATISFY RULE 4-5 (TRAJECTORY) IS MANDATORY			
		D. A/G COMMUNICATIONS			
		1. LIFTOFF THROUGH MILA LOS.	PRE LN	ONE A/G PATH (VIA GSFC OR A/G LONGLINE BETWEEN MCC/KSC) 1 OF 2 MANDATORY	TO PROVIDE ABORT RECOMMENDATIONS TO THE CREW.
		2. POST MILA LOS	PRE LN	ONE A/G PATH VIA GSFC IS MANDATORY	TO RELAY APOGEE KICK DATA TO THE CREW.
		3. VAN OR CYI			
A	4-19	GENERAL ORBITAL COVERAGE			
		IT IS REQUIRED THE MSFN HAVE THE CAPABILITY OF PROVIDING THE MCC THE MINIMUM MISSION CONTROL SUPPORT LISTED BELOW OF 2 MSFN USB SITES PER REVOLUTION THROUGH REVOLUTION 5 FOR THE 6-4 GO/NO-GO DECISION, AND ONE MSFN USB SITE PER REVOLUTION THEREAFTER.			
		A. CMD CCS	PRE LN	HIGHLY DESIRABLE	
		CSM USB	PRE LN	HIGHLY DESIRABLE	
		B. TELEMETRY			
		S-IVB VHF (CP-1) IU CCS (DP-1B)	PRE LN	1 OF 2 MANDATORY	ONE OF EACH PAIR OF DOWNLINKS IS REQUIRED TO RECOVER ALL S-IVB DATA.
		IU VHF (DP-1) IU S-BAND (DP-1A)	PRE LN	1 OF 2 MANDATORY	
		CSM USB	PRE LN	MANDATORY	
		C. TRACK C-BAND USB	PRE LN PRE LN	BOTH HIGHLY DESIRABLE	
		D. A/G COMMUNICATIONS	PRE LN	ONE A/G PATH IS MANDATORY.	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	4-20	REV 1 - CRO (OR HSK FOR USB ITEMS)			DATA MUST BE PROVIDED TO MCC SO THAT A GO/NO-GO DECISION CAN BE MADE FOR PTP 2-1. S-IVB SYSTEMS PERFORMANCE MUST BE EVALUATED TO INSURE CREW SAFETY WHILE ATTACHED TO S-IVB.
		A. CMD CCS	PRE LN	HIGHLY DESIRABLE	
		CSM USB	PRE LN	HIGHLY DESIRABLE	
		B. TELEMETRY			
		S-IVB VHF (CP-1) IU CCS (DP-1B)	PRE LN	1 OF 2 MANDATORY	
		IU VHF (DP-1) IU S-BAND (DP-1A)	PRE LN	1 OF 2 MANDATORY	
		CSM (USB)	PRE LN	MANDATORY	
		C. TRACK C-BAND USB	PRE LN	BOTH HIGHLY DESIRABLE	
		D. A/G COMMUNICATIONS	PRE LN	ONE A/G PATH IS MANDATORY	
A	4-21	REV 3/4 (AT APPROXIMATELY 4.5 HOURS) - HAW, RED, GYM		1 OF 3 MSFN SITES MANDATORY	COMMAND CAPABILITY IS REQUIRED TO REMOVE AN INHIBIT WHICH ALLOWS THE S-IVB RESTART TO BE ACCOMPLISHED.
		CMD CCS			
A		RULE NUMBERS 4-22 THROUGH 4-25 ARE RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-26	RIOMETER NETWORK SITES	PRE LN		
		A. LIMA		HIGHLY DESIRABLE	
		B. CRO, CYI		1 OF 2 HIGHLY DESIRABLE	

5 TRAJECTORY AND GUIDANCE

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MISSION RULES

REV	ITEM	
A	5-1	THE LAUNCH PHASE WILL BE TERMINATED FOR THE FOLLOWING CONDITIONS: A. VIOLATION OF VEHICLE BREAKUP LINE. B. $T_{FF} \leq$ 1+40 AND DECREASING AFTER TOWER JETTISON. C. VIOLATION OF ENTRY "G" LIMIT. D. V SAFE INCREASING. E. OVERSPEED CONDITIONS AT INSERTION. F. VIOLATION OF EXIT HEATING LIMITS.
	5-2	THE LES WILL NOT BE JETTISONED UNTIL MODE II CAPABILITY IS ESTABLISHED BY $T_{FF} \geq$ 1+20 AND INCREASING.
A	5-3	DELETED
A	5-4	MODE II, III, IV AND APOGEE KICK. A. THE GROUND IS PRIME FOR ABORT MODE DETERMINATION AND THE S/C IS PRIME FOR MANEUVER EXECUTION. B. MANEUVERS WILL BE INTERRUPTED WHEN T_{FF} = 1+40 AND DECREASING. C. MODE IV MANEUVERS WILL BE INTERRUPTED IF THE CURRENT ALTITUDE IS 75 NM AND DECREASING AND Hp <400K FT D. IF ENTERING, UTILIZE LIFT TO AVOID LAND. E. IF NO SLA SEP OR IF SPS FAILS: 1. Hp <40 - DO NOT BURN, CM/SM SEP BY T_{FF} = 1+40. 2. 40 <Hp <75 - GROUND WILL DECIDE TO USE SM RCS OR CM RCS ASAP OR AT APOGEE TO REDUCE Hp TO 40 NM (THE CM RCS WILL BE USED ONLY FOR THE NO SLA SEP CASES)
A	5-5	MODE III ABORTS. A. PREDICTED T_{FF} AFTER CUTOFF <1+40. 1. FULL LIFT IP ON WATER - DO NOT BURN. 2. G&N GO AND FULL LIFT IP ON LAND - BURN TO T_{FF} = 1+40, RL 90°. 3. G&N NO-GO AND FULL LIFT IP ON LAND - BURN A REDUCED ΔV TO MAINTAIN $T_{FF} \geq$1+40 AFTER C/O AND RL 90°. B. IF $\Delta T_B \leq$ 2 SECONDS, DO NOT BURN. C. IF NO IGNITION BY GETI +10 SECONDS, BURN UNTIL G&N ΔR = 0, RL 55°. (IF UNABLE TO BURN ΔR TO ZERO FLY RL90°.) ALL THRUSTING WILL BE TERMINATED AT T_{FF} = 1+40.

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MISSION RULES

REV	ITEM	
A	5-6	THE SPACECRAFT G&N WILL BE NO-GO FOR ABORT MANEUVER DETERMINATION AND MONITORING FOR THE FOLLOWING: A. CMC PROGRAM FAILURE B. RTCC AND CMC T_{FF} DIFFERENCE >40 SECONDS. C. CONFIRMED ERROR IN S/C PLATFORM VELOCITY COMPONENTS OF >50 FPS IN X OR 100 FPS IN Z. D.
	5-7	THE ORBIT IS "GO" IF $h_p \geq 75$ NM.
		RULE NUMBERS 5-8 THROUGH 5-19 ARE RESERVED FOR FURTHER LAUNCH RULES.

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MISSION RULES

REV	ITEM	
	5-20	MANNED VEHICLE ORBITAL ALTITUDE CONSTRAINTS. A. REAL-TIME MISSION PLANNING PERIGEE - 80 NM MINIMUM. MAXIMUM IS DEFINED BY RCS REDLINES. APOGEE - TBD. MAXIMUM B. CONTINGENCY (VIOLATIONS MUST BE CORRECTED ASAP) PERIGEE - 75 NM MINIMUM. APOGEE - TBD.
	5-21	CONTINGENCY CSM SEPARATION MANEUVERS. A. IMPENDING S-IVB OR UNMANNED LM EXPLOSION: 55 FPS SPS ASAP. B. S-IVB OR UNMANNED LM ATTITUDE RATES ≥5°/SEC: 5 FPS RCS ASAP. C. S-IVB OR UNMANNED LM YAW ATTITUDE >45°: 5 FPS RCS ASAP. D. CSM DEORBIT REQUIRED WHILE ATTACHED TO S-IVB: MANEUVER CSM/S-IVB TO RETROGRADE, HEADS-UP, HORIZON MONITOR ATTITUDE; SEPARATE 20 MINUTES PRIOR TO PLANNED RETROFIRE (OR GROUND/CREW AGREED UPON TIME) WITH 5 FPS +X TRANSLATION. E. CSM DEORBIT REQUIRED WHILE ATTACHED TO LM OR DOCKING RING: MANEUVER CSM/LM TO POSIGRADE, HEADS-DOWN, HORIZON MONITOR ATTITUDE; SEPARATE 20 MINUTES PRIOR TO PLANNED RETROFIRE (OR GROUND/CREW AGREED UPON TIME) WITH 5 FPS -X TRANSLATION.
	5-22	SPACECRAFT COMPUTER TIMING UPDATES ARE REQUIRED FOR SET ERRORS GREATER THAN: A. LGC AND CMC >0.5 SECONDS. B. AGS >.5 SECONDS. C. SPACECRAFT L.O. TIME WILL BE REPLACED BY SRO L.O., ON THE GRD, IF THE DIFFERENCE BETWEEN CMC L.O. TIME AND SRO L.O. TIME IS >10 SEC. THE S/C WILL BE UPDATED TO THE SRO L.O. TIME.
		RULE NUMBERS 5-23 THROUGH 5-29 ARE RESERVED FOR FURTHER ORBIT RULES.

REV	ITEM	
	5-30	MANEUVER RETARGETING AND STATE VECTOR UPDATES MAY BE REQUIRED WHEN RTCC TRAJECTORY UPDATES CAUSE PLANNED ORBITAL MANEUVERS TO RESULT IN UNACCEPTABLE TRAJECTORY CHARACTERISTICS.
	5-31	THE CMC (CSM) OR LGC (LM) WILL BE NO-GO FOR MANEUVERS FOR ANY OF THE FOLLOWING: A. COMPUTER FAILURE. B. CMC/IMU ALIGNMENT DISCREPANCY FOR MANEUVER, MONITORING AND ORBIT DETERMINATION. 1. SEXTANT STAR CHECK: AUTO OPTICS POSITIONING DOES NOT PLACE SELECTED STAR WITHIN 5 DEG OF THE CENTER OF THE TELESCOPE. 2. HORIZON CHECK ERROR >4 DEG FOR RETROFIRE. C. LGC/IMU ALIGNMENT DISCREPANCY. 1. AOT ANGLE A_1 ERROR > _____ DEG 2. AOT ANGLE A_2 ERROR > _____ DEG 3. HORIZON CHECK ERROR > _____ DEG D. DIFFERENCES BETWEEN CMC/LGC/GND NAV CHECK AFTER A NAV UPDATE FROM GROUND IS: 1. ϕ >0.02 DEG 2. λ >0.02 DEG 3. H >0.2 NM
A	5-32	NON-CRITICAL MANEUVERS WILL BE NO-GO OR TERMINATED FOR: A. h_p <80 NM AND DECREASING B. ATTITUDE EXCURSIONS >10 DEG C. D. ATTITUDE RATES >5 DEG/SEC E. 1 SEC OVERBURN WHEN UNDOCKED F. 3 SEC OVERBURN WHEN DOCKED
A	5-33	CRITICAL MANEUVERS WILL BE COMPLETED BY SCS (MTVC OR AUTO) OR AGS TAKEOVER FOR ANY OF THE FOLLOWING: A. ATTITUDE EXCURSIONS ≥ 10 DEG B. C. ATTITUDE RATES ≥ 5 DEG/SEC

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MISSION RULES

REV	ITEM	
	5-34	IF h_p <75 NM AND MANEUVER TO RAISE h_p IS NOT POSSIBLE (REF 5-20B): A. 40 <h_p <75 - EXECUTE SPS RETROGRADE ASAP UNTIL h_p <40. IF NO SPS, USE SM-RCS. B. h_p <40 - CM/SM SEP, RETRO WILL RECOMMEND ENTRY PROFILE.

RULE NUMBERS 5-35 THROUGH 5-39 ARE RESERVED FOR FURTHER MANEUVER RULES.

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MISSION RULES

REV	ITEM	
	5-40	MINIMUM ACCEPTABLE TARGET ORBIT FOR THE TARGET VEHICLE IS 110 NM CIRCULAR.
A	5-41	RENDEZVOUS PLANS SHALL, WHERE POSSIBLE, SATISFY THE FOLLOWING CONSTRAINTS: A. RENDEZVOUS MANEUVERS THROUGH TPI MUST BE AT LEAST 30 MINUTES APART. B. TPI ELEVATION ANGLE (27.5 DEG) WILL EXIST WHEN THE CSM IS 25 MIN FROM SUNRISE. C. THE ALLOWABLE SLIP IN TPI TIME IS 4 MIN EARLY OR 20 MIN LATE. D. THE ΔH (ABOVE AND BELOW) RESULTING FROM THE PHASING MANEUVER WILL BE 12 ±1 NM E. ΔH AFTER CDH IS CONSTRAINED TO BE +10 NM. F. G. AT LEAST 12 MINUTES OF TRACKING, ENDING AT LEAST 17 MINUTES PRIOR TO EACH MANEUVER. H. A VOICE UPDATE SITE AT LEAST 10 MINUTES PRIOR TO EACH MANEUVER BUT AT LEAST 7 MINUTES AFTER TRACKING ENDS.
A	5-42	THE PGNS IS PRIME FOR CSI AND CDH SOLUTIONS WITH THE AGS AS BACKUP UTILIZING THE ACCEPTED SOLUTION. A. THE ONBOARD SOLUTION OF CSI WILL NOT BE USED IF DIFFERENT FROM THE GROUND BY: 1. $\delta\Delta V_X = \pm 2$ FPS 2. $\delta\Delta V_Y = \pm 5$ FPS B. THE ONBOARD SOLUTION OF CDH WILL NOT BE USED IF DIFFERENT FROM THE GROUND BY: 1. TPI GETI -6-1/2 MIN (EARLY) OR +22-1/2 MIN (LATER). 2. $\delta\Delta V_X = \pm 2$ FPS 3. $\delta\Delta V_Y = \pm 5$ FPS 4. $\delta\Delta V_Z = \pm 6$ FPS C. CSI AND CDH OUT-OF-PLANE COMPONENTS ($\dot{Y}$) WILL NOT BE EXECUTED IF ≤ 1 FPS. IF A PLANE CHANGE MANEUVER OF >10 FPS IS REQUIRED (DURING THE RENDEZVOUS), IT MAY BE SCHEDULED FOR THE LM FOLLOWING CDH, OR CSI/CDH MAY BE REPLACED WITH N_{CC}/N_{SR} MANEUVER COMBINATION.

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MISSION RULES

REV	ITEM	
A	5-43	THE ORDER OF PRIORITY FOR TPI_{o_1} SOLUTIONS IS LGC, BACKUP CHARTS, CMC. THE LGC SOLUTION WILL NOT BE USED IF DIFFERENT FROM THE CMC BY: A. $\delta\Delta V_x = \pm 2$ FPS B. $\delta\Delta V_y = \pm 5$ FPS C. $\delta\Delta V_z = \pm 6$ FPS
A	5-44	THE ORDER OF PRIORITY FOR TPI_{o_2} SOLUTIONS IS LGC, BACKUP CHARTS, CMC, AND GROUND. THE ONBOARD LGC OR CMC TPI_{o_2} SOLUTIONS WILL NOT BE USED IF DIFFERENT FROM THE GROUND BY: A. $\delta\Delta V_x = \pm 2$ FPS B. $\delta\Delta V_y = \pm 5$ FPS C. $\delta\Delta V_z = \pm 6$ FPS
A	5-45	A. THE ORDER OF PRIORITY FOR TPI_F SOLUTIONS IS G&N, BACKUP CHARTS, CMC, GROUND. THE ONBOARD SOLUTIONS WILL NOT BE USED IF DIFFERENT FROM THE GROUND BY: 1. LGC (A) GETI ± 2 MINUTES (B) F/A ± 2 FPS (C) R/L ± 5 FPS (D) D/U ± 6 FPS 2. CMC (A) GETI ± 2 MINUTES (B) $\delta\Delta V_x = \pm 2$ FPS (C) $\delta\Delta V_y = \pm 5$ FPS (D) $\delta\Delta V_z = \pm 6$ FPS B. THE LGC SOLUTION WILL NOT BE USED IF DIFFERENT FROM THE CMC BY: 1. GETI ± 2 MINUTES 2. $\delta\Delta V_x = \pm 2$ FPS 3. $\delta\Delta V_y = \pm 5$ FPS 4. $\delta\Delta V_z = \pm 6$ FPS
		RULE NUMBERS 5-46 THROUGH 5-49 ARE RESERVED FOR FURTHER RENDEZVOUS RULES.

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MISSION RULES

REV	ITEM	
	5-50	RETROFIRE MANEUVERS WILL BE PLANNED SUCH THAT TIME BETWEEN GETI AND 400K FT WILL BE ≥ 9 MINUTES.
	5-51	IF $\Delta T_B \leq 7$ SECONDS, USE SCS AUTO TVC.
	5-52	PLANNED G&N AND SCS RETROFIRE MANEUVERS WILL BE UPDATED IF: A. THE COMPUTED RETROFIRE POSITION CHANGES BY >0.50 DEG LONGITUDE PRIOR TO GETI - 30 MINUTES. B. THE COMPUTED RETROFIRE POSITION CHANGES BY >2 DEG LONGITUDE AFTER GETI - 30 MINUTES.
	5-53	IF SPS FAILS AFTER IGNITION: A. Hp >75 NM - RETARGET FOR NEXT BEST PTP WITH RCS. B. 40 <Hp <75 NM - PITCH UP 50 DEG FROM RETRO ATTITUDE AND BURN SM-RCS USING FOLLOWING PRIORITIES: 1. BURN Hp TO PAD VALUE. 2. BURN MAXIMUM SM ΔV AVAILABLE IF SM-RCS ΔV INSUFFICIENT TO OBTAIN 40 NM BURN CM-RCS TO 40 NM C. Hp <40 NM - REMAIN IN RETRO ATTITUDE AND BURN SM-RCS USING FOLLOWING PRIORITY: 1. BURN ΔV RESIDUALS. 2. BURN MAXIMUM SM ΔV AVAILABLE. NOTE: IF Hp <40 NM TERMINATE ALL THRUSTING BY T_{ff} = 9 MINUTES.
	5-54	NO SLA SEP. A. S-IVB LOX DUMP CAPABILITY WILL BE USED FOR: 1. ORBIT SHAPING FOR A RETROFIRE MANEUVER. 2. REDUCING THE WEIGHT OF THE S-IVB TO OBTAIN MORE ΔV CAPABILITY FROM THE SM-RCS. B. THE S/C WILL PERFORM A HYBRID TYPE RETROFIRE WITH THE S-IVB/CSM STACK, USING 500 SEC SM-RCS PLUS CM-RCS TO OBTAIN $h_p \leq 40$ NM
	5-55	THE G&N IS NO-GO FOR ENTRY IF: A. CMC VALUE OF DOWNRANGE ERROR (R_P - R_T) AT .2g DIFFERS >±100 NM FROM GROUND VALUE OR >±130 NM FROM BACKUP CHART VALUE. CREW FAILOVER TO EMS ENTRY AS FIRST PRIORITY OR GROUND BANK ANGLE AND RETRB AS SECOND PRIORITY. B. V AND γ AT 400K ARE OUTSIDE CORRIDOR. GROUND WILL PROVIDE ENTRY PROFILE. RULE NUMBERS 5-56 THROUGH 5-69 ARE RESERVED.

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MISSION RULES

REV	ITEM	
A	5-70	RANGE SAFETY POLICIES AND CRITERIA ARE SPECIFIED IN AFETR MANUAL (AFETRM) 127-1, DATED JANUARY 1, 1969. THE FOLLOWING MISSION RULES CONCERNING SPECIFIC ETR/NASA INTERFACE SUPPLEMENT AFETRM 127.1.
A	5-71	THE RSO WILL ACCOMPLISH THE PAD EMERGENCY RANGE CUTOFF PROCEDURE IF IGNITION OCCURS BUT THE SPACE VEHICLE WILL NOT LIFT OFF AND NASA IS UNABLE TO ACCOMPLISH CUTOFF. THE RSO WILL SEND "ARM/MFCO" ONLY IN RESPONSE TO A CODED VERBAL REQUEST FROM THE NASA LAUNCH VEHICLE TEST CONDUCTOR (CLTC). THE CLTC WILL CALL THE RSO ON THE GREENPHONE CLTC-RSO LINK TO TRANSMIT THIS REQUEST. THE RSO WILL NOT EXECUTE THIS PROCEDURE IF HE HAS A LIFTOFF INDICATION.
A	5-72	THE FLIGHT DIRECTOR (FD) WILL INITIATE ABORT REQUEST IN RESPONSE TO A CODED VERBAL REQUEST FROM THE RSO. THIS PROCEDURE WILL BE EXECUTED IF RANGE SAFETY FLIGHT TERMINATION CRITERIA HAVE BEEN VIOLATED AND RSO EFFORTS TO TERMINATE THRUST HAVE FAILED. THE REQUEST FROM RSO TO FD WILL BE TRANSMITTED ON THE FIDO-RSO PRIVATE LINE WITH THE FLIGHT DIRECTOR LOOP AS BACKUP.
	5-73	THE RSO WILL SEND "ARM/MFCO" IN RESPONSE TO A CODED VERBAL REQUEST FROM THE FLIGHT DIRECTOR (FD) OR THE FLIGHT DYNAMICS OFFICER (FIDO). THIS PROCEDURE WILL BE EXECUTED IF ABORT LIMITS HAVE BEEN EXCEEDED AND ABORT ACTION HAS BEEN UNSUCCESSFUL. THE REQUEST FROM FD/FIDO TO THE RSO WILL BE TRANSMITTED ON THE APOLLO RSO LOOP, WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.
A	5-74	THE FD WILL INFORM THE RSO WHEN THE #3 ENGINE HAS SHUT DOWN BY STATING "RSO, #3 OUT" AND/OR ACTIVATE THE ENGINE OUT LIGHT ON THE RSO CONSOLE.
A	5-75	IF RANGE SAFETY DESTRUCT LINES ARE VIOLATED, THE RSO WILL SEND "ARM/MFCO" AND NOTIFY THE FD/FIDO. NO SPS THRUSTING MANEUVER WILL BE INITIATED FOLLOWING SUCH RANGE SAFETY ACTION.
A	5-76	IF THE "ARM/MFCO" COMMAND IS REQUIRED AND TRANSMITTED, AND AN ESTABLISHED IMPACT POINT (IP) IS ON THE CAPE KENNEDY LAND AREA, "DESTRUCT/PD" WILL BE SENT. "DESTRUCT/PD" WILL BE USED TO TERMINATE THRUST IF AN IP CANNOT BE ESTABLISHED.
A	5-77	WHEN THE IP HAS MOVED OFF THE CAPE, FLIGHT TERMINATION ACTION WILL BE LIMITED TO "ARM/MFCO" OR CREW INITIATED ABORT. THE "DESTRUCT/PD" FUNCTION WILL BE SENT AS NECESSARY ONLY FOR DISPERSION PURPOSES, AND ONLY AFTER FD/FIDO CONFIRMATION OF SATISFACTORY SPACECRAFT SEPARATION.
A	5-78	IF A SATISFACTORY IP IS ESTABLISHED AND "DESTRUCT/PD" IS DEEMED UNNECESSARY, THE RSO WILL NOTIFY FD/FIDO AND SEND "SAFE" UPON FD/FIDO'S REQUEST.

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MISSION RULES

REV	ITEM	
A	5-79	FD/FIDO WILL DECLARE TO THE RSO WHEN THERE IS NO POSSIBILITY OF INSERTING THE SPACECRAFT INTO AN ORBIT, AND THE RSO WILL NOT ALLOW THE AFRICAN GATE TO BE OVERFLOWN.
A	5-80	AN ETR RANGE SAFETY OFFICER (BRSO) IS REQUIRED AT BERMUDA TO MONITOR PRESENT POSITION AND IMPACT PREDICTION CHARTS, AND TO TRANSMIT THE RANGE SAFETY FUNCTIONS WHEN COMMANDED TO DO SO BY THE RSO. THE BRSO WILL ASSUME RANGE SAFETY RESPONSIBILITY IN THE EVENT OF LOSS OF COMMUNICATIONS BETWEEN THE BRSO AND THE RSO.
A	5-81	SAFING BY THE RSO WILL BE DONE ONLY IF THE RSO HAS VERIFICATION OF S-IVB C/O OR THE FD/FIDO REQUESTS "SAFE". WHEN SAFING IS CONFIRMED, THE RSO WILL STATE TO THE FD/FIDO "SAFING CONFIRMED."
A	5-82	IF SAFING CANNOT BE CONFIRMED BY THE RSO, ANOTHER SAFING ATTEMPT WILL BE MADE BY THE RSO ON THE FIRST ORBITAL PASS OVER THE CAPE. COORDINATION WILL BE EFFECTED WITH THE SUPERINTENDENT OF RANGE OPERATIONS (SRO) AND FIDO TO ENSURE COMMAND COVERAGE, NON-INTERFERENCE WITH OTHER COMMAND FUNCTIONS, AND TELEMETRY DISPLAY AVAILABILITY. AT THE AGREED TIME, FIDO WILL STATE, "COMMAND CLEAR, RSO SEND SAFE." UPON CONFIRMATION, THE RSO WILL STATE, "SAFING CONFIRMED."
A	5-83	TRACKING SOURCES AT LEAST TWO (2) VEHICLE POSITION DATA SOURCES ARE MANDATORY BEFORE LAUNCH FOR EACH PHASE OF POWERED FLIGHT TO ENABLE THE RANGE SAFETY OFFICER TO DETERMINE IF THE SPACE VEHICLE IS NORMAL OR VIOLATES ESTABLISHED INFLIGHT SAFETY CRITERIA.
A	5-84	DATA FROM TWO (2) OF THE FOLLOWING THREE (3) RADARS ARE MANDATORY BEFORE LAUNCH (OTHER HIGHLY DESIRABLE): BERMUDA FPS-16, BERMUDA FPQ-6, AND GRAND TURK TPQ-18.
A	5-85	XY, XZ AND IP PLOTS AT BERMUDA (BDA) USING INPUTS FROM EITHER THE BDA FPS-16 OR BDA FPQ-6 RADAR ARE HIGHLY DESIRABLE FOR LAUNCH.
A	5-86	ODOP DATA TO THE CAPE KENNEDY REAL-TIME COMPUTER SYSTEM (RTCS) FOR IP COMPUTATION AND RSO DISPLAY DURING FIRST STAGE BURN ARE HIGHLY DESIRABLE.

REV	ITEM	
A	5-87	AIRBORNE SYSTEMS: TWO (2) OPERATIONAL RANGE SAFETY COMMAND RECEIVERS ON EACH LAUNCH VEHICLE STAGE (S-IC, S-II, AND S-IVB) ARE MANDATORY FOR LAUNCH. THE RANGE SAFETY SUPERVISOR (CRSS) AT THE LAUNCH CONTROL CENTER WILL DETERMINE IF THE RECEIVERS ARE OPERATING PROPERLY FOR LAUNCH.
A	5-88	ONE (1) OF TWO (2) IU C-BAND BEACONS IS MANDATORY FOR LAUNCH. (OTHER HIGHLY DESIRABLE).
A	5-89	COMMAND/CONTROL THE NASA BERMUDA DRS COMMAND/CONTROL SYSTEM IS MANDATORY FOR LAUNCH.
A	5-90	RANGE SAFETY COMMAND ("ARM/MFCO" AND "DESTRUCT/PD") WILL HAVE MANDATORY PRECEDENCE OVER ALL OTHER COMMANDS. TIMERS IN THE RCC WILL PROVIDE A 4 SECOND TIME DELAY BETWEEN "ARM/MFCO" AND "DESTRUCT/PD."
A	5-91	COMMUNICATIONS: TWO (2) PRIVATE, INDEPENDENT, GEOGRAPHICALLY DIVERSIFIED COMMUNICATIONS LINKS BETWEEN THE RSO AND BRSO ARE REQUIRED. ONE OF TWO COMM LINKS IS MANDATORY.
A	5-92	TWO (2) OF THE FOLLOWING THREE (3) COMMUNICATIONS LINKS ARE MANDATORY BETWEEN THE RSO AND FD/FIDO: A. RSO LOOP (CAPE 111). B. RSO PRIVATE LINE (GREENPHONE/YELLOWPHONE). C. FLIGHT DIRECTOR LOOP.
A	5-93	A COMMUNICATIONS LINK BETWEEN THE RSO AND THE RANGE SAFETY SUPERVISOR (CRSS) AT THE LAUNCH CONTROL CENTER IS MANDATORY.
A	5-94	A GREENPHONE COMMUNICATIONS LINK BETWEEN THE RSO AND THE LAUNCH VEHICLE TEST CONDUCTOR (CLTC) IS HIGHLY DESIRABLE.

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MISSION RULES

REV	ITEM	
A	5-95	TELEMETRY: IU TELEMETRY DATA (ONBOARD GUIDANCE PARAMETERS) TO THE RTCS ARE HIGHLY DESIRABLE FROM T+0 UNTIL S-IVB CUTOFF FOR IP COMPUTATION AND RSO DISPLAY.
A	5-96	TELEMETRY REQUIREMENTS TO BE DISPLAYED FOR THE RSO AND BRSO ARE HIGHLY DESIRABLE. FOR LAUNCH VEHICLE AND SPACECRAFT HARDWARE ENTRIES AND APPROPRIATE CATEGORIES, REFERENCE THE FOLLOWING ITEMS: A. FOR RSO DISPLAY (SEE ATCH #1) B. FOR BRSO DISPLAY (SEE ATCH #2)
A	5-97	WEATHER: WIND RESTRICTIONS: AN ANNUAL PROFILE WIND RESTRICTION OF 1.25 SIGMA (11%) WILL BE IN EFFECT FOR THE LAUNCH AREA.
A	5-98	CEILING AND VISIBILITY RESTRICTIONS: MINIMUM RANGE SAFETY CEILING 2000 FEET WITH PAD VISIBLE FROM 11 NM.

6 SLV – TB1 THROUGH
TB4/TB4A

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-1	S-IC STAGE LOSS OF THRUST			
		A. ANY SINGLE ENGINE PRIOR TO TB3.	LAUNCH	A. CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO.	A&B. CUES: 1. THRUST OK SWITCHES (K33-115; K34-115; K35-115; K36-115; K37-115; K38-115; K39-115; K40-115; K41-115; K42-115; K43-115; K44-115; K45-115; K46-115; K47-115
		B. ANY TWO OR MORE ENGINES	LAUNCH		
		1. PRIOR TO DEACTIVATION OF TWO ENGINES OUT AUTOMATIC ABORT.		B.1. ABORT. BSE INFORM FLIGHT AND FIDO AND TRANSMIT ABORT REQUEST (ABORT WILL BE INITIATED AUTOMATICALLY).	
		2. AFTER DEACTIVATION OF TWO ENGINES OUT AUTOMATIC ABORT.		2. CONTINUE MISSION. (A) BSE INFORM FLIGHT AND FIDO. (B) CAPCOM ADVISE CREW OF POTENTIAL OVERRATE CONDITION.	2. THRUST CHAMBER PRESSURE <500 PSIA (D8-101 THROUGH D8-105) 3. LONGITUDINAL ACCELERATION. (VA2-603) 4. FINAL THRUST OK CUTOFF. (K52-115, K53-115, K54-115, K55-155, K56-115) A&B. NOTE: 1. CREW MAY DEACTIVATE AUTOMATIC ABORT AFTER TB1 + 120 SEC.
		C. LOSS OF THRUST-ENGINE 3 (THIS RULE APPLIES ONLY FOR THE UNIQUE CASE OF ENGINE 3 THRUST LOSS BETWEEN 0 TO 45 SEC.)	LAUNCH	C. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. FLIGHT WILL INFORM RSO.	C. CUES: 1. THRUST CHAMBER PRESSURE, (D8-103) < 500 PSIA 2. THRUST OK SWITCHES OFF (K39-115; K40-115; K41-115) 3. FINAL THRUST OK SWITCHES OFF (K54-115)
		1. VOICE COMM WITH RSO		1.(A) FLIGHT CONFIRM ENGINE 3 OUT VIA RSO PRIVATE LINE (B) FLIGHT CONFIRM NO OTHER KNOWN ANOMALIES BY LITE ACTIVATION AND VOICE REPORT	C. NOTES: 1. RSO LOOP 111 OR FD LOOP BACKUP TO PL. 2. CONFIRMATION OF NO OTHER KNOWN ANOMALIES WILL BE BASED ON: (A) ENGINE CHAMBER PRESSURE ABOVE 500 PSI AND HOLDING. (B) THRUST OK SWITCHES ON.
		2. NO VOICE COMM WITH RSO		2. FLIGHT CONFIRM ENGINE 3 OUT AND NO OTHER KNOWN ANOMALIES BY LITE ACTIVATION	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-2	S-IC STAGE GIMBAL SYSTEM FAILURE ANY SINGLE ACTUATOR HARD-OVER ANY ENGINE - PITCH OR YAW (TB1 + 0 SEC TO TB3 + 0 SEC)	LAUNCH	CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO.	CUES: 1. ACTUATOR POSITION EXCEEDS ±5 DEG (VG1-101 THROUGH VG1-104; VG2-101 THROUGH VG2-104) 2. ROLL ANGULAR RATE EXCEEDS 5 DEG/SEC (VR6-602; VR12-602) 3. ROLL ATTITUDE ERROR EXCEEDS 5 DEG (VH69-602; VH56-603). NOTES: 1. AUTOMATIC ABORT BY LES WHEN ATTITUDE RATE LIMIT IS EXCEEDED PRIOR TO AUTO ABORT/DEACTIVATION. 2. MANUAL ABORT BY LES WITH TWO CUES: (A) ATTITUDE ERROR LIMIT EXCEEDED. (B) Q-BALL ΔP (AOA) LIMIT EXCEEDED (C) PITCH OR YAW RATE LIMIT EXCEEDED
A	6-3	LOSS OF ATTITUDE CONTROL A. S-IC BURN

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-3 (CONT)				3. ACTUATOR POSITION INDICATES HARDOVER ±5 DEG OR ERRATIC ACTUATOR(S) (G8-201 THROUGH G8-204; G9-201 THROUGH G9-204) 4. S-II BURN MODE DISCRETE REMAINS OFF AT STAGING (K90-602) 5. S-IC BURN MODE DISCRETE REMAINS ON AT STAGING (K89-602)
		C. S-IVB BURN		C. BSE INFORM FLIGHT AND FIDO; CAPCOM ADVISE CREW OF IMPENDING LOSS OF ATTITUDE CONTROL.	C. S-IVB BURN 1. ANGULAR RATES EXCEED 5 DEG/SEC (VR4-602; VR8-602; VR5-602; VF12-602; VR13-602; VR6-602) 2. ROLL ATTITUDE ERROR ≥±3.5 DEG: PITCH OR YAW ATTITUDE ERROR >10 DEG (H69-602; H70-602; H71-602; H54-603; H55-603; H56-603) 3. ACTUATOR POSITION INDICATES SUSTAINED HARDOVER ±5 DEG (G1-400; G1-403) (G2-400; G2-403) 4. S-IVB BURN MODE DISCRETE REMAINS OFF AT STAGING (K20-602) NOTES: CREW ABORT LIMITS A. S-IC BURN 1. PITCH AND YAW RATES ±4 DEG/SEC 2. ROLL ±20 DEG/SEC 3. ATTITUDE ERROR >±5 DEG 4. Q-BALL ΔP >3.2 PSID B. S-II/S-IVB BURN 1. PITCH AND YAW RATES ±10 DEG/SEC 2. ROLL ±20 DEG/SEC

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A 1	6-4	ROLL PROGRAM FAILS TO INITIATE BY TB1 + 12 SEC	LAUNCH	CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO.	CUES: 1. ROLL RATE REMAINS CONSTANT AT APPROXIMATELY ZERO DEG/SEC (VR12-602; VR6-602) 2. ROLL COMMAND ANGLE REMAINS AT APPROXIMATELY LAUNCH VALUE (H60-603) 3. ROLL ATTITUDE REMAINS CONSTANT AT APPROXIMATELY LAUNCH VALUE (H69-603) 4. ROLL ATTITUDE ERROR REMAINS CONSTANT AT APPROXIMATELY ZERO (H69-602; VH56-602) 5. GUIDANCE MODE WORD ONE (MODE CODE 25) BIT D24 (H60-603)
A 1	6-5	PITCH PROGRAM FAILS TO INITIATE BY TB1 + 12 SEC	LAUNCH	CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO THAT VEHICLE WILL CONTINUE VERTICAL FLIGHT AND WILL EVENTUALLY VIOLATE RSO LIMITS. FIDO INFORM RSO.	CUES: 1. GUIDANCE MODE WORD ONE (MODE CODE 25) BIT D24 NOT SET TO "ONE" (H60-603) 2. PITCH COMMANDED ANGLE REMAINS AT APPROXIMATELY ZERO DEGREES (H60-603) 3. PITCH RATE REMAINS CONSTANT AT APPROXIMATELY ZERO DEG/SEC (VR4-602, VR13-602) 4. PITCH GIMBAL ANGLE REMAINS CONSTANT AT APPROXIMATELY ZERO OR 360° (H60-603) 5. PITCH ATTITUDE ERROR REMAINS CONSTANT AT APPROXIMATELY ZERO (VH71-602, VH54-603)

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-6	ROLL PROGRAM FAILS TO TERMINATE BY TB1 + 35 SEC	LAUNCH	CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO. CAPCOM ADVISE CREW OF TRAJECTORY DEVIATION AND VEHICLE CONTINUOUS ROLL.	CUES: 1. GUIDANCE MODE WORD ONE (MODE CODE 25) BIT D23 NOT SET TO ONE (H60-603) 2. ROLL COMMAND ANGLE NOT EQUAL TO ZERO (H60-603) 3. ROLL RATE REMAINS CONSTANT AT APPROXIMATELY 1 DEG/SEC (VR12-602; VR6-602) 4. ROLL ATTITUDE ERROR REMAINS IN EXCESS OF 0.5 DEGREES. (VH56-603; H69-602) 5. ROLL GIMBAL ANGLE CONTINUES TO CHANGE (H60-603) NOTE: CUES 1 AND 4 MUST CONCUR WITH CUE 2 AND/OR 3 BEFORE THEY CAN BE INTERPRETED AS INDICATIONS OF FAILURE.
A 1	6-7	PITCH PROGRAM FAILS TO TERMINATE BY TB1 + 2 MIN 37 SEC	LAUNCH	CONTINUE MISSION. A. BSE INFORM FLIGHT AND FIDO. B. CAPCOM ADVISE CREW OF CONTINUOUS PITCH THROUGH S-IC/S-II STAGING OF APPROXIMATELY 0.3 DEG/SEC.	CUES: 1. GUIDANCE MODE WORD (MODE CODE 25) BIT D21 NOT SET TO ONE (H60-603) 2. PITCH COMMAND ANGLE CONTINUES TO DECREASE (H60-603) 3. PITCH RATE REMAINS APPROXIMATELY 0.3 DEGREES/SECOND (VR4-602, VR13-602) 4. PITCH GIMBAL ANGLE CONTINUES TO DECREASE (H60-603) NOTE: PITCH PROGRAM COULD BE EXTENDED BY AS LONG AS 60 SEC WITH ONE S-IC ENGINE OUT.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-8	INERTIAL PLATFORM FAILURE - ACCELEROMETER	LAUNCH	CONTINUE MISSION. A. BSE INFORM FLIGHT, FIDO, AND GUIDO. B. CAPCOM ADVISE CREW OF PROBABLE DEGRADED ORBIT.	CUES: 1. GUIDANCE STATUS WORD ____ (MODE CODE 24) (H60-603) BITS D26 AND D25 FOR Z ACCEL SET TO "ONE" BITS D24 AND D23 FOR X ACCEL SET TO "ONE" BITS D22 AND D21 FOR Y ACCEL SET TO "ONE" 2. ACCELEROMETER PICKOFFS (X, Y, OR Z) INDICATE IN EXCESS OF 0.5° OR REMAIN CONSTANT AT ZERO (VH10-603, VH11-603, VH12-603) NOTES: 1. NO EFFECT ON VEHICLE TRAJECTORY DURING S-IC BURN. 2. LVDC SWITCHES TO A BACK-UP MODE AND UTILIZES A PRECOMPUTED F/M PROFILE FOR FAILED AXIS DURING THE S-IC, S-II AND S-IVB BURNS.
A	6-9	LAUNCH VEHICLE INERTIAL PLATFORM FAILURE - ATTITUDE REFERENCE A. PRIOR TO TB1 + 50 SEC B. AFTER TB1 + 50 SEC BUT PRIOR TO TB1 + 100 SEC C. AFTER TB1 + 100 SEC	LAUNCH	A. ABORT BSE INFORM FLIGHT, FIDO AND GUIDO, TRANSMIT ABORT REQUEST AT 50 SEC. B. ABORT BSE INFORM FLIGHT, FIDO AND GUIDO, TRANSMIT ABORT REQUEST (REF NOTE 3). C. CONTINUE MISSION. BSE INFORM FLIGHT, FIDO AND GUIDO (REF NOTE 4).	CUES: 1. GUIDANCE STATUS WORD - (MODE CODE 24) (H60-603) BITS D20 AND D19 FOR Z GIMBAL SET TO "ONE" BITS D18 AND D17 FOR X GIMBAL SET TO "ONE" BITS D16 AND D15 FOR Y GIMBAL SET TO "ONE" 2. LADDER OUTPUTS CONSTANT FOR FAILED AXIS (H54-603; H55-603; H56-603) 3. GUIDANCE MODE WORD #2 (MODE CODE 26) BIT D8 SET TO ONE NOTES: 1. THE LVDC/LVDA WILL HOLD THE LADDER SIGNALS AT THE LAST PREVIOUS VALID VALUE. 2. ATTITUDE CONTROL WILL BE LOST IN THE FAILED AXIS. 3. CREW PERFORM MANUAL ABORT ON THE TWO GUIDANCE FAILURE LIGHTS. 4. MANUAL ABORT WHEN FIDO LIMITS ARE EXCEEDED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-10	S-II STAGE GIMBAL SYSTEM FAILURE ANY SINGLE ACTUATOR HARDOVER (IN BOARD) A. PRIOR TO S-IVB TO ORBIT CAPABILITY B. AFTER S-IVB TO ORBIT CAPABILITY	LAUNCH	A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING.	CUES: 1. YAW ACTUATOR POSITION EXCEEDS +6 DEGREES (VG8-201 THROUGH 204) (G30-201 THROUGH 204) 2. PITCH ACTUATOR POSITION EXCEEDS +6 DEGREES (G9-201 THROUGH 204) (G31-201 THROUGH 204) 3. ROLL ATTITUDE ERROR EXCEEDS 5 DEG (VH69-602 AND VH56-603) 4. ROLL ATTITUDE RATE EXCEEDS 3 DEG/SEC (VR12-602 AND VR6-602)
		RULE NUMBERS 6-11 THROUGH 6-15 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-17	S-II LOSS OF THRUST	LAUNCH		CUES:
		A. ANY SINGLE ENGINE - FAILURE TO ATTAIN THRUST OR LOSS OF THRUST PRIOR TO NOMINAL S-II CUTOFF		A. CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO.	A.1. THRUST OK SWITCHES - OFF (K285-201 THROUGH 205) (K286-201 THROUGH 205) 2. THRUST CHAMBER PRESSURE <300 PSIA (D13-201 THROUGH 205) 3. LONGITUDINAL ACCELERATION (A2-603)
		B. ANY TWO ENGINES - FAILURE TO OBTAIN THRUST OR LOSS OF THRUST PRIOR DEPLETION SENSORS CUTOFF ARMED (TB3 + 5 MIN 39 SEC)			B.1.(A) TWO ENGINES OUT (CUES A.1, A.2, A.3) (B) ANGULAR RATE (R6-602, R8-602, R4-602, R13-602, R12-602, R5-602) (C) ATTITUDE ERRORS (H54-603, H55-603, H56-603, H69-602, H70-602, H71-602) (D) COMMAND ANGLES AND GIMBAL ANGLES (H60-603)
		1. ATTITUDE ERROR EXCEEDS 40 DEG		B.1. ABORT BSE INFORM FLIGHT AND FIDO TRANSMIT ABORT REQUEST.	
		2. ABORT LIMITS NOT EXCEEDED		2. EARLY STAGE BSE INFORM FLIGHT AND FIDO RECOMMEND EARLY STAGING AT CHI FREEZE PLUS 5 SEC.	B.2.(A) TWO ENGINES OUT (CUES A.1, A.2, A.3) (B) ANGULAR RATE (R6-602, R8-602, R4-602, R13-602, R12-602, R5-602) (C) ATTITUDE ERRORS (H54-603, H55-603, H56-603, H69-603, H70-602, H71-602) (D) COMMAND ANGLES AND GIMBAL ANGLES (H60-603)
		C. THREE OR MORE ENGINES-FAIL TO ATTAIN THRUST OR LOSS OF THRUST PRIOR TO S-IVB TO ORBIT CAPABILITY		C. ABORT BSE INFORM FLIGHT AND FIDO TRANSMIT ABORT REQUEST.	C.1. THRUST OK SWITCHES - OFF (K285-201 THROUGH 205) (K286-201 THROUGH 205) 2. THRUST CHAMBER PRESSURE <300 PSIA (D13-201 THROUGH 205) 3. LONGITUDINAL ACCELERATION (A2-603)
		D. THREE OR MORE ENGINES-LOSS OF THRUST AFTER S-IVB TO ORBIT CAPABILITY BUT PRIOR TO DEPLETION SENSORS CUTOFF ARMED		D. EARLY STAGE BSE INFORM FLIGHT AND FIDO RECOMMEND IMMEDIATE EARLY STAGING.	D.1. THRUST OK SWITCHES - OFF (K285-201 THROUGH 205) (K286-201 THROUGH 205) 2. THRUST CHAMBER PRESSURE <300 PSIA (D13-201 THROUGH 205) 3. LONGITUDINAL ACCELERATION (A2-603)
		E. TWO OR MORE ENGINES LOSS OF THRUST AFTER DEPLETION SENSORS CUTOFF ARMED		E. CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO.	E.1. THRUST OK SWITCHES - OFF (K285-201 THROUGH 205) (K286-201 THROUGH 205) 2. THRUST CHAMBER PRESSURE <300 PSIA (D13-201 THROUGH 205) 3. LONGITUDINAL ACCELERATION (A2-603) NOTE: CREW WILL TAKE APPROPRIATE ACTION BASED ON ENGINE OUT LIGHTS AND 10 DEG/SEC ANGULAR RATE.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-18	ITERATIVE GUIDANCE MODE (IGM) FAILS TO INITIATE AT TB3 + 41 SEC	LAUNCH	CONTINUE MISSION. A. BSE INFORM FLIGHT, FIDO AND GUIDANCE. B. CAPCOM ADVISE CREW.	CUES: 1. GUIDANCE MODE WORD 1 (MODE CODE 25) BIT D14 NOT SET TO ONE (H60-603) 2. PITCH GIMBAL ANGLE REMAINS CONSTANT (H60-603) 3. PITCH COMMANDED ANGLE REMAINS CONSTANT (H60-603) 4. ATTITUDE ERROR REMAINS AT APPROXIMATELY ZERO (H69-602, H70-602, H71-602, H54-603, H55-603, H56-603) NOTE: CUTOFF WILL BE INITIATED FROM SPACECRAFT BASED ON VIOLATION OF FIDO OR RSO LIMIT LINES.
A	6-19	S-II SECOND PLANE SEPARATION FAILS TO OCCUR BY TB3 + 31 SEC	LAUNCH	ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST PRIOR TO TB3 + 46 SEC.	CUES: 1. SECOND PLANE SEPARATION INDICATES NO SEPARATION (VM86-206; M87-206) 2. GUIDANCE MODE WORD 1 (MODE CODE 25) BIT D15 REMAINS ZERO (H60-603) 3. IGNITION BUS VOLTAGE REMAINS AT APPROXIMATELY 28 VDC (XM125-207) 4. RECIRCULATION BUS VOLTAGE REMAINS AT APPROXIMATELY 56 VDC (XM111-207) NOTES: 1. PROBABLE SUBSEQUENT LOSS OF VEHICLE DUE TO EXCESSIVE TEMPERATURE. 2. MANUAL ABORT BY CREW WITH ONBOARD INDICATION.
		RULE NUMBERS 6-22 THROUGH 6-26 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-27	S-IVB GIMBAL SYSTEM FAILURE A. S-IVB ENGINE ACTUATOR HARDOVER INDICATED PRIOR TO FIRST BURN B. S-IVB LOSS OF STAGE HYDRAULIC FLUID CONFIRMED PRIOR TO FIRST BURN	LAUNCH	A. CONTINUE MISSION. 1. BSE INFORM FLIGHT AND FIDO. 2. CAPCOM ADVISE CREW OF POSSIBLE OVER-RATE CONDITION AFTER S-IVB IGNITION. CREW EXECUTE MANUAL ABORT ON ESTABLISHED LIMITS AFTER S-IVB IGNITION. B. ABORT BSE INFORM FLIGHT AND FIDO RECOMMEND ABORT PRIOR TO S-II/S-IVB STAGING.	CUES: A.1. ACTUATOR POSITION ±5 DEG OR GREATER (G1-403, G2-403) NOTE: CREW ABORT LIMITS: THE RATE LIMITS WHICH THE CREW WILL ABORT DURING S-IVB FLIGHT ARE: A. PITCH OR YAW RATE: ±10 DEG/SEC B. ROLL RATE ±20 DEG/SEC CUES: B.1. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41-403) 2. HYDRAULIC RESERVOIR OIL LEVEL APPROXIMATELY ZERO (L7-403) 3. HYDRAULIC RESERVOIR PRESSURE APPROXIMATELY ZERO (D42-403) NOTE: ALL THREE CUES MUST CONFIRM MALFUNCTION PRIOR TO BSE TAKING ACTION.
A	6-28	S-IVB STAGE LOSS OF THRUST A. FAILS TO ATTAIN THRUST BY TB4 + 10 SECONDS OR TB4A (EARLY STAGE SEQUENCE) PLUS 15 SECONDS B. S-IVB PREMATURE SHUTDOWN PRIOR TO S-IVB FIRST BURN VELOCITY CUTOFF RULE NUMBERS 6-29 THROUGH 6-30 ARE RESERVED.	LAUNCH	A. ABORT 1. BSE INFORM FLIGHT AND FIDO AND RECOMMEND ABORT. B. CONTINUE MISSION 1. BSE INFORM FLIGHT AND FIDO (REF NOTE 1).	CUES: 1. THRUST CHAMBER PRESSURE - <300 PSIA (D1-401) 2. THRUST OK SWITCHES OFF (K14-401, K157-401, K158-401, K159-401) 3. LONGITUDINAL ACCELERATION- <.3g (VA2-603) 4. TIME BASE 5 IS INITIATED, MODE CODE 25, BIT D2 SET TO ONE. (H60-603) NOTE: FIDO WILL INITIATE APPROPRIATE ACTION IF UNACCEPTABLE ORBIT IS ATTAINED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-31	TIME BASE 5 FAILS TO INITIATE AT S-IVB CUTOFF	LAUNCH	S/C SEPARATION. BSE INFORM FLIGHT AND FIDO AND RECOMMEND IMMEDIATE SEPARATION TO A SAFE DISTANCE.	CUES: 1. TIME OF TB INITIATE REMAINS AT PREVIOUS VALUE (H60-603) 2. TIME-IN-TIME BASE CONTINUES TO COUNT (H60-603) 3. GUIDANCE MODE WORD ONE (MODE CODE 25) BIT D2 NOT SET TO "ONE" (H60-603) 4. ORBITAL SEQUENCE FAILS TO INITIATE. NOTES: 1. THIS CONDITION WILL RESULT IN LOSS OF SEQUENCING AND ATTITUDE CONTROL. 2. LVDC WILL INITIATE TB5 AFTER RECEIVING ANY TWO OF FOUR FUNCTIONS, AFTER TB4 + 10 SEC OR TB4A + 15 SEC. A. S-IVB ENGINE OUT "A". B. S-IVB ENGINE OUT "B". C. S-IVB VELOCITY CUTOFF. D. ACCELEROMETER LOSS OF THRUST INDICATION.
A	6-32	FAILURE OF S-IVB TO CUTOFF A. AT NOMINAL S-IVB FIRST BURN VELOCITY CUTOFF B. AT TB6 + 10 MIN 41 SEC, TB8 + 11 MIN 41 SEC OR TB8A + 14 MIN 41 SEC	LAUNCH LAUNCH	CONTINUE MISSION. A.1. BSE INFORM FLIGHT AND FIDO 2. CAPCOM REQUEST CREW TO CUTOFF S-IVB B. BSE INFORM FLIGHT AND FIDO	CUES: 1. THRUST CHAMBER PRESSURE GREATER THAN 300 PSIA (D1-403) 2. THRUST OK SWITCHES ON (K14-401, K157-401) 3. LVDC FAILURE EMR BITS D24, D25, AND D26 SET TO ONE (H60-603)

7 SLV – TB5 AND
TB7

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	7-1	S-IVB J-2 ENGINE START BOTTLE PRESSURE GREATER THAN 1500 PSIA FOR FIRST AND SECOND RESTART (TB 6/8 AND TB8A) RULE NUMBER 7-2 IS RESERVED.	ORBIT TD&E	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: A. START TANK VENT VALVE OPEN AND CLOSED B. REPEAT AS NECESSARY TO MAINTAIN START BOTTLE PRESSURE BETWEEN 1300 AND 1500 PSIA	CUES: 1. GH2 START BOTTLE PRESSURE (D0017-401; D0241-401) NOTE: IF START BOTTLE PRESSURE REACHES 1800 PSIA AND CANNOT BE VENTED TO AN ACCEPTABLE LEVEL, THE S/C SHOULD IMMEDIATELY SEPARATE TO A SAFE DISTANCE.
A	7-3	S-IVB COLD HELIUM SHUTOFF VALVES FAIL TO CLOSE AT: A. FIRST ENGINE CUTOFF (TB5 PLUS 1.4 SEC) B. SECOND ENGINE CUTOFF (TB7 PLUS 1.4 SEC)	ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND: 1. LOX TANK FLIGHT PRESSURIZATION SHUTOFF VALVES CLOSED IF UNSUCCESSFUL, BSE SEND: 2. LOX TANK NON-PROPULSIVE VENT OPEN 3. (AT CRO FIRST REV) LOX TANK NON-PROPULSIVE VENT CLOSED 4. RECOMMEND SPACECRAFT SEPARATION IF LOX ULLAGE PRESSURE AT 50 PSIA B. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND: 1. LOX TANK FLIGHT PRESSURIZATION SHUTOFF VALVES CLOSED IF UNSUCCESSFUL, AND ULLAGE PRESSURE RISES TO 50 PSIA OR SATURATED, BSE COMMAND: 2. LOX TANK VENT VALVE OPEN AND CLOSE TO MAINTAIN ULLAGE PRESSURE BELOW 40 PSIA AT ASC LOS	CUES: 1. COLD HELIUM DISCHARGE PRESSURE GREATER THAN 100 PSIA (D105-403) 2. COLD HELIUM BOTTLE PRESSURES DECAYING (D16-425; D248-405) 3. LOX TANK ULLAGE PRESSURES AT RELIEF SETTING (D179-406; D180-406) NOTES: 1. FAILURE TO CLOSE THE SHUTOFF VALVES WILL RESULT IN THE DEPLETION OF THE COLD HELIUM 2. ACTION REQUIRE TO AVOID EXCEEDING LOX TANK OVER PRESSURE LIMITS
A	7-4	S-IVB AUXILIARY HYDRAULIC PUMP FAILS TO TURN OFF AS PROGRAMMED	ORBIT TD&E	CONTINUE MISSION. BSE INFORM FLIGHT AND TRANSMIT: AUXILIARY HYDRAULIC PUMP FLIGHT MODE OFF AS SOON AS POSSIBLE	CUES: 1. SYSTEM PRESSURE ABOVE 1700 PSIA (D41-403) 2. RESERVOIR LEVEL BELOW 50 PERCENT (L7-403) 3. AFT BUS NO. 2 CURRENT ABOVE 20 AMPS (M22-404) 4. HYDRAULIC RESERVOIR OIL PRESSURE GREATER THAN 137 PSIA (D42-403) NOTE: FAILURE TO TURN OFF HYDRAULIC PUMP DEPLETES AFT NO. 2 BATTERY IN APPROXIMATELY 90 MIN AND MAY OVERHEAT HYDRAULIC SYSTEM IN APPROXIMATELY 13 MIN.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	7-5	LOSS OF ATTITUDE CONTROL			CUES:
		A. BEFORE CSM SEP	ORBIT	A. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION	1. THE DIFFERENCE BETWEEN COMMANDED ATTITUDE (CHI) AND THE ACTUAL VEHICLE ATTITUDE (THETA) IS GREATER THAN 5 DEG AND DIVERGING (H60-603)
		B. BEFORE DOCKING	TD&E	B. CONTINUE MISSION 1. BSE INFORM FLIGHT AND FIDO 2. BSE MAY RECOMMEND NO DOCK FOR LVDC FAILURE 3. CAPCOM ADVISE CREW	2. ATTITUDE ERROR SIGNALS 2.5 DEG IN PITCH AND YAW, 3.5 DEG IN ROLL AND ARE NOT DECREASING (H54-603 THRU H56-603; H69-602 THRU H71-602) 3. VEHICLE ANGULAR RATES GREATER THAN 1.2 DEG/SEC AND ARE NOT DECREASING (R4-602; R5-602; R6-602; R8-602; R12-602; R13-602)
		C. DURING LM EXTRACTION	TD&E	C. CONTINUE MISSION 1. BSE INFORM FLIGHT AND FIDO 2. CAPCOM ADVISE CREW	4. FLIGHT CONTROL COMPUTER NOT IN CORRECT MODE (K20-602) 5. EMR BITS D26, D25, AND D24 SET TO ONE (H60-603)
		D. AFTER LM EXTRACTION	TLI	D. CONTINUE MISSION BSE INFORM FLIGHT	6. GUIDANCE STATUS WORD (MODE CODE 24) BITS D16, D18, OR D20 SET TO ONE 7. GUIDANCE FAILURE DISCRETE (D04) MODE CODE 26, BIT 8 SET TO ONE (H60-603) NOTES: 1. THE SLV YAW GIMBAL (Z - AXIS) IS CRITICAL BEYOND ± 45 DEG 2. DURING PERIODS OF NO GROUND COMMUNICATIONS CREW MAY ATTEMPT ATTITUDE CONTROL SWITCH OVER TO ALLOW SEPARATION OVER A GROUND STATION

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	7-6	CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO OPEN A. TB5 + 59 SEC	ORBIT TLI	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND: 1. CVS RELIEF OVERRIDE SHUT-OFF VALVE OPEN IF UNSUCCESSFUL, BSE COMMAND: 2. VENT THE LH_2 TANK PRIOR TO TB6 TO A PRESSURE BELOW THE VALUE THAT SATISFIES THE CURVE (SEE BSE PROCEDURES) 3. IF THE LH_2 BLOWDOWN IS COMPLETED WITHIN 30 MIN PRIOR TO TB6 INITIATE COMMAND (A) ULLAGE ENGINES ON (B) AFTER 90 SEC OF ULLAGING COMMAND ULLAGE ENGINES OFF. ULLAGING SHOULD BE COMPLETED PRIOR TO THE AMBIENT REPRESSURIZATION	CUES: 1. LH_2 ULLAGE PRESSURE (D177-408; D178-408) 2. CVS NOZZLE PRESSURE (D181-409; D182-409) 3. CVS REGULATOR CLOSED (K154-411) NOTES: 1. IF THE CVS REGULATOR FAILS TO OPEN, THE LH_2 SATURATION TEMPERATURE WILL INCREASE ABOVE RESTART LIMITS TO INSURE A COMPLETE BURN 2. BLOWDOWN OF LH_2 TANK BELOW 19 PSIA WILL RESULT IN A LOSS OF 150 LBM OF USABLE LH_2 PROPELLANT PER PSIA 3. CVS NOZZLE PRESSURES SHORTLY AFTER CUTOFF (AFTER SEQUENCED OPENING OF CVS) A. BOTH LEGS OPEN 15-20 PSIA B. ORIFICE ONLY OPEN 4 PSIA C. BOTH LEGS CLOSED -0 PSIA
		B. TB7 + 0.5 SEC	ORBIT	B. CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: AT TB7 + 60 MIN 1. LH_2 VENT VALVE OPEN ON AT 21 PSIA 2. LH_2 VENT VALVE CLOSE AT TB8 + 6 MIN 3. S-IVB ULLAGE ENGINES ON	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-7	CVS ORIFICE LEG FAILS TO OPEN (TB5 OR TB7)	ORBIT TD&E TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND TRANSMIT: LH_2 TANK CONTINUOUS VENT ORIFICE SHUTOFF VALVE OPEN	CUES: 1. CVS NOZZLE PRESSURE (D181-409; D182-409) 2. LH_2 TANK CONTINUOUS VENT ORIFICE VALVE CLOSED (K155-411)
A	7-8	FAILURE TO TERMINATE APS ULLAGE ENGINE(S) THRUST AT TB5 + 1 MIN 27 SEC, TB7 + 19 SEC, TB8 + 7 MIN 33 SEC OR TB9 + 0 SEC.	ORBIT	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: S-IVB ULLAGE ENGINES OFF IF UNSUCCESSFUL, BSE INFORM FLIGHT OF IMPENDING LOSS OF ATTITUDE CONTROL	CUES: 1. ULLAGE ENGINE THRUST CHAMBER PRESSURE GREATER THAN 20 PSIA (D220-414; D221-415) 2. APS HELIUM SPHERE PRESSURE DECREASING (D35-414; D36-415; D250-414; D251-415) NOTE: FAILURE TO TERMINATE THRUST IN EITHER APS MODULE WILL RESULT IN APS PROPELLANT DEPLETION AT APPROXIMATELY TB5 + 14 MIN AND TB7 +3.6 MIN. FAILURE TO TERMINATE THRUST IN BOTH MODULES RESULT IN DEPLETION AT APPROXIMATELY TB5 + 18 MIN AND TB7 + 7 MIN
		RULE NUMBER 7-9 IS RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-10	IU ECS WATER VALVE FAILS TO CYCLE OPEN AND CLOSED.			CUES:
		A. WATER VALVE CLOSED AND COOLANT INLET CONTROL TEMPERATURE IS 64°F OR HIGHER, AND THE INERTIAL GIMBAL TEMPERATURE IS PREDICTED TO BE EQUAL TO OR GREATER THAN 115°F BEFORE THE NEXT SITE AOS, OR THE LVDC MEMORY TEMPERATURE IS PREDICTED TO BE EQUAL TO OR GREATER THAN 124°F BEFORE THE NEXT SITE AOS.	ALL	A. CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: 1. ECS LOGIC INHIBIT COMMAND 2. WATER VALVE OPEN	1. WATER VALVE CLOSED/OPEN (G5-601; G6-601) 2. ME/H_2O TEMP (C15-601) 3. OMW MODE CODE 27 BIT D8 SET TO ZERO (H60-603) 4. ST-124 INERTIAL GIMBAL TEMP (C34-603) 5. SUBLIMATER INLET TEMP (C11-601) 6. LVDC MEMORY TEMP (C54-603) 7. LVDA TEMP #1 (C55-603) 8. LVDA TEMP #2 (C56-603)
		B. WATER VALVE OPEN AND COOLANT INLET CONTROL TEMP IS 55°F OR LESS, AND THE INERTIAL GIMBAL TEMPERATURE IS PREDICTED TO BE 104°F OR LESS BEFORE THE NEXT SITE AOS, OR THE LVDC MEMORY TEMPERATURE IS PREDICTED TO BE 32°F OR LESS BEFORE THE NEXT SITE AOS.	ALL	B. CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: 1. ECS LOGIC INHIBIT COMMAND 2. WATER VALVE CLOSED	
		RULE NUMBER 7-11 IS RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-12	ENGINE PUMP PURGE FAILS ON AT TB5 + 10 MIN 3 SEC AND TB7 + 10 MIN 3 SEC	ORBIT TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: ENGINE PUMP PURGE CONTROL VALVE CLOSED.	CUES: 1. ENGINE PUMP PURGE REGULATOR PRESSURE FAILS TO DECREASE FROM ABOUT 100 PSIA TO ABOUT 10 PSIA. (D50-403) 2. AMBIENT BOTTLE PRESSURE DECREASING AT A RATE OF 23 PSIA/MIN (D236-403; D256-403). NOTE: IF NOT TERMINATED, THE PURGE WILL CAUSE THE DEPLETION OF THE AMBIENT HELIUM PNEUMATIC SUPPLY AT THE RATE OF 23 PSI/MIN.
	7-13	S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE REACHES OR EXCEEDS: A. MINUS 20 PSID PLUS 30 PSID	ORBIT TLI	A. CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: LH_2 AND/OR LOX TANK VENT VALVES OPEN OR CLOSED TO PRECLUDE REACHING THE SEPARATION LIMITS.	CUES: 1. LH_2 TANK ULLAGE PRESSURE (D0177-408, D0178-408) 2. LH_2 PUMP INLET PRESSURE (D0002-403) 3. LOX TANK ULLAGE PRESSURE (D0180-406, D0179-406) 4. LOX PUMP INLET PRESSURE (D0003-403) NOTES: 1. MINUS DELTA PRESSURE IS DEFINED AS A FUEL TANK ULLAGE PRESSURE GREATER THAN THE LOX TANK ULLAGE PRESSURE. 2. PLUS DELTA PRESSURE IS DEFINED AS A LOX TANK ULLAGE PRESSURE GREATER THAN THE FUEL TANK ULLAGE PRESSURE. 3. THE MINIMUM RECOMMENDED DISTANCE BETWEEN THE S-IVB AND THE SPACECRAFT IS 7000 FEET. 4. THE BULKHEAD WILL STRUCTURALLY FAIL AT THE ULTIMATE LIMITS OF MINUS 32.5 PSID OR PLUS 42.0 PSID.
		B. MINUS 26 PSID PLUS 36 PSID	ALL	B. CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION TO A SAFE DISTANCE.	
		RULE NUMBER 7-14 IS RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-15	S-IVB HYDRAULIC FLUID IS BELOW OR PREDICTED TO DROP BELOW 10 DEG F BEFORE NEXT AOS	ORBIT TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: AUXILIARY HYDRAULIC PUMP FLIGHT MODE ON AND OFF AS REQUIRED FOR THERMAL CONDITIONING	CUES: 1. HYDRAULIC PUMP INLET OIL TEMP (C50-401) 2. RESERVOIR OIL TEMP (C51-403)
	7-16	LOX NPV NOT OPEN AT TB5 + 6 HRS 18 MIN 55 SEC AND LH_2 VENT OPEN AS PROGRAMED.	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO AND COMMAND: A. LOX NPV OPENED AND LATCHED IF UNSUCCESSFUL, BSE COMMAND: B. CLOSE LH_2 TANK LATCHING RELIEF VALVE C. CLOSE CVS	CUES: 1. LOX ULLAGE PRESSURE (D179-406, D180-406) 2. LOX NPV NOZZLE PRESSURE (D243-404, D244-404) 3. LOX NPV DISCRETES (K198-403, K199-403)
		RULE NUMBER 7-17 THROUGH 7-18 ARE RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	7-19	LH_2 ULLAGE PRESSURE LESS THAN 18 PSIA DURING ORBITAL COAST (TB5 OR TB7)	EARTH ORBIT	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND CVS CLOSED, AND CVS ORIFICE LEG OPEN. IF PRESSURE RISES TO 21 PSIA, COMMAND CVS REGULATOR LEG OPEN. REPEAT AS NECESSARY TO MAINTAIN ULLAGE PRESSURE BETWEEN 18 AND 21 PSIA PRIOR TO INITIATION OF RESTART PREPS.	CUES: 1. FUEL TANK ULLAGE EDS NOS. 1 AND 2 PRESSURE (D0177-408, D0178-408). 2. FUEL PUMP INLET PRESSURE D0002-403).
A	7-20	FAILURE TO SAFE THE RANGE SAFETY RECEIVERS AT INSERTION. SAFING IS TO BE ACCOMPLISHED ON SUBSEQUENT PASSES OVER KSC. A. PROPELLANT DISPERSION SYSTEM NOT ARMED B. PROPELLANT DISPERSION SYSTEM ARMED	ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND RSO SEND SAFE COMMAND B. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND: 1. RECOMMEND SPACECRAFT SEPARATION TO A SAFE DISTANCE (7000 FT) 2. WHEN SPACECRAFT HAS REACHED A SAFE DISTANCE, RECOMMEND RSO SEND SAFE COMMAND	CUES: 1. FIRING UNIT 1 RS EBW (M30-411) >1.6 VOLTS 2. FIRING UNIT 2 RS EBW (M31-411) >1.6 VOLTS 3. RANGE SAFETY RECEIVER #1 ENABLE (NO57-411) BETWEEN 2.4 AND 4.5 VOLTS 4. RANGE SAFETY RECEIVER #2 ENABLE (NO62-411) BETWEEN 2.4 AND 4.5 VOLTS 5. RSO DISPLAY AND COMMAND SYSTEM STATUS NOTES: 1. RSO SHOULD NOT ATTEMPT TO SAFE THE RANGE SAFETY RECEIVERS ON REVS 1 AND 2 UNTIL MCC CONFIRMS THE PROPELLANT DISPERSION SYSTEM IS NOT ARMED 2. EITHER CUE 1 OR CUE 2 IS SUFFICIENT FOR IMPLEMENTING THIS RULE

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	7-21	J-2 ENGINE MAIN FUEL VALVE FAILS TO CLOSE AT S-IVB FIRST OR SECOND CUTOFF.	ORBIT	CONTINUE MISSION. A. BSE INFORM FLIGHT AND COMMAND PREVALVES AND RECIRC SHUTOFF VALVES CLOSED, AND CYCLE THE MAIN FUEL VALVES OPEN AND CLOSED. B. IF SUCCESSFUL, COMMAND PRE-VALVES AND RECIRC VALVES OPEN. C. IF UNSUCCESSFUL AT TB6/8 + __ COMMAND RECIRC VALVES OPEN.	CUES: 1. MAIN FUEL VALVE POSITION (G004-401) 2. MAIN FUEL VALVE OPEN DISCRETE (K118-401) 3. FUEL PUMP DISCHARGE TEMP (C134-401) 4. FUEL CIRCULATION PUMP FLOWMETER (F5-406) NOTE: NO COMMAND ACTION IS REQUIRED SHOULD FAILURE OCCUR FOLLOWING THIRD S-IVB CUTOFF
A	7-22	J-2 ENGINE MAIN OXIDIZER VALVE FAILS TO CLOSE AT S-IVB FIRST OR SECOND CUTOFF	ORBIT TLI	CONTINUE MISSION. A. BSE INFORM FLIGHT AND COMMAND (ASAP): PREVALVES AND RECIRC SHUTOFF VALVES CLOSED B. BSE ATTEMPT TO CYCLE MOV OPEN AND CLOSED. IF SUCCESS-FUL, BSE COMMAND: a. ENGINE MOV CLOSED b. PREVALVE AND RECIRC SHUTOFF VALVES OPEN	CUES: 1. MAIN OXIDIZER VALVE POSITION (G3-401) 2. MAIN OXIDIZER VALVE OPEN (K120-401) 3. LOX PUMP DISCHARGE TEMP (C133-401) 4. LOX CIRCULATION PUMP FLOWRATE (F4-424) NOTES: 1. 2. 3. NO COMMAND ACTION IS REQUIRED SHOULD FAILURE OCCUR FOLLOWING 3RD S-IVB CUTOFF.
	7-23	S-IVB STAGE PNEUMATIC REGU-LATOR OUTLET PRESSURE LESS THAN 400 PSIA AND DECREAS-ING IMMEDIATELY AFTER S-IVB CUTOFF (FIRST BURN)	ORBIT	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: LH_2 CONTINUOUS VENT SYSTEM OPEN	CUES: STAGE PNEUMATIC REG OUTLET PRESSURE (D014-403, D247-403) NOTES: IF PNEUMATIC REGULATOR HAS FAILED CLOSED, THE J-2 ENGINE PUMP PURGE WILL DEPLETE PRES-SURE DOWNSTREAM OF THE REGU-LATOR IN 45 SEC

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	7-24	DELETED			

8 SLV – TB6/TB8/
TB8A

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	8-1	S-IVB STAGE O_2/H_2 BURNER FUEL PROPELLANT VALVE FAILS CLOSED	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: BURNER SHUTDOWN SEQUENCE	CUES: 1. BURNER CHAMBER DOME TEMPERATURE INDICATES 460 DEG R OR LESS (C382-403) 2. BURNER NOZZLE TEMPERATURE OFF SCALE LOW (C380-403) 3. BURNER GH_2 INJECTOR TEMPERATURE (C383-403) 4. AMBIENT REPRESSURIZATION MODE SELECT (K195-404) 5. BURNER LH_2 PRESSURIZATION COIL TEMPERATURE (C379-403) 6. BURNER PROPELLANT VALVES POSITIONS (K180-404, K192-403) NOTE: THE O_2/H_2 BURNER VOTING CIRCUIT WILL NOT DETECT FAILURE OF THE BURNER TO IGNITE OR BURNER FLAME-OUT IN THE EVENT THE FUEL PROPELLANT VALVE FAILS CLOSED.
		RULE NUMBER 8-2 IS RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	8-3	CONTINUOUS VENT REGULATOR FAILS TO CLOSE DURING TB6/8/8A	ORBIT	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND IMMEDIATELY: A. CONTINUOUS VENT VALVE CLOSE B. IF UNSUCCESSFUL BSE COMMAND SECOND BURN RELAY OFF AFTER TB6/8/8A + 45 SECONDS	CUES: 1. CVS VALVE POSITION (K154-411) 2. CVS NOZZLE PRESSURE (D181-409, D182-409) NOTES: 1. CVS NOZZLE PRESSURES SHOULD DROP TO ZERO AT TB6/TB8A + 42.2 SEC OR TB8 + 6 MIN 24.4 SEC 2. POSITIVE INDICATION OF A FAILED OPEN REGULATOR IS NOZZLE PRESSURES GREATER THAN 3 PSIA AND OSCILLATING AT ABOUT 1 CPS 3. IF D181 AND D182 SHOW STEADY PRESSURE GREATER THAN 3 PSIA, THE REGULATOR MAY BE OPEN
A	8-4	S-IVB STAGE FAILS TO ATTAIN THRUST OR LOSS OF THRUST AFTER MAINSTAGE "OK" RULE NUMBERS 8-5 THROUGH 8-10 ARE RESERVED.	TLI	CONTINUE MISSION. BSE INFORM FLIGHT	CUES: 1. THRUST CHAMBER PRESSURE <300 PSIA (D1-403) 2. THRUST OK SWITCHES OFF (K14-401, K157-401) 3. LONGITUDINAL ACCELERATION <3g (VA2-603) 4. TB7/TB9 INITIATED (MODE CODE 26) BIT 20 EQUAL TO ONE (460-603) NOTE: IF THE S-IVB HAS FAILED TO ATTAIN THRUST BY: 1. TB6 PLUS 9 MIN 49 SEC, TB7 IS INITIATED. 2. TB8 PLUS 7 MIN 48 SEC, TB9 IS INITIATED. 3. TB8A PLUS 9 MIN 49 SEC, TB9 IS INITIATED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-11	LH_2 CHILLDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND AT TB6/TB8A + 8 MIN 45 SEC OR TB8 + 6 MIN 45 SEC COMMAND: A. S-IVB ENGINE CUTOFF OFF B. ENGINE READY BYPASS C. PREVALVES OPEN D. ENGINE START ON	CUES: 1. LH_2 PREVALVE OPEN (K111-404) 2. LH_2 PREVALVE CLOSE (K112-404) 3. LH_2 BLEED VALVE CLOSE (K127-401) 4. LH_2 RECIRC. VALVE CLOSE (K136-409) 5. LH_2 RECIRC. FLOW (F005-404) 6. LH_2 PUMP INLET PRESS (D002-403) 7. LH_2 ULLAGE PRESSURE (D177-408, D178-408) NOTES: LH_2 CHILLDOWN WILL NOT BE SATISFACTORY IF: A. PREVALVE IS OPEN B. RECIRC. VALVE IS CLOSED C. BLEED VALVE IS CLOSED D. CHILLDOWN PUMP IS NOT ON
A	8-12	S-IVB AUXILIARY HYDRAULIC PUMP FAILS TO TURN ON AT: TB6 + 3 MIN 39 SEC, TB8 + 1 MIN 39 SEC, OR TB8A + 3 MIN 39 SEC.	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND SEND: AUXILIARY HYDRAULIC PUMP FLIGHT MODE OFF.	CUES: 1. HYDRAULIC SYSTEM PRESSURE (D0041-403) <1700 PSIA 2. RESERVOIR OIL LEVEL (L0007-403). >50% 3. AFT BATTERY NO. 2 CURRENT (M022-404) ZERO AMPS 4. RESERVOIR OIL PRESSURE (D0042-403). <89 PSIA NOTES: IN THE EVENT THE AUXILIARY HYDRAULIC PUMP FAILS TO TURN ON DURING RESTART PREPARATIONS, FLIGHT MODE OFF SHOULD BE SENT TO PRECLUDE THE POSSIBILITY OF THE AUXILIARY HYDRAULIC PUMP STARTING WHILE THE CHILLDOWN PUMPS ARE OPERATING.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A 1	8-13	LH_2 AMBIENT REPRESS SUPPLY IS LESS THAN 1500 PSIA AT TB8.	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: A. AT TB8 + 3 MIN: 1. AMBIENT REPRESS MODE SELECT OFF. 2. LH_2 TANK REPRESS CONTROL VALVES OPEN ON. 3. CVS CLOSE. B. AT TB8 + 7 MIN: AMBIENT REPRESS MODE SELECT ON.	CUES: 1. FUEL TANK HELIUM BOTTLE REPRESSURIZATION PRESSURE (D0020-403, D0249-403). 2. LOX TANK REPRESSURIZATION SPHERES PRESSURE (D0088-403, D0254-403).
	8-14	PRESSURE SWITCHES FAIL TO TERMINATE LOX OR FUEL AMBIENT REPRESSURIZATION.	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: A. LOX TANK REPRESSURIZATION CONTROL VALVES CLOSED OR B. LH_2 TANK REPRESSURIZATION CONTROL VALVES CLOSED	CUES: 1. LOX TANK ULLAGE PRESSURES (D179-406, D180-406) 2. LH_2 TANK ULLAGE PRESSURES (D177-408, D178-408)

9 SLV - TB9

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	9-1	CONTINUOUS VENT VALVE REGULATOR FAILS CLOSED	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND TRANSMIT: A. CONTINUOUS VENT RELIEF OVERRIDE SHUTOFF VALVE OPEN B. IF THE CVS REG REMAINS CLOSED, COMMAND THE LH_2 VENT VALVE OPEN AND CLOSED TO MAINTAIN AN ULLAGE PRESSURE OF 15-20 PSIA	CUES: 1. LH_2 TANK ULLAGE PRESSURES (D177-408, D178-408) 2. CVS VALVE POSITION (K154-411) 3. CVS NOZZLE PRESSURE (D181-409, D182-409) 4. CVS NOZZLE TEMPERATURES (C256-409, C257-409) NOTE: MUST MAINTAIN 15 PSIA IN LH_2 TANK FOR ACCEPTABLE LH_2 DUMP
		RULE NUMBER 9-2 IS RESERVED			

MSC/TSD Form 291 (AUG 68)

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	9-3	FAILURE OF LOX NONPROPULSIVE VENT TO LATCH OPEN (TB9 + 12 MIN 42 SEC)	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: 1. LOX NPV VALVE OPEN AND LATCHED. IF UNSUCCESSFUL, BSE COMMAND: 2. LOX NPV OPEN IF 1 AND 2 ARE UNSUCCESSFUL, SEND: 3. LOX VENT VALVE OPEN	CUES: 1. LOX TANK ULLAGE PRESSURE (D179-406, D180-406) 2. LOX NPV NOZZLE PRESSURES (D243-404, D244-404) 3. LOX NPV DISCRETES (K198-403, K199-403)
A	9-4	FAILURE OF S-IVB LOX DUMP TO INITIATE AT TB9 + 1 MIN 30 SEC	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: ENGINE MAIN LOX VALVE OPEN	CUES: 1. MAIN OXIDIZER VALVE OPEN - CLOSED (G3-401) 2. LOX PUMP DISCHARGE TEMPERATURE (C133-401) 3. MAIN OXIDIZER VALVE OPEN/CLOSED DISCRETE (K120-401)
A	9-5	FAILURE OF LH_2 DUMP TO INITIATE AT TB9 + 12 MIN 50 SEC	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: ENGINE MAIN FUEL VALVE OPEN	CUES: 1. MAIN FUEL VALVE OPEN - CLOSED (G4-401) 2. LH_2 PUMP DISCHARGE TEMPERATURE (C134-401) 3. MAIN FUEL VALVE OPEN/CLOSED DISCRETE (K118-401)
	9-6	FAILURE OF COLD HELIUM DUMP TO INITIATE	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: 1. COLD HELIUM DUMP THRU BURNER IF UNSUCCESSFUL, BSE COMMAND AFTER TB9 + 12 MIN 40 SEC: 2. LOX TANK FLIGHT PRESSURIZATION SHUTOFF VALVE OPEN	CUES: 1. COLD HELIUM BOTTLE PRESSURE (D16-425, D248-405) 2. GOX/GH_2 BURNER LH_2 PRESSURE COIL (D231-403)

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	9-7	FAILURE ENGINE START BOTTLE DUMP TO INITIATE	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: START BOTTLE VENT CONTROL VALVE OPEN	CUES: GH_2 START BOTTLE PRESSURE (D17-401, D241-401)
	9-8	FAILURE OF S-IVB STAGE CONTROL PNEUMATIC DUMP TO INITIATE.	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: 1. ENGINE PUMP SEAL PURGE ON IF UNSUCCESSFUL, BSE COMMAND: 2. LOX SHUTDOWN VALVE CLOSED	CUES: 1. HELIUM AMBIENT SPHERE PRESSURE NOT DECREASING (D236-403, D256-403) 2. ENGINE PUMP PURGE (D50-403)
	9-9	FAILURE OF ENGINE CONTROL BOTTLE HELIUM DUMP TO INITIATE	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: 1. ENGINE PNEUMATIC SYSTEM VENT OPEN IF UNSUCCESSFUL, BSE COMMAND: 2. ENGINE HELIUM CONTROL SHUTOFF VALVE OPEN	CUE: ENGINE CONTROL HELIUM SPHERE PRESSURE (D19-401, D242-401)
A	9-10	LOSS OF EITHER OR BOTH APS MODULES PRIOR TO OR DURING PROPELLANT DUMP RULE NUMBERS 9-11 THROUGH 9-15 ARE RESERVED	TLI	CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: S-IVB BURN MODE ON	CUES: 1. ATTITUDE CONTROL HELIUM CONTROL PRESSURE TANK 1 LESS THAN 1100 PSIA (D35-414, D250-414) 2. MANIFOLD PRESSURE MOD 1 LESS THAN 160 PSIA (OXID-FUEL) (D70-414, D71-414) 3. ATTITUDE CONTROL HELIUM CONTROL PRESSURE TANK 2 LESS THAN 1100 PSIA (D36-415, D251-415) 4. MANIFOLD PRESSURE MOD 2 LESS THAN 160 PSIA (OXID-FUEL) (D72-415, D73-415)

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REV	ITEM
A	9-16

PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
S-IC STAGE SYSTEMS					
PRESS, COMBUSTION CHAMBER	D8-101			HD	
PRESS, COMBUSTION CHAMBER	D8-102			HD	
PRESS, COMBUSTION CHAMBER	D8-103			HD	
PRESS, COMBUSTION CHAMBER	D8-104			HD	
PRESS, COMBUSTION CHAMBER	D8-105			HD	
FINAL THRUST OK CUTOFF ENG NO. 1	VK52-115			HD	
FINAL THRUST OK CUTOFF ENG NO. 2	VK53-115			HD	
FINAL THRUST OK CUTOFF ENG NO. 3	VK54-115			HD	
FINAL THRUST OK CUTOFF ENG NO. 4	VK55-115			HD	
FINAL THRUST OK CUTOFF ENG NO. 5	VK56-115			HD	
S-II STAGE SYSTEMS					
TEMP, RECIRCULATION BATTERY 1	C540-200			HD	
TEMP, RECIRCULATION BATTERY 2	C541-200			HD	
PRESS, THRUST CHAMBER, ENG 1	D13-201			HD	
PRESS, THRUST CHAMBER, ENG 2	D13-202			HD	
PRESS, THRUST CHAMBER, ENG 3	D13-203			HD	
PRESS, THRUST CHAMBER, ENG 4	D13-204			HD	
PRESS, THRUST CHAMBER, ENG 5	D13-205			HD	
POSITION, YAW ACTUATOR	VG8-201			HD	
	G30-201			HD	
POSITION, YAW ACTUATOR	VG8-202			HD	
	G30-202			HD	
POSITION, YAW ACTUATOR	VG8-203			HD	
	G30-203			HD	
POSITION, YAW ACTUATOR	VG8-204			HD	
	G30-204			HD	
POSITION, PITCH ACTUATOR	VG9-201			HD	
	G31-201			HD	
POSITION, PITCH ACTUATOR	VG9-202			HD	
	G31-202			HD	
POSITION, PITCH ACTUATOR	VG9-203			HD	
	G31-203			HD	
POSITION, PITCH ACTUATOR	VG9-204			HD	
	G31-204			HD	
DEPRESS, MAINSTAGE OK SW A, ENG 1	K285-201			HD	
DEPRESS, MAINSTAGE OK SW B, ENG 1	K286-201			HD	
DEPRESS, MAINSTAGE OK SW A, ENG 2	K285-202			HD	
DEPRESS, MAINSTAGE OK SW B, ENG 2	K286-202			HD	
DEPRESS, MAINSTAGE OK SW A, ENG 3	K285-203			HD	
DEPRESS, MAINSTAGE OK SW B, ENG 3	K286-203			HD	
DEPRESS, MAINSTAGE OK SW A, ENG 4	K285-204			HD	
DEPRESS, MAINSTAGE OK SW B, ENG 4	K286-204			HD	
DEPRESS, MAINSTAGE OK SW A, ENG 5	K285-205			HD	
DEPRESS, MAINSTAGE OK SW B, ENG 5	K286-205			HD	
VOLTAGE, RECIRC BATTERY	XM111-207			HD	

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MISSION RULES

REV	ITEM	MEAS DESCRIPTION	MEAS NO.	ONBOARD	TRANSDUCER	CATEGORY	MISSION RULE REFERENCE
A	9-16 (CONT'D)	S-IVB STAGE SYSTEMS					
		LINK CP1				HD	
		MUX CP1AO				HD	
		MUX CP1BO				HD	
		MUX RDSM				HD	
		MUX RLSM				HD	
		PRESS, FUEL TANK ULLAGE EDS 1	VD177-408			HD	
		PRESS, HYDRAULIC RESERVOIR	D042-403			HD	
		PRESS, HYDRAULIC SYSTEM	D041-403				
		PRESS, FUEL TANK ULLAGE EDS 2	VD178-408			HD	
		PRESS, OXID TANK ULLAGE EDS 1	VD179-408			HD	
		PRESS, OXID TANK ULLAGE EDS 2	VD180-406			HD	
		LEVEL, RESERVOIR OIL	VXL7-403			HD	
		VOLT, F/V 1 ESW RANGE SAFETY	XM30-411			HD	
		VOLT, F/V 2 ESW RANGE SAFETY	XM31-411			HD	
		MISC, SEC R/S RCVR 1 L/L SIG STR	VN57-411			HD	
		MISC, SEC R/S RCVR 2 L/L SIG STR	VN62-411			HD	

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MISSION RULES

REV	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
A	9-16 (CONT'D)	IU STAGE SYSTEMS					
		LINK DP1 LINK DP-1A				1 OF 2 M	
		LINK DP-1B				HD	
		MUX DP1A0				HD	
		MUX DP1B0				HD	
		EDS				M	
		CCS DIGITAL COMMAND SYSTEM				M	
		ATT PITCH, LADDER OUTPUT GUID COMP	VH54-603			HD	
		ATT YAW, LADDER OUTPUT GUID COMP	VH55-603			HD	
		ATT ROLL, LADDER OUTPUT GUID COMP	VH56-603			HD	
		GUIDANCE COMPUTER OPERATION	H60-603			M	
		ATT ERROR SIGNAL ANG POS ROLL	VH69-603			HD	
		ATT ERROR SIGNAL ANG POS YAW	VH70-603			HD	
		ATT ERROR SIGNAL ANG POS PITCH	VH71-603			HD	
		COMPUTER RESET PULSE #1 GUIDANCE DECODER	J71-603			1 OF 2 M	
		COMPUTER RESET PULSE #2 GUIDANCE DECODER	J72-603				
		ANG VEL, PITCH CONTROL	VR4-602			HD	
		ANG VEL, PITCH EDS GROUP 3 (REF)	VR13-602			HD	
		ANG VEL, YAW CONTROL	VR5-602			HD	
		ANG VEL, YAW EDS GROUP 1 (REF)	VR8-602			HD	
		ANG VEL, ROLL CONTROL	VR6-602			HD	
		ANG VEL, ROLL EDS GROUP 2 (REF)	VR12-602			HD	

10 CSM ENVIRONMENTAL CONTROL

REV	ITEM	GENERAL
	10-1	LAUNCH LAUNCH WILL BE CONTINUED AS LONG AS THE SUIT CIRCUIT AND O_2 SUPPLY WILL SUPPORT FLIGHT CREW DEMANDS FOR AT LEAST ONE REV AND ENTRY INTO 2-1. THERE ARE NO COOLANT FAILURES FOR WHICH LAUNCH/INSERTION PHASE WILL BE TERMINATED. ALL MISSION PHASES TO CONTINUE THE MISSION THE CABIN AND SUIT CIRCUIT INCLUDING THE O_2 MANIFOLD AND SURGE TANK OR REPRESS PACK MUST BE CAPABLE OF PROVIDING A CONTAMINANT - FREE, LIFE - SUSTAINING ENVIRONMENT. THE COOLANT SYSTEM LOOP MUST BE CAPABLE OF PROVIDING AN ADEQUATE THERMAL ENVIRONMENT FOR CREW AND COLDPLATED EQUIPMENT. SUFFICIENT WATER MUST BE AVAILABLE FOR CREW CONSUMPTION AND EVAPORATIVE COOLING REQUIREMENTS TO COMPLETE THE SCHEDULED PHASE OR TO ACHIEVE THE NEXT GO/NO-GO PTP; URINE DUMP CAPABILITY OR URINE STORAGE CAPABILITY IN LM MUST BE AVAILABLE TO CONTINUE. TD&E UNDOCKING RENDEZVOUS IVT DOCKED DPS BURN EVA IN ADDITION TO THE PRECEDING REQUIREMENTS, SUIT INTEGRITY IS REQUIRED TO ENTER THESE PHASES. RENDEZVOUS IN ADDITION TO THE PRECEDING REQUIREMENTS, THE PRIMARY LOOP COOLING IS REQUIRED. EVA IN ADDITION TO THE PRECEDING REQUIREMENTS, BOTH THE SURGE TANK AND THE REPRESS PACK ARE REQUIRED FOR EVA.

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MISSION RULES

REV	ITEM	
	10-2	DEFINITIONS

LOSS OF CABIN INTEGRITY:	CM PRESSURE VESSEL LEAKAGE SUCH THAT CABIN PRESSURE CANNOT BE MAINTAINED $\geq$4.5 PSIA BY CABIN PRESSURE REGULATORS (1.2 LB/HR TOTAL)
LOSS OF SUIT INTEGRITY:	TOTAL PGA AND SUIT LOOP LEAKAGE >0.5 PSI/MIN (1.5 LB/HR) DURING PGA SUIT LOOP PRESSURE CHECK.
LOSS OF SUIT CIRCUIT:	INABILITY OF THE SUIT CIRCUIT TO MAINTAIN ADEQUATE CREW COMFORT AND/OR CO_2 REMOVAL WITHOUT USING DIRECT O_2.
LOSS OF O_2 MANIFOLD:	AN O_2 MANIFOLD OR REGULATOR FAILURE WITH WHICH THE SUIT CIRCUIT O_2 DEMANDS CANNOT BE SUPPLIED FOR ENTRY.
LOSS OF PRIMARY LOOP COOLING:	LOSS OF ALL FLOW, A LEAK WHICH CANNOT BE ISOLATED, OR COMBINED FAILURES SUCH THAT RADIATORS AND EVAPORATOR PROVIDE NO COOLING.
LOSS OF SECONDARY LOOP COOLING:	LOSS OF ALL FLOW, A LEAK WHICH CANNOT BE ISOLATED, OR COMBINED FAILURES SUCH THAT RADIATOR AND EVAPORATOR PROVIDE NO COOLING.
LOSS OF COOLANT LOOP RADIATORS:	RADIATOR LEAK, BLOCKAGE OF ALL FLOW THROUGH RADIATORS, OR RADIATOR DEGRADATION SUCH THAT TOTAL LONG TERM USAGE OF WATER IS MORE THAN IS BEING PRODUCED.
LOSS OF ALL COOLING:	LOSS OF PRIMARY AND SECONDARY LOOP COOLING.
LOSS OF SURGE TANK AND/OR REPRESS PACK:	SURGE TANK, REPRESS PACK, OR PLUMBING FAILURES WHICH REQUIRE ISOLATION OF THE SURGE TANK AND/OR REPRESS PACK.

RULES 10-3 THROUGH 10-9
ARE RESERVED.

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MISSION RULES

REV	ITEM	

SYSTEMS MANAGEMENT

10-10 O_2 SYSTEM

A. SUIT FLOW RELIEF VALVE WILL REMAIN CLOSED FOR DURATION OF FLIGHT.

B. NORMAL CM REPRESSURIZATION WITH LM MANNED WILL UTILIZE THE REPRESS PACK.

C. SURGE TANK WILL BE ON LINE EXCEPT DURING LM PRESSURIZATION OR CM PRESSURIZATION WITH THE LM MANNED, WHEN IT WILL BE ISOLATED TO MAINTAIN QUANTITY >500 PSIA.

D. THE PLSS VALVE WILL BE IN OFF POSITION FOR ORBIT.

E. THE SUIT CIRCUIT MUST BE PURGED OF ACCUMULATED H_2 ONCE EVERY 6 HOURS FOR ONE MINUTE WHEN ALL CREWMEN ARE SUITED AND THE SUIT CIRCUIT IS ISOLATED.

F. THE SURGE TANK AND REPRESS PACK WILL NORMALLY BE RECHARGED SIMULTANEOUSLY.

G. CM CABIN PRESSURE WILL NOT BE ALLOWED TO DROP BELOW 4.0 PSIA DURING NORMAL LM PRESSURIZATION EXCEPT DURING TD&E.

H. THE CM ECS WILL NORMALLY SUPPLY ALL O_2 FOR CONSUMPTION AND LEAKAGE DURING IVT PHASES.

I. CSM FORWARD HATCH WILL BE INSTALLED FOR EVA.

J. THE FLIGHT CREW WILL DON SUITS FOR THE FOLLOWING:

1. INABILITY TO MAINTAIN CABIN PRESSURE ABOVE 4.5 PSIA
2. ALL LM MANNING AND EVA OPERATIONS
3. TD&E
4. GLYCOL LEAKS IN COMMAND MODULE
5. FIRE, SMOKE, CONTAMINATION IN CABIN

K. THE FLIGHT CREW WILL DOFF SUITS (TIME AND CONDITIONS PERMITTING) FOR THE FOLLOWING:

1. LOSS OF SUIT CIRCUIT
2. CONFIRMED LEAK OF GLYCOL IN SUIT CIRCUIT.

COOLANT MANAGEMENT

A. FOR SIMULATANEOUS PRIMARY AND SECONDARY LOOP OPERATION, NORMALLY EITHER THE PRIMARY OR SECONDARY LOOP RADIATOR WILL BE ISOLATED.

B. GLYCOL RESERVOIR WILL BE ON LINE AND RADIATORS WILL BE BYPASSED FOR LAUNCH.

C. INDICATED GLYCOL ACCUMULATOR QUANTITY WILL BE MAINTAINED BETWEEN 30% AND 65%.

D. SECONDARY COOLANT WILL BE OFF FOR LAUNCH.

E. ADDITIONAL POWER LOADS WILL BE ADDED AS REQUIRED IN AN ATTEMPT TO MAINTAIN PRIMARY RADIATOR OUTLET TEMPERATURE >-20 DEGREES.

F. SIMULTANEOUS PRIMARY AND SECONDARY LOOP OPERATION WILL BE USED FOR ENTRY.

WATER SYSTEM

A. WASTE WATER WILL BE DUMPED OVERBOARD AS REQUIRED TO MAINTAIN INDICATED QUANTITY <85-90%. WASTE WATER WILL NORMALLY BE DUMPED TO 25%; HOWEVER, IF WASTE WATER QUANTITY INSTRUMENTATION (CF0009) IS LOST, WASTE WATER WILL BE DUMPED UNTIL POTABLE WATER QUANTITY (CF0010) BEGINS TO DECREASE.

B. WATER DUMPS WILL BE MANAGED SO THAT CM-SM SEPARATION THE POTABLE WATER TANK WILL BE FULL AND THE WASTE WATER TANK WILL BE 90% FULL.

RULE NUMBERS 10-11 THROUGH
10-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-20	CABIN PRESSURE CANNOT BE RELIEVED	LAUNCH	CONTINUE MISSION	NORMAL RELIEF STARTS AT 50 SECONDS
	10-21	CABIN PRESSURE DECREASING AND/OR <4.5 PSIA AND:			
		A. SUIT PRESSURE ≥3.5 PSIA	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2. ENTER NEXT BEST PTP IF CABIN PRESS NOT RESTORED >4.5 PSIA.	
		B. SUIT PRESSURE <3.5 PSIA	LAUNCH	B.1. ABORT ASAP	
			ALL	2. ENTER ASAP	
		C. LOSS OF SUIT CIRCUIT	LAUNCH	C.1. ABORT ASAP OPEN DIRECT O_2 45 DEG FROM LAUNCH SETTING.	C.1. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM/CREWMAN)
			ALL	2. ENTER ASAP	
	10-22	LOSS OF SUIT CIRCUIT, CABIN STABLE AND >4.5 PSIA	LAUNCH	A. CONTINUE MISSION OPEN DIRECT O_2 VALVE 45 DEG FROM LAUNCH SETTING	A. CORRESPONDS TO 12.6 LB/HR (APPROX. 3 CFM/CREWMAN)
			ALL	B. TERMINATE PHASE 1. IF LM IS MANNED, SET UP FOR APS BURN 2. DOFF SUITS 3. OPEN WASTE OVERBOARD DRAIN VALVE TO OBTAIN CABIN BLEED FLOW. 4. DON FACE MASKS AFTER 1 HOUR.	B.3. WASTE OVERBOARD BLEED = 0.67 LB [illegible]/HR 4. TIME REQUIRED FOR CM CO_2 PARTIAL PRESSURE TO INCREASE TO 7.6 MM HG: 1 CREWMAN: 4 HR. 3 CREWMAN: 80 MIN.
				C. ENTER NEXT BEST PTP	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	10-23	LOSS OF SURGE TANK AND REPRESS PACK			FOR LEAK IN SURGE TANK, ISOLATE SURGE TANK AND PLACE PLSS VALVE TO FILL.
			LAUNCH	A. CONTINUE MISSION	
			EVA	B. TERMINATE EVA	
			ALL	C. CONTINUE MISSION	C. IF LOST PRIOR TO LM FINAL SEP, TRANSFER ONE OPS BOTTLE TO CM AFTER RENDEZVOUS
	10-24	LOSS OF SURGE TANK AND REPRESS PACK			
			LAUNCH	A. CONTINUE MISSION	
			ALL	B. TERMINATE PHASE ENTER NEXT BEST PTP. IF LM IS MANNED, SET UP FOR APS BURN.	
	10-25	FIRE OR SMOKE IN COMMAND MODULE	LAUNCH	A. ABORT 1. DECOMPRESS CABIN 2. TROUBLESHOOT ELECTRICAL SYSTEM PER FLIGHT CREW CHECKLIST BOOST FIRE PROCEDURES.	
			ALL	B. TERMINATE PHASE 1. TROUBLESHOOT/COMBAT FIRE PER FLIGHT CREW CHECKLIST EMERGENCY PROCEDURES. 2. ASSESS DAMAGE AND REMOVE POWER FROM AFFECTED SYSTEMS. 3. ENTER NEXT BEST PTP	
	10-26	CONTAMINATION IN CABIN	LAUNCH	A. CREW MAY ELECT TO DECOMPRESS	
			ALL	B. CREW MAY ELECT TO DECOMPRESS	B. IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-27	LOSS OF SUIT INTEGRITY			CONTINUE MISSION EXCEPT FOR MAJOR CSM PRESSURE VESSEL CONFIGURATION CHANGES
			LAUNCH	A. CONTINUE MISSION	
			ORBIT (S-IVB)	B. INHIBIT TD&E	B. REF ALTERNATE MISSION A
			DOCKED	C. CONTINUE MISSION DO NOT UNDOCK	C. 1. INHIBIT DOCKED DPS AND SPS BURNS 2. NO-GO FOR EVA OR UNDOCKING
			TD&E	D. TERMINATE PHASE CONTINUE LM EJECTION IF LM IS PRESSURIZED AND TUNNEL WORK IS COMPLETE	
			ALL	E. CONTINUE MISSION	
	10-28	LOSS OF O_2 MANIFOLD			
		A. WITHOUT LOSS OF CABIN INTEGRITY	LAUNCH	A. 1. CONTINUE MISSION	
			ALL	2. ENTER NEXT BEST PTP	A. 2. APPROXIMATELY 5 HOURS ARE REQUIRED TO DEPLETE CABIN O_2 FROM 4.3 TO 3.5 PSIA, WITH 0.456 LB/HR USAGE RATE (CREW + CABIN LEAK + TANK PRESS BLEED)
		B. WITH LOSS OF CABIN INTEGRITY	LAUNCH	B. 1. ABORT ASAP	
			ALL	2. ENTER ASAP	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	10-29	PRIMARY COOLANT LOOP MALFUNCTIONS			
		A. LOSS OF EVAPORATOR	LAUNCH	A.1. CONTINUE MISSION	A.1. REF MALF PROC ____
			ALL	2. CONTINUE MISSION ACTIVATE SECONDARY COOLANT LOOP WITH RADIATORS IN BY-PASS AS REQUIRED TO MAINTAIN PRIMARY EVAPORATOR OUT TEMP <60°F.	2. (A) MAINTAIN PRI RAD OUT TEMP >-20°F. (B) WATER MANAGEMENT MAY DICTATE ACTIVATION AND DEACTIVATION OF SECONDARY LOOP TO MAINTAIN PRI RAD OUT TEMP BETWEEN 45 AND 60°F.
		B. LOSS OF RADIATORS	ALL	B. CONTINUE MISSION	B. REF MALF PROC ECS-14, 15 USE PRIMARY LOOP IN ADDITION TO SECONDARY LOOP FOR G&N OPERATIONS
		C. TOTAL LOSS OF LOOP	LAUNCH	C.1. CONTINUE MISSION	
			DOCKED	2. CONTINUE MISSION	C.2. UNDOCKING AND STATION KEEPING MAY BE PERFORMED
			RNDZ	3. TERMINATE PHASE	
			EVA	4. CONTINUE MISSION	
			ALL	5. CONTINUE MISSION	
	10-30	SECONDARY LOOP MALFUNCTIONS TOTAL LOSS OF LOOP	ALL	CONTINUE MISSION	
	10-31	LOSS OF ALL COOLING, PRIMARY AND SECONDARY	LAUNCH	A. CONTINUE MISSION	
			ALL	B. TERMINATE PHASE ENTER NEXT BEST PTP OR ATP MAXIMUM ORBIT TIME: 4 HOURS EMERGENCY POWER DOWN FOLLOWED BY 1.5 HOURS OF POWER UP FOR ENTRY.	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-32	CONFIRMED LEAK OF GLYCOL COOLANT			
		A. IN COMMAND MODULE	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2. TERMINATE PHASE ENTER NEXT BEST PTP. SELECT ALTERNATE MISSION BASED ON TIME AVAILABLE	2. DON SUITS AND PURGE DIRECT O_2
		B. IN SUIT CIRCUIT	ALL	B. TERMINATE PHASE ENTER NEXT BEST PTP. DOFF SUITS AND USE FACE MASKS IF REQUIRED.	
		RULE NUMBERS 10-33 THROUGH 10-39 ARE RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-40	LOSS OF OVERBOARD DUMPS			
		A. NORMAL OVERBOARD DUMPS FROZEN OR BLOCKED	ALL	A. CONTINUE MISSION	A.1. UTILIZE AUXILIARY DUMP FOR URINE AND WASTE WATER DISPOSAL. 2. BLEED O_2 FROM WATER TANK THROUGH WASTE MANAGEMENT OVERBOARD DRAIN VALVE INTO CABIN.
		B. LOSS OF ALL OVERBOARD DUMP CAPABILITY	ORBIT (SOLO)	B.1. ENTER NEXT BEST PTP	B.1. IF POTABLE AND WASTE TANKS...OR WASTE TANK ALONE...BECOMES FULL, FORCED WATER BOILING WILL BE NECESSARY TO ALLOW FUEL CELL AND/OR CYCLIC ACCUMULATOR OPERATION.
			ALL	2. CONTINUE MISSION (A) IF LM IS UNMANNED, ENTER LM EARLY IF REQUIRED TO USE LM URINE STORAGE BAGS. (B) IF LM IS MANNED, TRANSFER URINE COLLECTION BAG FROM LM TO CM CREWMAN.	2. MISSION DURATION WILL BE DETERMINED BY REMAINING LM URINE STORAGE CAPACITY.
A	10-41	WASTE WATER TANK LEAK OR LOSS OF WASTE WATER STORAGE CAPABILITY	ALL	CONTINUE MISSION	WHEN POTABLE WATER TANK BECOMES FULL, FUEL CELL WATER WILL BE DUMPED THROUGH OVERBOARD PRESSURE RELIEF VALVES.
	10-42	CONFIRMED LEAK IN POTABLE TANK OR UNABLE TO TRANSFER FUEL CELL WATER TO POTABLE TANK	LAUNCH ORBIT (S-IVB) TD&E	A. CONTINUE MISSION	
			ALL	B. ENTER NEXT BEST PTP AFTER TANK IS DEPLETED.	
	10-43	LOSS OF SUIT LOOP WATER REMOVAL CAPABILITY	LAUNCH	A. CONTINUE MISSION	
			ALL	B. ENTER NEXT BEST PTP TERMINATE SUITED OPERATIONS	
A	10-44	UNABLE TO VENT SIDE HATCH COUNTERBALANCE MECHANISM	EVA	CONTINUE MISSION DO NOT OPEN SIDE HATCH	
A		RULE NUMBERS 10-45 THROUGH 10-49 ARE RESERVED.			

REV	ITEM
	10-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	REFERENCE
CABIN PRESS	CF0001P	METER	COMMON	1 OF 3 M	10-20
SUIT PRESS	CF0012P	METER	COMMON		
TANK BLADDER PRESS	CF0120P	-----	------		
SUIT PRESS (CUFF GAGES)	-------	-----	------	MANDATORY (EACH CREWMAN)	10-21
SURGE TANK PRESS	CF0006P	METER	COMMON	1 OF 2 M	10-28
OXYGEN REPRESS PRESS	-------	METER	------		
PRIM ACCUM QTY	CF0019Q	METER	COMMON	1 OF 2 M	10-29, 10-32
PRIM PUMP OUT PRESS	CF0016P	METER	COMMON		
POTABLE H_2O QTY	CF0010Q	METER	COMMON	1 OF 2 M	10-41. 10-42
WASTE H_2O QTY	CF0009Q	METER	COMMON		
SEC STEAM PRESS	CF0073P	METER	COMMON	1 OF 2 M	10-30
SEC EVAP OUT TEMP	CF0071T	METER	COMMON		
SEC ACCUM QTY	CF0072Q	METER	COMMON	HD	
SEC PUMP OUT PRESS	CF0070P	METER	COMMON	HD	
PRIM EVAP OUT TEMP	CF0018T	METER	COMMON	HD	
PRIM STEAM PRESS	CF0034	METER	COMMON	HD	
ECS O_2 FLOW	CF0035R	METER	COMMON	HD	
O_2 MANIFOLD PRESS	CF0036P	-----	------	HD	
SUIT COMP PRESS	CF0015P	METER	COMMON	HD	
PRIM RAD OUT TEMP	CF0020T	METER	COMMON	HD	
PRIM EVAP INLET TEMP	CF0181T	-----	------	HD	
STEAM DUCT TEMP	CF0017T	-----	------	HD	
SEC RAD OUT TEMP	SF0236T 2637	METER	------	HD	

NOT IN LMRD

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MISSION RULES

REV	ITEM	
		GENERAL
	11-1	LAUNCH THERE ARE NO CRYO FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED. FOR COMPLETE LOSS OF THE SYSTEM RESULTING IN THREE FUEL CELL FAILURES, ENTRY WILL BE PLANNED INTO PTP 2-1. THREE ENTRY BATTERIES ARE CAPABLE OF SUPPORTING THE LAUNCH, ONE REV OF POWER DOWN AND SCS ENTRY.
	11-2	ORBIT THE CRYOGENICS SYSTEM IS REQUIRED UNTIL CM/SM SEP SO THAT THE ENTRY AND LANDING PHASES WILL BE ENTERED INTO WITH FULL CONSUMABLES POTENTIAL, THAT IS, FULLY CHARGED ENTRY BATTERIES AND ENTRY O_2 TANKS. IF THIS CAPABILITY IS POTENTIALLY JEOPARDIZED BY CRYO SYSTEMS DEPLETION OR MALFUNCTION, MISSION TERMINATION PROCEDURES WILL BE ENACTED IN WHATEVER TIME FRAME IS APPROPRIATE OR AVAILABLE. ANY ENTRY BATTERY OR ENTRY O_2 USAGE IN ORBIT AFTER LOSS OF RECHARGE CAPABILITY FROM THE CRYO SYSTEM WILL REDUCE SUPPLY AVAILABLE FOR ENTRY, LANDING, AND POSTLANDING.
	11-3	LOSS OF A CRYOGENIC TANK IS DEFINED AS: PRESSURE CANNOT BE MAINTAINED ABOVE 150 PSIA FOR O_2 AND 100 PSIA FOR H_2.
	11-4	MINIMUM REQUIREMENT TO CONTINUE BEYOND A DAILY GO/NO-GO POINT IS SUFFICIENT OXYGEN AND HYDROGEN TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS 2 REVS (DRIFTING FLIGHT PLUS GUIDED ENTRY MANEUVER.) MINIMUM REQUIREMENT TO CONTINUE BEYOND A SPECIFIC ACTIVITY PHASE GO/NO-GO POINT IS SUFFICIENT OXYGEN AND HYDROGEN TO SUPPLY EPS AND ECS DEMANDS DURING THAT PHASE PLUS THE TIME REQUIRED TO RECOVER FROM THE PHASE AND PREPARE FOR ENTRY.
		RULE NUMBERS 11-5 THROUGH 11-9 ARE RESERVED.

REV	ITEM	
		SYSTEMS MANAGEMENT
	11-10	CRYO MANAGEMENT A. MANUAL PRESSURE CONTROL WILL BE USED AS REQUIRED TO MAINTAIN: 1. TANK PRESSURES GREATER THAN 750 PSIA O_2 AND 200 PSIA FOR H_2 2. QUANTITY BALANCE WITHIN 4 PERCENT O_2 AND 3 PCT FOR H_2 B. CRYO TANKS WILL BE ALLOWED TO VENT NORMALLY THROUGH TANK RELIEF VALVES. C. O_2 TANK FANS AND H_2 TANK FANS NORMALLY WILL NOT BE OPERATED IN THE AUTO MODE. D. O_2 TANK HEATERS AND H_2 TANK HEATERS NORMALLY WILL BE OPERATED IN THE AUTO MODE.
	11-11	CRYO GAGING A. ONBOARD CRYOGENIC QUANTITY GAGING IS PRIME. ACCURACY IS ±2.65 PERCENT (±8.48 LBS O_2, ±0.72 LBS H_2) PER TANK. B. MCC CALCULATED QUANTITY USING PRESSURE VERSUS TEMPERATURE IS BACKUP.

RULE NUMBERS 11-12 THROUGH
11-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	11-20	LOSS OF ONE O_2 AND/OR H_2 CRYO TANK	LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONTINUE MISSION MISSION DURATION IS FUNCTION OF CRYO REMAINING.	B.1. REF MR 11-4 2. REF ALTERNATE MISSION B
	11-21	LOSS OF BOTH O_2 AND/OR H_2 CRYO TANK	LAUNCH	A. CONTINUE MISSION IF LOSS IS O_2 ISOLATE SURGE TANK PRIOR TO 800 PSIA. ENTER 2-1	A. REF MR 11-1
			ALL	B. TERMINATE PHASE ENTER NEXT BEST PTP. MAXIMUM ORBIT TIME IS 4.75 HRS FOR LOSS OF THREE FUEL CELLS.	B. IF 3 FUEL CELLS ARE LOST PRIOR TO CM/SM SEP, SMJC'S WILL BE INOPERATIVE.

RULE NUMBERS 11-22 THROUGH 11-49 ARE RESERVED

REV	ITEM
	11-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
O_2 TANK 1 QTY	SC0032Q	METER	COMMON	1 OF 2 MANDATORY	11-4
O_2 TANK 2 QTY	SC0033Q	METER	COMMON		
O_2 TANK 1 TEMP	SC0041T	-----	------	HIGHLY DESIRABLE	11-4
O_2 TANK 2 TEMP	SC0042T	-----	------	HIGHLY DESIRABLE	
H_2 TANK 1 QTY	SC0030Q	METER	COMMON	1 OF 2 MANDATORY	11-4
H_2 TANK 2 QTY	SC0031Q	METER	COMMON		
H_2 TANK 1 TEMP	SC0043T	-----	------	HIGHLY DESIRABLE	11-4
H_2 TANK 2 TEMP	SC0044T	-----	------	HIGHLY DESIRABLE	
O_2 TANK 1 PRESS	SC0037P	METER	COMMON	1 OF 2 MANDATORY	11-3,4
O_2 TANK 2 PRESS	SC0038P	METER	COMMON		
H_2 TANK 1 PRESS	SC0039P	METER	COMMON	1 OF 2 MANDATORY	11-3,4
H_2 TANK 2 PRESS	SC0040P	METER	COMMON		

12 CSM ELECTRICAL
POWER SYSTEM

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MISSION RULES

REV	ITEM	
		GENERAL
A	12-1	LAUNCH LAUNCH WILL BE CONTINUED AS LONG AS SUFFICIENT ENERGY IS AVAILABLE TO PERFORM AN ENTRY INTO AT LEAST PTP 2-1. THERE MUST BE AT LEAST ONE MAIN BUS AND ONE AC BUS OPERATIONAL TO CONTINUE.
	12-2	THERE ARE NO FUEL CELL FAILURES FOR WHICH THE LAUNCH PHASE WILL BE TERMINATED AS LONG AS THREE ENTRY BATTERIES ARE REMAINING TO SUPPLY MAIN BUS LOADS.
A	12-3	ALL MISSION PHASES TO CONTINUE THE MISSION THE FOLLOWING MUST BE AVAILABLE: BOTH MAIN BUSES, BOTH BATTERY BUSES, BOTH AC BUSES, THE BATTERY RELAY BUS, AND AT LEAST TWO FUEL CELLS, TWO BATTERIES, AND TWO INVERTERS. MISSION WILL BE CONTINUED AS LONG AS THE FUEL CELLS ARE CAPABLE OF SUPPORTING DRIFTING FLIGHT REQUIREMENTS (WITHOUT BATTERY SUPPLEMENT, AS DEFINED IN THE FLIGHT PLAN) AND ENOUGH BATTERY ENERGY IS AVAILABLE TO PERFORM A HYBRID DEORBIT (80 FT/SEC CM RCS) AND ENTRY PLUS 18 HRS POSTLANDING AND A ONE BAG FAILURE UPRIGHTING (70 AMP-HRS TOTAL IN THREE BATTERIES, OR 74 AMP-HRS TOTAL IN TWO BATTERIES). IF SM RCS ONLY DEORBIT CAPABILITY IS RESERVED, BATTERY REQUIREMENT CAN BE DOWNGRADED TO 52 AMP-HRS TOTAL IN THREE BATTERIES OR 56 AMP-HRS TOTAL IN TWO BATTERIES. RENDEZVOUS IN ADDITION TO THE PRECEDING, TO BEGIN AND CONTINUE RENDEZVOUS ACTIVITIES TWO FUEL CELLS ARE REQUIRED, AND EITHER THREE BATTERIES OR TWO BATTERIES AND THE BATTERY CHARGER ARE REQUIRED.
	12-4	BATTERY IS CONSIDERED FAILED IF: A. OUTPUT <3 AMPS WHEN CONNECTED TO A MAIN BUS DURING SPS MANEUVERS (NOMINAL TOTAL BATTERY CURRENT FOR SPS MANEUVERS IS 20 ± 2 AMPS). B. SUSTAINED BATTERY CHARGER OUTPUT >2.0 AMPS AND ALL LOADS REMOVED.
	12-5	AN AC BUS IS CONSIDERED FAILED IF ANY TWO PHASES CANNOT BE MAINTAINED >95 VOLTS.
	12-6	AN INVERTER IS CONSIDERED FAILED IF: A. OUTPUT VOLTAGE ON ANY PHASE >130 VAC. B. OUTPUT VOLTAGE ON ANY TWO PHASES <95 VAC.

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MISSION RULES

REV	ITEM	
	12-7	FUEL CELL IS CONSIDERED FAILED FOR MISSION PLANNING IF: A. FUEL CELL CANNOT SUPPLY SUFFICIENT POWER TO MEET ITS OWN PARASITIC LOADS (5 AMPS PLUS INLINE HEATER POWER AS REQUIRED). B. FUEL CELL H_2 LOOP IS CONTAMINATED WITH KOH. RULE NUMBERS 12-8 THROUGH 12-19 ARE RESERVED
		SYSTEMS MANAGEMENT
	12-20	BUS MANAGEMENT A. FOR THREE FUEL CELL OPERATION, ONLY ONE FUEL CELL WILL BE TIED TO BOTH MAIN BUSES. FOR TWO FUEL CELL OPERATION, ONE FUEL CELL WILL BE TIED TO EACH MAIN BUS. B. INVERTERS WILL BE CONFIGURED SUCH THAT MAIN BUS A WILL SUPPLY AC BUS 1 AND MAIN BUS B WILL SUPPLY AC BUS 2. C. MAIN BUS VOLTAGE WILL BE MAINTAINED >26.5 VDC AND <31 VDC. ONE FUEL CELL MAY BE OPEN CIRCUITED FOR OPTIMUM VOLTAGE AND POWER MANAGEMENT. D. THE BATTERY CHARGER WILL BE USED TO CHECK OUT A SUSPECTED SHORTED BUS (EXCEPT MAIN BUSES) AFTER ALL EQUIPMENT AND POWER SOURCES HAVE BEEN REMOVED FROM BUS.
A	12-21	BATTERY MANAGEMENT A. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FROM T-75 SECONDS TO INSERTION. B. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FOR SPS MANEUVERS. BATTERY C WILL BE ROTATED IN THE EVENT THE BATTERY CHARGER FAILS TO MAINTAIN BATTERY BALANCE. C. BATTERY CHARGING WILL BE TERMINATED FOR ONE OF THE FOLLOWING, WHICHEVER OCCURS FIRST: 1. INTEGRATED AMP-HOURS INTO BATTERY BY CHARGER EQUALS INTEGRATED AMP-HOURS OUT OF BATTERY BY LOADS. 2. BATTERY CHARGER CURRENT DROPS TO 0.4 AMPS D. THREE BATTERIES WILL BE TIED TO THE MAIN BUSES FOR DEORBIT MANEUVER AND ENTRY. E. BATTERIES ARE CONSIDERED TO HAVE 40 AMP-HR CAPABILITY INFLIGHT AND 45 AMP-HR CAPABILITY FOR POSTLANDING. F. A SINGLE BATTERY THAT CANNOT BE RECHARGED WILL NOT BE USED EXCEPT DURING DEORBIT, ENTRY, AND POST-LANDING.

REV	ITEM	
	12-22	FUEL CELL MANAGEMENT A. FUEL CELL WILL BE "SHUTDOWN" FOR THE FOLLOWING: 1. SUSTAINED CURRENT OUTPUT LESS THAN 5 AMPS. 2. FUEL CELL H_2 LOOP IS CONTAMINATED WITH KOH. 3. REACTANT LEAKAGE JEOPARDIZING MISSION DURATION. B. FUEL CELL MAY BE "OPEN CIRCUITED" FOR THE FOLLOWING: 1. SKIN TEMP >475°F. 2. TCE TEMP >200°F. 3. FAILURE OF H_2 PUMP OR GLYCOL PUMP. 4. VOLTAGE MANAGEMENT. 5. FUEL CELL CANNOT BE PURGED AND TIME TO GO IS GREATER THAN PREDICTED FUEL CELL LIFETIME. C. FUEL CELL O_2 PURGES WILL BE DONE AT 12 HOUR INTERVALS. FUEL CELL H_2 PURGES WILL BE DONE AT 48 HOUR INTERVALS. D. ADDITIONAL PURGES WILL BE INITIATED AS OPERATIONAL CONDITIONS DICTATE. E. FUEL CELLS WILL NOT BE PURGED UNDER THE FOLLOWING CONDITIONS: 1. CONFIRMED HIGH PH INDICATION. 2. ANY CONDITION WHERE KOH IS LIKELY TO BE VENTED INTO THE H_2 OR O_2 MANIFOLD. F. EACH H_2 PURGE WILL NORMALLY BE PRECEDED BY 20 MINUTES OF H_2 VENT HEATER OPERATION. G. FC INLINE HEATERS WILL NORMALLY OPERATE IN "AUTO" CONTINUOUSLY. H. REACTANT VALVES MUST REMAIN OPEN AT ALL TIMES UNLESS THE FUEL CELL IS DECLARED FAILED. I. ADDITIONAL POWER LOADS WILL BE ADDED AS REQUIRED TO MAINTAIN FC RAD OUT TEMP >-40 DEGREES. IF CRYO BUDGET JEOPARDIZED OR RAD OUT TEMPS NOT MAINTAINED >-40 DEGREES, FC RAD WILL BE PLACED IN EMERGENCY BYPASS. J. FUEL CELLS MAY BE PURGED TO PRECLUDE VENTING OF CRYO TANKS.
	12-23	INVERTER MANAGEMENT INVERTERS MAY BE REMOVED FROM LINE FOR ANY OF THE FOLLOWING REASONS: A. INVERTER TEMP >199°F B. SPACECRAFT LOAD MANAGEMENT RULE NUMBERS 12-24 THROUGH 12-29 ARE RESERVED

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	12-30	LOSS OF ONE FUEL CELL OUTPUT <5 AMPS	LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONTINUE MISSION 1. OPEN CIRCUIT FUEL CELL. 2. RECONFIGURE REMAINING TWO FUEL CELLS TO ONE FUEL CELL PER MAIN BUS ONLY. 3. IF FUEL CELL CANNOT BE RESTORED PERFORM SHUTDOWN.	B.1. REF MALF PROC EPS 5 2. REF ALTERNATE MISSION B
	12-31	LOSS OF TWO FUEL CELLS OUTPUT <5 AMPS EACH	LAUNCH	A. CONTINUE MISSION AFTER 2 + 00 GET PERFORM: 1. EDS AUTO/OFF TO OFF. 2. IF LOSS OF FC 1 AND 2, TIE BAT C TO MAIN A. 3. IF LOSS OF FC 2 AND 3, TIE BAT C TO MAIN B. 4. IF LOSS OF FC 1 AND 3, TIE BAT C TO BOTH MAIN BUSES.	
			ORBIT (S-IVB) ORBIT (SOLO)	B. ENTER NEXT BEST PTP CONNECT REMAINING FUEL CELL TO BOTH MAIN BUSES	B. ONE ENTRY BATTERY MAY BE USED TO SUPPLEMENT REMAINING FC FOR G&N ALIGNMENT PRIOR TO DEORBIT.
			TD&E	C. ENTER NEXT BEST PTP TERMINATE TD & E	
			DOCKED EVA	D. ENTER NEXT BEST PTP	D. IVT AND SETUP FOR UNMANNED APS BURN MAY BE PERFORMED.
			UNDOCKED RNDZ	E. ENTER NEXT BEST PTP 1. TERMINATE RNDZ 2. PERFORM CSM/LM FINAL SEP	E.2. SETUP FOR UNMANNED APS BURN MAY BE PERFORMED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-32	LOSS OF THREE FUEL CELLS			
		A. OUTPUT <10 AMPS EACH	LAUNCH	A.1. CONTINUE MISSION (A) AFTER 2 + 00 EDS AUTO/OFF TO OFF. (B) TIE BAT C TO BOTH MAIN BUSES (C) POWER DOWN AT INSERTION ENTER 2-1 IF FUEL CELLS CANNOT BE RESTORED.	A.1.(A) IF TOTAL OUTPUT CAPABILITY LESS THAN 8 AMPS AT 22 VDC, SMJC WILL BE INOPERATIVE FOR CM/SM SEP.
			ALL	2. ENTER NEXT BEST PTP	A.2. 4.75 HOURS LEFT IN ORBIT BEFORE DEORBIT MANEUVER.
		B. TOTAL OUTPUT CAPABILITY INSUFFICIENT TO SUPPORT DRIFTING FLIGHT LOADS	ALL	B.1. ENTER NEXT BEST PTP MANIPULATION OF CYCLIC LOADS WILL BE ATTEMPTED TO MAINTAIN VM >26.5 VDC	B.1. 89 AMPS REPRESENTS MAXIMUM DRIFTING FLIGHT REQUIREMENTS (63 AMPS AVERAGE).
			LAUNCH	2. NOT APPLICABLE	
		C. TOTAL OUTPUT CAPABILITY <36 AMPS AT MAIN BUS VOLTAGE OF 26.5 VDC	ALL	C.1. ENTER NEXT BEST ATP OR PTP	C.1. BASED ON FC OUTPUT AND BATTERY ENERGY REMAINING, 36 AMPS REPRESENTS MINIMUM POWER TO SUPPORT S/C SYSTEMS IN ORBIT.
			LAUNCH	2. NOT APPLICABLE	
	12-23	LOSS OF THREE FUEL CELLS PLUS ONE BATTERY CURRENT <50% OF LOAD ON EITHER REMAINING BATTERY	LAUNCH	A. ABORT	A. ASSUMES ALL THREE FUEL CELL CURRENTS ≤5 AND BATTERY C TIED TO BOTH MAINS.
			ALL	B. ENTER NEXT BEST ATP OR PTP PERFORM EMERGENCY POWER DOWN	B. 2.4 HOURS LEFT IN ORBIT BEFORE DEORBIT MANEUVER.
		RULE NUMBERS 12-24 THROUGH 12-39 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-40	LOSS OF ONE ENTRY BATTERY (OUTPUT <3 AMPS WHEN TIED TO MAIN BUS)	LAUNCH	A. CONTINUE MISSION 1. EDS AUTO/OFF TO OFF 2. IF LOSS OF BAT A, TIE BAT C TO MAIN A 3. IF LOSS OF BAT B, TIE BAT C TO MAIN B.	
			SPS MANEUVER	B. CONTINUE MISSION MANEUVER ON REMAINING BATTERY	
			ALL	C. CONTINUE MISSION USE REMAINING TWO BATS DURING SPS BURNS AND ENTRY.	
	12-41	LOSS OF TWO ENTRY BATTERIES (OUTPUT <3 AMPS EACH WHEN CONNECTED TO MAIN BUS)	LAUNCH	A. CONTINUE MISSION 1. EDS AUTO/OFF TO OFF. 2. ENTER 2-1 POWERED DOWN.	
			SPS MANEUVER	B. CONTINUE MANEUVER ENTER NEXT BEST PTP IF AT LEAST TWO BATTERIES CANNOT BE RESTORED	
			ALL	C. ENTER NEXT BEST PTP IF AT LEAST TWO BATTERIES CANNOT BE RESTORED	
	12-42	LOSS OF BATTERY CHARGER	ALL	CONTINUE MISSION ROTATE BATTERY C FOR BURNS TO MAINTAIN BALANCED BATTERIES	REF MALF PROC EPS-5 BATTERY CHARGING NOT REQUIRED FOR NOMINAL MISSION PLUS HYBRID DEORBIT AND 18 HOURS POSTLANDING WITH ONE BAG FAILURE UPRIGHTING.
		RULE NUMBERS 12-43 THROUGH 12-49 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-50	MAIN BUS TIE MOTOR SWITCH FAILURES			
		A. ONE MOTOR SWITCH FAILS OPEN	LAUNCH	A.1. CONTINUE MISSION (A) IF MOTOR SW A/C, TIE BAT C TO MAIN BUS A (B) IF MOTOR SW B/C, TIE BAT C TO MAIN BUS B	
			ALL	2. CONTINUE MISSION CLOSE ALTERNATE MOTOR SW AND USE MAIN BUS TIE CB'S AS MOTOR SWITCHES	A.2. BATTERIES MUST BE CHARGED THROUGH OPEN MOTOR SW. LEAVE BAT RLY C.B. CLOSED FOR CHARGING.
		B. ONE OR BOTH MOTOR SW FAILED CLOSED	ALL	B. CONTINUE MISSION USE CB'S AS MOTOR SWITCHES	B. IF BOTH MOTOR SWITCHES FAIL CLOSED, BATTERIES CANNOT BE CHARGED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-51	MAIN BUS SHORTED CAUSING FUEL CELL REVERSE CURRENT DISCONNECT			
		A. FUEL CELL 2 DISCONNECTS FROM MAIN A	LAUNCH	A.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF. (B) TIE BAT C TO MAIN A. (C) INVERTER 3 TO AC BUS NO. 2. (D) POWER DOWN MAIN BUS B.	A.1. >85 AMPS SHORT ON MAIN B WILL CAUSE REVERSE DISCONNECT DURING LAUNCH MALF EPS-3.
			ALL	2. ENTER NEXT BEST PTP IF BUS NOT RESTORED. POWER DOWN MAIN BUS B.	2. REF MALF PROC EPS SSR-2
		B. FUEL CELL 2 DISCONNECTS FROM MAIN B	LAUNCH	B.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF. (B) TIE BAT C TO MAIN BUS B. (C) INVERTER 3 TO AC BUS NO. 1. (D) POWER DOWN MAIN BUS A. (E) SWITCH TO SECONDARY GMBL SYSTEM.	B.1. >79 AMPS SHORT ON MAIN A WILL CAUSE REVERSE DISCONNECT DURING LAUNCH. B.1.(E) TVC GMBL DRIVE, P, Y -2.
			ALL	2. ENTER NEXT BEST PTP IF BUS NOT RESTORED. POWER DOWN MAIN BUS A	
		C. MAIN BUS SHORTED >25 AMPS AND FUEL CELLS CANNOT BE DISCONNECTED FROM SHORTED BUS.	LAUNCH	C.1. ABORT	C.1. FAILURE OF MOTOR SWITCH TO DISCONNECT FROM SHORTED BUS INDICATED BY FC SHORTED BUS T/B GRAY.
			ALL	2. ENTER NEXT BEST PTP IF MAIN BUS NOT RESTORED.	C.2. IF FUEL CELL FEED CIRCUITRY SHORTED, CLOSE FC REACTANT VALVES.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-52	A. BATTERY BUS SHORTED >10 AMPS	LAUNCH	A.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF. (B) OPEN ASSOCIATED MAIN BUS TO BAT BUS C.B. (C) TIE BAT C TO ASSOCIATED MAIN BUS.	A.1. >22 AMPS WILL CAUSE BATTERY BUS VOLTAGE TO BE ≤ MAIN BUS VOLTAGE.
			ALL	2. ENTER NEXT BEST PTP IF BUS NOT RESTORED	A.2. REMOVE POWER FROM BUS, IF SHORTED ≤ 10 AMPS. POWER BUS JUST PRIOR TO ENTRY TO MAINTAIN SECS REDUNDANCY.
		B. BATTERY BUS SHORTED ≤10 AMPS	ALL	B. CONTINUE MISSION REMOVE POWER FROM BUS EXCEPT FOR MANEUVERS AND ENTRY	
	12-53	BATTERY RELAY BUS			
		A. SHORT >2.0 AMPS	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2. ENTER NEXT BEST PTP OPEN BATTERY BUS TO BATTERY RELAY BUS CB'S.	A.2. REF MALF PROC EPS-SSR-2
		B. SHORT <2.0 AMPS	ALL	B. CONTINUE MISSION	B. PLACE BATTERY A ONLY TO BAT RELAY BUS AND CHARGE BAT B CONTINUOUSLY WITH BAT B POWER ENTRY AND POST LANDING CB OPEN. CONSIDER BATTERY CHARGER LOST FOR MISSION PLANNING. MALF EPS SSR-2
		RULE NUMBERS 12-54 THROUGH 12-59 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-60	LOSS OF TWO INVERTERS	LAUNCH	A. CONTINUE MISSION	A. REF MALF PROC _____ PLACE REMAINING INVERTER ON BOTH AC BUSES.
			ALL	B. ENTER NEXT BEST PTP	
	12-61	LOSS OF ONE AC BUS (TWO PHASES CANNOT BE MAINTAINED >95 VAC)	LAUNCH	A. CONTINUE MISSION	
			ALL	B. ENTER NEXT BEST PTP	
	12-62	LOSS OF BOTH AC BUSES	LAUNCH	A. ABORT MODE I OR MODE II	A. REF MR _____
				1. OPEN DIRECT O_2 FOR SUIT VENTILATION.	
				2. IF AFTER MODE II, ENTER 2-1 PTP.	A.2. INITIATE CONTINUOUS FC H_2 PURGE FOR COOLING.
			ALL	B. ENTER NEXT BEST PTP OR ATP	B. ENTER WITHIN 1-1/2 HOURS. INITIATE CONTINUOUS FC H_2 PURGE FOR COOLING.
				IF SUITED, REMOVE HELMET AND GLOVES. IF TIME PERMITS, REMOVE SUITS. IF CABIN DEPRESSURIZED, USE DIRECT O_2 UNTIL CABIN IS REPRESSURIZED.	
		RULE NUMBERS 12-63 THROUGH 12-69 ARE RESERVED.			

Form 291 (AUG 68)

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MISSION RULES

REV	ITEM
A	12-70

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ON-BOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
AC BUS 1 YELLOW	-------	MCWS	----------	HIGHLY DESIRABLE	12-5,6,61
AC BUS 1 ϕA VAC	CC0200V	METER	SEPARATE	HIGHLY DESIRABLE	
AC BUS 1 ϕB VAC	-------	METER	----------	HIGHLY DESIRABLE	
AC BUS 1 ϕC VAC	-------	METER	----------	HIGHLY DESIRABLE	
		COMMON METER			
AC BUS 2 ϕA VAC	CC0203V	METER	SEPARATE	HIGHLY DESIRABLE	12-5,6,61
AC BUS 2 ϕB VAC	-------	METER	----------	HIGHLY DESIRABLE	
AC BUS 2 ϕC VAC	-------	METER	----------	HIGHLY DESIRABLE	
AC BUS 2 YELLOW	-------	MCWS	----------	HIGHLY DESIRABLE	
MAIN BUS A VDC	CC0206V	METER	SEPARATE	1 OF 2 MANDATORY	12-32,52,20C 12-22
MAIN BUS B VDC	CC0207V	METER	SEPARATE		
BAT BUS A VDC	CC0210V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT BUS B VDC	CC0211V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT RELAY BUS VDC	CC0232V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT A CURRENT	CC0222C	METER	COMMON	2 OF 3 MANDATORY	12-4,33,40,41
BAT B CURRENT	CC0223C	METER	COMMON		
BAT C CURRENT	CC0224C	METER	COMMON		
FC 1 CURRENT	SC2113C	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33, 22A
FC 1 O_2 FLO	SC2142R	METER	COMMON		
FC 1 H_2 FLO	SC2139R	METER	COMMON		
FC 2 CURRENT	SC2114C	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33, 22A
FC 2 O_2 FLO	SC2143R	METER	COMMON		
FC 2 H_2 FLO	SC2140R	METER	COMMON		
FC 3 CURRENT	SC2115C	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33, 22A
FC 3 O_2 FLO	SC2144R	METER	COMMON		
FC 3 H_2 FLO	SC2141R	METER	COMMON		
BAT CHARGER CURRENT	SC0215C	METER	COMMON	HIGHLY DESIRABLE	
FC 1 SKIN TEMP	SC2084T	METER	COMMON	HIGHLY DESIRABLE	12-22B
FC 2 SKIN TEMP	SC2085T	METER	COMMON	HIGHLY DESIRABLE	
FC 3 SKIN TEMP	SC2086T	METER	COMMON	HIGHLY DESIRABLE	
FC 1 COND TEMP	SC2081T	METER	COMMON	HIGHLY DESIRABLE	12-22B
FC 2 COND TEMP	SC2082T	METER	COMMON	HIGHLY DESIRABLE	
FC 3 COND TEMP	SC2083T	METER	COMMON	HIGHLY DESIRABLE	
FC 1 RAD OUT TEMP	SC2087T	METER	COMMON	HIGHLY DESIRABLE	12-22I
FC 2 RAD OUT TEMP	SC2088T	METER	COMMON	HIGHLY DESIRABLE	
FC 3 RAD OUT TEMP	SC2089T	METER	COMMON	HIGHLY DESIRABLE	
BAT MANIFOLD PRESS	-------	METER	------	HIGHLY DESIRABLE	-------
INV 1 TEMP	CC0175T	MCWS	COMMON	HIGHLY DESIRABLE	-------
INV 2 TEMP	CC0176T	MCWS	COMMON	HIGHLY DESIRABLE	-------
INV 3 TEMP	CC0177T	MCWS	COMMON	HIGHLY DESIRABLE	-------
FC 1 PH	SC2160X	TALKBACK	COMMON	HIGHLY DESIRABLE	12-22E
FC 2 PH	SC2161X	TALKBACK	COMMON	HIGHLY DESIRABLE	
FC 3 PH	SC2162X	TALKBACK	COMMON	HIGHLY DESIRABLE	

NOTE: USE BAT C IN LIEU OF BATTERY WITH LOST INST

13 CSM COMM/
INSTRUMENTATION
(SEE SECTION 32)

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MISSION RULES

REV	ITEM

THIS
SECTION
HAS BEEN
DELETED

ALL DATA FORMERLY CONTAINED
IN THIS SECTION IS NOW IN
SECTION 32.

14 CSM SEQUENTIAL

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MISSION RULES

REV	ITEM	
		GENERAL
	14-1	LAUNCH THERE ARE NO SEQUENTIAL MALFUNCTIONS FOR WHICH LAUNCH WILL BE TERMINATED.
	14-2	IF AN ENTRY BATTERY IS LOST, THE EDS WILL BE FLOWN OPEN LOOP.
	14-3	ALL MISSION PHASES TO CONTINUE THE MISSION, BOTH PYRO BUSES AND BOTH LOGIC BUSES ARE REQUIRED.
	14-4	SEQUENTIAL LOGIC BUS IS CONSIDERED FAILED IF: A. VOLTAGE <22 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS (CD0170X AND/OR CD0123X SYSTEM A, CD0171X AND/OR CD0124X SYSTEM B). B. LOGIC BUS SHORTED >10 AMPS.
	14-5	PYRO BUS IS CONSIDERED FAILED IF: A. SHORTED >10 AMPS B. FAILURE TO PERFORM ANY SEQUENTIAL FUNCTION WITH SUSPECTED FAILED PYRO SYSTEM.
		RULE NUMBERS 14-6 THROUGH 14-9 ARE RESERVED

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MISSION RULES

REV	ITEM	MANAGEMENT
	14-10	ARMING OF THE SEQUENTIAL SYSTEM WILL BE PERFORMED WHILE IN CONTACT WITH A GROUND TELEMETRY SITE. THE FLIGHT CREW WILL ARM THE LOGIC BUSES AND THE STAND BY FOR A GO FROM THE GROUND TO PROCEED WITH ARMING THE PYRO BUSES.

RULE NUMBERS 14-11 THROUGH
14-19 ARE RESERVED

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	14-20	SEQUENTIAL LOGIC BUS A OR B ≤22 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS			CD0170X AND/OR CD0123X SYSTEM A, CD0171X AND/OR CD0124X SYSTEM B
			LAUNCH	A. CONTINUE MISSION ENTER 3-1 IS BUS NOT RESTORED	
			ALL	B. TERMINATE OPERATIONS ENTER NEXT BEST PTP IF BUS NOT RESTORED	
	14-21	PYRO BUS A OR B ≤35 VDC			
		A. SHORTED >10 AMPS	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2. TERMINATE OPERATIONS ENTER NEXT BEST PTP	A.2. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS
		B. SHORTED <10 AMPS	ALL	B. CONTINUE MISSION	B. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS
		C. PYRO BUS TM READS 0 VDC AND PYRO BAT ONBOARD >35 VDC	LAUNCH	C.1. CONTINUE MISSION	
			ALL	2. ATTEMPT FUNCTION USING SUSPECTED FAILED BUS ONLY: (A) IF FUNCTION NORMAL, CONTINUE MISSION (B) IF FUNCTION DOES NOT WORK NORMALLY, ENTER NEXT BEST PTP	C.2. ASSUME PYRO BAT VERIFIED >35 VDC PRIOR TO ARMING. IF ENTRY BAT USED IN LIEU OF PYRO BAT, VOLTAGE SHOULD BE APPROXIMATELY = TO BAT BUS VOLTAGE.
	14-22	TELEMETRY INDICATES AN EDS VOTE INPUT 1, 2, OR 3	LAUNCH	CONTINUE MISSION A. IF ANY ENTRY BATTERY <22 VDC, EDS AUTO/OFF SWITCH TO OFF B. ALL ENTRY BATTERIES >22 VDC: CHECK CORRESPONDING EDS C.B.'S 1, 2, OR 3 CLOSED	PARAMETERS ARE CD0132X, CD0133X, AND CD0134X RESPECTIVELY. A. BAT C VOLTAGE CAN ONLY BE MONITORED ONBOARD
	14-23	LET JETTISON MOTOR DOES NOT FIRE	LAUNCH	CONTINUE MISSION ATTEMPT JETTISON PER CREW CHECKLIST EMERGENCY PROCEDURE	

MSC 7-63 Form 891 (Aug 68)

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	14-24	SMJC ACTIVATES PREMATURELY	ALL	ENTER NEXT BEST PTP A. TERMINATE OPERATIONS AND POWER DOWN AFFECTED MAIN BUS. DO NOT ARM AFFECTED PYRO BUS B. IF UNDOCKED, RETURN TO CSM AND PERFORM CSM/LM FINAL SEP C. REPOWER AFFECTED MAIN BUS AFTER CM/SM SEP	A. USE GOOD SEQUENTIAL SYSTEM IF IN CONTACT WITH MSFN, ARMING OF LOGIC BUSES WILL INDICATE WHICH MAIN BUS MUST BE POWERED DOWN. MAIN A IF SYSTEM A CM/SM SEP. MAIN B IF SYSTEM B CM/SM SEP EVENT IS ACTIVATED. B. USE GOOD SEQUENTIAL SYSTEM
	14-25	ACTIVATED CM RCS PRESS LOGIC RELAYS.	ALL	CONTINUE MISSION A. PRIOR TO CM RCS PRESS: DO NOT ARM RESPECTIVE PYRO BUS (FOR BOTH INDICATIONS PERFORM SLA SEP WITH SECS ARM CB'S OPEN.) B. **AT CM RCS PRESS: ARM** RESPECTIVE PYRO BUS	CD0173X AND/OR CD0174X
	14-26	ACTIVATED SLA DEPLOY LOGIC RELAYS	ALL	CONTINUE MISSION A. PRIOR TO SLA SEP: DO NOT ARM RESPECTIVE PYRO BUS B. FOR SLA SEP: ARM RESPECTIVE PYRO BUS FIRST	CD0123X AND/OR CD0124X
	14-27	UNABLE TO PERFORM SLA SEPARATION	ORBIT (S-IVB)	ENTER NEXT BEST PTP	REF MR ____
	14-28	LOST GROUND TO RESISTER NETWORK FOR LOGIC OR PYRO BUS VOLTS MEASUREMENTS RULE NUMBERS 14-29 THROUGH 14-39 ARE RESERVED	ALL	CONTINUE MISSION DO NOT ARM AFFECTED SYSTEM UNTIL CM/SM SEP UNLESS OTHER SYSTEM FAILS IF PYRO BUS: USE BAT BUS TO PYRO TIE. DO NOT ARM UNTIL CM/SM SEP UNLESS OTHER SYSTEM FAILS.	ARMING SYSTEM WITH VOLTAGE >30 VDC WILL RESULT IN PERMANENT LOSS OF ALL ANALOG TELEMETRY PARAMETERS.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	14-40	ACTIVATED APEX JETTISON LOGIC RELAYS	ALL	ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	DETECTED AT SECS POWER UP (CD0230X AND CD023X)
	14-41	ACTIVATED DROGUE CHUTE DEPLOY LOGIC RELAYS	ALL	ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	MAY BE DETECTED AT ANY TIME (CE0001X AND/OR CE0002X)
	14-42	ACTIVATED PILOT CHUTE DEPLOY LOGIC RELAYS	ORBIT (SOLO)	ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	DETECTED AT SECS POWER UP PRIOR TO ENTRY (CE0003X AND/OR CE0004X) WITH ELS BAT A(B) C.B. CLOSED.
		RULE NUMBERS 14-43 THROUGH 14-49 ARE RESERVED			

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MISSION RULES

REV	ITEM
A	14-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
PYRO BUS A VOLTS	CD0005V	-------	----------	1 OF	14-21
PYRO BUS B VOLTS	CD0006V	-------	----------	2 M	14-21
SEQ LOGIC BUS A VOLTS	CD0200V	-------	----------	HD	14-20, 14-12
SEQ LOGIC BUS B VOLTS	CD0201V	-------	----------	HD	14-20, 14-12
APEX JET A	CD0230X	-------	----------	HD	14-40
APEX JET B	CD0231X	-------	----------	HD	14-40
DROGUE DEPLOY A	CE0001X	-------	----------	HD	14-41
DROGUE DEPLOY B	CE0002X	-------	----------	HD	14-41
PILOT CHUTE DEPLOY A	CE0003X	-------	----------	HD	14-42
PILOT CHUTE DEPLOY B	CE0004X	-------	----------	HD	14-42
SLA SEP RELAY A	CD0123X	-------	----------	HD	14-26
RCS/SCS ACTIVATE A	CD0170X	-------	----------	HD	-----
SLA SEP RELAY B	CD0124X	-------	----------	HD	14-26
RCS/SCS ACTIVATE B	CD0171X	-------	----------	HD	-----
CM RCS PRESS SIG A	CD0173X	-------	----------	HD	14-25
CM RCS PRESS SIG B	CD0174X	-------	----------	HD	14-25
CM-SM SEP RELAY A	CD0023X	-------	----------	HD	----
CM-SM SEP RELAY B	CD0024X	-------	----------	HD	-----
CREW ABORT A	CD0130X	-------	----------	HD	-----
CREW ABORT B	CD0131X	-------	----------	HD	-----
EDS ABORT VOTE 1	CD0132X	-------	----------	HD	14-22
EDS ABORT VOTE 2	CD0133X	-------	----------	HD	14-22
EDS ABORT VOTE 3	CD0134X	-------	----------	HD	14-22
EDS ABORT A	CD0135X	-------	----------	HD	-----
EDS ABORT B	CD0136X	-------	----------	HD	-----
MAIN CHUTE DISC A	CE0321X	-------	----------	HD	-----
MAIN CHUTE DISC B	CE0322X	-------	----------	HD	-----
EDS ABORT REQ A	BS0080X	-------	----------	HD	-----
EDS ABORT REQ B	BS0081X	-------	----------	HD	-----
DOCKING PROBE TEMP	CS0220T	-------	----------	HD	-----
CSM-LM LOCK RING SEP RELAY A	CD1154X	-------	----------	HD	19-16
CSM-LM LOCK RING SEP RELAY B	CD1155X	-------	----------	HD	19-16
LM CURRENT	SC2962C	METER	COMMON	HD	-----

15 CSM GUIDANCE
AND CONTROL

REV	ITEM	

GENERAL

15-1 LAUNCH

THERE ARE NO FAILURES OF THE CSM GUIDANCE AND CONTROL SYSTEM WHICH ARE CAUSE FOR ABORT.

15-2 ALL ORBIT PHASES

A. IN ORDER TO CONTINUE THE MISSION PAST THE NEXT BEST PTP, THE GUIDANCE AND CONTROL SYSTEMS MUST SUPPORT TWO METHODS OF DEORBIT (SPS, SM, OR HYBRID). THE FOLLOWING MINIMUM CAPABILITIES MUST BE AVAILABLE.

1. ATTITUDE CONTROL: DIRECT RCS AND RATE DAMPING IN EACH AXIS.

2. SPS DEORBIT: ONE TVC SERVO LOOP IN EACH AXIS AND ONE TVC CONTROL MODE (MTVC ACCEL CMD EXCLUDED).

3. BACKUP DEORBIT: AS LONG AS ENOUGH PROPELLANT IS AVAILABLE FOR AN SM DEORBIT, THE G&C SYSTEMS MUST PROVIDE CAPABILITY FOR AN SM DEORBIT. IF SM DEORBIT IS NOT POSSIBLE, THE G&C SYSTEM MUST PROVIDE CAPABILITY FOR A HYBRID DEORBIT.

(A) SM DEORBIT REQUIREMENTS:

- TRANSLATION CAPABILITY
- ONE OPERATIONAL FDAI
- RATE DAMPING IN ALL THREE AXES (DAP OR SCS)

(B) HYBRID DEORBIT REQUIREMENTS:

- ALL SM DEORBIT REQUIREMENTS (RATE DAMPING MUST BE SCS)
- OPERATIONAL IMU, CMC, AND DSKY
- TWO OPERATIONAL RHC'S

B. IN ORDER TO PERFORM A NON-CRITICAL BURN, THE G&C SYSTEMS MUST PROVIDE THE CAPABILITY TO EXECUTE AN ULLAGE MANEUVER BY EITHER CMC AUTO (RCS DAP), SCS AUTO, OR DIRECT ULLAGE.

C. THE SPS WILL NOT BE SHUTDOWN FOR AN FCSM INDICATION.

A 15-3 DELETED

A 15-4 UNDOCKED

THE UNDOCKED PHASE WILL BE DELETED OR TERMINATED IF THE G&C SYSTEMS CANNOT PROVIDE REDOCKING CAPABILITY. THE G&C SYSTEMS MUST PROVIDE DIRECT RCS AND RATE DAMPING IN EACH AXIS AND TRANSLATION CAPABILITY IN THE X-AXIS FOR DOCKING/UNDOCKING CONTROL.

15-5 RENDEZVOUS

THE RENDEZVOUS PHASE WILL BE DELETED OR TERMINATED IF THE G&C SYSTEM CANNOT PROVIDE AN SPS CRITICAL BURN CAPABILITY. IN ADDITION, THE GUIDANCE AND CONTROL SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES FOR LM RESCUE:

- OPERATIONAL OPTICS SUBSYSTEM
- ONE DSKY
- TRANSLATION CAPABILITY
- RATE DAMPING IN ALL THREE AXIS
- OPERATIONAL IMU AND CMC
- ONE OPERATIONAL RHC
- ONE OPERATIONAL FDAI

RULE NUMBERS 15-6 THROUGH 15-9 ARE RESERVED.

REV	ITEM	

SYSTEMS MANAGEMENT

15-10 ATTITUDE CONTROL: CSM IN ACTIVE RCS CONTROL; LM WILL NOT BE IN ACTIVE ATTITUDE HOLD.

LM IN ACTIVE RCS CONTROL; CSM WILL NOT BE IN ACTIVE ATTITUDE HOLD.

FOR DOCKED ACTIVITIES AFTER OPENING THE APS INTERCONNECT (BOTH VEHICLES IN ACTIVE RCS CONTROL), THE CSM MUST BE IN A TIGHTER DEADBAND THAN THE LM.

15-11 PIPA AND IRIG BIAS WILL BE UPDATED WHEN ACTUAL BIASES DIFFER FROM VALUES IN CMC ERASABLE BY .02 FT/SEC^2 AND 0.075 DEG/HR RESPECTIVELY.

15-12 ΔV COUNTER DRIFT

SHOULD THE ΔV COUNTER DRIFT BE >0.01 FT/SEC^2 FOR AN RCS MANEUVER, THE Vc SETTING WILL BE APPROPRIATELY BIASED. SHOULD THE DRIFT BE >0.1 FT/SEC^2, THE EMS WILL BE CONSIDERED FAILED.

15-13 DAP INITIALIZATION

GIMBAL TRIMS: WILL BE UPDATED FOR EVERY SPS MANEUVER BASED ON FINAL TRIM POSITIONS OF THE PREVIOUS MANEUVER AS MONITORED ON TELEMETRY, IF THE PREVIOUS MANEUVER WAS SCS CONTROLLED. IF THE PREVIOUS MANEUVER WAS G&N CONTROLLED, THE CMC STORED VALUES WILL BE USED. TRIMS WILL BE REINITIALIZED FROM THE GROUND AFTER EACH VEHICLE CONFIGURATION CHANGE AND AFTER EACH WEIGHT UPDATE. TRIMS MUST BE UPDATED WHEN GROUND COMPUTED VALUES DIFFER FROM CMC STORED VALUES BY 0.5 DEGREE.

CSM, LM WEIGHT: WILL BE UPDATED WHEN GROUND COMPUTED VALUES DIFFER FROM CMC STORED VALUES BY 1.0 PERCENT. WEIGHTS MUST BE UPDATED WHEN GROUND VALUES DIFFER FROM CMC STORED VALUES BY 10.0 PERCENT.

RULE NUMBERS 15-14 THROUGH 15-19 RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	15-20	LOSS OF EITHER BMAG 1 OR 2 IN EITHER PITCH OR YAW CHANNEL	ALL	CONTINUE MISSION	A. REF MALF PROC G&C 1,2,3,4 B. NO SCS AUTO TVC C. IF IN YAW CHANNEL, AFTER .05G, RSI IS USABLE IF REMAINING GYRO IS SELECTED FOR RATE. RSI MUST BE RE-ALIGNED IN ADDITION TO THE ABOVE, FOR YAW FAILURE AFTER .05G.
A	15-21	LOSS OF BOTH BMAG 1 AND 2 IN EITHER PITCH OR YAW CHANNEL			• REF MALF PROC G&C 1,2,3,4
			LAUNCH	A. CONTINUE MISSION	A. MTVC ACCEL CMD IS ONLY MODE III OR MODE IV SPS CONTROL MODE.
			ALL	B.1. TERMINATE PHASE	B.1. LOSS OF PITCH CHANNEL RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO SINGLE FAILURES IN THE G&N SYSTEM. THE YAW LOSS PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH RE-MAINING DEORBIT METHODS TO SINGLE FAILURES IN THE G&N SYSTEM
				2. ENTER NEXT BEST PTP	
			ENTRY	C. CONTINUE MISSION	C. RSI AND SCS FDAI ROLL UNUSABLE WITH YAW CHANNEL FAILURES.
A	15-22	LOSS OF ROLL BMAG			• REF MALF PROC G&C 1,2,3,4
		A. NUMBER ONE	ALL	A.1. CONTINUE MISSION	A.1. MANUAL ROLL ATTITUDE CONTROL REQUIRED IN ALL SCS MODES. 2. NO SCS FDAI ROLL. RSI VALID.
		B. NUMBER TWO	ALL	B.1. CONTINUE MISSION	B.1. USE OF ATT 1/RATE 2 AND LIM CYCLE MAY PROVIDE RATE DAMPED ATTITUDE HOLD WHEN RCS DAP IS NOT USED. GYRO PACKAGE 2 MUST BE POWERED DOWN TO EFFECT ATTITUDE HOLD IF FAILURE IS HARDOVER. 2. SELECTION OF RATE 1 WILL PROVIDE BOTH RSI AND SCS FDAI ROLL FOR ENTRY. RSI MUST BE REALIGNED FOR ROLL FAILURE AFTER .05G.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A I	15-23	LOSS OF BOTH ROLL BMAG'S			• VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS
			LAUNCH	A. CONTINUE MISSION	• REF MALF PROC G&C 1,2,3,4
			ALL	B.1. CONTINUE MISSION IF BOTH SPS AND SM DEORBIT ARE AVAILABLE. 2. TERMINATE PHASE AND ENTER NEXT BEST PTP. IF EITHER SPS OR SM DEORBIT IS NOT AVAILABLE.	
			ENTRY	C. CONTINUE MISSION	C. NO SCS FDAI ROLL OR RSI AVAILABLE.
A I	15-24	LOSS OF EITHER TVC SERVO LOOP IN EITHER PITCH OR YAW AXIS	ALL	CONTINUE MISSION SELECT 1 OR 2 ON TVC GMBL DR SWITCH IN APPROPRIATE AXIS.	MAINTAIN 20 LBS/QUAD/AXIS FOR HARDOVER RECOVERY FOR UNDOCKED AND ____ LBS/QUAD/AXIS FOR HARDOVER RECOVERY FOR DOCKED SPS MANEUVERS • REF MALF PROC G&C 1
A I I	15-25	LOSS OF BOTH TVC SERVO LOOPS			• REF MALF PROC G&C 1
			LAUNCH	A. CONTINUE MISSION	2. NO MODE III OR IV CAPABILITY. LIMITED LANDING POINT CONTROL IN MODE III OR IV WITH SM-RCS.
			ALL	B.1. CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE. 2. ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE. RCS DEORBIT.	
			DOCKED	C.1. CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AND CSM ACTIVE DOCKING CAPABILITY AVAILABLE. 2. DO NOT UNDOCK IF CSM ACTIVE DOCKING CAPABILITY NOT AVAILABLE.	C.1. REF ALTERNATE MISSION B MAINTAINED 30 LBS RCS FOR CSM ACTIVE DOCKING. 2. REF ALTERNATE MISSION D
			RENDZ	D. TERMINATE AT NEXT POINT	
			CSM (SOLO)	E. ENTER NEXT BEST PTP RCS DEORBIT	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	15-26	LOSS OF PROPORTIONAL CONTROL FROM:			• REF MALF PROC G&C 1
		A. EITHER RHC	ALL	A. CONTINUE MISSION USE REMAINING RHC.	
		B. BOTH RHC'S	ALL	B. CONTINUE MISSION USE DIRECT RCS OR ACCEL CMD FOR MANUAL MANEUVERS.	B. NO MTVC RATE OR MTVC ACCEL CMD CAPABILITY.
A	15-27	LOSS OF DIRECT RCS CONTROL FROM:			• REF MALF PROC SCS 5
		A. EITHER RHC	ALL	A. CONTINUE MISSION	
		B. BOTH RHC'S	LAUNCH	B.1. CONTINUE MISSION	
			ALL	2. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.2. VIOLATES DIRECT RCS REQUIREMENT.
A	15-28	COMPLETE LOSS OF AUTO ATTITUDE CONTROL IN PITCH AND YAW CHANNELS.			• SUSPECTED FAILURE WOULD BE AUTO INHIBIT CIRCUITRY.
		A. CONTROL IS REGAINED BY OPENING EMS CB'S.	ALL	A. CONTINUE MISSION AFTER SM JETTISON EMS MAY BE REENABLED WITHOUT LOSS OF AUTO RCS.	
		B. CONTROL IS REGAINED BY PLACING S/C CONTROL SWITCH TO CMC.	ALL	B. CONTINUE MISSION	B. NO SCS ATTITUDE OR TVC CONTROL
		C. CONTROL IS NOT REGAINED	ALL	C. TERMINATE PHASE AND ENTER NEXT BEST PTP USE DIRECT ULLAGE AND DIRECT RCS.	C. FAILURE VIOLATES MINIMUM CAPABILITY CRITERIA FOR BOTH SM AND HYBRID DEORBIT.
A	15-29	LOSS OF FLIGHT DIRECTOR ATTITUDE INDICATORS			• REF MALF PROC G&C 4
		A. ONE	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2.(A) CONTINUE MISSION IF SPS DEORBIT AVAILABLE.	
				(B) TERMINATE PHASE AND ENTER NEXT BEST PTP IF SPS DEORBIT NOT AVAILABLE.	A.2.(B) REMAINING DEORBIT METHODS SUBJECT TO THE SAME SINGLE FAILURES IN SCS SYSTEM.
		B. BOTH	LAUNCH	B.1. CONTINUE MISSION	
			ALL	2. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.2. USE WINDOW REF

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-30	LOSS OF AC1 ϕA			• LOSS OF AC1 ϕA RESULTS IN THE LOSS OF: A. REDUNDANT SERVO LOOP POWER. BOTH SERVO LOOPS MUST BE POWERED BY THE SAME BUS. B. PROPORTIONAL ATTITUDE CONTROL FROM BOTH RHC'S. ALL PROPORTIONAL CONTROL FROM RHC #1 C. FDAI #1 D. GYRO ASSEMBLY #1 E. SCS TOTAL ATTITUDE ERROR F. SCS TOTAL ATTITUDE G. SCS AUTO TVC CAPABILITY H. SCS MINIMUM IMPULSE CAPABILITY I. SCS ATTITUDE CONTROL RATE DAMPING J. GPI P&Y DRIVE #1. • LOSS OF AC1 PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO A SINGLE FAILURE (AC2 ϕA).
			LAUNCH	A. CONTINUE MISSION	
			ALL	B. TERMINATE PHASE AND ENTER NEXT BEST PTP	
	15-31	LOSS OF AC2 ϕA			• LOSS OF AC2 ϕA RESULTS IN THE LOSS OF: A. REDUNDANT SERVO LOOP POWER B. ALL PROPORTIONAL CONTROL C. FDAI #2 D. GYRO ASSEMBLY #2 E. SCS PITCH AND YAW TOTAL ATTITUDE F. ALL SCS TVC CAPABILITY (AUTO, RATE AND ACCEL CMD) G. RSI H. GPI P&Y DRIVE #2 • LOSS OF AC2 RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO A SINGLE FAILURE (AC1 ϕA).
			LAUNCH	A. CONTINUE MISSION	
			ALL	B. TERMINATE PHASE AND ENTER NEXT BEST PTP	
	15-32	LOSS OF ORBIT RATE DISPLAY (ORDEAL) EARTH AND LUNAR	ALL	CONTINUE MISSION	REF MALF PROC SCS _____

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	15-33	LOSS OF ENTRY MONITOR SYSTEM	ALL	CONTINUE MISSION	• REF MALF PROC EMS 1 THRU 15
A	15-34	GROUND AT EITHER SPS SOL DRIVER OUTPUT AND UNABLE TO REMOVE.	LAUNCH ALL	A. CONTINUE MISSION B. CONTINUE MISSION USE OTHER SPS BANK FOR ENGINE OPERATION.	• REF MALF PROC SPS 3
A	15-35	LOSS OF TRANSLATION HAND CONTROLLER	LAUNCH ALL	A. CONTINUE MISSION B. TERMINATE PHASE AND ENTER NEXT BEST PTP	• VIOLATES BOTH SM AND HYBRID DEORBIT MINIMUM REQUIREMENTS. • REF MALF PROC SCS 7
		RULE NUMBERS 15-36 THROUGH 15-49 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	15-50	LOSS OF COMMAND MODULE COMPUTER			• REF MALF PROC G&N 5
			LAUNCH	A. CONTINUE MISSION	
			ALL	B.1. CONTINUE MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE.	
				2. TERMINATE PHASE AND ENTER NEXT BEST PTP IF EITHER SPS OR SM CAPABILITY NOT AVAILABLE	B.2. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS.
			UNDOCKED	C. INHIBIT PHASING MANEUVER REF ALTERNATE MISSION B.	C. VIOLATES RESCUE MINIMUM REQUIREMENTS
			RENDZ	D. TERMINATE AT NEXT EXIT POINT	
			ENTRY	E. PERFORM BACKUP ENTRY	
A	15-51	LOSS OF DSKY			
		A. EITHER MDC OR LEB DSKY	ALL	A. CONTINUE MISSION	
		B. BOTH MDC AND LEB DSKY	ALL	B.1.(A) CONTINUE MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE.	
				(B) TERMINATE PHASE AND ENTER NEXT BEST PTP IF EITHER SPS OR SM DEORBIT CAPABILITY NOT AVAILABLE.	B.1.(B) VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS.
			UNDOCKED	2. INHIBIT PHASING MANEUVER REF ALTERNATE MISSION B	B.2. VIOLATES RESCUE MINIMUM REQUIREMENTS
			RNDZ	3. TERMINATE AT NEXT EXIT POINT.	
			ENTRY	4. PERFORM BACKUP ENTRY	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A 1	15-52	CMC WARNING RELAY IN NAV DSKY CLOSED			• CONSTITUTES LOSS OF PIPA'S G&N TVC, ENTRY GUIDANCE AND FINE ALIGN.
			LAUNCH	A.1. CONTINUE MISSION.	
			ALL	A.2.(A) CONTINUE MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	
				(B) TERMINATE PHASE AND ENTER NEXT BEST PTP IF EITHER SPS OR SM DEORBIT NOT AVAILABLE.	A.2.(B) PIPA'S ARE REQUIRED FOR DV SENSING IN HYBRID DEORBIT
1			UNDOCKED	3. INHIBIT PHASING MANEUVER. REF ALTERNATE MISSION B.	
			RNDZ	4. TERMINATE AT NEXT EXIT POINT.	
			ENTRY	5. PERFORM BACKUP ENTRY.	
A 1	15-53	LOSS OF INERTIAL SUBSYSTEM			• REF MALF PROC G&N 6
			LAUNCH	A. CONTINUE MISSION.	
			ALL	B.1. CONTINUE MISSION. IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE.	
				2. TERMINATE PHASE AND ENTER NEXT BEST PTP IF EITHER SPS OR SM CAPABILITY NOT AVAILABLE.	B.2. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS.
1			UNDOCKED	C. INHIBIT PHASING MANEUVER REF ALTERNATE MISSION B	C. VIOLATES RESCUE MINIMUM REQUIREMENTS
			RNDZ	D. TERMINATE AT NEXT EXIT POINT	
			ENTRY	E. PERFORM BACKUP ENTRY.	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	15-54	LOSS OF OPTICS SUBSYSTEM	ALL	A. CONTINUE MISSION. USE BACKUP ALIGNMENT PROCEDURE. (COAS)	
			UNDOCKED	B. INHIBIT PHASING MANEUVER REF ALTERNATE MISSION B.	B. VIOLATES RESCUE MINIMUM REQUIREMENTS
			RNDZ	C. TERMINATE AT NEXT EXIT POINT.	
A	15-55	LOSS OF OPTICS SUBSYSTEM COUPLING DATA UNIT DIGITAL TO ANALOG CONVERTER.	ALL	CONTINUE MISSION. DELETE PLANNED TVC DAP MANEUVERS.	• REF MALF PROC G&N 10 CONSTITUTES LOSS OF TVC DAP. REF ALTERNATE MISSION B
		RULE NUMBERS 15-56 THROUGH 15-59 ARE RESERVED.			

MSC/TSG Form 291 (AUG 68)

REV | ITEM

INSTRUMENTATION REQUIREMENTS

15-60 MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
CMC DIGITAL DATA	CG0001V	-	-	MANDATORY	-
SPS SOL DRIVER 1	CH3604X	EMS-SPS ON	SEPARATE	HIGHLY DESIRABLE	-
SPS SOL DRIVER 2	CH3605X	EMS-SPS ON	SEPARATE	HIGHLY DESIRABLE	-
PITCH GIMBAL POS 1 & 2	CH3517H	GPI	COMMON 1 OF 2	MANDATORY-OB/H.D.-PCM	15-24/25
YAW GIMBAL POS 1 & 2	CH3518H	GPI	COMMON 1 OF 2	MANDATORY-OB/H.D.-PCM	15-24/25
TM BIAS 2.5 VDC	CG1110V	-	-	HIGHLY DESIRABLE	15-53/54/55
PIPA TEMP	CG2300T	-	-	HIGHLY DESIRABLE	15-53
IMU HTR +28 VDC	CG1513X	-	-	HIGHLY DESIRABLE	15-53
CMC OPERATE +28 VDC	CG1523X	-	-	HIGHLY DESIRABLE	15-50
OPTX OPERATE 28 VAC	CG1533X	-	-	HIGHLY DESIRABLE	15-55
IG 1X RSVR OUT SIN	CG2112V	FDAI	COMMON	HIGHLY DESIRABLE	15-53
IG 1X RSVR OUT COS	CG2113V	FDAI	COMMON	HIGHLY DESIRABLE	15-53
MG 1X RSVR OUT SIN	CG2142V	FDAI	COMMON	HIGHLY DESIRABLE	15-53
MG 1X RSVR OUT COS	CG2143V	FDAI	COMMON	HIGHLY DESIRABLE	15-53
OG 1X RSVR OUT SIN	CG2172V	FDAI	COMMON	HIGHLY DESIRABLE	15-53
OG 1X RSVR OUT COS	CG2173V	FDAI	COMMON	HIGHLY DESIRABLE	15-53
SHAFT CDU DAC OUT	CG3721V	-	-	HIGHLY DESIRABLE	15-55
TRUNNION CDU DAC OUT	CG3722V	-	-	HIGHLY DESIRABLE	15-55
CMC WARNING	CG5040X	C&W	COMMON	HIGHLY DESIRABLE	15-52
PITCH ATT ERROR	CH3500H	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
YAW ATT ERROR	CH3501H	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
ROLL ATT ERROR	CH3502H	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS PITCH BODY RATE	CH3503R	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS YAW BODY RATE	CH3504R	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS ROLL BODY RATE	CH3505R	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS TVC PITCH AUTO CMD	CH3582V	-	-	HIGHLY DESIRABLE	15-2/24/25
SCS TVC YAW AUTO CMD	CH3583V	-	-	HIGHLY DESIRABLE	15-2/24/25
MTVC PITCH CMD	CH3585H	-	-	HIGHLY DESIRABLE	15-2/24/25
MTVC YAW CMD	CH3586H	-	-	HIGHLY DESIRABLE	15-2/24/25
FDAI ERROR 5, RATE 5	CH3592X	-	-	HIGHLY DESIRABLE	15-20/21/22/23
FDAI ERROR 50/15, RATE 50/10	CH3593X	-	-	HIGHLY DESIRABLE	15-20/21/22/23
PITCH DIFF CLUTCH CUR	CH3666C	-	-	HIGHLY DESIRABLE	15-2/24/25
YAW DIFF CLUTCH CUR	CH3667C	-	-	HIGHLY DESIRABLE	15-2/24/25

16 CSM SERVICE
PROPULSION
SYSTEM

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MISSION RULES

REV	ITEM	
		GENERAL
	16-1	LAUNCH THERE ARE NO SPS FAILURES WHICH ARE CONSIDERED CAUSE FOR ABORT.
A	16-2	REMAINING MISSION PHASES A. FAILURES AFFECTING THE SPS FALL INTO ONE OF THREE CATEGORIES: 1. FAILURES WHICH CAUSE THE SPS TO BE UNSAFE. FAILURES IN THIS CATEGORY CAUSE THE MISSION TO BE TERMINATED BY ENTRY INTO THE NEXT BEST PTP, USING THE SM OR HYBRID DEORBIT TECHNIQUES. THIS CATEGORY OF FAILURES WILL NECESSARILY CAUSE TERMINATION OF ALL OTHER MISSION PHASES. 2. FAILURES WHICH CAUSE THE SPS TO BE INOPERABLE OR UNSAFE TO OPERATE. FAILURES IN THIS CATEGORY, WILL ALLOW THE MISSION TO CONTINUE IF BOTH SM AND HYBRID DEORBIT CAPABILITY IS AVAILABLE; HOWEVER, THE RENDEZVOUS AND CSM SOLO PHASES WILL BE TERMINATED. IN ORDER TO PROVIDE THE TOTAL CAPABILITY TO DEORBIT FROM ANY POINT IN THE MISSION, THE LM DPS AND LM RCS MAY BE USED FOR ORBIT SHAPING. 3. FAILURES WHICH DEGRADE THE CAPABILITY OF THE SPS TO A DEGREE THAT REQUIRES THAT ALL PLANNED SPS BURNS, EXCEPT THE DEORBIT, APOGEE KICK, OR LM RESCUE BURN(S), BE DELETED. MAXIMUM ALLOWABLE TIME BETWEEN THE LAST BURN AND THE DEORBIT MANEUVER IS CONSTRAINED BY PROPELLANT BULK TEMPERATURE AND IS A FUNCTION OF PROPELLANT REMAINING. B. WITH STORAGE TANKS EMPTY, EITHER A TWO-JET OR FOUR-JET ULLAGE MANEUVER IS REQUIRED PRIOR TO ALL NON-CRITICAL MANEUVERS. LACK OF CAPABILITY TO PERFORM AN ULLAGE MANEUVER WILL NOT BE CAUSE FOR INHIBITING A CRITICAL BURN. C. SPS ANOMALIES OR DEGRADING ARE NOT CAUSE FOR TERMINATING A CRITICAL BURN. NONCRITICAL BURNS WILL BE TERMINATED FOR SPS ANOMALIES OR DEGRADATIONS WHICH CAUSE OR COULD LEAD TO UNSAFE CONDITIONS. D. A 40 SECOND SPS BURN IS REQUIRED AFTER THE LM DOCKED DPS MANEUVER TO PURGE THE SYSTEM OF TRAPPED HELIUM. RULE NUMBERS 16-3 THROUGH 16-9 ARE RESERVED.
		SYSTEM MANAGEMENT
A	16-10	PROPELLANT GAGING A. PRIME METHOD: ONBOARD GAGING SYSTEM (1%) B. BACKUP METHOD: FLOW RATE X BURN TIME (3%)
	16-11	PROPELLANT UTILIZATION VALVE THE PU VALVE WILL BE USED TO CONTROL THE O/F MIXTURE RATIO TO MAINTAIN OXIDIZER IMBALANCE WITHIN +100 POUNDS.
A	16-12	DUAL BANK VS SINGLE BANK OPERATION ALL SPS BURNS WILL BE STARTED SINGLE BANK, USING BANK A. BANK B WILL BE BROUGHT ONLINE APPROXIMATELY 3 SECONDS AFTER THRUST ONSET FOR THE FIRST SPS BURN FOLLOWING THE DOCKED DPS MANEUVER AND FOR THE DEORBIT BURN. BANK B MAY ALSO BE BROUGHT ONLINE APPROXIMATELY 3 SECONDS AFTER THRUST ONSET FOR ANY SPS BURN OF SUFFICIENT DURATION THAT ALLOWS THE CREW TO EFFECTIVELY PERFORM THE PROCEDURE.

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MISSION RULES

REV	ITEM	
	16-13	PROPELLANT MANAGEMENT A. THE SPS PROPELLANT REDLINE TO PROVIDE A MINIMUM 40-SECOND POST-DOCKED DPS BURN, LM RESCUE, AND DEORBIT CAPABILITY FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT IS 14.1 PERCENT INDICATED PROPELLANT REMAINING. B. THE SPS PROPELLANT REDLINE TO PROVIDE 21 SECONDS OF BURN FOR LM RESCUE PLUS DEORBIT CAPABILITY FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT IS 7.3 PERCENT INDICATED PROPELLANT REMAINING. C. THE SPS PROPELLANT REDLINE TO PROVIDE A DEORBIT CAPABILITY OF 620 FPS IS 3.6 PERCENT INDICATED PROPELLANT REMAINING AND IS SUFFICIENT TO ACCOMPLISH DEORBIT FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT.
	16-14	PROPELLANT FEEDLINE TEMPERATURE MANAGEMENT SPS LINE HEATERS WILL BE MANUALLY CYCLED TO MAINTAIN FEEDLINE TEMPERATURES BETWEEN 55°F AND 75°F AND ENGINE VALVE TEMPERATURE ABOVE 50°F.
	16-15	ULLAGE MANAGEMENT IN GENERAL DOCKED SPS BURNS REQUIRING ULLAGE WILL BE PRECEDED BY A FOUR-JET ULLAGE; UNDOCKED SPS BURNS BY A TWO-JET ULLAGE. TWO-JET ULLAGE WILL BE USED WHENEVER NECESSARY TO IMPROVE SM-RCS PROPELLANT CAPABILITY.
		RULE NUMBERS 16-16 THROUGH 16-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
A I	16-20	SUSTAINED PRESSURE DECAY IN EITHER THE FUEL OR OXIDIZER TANK (COULD BE HELIUM OR FUEL OR OXIDIZER).			• REF MALF PROC SPS 1
			LAUNCH	CONTINUE MISSION • PLAN RCS DEORBIT INTO PTP 2-1 RCS DEORBIT • IF LAND IP IS UNAVOIDABLE AFTER ABORT, REPRESSURIZE TANKS MANUALLY	
		A. COAST	ALL	A.1. TERMINATE PHASE 2. ENTER NEXT BEST PTP RCS DEORBIT	
		B. NON-CRITICAL BURN	ALL	B.1. TERMINATE BURN 2. ENTER NEXT BEST PTP RCS DEORBIT	
		C. CRITICAL BURN	ALL	C.1. CONTINUE BURN 2. ENTER NEXT BEST PTP RCS DEORBIT	
A I	16-21	LOSS OF BOTH GN_2 TANK PRESSURES (<400 PSI).	LAUNCH	A. CONTINUE MISSION	
			ALL	B.1. CONTINUE MISSION IF BOTH SM AND HYBRID DE-ORBIT AVAILABLE. 2. ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DE-ORBIT NOT AVAILABLE. RCS DEORBIT.	
			DOCKED	C.1. CONTINUE MISSION 2. REF ALTERNATE MISSION B	C. MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
			RENDZ	D. TERMINATE AT NEXT EXIT POINT	
			CSM SOLO	E. ENTER NEXT BEST PTP RCS DEORBIT	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	16-22	FUEL FEEDLINE AND/OR OXIDIZER FEEDLINE TEMP <27°F AND UNABLE TO INCREASE.	LAUNCH	A. CONTINUE MISSION	
			ALL	B.1. CONTINUE MISSION IF BOTH SM AND HYBRID DE-ORBIT AVAILABLE.	
				2. ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DE-ORBIT NOT AVAILABLE. RCS DEORBIT.	
I			DOCKED	C.1. CONTINUE MISSION	C. MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
				2. REF ALTERNATE MISSION 8	
			RENDZ	D. TERMINATE AT NEXT EXIT POINT	
			CSM SOLO	E. ENTER NEXT BEST PTP RCS DEORBIT	
A I	16-23	ENGINE FLANGE TEMP GOES HIGHER THAN 480°F DURING AN SPS BURN.	LAUNCH	NOT APPLICABLE	MALF PROC SPS 5
		A. COAST	ALL	A.1.(A) CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE.	
				(B) ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE. RCS DEORBIT	
I			DOCKED	2.(A) CONTINUE MISSION	A.2.(A) MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
				(B) REF ALTERNATE MISSION B	
			CSM SOLO	3. ENTER NEXT BEST PTP RCS DEORBIT	
		B. NON-CRITICAL BURN	ALL	B. TERMINATE BURN INHIBIT FURTHER BURNS.	
		C. CRITICAL BURN	ALL	C. CONTINUE BURN INHIBIT FURTHER BURNS.	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	16-24	UNABLE TO IGNITE SPS	LAUNCH	NOT APPLICABLE	
			ALL	A.1. CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE	
				2. ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE. RCS DEORBIT.	
1			DOCKED	B.1. CONTINUE MISSION	B.1. MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
				2. REF ALTERNATE MISSION B	
			CSM SOLO	C. ENTER NEXT BEST PTP RCS DEORBIT	
A 1	16-25	THRUST CHAMBER PRESSURE <70 PSI CONFIRMED BY OTHER INSTRUMENTATION	LAUNCH	NOT APPLICABLE	• REF MALF PROC SPS 6
		A. COAST	ALL	A.1.(A) CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE.	CONFIRMING INSTRUMENTATION INCLUDES ONBOARD PC METER, CREW, DEGRADED THRUST, FU AND OX INTERFACE PRESSURES, F/O VALVE POSITIONS, FU AND OX TANK PRESSURES.
				(B) ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE. RCS DEORBIT.	
1			DOCKED	2.(A) CONTINUE MISSION	A.2.(A) MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
				(B) REF ALTERNATE MISSION B	
			CSM SOLO	3. ENTER NEXT BEST PTP RCS DEORBIT	
		B. NON-CRITICAL BURN	ALL	B. TERMINATE BURN INHIBIT FURTHER BURNS	
		C. CRITICAL BURN	ALL	C. CONTINUE BURN INHIBIT FURTHER BURNS	
A 1	16-26	LACK OF ULLAGE CAPABILITY AFTER STORAGE TANK EMPTY #1	ALL	CONTINUE MISSION INHIBIT ALL NON-CRITICAL SPS BURNS.	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	16-27	FIRST BURN SUBSEQUENT TO DOCKED DPS MANEUVER WAS LESS THAN 40 SEC.	ALL	A. IF BURN IS TERMINATED FOR ANY REASON: A.1. INHIBIT ALL BURNS 2. CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE 3. ENTER NEXT BEST PTP IF EITHER SM OR HYBRID NOT AVAILABLE. RCS DEORBIT.	1. BEFORE 4 SECONDS - REPEAT ENTIRE 40 SECOND BURN WITH ULLAGE. NO CONSTRAINT ON REIGNITION TIME. 2. AFTER 4 SECONDS COMPLETE REMAINDER OF BURN WITH NO ULLAGE REIGNITE AS SOON AS POSSIBLE. 3. AFTER 9 SECONDS, BUT BEFORE 40 SECONDS - COMPLETE REMAINDER OF BURN WITH NO ULLAGE. REIGNITE AS SOON AS POSSIBLE.
			DOCKED	B.1. CONTINUE MISSION 2. REF ALTERNATE MISSION B	B.1. MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
			CSM SOLO	C. ENTER NEXT BEST PTP RCS DEORBIT	
A	16-28	ΔP BETWEEN FUEL AND OXIDIZER TANK PRESSURES >20 PSI AND UNABLE TO DECREASE.	LAUNCH	CONTINUE MISSION	• REF MALF PROC SPS 1c
		A. COAST	ALL	A.1.(A) CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE. (B) ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE. RCS DEORBIT.	
			DOCKED	2.(A) CONTINUE MISSION (B) REF ALTERNATE MISSION B	A.2.(A) MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
			CSM SOLO	3. ENTER NEXT BEST PTP RCS DEORBIT	
		B. NON-CRITICAL BURN		B. INHIBIT OR TERMINATE BURN	
		C. CRITICAL BURN		C. CONTINUE BURN	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	16-29	LEAK OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE OR BOTH HELIUM VALVES FAIL CLOSED.			
		A. ΔV CAPABILITY GREATER THAN 620 FT/SEC.	ALL	A. CONTINUE MISSION PLAN SPS PROFILE TO MAINTAIN 620 FT/SEC FOR SPS DEORBIT.	A. BLOW DOWN ΔV REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE.
		B. ΔV CAPABILITY LESS THAN 620 FT/SEC.	ALL	B.1.(A) CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE (B) ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE	
			DOCKED	2.(A) CONTINUE MISSION (B) REF ALTERNATE MISSION B	B.2.(A) MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.
			RNDZ	TERMINATE AT NEXT EXIT POINT	
			CSM SOLO	ENTER NEXT BEST PTP	
		RULE NUMBERS 16-30 THROUGH 16-49 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-29	LEAK OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE OR BOTH HELIUM VALVES FAIL CLOSED.			
		A. ΔV CAPABILITY GREATER THAN 620 FT/SEC.	ALL	A. CONTINUE MISSION PLAN SPS PROFILE TO MAINTAIN 620 FT/SEC FOR SPS DEORBIT.	A. BLOW DOWN ΔV REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE.
		B. ΔV CAPABILITY LESS THAN 620 FT/SEC.	ALL	B.1.(A) CONTINUE MISSION IF BOTH SM AND HYBRID DEORBIT AVAILABLE (B) ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORBIT NOT AVAILABLE	
			DOCKED	2.(A) CONTINUE MISSION (B) REF ALTERNATE MISSION B	B.2.(A) MAINTAIN ___ LBS RCS FOR CSM ACTIVE DOCKING.
			RNDZ	TERMINATE AT NEXT EXIT POINT	
			CSM SOLO	ENTER NEXT BEST PTP	
		RULE NUMBERS 16-30 THROUGH 16-49 ARE RESERVED.			

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MISSION RULES

REV | ITEM

INSTRUMENTATION REQUIREMENTS

16-50 MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
OX TK PRESS	SP0003P	METER/C&W	COMMON	-1 OF 2 M	16-20
OX SM/ENG INTERFACE P	SP0931P	-	-		
FU TK PRESS	SP0006P	METER/C&W	COMMON	-1 OF 2 M	16-20
FU SM/ENG INTERFACE P	SP0930P	-	-		
SPS VLV ACT PRESS-PRI	SP0600P	METER	COMMON	-1 OF 2 M	16-21
SPS VLV ACT PRESS-SEC	SP0601P	METER	COMMON		16-21
SPS FU FEEDLINE TEMP	SP0048T	METER	COMMON	-1 OF 2 M	16-22
SPS OX FEEDLINE TEMP	SP0049T	SYS TEST	COMMON		
SPS INJ FLANGE TEMP 1	SP0061T	C&W	COMMON	-1 OF 2 M	16-23
SPS INJ FLANGE TEMP 2	SP0062T	C&W	COMMON		
ENG CHAMBER PRESS	SP0661P	METER	COMMON	PCM HD - METER HAND	16-25
HE TK PRESS	SP0001P	METER	SEPARATE	HD	16-30
FU/OX VLV 1 POS	SP0022H	DISPLAY	SEPARATE	HD	16-32
FU/OX VLV 2 POS	SP0023H	DISPLAY	SEPARATE	HD	16-32
FU/OX VLV 3 POS	SP0024H	DISPLAY	SEPARATE	HD	16-32
FU/OX VLV 4 POS	SP0025H	DISPLAY	SEPARATE	HD	16-32
OX TK 1 QTY - TOTAL AUX	SP0655Q	DISPLAY	COMMON	HD	16-10/11/13
OX TK 2 QTY	SP0656Q	DISPLAY	COMMON	HD	16-10/11/13
FU TK 1 QTY - TOTAL AUX	SP0657Q	DISPLAY	COMMON	HD	16-10/11/13
FU TK 2 QTY	SP0658Q	DISPLAY	COMMON	HD	16-10/11/13

17 CSM SM-RCS

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MISSION RULES

REV	ITEM	
		GENERAL
	17-1	LAUNCH THE LOSS OF ONE QUAD IS NOT CAUSE FOR ABORT. THERE ARE NO SINGLE FAILURES NOR ANY REASONABLE OR REALISTIC COMBINATION OF FAILURES WHICH LEAD ONLY TO LOSS OF MULTIPLE QUADS. THEREFORE, THERE ARE NO SM-RCS FAILURES WHICH ARE CONSIDERED CAUSE FOR ABORT.
	17-2	ALL ORBIT PHASES A. LOSS OF ONE QUAD, IN ITSELF, IS NOT NECESSARILY CAUSE FOR EARLY TERMINATION OF THE MISSION. THE GUIDELINE IS THAT AS LONG AS THE SPACECRAFT ATTITUDE CAN BE CONTROLLED AND THE SPS CAN BE BURNED THE MISSION NEED NOT BE TERMINATED EARLY. HOWEVER, LOSS OF ONE QUAD WILL RESULT IN REDUCED PROPELLANT AVAILABLE, AND MAY LEAD TO EARLY MISSION TERMINATION SINCE THE CAPABILITY TO PERFORM SM OR HYBRID DEORBIT WILL BE AFFECTED. B. LOSS OF TWO OR MORE QUADS IS CAUSE FOR ENTRY INTO NEXT BEST PTP. 1. LOSS OF TWO ADJACENT QUADS WILL DESTROY THE CAPABILITY TO PERFORM ULLAGE MANEUVERS AND WILL REQUIRE DELETION OF NON-CRITICAL SPS BURNS. LOSS OF TWO ADJACENT QUADS PRECLUDES SM AND HYBRID DEORBIT, OR LM RESCUE. 2. LOSS OF TWO OPPOSITE QUADS WILL DESTROY THE CAPABILITY TO PERFORM PRECISE 3-AXIS ATTITUDE CONTROL AND PRECLUDES SM AND HYBRID DEORBIT, OR LM RESCUE.
	17-3	EVA SINGLE JET CONTROL CAPABILITY IN ALL AXES, WITH NO POSSIBLE THRUSTER IMPINGEMENT INTO THE EVT PATH, IS REQUIRED TO INITIATE EVA. IF A FAILURE OCCURS DURING EVA WHICH VIOLATES THIS CONSTRAINT, THE S/C WILL BE ALLOWED TO DRIFT IN THAT AXIS UNTIL EVT IS COMPLETE.
	17-4	DOCKING/UNDOCKING A. SHOULD ONE QUAD FAIL, UNDOCKING, STATION KEEPING, AND ASSOCIATED LM ACTIVITIES WILL BE ALLOWED. IF SPS CRITICAL CAPABILITY IS NOT AVAILABLE, PROPELLANT REMAINING MUST BE GREATER THAN SM DEORBIT PLUS CSM ACTIVE DOCKING. B. IF TWO QUADS FAIL THE VEHICLES WILL NOT UNDOCK. IF TWO QUADS FAIL AFTER UNDOCKING, THE VEHICLES WILL REDOCK ASAP. FAILURE OF OPPOSITE QUADS MAY REQUIRE USE OF THE CM RCS SYSTEMS FOR DOCKING. REF MR 17-28.
		RULE NUMBERS 17-5 THROUGH 17-9 ARE RESERVED.

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MISSION RULES

REV	ITEM	
		SYSTEMS MANAGEMENT
	17-10	PROPELLANT GAGING A. PRIME METHOD: RTCC EQUATION (6%) B. BACKUP METHOD: (ONBOARD) HELIUM PRESSURE/TEMPERATURE (11%)
	17-11	QUAD PROPELLANT BALANCE PROP ISOLATION VALVES WILL NOT BE USED FOR QUAD PROPELLANT BALANCE. PROPELLANT BALANCE WILL BE ACCOMPLISHED BY SELECTING TWO-JET +X AND -X TRANSLATIONS WITH EITHER THE PITCH OR YAW QUAD AND BY CHOOSING SUITABLE JETS FOR ATTITUDE CONTROL. PROPELLANT DIFFERENCES BETWEEN QUADS WILL BE MAINTAINED WITHIN ±50 POUNDS.
	17-12	SECONDARY PROPELLANT FUEL PRESSURE VALVE THE RCS SECONDARY FUEL PRESSURIZATION VALVE WILL BE OPENED WHEN THE PRIMARY FUEL MANIFOLD PRESSURE REACHES 150 PSIA.
		RULE NUMBERS 17-13 THROUGH 17-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
A	17-20	SUSTAINED LEAK IN HELIUM TANK			• REF MALF PROC RCS 1C QUAD WILL REMAIN USABLE UNTIL HE MANIFOLD PRESSURE REACHES 75 PSI.
		A. ONE QUAD (ALL OTHER QUADS NORMAL)	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2. CONTINUE MISSION	
			TD&E	3.(A) ATTEMPT TD&E	
				(B) DISCONTINUE DOCKING ATTEMPT WHEN PROPELLANT REMAINING IN EITHER ADJACENT QUAD = ____LBS.	
			UNDOCKED	4.(A) INHIBIT PHASING MANEUVER	
			RNDZ	5. TERMINATE AT NEXT EXIT POINT	
		B. MORE THAN ONE QUAD AND			
		1. HE TNK PRESS > HE MNFLD PRES IN AT LEAST THREE QUADS AND HYBRID DEORBIT STILL AVAILABLE	LAUNCH	B.1.(A) CONTINUE MISSION	
			ALL	(B) CONTINUE MISSION	
			TD&E	(C)(1) CONTINUE MISSION IF DOCKED	
				(2) TERMINATE PHASE IF NOT DOCKED	
			DOCKED	(D)(1) DO NOT UNDOCK	
				(2) REFERENCE ALTERNATE MISSION D	
			UNDOCKED	(E)(1) REDOCK LM ACTIVE	
				(2) REFERENCE ALTERNATE MISSION D	
			RNDZ	(F) TERMINATE AT NEXT EXIT	
		2. HE TNK PRESS < HE MNFLD PRESS IN TWO OR MORE QUADS	LAUNCH	B.2.(A) CONTINUE MISSION	
			ALL	(B) TERMINATE PHASE AND ENTER NEXT BEST PTP	

Form 391 (AUG 68)

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	17-21	SUSTAINED LEAK BELOW HELIUM ISOLATION VALVE (COULD BE HELIUM OR FUEL OR OXIDIZER).			• REF MALF PROC RCS 2
		A. ONE QUAD (ALL OTHER QUADS NORMAL).	LAUNCH	A.1. CONTINUE MISSION	QUAD WILL REMAIN USABLE UNTIL He MANIFOLD PRESSURE REACHES 75 PSI.
			ALL	2. CONTINUE MISSION	
			TD&E	3.(A) ATTEMPT TD&E.	
				(B) DISCONTINUE DOCKING ATTEMPT WHEN PROPELLANT REMAINING IN EITHER ADJACENT QUAD = TBD LBS.	
			EVT	4. TERMINATE EVT	
			UNDOCKED	5.(A) INHIBIT PHASING MANEUVER.	
			RENDZ	6. TERMINATE AT NEXT EXIT POINT.	
		B. MORE THAN ONE QUAD	LAUNCH	B.1. CONTINUE MISSION	
			ALL	2. TERMINATE PHASE AND ENTER NEXT BEST PTP.	
A	17-22	PACKAGE TEMP <70°F AND UNABLE TO INCREASE			• REF MALF PROC RCS 1A
		A. ONE QUAD (ALL OTHER QUADS NORMAL).	ALL	A.1. CONTINUE MISSION	
			TD&E	2.(A) ATTEMPT TD&E	
				(B) DISCONTINUE DOCKING ATTEMPT WHEN PROPELLANT REMAINING IN EITHER ADJACENT QUAD = TBD LBS.	
			UNDOCKED	3.(A) INHIBIT PHASING MANEUVER	
			RENDZ	4. TERMINATE AT NEXT EXIT POINT	
		B. MORE THAN ONE QUAD	ALL	B. TERMINATE PHASE AND ENTER NEXT BEST PTP.	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	17-23	LOSS OF INDIVIDUAL THRUSTERS AS A RESULT OF CLOGGING, FREEZING, OR BURNOUT WHICH RESULT IN:			
		A. LOSS OF ULLAGE CAPABILITY	ALL	A. CONTINUE MISSION	A. REF MR 16-26, 27
		B. LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES (P, Y, R)	ALL	B. TERMINATE PHASE AND ENTER NEXT BEST PTP	
		C. LOSS OF ATTITUDE CONTROL IN ONE OR MORE AXES WITHOUT THRUSTER IMPINGEMENT IN THE EVT PATH.	EVA	C. CONTINUE EVA	C. S/C WILL BE ALLOWED TO DRIFT IN THAT AXIS UNTIL EVT IS COMPLETE.
		RULE NUMBERS 17-24 THROUGH 17-49 ARE RESERVED.			

REV	ITEM
	17-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
SM HE TK A PRESS	SR5001P	METER	COMMON	-1 OF	17-20
QTY SM-RCS PROP SYS A	SR5025Q	METER	COMMON	2 M	17-21
SM HE TK B PRESS	SR5002P	METER	COMMON	-1 OF	17-20
QTY SM-RCS PROP SYS B	SR5026Q	METER	COMMON	2 M	17-21
SM HE TK C PRESS	SR5003P	METER	COMMON	-1 OF	17-20
QTY SM-RCS PROP SYS C	SR5027Q	METER	COMMON	2 M	17-21
SM HE TK D PRESS	SR5004P	METER	COMMON	-1 OF	17-20
QTY SM-RCS PROP SYS D	SR5028Q	METER	COMMON	2 M	17-21
SM ENG PKG A TEMP	SR5065T	METER/C&W	COMMON	M	17-22
SM ENG PKG B TEMP	SR5066T	METER/C&W	COMMON	M	17-22
SM ENG PKG C TEMP	SR5067T	METER/C&W	COMMON	M	17-22
SM ENG PKG D TEMP	SR5068T	METER/C&W	COMMON	M	17-22
SM HE TK A TEMP	SR5013T	METER	COMMON	M	17-20/21
SM HE TK B TEMP	SR5014T	METER	COMMON	M	17-20/21
SM HE TK C TEMP	SR5015T	METER	COMMON	M	17-20/21
SM HE TK D TEMP	SR5016T	METER	COMMON	M	17-20/21
SM HE MAN A PRESS	SR5729P	-----	------	HD	17-20/21
SM HE MAN B PRESS	SR5776P	-----	------	HD	17-20/21
SM HE MAN C PRESS	SR5817P	-----	------	HD	17-20/21
SM HE MAN D PRESS	SR5830P	-----	------	HD	17-20/21
SM FU MAN A PRESS	SR5737P	METER/C&W	COMMON	HD	17-12
SM FU MAN B PRESS	SR5784P	METER/C&W	COMMON	HD	17-12
SM FU MAN C PRESS	SR5822P	METER/C&W	COMMON	HD	17-12
SM FU MAN D PRESS	SR5823P	METER/C&W	COMMON	HD	17-12
SM OX MAN A PRESS	SR5733P	----	----	HD	17-21
SM OX MAN B PRESS	SR5780P	----	----	HD	17-21
SM OX MAN C PRESS	SR5820P	----	----	HD	17-21
SM OX MAN D PRESS	SR5821P	----	----	HD	17-21

18 CSM CM-RCS

REV	ITEM	
		GENERAL
	18-1	LAUNCH A. A SUSTAINED LEAK IN OR THE LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN ONE CM RCS RING IS NOT CAUSE FOR ABORT SINCE THE REMAINING RING IS CAPABLE OF ABORT OR ENTRY ATTITUDE CONTROL; THIS FAILURE WILL REQUIRE ENTRY INTO PTP 6-4 SINCE SYSTEMS ARE NOT LONGER REDUNDANT. B. A SUSTAINED LEAK IN OR THE LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN BOTH CM RCS RINGS PRIOR TO TOWER JETTISON IS JUSTIFICATION FOR A MODE I ABORT. AFTER TOWER JETTISON, IT IS NOT CAUSE FOR ABORT SINCE THE ABILITY TO PERFORM A SAFE ENTRY INTO THE ATLANTIC AT THE END OF THE FIRST REV STILL EXISTS BY USING THE CONTINGENCY SM RCS SPINUP PRIOR TO CM/SM SEP. THIS METHOD OF ENTRY IS CONSIDERED OPERATIONALLY PREFERABLE TO PERFORMING AN ABORT AND PRESENTS LESS POTENTIAL HAZARD TO CREW RECOVERY. FURTHERMORE, CM RCS CONTROL IS REQUIRED FOR ABORTS IN THE MODE II AND MODE III REGIONS, AND TO ABORT THE LAUNCH IN THESE REGIONS FOR LOSS OF CM RCS CAPABILITY WOULD PLACE THE SPACECRAFT AND CREW INTO AN UNSAFE ENVIRONMENT.
	18-2	ALL ORBIT PHASES A. SUSTAINED LEAK IN OR LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE (COULD BE EITHER FUEL OR OXIDIZER) IN ONE CM RCS RING DELETES THE REDUNDANCY OF THE ENTRY ATTITUDE CONTROL SYSTEM AND REDUCES THE ΔV AVAILABLE FOR HYBRID DEORBIT. LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN BOTH CM RCS RINGS DELETES ALL ENTRY ATTITUDE CONTROL CAPABILITY REQUIRING CONTINGENCY SM RCS SPIN-UP PRIOR TO CM/SM SEP. THE LOSS OF ONE OR BOTH CM RCS RINGS IS CAUSE FOR TERMINATING THE PHASE AND MISSION BY ENTRY INTO THE NEXT BEST PTP. B. ARMING OF THE CM RCS RINGS, WHETHER THE PROPELLANT ISOLATION VALVES ARE OPENED OR CLOSED, IS CAUSE FOR TERMINATING THE PHASE AND MISSION INTO THE NEXT BEST PTP. RULE NUMBERS 18-3 THROUGH 18-9 ARE RESERVED
		SYSTEMS MANAGEMENT
A	18-10	THRUSTER TEMP CONTROL CM RCS THRUSTERS WILL BE HEATED PRIOR TO ENTRY FOR 20 MINUTES OR UNTIL THE LOWEST INDICATED TEMPERATURE IS ≥28°F, WHICHEVER COMES FIRST. IF THRUSTER(S) HEATER FUNCTION FAILS, CM RCS IS STILL CONSIDERED OPERATIONAL PENDING RESULTS OF CM RCS CHECKOUT PRIOR TO DEORBIT. REF MALF PROC RCS 5
A	18-11	HELIUM INTERCONNECT AS A LAST RESORT, IF THE HELIUM IN ONE RING IS DEPLETED DUE TO A LEAK AND PROPELLANT IS DEPLETED IN THE OTHER RING, THE SYSTEMS MAY BE INTERCONNECTED IF THE REMAINING PROPELLANT IS REQUIRED FOR CONTROL. ONCE INTERCONNECTED, THE RINGS CANNOT BE ISOLATED. REF MALF PROC RCS 4 RULE NUMBERS 18-12 THROUGH 18-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	18-20	SUSTAINED LEAK IN OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE.			
		A. ONE RING	LAUNCH	A.1. CONTINUE MISSION AND ENTER PTP 6-4	
			ALL	2. TERMINATE PHASE AND ENTER NEXT BEST PTP	A.2. NORMAL ENTRY
		B. BOTH RINGS	LAUNCH	B.1. CONTINUE MISSION AND ENTER PTP 2-1 UNLESS PRIOR TO TOWER JETTISON. IF PRIOR TO TOWER JETTISON, ABORT.	
			ALL	2. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.2. CONTINGENCY SM RCS SPIN-UP PRIOR TO CM/SM SEP.
	18-21	SUSTAINED LEAK IN OR COMPLETE LOSS OF HELIUM MANIFOLD PRESSURE (COULD BE EITHER FUEL OR OXIDIZER).			
		A. ONE RING	LAUNCH	A.1. CONTINUE MISSION AND ENTER PTP 6-4	
			ALL	2. TERMINATE PHASE AND ENTER NEXT BEST PTP	
		B. BOTH RINGS	LAUNCH	B.1. CONTINUE MISSION AND ENTER PTP 2-1 UNLESS PRIOR TO TOWER JETTISON. IF PRIOR TO TOWER JETTISON, ABORT.	
			ALL	2. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.2. CONTINGENCY SM RCS SPIN-UP PRIOR TO CM/SM SEP
	18-22	CM RCS IS ARMED FOR ANY REASON	ALL	TERMINATE PHASE AND ENTER NEXT BEST PTP	
		RULE NUMBERS 18-23 THROUGH 18-49 ARE RESERVED.			

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MISSION RULES

REV	ITEM
	18-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
CM HE TK A PRESS	CR0001P	METER	COMMON	M	18-20
CM HE TK B PRESS	CR0002P	METER	COMMON	M	18-20
CM HE TK A TEMP	CR0003T	METER	COMMON	M	18-20
CM HE TK B TEMP	CR0004T	METER	COMMON	M	18-20
CM HE MNFLD A PRESS	CR0035P	METER/C/W	SEPARATE	M (BOTH)	18-21
CM HE MNFLD B PRESS	CR0036P	METER/C/W	SEPARATE	M (BOTH)	18-21

19 DOCKING AND UMBILICAL

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MISSION RULES

REV	ITEM	
		GENERAL
	19-1	THREE GOOD DOCKING RING LATCHES 120 DEGREES APART ARE REQUIRED FOR AN IVT.
	19-2	THREE GOOD DOCKING RING LATCHES 120 DEGREES APART ARE REQUIRED FOR A DOCKED RCS MANEUVER.
A	19-3	THE DOCKED SPS OR DPS BURNS REQUIRE THAT NO MORE THAN THREE DOCKING RING LATCHES BE UNLATCHED.
	19-4	MANNED UNDOCKING OPERATIONS WILL BE TERMINATED FOR ANY FAILURE OF A DOCKING RING LATCH TO RELEASE. NO ATTEMPT WILL BE MADE TO DISASSEMBLE A DOCKING RING LATCH.
A	19-5	WITH FAILURE OF THE CSM FORWARD HATCH PRIMARY LOCK/UNLOCK MECHANISM, THE SECONDARY LOCK/UNLOCK MECHANISM WILL ONLY BE USED TO LOCK THE HATCH, WITH THE EXCEPTION THAT THE SECONDARY LOCK/UNLOCK MECHANISM MAY BE USED TO UNLOCK THE HATCH TO PERFORM AN IVT FROM THE LM.
	19-6	LOSS OF VISUAL DOCKING AIDS (COAS AND TARGETS) WILL NOT INHIBIT DOCKING, AND UNDOCKING.
A	19-7	FOR CASES WHERE "FINAL" LM SEPARATION IS NOT ATTEMPTED, THE DOCKING RING WILL BE JETTISONED 20 MIN PRIOR TO RETROFIRE. REF MR 5-21E
	19-8	IF THE DOCKING PROBE FAILS TO INDICATE EXTENSION OR IF BOTH TALK BACK INDICATORS* ARE BARBER POLE, TD&E WILL BE ATTEMPTED. *NOTE: THE ONLY DOCKING PROBE INSTRUMENTATION CONSISTS OF TWO TALK BACK INDICATORS IN THE CSM. RULE NUMBERS 19-9 THROUGH 19-10 ARE RESERVED.
		MANAGEMENT MISSION RULES
	19-11	FOR MISFIRE OF A DOCKING RETRACT SQUIB, THE REMAINING SQUIB IN THE SAME SYSTEM WILL BE USED TO COMPLETE DOCKING. SUBSEQUENT UNDOCKING WILL BE GO SINCE REDUNDANT SQUIBS EXIST IN THE REMAINING SYSTEM.
	19-12	THE CM FORWARD AND LM UPPER HATCH NORMALLY WILL BE INSTALLED FOR ANY TYPE OF MANEUVER OR DOCKING. RULE NUMBERS 19-13 THROUGH 19-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	QUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
A	19-20	FAILURE TO MATE LM UMBILICAL			
		A. PLUG P23	TD&E	A. CONTINUE MISSION	A. P23 IS LOCATED BETWEEN CSM -Y AND -Z AXIS
		B. PLUS P24	TD&E	B. CONTINUE MISSION INGRESS LM WITHIN 30 HRS AND TURN OFF LM DESCENT BATTERIES TO EFFECT X-LUNAR BUS TRANSFER TO CSM POWER	B. P24 IS LOCATED BETWEEN CSM -Z AND +Y AXIS. P24 UMBILICAL CONTAINS LM DESCENT BATTERY RESET FUNCTION.
		C. BOTH P23 AND P24	TD&E	C. PERFORM CSM/LM FINAL SEP REF ALTERNATE MISSION A	C. S-IVB/LM SEP CANNOT BE ACHIEVED WITHOUT MATING AT LEAST ONE UMBILICAL
A	19-21	FAILURE TO MAINTAIN LM X-LUNAR BUS POWER FROM CSM	DOCKED	1. CONTINUE MISSION IF UNABLE TO TRANSFER POWER FROM CSM TO LM DESCENT BATTERY, INGRESS LM WITHIN 10 HRS AND TURN LM DESCENT BATTERY ON	LM DESCENT STAGE LIFETIME IS CRITICAL MAX LIFETIME OF CRITICAL EQUIPMENT WITHOUT HEATERS IS 10 HOURS
	19-22	FAILURE TO ACHIEVE S-IVB/LM SEPARATION	TD&E	PERFORM CSM/LM FINAL SEP REF ALT MISSION A	
	19-23	FAILURE TO ACHIEVE CSM/LM FINAL SEPARATION	DOCKED	MUST PERFORM NORMAL UNDOCKING A. RETRIEVE PROBE AND DROGUE AND INSTALL. B. AFTER UNDOCKING, DEPRESS CSM AND JETTISON PROBE OVERBOARD.	LM MASS MAY HAVE TO BE MODIFIED FOR APS BURN
	19-24	FAILURE TO INDICATE DOCKING PROBE EXTEND OR BOTH TALK BACK INDICATORS ARE BARBER POLE.	TD&E UNDOCKED	A. CONTINUE MISSION ATTEMPT TD&E B. CONTINUE MISSION ATTEMPT DOCKING	DOCKING RING/TUNNEL STRUCTURE DAMAGE MAY OCCUR TO THE EXTENT THAT TUNNEL PRESSURE CAN NOT BE MAINTAINED.
	19-25	FAILURE TO CAPTURE OR TO ACHIEVE DOCKING	TD&E UNDOCKED	TERMINATE TD&E PERFORM EVT	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	19-26	CANNOT REMOVE CSM FORWARD HATCH	TD&E DOCKED	A. PERFORM CSM/LM FINAL SEP B. PERFORM CSM/LM FINAL SEP IF LM MANNED, PERFORM EVT TO CSM.	
	19-27	CANNOT REMOVE DOCKING PROBE, LM DROGUE, AND/OR LM UPPER HATCH.	TD&E DOCKED	A. CONTINUE MISSION B. CONTINUE MISSION REF ALTERNATE MISSION ____	B. SPS AND CM RCS MANEUVERS MAY BE PERFORMED
	19-28	FAILURE TO ACHIEVE CSM/LM UNDOCKING	DOCKED	NO UNDOCKED ACTIVITIES REF ALTERNATE MISSION D	
	19-29	FAILURE TO RELEASE CAPTURE LATCHES	DOCKED	NO UNDOCKING 1. PERFORM RETRACTION 2. REF ALTERNATE MISSION D	
	19-30	PRIMARY FORWARD HATCH LOCK/UNLOCK MECHANICSM INOPERATIVE	ALL	CONTINUE MISSION IF LM MANNED, CONTINUE EXTENDED LM EVALUATION AND THEN SETUP FOR UNMANNED APS BURN. TERMINATE MANNED LM ACTIVITY. SECURE HATCH USING SECONDARY LOCK/UNLOCK MECHANISM.	SECONDARY MECHANISM WILL ONLY BE USED TO ACCOMPLISH FINAL EGRESS OF LM.
	19-31	FAILURE TO REINSTALL CSM FORWARD HATCH	TD&E DOCKED	ENTER NEXT BEST PTP	REF BACKUP PROCEDURES
	19-32	FAILURE TO REINSTALL PROBE AND/OR DROGUE OR FAILURE TO CLOSE LM UPPER HATCH	DOCKED	NO UNDOCKING REF ALTERNATE MISSION D.	

20 EMU/EVA

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MISSION RULES

REV	ITEM	
		GENERAL
	20-1	TO INITIATE AND CONTINUE THE FOLLOWING MISSION PHASES, THE EXTRAVEHICULAR MOBILITY UNIT (EMU) MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES: A. DOCKED TWO LIFE SUPPORT UNITS (PLSS AND OPS OR 2 OPS) PROVIDING SUFFICIENT CONSUMABLES TO SUPPORT A 30 MINUTE CONTINGENCY TRANSFER. B. EVA SUFFICIENT PLSS CONSUMABLES TO SUPPORT ORBITAL CHECKOUT AND PLANNED EVA C. UNDOCKED/RNDZ TWO LIFE SUPPORT UNITS (PLSS AND OPS OR 2 OPS) PROVIDING SUFFICIENT CONSUMABLES TO SUPPORT A CONTINGENCY TRANSFER, OR ONE UNIT FOR SINGLE MAN UNDOCKED OPERATION.
		MANAGEMENT
	20-2	THE PLSS BATTERY IS CONSIDERED TO HAVE A MINIMUM OF 14.3 AMP-HR CAPABILITY. THIS CONSUMABLE IS GAGED BY MONITORING GT8140C AND PROCESSING IN THE RTCC TO OBTAIN AMP-HRS.
	20-3	THE PLSS PRIMARY OXYGEN SUBSYSTEM (POS) IS CONSIDERED TO HAVE A NOMINAL SOURCE PRESSURE OF 850 PSIA. THIS CONSUMABLE IS GAGED BY MONITORING GT8182P AND PROCESSING IN THE RTCC TO OBTAIN LBS MASS.
	20-4	THE PLSS FEEDWATER RESERVOIR IS CONSIDERED TO HAVE A NOMINAL LOADING OF 8.3 LBS. THIS CONSUMABLE IS GAGED BY MONITORING GT8154T, GT8196T, GT8182P, GT8110P AND PROCESSING IN THE RTACF TO OBTAIN LBS REMAINING.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	20-20	LOSS OF PRESSURE INTEGRITY A. PGA PRESS <3.75 PSIA (TM) AND DECREASING OR PGA PRESS GAUGE OF <3.7 PSIA AND DECREASING B. PGA PRESS >4.05 PSIA (TM) AND INCREASING OR PGA PRESS GAUGE OF >4.0 PSIA AND INCREASING	EVA	A. TERMINATE EVA 1. ACTIVATE OPS 2. INGRESS S/C B. TERMINATE EVA 1. ACTIVATE OPS 2. CLOSE POS SHUTOFF VALVE 3. INGRESS S/C	• REF MALF EMU 5-4, 5-9, 5-24 A. GT8168P PGA PRESS PGA PRESS GAUGE LOW PGA PRESS TONE (3.0 KHZ) • REF MALF PROC 5-13, 5-23 B. GT8168P PGA PRESS PGA PRESS GAUGE CREW SENSIBLE DETECTION
A	20-21	LOSS OF OXYGEN VENTILATION A. FAN FAILURE	EVA	A. TERMINATE EVA 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE 3. INGRESS S/C ASAP	REF MALF EMU 5-4, 5-32, 5-34 A. GT8140C PLSS BAT CUR GT8141V PLSS BAT VOLT LOW VENT FLOW TONE (3.0 KHZ)
		B. NOXIOUS ODOR	EVA	B. TERMINATE EVA 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE 3. INGRESS S/C ASAP	B. CREW SENSIBLE DETECTION
A	20-22	HUMIDITY CONTROL MALFUNCTION A. DEGRADED OPERATION OF WATER SEPARATOR	EVA	A. CONTINUE MISSION REDUCE WORK PROFILE TO COMPENSATE FOR INCREASED HUMIDITY	REF MALF EMU 5-14, 5-29 A. CREW SENSIBLE DETECTION
		B. TOTAL LOSS OF WATER SEPARATOR	EVA	B. TERMINATE EVA 1. IF DEHUMIDIFICATION IS REQUIRED, ACTIVATE OPS IN PURGE MODE 2. INGRESS S/C ASAP	B. CREW SENSIBLE DETECTION GT8110P FEED H_2O PRESS GT8140C PLSS BAT CUR GT8196T LCG H_2O ΔT LOW FEED H_2O PRESS TONE (1.5 KHZ)
		RULES 20-23 THROUGH 20-29 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	20-30	LOSS OF LIQUID TRANSPORT LOOP THERMAL CONTROL			REF MALF EMU 5-17, 5-31, 5-32 5-34
		A. DEGRADED CIRCULATION (<3.5 LBS/MIN AND DECREASING)	EVA	A. CONTINUE MISSION ADJUST WORK PROFILE TO COMPENSATE FOR DEGRADED COOLING	A. GT8154T LCG H_2O TEMP GT8196T LCG H_2O ΔT GT8140C PLSS BAT CUR CREW SENSIBLE DETECTION GT8141V PLSS BAT VOLT
		B. LOSS OF CIRCULATION	EVA	B. TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS IN PURGE MODE 2. INGRESS S/C ASAP	REF MALF EMU 5-16, 5-34 B. GT8154T LCG H_2O TEMP GT8196T LCG H_2O ΔT GT8140C PLSS BAT CUR GT8141V PLSS BAT VOLT CREW SENSIBLE DETECTION
		C. DEGRADED SUBLIMATOR (LIQUID TRANSPORT LOOP HEAT REJECTION <1250 BTU/HR IN MAX H_2O DIVERTER VALVE POSITION)	EVA	C. CONTINUE MISSION 1. ADJUST WORK PROFILE TO COMPENSATE FOR DEGRADED COOLING 2. IF COOLING IS INADEQUATE, CREWMAN MAY ATTEMPT A WET SUBLIMATOR RESTART	REF MALF EMU 5-17, 5-30 C. GT8154T LCG H_2O TEMP GT8196T LCG H_2O ΔT GT8110P FEED H_2O PRESS CREW SENSIBLE DETECTION REF MALF EMU 5-14
		D. SUBLIMATOR FAILURE	EVA	D. TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS IN PURGE MODE 2. INGRESS S/C ASAP	D. GT8154T LCG H_2O TEMP GT8196T LCG H_2O ΔT GT8110P FEED H_2O PRESS LOW FEED H_2O PRESS TONE (1.5 KHZ)
A	20-31	FEED H_2O PRESSURE DECAY			• REF MAL EMU 5-14, 5-29
		A. FEED H_2O PRESSURE <2.0 PSIA	EVA	A. CONTINUE MISSION 1. ADJUST WORK PROFILE TO COMPENSATE FOR HIGH FEED H_2O CONSUMPTION RATE AND DEGRADED COOLING. 2. IF COOLING INADEQUATE, CREWMAN MAY ATTEMPT A WET SUBLIMATOR RESTART	A. GT8110P FEED H_2O PRESS CREW SENSIBLE DETECTION
		B. FEED H_2O PRESSURE <1.6 PSIA AND DECREASING	EVA	B. TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS IN PURGE MODE. 2. INGRESS S/C ASAP	B. GT8110P FEED H_2O PRESS LOW FEED H_2O PRESS TONE (1.5 KHZ) CREW SENSIBLE DETECTION
A	20-32	DEPLETION OF POS			• REF MALF EMU 5-4, 5-10, 5-27
		A. POS PRESS <130 PSIA	EVA	TERMINATE EVA A. ACTIVATE OPS B. INGRESS S/C	A. GT8182P PLSS O_2 PRESS GT8168P PGA PRESS PGA PRESS GAUGE LOW PGA PRESS TONE (3.0 KHZ) B. PLSS O_2 QTY IND

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	20-33	LOSS OF MAIN POWER SUPPLY			• REF MALF EMU 5-36
		A. PLSS BAT VOLT <16.0 VDC AND DECREASING	EVA	A. TERMINATE EVA 1. ACTIVATE OPS IN A PURGE MODE 2. INGRESS S/C ASAP	A. GT8141V PLSS BAT VOLT GT8140C PLSS BAT CUR CREW SENSIBLE DETECTION LOW VENT FLOW (3.0 KHZ)
		B. TOTAL AMP-HRS REMAINING <4.3 AMP-HRS	DOCKED UNDOCKED	B. REPLACE PLSS BATTERY IF ONE OPS FAILS TO CHECK OUT PRIOR TO UNDOCKING.	B. GT8140C PLSS BAT CUR
		C. TOTAL AMP-HRS REMAINING ≤1.4 AMP-HRS	EVA	C. TERMINATE EVA	C. GT8140C PLSS BAT CUR
A	20-34	DEGRADED POWER PROFILE CUR <2.0 AMP OR CUR >3.0 AMP	EVA	CONTINUE MISSION VERIFY PERFORMANCE OF FAN, PUMP, AND SSC	• REF MALF EMU 5-32 - 5-34 GT8140C PLSS BAT CUR
	20-35	LOSS OF TM	EVA	CONTINUE MISSION	
A	20-36	LOSS OF ANY CRITICAL INSTRUMENTATION	EVA	TERMINATE EVA	REF MR 20-42
A				NOTE: REF SECTION 32 FOR EVA COMMUNICATIONS RULES	

RULES 20-37 THROUGH 20-40 ARE RESERVED.

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MISSION RULES

REV	ITEM
A	20-41

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	FM/FM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
FEED H_2O PRESS	GT8110P			HD	20-22,30,31
LOW FEED H_2O PRESS		WARNING TONE (1.5 KHZ)	COMMON	M	20-22,30,31
PLSS EKG	GT8124J			*	
PLSS BAT CUR	GT8140C			HD	20-21,22,30,33,34
PLSS BAT VOLT	GT8141V			HD	20-21,30,33
LCG H_2O TEMP	GT8154T			HD	20-30
PGA PRESS	GT8168P			HD	20-20,32
PLSS O_2 PRESS	GT8182P	METER	COMMON	HD	20-32
PLSS O_2 QTY IND				M	20-32
LCG H_2O ΔT	GT8196T			HD	20-22,30
LOW VENT FLOW		WARNING TONE (3.0 KHZ)		M	20-21,33
PGA PRESS GAUGE		METER		M	20-20,32
LOW PGA PRESS		WARNING TONE (3.0 KHZ)		M	20-20,32
OPS PRESS GAUGE		METER		M	
OPS REG PRESS GAUGE		METER		***M	
HEATER STATUS CHECK		GREEN LIGHTS		1 OF 2 M	

*AEROMEDICAL PARAMETER REFERENCE SECTION 31.

***NOTE: 1 OF 2 OPS REG PRESS GAUGES IS MANDATORY.

ITEM
20-42

CRITICAL INSTRUMENTATION

MEAS DESCRIPTION	FM/FM	ONBOARD	TRANSDUCER
PLSS O_2 PRESS/PLSS O_2 QTY IND	GT8182P	METER	COMMON
PGA PRESS GAUGE		METER	
LOW VENT FLOW		WARNING TONE (3.0 KHZ)	

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21 LM SEQUENTIAL AND PYROTECHNIC

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MISSION RULES

REV	ITEM	
		GENERAL MISSION RULES
A	21-1	TO INITIATE THE FOLLOWING MISSION EVENTS, THE PYROTECHNIC SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES: A. DOCKED ONE OPERATIONAL PYRO SYSTEM B. INSERTION AND/OR NORMAL STAGING TWO OPERATIONAL PYRO SYSTEMS
A	21-2	A PYRO SYSTEM IS CONSIDERED LOST IF: A. PYRO BATTERY OPEN CIRCUIT VOLTAGE <35 VDC B. UNABLE TO ARM SYSTEM
A	21-3	A PYRO SYSTEM WILL BE DISABLED IF: A. ANY RELAY K2 THROUGH K6 INADVERTANTLY CLOSES B. ANY RELAY K7 THROUGH K15 INADVERTANTLY CLOSES SYSTEM WILL BE USED FOR APS PRESSURIZATION AND STAGING.
A	21-4	THE ASCENT AND DESCENT STAGES ARE CONSIDERED RIGIDLY ATTACHED WITH ONLY ONE BOLT/NUT COMBINATION INTACT.
A	21-5	THE ASCENT AND DESCENT STAGES ARE CONSIDERED NON-RIGIDLY ATTACHED IF THE GUILLOTINE FAILS TO SEVER THE INTERSTAGE UMBILICALS.
		RULE NUMBERS 21-6 THROUGH 21-9 ARE RESERVED.
		MANAGEMENT MISSION RULES
A	21-10	APS WILL BE PRESSURIZED PRIOR TO UNDOCKING/STAGING. APS WILL NOT NORMALLY BE PRESSURIZED MORE THAN 24 HOURS PRIOR TO THE LAST APS BURN; HOWEVER, IN A CONTINGENCY CASE, THE APS MAY BE PRESSURIZED UP TO 3-1/2 DAYS PRIOR TO THE LAST APS BURN.
A	21-11	IF UNABLE TO DEPLOY ONE OR MORE LANDING GEAR, DESCENT ENGINE BURNS WILL BE CONTINUED SINCE CONTROL PROBLEMS ARE NOT EXPECTED TO EXIST AND DAMAGE TO THE LANDING GEAR FROM THE BURN WILL NOT AFFECT THE MISSION.
A	21-12	UNDOCKED STAGING WITH ONE PYRO SYSTEM WILL BE PERFORMED ONLY IF ABSOLUTELY NECESSARY TO MAINTAIN CREW SAFETY.
A	21-13	FOR A K1 THROUGH K6 FAILURE, THE GOOD SYSTEM WILL BE DISABLED AND A PYRO FUNCTION, OTHER THAN STAGING, ATTEMPTED TO DETERMINE IF K1 HAS FAILED CLOSED. IF BOTH SYSTEMS ARE FAILED IN THIS MODE, THEY MUST BOTH BE TESTED FOR A K1 FAILURE INDEPENDENTLY. A PYRO SYSTEM CANNOT BE DISABLED FOR A K1 FAILURE.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
			SPECIFIC MISSION RULES		
A	21-20	PYRO BATTERY VOLTAGE <35 VDC			
		A. ONE SYSTEM	DOCKED UNDOCKED	A.1. CONTINUE MISSION DO NOT STAGE	
			RNDZ	2. SEPARATION - CONTINUE MISSION DO NOT STAGE	
				3. PHASING - DO NOT PERFORM INSERTION DO NOT STAGE	
				4. INSERTION - DELAY STAGING AS LONG AS POSSIBLE	
		B. TWO SYSTEMS	ALL	B. CONTINUE MISSION DO NOT STAGE	
A	21-21	UNABLE TO ARM PYRO SYSTEM(S)			
		A. ONE SYSTEM	DOCKED UNDOCKED	A.1. CONTINUE MISSION DO NOT STAGE	
			RNDZ	2. SEPARATION - CONTINUE MISSION DO NOT STAGE	
				3. PHASING - DO NOT PERFORM INSERTION DO NOT STAGE	
				4. INSERTION - DELAY STAGING AS LONG AS POSSIBLE	
		B. BOTH SYSTEMS PRIOR TO:			
		1. RCS PRESSURIZATION	DOCKED	B.1. CONTINUE MISSION PERFORM EVA AND DOCKED LM SYSTEMS ACTIVITIES EXCEPT DPS BURN. DO NOT UNDOCK	
		2. DPS PRESSURIZATION	DOCKED	2. CONTINUE MISSION PERFORM EVA AND LM SYSTEMS ACTIVITIES EXCEPT DPS BURN.	
		3. APS PRESSURIZATION	DOCKED	3. CONTINUE MISSION PERFORM SINGLE OR DOUBLE FOOTBALL	
		4. STAGING	RNDZ	4. CONTINUE MISSION DO NOT ATTEMPT STAGING	4. CSM RESCUE MAY BE REQUIRED DUE TO ECS RED-LINES.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	21-22	UNABLE TO DISARM PYRO SYSTEM(S)	DOCKED EVA RNDZ	A. CONTINUE MISSION DO NOT PERFORM EVA B. TERMINATE EVA C. CONTINUE MISSION STAGE NORMALLY	REF MALF PROCED ED 1 K1 = MASTER ARM RELAY
A	21-23	RELAY K2 THROUGH K6 (OR K1 THROUGH K6 AFTER APS PRESS) INADVERTANTLY CLOSED AND CANNOT BE RESET	DOCKED EVA	CONTINUE MISSION DO NOT PERFORM EVA TERMINATE EVA	RELAYS K2 = STAGE K3 = STAGE SEQUENCE K4 = 1 GUILLOTINE K5 = 2 BOLTS (SYS A) AND 2 NUTS (SYS B) K5A = 2 BOLTS (SYS A) AND 2 NUTS (SYS B) K6 = 3 ELECTRICAL CIRCUIT INTERRUPTERS
		A. SYSTEM A (DESCENT STAGE)	ALL	A. CONTINUE MISSION OPEN LOGIC POWER A C/B UNTIL TIME TO STAGE, THEN: 1. CLOSE LOGIC POWER A AND B CB/'S 2. PLACE STAGE SW TO FIRE 3. PLACE MASTER ARM SW TO ON	A. ALL PYRO FUNCTIONS EXCEPT STAGING WILL BE PERFORMED ON SYSTEM B
		B. SYSTEM B (ASCENT STAGE)	ALL	B. CONTINUE MISSION OPEN LOGIC POWER B C/B UNTIL TIME TO STAGE, THEN: 1. CLOSE LOGIC POWER A C/B 2. PLACE MASTER ARM SW TO ON 3. PLACE STAGE SW TO FIRE 4. CLOSE LOGIC POWER B C/B	B. ALL PYRO FUNCTIONS EXCEPT STAGING WILL BE PERFORMED ON SYSTEM A
		C. BOTH SYSTEMS	ALL	C. CONTINUE MISSION OPEN BOTH LOGIC POWER A & B C/B'S UNTIL TIME TC STAGE, THEN: 1. CLOSE LOGIC POWER A C/B' 2. PLACE STAGE SW TO FIRE 3. PLACE MASTER ARM SW TO ON 4. CLOSE LOGIC POWER B C/B	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	21-24	A RELAY K7 THROUGH K15 INADVERTANTLY CLOSES	ALL		RELAYS K7 = RCS PRESS K8 = LAND GEAR DEPLOY K8A = LAND GEAR DEPLOY K9 = DPS CRYO He PRESS K10 = ASC He TANK 1 K11 = ASC He TANK 2 K12 = ASC FUEL & OX COMP VALVE K12A = ASC FUEL & OX COMP VALVES (SYSTEM A ONLY) K13 = DPS FU & OX VENT K14 = DPS AMBIENT He K15 = DPS FU & OX COMP VALVES
		A. SYSTEM A		A. <u>CONTINUE MISSION</u> OPEN LOGIC POWER A C/B UNTIL DPS He PRESSURIZATION ACCOMPLISHED	A. ALL PYRO FUNCTIONS EXCEPT STAGING WILL BE PERFORMED ON SYSTEM B
		B. SYSTEM B		B. <u>CONTINUE MISSION</u> OPEN LOGIC POWER B C/B UNTIL DPS CRYO He PRESSURIZATION ACCOMPLISHED	B. ALL PYRO FUNCTIONS EXCEPT STAGING WILL BE PERFORMED ON SYSTEM A
		C. BOTH SYSTEMS		C.1. <u>CONTINUE MISSION</u> 2. PRIOR TO POSITIONING MASTER ARM SW TO ON: CLOSE DESC He REG 1 & 2 3. OPEN DESC He REG 1 AT Tig OF DPS 1 BURN.	
A	21-25	UNABLE TO STAGE			
		A. ASCENT AND DESCENT STAGE STILL RIGIDLY TIED TOGETHER	RNDZ	A.1. <u>CONTINUE MISSION</u> 2. USE RCS FOR MANEUVERS	A. CSM RESCUE MAY BE INITIATED DUE TO RCS REDLINES
		B. INCOMPLETE STAGING, VEHICLE NOT RIGID	RNDZ	B.1. <u>EXECUTE CSM RESCUE</u> 2. GO TO DRIFTING FLIGHT	B. EVT MAY BE REQUIRED
		RULE NUMBERS 21-26 THROUGH 21-49 ARE RESERVED			

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MISSION RULES

REV	ITEM
A	21-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD		CATEGORY	MISSION RULE REFERENCE
ED RLY A K1-K6	GY0201X	SYS A STAGING LIGHT CAUTION	COMMON CAUTION LIGHT	M HD	21-1, 2, 3, 13, 21, 22, 23
ED RLY B K1-K6	GY0202X	SYS B STAGING LIGHT CAUTION		M HD	21-1, 2, 3, 13, 21, 22, 23
ED RLY A K7-K15	GY0231X	--------		M	21-1, 3, 24
ED RLY B K7-K15	GY0232X	--------		M	21-1, 3, 24
SELECTED ED BAT VOLT	-------	METER		M	21-1, 2, 20

REV	ITEM	GENERAL
A	22-1	TO INITIATE THE FOLLOWING MISSION EVENTS, THE ELECTRICAL POWER SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES:

A. DOCKED WITH HATCH CLOSED

1. CDR AND LMP BUSES
2. TWO DESCENT BATTERIES PLUS TWO ASCENT BATTERIES OR THREE DESCENT BATTERIES PLUS ONE ASCENT BATTERY
3. BOTH ASCENT FEEDERS PLUS ONE DESCENT FEEDER
4. ONE INVERTER AND AC BUS A (DPS BURN ONLY)
5. SUFFICIENT AVAILABLE ELECTRICAL ENERGY TO POWER THE LM FOR ONE REV (1.5 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER

B. DOCKED WITH HATCH OPEN AND ONE CREWMAN IN LM ON TRANSFER UMBILICAL

1. CDR OR LMP BUS (CDR BUS FOR DPS BURN)
2. TWO DESCENT BATTERIES WITH ASSOCIATED FEEDER OR ONE ASCENT BATTERY WITH ASSOCIATED FEEDER
3.
4. ONE INVERTER AND AC BUS A (DPS BURN ONLY)

C. EVA

1. CDR AND LMP BUSES
2. TWO DESCENT BATTERIES PLUS TWO ASCENT BATTERIES OR THREE DESCENT BATTERIES PLUS ONE ASCENT BATTERY
3. BOTH ASCENT FEEDERS PLUS ONE DESCENT FEEDER
4. SUFFICIENT AVAILABLE ELECTRICAL ENERGY TO POWER THE LM FOR ONE REV (1.5 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER

D. UNDOCKING

1. CDR AND LMP BUSES
2. TWO DESCENT BATTERIES PLUS TWO ASCENT BATTERIES OR THREE DESCENT BATTERIES PLUS ONE ASCENT BATTERY
3. BOTH ASCENT FEEDERS PLUS ONE DESCENT FEEDER
4. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED CONTINGENCY LM TO CSM CREW TRANSFER

E. SEPARATION

1. CDR AND LMP BUSES
2. TWO DESCENT BATTERIES PLUS TWO ASCENT BATTERIES OR THREE DESCENT BATTERIES PLUS ONE ASCENT BATTERY
3. BOTH ASCENT FEEDERS PLUS ONE DESCENT FEEDER
4. ONE INVERTER AND AC BUS A
5. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR 2 REVS (3.0 HOURS) BEYOND THE PLANNED CONTINGENCY LM TO CSM TRANSFER

REV	ITEM	
A	22-1 CONT	F. PHASING 1. CDR AND LMP BUSES 2. TWO DESCENT BATTERIES PLUS TWO ASCENT BATTERIES OR THREE DESCENT BATTERIES PLUS ONE ASCENT BATTERY 3. BOTH ASCENT FEEDERS PLUS ONE DESCENT FEEDER 4. ONE INVERTER AND AC BUS A 5. TRACKING LIGHT 6. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED CONTINGENCY LM TO CSM CREW TRANSFER G. INSERTION 1. CDR AND LMP BUSES 2. THREE DESCENT BATTERIES PLUS BOTH ASCENT BATTERIES 3. BOTH ASCENT FEEDERS PLUS ONE DESCENT FEEDER 4. BOTH INVERTERS AND BOTH AC BUSES 5. TRACKING LIGHT 6. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER H. STAGING (UNDOCKED, NORMAL OR DELAYED) 1. CDR AND LMP BUSES 2. BOTH ASCENT BATTERIES OR ONE ASCENT BATTERY IF NO DESCENT ENERGY REMAINS AND DESCENT O_2 TANK IS DEPLETED 3. BOTH ASCENT FEEDERS 4. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER I. STAGING (DOCKED, HATCH OPEN, CDR IN CSM AND LMP ON TRANSFER UMBILICAL) 1. CDR AND LMP BUSES 2. ONE ASCENT BATTERY 3. ONE ASCENT FEEDER 4. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR ONE REV (1.5 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER J. UNMANNED APS BURN 1. CDR BUS 2. ONE ASCENT BATTERY 3. ONE ASCENT FEEDER
A	22-2	THE CDR OR LMP BUS IS CONSIDERED LOST IF: A. BUS VOLTAGE CANNOT BE MAINTAINED ABOVE 26.5 VDC B. BUS CURRENT $\geq$90 AMPS

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MISSION RULES

REV	ITEM	
A	22-3	A BATTERY IS CONSIDERED LOST IF: A. OUTPUT ≤2 AMPS WHEN CONNECTED TO THE BUS B. TEMPERATURE IS ≥145°F C. CANNOT MEET VOLTAGE REGULATION AT REQUIRED LOAD D. CANNOT BE CONNECTED TO A FEEDER DUE TO A MALFUNCTIONING ECA
A	22-4	A DC BUS FEEDER IS CONSIDERED LOST IF: CANNOT BE USED AS A POWER PATH
A	22-5	AN INVERTER AND/OR ASSOCIATED AC DISTRIBUTION SYSTEM IS CONSIDERED LOST IF: A. AC BUS VOLTAGE ≤110.5 OR ≥120 VAC B. AC BUS FREQUENCY ≤390 OR ≥410 HZ C. POWER CANNOT BE SUPPLIED TO AN AC BUS
A	22-6	A. ECA OVERCURRENT PROTECTION IS <u>DEFINITELY</u> LOST IF: BOTH CIRCUIT BREAKERS POWERING THE ECA'S FAIL OPEN (ALL DESCENT OR ALL ASCENT ECA'S, WHICHEVER IS APPLICABLE) B. ECA OVERCURRENT PROTECTION IS <u>PROBABLY</u> LOST IF: 1. UNABLE TO MEASURE A BATTERY CURRENT BOTH ONBOARD AND ON TELEMETRY 2. UNABLE TO TAKE THE BATTERY OFF LINE
A		RULE NUMBERS 22-7 THROUGH 22-9 ARE RESERVED.

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MISSION RULES

REV	ITEM	MANAGEMENT RULES
A	22-10	THE MISSION WILL BE CONTINUED WITH THE PROBABLE LOSS OF OVERCURRENT PROTECTION. IF THIS PROTECTION IS LOST PRIOR TO LIFTOFF, A HOLD WILL BE CALLED. (REF MR 22-22 FOR DEFINITE LOSS OF OVERCURRENT PROTECTION)
	22-11	FOR NOMINAL STAGING, THE ASCENT BATTERIES WILL BE PRECONDITIONED FOR ONE ASCENT BATTERY OPERATION BY REMOVING 20 AMP-HRS FROM EACH BATTERY IMMEDIATELY PRIOR TO THE EVENT.
	22-12	FOR CONTINGENCY STAGING, THE ASCENT BATTERIES WILL BE PRECONDITIONED FOR TWO ASCENT BATTERY OPERATION BY REMOVING 5 AMP-HRS FROM EACH BATTERY IMMEDIATELY PRIOR TO THE EVENT. THIS IS PRESENTLY PLANNED TO BE ACCOMPLISHED ONLY FOR THE INSERTION MANUEVER.
	22-13	STAGED OPERATION WILL BE SPLIT-BUS CONFIGURATION UNTIL 20 AMP-HRS HAVE BEEN REMOVED FROM EACH ASCENT BATTERY.

NOTE: DUE TO A LACK OF DATA ON THE EFFECTS OF UNDERVOLTAGE SPIKES ON LM COMPUTERS MR'S 22-11, 12, 13 WERE WRITTEN IN ORDER TO PREVENT THE SPIKES.

RULE NUMBERS 22-14 THROUGH 22-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
A	22-20	LOSS OF EITHER DC BUS	ALL	A. DO NOT STAGE	• REF MALF PROC EPS:
			DOCKED	B. CONTINUE MISSION 1. DO NOT UNDOCK 2. DO NOT PERFORM EVA 3. ONE CREWMAN RETURN TO CSM 4. REMAINING CREWMAN CONNECT TO CSM TRANSFER UMBILICAL, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR 5. PERFORM LIMITED SYSTEMS EVALUATION	1 UNSTAGED DC BUS 2 STAGED DC BUS 3 UNSTAGED DC BUS W/BUS FAULT 4 STAGED DC BUS W/BUS FAULT 5 UNSTAGED DC BUS W/BAT FAULT 6 STAGED DC BUS W/BAT FAULT 7 UNSTAGED C&W PWR 8 STAGED C&W PWR 9 BATTERY
			EVA	C. TERMINATE EVA	
			UNDOCKED RNDZ	D. DOCK ASAP	• LOSS OF DC BUS RESULTS IN LOSS OF ONE PYRO SYSTEM
A	22-21	SHORTED DC BUS FEEDER			• REF MALF PROC EPS:
		A. DESCENT	ALL	A. CONTINUE MISSION PUT BOTH ASCENT BATTERIES ON NORMAL FEED AND ISOLATE SHORT WITH DFR	5 UNSTAGED DC BUS W/BAT FAULT 6 STAGED DC BUS W/BAT FAULT 7 UNSTAGED C&W PWR 8 STAGED C&W PWR
		B. ASCENT	ALL DOCKED	B.1. SET UP FOR UNMANNED APS BURN 2. CONTINUE MISSION (A) DO NOT UNDOCK (B) DO NOT PERFORM EVA (C) POWER AFFECTED BUS FROM OTHER BUS VIA 100 AMP CROSSTIE C/B'S (D) ONE CREWMAN RETURN TO CSM (E) REMAINING CREWMAN CONNECT TO CSM TRANSFER UMBILICAL, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR. (F) CONNECT LM/CSM ELECTRICAL UMBILICAL (G) PERFORM SYSTEMS EVALUATION AND DOCKED DPS BURN	
			EVA	3. TERMINATE EVA	
			UNDOCKED RNDZ	4. DOCK ASAP	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	22-22	DEFINITE LOSS OF OVER-CURRENT PROTECTION			• NO APPLICABLE MALF PROC REF MR 22-6
		A. DESCENT BATTERIES	ALL	A. CONTINUE MISSION	
		B. ASCENT BATTERIES	ALL	B.1. DO NOT STAGE UNDOCKED	
			UNDOCKED	2. CONTINUE MISSION DO NOT PERFORM SEPARATION	
			RNDZ	3. RETURN TO VICINTY OF CSM ASAP	
A	22-23	LOSS OF ASCENT BATTERIES:			• REF MALF PROC EPS:
		A. LOSS OF ONE ASCENT BATTERY	DOCKED EVA UNDOCKED	A.1. CONTINUE MISSION	2 STAGED DC BUS 4 STAGED DC BUS W/BUS FAULT
			RNDZ	2. SEPARATION - CONTINUE MISSION 3. PHASING - DO NOT PERFORM INSERTION 4. INSERTION - CONTINUE MISSION DO NOT STAGE UNLESS DESCENT BATTERIES ARE DEPLETED AND DESCENT O_2 TANK DEPLETED	6 STAGED DC BUS W/BATTERY FAULT 8 STAGED C&W POWER 9 BATTERY
		B. LOSS OF TWO ASCENT BATTERIES	ALL	B.1. DO NOT STAGE 2. CONTINUE MISSION (A) DO NOT UNDOCK (B) DO NOT PERFORM EVA (C) ONE CREWMAN RETURN TO CSM (D) REMAINING CREWMAN CONNECT TO CSM TRANSFER UMBILICAL, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR. (E) CONNECT LM/CSM ELECTRICAL UMBILICAL (F) PERFORM SYSTEMS EVALUATION AND DOCKED DPS BURN	
			EVA	3. TERMINATE EVA TERMINATE LM ACTIVITIES	
			UNDOCKED RNDZ	4. DOCK ASAP TERMINATE LM ACTIVITIES	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	22-24	LOSS OF DESCENT BATTERIES:			• REF MALF PROC EPS:
		A. LOSS OF ONE DESCENT BATTERY	ALL	A. CONTINUE MISSION	1 UNSTAGED DC BUS
		B. LOSS OF TWO DESCENT BATTERIES	DOCKED EVA UNDOCKED	B.1. CONTINUE MISSION	3 UNSTAGED DC BUS W/BUS FAULT
			RNDZ	2. CONTINUE MISSION DO NOT PERFORM INSERTION	5 UNSTAGED DC BUS W/BATTERY FAULT
		C. LOSS OF THREE OR MORE DESCENT BATTERIES	ALL DOCKED	C.1. SETUP FOR UNMANNED APS BURN	7 UNSTAGED C&W POWER
				2. CONTINUE MISSION (A) DO NOT UNDOCK (B) DO NOT PERFORM EVA (C) ONE CREWMAN RETURN TO CSM (D) REMAINING CREWMAN CONNECT TO CSM TRANSFER UMBILICAL, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR. (E) PERFORM SYSTEMS EVALUATION AND DOCKED DPS BURN	9 BATTERY
			EVA	3. TERMINATE EVA	
			UNDOCKED RNDZ	4. DOCK ASAP	
A	22-25	LOSS OF INVERTERS	ALL	CONTINUE MISSION	• REF MALF PROC EPS:
		A. LOSS OF ONE INVERTER	RNDZ	A.1. SEPARATION - CONTINUE MISSION	10 INVERTER
				2. PHASING - CONTINUE MISSION DO NOT PERFORM INSERTION	
				3. INSERTION - CONTINUE MISSION	
		B. LOSS OF BOTH INVERTERS	DOCKED	B.1. DO NOT BURN DPS (A) DO NOT PERFORM RENDEZVOUS (B) UNDOCKING IS PERMITTED	
			RNDZ	2. RETURN TO VICINITY OF CSM ASAP	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	22-26	LOSS OF AC BUSES			• REF MALF PROC EPS:
		A. LOSS OF BUS A	DOCKED	A.1. DO NOT BURN DPS	10 INVERTER
			EVA UNDOCKED	2. CONTINUE MISSION	BUS A REQUIRED FOR ONBOARD ATTITUDE READOUT
			RNDZ	3. RETURN TO VICINITY OF CSM ASAP	
		B. LOSS OF BUS B	DOCKED EVA UNDOCKED	B.1. CONTINUE MISSION	
			RNDZ	2. SEPARATION - CONTINUE MISSION	
				3. PHASING - RETURN TO VICINITY OF CSM ASAP DO NOT PERFORM INSERTION	
				4. INSERTION - CONTINUE MISSION	
		C. LOSS OF BOTH AC BUSES	DOCKED EVA UNDOCKED	C.1. CONTINUE MISSION UNDOCKING IS PERMITTED DO NOT PERFORM RENDEZVOUS	
			RNDZ	2. RETURN TO VICINITY OF CSM ASAP	
		RULE NUMBERS 22-27 THROUGH 22-49 ARE RESERVED.			

INSTRUMENTATION REQUIREMENTS

REV	ITEM	MEAS DESCRIPTION	PCM	ONBOARD		CATEGORY	MISSION RULE REFERENCE
A	22-50	AC BUS FREQ	GC0155F	CAUTION	COMMON LIGHT	M	22-1,5,25,26
		AC BUS VOLTS	GC0071V	METER/CAUTION		M	
		BAT 1 VOLTS	GC0201V	METER	COMMON METER	HD	22-1,2,3,10, 20,21,22,24
		BAT 2 VOLTS	GC0202V	METER		HD	
		BAT 3 VOLTS	GC0203V	METER		HD	
		BAT 4 VOLTS	GC0204V	METER		HD	
		BAT 5 VOLTS	GC0205V	METER		M	22-1,2,3,10, 20,21,22,23
		BAT 6 VOLTS	GC0206V	METER		M	
		CDR BUS VOLTS	GC0301V	METER/WARNING	COMMON LIGHT	1 OF 2	22-1,2,3,20, 21,22,23,24
		LMP BUS VOLTS	GC0302V	METER/WARNING		M	
		BAT 1 CUR	GC1201C	METER	COMMON METER	M PCM	22-1,2,3,10, 20,21,22,24
		BAT 2 CUR	GC1202C	METER		M PCM	
		BAT 3 CUR	GC1203C	METER		M PCM	
		BAT 4 CUR	GC1204C	METER		M PCM	
		BAT 5 CUR	GC1205C	METER		M PCM	22-1,2,3,10, 20,21,22,23
		BAT 6 CUR	GC1206C	METER		M PCM	
		BAT 1 MAL	GC9961U	CAUTION/COMP	COMMON LIGHTS	M ONBOARD	22-1,2,3, 10,22,24
		BAT 2 MAL	GC9962U	CAUTION/COMP		M ONBOARD	
		BAT 3 MAL	GC9963U	CAUTION/COMP		M ONBOARD	
		BAT 4 MAL	GC9964U	CAUTION/COMP		M ONBOARD	
		BAT 5 MAL	GC9965U	CAUTION/COMP		M ONBOARD	22-1,2,3,10,22,23
		BAT 6 MAL	GC9966U	CAUTION/COMP		M ONBOARD	
		BAT 1 LOW TAP	GC4362X	FLAG		HD	22-1,2,3,10,20,22,24
		BAT 2 LOW TAP	GC4364X	FLAG		HD	
		BAT 3 LOW TAP	GC4366X	FLAG		HD	
		BAT 4 LOW TAP	GC4368X	FLAG		HD	
		BAT 5 B/U CDR	GC4369X	FLAG		HD	22-1,2,3,10,20, 21,22,23
		BAT 6 NORM CDR	GC4370X	FLAG		HD	
		BAT 5 NORM LMP	GC4371X	FLAG		HD	
		BAT 6 B/U LMP	GC4372X	FLAG		HD	

REV	ITEM
A	23-1

GENERAL

TO INITIATE THE FOLLOWING NOMINAL MISSION EVENTS, THE ENVIRONMENTAL CONTROL SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES:

A. DOCKED WITH HATCH CLOSED

1. CABIN PRESSURE INTEGRITY
2. SUIT LOOP/PGA PRESSURE INTEGRITY
3. ONE SUIT FAN
4. ONE DEMAND REGULATOR
5. ONE H_2O SEPARATOR (CREW OPTION)
6. ONE COOLANT LOOP
7. SUFFICIENT AVAILABLE LiOH, H_2O AND O_2 CONSUMABLES TO MAINTAIN THE LM FOR ONE REV (1.5 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER

B. DOCKED WITH CONNECTING HATCH OPEN AND ONE CREWMAN IN LM ON TRANSFER UMBILICAL

1. COMBINED VEHICLE PRESSURE INTEGRITY FOR SUSTAINED OPERATIONS
2. ONE LM COOLANT LOOP FOR SUSTAINED OPERATIONS

C. EVA

1. CABIN PRESSURE INTEGRITY
2. SUIT LOOP/PGA PRESSURE INTEGRITY
3. ONE SUIT FAN
4. ONE DEMAND REGULATOR
5. ONE H_2O SEPARATOR (CREW OPTION)
6. ONE COOLANT LOOP
7. GREATER THAN 1400 PSIA IN THE DESCENT O_2 TANK PLUS SUFFICIENT O_2 IN ONE ASCENT O_2 TANK TO SATISFY THE METABOLIC AND LEAKAGE REQUIREMENTS FOR ONE REV (1.5 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER.
8. SUFFICIENT LiOH AND H_2O TO MAINTAIN THE LM FOR 1 REV (1.5 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER.

D. UNDOCKING

1. CABIN PRESSURE INTEGRITY
2. SUIT LOOP/PGA PRESSURE INTEGRITY
3. ONE SUIT FAN
4. ONE DEMAND REGULATOR
5. ONE H_2O SEPARATOR (CREW OPTION)
6. ONE COOLANT LOOP
7. TWO OF THREE O_2 TANKS
8. SUFFICIENT AVAILABLE LiOH, H_2O AND ASCENT O_2 TO MAINTAIN THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED CONTINGENCY LM TO CSM CREW TRANSFER.

REV	ITEM	
A	23-1 (CONT)	E. SEPARATION 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP/PGA PRESSURE INTEGRITY 3. ONE SUIT FAN 4. ONE DEMAND REGULATOR 5. ONE H_2O SEPARATOR (CREW OPTION) 6. BOTH COOLANT LOOPS 7. PRIMARY H_2O FEEDPATH 8. TWO OF THREE O_2 TANKS 9. SUFFICIENT AVAILABLE LiOH, H_2O AND ASCENT O_2 TO MAINTAIN THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED CONTINGENCY LM TO CSM CREW TRANSFER. F. PHASING 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP/PGA PRESSURE INTEGRITY 3. ONE SUIT FAN 4. ONE DEMAND REGULATOR 5. ONE H_2O SEPARATOR 6. BOTH COOLANT LOOPS 7. PRIMARY H_2O FEEDPATH 8. TWO OF THREE O_2 TANKS 9. SUFFICIENT AVAILABLE LiOH, H_2O AND ASCENT O_2 TO MAINTAIN THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED CONTINGENCY LM TO CSM CREW TRANSFER. G. INSERTION 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP/PGA PRESSURE INTEGRITY 3. ONE SUIT FAN 4. ONE DEMAND REGULATOR 5. ONE H_2O SEPARATOR 6. BOTH COOLANT LOOPS 7. PRIMARY H_2O FEEDPATH 8. DESCENT O_2 TANK* 9. ONE OF TWO ASCENT O_2 TANKS 10. TWO OF THREE H_2O TANKS 11. SUFFICIENT AVAILABLE LiOH, ASCENT H_2O AND ASCENT O_2 TO MAINTAIN THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER. *IF BOTH H_2O SEPARATORS AND BOTH SUIT FANS ARE FULLY OPERATIONAL AND BOTH ASCENT O_2 TANKS CONTAIN THE REQUIRED CONSUMABLES, THE RENDEZVOUS WILL BE PERFORMED WITHOUT THE DESCENT O_2 TANK. A FAILURE OF ANY OF THESE REQUIREMENTS WILL REQUIRE THE DESCENT O_2 TANK FOR RENDEZVOUS.

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MISSION RULES

REV	ITEM	
A	23-1 (CONT)	H. STAGING (NOMINAL) 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP/PGA PRESSURE INTEGRITY 3. ONE SUIT FAN 4. ONE DEMAND REGULATOR 5. ONE H_2O SEPARATOR 6. ONE COOLANT LOOP 7. TWO ASCENT O_2 TANKS 8. SUFFICIENT AVAILABLE LiOH, ASCENT H_2O AND ASCENT O_2 TO MAINTAIN THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER. I. DELAYED STAGING 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP/PGA PRESSURE INTEGRITY 3. ONE SUIT FAN 4. ONE COOLANT LOOP 5. TWO ASCENT O_2 TANKS 6. SUFFICIENT AVAILABLE LiOH, ASCENT H_2O AND ASCENT O_2 TO MAINTAIN THE LM FOR TWO REVS (3.0 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER.
A	23-2	DEFINITIONS:

A. LOSS OF CABIN INTEGRITY	LM PRESSURE VESSEL LEAKAGE SUCH THAT CABIN PRESSURE CANNOT BE MAINTAINED $\geq$4.6 PSIA WITH AN O_2 FLOW RATE OF 1.2 LBS/HR. FOR DOCKED ACTIVITIES, THIS WILL BE RELAXED TO A FLOW RATE OF 6 LBS/HR.
B. LOSS OF SUIT LOOP/PGA INTEGRITY	TOTAL PGA/SUIT LOOP LEAKAGE $\geq$0.5 PSI/MIN (1.5 LB/HR) DURING SUIT LOOP PRESSURE CHECK OR A VISIBLE TEAR IN THE PGA. DURING EVA, INCREASE IN DESCENT TANK QUANTITY USAGE >1.2 LB/HR
C. LOSS OF COOLANT LOOP	SUSTAINED GLYCOL TEMPERATURE $\geq$50°F AND RISING EXCEPT DURING COOLANT LOOP STARTUP AND DRYOUT (SUBLIMATOR LOST) OR GLYCOL PUMP $\Delta P \leq 6$ PSID (CIRCULATION LOST) OR KNOWN LOSS OF H_2O FEED CAPABILITY TO THE SUBLIMATOR(S)
D. GLYCOL COOLANT LEAK	OBSERVED FLUID IN CABIN CONFIRMED BY TASTE OR PRESENCE OF GLYCOL LOW INDICATION CONFIRMED BY STATIC PRESSURE DROP.
E. LOSS OF DESCENT O_2 TANK	INABILITY TO TRANSFER O_2 FROM DESCENT TANK OR MSFN CONFIRMATION OF LOSS OF DESCENT TANK PRESSURE WITH O_2 MANIFOLD PRESSURE
F. LOSS OF ASCENT O_2 TANK	(1) MSFN CONFIRMATION OF LOSS OF ASCENT TANK PRESSURE WITH O_2 MANIFOLD PRESSURE OR (2) IF UNSTAGED AND DESCENT TANK >35%, CREW CONFIRM LOSS BY BALANCING ONE TANK AGAINST THE OTHER OR (3) IF STAGED OR IF DESCENT O_2 <35%, LOSS OF ONBOARD AND MSFN READOUTS

REV	ITEM	
A	23-2 (CONT)	G. LOSS OF DESCENT H_2O TANK — INABILITY TO SUPPLY H_2O TO W/B RESULTING IN RISING GLYCOL AND SUIT LOOP TEMPERATURE (CREW AND MSFN) AND DROP IN H_2O ΔP (MSFN ONLY) H. LOSS OF ASCENT H_2O TANK — LOSS OF MEASUREMENT AND REMAINING TANK FEEDING AT TWICE NORMAL RATE OR ONE TANK FEEDING TWICE NORMAL RATE AND NO CHANGE IN MEASUREMENT ON OTHER TANK
A	23-3	WITH THE LOSS OF CABIN AND/OR SUIT LOOP INTEGRITY, THE LM MUST BE DOCKED AND MANNED BY ONE CREW MEMBER ON THE CSM TRANSFER UMBILICAL BEFORE STAGING IS ATTEMPTED.
A	23-4	IF A SUBLIMATOR IS LOST DUE TO BREAKTHROUGH, NO RESTART ATTEMPT WILL BE MADE.
A	23-5	OXYGEN PURGE SYSTEM AND PLSS CONSUMABLES WILL BE RESERVED FOR POSSIBLE EVT AND WILL NOT BE CONSIDERED FOR NOMINAL OR REDLINE USAGE.
A		RULE NUMBERS 23-6 THROUGH 23-9 ARE RESERVED

REV	ITEM	MANAGEMENT
A	23-10	PRIMARY GLYCOL LOOP CIRCULATION WILL BE DISCONTINUED AT STARTUP OF THE SECONDARY LOOP BUT MAY BE REINITIATED FOLLOWING SECONDARY LOOP STABILIZATION IF DEEMED NECESSARY.
A	23-11	IF EITHER ASCENT O_2 TANK IS $\leq$95%, IT WILL BE REPLENISHED FROM THE DESCENT O_2 WHEN THE DESCENT TANK QUANTITY $\geq$35% AND AS CLOSE TO STAGING AS POSSIBLE.
A	23-12	PLSS FILL VALVE WILL BE CLOSED, EXCEPT FOR REPRESSURIZING THE PLSS AND FOR MSFN REQUESTED READOUTS OF O_2 MANIFOLD PRESSURE.
A	23-13	CREW WILL GO TO EGRESS MODE IF INSUFFICIENT O_2 IS AVAILABLE TO MAINTAIN CABIN PRESSURE FOR THE REQUIRED TIME. ADDITIONALLY, A MISSION PHASE WILL NOT BE INITIATED IF THIS CONDITION CAN BE ANTICIPATED.
A	23-14	CREW WILL BE REQUIRED TO BREATHE PURE O_2 FOR 2 MIN VIA PURGE MODE PRIOR TO EVA.

RULE NUMBERS 23-15 THROUGH
23-19 ARE RESERVED

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
A	23-20	LOSS OF CABIN PRESSURE INTEGRITY			• REF MR 23-2A, 23-3, 23-14
			ALL	A. SET UP FOR UNMANNED APS BURN	A. REF MALF PROC ECS: 1 CABIN, 17 ABNORMAL DECAY OF DESCENT O_2
			DOCKED	B. CONTINUE MISSION 1. DO NOT UNDOCK 2. DO NOT PERFORM EVA 3. ONE CREWMAN RETURN TO CSM 4. REMAINING CREWMAN CONNECT TO BOTH CSM AND LM UMBILICALS, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR. 5. PERFORM SYSTEMS EVALUATION AND DOCKED DPS BURN.	
			UNDOCKED RNDZ	C. DOCK ASAP DO NOT STAGE UNDOCKED	
A	23-21	LOSS OF SUIT LOOP/PGA INTEGRITY			• REF MR 23-2B, 23-3
			ALL	A. SET UP FOR UNMANNED APS BURN	• REF AOH EMERGENCY PROC: SUIT LEAK IN DEPRESSURIZED CABIN
			DOCKED	B. PERFORM SYSTEMS EVALUATION DO NOT PERFORM EVA, UNDOCKING, OR DOCKED DPS	
			EVA	C. TERMINATE MANNED LM ACTIVITIES DO NOT PERFORM SUBSEQUENT MANNED PHASES	C. REF MALF PROC ECS: 3 SUIT/FAN
			UNDOCKED RNDZ	D. DOCK ASAP DO NOT STAGE UNDOCKED	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	23-22	SUIT FAN(S) FAILURE			
		A. ONE SUIT FAN	ALL	A. CONTINUE MISSION	A. REF MALF PROC ECS: 5 ECS
		B. TWO SUIT FANS	ALL	B.1. SET UP FOR UNMANNED APS	
			DOCKED	2. CONTINUE MISSION (A) DO NOT UNDOCK (B) DO NOT PERFORM EVA (C) ONE CREWMAN RETURN TO CSM (D) REMAINING CREWMAN CONNECT TO CSM TRANSFER UMBILICAL, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR. (E) PERFORM SYSTEMS EVALUATION AND DOCKED DPS BURN.	
			EVA	3.(A) TERMINATE EVA GO TO SUIT PURGE MODE UNTIL CABIN REPRESS COMPLETE. (B) LMP RETURN TO NEAREST VEHICLE DO NOT UNDOCK	
			UNDOCKED RNDZ	4. DOCK ASAP DO NOT STAGE UNDOCKED	
A	23-23	LOSS OF H_2O SEPARATOR(S)			• REF MALF PROC ECS: 6 ECS
		A. ONE SEPARATOR	ALL	A. CONTINUE MISSION	
		B. TWO SEPARATORS	DOCKED	B.1. CONTINUE MISSION	
			EVA	2. CONTINUE MISSION AT CREW OPTION	
			UNDOCKED	3. CONTINUE MISSION AT CREW OPTION	
			RNDZ	4.(A) SEPARATION - DO NOT PERFORM PHASING (B) PHASING - DO NOT PERFORM INSERTION (C) INSERTION - DELAY STAGING AS LONG AS POSSIBLE	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	23-24	DEMAND REGULATOR(S) FAIL OPEN OR CLOSE (AUTOMATIC FUNCTION ONLY)			
		A. ONE REGULATOR	ALL	A. CONTINUE MISSION	REF MALF PROC ECS: 17 ABNORMAL DECAY DESCENT O_2
		B. TWO REGULATORS	ALL	B.1. SET UP FOR UNMANNED APS	B. REGULATOR ON-OFF CYCLING WILL BE REQUIRED TO MAINTAIN CABIN AND/OR SUIT PRESSURE
			DOCKED	2. CONTINUE MISSION (A) DO NOT UNDOCK (B) DO NOT PERFORM EVA (C) ONE CREWMAN RETURN TO CSM (D) REMAINING CREWMAN CONNECT TO CSM UMBILICAL; OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR. (E) PERFORM SYSTEMS EVALUATION AND DOCKED DPS BURN.	
			EVA	3. TERMINATE EVA	
			UNDOCKED	4. DOCK ASAP	
			RNDZ	5.(A) SEPARATION - DO NOT PERFORM PHASING (B) PHASING - DO NOT PERFORM INSERTION (C) INSERTION - DELAY STAGING AS LONG AS POSSIBLE	
A	23-25	LOSS OF COOLANT LOOP(S)			• REF MR 23-2C, 23-2D, 23-4 • REF MALF PROC ECS: 8 ECS, 10 GLYCOL
		A. PRIMARY LOOP	DOCKED EVA UNDOCKED	A. CONTINUE MISSION ON SECONDARY LOOP DO NOT PERFORM SEPARATION	A. PGNS, DSE, DCA, LCA DFI NOT COOLED BY SECONDARY LOOP
			RNDZ	B.1. RETURN TO VICINITY OF CSM ASAP 2. OPERATE ON SECONDARY LOOP	
		B. BOTH LOOPS (ANY COMBINATION OF LOSS OF CIRCULATION, SUBLIMATION CAPABILITY, OF H_2O FEED FOR BOTH LOOPS)	DOCKED	B.1. INGRESS CSM ASAP DO NOT PERFORM EVA, UNDOCKING	
			EVA	2. TERMINATE EVA (A) GO TO SUIT PURGE MODE UNTIL CABIN REPRESS COMPLETE (B) LMP RETURN TO CSM	
			UNDOCKED	3. DOCK ASAP DO NOT PERFORM SEPARATION	
			RNDZ	4. DOCK ASAP (A) CONTINUE GLYCOL CIRCULATION IF POSSIBLE (B) POWER DOWN SPACECRAFT FOR LIFE SUPPORT ONLY (C) AWAIT CSM RESCUE	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	23-26	LOSS OF PRIMARY H_2O FEEDPATH	ALL DOCKED EVA UNDOCKED RNDZ	A. SET UP FOR UNMANNED APS B. CONTINUE MISSION DO NOT PERFORM SEPARATION C. RETURN TO VICINITY OF CSM ASAP	• REF MALF PROC ECS: 10 GLYCOL
A	23-27	FIRE OR SMOKE IN CABIN OR SUIT	ALL	A. TROUBLESHOOT/COMBAT FIRE B. ASSESS DAMAGE AND TRANSFER TO CSM IF NECESSARY	• REF AOH PROC 5.3.2
A	23-28	CONTAMINATION IN CABIN	ALL	CREW MAY ELECT TO DECOMPRESS TO CLEAR CONTAMINATION	IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY.
A	23-29	GLYCOL COOLANT LEAK A. CABIN B. SUIT LOOP RULE NUMBERS 23-30 THROUGH 23-49 ARE RESERVED.	ALL ALL ALL	TRANSFER TO CSM PERFORM DOCKED ACTIVITIES ON CSM UMBILICAL AND SET UP FOR APS BURN A.1. GO TO EGRESS OPERATION (CLOSED SUIT LOOP) 2. PURGE SUIT LOOP WITH DESCENT O_2 IF UNSTAGED B. DISCONNECT FROM SUIT LOOP	• REF MR 23-2D • REF MALF PROC ECS: 10 GLYCOL

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MISSION RULES

INSTRUMENTATION REQUIREMENTS

REV	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	MISSION RULE REFERENCE
A	23-50	SUIT PRESS	GF1301P	METER	M	23-1,2,3,20,21,22,23,24
		CABIN PRESS	GF3571P	WARNING	M	23-1,2,3,20,23,24
		REPR ELEC OPEN	GF3572X	METER	M	23-1,2,3,20,23,24
		CO_2 PART PRESS	GF1521P	WARNING	HD	
		H_2O SEP RATE	GF9999U	METER, CAUTION	HD	23-1,22,23
		DES O_2 PRESS	GF3584P	CAUTION, COMP	M	23-1,3,20,24
		ASC 1 O_2 PRESS	GF3582P	METER, CAUTION	1 OF 2	23-1,3,20,24
		ASC 2 O_2 PRESS	GF3583P	METER, CAUTION	M	23-1,3,20,24
		O_2 MANIFOLD PRESS	GF3589P	METER, CAUTION	M	23-1,3,20,24
		GLYCOL PUMP ΔP	GF2021P	-----	M	23-25,26,29
		GLYCOL PUMP SW/O	GF2936X	-----	HD	23-25,26,29
		GLYCOL PUMP P	GF9997U	COMP	M	23-25,26,29
		GLYCOL LEVEL LOW	GF2041X	METER	M	23-25,26,29
		GLYCOL TEMP	GF9998U	CAUTION	M PCM	23-25,26
		DES H_2O QTY	GF4581Q	METER, CAUTION	M	23-25,26
		ASC 1 H_2O QTY	GF4582 } 1 OF 2	CAUTION	M BOTH } 1 OF 2	23-25,26
		ASC 2 H_2O QTY	GF4583 } 1 OF 2	METER	M	
			GF4582Q	-----	M	23-25,26
			GF4583Q	-----	HD	23-20,24
		PRI H_2O REG ΔP	GF4101P	-----	HD	23-23
		SUIT DIV EGRESS	GF1221X	METER	HD	23-25,26
		SUIT TEMP	GF1281T	METER	HD	
		CABIN TEMP	GF1651T			

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24 LM/COMM INSTRUMENTATION (SEE SECTION 32)

25 LM GUIDANCE AND CONTROL

26 LM DPS

27 LM APS

28 LM REACTION CONTROL SYSTEM

29 SPACE ENVIRONMENT

30 RECOVERY

31 AEROMEDICAL

32 COMMUNICATIONS/ INSTRUMENTATION

APPENDICES

A ACRONYMS AND SYMBOLS

B DISTRIBUTION LIST

C CHANGE CONTROL

24 LM/COMM
INSTRUMENTATION
(SEE SECTION 32)

REV	ITEM

THIS
SECTION
HAS BEEN
DELETED

ALL DATA FORMERLY
CONTAINED IN THIS
SECTION IS NOW IN
SECTION 32.

25 LM GUIDANCE
AND CONTROL

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MISSION RULES

REV	ITEM	
		GENERAL
A	25-1	DOCKED

IN ORDER TO INITIATE AND CONTINUE THE DOCKED PHASE OF THE MISSION, THE G&C SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES FOR THE DOCKED DPS BURN:

A. EITHER AN OPERATIONAL PGNS, WHERE AN OPERATIONAL PGNS IS DEFINED AS

1. NO LGC FAILURE,
2. NO ISS FAILURE,
3. 3-AXIS ATTITUDE CONTROL CAPABILITY,

OR MANUAL TTCA ATTITUDE CONTROL CAPABILITY.

B. THRUST VECTOR CONTROL, DEFINED AS:

1. AN OPERATIONAL PGNS OR AGS THRUST VECTOR CONTROL
2. A FUNCTIONAL DPS GIMBAL TRIM SYSTEM

C. +X ULLAGE CAPABILITY, DEFINED AS ONE OF THE FOLLOWING:

1. +X VIA ONE TTCA
2. +X TRANS OVRD SWITCH
3. AUTO PGNS ULLAGE CAPABILITY
4. CSM ULLAGE

D. ENG ON/OFF CAPABILITY, DEFINED AS ONE OF THE FOLLOWING:

1. AUTO ON/OFF CAPABILITY
2. MANUAL ON/OFF CAPABILITY

E. OPERATIONAL ENGINE THROTTLE CONTROL, DEFINED AS:

1. NO DPS ENGINE START GREATER THAN 60% THROTTLE ACTUATOR POSITION
2. NO MORE THAN 100 SECONDS MAXIMUM DPS OPERATION IN THE NON-THROTTEABLE RANGE.

A 25-2 UNDOCKED

IN ORDER TO INITIATE AND CONTINUE THE UNDOCKED PHASE, THE G&C SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES:

A. REDUNDANT 3-AXIS ATTITUDE CONTROL, DEFINED AS HAVING A MINIMUM OF:

1. ONE HAND CONTROLLER (ACA)
2. EITHER AN OPERATIONAL PGNS AND AGS WHERE AN OPERATIONAL AGS IS DEFINED AS

(A) NO AEA FAILURE,
(B) NO ASA FAILURE,
(C) AN OPERATIONAL DEDA,
(D) AGS 3-AXIS ATTITUDE CONTROL CAPABILITY,

OR AN OPERATIONAL AGS AND SECONDARY COILS.

B. 3-AXIS TRANSLATION CAPABILITY, DEFINED AS HAVING A MINIMUM OF:

1. ONE TTCA
2. AN OPERATIONAL PGNS OR AGS

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MISSION RULES

REV	ITEM	
A	25-3	RNDZ

IN ORDER TO INITIATE AND CONTINUE THE RENDEZVOUS PHASE, THE G&C SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES:

A. SEPARATION:

1. REDUNDANT 3-AXIS ATTITUDE CONTROL CAPABILITY
2. OPERATIONAL PGNS
3. 3-AXIS TRANSLATION CAPABILITY
4. OPERATIONAL RENDEZVOUS RADAR AND TRANSPONDER, DEFINED AS:

   COMPLETION OF A VALID RR AND TRANSPONDER SELF-TEST EXCEPT FOR RR/LGC INTERFACE
5. ONE OPERATIONAL FDAI
6. AN OPERATIONAL DSKY

B. PHASING:

1. SAME AS SEPARATION WITH THE ADDITION OF:

   (A) ENG ON/OFF CAPABILITY
   (B) OPERATIONAL ENGINE THROTTLE CAPABILITY
   (C) EITHER AN OPERATIONAL AOT OR COAS
   (D) RR LOCK ON AND VALID RR/LGC INTERFACE

C. INSERTION:

1. OPERATIONAL PGNS
2. REDUNDANT 3-AXIS ATTITUDE CONTROL CAPABILITY
3. ENG ON/OFF CAPABILITY
4. OPERATIONAL ENGINE THROTTLE CAPABILITY
5. +X AXIS TRANSLATION CAPABILITY

D. STAGING:

1. OPERATIONAL AGS OR PGNS
2. +X AXIS TRANSLATION CAPABILITY

25-4 UNMANNED

IN ORDER TO INITIATE AND CONTINUE THE UNMANNED PHASE OF THE MISSION, THE G&C SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES FOR THE UNMANNED APS BURN.

A. OPERATIONAL PGNS

B. APS ENG ARM/DEARM - ON/OFF CONTROL.

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REV	ITEM	
		SYSTEMS MANAGEMENT
	25-10	IMU A. THE PIPA AND IRIG BIASES WILL BE UPDATED WHEN DIFFERENCES OF .020 FT/SEC^2 (.600 CM/SEC^2) AND .225°/HR RESPECTIVELY. B. THE IMU HEATER POWER MAY BE REMOVED FOR 10 HRS WITHOUT GLYCOL COOLING TO SUPPORT THE APS BURN TO DEPLETION.
A	25-11	LGC A. A MASS UPDATE IS REQUIRED IF A MASS Δ OF ± 10 PERCENT (DIFFERENCE BETWEEN GROUND CALCULATION AND LGC VALUE) EXISTS WHEN IN THE DPS CONFIGURATION, OR ± 5 PERCENT IN APS CONFIGURATION. B. ALL DESCENT ENGINE STARTS MUST NOMINALLY BE PRECEDED BY A PROPELLANT SETTLING MANEUVER USING TWO SYSTEM B JETS OR TWO SYSTEM A JETS IN CASE OF A CONTINGENCY. C. ULLAGE FOR ALL APS BURNS MAY BE 4 JET OR 2 JET SYSTEM A OR B. D. ALL ± (U-V) JETS WILL BE INHIBITED VIA V65 DURING DOCKED DPS BURNS. E. DURING DOCKED MANEUVERS, ALL DPS GIMBAL TRIMMING MUST BE DONE AT 40 PERCENT THROTTLE IN THE AUTO THROTTLE MODE.
	25-12	RENDEZVOUS RADAR A. THE RR MUST NOT BE OPERATED UNTIL THE ANTENNA TEMPERATURE (X96 MULT) IS ≥15°F AND THE GYRO PACKAGE IS ESTIMATED TO BE ≥15°F. B. THE RR CAN NOT BE OPERATED AT AN ANTENNA TEMPERATURE ≥145°F AND/OR A GYRO PACKAGE TEMP (CALCULATED) OF ≥200°F. C. THE RR CANNOT BE OPERATED FOR MORE THAN 15 MINUTES WHEN THE ANTENNA IS STOWED. THIS TIME INCLUDES SELF TEST TIME.
	25-13	THE AGS WILL NOT BE USED FOR CONTROLLING DOCKED BURNS.
	25-14	IF THE AGS IS DECLARED NO-GO OR IS OF NO FURTHER USE TO MISSION TEST OBJECTIVES, THE AGS MAY BE POWERED DOWN.
		RULE NUMBERS 25-15 THROUGH 25-19 ARE RESERVED

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
A	25-20	LOSS OF AN OPERATIONAL PGNS			• REF MAL PROC PGNS 1, ISS WARN • REF MAL PROC PGNS 2,3, LGC WARN • REF MAL PROC PGNS 9, TEMP CAUTION
		A. IN PGNS CONTROL	DOCKED	A.1. PERFORM DPS BURN MANUALLY USING TTCA FOR ATTITUDE CONTROL	
			UNDOCKED	2. CONTINUE MISSION (A) SELECT AGS (B) RNDZ NO-GO (C) REF ALT MISSION F	
			RNDZ	3. RETURN TO CSM ASAP (A) SELECT AGS (B) UNMANNED APS NO-GO	
			UNMANNED	4. CONTINUE BURN UNLESS TRAJECTORY CONSTRAINTS ARE VIOLATED OR LOSS OF ATTITUDE CONTROL OCCURS	
		B. IN AGS CONTROL	RNDZ	B. RETURN TO CSM ASAP	
A	25-21	LOSS OF DSKY	DOCKED	A. CONTINUE MISSION 1. RNDZ NO-GO 2. REF ALT MISSION B	• REF MAL PROC PGNS 15, ABNORMAL DSKY RESPONSE • REF MAL PROC PGNS 16, MISSING NUMERICS ON DSKY • REF MAL PROC PGNS 17, ABNORMAL DSKY PUSHBUTTON RESPONSE
			UNDOCKED	B. CONTINUE MISSION 1. SELECT AGS 2. RENDZ NO-GO 3. REF ALT MISSION B	
			RNDZ	C. RETURN TO CSM ASAP 1. SELECT AGS 2. REF ALT MISSION B	
			UNMANNED	D. CONTINUE MISSION	
	25-22	LOSS OF FDAI			
		A. ONE	ALL	A. CONTINUE MISSION	
		B. BOTH	DOCKED	B.1. CONTINUE MISSION	
			UNDOCKED	2. CONTINUE MISSION RNDZ NO-GO	
			RNDZ	3. RETURN TO CSM ASAP	
			UNMANNED	4. CONTINUE MISSION	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	25-23	LOSS OF AOT AND/OR COAS			
		A. EITHER	ALL	A. CONTINUE MISSION	
		B. BOTH	DOCKED/ UNDOCKED	B.1. CONTINUE MISSION RNDZ NO-GO	
			RNDZ	2. RETURN TO CSM ASAP REF ALT MISSION B	
			UNMANNED	3. CONTINUE MISSION	
A	25-24	LOSS OF RENDEZVOUS RADAR AND/OR TRANSPONDER	DOCKED	A. CONTINUE MISSION	• REF MAL PROC PGNS 5, HEATER CAUTION
			UNDOCKED	B. CONTINUE MISSION	• REF MAL PROC PGNS 6,7, RNDZ RDR CAUTION
				1. NO-GO FOR RNDZ	• REF MAL PROC PGNS 8, NO TRACK
				2. REF ALT MISSION B	
			RNDZ	C.1. PRIOR TO PHASING RETURN TO CSM ASAP	
				2. AFTER PHASING CONTINUE MISSION	
			UNMANNED	D. CONTINUE MISSION	
	25-25	LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL			
			DOCKED	A. CONTINUE MISSION	
				1. DO NOT UNDOCK	
				2. REF ALT MISSION D PLUS EVA	
			UNDOCKED	B. RETURN TO CSM AND DOCK ASAP	
				REF ALT MISSION D	
			RNDZ	C. RETURN TO CSM ASAP	
			UNMANNED	D. CONTINUE MISSION	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	25-26	LOSS OF TRANSLATION CAPABILITY			
		A. ULLAGE (+X)	DOCKED	A.1. CONTINUE MISSION (A) CSM PROVIDE LM ULLAGE, LM PROVIDE ATT CONTROL (B) DO NOT UNDOCK (C) REF ALT MISSION D	A. MAX CSM ULLAGE TIME IS 7 SEC DUE TO LM IMPINGEMENT CONSTRAINT.
			UNDOCKED	2. RETURN TO CSM AND DOCK ASAP CSM ACTIVE DOCKING	
			RNDZ	3. CSM RESCUE	
			UNMANNED	4. CONTINUE MISSION	
		B. EITHER ±Y, ±Z, -X TRANSLATION	DOCKED	B.1. CONTINUE MISSION (A) REF ALT MISSION D (B) DO NOT UNDOCK	
			UNDOCKED	2. RETURN TO CSM AND DOCK ASAP CSM PERFORM BRAKING MANEUVER AND DOCKING	
			RNDZ	3. (A) PRIOR TO PHASING: RETURN TO CSM AND DOCK ASAP CSM PERFORM BRAKING MANEUVER AND DOCKING (B) AFTER PHASING: CONTINUE MISSION CSM PERFORM TRANSLATION MANEUVERS IF REQUIRED	
			UNMANNED	4. CONTINUE MISSION	
	25-27	LOSS OF THRUST VECTOR CONTROL	DOCKED	A. INHIBIT DPS BURN IF BURNING, CONTINUE BURN UNTIL ATT ERROR OR RATE LIMIT IS EXCEEDED.	
			ALL	B. CONTINUE MISSION UNLESS RCS IMPINGEMENT CONSTRAINTS ARE VIOLATED	B. RCS IMPINGEMENT CONSTRAINTS MAY BE VIOLATED BECAUSE OF RCS OPPOSING THRUST VECTOR OFFSET.
	25-28	ENG DOES NOT IGNITE AFTER START PB DEPRESSED	DOCKED	A.1. SET STOP PB (A) DE-ARM DPS (B) RESCHEDULE DPS BURN USING DESCENT CMD OVERRIDE SWITCH	A.1. STOP PB MUST BE SET TO RESET THE LATCHING RELAYS ENERGIZED BY START PB DEPRESSION
			RNDZ	B.1. FOR PHASING BURN, SET STOP PB (A) DE-ARM DPS (B) REF ALT MISSION E-5c	
				2. FOR BURNS AFTER PHASING, SET STOP PB (A) DE-ARM DPS (B) RETURN TO CSM ASAP	B.2. NO APS START CAPABILITY EXISTS
			UNMANNED	C.1. NO-GO FOR APS BURN	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-29	LOSS OF OPERATIONAL AGS	ALL	CONTINUE MISSION	
	25-30	DPS BURN IN NON-THROTTLE-ABLE RANGE			
		A. PRIOR TO TGO 4 MIN 1 SEC	DOCKED	A.1. AT TGO 4 MIN 1 SEC PERFORM MANUAL SHUTDOWN	
			RNDZ	2. CONTINUE BURN	
		B. BETWEEN TGO 4 MIN 1 SEC AND TGO 2 MIN 21 SEC	DOCKED	B. AT TGO 2 MIN 21 SEC PERFORM MANUAL SHUTDOWN IMMEDIATELY	
		C. AFTER TGO 2 MIN 21 SEC	DOCKED	C. CONTINUE BURN	
	25-31	LOSS OF MANUAL THRUST CON-TROL			
		A. ZERO OUTPUT	DOCKED	A.1. IF BURN CONTINUES TO THROT-TLE DOWN POINT, STOP BURN MANUALLY.	
			RNDZ	2. CONTINUE MISSION USE LOW STOP POINT	A.2. THE THROTTLE WILL MECH-ANICALLY GO TO APPROX 10 PERCENT WITH ZERO INPUT TO VARIABLE THROT-TLE ACTUATOR ELECTRONIC CONTROLS.
		B. MAXIMUM THRUST	ALL	B. IF BURNING, CONTINUE BURN UNTIL COMMAND SHUTDOWN FURTHER DPS BURNS PROHIBITED	
A	25-32	LOSS OF ACA			
		A. ONE	ALL	A. CONTINUE MISSION	
		B. BOTH	DOCKED	B. CONTINUE MISSION DO NOT UNDOCK REF ALT MISSION D	
			UNDOCKED/ RNDZ	C. RETURN TO CSM ASAP	
			UNMANNED	D. CONTINUE MISSION	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-33	LOSS OF TTCA			
		A. ONE	ALL	A. CONTINUE MISSION	
		B. BOTH	DOCKED	B. CONTINUE MISSION DO NOT UNDOCK	
			UNDOCKED	C. RETURN TO CSM ASAP REF ALT MISSION D	
			RNDZ	D. RETURN TO CSM ASAP	
			UNMANNED	E. CONTINUE MISSION	
		RULE NUMBERS 25-34 THROUGH 25-39 ARE RESERVED.			

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MISSION RULES

REV | ITEM 25-40

PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
LGC DOWNLINK	GG00010	-	-	M	25-20
LS TORQ REF	GG1040V	-	-	HD	25-20
2.5 VDC TM BIAS	GG1110V	-	-	HD	25-20
IMU 28 VAC 800	GG1201V	-	-	HD	25-20
IRIG SUSP 3.2 KC	GG1331V	-	-	HD	25-20
IMU STBY	GG1513X	-	-	HD	25-20
LGC OPR	GG1523X	-	-	HD	25-20
X PIPA OUT IN ϕ	GG2001V	-	-	HD	25-20
Y PIPA OUT IN ϕ	GG2021V	-	-	HD	25-20
Z PIPA OUT IN ϕ	GG2041V	-	-	HD	25-20
LG SVO ERR IN ϕ	GG2107V	-	-	HD } 1 OF 2	25-20
LG TORQ MTR CUR	GG2110C	-	-	HD } M-PCM	25-20
LG IX RSVR OUT SIN	GG2112V	FDAI	COMMON	M-PCM	25-20
LG IX RSVR OUT COS	GG2113V	FDAI	COMMON	M-PCM	25-20
MG SVO ERR IN ϕ	GG2137V	-	-	HD } 1 OF 2	25-20
MG TORQ MTR CUR	GG2140C	-	-	HD } M-PCM	25-20
MG IX RSVR OUT SIN	GG2142V	FDAI	COMMON	M-PCM	25-20
MG IX RSVR OUT COS	GG2143V	FDAI	COMMON	M-PCM	25-20
OG SVO ERR IN ϕ	GG2167V	-	-	HD } 1 OF 2	25-20
OG TORQ MTR CUR	GG2170C	-	-	HD } M-PCM	25-20
OG RSVR OUT SIN	GG2172V	FDAI	COMMON	M-PCM	25-20
OG RSVR OUT COS	GG2173V	FDAI	COMMON	M-PCM	25-20
PITCH ATT ERR	GG2219V	FDAI	COMMON	HD - PCM	25-20
YAW ATT ERR	GG2249V	FDAI	COMMON	HD - PCM	25-20
ROLL ATT ERR	GG2279V	FDAI	COMMON	HD - PCM	25-20
PIPA TEMP	GG2300T	C&W	SEPARATE	M-PCM	25-20
IRIG TEMP	GG2301T	C&W	SEPARATE	HD - PCM	25-20
RR SHFT SIN	GG3304V	FDAI	COMMON	HD - PCM	25-24
RR SHFT COS	GG3305V	FDAI	COMMON	HD - PCM	25-24
RR TRUN SIN	GG3324V	FDAI	COMMON	HD - PCM	25-24
RR TRUN COS	GG3325V	FDAI	COMMON	HD - PCM	25-24
PIPA CAL TEMP	GG6020T	-	-	HD - PCM	25-20
LGC WARNING	GG9001X	C&W	COMMON	HD - PCM	25-20
LSS WARNING	GG9002X	C&W	COMMON	HD - PCM	25-20
LR ANT TEMP	GN7563T	TEMP MONITOR	COMMON	HD - PCM	
RR NO TRACK	GN7621X	C&W	COMMON	HD - PCM	25-24
RR ANT TEMP	GN7723T	TEMP MONITOR	COMMON	M-PCM	25-24
YAW ERR CMD	GH1247V	-	-	M	25-25
PITCH ERR CMD	GH1248V	-	-	M	25-25
ROLL ERR CMD	GH1249V	-	-	M	25-25
OD A4D OUTPUT	GH1419V	-	-	HD	25-25,25-26
RCS TCP A4D	GR5032X	-	-	HD	25-25,25-26
OD B3D OUTPUT	GH1423V	-	-	HD	25-25,25-26
RCS TCP B3D	GR5036X	-	-	HD	25-25,25-26
OD A2D OUTPUT	GH1427V	-	-	HD	25-25,25-26
RCS TCP A2D	GR5040X	-	-	HD	25-25,25-26
OD B1D OUTPUT	GH1431V	-	-	HD	25-25,25-26
RCS TCP B1D	GR5044X	-	-	HD	25-25,25-26
OD B4U OUTPUT	GH1418V	-	-	HD	25-25,25-26
OD B4F OUTPUT	GH1420V	-	-	HD	25-25,25-26
OD A4R OUTPUT	GH1421V	-	-	HD	25-25,25-26
OD A3U OUTPUT	GH1422V	-	-	HD	25-25,25-26
OD B3A OUTPUT	GH1424V	-	-	HD	25-25,25-26
OD A3R OUTPUT	GH1425V	-	-	HD	25-25,25-26
OD B2U OUTPUT	GH1426V	-	-	HD	25-25,25-26
OD A2A OUTPUT	GH1428V	-	-	HD	25-25,25-26
OD B2L OUTPUT	GH1429V	-	-	HD	25-25,25-26
OD A1U OUTPUT	GH1430V	-	-	HD	25-25,25-26
OD A1F OUTPUT	GH1432V	-	-	HD	25-25,25-26
OD B1L OUTPUT	GH1433V	-	-	HD	25-25,25-26
RCS TCP B4U	GR5031X	-	-	HD	25-25,25-26
RCS TCP B4F	GR5033X	-	-	HD	25-25,25-26
RCS TCO A4R	GR5034X	-	-	HD	25-25,25-26
RCS TCP A3U	GR5035X	-	-	HD	25-25,25-26
RCS TCP B3A	GR5037X	-	-	HD	25-25,25-26
RCS TCP A3R	GR5038X	-	-	HD	25-25,25-26
RCS TCP B2U	GR5039X	-	-	HD	25-25,25-26
RCS TCP A2A	GR5041X	-	-	HD	25-25,25-26
RCS TCP B2L	GR5042X	-	-	HD	25-25,25-26
RCS TCP A1U	GR5043X	-	-	HD	25-25,25-26
RCS TCP A1F	GR5045X	-	-	HD	25-25,25-26

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MISSION RULES

REV	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
A	25-40 (CONT'D)	RCS TCP BIL	GR5046X	-	-	HD	25-25,25-26
		YAW ATT ERR	GH1455V	FDAI	COMMON	HD	25-25
		PITCH ATT ERR	GH1456V	FDAI	COMMON	HD	25-25
		ROLL ATT ERR	GH1457V	FDAI	COMMON	HD	25-25
		RGA YAW RATE	GH1461V	FDAI	COMMON	M } ON BOARD PCM/HD	25-25
		RGA PITCH RATE	GH1462V	FDAI	COMMON	M	25-25
		RGA ROLL RATE	GH1463V	FDAI	COMMON	M	25-25
		AUTO MODE	GH1608X	-	-	HD	25-25
		ATT HOLD	GH1609X	-	-	HD	25-25
		AGS SEL	GH1621X	-	-	HD	25-25
		ROLL PLSD/DIR	GH1628X	-	-	HD	25-25
		PITCH PLSD/DIR	GH1629X	-	-	HD	25-25
		YAW PLSD/DIR	GH1630X	-	-	HD	25-25
		AUTO ON	GH1214X	-	-	M	
		APS ARM	GH1230X	-	-	M	
I		ENG FIRE OVRD	GH1286X	-	-	HD	25-28
		MAN THRUST CMD	GH1311V	METER	SEPARATE	M	25-30,25-31
		PITCH GDA POS	GH1313V	-	-	M	25-27
		ROLL GDA POS	GH1314V	-	-	M	25-27
I		P TRM FAIL	GL9003U	C&W	COMMON	HD	25-27
		R TRM FAIL	GL9004U	C&W	COMMON	HD	25-27
		AUTO THRUST CMD	GH1331V	METER	SEPARATE	HD	25-31
		DPS ARM	GH1348X	-	-	M	
		VAR INJ ACT POS	GQ6806H	-	-	M	25-30
		CES AC PWR FAIL	GL4026X	C&W	COMMON	M	25-29
		CES DC PWR FAIL	GL4027X	C&W	COMMON	M	25-27
		AGS DOWNLINK DATA	GI0001X	-	-	M	25-29
		ASA TEMP	GI3301T	-	-	HD	25-29
I		ASA PWR/AEA FAIL	GL4028X	C&W	COMMON	M	25-29

26 LM DPS

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MISSION RULES

REV	ITEM	
		GENERAL
A	26-1	DOCKED IN ORDER TO INITIATE AND CONTINUE THE DOCKED PHASE, THE DPS SUBSYSTEM MUST PROVIDE A SAFE BURN CAPABILITY DEFINED AS FOLLOWS: A. NO PROPELLANT LEAKS B. AN OPERATIONAL DPS DEFINED AS FOLLOWS: 1. FUEL AND OXID ENGINE INLET PRESSURE >100 PSI AT BURN INITIATION AND >120 PSI DURING BURN (THROTTLE SETTING LESS THAN 65 PERCENT) OR >150 PSI (THROTTLE SETTING OF MORE THAN 65 PERCENT.) 2. DPS PROPELLANT TEMPS >50°F AND < PROPELLANT TEMP DEFINED BY PRESSURE - TEMPERATURE CURVE, FIGURE 26-2 TBA, (ONLY TO INITIATE A BURN). 3. ΔT BETWEEN OXID AND FUEL TEMP LESS THAN 25°F (ONLY TO INITIATE A BURN). 4. ΔP BETWEEN FUEL AND OXIDIZER ENGINE INLET PRESSURE LESS THAN 12 PSID WITH OXIDIZER READING HIGH ΔP BETWEEN FUEL AND OXIDIZER ENGINE INLET PRESSURE LESS THAN 25 PSID WITH FUEL READING HIGH.
	26-2	EVA IN ORDER TO INITIATE AND CONTINUE THE EVA PHASE, THE DPS SUBSYSTEM MUST MEET THE FOLLOWING CONDITIONS: A. NO DPS PROPELLANT LEAKS B. NO IMPENDING PROPELLANT VENTING (P <258 PSIA)
	26-3	UNDOCK IN ORDER TO INITIATE AND CONTINUE THE UNDOCKED PHASE, THE DPS SUBSYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CONDITION: NO DPS PROPELLANT LEAK
	26-4	RENDEZVOUS IN ORDER TO INITIATE AND CONTINUE THE RENDEZVOUS PHASE, THE DPS SUBSYSTEM MUST PROVIDE A SAFE BURN CAPABILITY AND 245 FPS ΔV CAPABILITY AND NO DPS PROPELLANT LEAKS.
		RULE NUMBERS 26-5 THROUGH 26-10 ARE RESERVED.

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MISSION RULES

REV	ITEM	MANAGEMENT
	26-11	THE LOW THROTTLE POINT IS THE MINIMUM THROTTLE POSITION THAT THE THROTTLE ACTUATOR WILL ASSUME WITH MINIMUM MANUAL THROTTLE COMMAND VOLTAGE (11.5 PERCENT FOR LM-3).
A	26-12	DPS USABLE PROPELLANT IS 17,430.4 LBS. TOTAL LOADED 18,039.9 LBS TRAPPED 367.5 LBS TM ERROR 242.0 LBS USABLE 17,430.4 LBS
A	26-13	ALL DESCENT ENGINE STARTS MUST NOMINALLY BE PRECEDED BY A PROPELLANT SETTLING MANEUVER USING TWO SYSTEM B JETS OR TWO SYSTEM A JETS IN CASE OF A CONTINGENCY.
	26-14	THE TOTAL ACCUMULATED BURN TIME OF THE DESCENT ENGINE SHALL NOT EXCEED 910 SECONDS OF OPERATION INDEPENDENT OF THRUST LEVEL.
A	26-15	THE DPS WILL NOT NORMALLY BE OPERATED FOR LESS THAN 3.5 SEC OF BURN AT THE LOW THROTTLE POINT. ONLY TWO CONSECUTIVE 3.5 SEC BURNS MAY BE PERFORMED WITH A MINIMUM COAST TIME OF 10 MINUTES.
	26-16	ALL DPS STARTS MUST BE NOMINALLY PLANNED AT THE LOW THROTTLE POINT. IN NO CASE, SHOULD THE DPS BE STARTED ABOVE THE 60 PERCENT THROTTLE POINT.
	26-17	THE DPS ENGINE MUST NOT BE OPERATED IN THE NON-THROTTLING RANGE (65 PERCENT TO FTP) FOR MORE THAN 100 SEC.
	26-18	SUPERCRITICAL HELIUM BURST DISC RUPTURE DURING MANNED OPERATION WILL NOT DAMAGE SPACECRAFT, ENDANGER CREW, OR EFFECT ATTITUDE CONTROL AND IS THEREFORE AN ALLOWABLE EVENT.

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MISSION RULES

REV	ITEM
A	26-19

DPS ENGINE RESTART CAN BE MADE WITH THE FOLLOWING CONSTRAINTS:

INITIAL BURN	REQUIRED COAST TIME	MAXIMUM RESTART BURN TIME
A. UP TO 190 SECS	10 MINUTES	400 SECS
B. 190 SECS TO 600 SECS	REFERENCE (SEE FIGURE BELOW)	100 SECS
C. GREATER THAN 600 SECS	NO RESTART	---

THESE CONSTRAINTS ARE BASED ON ENGINE THRUST CHAMBER HEATING AND SOAK BACK LIMITS. TERMINATE THE BURN IF THE MAXIMUM RESTART BURN TIME IS EXCEEDED.

THERE SHALL BE NO MORE THAN 5 RESTARTS AFTER THE INITIAL BURN.

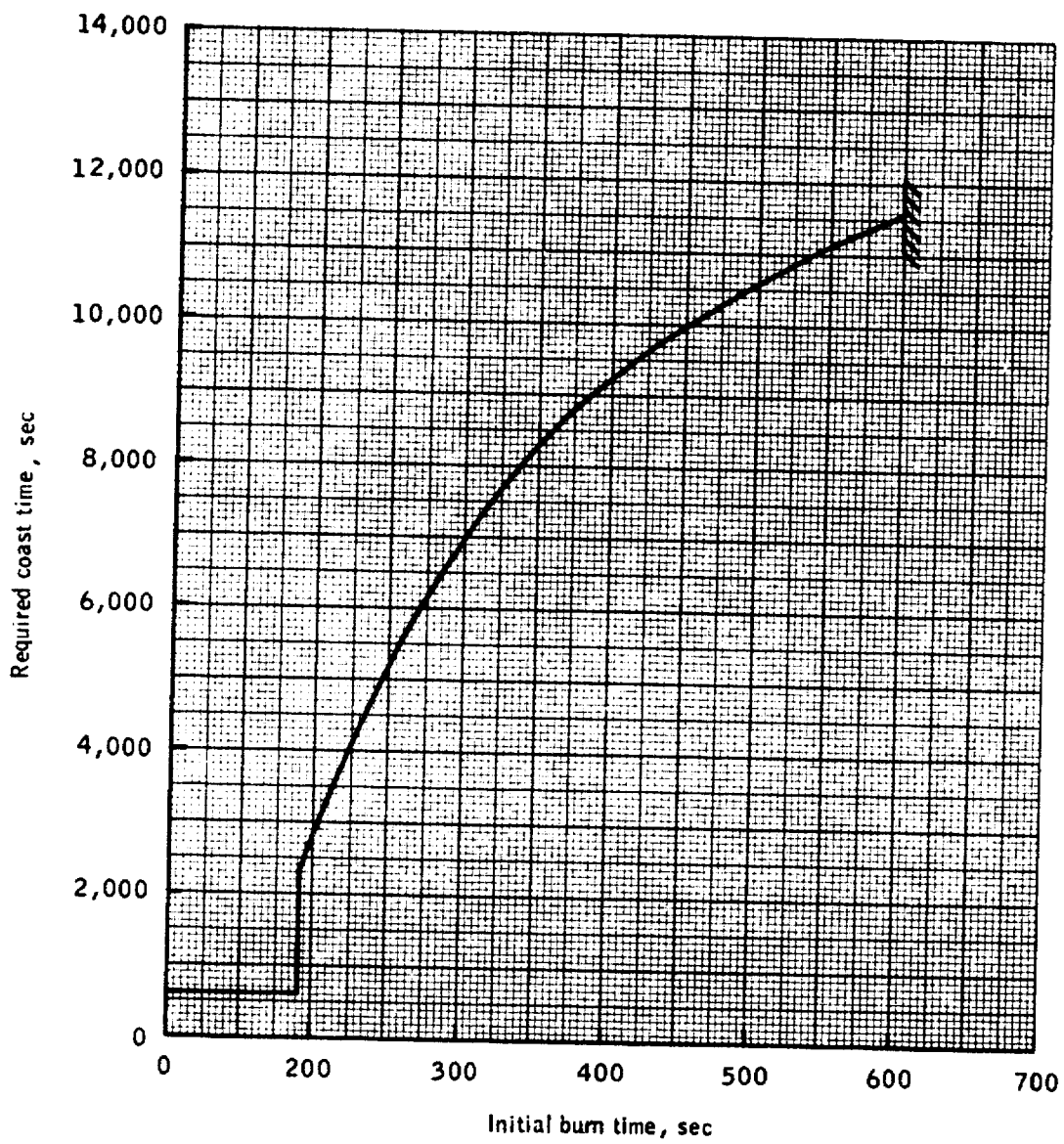

Figure 26-1.- LMDE required coast time vs initial burn time for engine chamber heating limitations.

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MISSION RULES

REV	ITEM	
	26-20	ONLY PREMISSION APPROVED ALTERNATE DPS/MULTI BURN PROFILES WILL BE EXECUTED SINCE NO DATA EXISTS TO ALLOW REAL TIME SUPPORT FOR EXAMINING DPS FREEZING, CHARING, BACKWALL TEMPERATURE CONSTRAINTS FOR MULTI BURN PROFILES.
	26-21	PROPELLANT GAGING A. PRIME METHOD: PQGS (TM ONBOARD) 1.3% B. BACKUP METHOD: GROUND MASS CALCULATION 5.0%

RULE NUMBERS 26-22 THROUGH 26-29 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC - DPS MISSION RULES	
A	26-30	LOSS OF OPERATIONAL DPS	DOCKED	A. INHIBIT DPS BURN 1. STOP BURN, IF IN PROGRESS 2. REF ALT MISSION E-5C	
			UNDOCKED/ RNDZ	B.1. PRIOR TO PHASING: (A) STAGE AT PHASING (B) REF ALT MISSION E-1 2. AFTER PHASING: (A) CONTINUE MISSION (B) STAGE AT INSERTION	B.2 AN OPERATIONAL APS AND RCS IS REQUIRED
A	26-31	START TANK LEAK PRIOR TO PRESS A. FU AND OXID ENGINE INLET PRESS > 100 PSI AT IGNITION. B. FU AND/OR OXID ENGINE INLET < 100 PSI	DOCKED	A. CONTINUE MISSION INHIBIT FIRING DPS START TANK SQUIB B. CONTINUE MISSION FIRE SQUIB TO START TANK	REF MAL PROC DPS, 3 AND 4 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION NOTE: PRESSURIZATION SYSTEM WILL BE OPENED TO START TANK LEAK. SUBSEQUENT DPS BURN CAPABILITY WILL DEPEND UPON LENGTH OF DPS 1 BURN AND RESULTING ULLAGE VOLUME/BLOWDOWN CAPABILITY.
A	26-32	DPS FAILS TO PRESSURIZE A. START TANK 1. INLET PRESS <100 PSI 2. INLET PRESS >100 PSI B. SUPERCRITICAL HELIUM	DOCKED	A.1. INHIBIT ALL DPS BURNS REF ALT MISSION E5c AND APS UNMANNED BURN 2. CONTINUE MISSION B. CUTOFF BURN ON INLET PRESS REF ALT MISSION E AND APS UNMANNED BURN	REF MR 26-1 REF MAL PROC DPS 3 AND 4 OFF-NOMINAL HELIUM PRESSURE OR PROPELLANT TEMP OR PRESSURE INDICATION REF MR 26-1 REF MAL PROC DPS 3 AND 4 OFF-NOMINAL HELIUM PRESSURE OR PROPELLANT TEMP OR PRESSURE INDICATION
A	26-33	OFF NOMINAL SUPERCRITICAL HELIUM PRESS <350 PSI	DOCKED	CONTINUE MISSION REMAIN AT 40 PERCENT THRUST UNTIL SHE PRESS >350 PSIA	REF MAL PROC DPS 3 AND 4 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	26-34	DELETED			
A	26-35	DPS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES	DOCKED	A. INHIBIT DPS BURN 1. STOP BURN IF BURNING 2. STAGE ASAP 3. REF ALT MISSION E5c PLUS UNMANNED APS	REF MAL PROC DPS 1, 3 AND 4 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION AND DES REG WARNING LIGHT ILLUMINATED.
			UNDOCKED	B. STAGE ASAP REF ALT MISSION E5c PLUS UNMANNED APS.	
			RNDZ	C.1. PRIOR TO INSERTION: (A) STOP BURN IF BURNING (B) STAGE ASAP (C) RETURN TO CSM ASAP	
				2. DURING INSERTION: (A) STOP BURN (B) STAGE ASAP (C) COMPLETE MANEUVER WITH LM RCS	C.2.(C) REF MR 2-17 (C.10)
				3. AFTER INSERTION: (A) STAGE ASAP (B) CONTINUE MISSION	
		RULE NUMBERS 26-36 THROUGH 26-39 ARE RESERVED.			

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 9	A	2/15/69	LM DPS	SPECIFIC	26-6

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MISSION RULES

REV	ITEM
	26-40

DPS - PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY	MISSION RULE REFERENCE
START TNK PRESS	GQ3015P	HE MON	COMMON	M	26-31,32
HE REG PRESS	GQ3018P	C & W	COMMON	HD } 1 OF 2	26-34,30
HE REG PRESS	GQ3025P			HD } M-PCM	26-34,30
HE PRESS	GQ3435P			HD } 1 OF 2	26-33
HE PRESS	GQ3436P	PRESS		HD } M	
FU TNK 1 QTY	GQ3603Q	QTY	COMMON	HD } 1 OF 2	
FU TNK 2 QTY	GQ3604Q	QTY	COMMON	HD } M	
OX TNK 1 QTY	GQ4103Q	QTY	COMMON	HD } 1 OF 2	
OX TNK 2 QTY	GQ4104Q	QTY	COMMON	HD } M	
FU 1 TEMP	GQ3718T	TEMP MON	COMMON	HD } 1 OF 2	26-30
FU 2 TEMP	GQ3719T	TEMP MON	COMMON	HD } M	26-30
OX 1 TEMP	GQ4218T	TEMP MON	COMMON	HD } 1 OF 2	26-30
OX 2 TEMP	GQ4219T	TEMP MON	COMMON	HD } M	26-30
FU PRESS	GQ3611P			M	26-30,35
OX PRESS	GQ4111P			M	26-30,35
TCP	GQ6510P	THRUST	COMMON	M-PCM	26-30

27 LM APS

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MISSION RULES

REV	ITEM	
	27-1	DOCKED, EVA, UNDOCKING, SEPARATION, PHASING NO APS PROPELLANT LEAKS
A	27-2	INSERTION IN ORDER TO INITIATE THE INSERTION MANEUVER AND CONTINUE THE RENDEZVOUS PHASE OF THE MISSION, THE APS SUBSYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITY: NO PROPELLANT LEAKS
A	27-3	AN OPERATIONAL APS, IS DEFINED AS FOLLOWS:

MANNED	START BURN	CONTINUE BURN
1. APS BULK TEMP	>50°F <90°F	N/A
2. OX-FUEL ΔT	<60°F	N/A
3. INLET PRESS	>120<203 PSI	>115<203 PSI, NO PRESS OSCILLATIONS
4. INLET PRESS ΔP	<27 PSID	<10 PSID
5. TCP	N/A	>80<150 PSI, NO PRESS OSCILLATIONS
6. PROPELLANT LEAK	NONE	NONE
UNMANNED		
1. APS BULK TEMP	N/A	N/A
2. OXID-FUEL ΔT	N/A	N/A
3. INLET PRESS	<203 PSI	<203 PSI, NO PRESS OSCILLATIONS
4. INLET PRESS ΔP	<90 PSID	<27 PSID
5. TCP	N/A	<150, NO PRESS OSCILLATIONS
6. PROPELLANT LEAK	NONE	NONE

RULE NUMBERS 27-4 THROUGH 27-9 ARE RESERVED.

REV	ITEM	
		MANAGEMENT
A	27-10	APS MANNED ENGINE STARTS MUST BE PRECEDED BY A PROPELLANT SETTLING MANEUVER USING 4 JET OR 2 JET ULLAGE, SYSTEM A OR B.
	27-11	APS PROPULSION SYSTEM CANNOT REMAIN ACTIVATED (COMPATABILITY SQUIB VALVES FIRED) LONGER THAN 24 HOURS BEFORE ITS USAGE IS COMPLETED NOMINALLY. IN CASE OF A CONTINGENCY, THE TIME CAN BE EXTENDED TO 3 1/2 DAYS.
A	27-12	THE USABLE PROPELLANT FOR APS IS 4103.5 LBS. TOTAL LOADED 4150.1 LBS UNUSABLE 46.6 LBS USABLE 4103.5 LBS
A	27-13	THE MINIMUM IMPULSE OF THE APS ENGINE IS 1200 LBS/SEC, WHICH CORRESPONDS TO A BURN TIME OF 0.5 SEC. A MINIMUM COAST TIME OF 5 MINUTES IS REQUIRED BETWEEN MINIMUM IMPULSE FIRING AND SUBSEQUENT RESTART.
	27-14	ONLY PREMISSION APPROVED APS MULTI BURN PROFILES WILL BE EXECUTED SINCE NO DATA EXISTS TO ALLOW REAL-TIME SUPPORT FOR EXAMINING APS FREEZING, CHARRING, BACKWALL TEMPERATURE CONSTRAINTS FOR MULTI BURN PROFILES.
	27-15	PROPELLANT GAGING (NO ONBOARD READOUT) A. PRIME METHOD: FLOW RATE X TIME (5%) B. BACKUP METHOD: GROUND MASS CALCULATION (5%)
		RULE NUMBERS 27-16 THROUGH 27-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
			SPECIFIC - APS MISSION RULES		
A	27-20	LOSS OF AN OPERATIONAL APS	RNDZ	A.1. STOP BURN IF POSSIBLE 2. INHIBIT FURTHER APS BURNS 3. PERFORM CDH WITH RCS UNMANNED B.1. STOP BURN IF IN PROGRESS 2. INHIBIT FURTHER APS BURNS	• REF MR 27-3 • REF MAL PROC APS 2 ASC HI REG APS 5 OFF-NOMINAL PROPELLANT TEMP OR PRESS INDICATION
A	27-21	APS HE SOURCE TEMP A. ≥120°F (P 3400 PSI) B. ≥140°F (P 3500 PSI) C. ≤ -130°F	ALL ALL RNDZ	A. CONTINUE MISSION POSITION S/C TO REDUCE HEATING B. CONTINUE MISSION PRESSURIZE APS FROM EFFECTED TANK(S) C. CONTINUE MISSION 1. CLOSE He REG SHUTOFF VALVES 2. PERFORM APS BURNS IN BLOWDOWN MODE	REF MAL PROC APS 4 AND 5 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION.
A	27-22	APS He SOURCE PRESSURE A. LEAK PRIOR TO PRESSURIZATION B. SOURCE PRESSURE LESS THAN ENGINE INLET PRESSURE	ALL ALL RNDZ	A. CONTINUE MISSION INHIBIT USE OF EFFECTED TANK B.1. CONTINUE MISSION CLOSE He REG SHUTOFF VALVES 2. CONTINUE MISSION (A) CLOSE He REG SHUTOFF VALVES (B) OPERATE IN BLOWDOWN MODE	REF MAL PROC APS 4 AND 5 OFF-NOMINAL HELIUM PRESSURE OR PROPELLANT TEMP OR PRESSURE INDICATION.
A	27-23	APS He LEAK BETWEEN QUAD CHECK VALVES AND He SHUTOFF VALVES	ALL	CONTINUE MISSION A. CLOSE He REG SHUTOFF VALVES B. OPEN He REG SHUTOFF VALVES PRIOR TO EACH BURN	REF MAL PROC APS 1 ASC PRESS WARNING LIGHT ILLUMINATED

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	27-24	APS HELIUM/PROPELLANT VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES	DOCKED	A. INHIBIT DPS BURN 1. STOP BURN IF BURNING 2. CREW EVACUATE LM ASAP 3. UNDOCK FROM LM 4. CSM SEPARATE TO SAFE DISTANCE	REF MAL PROC APS 3, 4, AND 5 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION, AND ASC QTY CAUTION LIGHT ILLUMINATED.
			UNDOCKED/ RNDZ	B. INHIBIT ALL BURNS 1. STOP BURN IF BURNING 2. DO NOT STAGE 3. RETURN TO CSM ASAP USING LM RCS IF POSSIBLE, IF NOT, CSM RESCUE	
			UNMANNED	C. INHIBIT APS BURN 1. STOP BURN IF BURNING	
	27-25	APS PROP VALVE MISMATCH (Δ POS)	RNDZ	A.1. CONTINUE BURN IN PROGRESS INHIBIT FURTHER MANNED APS BURNS	THIS INDICATION PRIOR TO FIRST APS ENGINE ON WILL BE CONSIDERED A TN FAILURE.
			UNMANNED	2. CONTINUE MISSION	
		RULE NUMBERS 27-26 THROUGH 27-29 ARE RESERVED.			

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 9	A	2/15/69	LM APS	SPECIFIC	27-3A

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MISSION RULES

REV	ITEM
A	27-30

APS - PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY	MISSION RULE REFERENCE
APS HE 1 PRESS	GP0001P	HEL MON C&W	COMMON	M - PCM	27-21,22,20
APS HE 2 PRESS	GP0002P	HEL MON C&W	COMMON	M - PCM	27-21,22,20
APS HE REG PRESS	GP0018P			HD } 1 OF 2	27-20,23
APS HE REG PRESS	GP0025P	C&W	COMMON	HD } M - PCM	27-20,23
APS HE 1 TEMP	GP0201T	HEL MON	COMMON	M - PCM	27-21,22
APS HE 2 TEMP	GP0202T	HEL MON	COMMON	M - PCM	27-21,22
APS FUEL TEMP	GP0718T	TEMP	COMMON	M - PCM	27-20
APS FUEL LOW	GP0908X	C&W	COMMON	HD	
APS OXID TEMP	GP1218T	TEMP	COMMON	M - PCM	27-20
APS OXID LOW	GP1408X	C&W	COMMON	HD	
APS FUEL PRESS	GP1501P	C&W	COMMON	M - PCM	27-20,24
APS OXID PRESS	GP1503P	C&W	COMMON	M - PCM	27-20,24
VLVS A ΔPOS	GP2997U			HD	27-25
VLVS B ΔPOS	GP2998U			HD	27-25
APS TCP	GP2010P			M	27-20

28 LM REACTION
CONTROL SYSTEM

REV	ITEM	GENERAL
	28-1	DOCKED IN ORDER TO INITIATE AND CONTINUE THE DOCKED PHASE OF THE MISSION, THE RCS SUBSYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES: A. RCS ULLAGE CAPABILITY B. 3-AXIS ATTITUDE CONTROL CAPABILITY C. NO PROPELLANT LEAKS
A	28-2	A. UNDOCKED/SEPARATION/PHASING/INSERTION IN ORDER TO INITIATE AND CONTINUE THE UNDOCKED MISSION PHASE, 3-AXIS TRANSLATION CONTROL AND REDUNDANT 3-AXIS RCS ATTITUDE CONTROL CAPABILITY IS REQUIRED. TO ASSURE THAT NO SINGLE FAILURE CAN DISABLE ATTITUDE CONTROL, THE FOLLOWING MINIMUM CAPABILITIES ARE REQUIRED: 1. REDUNDANT CAPABILITY TO SUPPLY PROPELLANT FOR MAINTAINING RCS 3-AXIS ATTITUDE CONTROL VIA ONE OF THE FOLLOWING: (A) OPERATIONAL SYSTEM A & B (B) OPERATIONAL SYSTEM A OR B, PLUS CROSSFEED CAPABILITY AND ASC FEED CAPABILITY. 2. NO THRUSTER PAIRS ISOLATED OR ANY SINGLE VERTICAL JET FAILED. 3. NO PROPELLANT LEAKS B. SEPARATION/PHASING IN ORDER TO INITIATE AND CONTINUE THIS MISSION PHASE, 3-AXIS TRANSLATION CONTROL AND REDUNDANT 3-AXIS RCS ATTITUDE CONTROL CAPABILITY IS REQUIRED. TO ASSURE THAT NO SINGLE FAILURE CAN DISABLE ATTITUDE CONTROL, THE FOLLOWING MINIMUM CAPABILITIES ARE REQUIRED: 1. RCS SYSTEM A & B OPERATIONAL 2. NO THRUSTER PAIRS ISOLATED OR ANY SINGLE VERTICAL JET FAILED. 3. NO LEAKS C. INSERTION IN ORDER TO INITIATE AND CONTINUE THE INSERTION, +X-AXIS TRANSLATION CONTROL AND REDUNDANT 3-AXIS RCS ATTITUDE CONTROL IS REQUIRED. THE FOLLOWING MINIMUM CAPABILITIES ARE REQUIRED: 1. SAME AS SEPARATION/PHASING D. STAGING IN ORDER TO INITIATE STAGING, THE FOLLOWING MINIMUM CAPABILITIES ARE REQUIRED: 1. 3-AXIS RCS ATTITUDE CONTROL 2. +X-AXIS RCS TRANSLATION
	28-3	EVA RCS NOMINALLY NOT REQUIRED NO RCS PROPELLANT LEAKS

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MISSION RULES

REV	ITEM	
	28-4	UNMANNED IN ORDER TO INITIATE AND CONTINUE THE UNMANNED PHASE OF THE MISSION, THE RCS SUBSYSTEM MUST PROVIDE THE MINIMUM CAPABILITY OF 3-AXIS ATTITUDE CONTROL.
		RULE NUMBERS 28-5 THROUGH 28-8 ARE RESERVED.

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MISSION RULES

REV	ITEM	MANAGEMENT
A	28-9	AN OPERATIONAL RCS SYSTEM IS DEFINED AS: A. PROPELLANT MANIFOLD PRESSURE >100 PSI OR ΔP BETWEEN OX AND FU <80 PSI B. FUEL TEMP >40 AND <100°F C. CAPABILITY TO EXPEL REQUIRED RCS PROPELLANTS FROM TANKS TO SUPPORT PLANNED GO/NO-GO'S
A	28-10	THRUSTER TEMP THE RCS QUAD TEMPERATURE MUST BE BROUGHT UP TO OPERATING TEMPERATURE (>119°F) AND HAVE BEEN AT THIS TEMPERATURE FOR 25 MINUTES PRIOR TO FIRING THE RCS ENGINES. THE MAXIMUM RCS QUAD TEMPERATURE SHOULD BE MAINTAINED AT LESS THAN 190°F EXCEPT DURING PERIODS OF HEAVY DUTY CYCLE WITH EXPECTED TEMPERATURE RISES SUCH AS DURING THE RENDEZVOUS BRAKING AND DOCKING MANEUVERS.
A	28-11	USABLE RCS PROPELLANT IS 546.6 LBS TOTAL LOADED 633.0 LBS TRAPPED 42.1 LBS TM ERROR 44.3 LBS USABLE 546.6 LBS
	28-12	DO NOT NOMINALLY OPEN CROSSFEED DURING MANNED OPERATIONS.
	28-13	ASCENT FEED OPERATION IN UNMANNED COASTING FLIGHT IS PERMISSIBLE IN ORDER TO SUPPORT THE UNMANNED APS DEPLETION BURN.
	28-14	IF THE LM IS REQUIRED TO PROVIDE ATTITUDE CONTROL DURING THE EVA PHASE, THE LM WILL HAVE THE FOLLOWING RCS THRUSTER AND CONTROL MODE CONFIGURATION: A. SYSTEM "A" QUAD 1 THRUSTER PAIR CLOSED B. SYSTEM "B" QUAD 4 THRUSTER PAIR CLOSED C. ALL OTHER QUAD THRUSTER PAIRS OPEN D. AGS IN CONTROL, ATT HOLD, MAX DEADBAND.
A	28-15	PROPELLANT GAGING A. PRIME METHOD: RCS GROUND PROGRAM (7.0%) B. BACKUP METHOD: PQMD TM (10%) ONBOARD (13%)

REV	ITEM	
A	28-16	RCS PLUME IMPINGEMENT ON THE LM MAXIMUM ALLOWABLE CONTINUOUS FIRING OF RCS JETS: A. LM, +X (DOWN FIRING ENGINE): 15 SEC UNSTAGED. EXCEEDING +X IMPINGEMENT TIME COULD RESULT IN PROPELLANT LINE FREEZING AND LARGE TEMPERATURE DIFFERENCES BETWEEN PROPELLANT TANK DUE TO DAMAGE TO ASCENT AND DESCENT STAGE THERMAL INSULATION. B. LM, +X (DOWN FIRING ENGINE): 120 SEC STAGED. C. LM, -X (UP FIRING ENGINE) 30 SEC (-X THRUSTERS OF QUAD 1, 3, AND 4): EXCEEDING -X IMPINGEMENT TIME COULD RESULT IN DAMAGE TO S-BAND AND/OR RR ANTENNA BECAUSE OF OVERHEATING OR OVER PRESSURE DUE TO PLUME.
		RULE NUMBERS 28-17 THROUGH 28-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	28-20	LOSS OF OPERATIONAL RCS SYSTEM A OR B	ALL	A.1. ISOLATE EFFECTED SYSTEM 2. UTILIZE GOOD SYSTEM 3. CROSSFEED IF POSSIBLE	
			DOCKED/ UNDOCKED	B. CONTINUE MISSION REF ALT MISSION B	
			RNDZ	C. RETURN TO CSM ASAP REF ALT MISSION D	
			UNMANNED	D. CONTINUE MISSION	
A	28-21	RCS THRUSTER PAIR			REF MALF PROC RCS 1
		A. ONE PAIR ISOLATED	DOCKED	A.1. DO NOT UNDOCK REF ALT MISSION D PLUS EVA	RCS TCA WARNING LIGHT
			UNDOCKED/ RNDZ	2. RETURN TO CSM ASAP REF ALT MISSION D	
			UNMANNED	3. CONTINUE MISSION	
		B. COMBINATION ISOLATED RESULTING IN LOSS OF ATTITUDE CONTROL	DOCKED	B.1. INHIBIT DOCKED BURN. DO NOT UNDOCK	
			UNDOCK	2. CSM ACTIVE DOCK ASAP	
			RNDZ	3. CSM RESCUE	
			UNMANNED	4. DO NOT PERFORM APS DEPLETION	
A	28-22	DELETED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	28-23	DELETED			
A	28-24	RCS PROPELLANT LEAK DOWN-STREAM OF MAINS	DOCKED UNDOCK/ RNDZ UNMANNED	A.1. CREW EVACUATE SPACECRAFT (A) UNDOCK (B) CSM SEPARATE FROM LM (C) INHIBIT FURTHER MANNING OF LM 2. RETURN TO CSM ASAP CSM RESCUE REQUIRED 3. INHIBIT UNMANNED APS	REF MALF PROC RCS 6 PQMD OFF NOMINAL
A	28-25	DELETED			
A	28-26	RCS QUAD TEMP <119°F OR >190°F EXCEPT DURING PERIODS OF HEAVY DUTY CYCLE WITH EXPECTED TEMP RISES SUCH AS DOCKING RULE NUMBERS 28-27 THROUGH 28-29 ARE RESERVED.	ALL	ISOLATE BOTH THRUSTER PAIRS IN EFFECTED QUAD	REF MR 28-21 REF MAL PROC RCS 1 RCS TCA WARNING LIGHT • QUAD TEMPS LESS THAN 199°F INDICATE THE POSSIBILITY OF INCOMPLETE COMBUSTION, WHICH COULD CAUSE HARD STARTS AND POSSIBLE EXPLOSIONS DURING MINIMUM IMPULSE FIRINGS. QUAD TEMPS GREATER THAN 190°F INDICATES PREMATURE OXID VAPORIZATION AND ALSO POSSIBILITY OF VALVE SEAT DAMAGE.

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MISSION RULES

REV	ITEM
	28-30

PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY	MISSION RULE REFERENCE
RCS "A" PROP QTY	GR1085Q	QUANTITY	COMMON	M	28-23
RCS "B" PROP QTY	GR1095Q	QUANTITY	COMMON	M	28-23
RCS "A" REG PRESS	GR1201P	PRESS MON C&W	COMMON	M-PCM	28-20,22
RCS "B" REG PRESS	GR1202P	PRESS MON C&W	COMMON	M-PCM	28-20,22
RCS "A" HE PRESS	GR1101P	PRESS MON C&W	COMMON	M-PCM	28-23,25
RCS "B" HE PRESS	GR1102P	PRESS MON C&W	COMMON	M-PCM	28-23,25
RCS "A" FUEL TEMP	GR2121T	TEMP MON	COMMON	M-PCM	28-20
RCS "B" FUEL TEMP	GR2122T	TEMP MON	COMMON	M-PCM	28-20
RCS MAIN "A" CLSD	GR9609U	MAIN SOV	COMMON	HD	
RCS MAIN "B" CLSD	GR9610U	MAIN SOV	COMMON	HD	
RCS "A" FUEL MFLD PRESS	GR2201P	PRESS MON	COMMON	M	28-20,24,25
RCS "B" FUEL MFLD PRESS	GR2202P	PRESS MON	COMMON	M	28-20,24,25
RCS "A" OX MFLD PRESS	GR3201P	PRESS MON	COMMON	M	28-20,24,25
RCS "B" OX MFLD PRESS	GR3202P	PRESS MON	COMMON	M	28-20,24,25
A/B XFEED OPEN	GR9613U	CRSFD	COMMON	HD	
QUAD 1 "A" TCA ISOL VLV	GR9667U	SYS A QUAD 1	COMMON	HD	28-21
QUAD 2 "A" TCA ISOL VLV	GR9665U	SYS A QUAD 2	COMMON	HD	28-21
QUAD 3 "A" TCA ISOL VLV	GR9663U	SYS A QUAD 3	COMMON	HD	28-21
QUAD 4 "A" TCA ISOL VLV	GR9661U	SYS A QUAD 4	COMMON	HD	28-21
QUAD 1 "B" TCA ISOL VLV	GR9668U	SYS B QUAD 1	COMMON	HD	28-21
QUAD 2 "B" TCA ISOL VLV	GR9666U	SYS B QUAD 2	COMMON	HD	28-21
QUAD 3 "B" TCA ISOL VLV	GR9664U	SYS B QUAD 3	COMMON	HD	28-21
QUAD 4 "B" TCA ISOL VLV	GR9662U	SYS B QUAD 4	COMMON	HD	28-21
QUAD 1 TEMP	GR6004T	TEMP MON C&W	COMMON	M	28-26
QUAD 2 TEMP	GR6003T	TEMP MON C&W	COMMON	M	28-26
QUAD 3 TEMP	GR6002T	TEMP MON C&W	COMMON	M	28-26
QUAD 4 TEMP	GR6001T	TEMP MON C&W	COMMON	M	28-26
ASC FEED OXID "A" OPEN	GR9641U	SYS A ASC OXID ASC FUEL	COMMON	HD	
ASC FEED FUEL "A" OPEN	GR9631U	SYS A ASC OXID ASC FUEL	COMMON	HD	
ASC FEED FUEL "B" OPEN	GR9632U	SYS B ASC OXID ASC FUEL	COMMON	HD	
ASC FEED OXID "B" OPEN	GR9642U	SYS B ASC OXID ASC FUEL	COMMON	HD	

29 SPACE
ENVIRONMENT

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MISSION RULES

REV	ITEM	
		GENERAL
	29-1	ALL DECISIONS WILL BE BASED ON CONFIRMED MEASUREMENTS AND/OR EVENTS AND PROJECTIONS BASED ON CONFIRMED EVENTS.
	29-2	DEFINITIONS: A. THE MAXIMUM OPERATIONAL DOSE (MOD) IS THE MAXIMUM RADIATION DOSE TO WHICH THE CREW WOULD BE SUBJECTED BASED ON A SKIN DOSE OF 400 RAD AND/OR A DEPTH (GASTRO INTESTINAL) DOSE OF 50 RAD. B. THE PLANNING OPERATIONAL DOSE (POD) IS THE MAXIMUM RADIATION DOSE TO THE CREW WHICH ANY MISSION WOULD BE DESIGNED DURING THE PLANNING PERIOD BASED ON A SKIN DOSE OF 250 RAD AND/OR A DEPTH DOSE OF 25 RAD. C. RADIATION DOSES DETERMINE THE POINT WHERE A DECISION MUST BE MADE AS TO WHETHER TO CONTINUE OR TERMINATE THE MISSION. D. THE RADIATION ABSORBED DOSE (RAD) IS A UNIT OF ABSORBED DOSE WHICH IS EQUAL TO AN ENERGY DEPOSITION OF 100 ERGS/GRAM. E. THE RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) EXPRESSES THE EFFECTIVENESS OF PARTICULAR TYPES OF RADIATION IN PRODUCING THE SAME BIOLOGICAL RESPONSE.
		MANAGEMENT
	29-3	THE EXISTING AND PROJECTED ENVIRONMENT WILL BE A PART OF THE GO/NO-GO DECISION PROCESS.
	29-4	DUE TO THE SHIELDING CAPABILITY OF THE VAN ALLEN BELTS, THERE ARE NO RADIATION HAZARDS TO THE APOLLO 9 MISSION FROM SOLAR FLARE PARTICLE EVENTS.
	29-5	PRIORITY OF DATA FOR ARTIFICAL RADIATION A. PRELAUNCH 1. RIOMETERS 2. SOUTH ATLANTIC ANOMALY PROBE (SAAP) B. EARTH ORBIT 1. PERSONAL RADIATION DOSIMETER (PRD) AND RATE SURVEY METER (RSM) 2. RIOMETERS 3. SOUTH ATLANTIC ANOMALY PROBE
		RULE NUMBERS 29-6 THROUGH 29-9 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	29-10	ANY SOURCE REPORTS A POSSIBLE ARTIFICAL EVENT	ALL	PROCEED UNTIL VERIFICATION FROM ALL OTHER SOURCES	
	29-11	DEFINITE ARTIFICAL EVENT CONFIRMED AND NO DIRECT S/C MEASUREMENTS ARE AVAILABLE	PRELAUNCH	A.1. HOLD UNTIL DIRECT MEASUREMENT OF SOUTH ATLANTIC ANOMALY HAS BEEN MADE AND ANALYZED 2. SCRUB IF ANALYSIS CONFIRMS THAT THE MOD WILL BE EXCEEDED DURING THE MISSION.	
			EARTH ORBIT	B.1. RETURN TO CSM IF LM IS MANNED 2. CONTINUE MISSION LOWER ORBIT TO THE MINIMUM ALTITUDE THAT CAN BE SUSTAINED.	B.1. CREW SHOULD BEGIN PERSONAL DOSIMETER READOUTS PER SOP 1-9.
	29-12	RADIATION CONFIRMED BY PRD READOUTS OR ONBOARD TM AND PROJECTED TO EXCEED THE MOD.	EARTH ORBIT	REENTER NEXT BEST PTP	
	29-13	MAJOR SOLAR FLARE PREDICTED	ALL	CONTINUE MISSION	
	29-14	MAJOR SOLAR FLARE HAS OCCURRED A. UNCONFIRMED PARTICLE EVENT B. CONFIRMED PARTICLE EVENT	ALL	A. CONTINUE MISSION B. CONTINUE MISSION	

FEC/TSC Form 291 (AUG 68)

REV	ITEM
	29-15

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION		PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
RADIATION DOSIMETER 1 (CM DEPTH DOSE RATE)	VABD	CK1051K	-	-	H.D.	29-12
RADIATION DOSIMETER 2 (CM SKIN DOSE RATE)	VABD	CK1052K	-	-	H.D.	29-12
DOSIMETER RATE CHANGE	VABD	CK1053R	-	-	H.D.	29-12
PROTON COUNT RATE CHAN 1	NPDS	ST0820K	-	-	H.D.	29-12
PROTON COUNT RATE CHAN 2	NPDS	ST0821K	-	-	H.D.	29-12
PROTON COUNT RATE CHAN 3	NPDS	ST0822K	-	-	H.D.	29-12
PROTON COUNT RATE CHAN 4	NPDS	ST0823K	-	-	H.D.	29-12
ALPHA COUNT RATE CHAN 1	NPDS	ST0830K	-	-	H.D.	29-12
ALPHA COUNT RATE CHAN 2	NPDS	ST0831K	-	-	H.D.	29-12
ALPHA COUNT RATE CHAN 3	NPDS	ST0832K	-	-	H.D.	29-12
PROTON INTEGR COUNT RATE	NPDS	ST0838K	-	-	H.D.	29-12
TEMP NUCLEAR PARTICLE DETECTOR	NPDS	ST0840T	-	-	H.D.	29-12
TEMP NUCLEAR PARTICLE ANALYSIS	NPDS	ST0841T	-	-	H.D.	29-12
PERSONAL RADIATION DOSIMETER (PRD)		-	3 - ONBOARD	-	MANDATORY TO BE ONBOARD	29-12
RATE SURVEY METER (RSM)		-	1 - ONBOARD	-	MANDATORY TO BE ONBOARD	29-12

30 RECOVERY

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MISSION RULES

REV	ITEM	
A	30-1	A PREFERRED TARGET POINT (PTP) PROVIDING A WATER LANDING WILL BE CHOSEN FOR EACH REVOLUTION. AN ALTERNATE TARGET POINT (ATP) PROVIDING A WATER LANDING MAY BE CHOSEN DURING THE MISSION FOR CERTAIN REVOLUTIONS SHOULD THE NEED ARISE.
	30-2	RECOVERY CAPABILITY WILL BE BASED PRIMARILY UPON THE LOCAL RECOVERY UNIT COMMANDER'S EVALUATION OF HIS ABILITY TO PERFORM THE RECOVERY OPERATION. ONE OF THE FACTORS WHICH WILL DETERMINE RECOVERY CAPABILITY IS WEATHER. GUIDELINES USED TO INDICATE WHEN IT MAY BE NECESSARY TO REEVALUATE THIS CAPABILITY ARE: SURFACE WINDS - 25 KNOTS CEILING - 1500 FEET VISIBILITY - 3 N.MI. WAVE HEIGHT - 8 FEET

FEC/TSG Form 292 (AUG 68)

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	30-3	RECOVERY CAPABILITY IN THE LAUNCH SITE AREA AT THE TIME OF LES ARMING	PRELAUNCH	MANDATORY	
	30-4	RECOVERY CAPABILITY IN THE LAUNCH ABORT AREA AT LAUNCH	PRELAUNCH	HIGHLY DESIRABLE	
	30-5	RECOVERY CAPABILITY IN THE WEST ATLANTIC AND MID-PACIFIC RECOVERY ZONES DURING THE FIRST 6 REVOLUTIONS WHEN LANDINGS MAY OCCUR.	PRELAUNCH	HIGHLY DESIRABLE	
	30-6	IT IS REQUIRED THAT 18 HOURS OF CM POSTLANDING POWER (35 AMP HOURS) BE AVAILABLE AT LANDING	ORBIT/ ENTRY	MANDATORY	THIS TIME MAY BE REDUCED ONLY TO PROVIDE FOR A MORE FAVORABLE LANDING POINT.

31 AEROMEDICAL

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MISSION RULES

REV	ITEM	
		GENERAL
	31-1	PRELAUNCH PRIOR TO COMMITTING TO LAUNCH, THE FOLLOWING CONDITIONS MUST BE MET: A. SATISFACTORY FLIGHT CREW PHYSIOLOGICAL STATUS. B. THE MINIMUM CABIN OXYGEN CONCENTRATION FOR LAUNCH IS 60 PERCENT. C. THE MINIMUM SUIT OXYGEN CONCENTRATION FOR LAUNCH IS 95 PERCENT.
	31-2	THE SUIT CIRCUIT MUST BE MAINTAINED AT LEAST 2 IN. WATER PRESSURE ABOVE THE CABIN PRESSURE. SUIT LOOP PURGE IS REQUIRED IF THE SUIT-TO-CABIN DELTA PRESSURE REMAINS AT ZERO FOR A PERIOD OF 5 MINUTES.
	31-3	THE POTABLE WATER PH MUST BE WITHIN 6.0 TO 8.0 AT SERVICING AND FINAL SAMPLING.
	31-4	LAUNCH THERE ARE NO MEDICAL REASONS FOR ABORTING DURING THE LAUNCH PHASE OTHER THAN THOSE CONDITIONS INTOLERABLE TO THE CREW.
	31-5	ORBIT EARLY MISSION TERMINATION FOR MEDICAL REASONS FALL INTO TWO CATEGORIES: A. ONSET OF CONDITIONS WHICH ADVERSELY AFFECT CREW SAFETY, HEALTH, OR FUNCTION AND PERFORMANCE. B. FAILURE OF SPACECRAFT SYSTEMS TO MAINTAIN A PHYSIOLOGICALLY SATISFACTORY ENVIRONMENT.
	31-6	WATER PALATABILITY CREW EVALUATION OF THE DRINKING WATER TASTE WILL BE THE BASIS FOR DETERMINING WATER PALATABILITY, EVEN FOR KOH CONTAMINATION.
		RULE NUMBERS 31-7 THROUGH 31-14 ARE RESERVED

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	31-15	LOSS OR UNREADABLE EKG	LAUNCH	A. CONTINUE MISSION	ARTIFACTS ANTICIPATED DURING LAUNCH.
			EVA	B. CONTINUE MISSION	ARTIFACTS ANTICIPATED AFTER TRANSFER WHILE IN LM.
			ALL	C. CONTINUE MISSION	MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND TERMINATION OF EVA ACTIVITY. MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
	31-16	ABNORMAL HEART RATE, RHYTHM OR EKG	ALL	CONTINUE MISSION	MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
	31-17	ABNORMAL RESPIRATORY RATE	ALL	CONTINUE MISSION	THE ABNORMAL RATES WILL BE EVALUATED BY THE MCC SURGEON AND EARLY MISSION TERMINATION MAY BE RECOMMENDED IF CORRECTIVE ACTION IS NOT EFFECTIVE.
	31-18	ONSET OF SERIOUS MEDICAL PROBLEM	LAUNCH	A. CONTINUE MISSION CREW MAY ELECT TO ABORT IF INTOLERABLE	MCC SURGEON WILL EVALUATE AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IF NOT EFFECTIVE.
			ALL	B. CONTINUE MISSION	

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-19	DYSBARISM IN ANY CREWMAN	LAUNCH	A. CONTINUE MISSION CREW MAY ELECT TO ABORT IF CONDITION IS INTOLERABLE.	• CHECK SUIT INTEGRITY. • IF CONDITIONS PERMIT CREW MAY ELECT TO OVER-PRESSURIZE.
			ALL	B. TERMINATE PHASE ENTER NEXT BEST PTP	• MCC SURGEON WILL EVALUATE AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
	31-20	ORAL TEMP EXCEEDS 101°F DESPITE CORRECTIVE ACTION.			MCC SURGEON MAY RECOMMEND EARLY MISSION TERMINATION IF TREATMENT IS UNSUCCESSFUL.
		A. IF DUE TO ILLNESS	LAUNCH	A.1. NOT APPLICABLE	
			ALL	2. TERMINATE PHASE ENTER NEXT BEST PTP	
		B. IF RESULTANT FROM THERMAL OVERLOAD	LAUNCH	B.1. NOT APPLICABLE	
			ALL	2. TERMINATE PHASE ENTER NEXT BEST PTP	
		RULE NUMBERS 31-21 THROUGH 31-24 ARE RESERVED			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-25	INCREASE IN PCO_2			
		A. $\geq$7.6 MM HG	LAUNCH	A.1. CONTINUE MISSION	A. PCO_2 SHOULD DECREASE BELOW 2 MM HG WITHIN 30 MINUTES.
			ALL	2. CONTINUE MISSION CHANGE LiOH CANISTER	
		B. $\geq$7.6 MM HG AND UNABLE TO DECREASE	LAUNCH	B.1. CONTINUE MISSION	
			ALL	2. CONTINUE MISSION (A) OPEN SUITS AND BREATHE FROM CABIN (B) CHANGE SECOND LiOH CANISTER (C) TEST PCO_2 SENSOR	B.2. LiOH CANISTERS WILL NOT BE CHANGED IN AN UN-PRESSURIZED CABIN.
		C. $\geq$10 MM HG	LAUNCH	C.1. CONTINUE MISSION	
			ALL	2. TERMINATE PHASE ENTER NEXT BEST PTP	
	31-26	PCO_2 INSTRUMENTATION FAILURE	ALL	CONTINUE MISSION	
		RULE NUMBERS 31-27 THROUGH 31-34 ARE RESERVED			

REV | ITEM

INSTRUMENTATION REQUIREMENTS

CSM

ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
31-35	ELECTROCARDIOGRAM	CJ0060J	NOT DISPLAYED		MANDATORY*	31-15/16
	ELECTROCARDIOGRAM	CJ0061J	NOT DISPLAYED		MANDATORY*	31-15/16
	ELECTROCARDIOGRAM	CJ0062J	NOT DISPLAYED		MANDATORY*	31-15/16
	CO_2 PARTIAL PRESSURE	CJ0005P	METER	COMMON	HIGHLY DESIRABLE	31-2/27/23
	SUIT CABIN DELTA PRESS	CF0003P	NOT DISPLAYED		HIGHLY DESIRABLE	31-3/10
	ORAL TEMPERATURE		CLINICAL THERMOMETER		MANDATORY*	31-20
	PNEUMOGRAM	CJ0200R	NOT DISPLAYED		HIGHLY DESIRABLE	31-17
	PNEUMOGRAM	CJ0201R	NOT DISPLAYED		HIGHLY DESIRABLE	31-17
	PNEUMOGRAM	CJ0202R	NOT DISPLAYED		HIGHLY DESIRABLE	31-17

LM

ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
	CO_2 PARTIAL PRESSURE	GF1521P	METER		HIGHLY DESIRABLE	
NOT IN LM	ELECTROCARDIOGRAM	GT9999	NOT DISPLAYED		HIGHLY DESIRABLE	31-15/16
	PNEUMOGRAM		NOT DISPLAYED		HIGHLY DESIRABLE	31-17

PLSS

ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
	PLSS ELECTROCARDIOGRAM	GT8124J			MANDATORY	31-15/16

*MANDATORY TO CABIN CLOSEOUT

32 COMMUNICATIONS/
INSTRUMENTATION

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MISSION RULES

REV	ITEM	GENERAL
	32-1	TO INITIATE AND CONTINUE THE FOLLOWING MISSION PHASES, THE CSM, LM, AND EVA COMMUNICATIONS AND INSTRUMENTATION SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES: A. LAUNCH THERE ARE NO COMMUNICATIONS/INSTRUMENTATION FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED. B. ALL PHASES EXCEPT LAUNCH 1. CRITICAL ONBOARD DISPLAYS 2. TWO-WAY VOICE COMM BETWEEN ALL CREWMEN/SPACECRAFT. NOTE: THIS MAY BE SATISFIED BY UMBILICAL INTERCOM EXCEPT FOR THE DOCKED DPS BURN, EVA, OR RENDEZVOUS. 3. TWO-WAY VOICE COMM BETWEEN CSM OR LM AND MSFN DURING ALL DOCKED ACTIVITIES AND BETWEEN BOTH SPACECRAFT AND MSFN DURING UNDOCKED ACTIVITIES. C. RENDEZVOUS 1. TWO-WAY VOICE COMM BETWEEN CSM AND LM WITH BACKUP 2. LM AND CSM OPERATIONAL TELEMETRY
	32-2	LM DFI DATA IS MANDATORY TO LIFTOFF, BUT LOSS OF DFI DATA WILL NOT CONSTRAIN ORBITAL PHASES (A KSC HOLD RESPONSIBILITY).
	32-3	THE MISSION WILL BE CONTINUED WITH THE LOSS OF: A. EITHER OR BOTH THE CSM AND THE LM UPDATA LINK B. EITHER OR BOTH THE CSM AND THE LM CAUTION AND WARNING SYSTEM C. THE CSM DATA STORAGE EQUIPMENT D. PLSS TELEMETRY
	32-4	S-BAND ONE-WAY RELAY IS EXPLAINED AS: A. PLANNED - CSM B. BACKUP - LM
	32-5	VHF EVA COMMUNICATIONS PRIORITIES ARE: A. PRIMARY (PLANNED) EMU COMMUNICATIONS ARE DUPLEX B, EMU TRANSMIT 259.7 MHZ RECEIVE 296.8 MHZ. B. SECONDARY (BACKUP) EMU COMMUNICATIONS ARE DUPLEX A, EMU TRANSMIT 296.8 MHZ RECEIVE 259.7 MHZ.
		RULE NUMBERS 32-6 THROUGH 32-9 ARE RESERVED.

REV	ITEM	MANAGEMENT
A	32-10	CSM/LM/PLSS COMM MANAGEMENT A. RECONFIGURATION OF COMMUNICATION EQUIPMENT DURING EVA WILL BE AVOIDED IF POSSIBLE. B. ANY S/C VHF (A/C VOICE) ANTENNA WILL BE DEACTIVATED IF IT WILL BE RADIATING WHEN AN OPERATING PLSS IS WITHIN 3.5 FEET.
A	32-11	VOICE CONFIGURATION A. LM/CSM/MSFN CONFERENCE 1. VHF A SIMPLEX 296.8 MHZ IS PRIME EXCEPT: (A) PRELAUNCH THRU CYI, REV 1 WHERE THE CSM/MSFN LOOP WILL BE DUPLEX B. (B) OVER DSIF SITES WHERE S-BAND WILL BE USED. 2. S-BAND IS BACKUP TO THE VHF A AND WILL BE DOWNLINKED SIMULTANEOUSLY WHERE PRACTICAL. 3. VHF B SIMPLEX 295.7 MHZ IS AN ALTERNATE BACKUP TO VHF A, BUT WILL BE USED ONLY IF REQUIRED. B. LM/CSM/EVA/MSFN CONFERENCE 1. CSM ONE-WAY RELAY WITH EMU PRIMARY IS PLANNED FOR EVA OPERATIONS; CSM: DUPLEX A, RECEIVE A ONLY; LM: TRANSMIT A, RECEIVE A AND B. 2. CSM ONE-WAY RELAY WITH EMU SECONDARY IS BACKUP FOR EVA; CSM: SIMPLEX B, RECEIVE A ONLY; LM: TRANSMIT B, RECEIVE A AND B. 3. LM ONE-WAY RELAY WITH EMU PRIMARY IS AN ALTERNATE; CSM: DUPLEX A, RECEIVE A ONLY; LM: TRANSMIT A, RECEIVE A AND B. 4. LM ONE-WAY RELAY WITH EMU SECONDARY IS A SECOND ALTERNATE; CSM: SIMPLEX B, RECEIVE A ONLY; LM: TRANSMIT B, RECEIVE A AND B.
	32-12	TELEMETRY CONFIGURATION A. S-BAND TELEMETRY IS PRIME FOR BOTH LM AND CSM EXCEPT OVER SINGLE AND MODIFIED USB SITES WHERE THE LM DFI VHF TRANSMITTER "B" 237.8 MHZ WILL BE USED. B. LM DFI POSTFLIGHT ANALYSIS DATA WILL BE PREDETECTION RECORDED FOR SPECIFIC EVENTS DURING LM CHECKOUT AND THE RENDEZVOUS.
	32-13	CSM VHF/USB MANAGEMENT A. SPACECRAFT AND GROUND WILL TRANSMIT SIMULTANEOUSLY ON VHF A 296.8 MHZ AND S-BAND FOR ORBIT PHASE. B. FOR CREW REST PERIODS, CSM S-BAND ANTENNA B WILL BE SELECTED. RTC CAN SWITCH TO OMNI D. C. NORMAL CONTROL OF THE S-BAND MODES WILL BE BY GROUND COMMAND. CSM COMMUNICATIONS SWITCH POSITION WILL REFLECT OUT-OF-SITE CONTACT CONFIGURATION. D. HIGH POWER MODE ON PM POWER AMPLIFIER WILL BE USED CONTINUOUSLY, EXCEPT DURING HGA TESTS. DURING THIS TEST, BYPASS MODE WILL BE USED.

REV	ITEM	
A	32-14	DSE MANAGEMENT A. LM AND CSM LOW BIT RATE TELEMETRY WILL BE RECORDED CONTINUOUSLY WHEN NOT IN CONTACT WITH GROUND TELEMETRY SITES AND WILL BE PLAYED BACK AT LEAST ONCE PER REVOLUTION. DURING RENDEZVOUS, NO LM LOW-BIT RATE DATA WILL BE RECORDED ON CSM DSE. B. CM HIGH BIT RATE DSE RECORDINGS WILL BE MADE DURING THE FOLLOWING OPERATIONS: 1. LAUNCH 2. S-IVB/CSM SEPARATION 3. ALL SPS MANEUVERS 4. DEORBIT MANEUVER, CM/SM SEPARATION AND ENTRY 5. DTO REQUIREMENTS (TBD)
	32-15	CTE AND MISSION TIMER MANAGEMENT A. CTE AND THE MISSION TIMER WILL BE CONFIGURED TO CLOCK IN GET FOR FLIGHT: HOWEVER, IF A HOLD OCCURS AFTER T-15 MINUTES, CTE WILL NOT BE CORRECTED UNTIL COMPLETION OF POWERED FLIGHT. B. CTE AND THE MISSION TIMER WILL BE ALLOWED TO DRIFT ±5 SECONDS BEFORE BEING UPDATED, AFTER ORBIT INSERTION.
	32-16	LM USB MANAGEMENT HIGH POWER MODE WILL BE USED CONTINUOUSLY DURING PM AND FM TRANSMISSIONS EXCEPT DURING THE STEERABLE ANTENNA TEST AND MODE 7 CHECK.
		RULE NUMBERS 32-17 THROUGH 32-19 ARE RESERVED.

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	32-20	LOSS OF TWO-WAY DIRECT VOICE COMM BETWEEN S/C	DOCKED	A. CONTINUE MISSION DO NOT UNDOCK	REF MALF PROC _____. LM LOSS OF VHF A VOICE NO. 4 UTILIZE TRANSFER UMBILICAL TO MAINTAIN COMMUNICATIONS.
			UNDOCKED	B. DOCK ASAP	
			RNDZ	C. DO NOT PERFORM SEPARATION, PHASING, OR INSERTION BURNS IF AFTER INSERTION, LM PERFORMS ALL MANEUVERS.	
			EVA	D. CONTINUE MISSION LMP ACTS AS RELAY BETWEEN CDR AND CMP	
	32-21	LOSS OF VOICE COMM WITH MSFN			
		A. EITHER S/C	DOCKED	A.1. CONTINUE MISSION DO NOT UNDOCK	REF MALF PROC LM LOSS OF VHF VOICE COMM WITH MSFN NO. 3
			EVA	2. TERMINATE EVA	
			UNDOCKED	3. DOCK ASAP	
			RNDZ	4. TERMINATE RNDZ AT NEXT EXIT POINT	
		B. CSM ONLY	LAUNCH	B.1. CONTINUE MISSION	
			ORBIT (SOLO)	2. ENTER NEXT BLOCK DATA POINT	
A	32-22	LOSS OF PRIMARY EMU TWO-WAY VOICE COMM			
		A. WITH EITHER LM OR CSM	EVA	A. CONTINUE MISSION CMP OR CDR WILL ACT AS VOICE RELAY TO LMP	
		B. WITH BOTH LM AND CSM	EVA	B. CONTINUE MISSION 1. LMP RETURN TO VISUAL VICINITY OF NEAREST CREWMAN. 2. RECONFIGURE TO EMU SECONDARY VOICE COMM. 3. IF COMMUNICATION NOT REESTABLISHED TERMINATE EVA	REF MALF PROC 5-18, 5-21

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	32-23	LOSS OF EITHER SPACECRAFT PCM TELEMETRY AND:			• MUST COMPARE GROUND AND ONBOARD SOLUTIONS VIA DSKY AND VOICE UPDATES.
		A. ONBOARD DISPLAYS NORMAL AND NO PENDING SYSTEMS PROBLEMS	ALL	A.1. CONTINUE MISSION REF ALTERNATE MISSION B	• MUST COMMAND UNMANNED APS BURN IN THE BLIND.
			UNDOCKED	2. DO NOT PERFORM SEPARATION MANEUVER	• MANDATORY/DFI DATA WILL BE RETRIEVED.
			RNDZ	3. LM RETURN TO VICINITY OF CSM ASAP	
		B. LOSS OF CRITICAL ONBOARD DISPLAYS			
		1. CSM	LAUNCH	B.1.(A) CONTINUE MISSION (B) ENTER NEXT BEST PTP	
		2. LM	ALL	2. TRANSFER TO CSM SETUP FOR UNMANNED APS BURN	B.2. WITH NO DFI TELEMETRY THE UNMANNED APS BURN WILL NOT BE ATTEMPTED.
A		RULE NUMBERS 32-24 THROUGH 32-39 ARE RESERVED.			

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MISSION RULES

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	32-23	LOSS OF EITHER SPACECRAFT PCM TELEMETRY AND:			• MUST COMPARE GROUND AND ONBOARD SOLUTIONS VIA DSKY AND VOICE UPDATES.
		A. ONBOARD DISPLAYS NORMAL AND NO PENDING SYSTEMS PROBLEMS	ALL	A.1. CONTINUE MISSION REF ALTERNATE MISSION B	• MUST COMMAND UNMANNED APS BURN IN THE BLIND.
			UNDOCKED	2. DO NOT PERFORM SEPARATION MANEUVER	• MANDATORY/DFI DATA WILL BE RETRIEVED.
			RNDZ	3. LM RETURN TO VICINITY OF CSM ASAP	
		B. LOSS OF CRITICAL ONBOARD DISPLAYS			
		1. CSM	LAUNCH	B.1.(A) CONTINUE MISSION (B) ENTER NEXT BEST PTP	
		2. LM	ALL	2. TRANSFER TO CSM SETUP FOR UNMANNED APS BURN	B.2. WITH NO DFI TELEMETRY THE UNMANNED APS BURN WILL NOT BE ATTEMPTED.

REV	ITEM
A	32-40

CSM - INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
UDL VALIDITY SIGNAL	CT0262V	-----	-------	HD	13-10B, 10E, 11C
USB RECEIVER AGC	CT0620E	METER	COMMON	HD	13-10B
USB RECEIVER AGC	METER	-----	-------	HD	13-10B
USB REC ERROR	CT0640F	-----	-------	HD	
DSE TAPE MOTION	CT0012X	TB	-------	HD	13-11
CTE TIME	CT0145F	-----	-------	HD	13-11
SCE 10 VDC	CT0018V	-----	-------	HD	
SCE 5 VDC	CT0017V	-----	-------	HD	
SCE 20 VDC	CT0015V	-----	-------	HD	
SCE -20 VDC	CT0016V	-----	-------	HD	
PCM HI REF 85 PERCENT	CT0125V	-----	-------	HD	
PCM HI REF 15 PERCENT	CT0126V	-----	-------	HD	

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MISSION RULES

REV	ITEM
A	32-41

LM - INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	MISSION RULE REFERENCE
PCM OSC FAIL 2	GL0422V	-------	1 OF 2	
PCM OSC FAIL 3	GL0423V	-------	HD	
CAL 85 PCT	GL0401V	-------	HD	
CAL 15 PCT	GL0402V	-------	HD	
MET	GL0501W	-------	M	
C&W PWR FAIL	GL4054X	CAUTION	HD	24-23
MASTER ALARM	GL4069X	MASTER ALARM	HD	24-23
S-BND PWR AMP PO	GT0201E	-------	HD	24-14C
DCA STATUS	GT0441X	-------	M	24-22
UHF SIG STR	GT0619V	-------	M	24-22
S-BND ST PH ERR	GT0992B	-------	HD	
S-BND RCVR SIG	GT0994V	METER	HD	24-14D

APPENDICES

A ACRONYMS AND SYMBOLS

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MISSION RULES

ITEM	
AC	ALTERNATING CURRENT
ACA	ATTITUDE CONTROLLER ASSEMBLY
ACCEL	ACCELEROMETER
ACCUM	ACCUMULATOR
ACS	ATTITUDE CONTROL AND STABILIZATION SYSTEM
ACT	ACTUATOR
ADEG	AUXILIARY DISPLAY EQUIPMENT GROUP
AEA	ABORT ELECTRONICS ASSEMBLY
AELD	ASCENT ENGINE LATCHING DEVICE
AFD	ASSISTANT FLIGHT DIRECTOR
AFETR	AIR FORCE EASTERN TEST RANGE
A/G	AIR-TO-GROUND
AGS	ABORT GUIDANCE SYSTEM
ALDS	APOLLO LAUNCH DATA SYSTEM
ALT	ALTERNATE
AM	AMPLITUDE MODULATION
AMP	AMPERE(S)
ANT	ANTENNA
AOA	ANGLE OF ATTACK
AOH	APOLLO OPERATIONS HANDBOOK
AOT	ALIGNMENT OPTICAL TELESCOPE
APS	ASCENT PROPULSION SYSTEM
APS	AUXILIARY PROPULSION SYSTEM
ARIA	APOLLO RANGE INSTRUMENTATION AIRCRAFT
ASA	ABORT SENSOR ASSEMBLY
ASAP	AS SOON AS PRACTICAL
ASC	ASCENT
ATCA	ATTITUDE TRANSLATION CONTROLLER ASSEMBLY
ATP	ALTERNATE TARGET POINT
ATT	ATTITUDE
AUX	AUXILIARY
AZUSA	ELECTRONIC TRACKING AND VECTORING SYSTEM (ETR)
BA	BANK ANGLE
BAT	BATTERY
BDA	BERMUDA (MSFN REMOTED SITE)
B/H	BLOCK HOUSE
BMAG	BODY MOUNTED ATTITUDE GYRO
BRSO	BERMUDA RANGE SAFETY OFFICER
BSE	BOOSTER SYSTEMS ENGINEER
BTU	BRITISH THERMAL UNIT
CAL	CALIBRATE
CASTS	COUNTDOWN AND STATUS TRANSMISSION SYSTEM
CB	CIRCUIT-BREAKER
CCATS	COMMAND, COMMUNICATIONS, AND TELEMETRY SYSTEM
CCW	COUNTERCLOCKWISE
CDH	CONSTANT DELTA HEIGHT
CDP	COMMAND DATA PROCESSOR
CDR	COMMANDER
CDU	COUPLING DATA UNIT
CES	CONTROL ELECTRONICS SYSTEM
CFM	CUBIC FEET PER MINUTE
CIF	CENTRAL INSTRUMENTATION FACILITY
CIM	COMPUTER INPUT MATRIX
CKT	CIRCUIT
CLTC	CHIEF LAUNCH VEHICLE TEST CONDUCTOR
CM	COMMAND MODULE
CMC	COMMAND MODULE COMPUTER
CMD	COMMAND
CMP	COMMAND MODULE PILOT
C/O	CUTOFF
CO_2	CARBON DIOXIDE
COAS	CREW OPTICAL ALIGNMENT SIGHT
COI	CONTINGENCY ORBIT INSERTION
COMM	COMMUNICATION
CONF	CONFERENCE
CONTROL	LM GNC SYSTEMS ENGINEER
CP	COMMUNICATIONS PROCESSOR
CRO	CARNARVON (MSFN REMOTED SITE)
CRYO	CRYOGENICS
CSI	CONCENTRIC SEQUENCE INITIATE
CSM	COMMAND SERVICE MODULE
CTE	CENTRAL TIMING EQUIPMENT
CVS	CONTINUOUS VENT SYSTEM
CVTS	CHIEF VEHICLE TEST SUPERVISOR
CW	CLOCKWISE
C&W	CAUTION AND WARNING
CYI	CANARY ISLAND
DAP	DIGITAL AUTO PILOT
DB	DEADBAND
DC	DIRECT CURRENT
DCA	DIGITAL COMMAND ASSEMBLY
DCS	DIGITAL COMMAND SYSTEM
DDD	DIGITAL DISPLAY DRIVER
DECA	DESCENT ENGINE CONTROL ASSEMBLY
DEDA	DATA ENTRY AND DISPLAY ASSEMBLY
DEG	DEGREE
DESC	DESCENT
DFI	DEVELOPMENT FLIGHT INSTRUMENTATION
DK	DOCK
DKD	DOCKED
DOD	DEPARTMENT OF DEFENSE
DPS	DESCENT PROPULSION SYSTEM
DRA	DISCRETE RECOVERY AREA
DRS	DATA RECEIVING STATION
DSC	DYNAMIC STANDBY COMPUTER
DSE	DATA STORAGE EQUIPMENT
DSKY	DISPLAY KEYBOARD
DTO	DETAILED TEST OBJECTIVE
D/TV	DIGITAL TO TELEVISION
ECS	ENVIRONMENTAL CONTROL SYSTEM
EDS	EMERGENCY DETECTION SYSTEM
EECOM	ELECTRICAL, ENVIRONMENTAL, AND COMMUNICATIONS
EKG	ELECTROCARDIOGRAM
EMR	ERROR MONITOR REGISTER
EMS	ENTRY MONITORING SYSTEM
EMU	EXTRA-VEHICULAR MOBILITY UNIT
ENG	ENGINE
EPS	ELECTRICAL POWER SYSTEM
ERR	ERROR
ESE	ELECTRONIC SUPPORT EQUIPMENT
ETDM	RANGE SAFETY SUPERVISOR (DESC CALLOUT)
ETR	EASTERN TEST RANGE
EVA	EXTRA-VEHICULAR ACTIVITY
EVAP	EVAPORATOR
EVT	EXTRA-VEHICULAR TRANSFER
EVVA	EXTRA-VEHICULAR VISOR ASSEMBLY
F/A	FORWARD/AFT
FC	FUEL CELL OR FLIGHT CONTROL
FCSM	FLIGHT COMBUSTION STABILITY MONITOR
FD	FLIGHT DIRECTOR
FDAI	FLIGHT DIRECTOR ATTITUDE INDICATOR
FDO	FLIGHT DYNAMICS OFFICER
FIDO	FLIGHT DYNAMICS OFFICER
FIG	FIGURE
FITH	FIRE IN THE HOLE
FL	FULL LIFT
FM	FREQUENCY MODULATION
FPS	FEET PER SECOND
FQR	FLIGHT QUALIFICATION RECORDER
FTP	FIXED THROTTLE POINT

REV	ITEM		
		G	GRAVITY
		G&C	GUIDANCE AND CONTROL
		GASTA	GIMBAL ANGLE SEQUENCE TRANSLATION ASSEMBLY
		GBI	GRAND BAHAMA ISLAND
		GDA	GIMBAL DRIVE ASSEMBLY
		GDC	GYRO DISPLAY COUPLER
		GET	GROUND ELAPSED TIME
		GETI	GROUND ELAPSED TIME OF IGNITION
		GMT	GREENWICH MEAN TIME
		GMTLO	GREENWICH MEAN TIME OF LIFTOFF
		G&N	GUIDANCE AND NAVIGATION
		GN_2	GASEOUS NITROGEN
		GNC	GUIDANCE NAVIGATION CONTROL
		GNCS	GUIDANCE, NAVIGATION, AND CONTROL SYSTEM
		GND	GROUND
		GRR	GUIDANCE REFERENCE RELEASE
		GSFC	GODDARD SPACE FLIGHT CENTER
		GTS	GIMBAL TRIM SYSTEM
		GUIDO	GUIDANCE OFFICER
		H_2	HYDROGEN
		H_2O	WATER
		Ha	HEIGHT OF APOGEE
		HAW	HAWAII
		HBR	HIGH-BIT-RATE
		HF	HIGH FREQUENCY
		H_p	HEIGHT OF PERIGEE
		HS	HIGH-SPEED
		HZ	HERTZ
		IC	INTERCOMMUNICATIONS EQUIPMENT
		IGA	INNER GIMBAL AXIS
		IMU	INERTIAL MEASUREMENT UNIT
		INJ	INJECTOR
		INST	INSTRUMENTATION
		INV	INVERTER
		IP	IMPACT POINT OR IMPACT PREDICTOR
		IRIG	INERTIAL RATE INTEGRATING GYRO
		ISOL	ISOLATION
		ISS	INERTIAL SUBSYSTEM
		IU	INSTRUMENTATION UNIT
		IVT	INTRAVEHICULAR TRANSFER
		JD	JET-DRIVER
		KOH	POTASSIUM HYDROXIDE
		KSC	KENNEDY SPACE CENTER
		LB	POUND
		LBR	LOW-BIT-RATE
		LCG	LIQUID COOLING GARMENT
		LES	LAUNCH ESCAPE SYSTEM
		LET	LAUNCH ESCAPE TOWER
		LGC	LM GUIDANCE COMPUTER
		LH_2	LIQUID HYDROGEN
		LiOH	LITHIUM HYDROXIDE
		LM	LUNAR MODULE
		LMDE	LM DESCENT ENGINE
		LMP	LM MODULE PILOT
		L/O	LIFTOFF
		LOS	LINE-OF-SIGHT
		LOX	LIQUID OXYGEN
		L/R	LEFT/RIGHT
		LV	LOW-VOLTAGE
		L/V	LAUNCH VEHICLE
		LVDA	LAUNCH VEHICLE DATA ADAPTER
		LVDC	LAUNCH VEHICLE DIGITAL COMPUTER
		MALF	MALFUNCTION
		MCC	MISSION CONTROL CENTER
		MC&W	MASTER CAUTION AND WARNING
		MDAS	MEDICAL DATA ACQUISITION SYSTEM
		MED	MANUAL ENTRY DEVICE
		MESC	MASTER EVENTS SEQUENCE CONTROLLER
		MFCO	MANUAL FUEL CUTOFF
		MFV	MAIN FUEL VALVE
		MGA	MIDDLE GIMBAL AXIS
		MIL	MERRITT ISLAND
		MITE	MASTER INSTRUMENTATION TIMING EQUIPMENT
		MNFLD	MANIFOLD
		M&O	MAINTENANCE AND OPERATION
		MOC	MISSION OPERATIONS COMPUTER
		MSFN	MANNED SPACE FLIGHT NETWORK
		MSK	MANUAL SELECT KEYBOARD
		MSTC	CSM SPACECRAFT TEST CONDUCTOR
		MTVC	MANUAL THRUST VECTOR CONTROL
		MUX	MULTIPLEXER
		NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
		NCC	COMBINED CORRECTIVE MANEUVER
		NM	NAUTICAL MILES
		NPV	NON-PROPULSIVE VENT
		NSR	COELLIPTICAL MANEUVER
		O_2	OXYGEN
		O/B	ONBOARD
		ODOP	OFFSET DOPPLER AND POSITION
		OGA	OUTER GIMBAL AXIS
		OMSF	OFFICE OF MANNED SPACE FLIGHT
		OPS	OXYGEN PURGE SYSTEM
		ORDEAL	ORBITAL RATE DRIVE ELECTRONICS APOLLO LM
		OXID	OXIDIZER
		PAFB	PATRICK AIR FORCE BASE
		PAM	PULSE AMPLITUDE MODULATION
		PB	PUSH-BUTTON
		PCM	PULSE CODE MODULATION
		PCMGS	PULSE CODE MODULATION GROUND STATION
		PCO_2	PARTIAL PRESSURE CARBON DIOXIDE
		PDS/DD	PLOTTING DISPLAY SUBCHANNEL/DATA DISTRIBUTION
		PGA	PRESSURE GARMENT ASSEMBLY
		PGNCS	PRIMARY GUIDANCE AND NAVIGATION CONTROL SYSTEM (CSM)
		PGNS	PRIMARY GUIDANCE AND NAVIGATION SYSTEM (LM)
		PIPA	PULSE INTEGRATING PENDULOUS ACCELEROMETER
		PLSS	PORTABLE LIFE SUPPORT SYSTEM
		PO	POWER OUT
		PO_2	PARTIAL PRESSURE OXYGEN
		POS	POSITION
		POS	PRIMARY OXYGEN SYSTEM
		PPM	PARTS PER MILLION
		PQGS	PROPELLANT QUANTITY GAGING SYSTEM
		PRELN	PRE-LAUNCH
		PRESS	PRESSURE
		PRI	PRIMARY
		PROC	PROCEDURE
		PROP	PROPELLANT
		PSA	POWER SERVO AMPLIFIER
		PSI	POUNDS PER SQUARE INCH
		PSID	POUNDS PER SQUARE INCH DIFFERENCE
		PSS	PAD SAFETY SUPERVISOR
		PTA	PULSE TORQUE ASSEMBLY
		PTP	PREFERRED TARGET POINT

REV	ITEM

PTV	PITCH THRUST VECTOR
PU	PROPELLANT UTILIZATION
PUGS	PROPELLANT UTILIZATION AND GAGING SYSTEM
PVT	PRESSURE-VOLUME-TEMPERATURE
PYRO	PYROTECHNICS
QTY	QUANTITY
RAD	RADIATOR
RET	RETRACT
RCS	REACTION CONTROL SYSTEM
RCU	REMOTE CONTROL UNIT
RCVR	RECEIVER
REF	REFERENCE
REFSMMAT	REFFERENCE STABLE MEMBER MATRIX
REQD	REQUIRED
RETRB	RETRO ELAPSED TIME TO REVERSE BANK
RETRO	RETROFIRE OFFICER
REV	REVOLUTION
RF	RADIO FREQUENCY
RFO	RETROFIRE OFFICER
RGA	RATE GYRO ASSEMBLY
RHC	ROTATION HAND CONTROLLER
RIP	RANGE OF IMPACT POINT
RL	ROLL LEFT
RNDZ	RENDEZVOUS
Rp-Rt	DOWNRANGE ERROR
RR	RENDEZVOUS RADAR
RR	ROLL RIGHT
RSI	ROLL STABILITY INDICATOR
RSO	RANGE SAFETY OFFICER
RSVR	RESOLVER
RTACF	REAL-TIME AUXILIARY COMPUTING FACILITY
RTC	REAL-TIME COMMAND
RTCC	REAL-TIME COMPUTER COMPLEX
S/C	SPACECRAFT
SCE	SIGNAL CONDITIONING EQUIPMENT
SCS	STABILIZATION AND CONTROL SYSTEM
SEC	SECONDARY
SEC	SECOND
SECC	SUSTAINER ENGINE CUTOFF (S-IVB CUTOFF)
SECS	SEQUENTIAL EVENTS CONTROL SYSTEM
SHe	SUPER-CRITICAL HELIUM
SIG	SIGNAL
SLA	SPACECRAFT LM ADAPTER
SLV	SATURN LAUNCH VEHICLE
SM	SERVICE MODULE
SMJC	SERVICE MODULE JETTISON CONTROLLER
SODB	SPACECRAFT OPERATIONAL DATA BOOK
SOL	SOLENOID
SOP	STANDARD OPERATING PROCEDURE
SOV	SHUT-OFF VALVE
SPAN	SPACECRAFT PLANNING AND ANALYSIS
SPS	SERVICE PROPULSION SYSTEM
SRO	SUPERINTENDENT RANGE OPERATIONS
SSC	SPACE SUIT COMMUNICATOR
STBY	STANDBY
SW	SWITCH
SXT	SEXTANT
TB	TIME BASE
TBD	TO BE DETERMINED
TC	TEST CONDUCTOR
T/C	TELEMETRY AND COMMUNICATIONS
TCE	CONDENSER EXHAUST TEMPERATURE
TCP	THRUST CHAMBER PRESSURE
TD&E	TRANSPORTATION, DOCKING AND EXTRACTION
TDP	TELEMETRY DATA PROCESSOR
TELCOM	LM EECOM
TEMP	TEMPERATURE
T_{FF}	TIME OF FREE FALL
THC	THRUST HAND CONTROLLER
T_{ig}	TIME OF IGNITION
TLI	TRANSLUNAR INJECTION
TM	TELEMETRY
TMG	THERMAL METEROID GARMENT
TNK	TANK
TOK	THRUST OKAY
TPF	TERMINAL PHASE FINALIZATION
TPI	TERMINAL PHASE INITIATE
TRNS	TRANSFER
TRUN	TRUNNION
TTC	TRANSLATION THRUST CONTROLLER
TTY	TELETYPE
TVC	THRUST VECTOR CONTROL
U/D	UP/DOWN
UDL	UPDATA LINK
UHF	ULTRA HIGH FREQUENCY
UNDKD	UNDOCKED
USB	UNIFIED S-BAND
Vc	VELOCITY COUNTER
Vgx	VELOCITY TO BE GAINED X-AXIS
Vgy	VELOCITY TO BE GAINED Y-AXIS
Vgz	VELOCITY TO BE GAINED Z-AXIS
VHF	VERY HIGH FREQUENCY
VLV	VALVE
VSM	VIDEO SWITCHING MATRIX
WBD	WIDE-BAND DATA
WMS	WASTE MANAGEMENT SYSTEM
WT	WEIGHT
XFEED	CROSSFEED
XMIT	TRANSMIT
XMRT	TRANSMITTER
Y	YAW OR Y-AXIS
YTV	YAW THRUST VECTOR
Z	Z-AXIS

SYMBOLS

h	ALTITUDE
Δ	DIFFERENCE
γ	FLIGHT PATH ANGLE
ϕ	LATTITUDE OR PHASE
q	DYNAMIC PRESSURE
≈	APPROXIMATELY
d	DOWNRANGE DISTANCE
±	PLUS OR MINUS
>	GREATER THAN
<	LESS THAN
≥	EQUAL TO OR GREATER THAN
≤	EQUAL TO OR LESS THAN
λ	LONGITUDE
γ_i	INERTIAL FLIGHT PATH ANGLE
γ_{EI}	INERTIAL FLIGHT PATH ANGLE AT ENTRY
γ_{EI}	INERTIAL VELOCITY AT ENTRY INTERFACE
ΔV_{IN}	DELTA VELOCITY IN INSERTION
ΔT_B	DELTA BURN TIME
ΔH	DELTA ALTITUDE

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EE4/RIEGERT, D.
JOHNSON, G.
MUFORD, R.E.
ROTRAMEL, F.
COMPOS, A.B.
DIETZ, R.H.
FENNER, R.G.
WALTER, R.T.
GIESECKE, R.L.
EE12/LUSE, M.B.
EE13/TREMONT, R.
EDMISTON, C.R.
EG/KAYTON, M.
EG23/COX, K.J., DR.
EG25/HANAWAY, J.
WASSON, C.
EG42/RICE, G. (2)
EG43/LEWIS, R.E.
KURTEN, P.M.
SHELTON, D.H.
EP/MCSHEEHY, R.
EP2/TOWNSEND, N.A.
WOOD, J.
HUMPHRIES, C.E.
HAMMOCK, W.R.
LAMBERT, C.H.
EP4/KARAKULKO, W.
EP5/BELL, D.
OWENS, S.
TROUT, B.
ES/CHAUVEN, L.
ES3/STROUHAL, G.
ES127/SMITH, J.
ES12/GLYNN, P.C.
WEISS, S.P.
PAVLOSKY, J.E.
EX/SILVERIA, M.
EX21/REDD, B.

FLIGHT SAFETY OFFICE

MSC/SA FRENCH, J.C.
SF/GREENWELL, D.
KSC/HY VAUGHN, N.B.

RELIABILITY AND CERTIFICATION OFFICE

NB2/WILLIAMS, H.L. (2)

DIRECTOR OF SCIENCE AND APPLICATIONS

TG5/~~HILL, J.C.~~ Bates
TA/CALIO, A.J.

TRW-HOUSTON

ROBERTSON, R.L. (3)
TRW TECHNICAL INFORMATION CENTER, HOUSTON OPERATIONS (2)

NORTH AMERICAN ROCKWELL HOUSTON

HARMAN, H.A. (2)

GODDARD SPACE FLIGHT CENTER

KNOX, C.B. (9)
CODE 821.1
MANNED FLIGHT OPERATIONS DIVISION, REQUIREMENTS SECTION

JOHN F. KENNEDY SPACE CENTER NASA - MSOB

KENNEDY SPACE CENTER, FLORIDA
ATTEN, HO/ASTRO OFL (6)
CD/DE BUS, K., DR.
AS-SAT/BARNETT, V. (2)
AP-SCO/BEDDINGFIELD, S.
AP-OPN/BLACKWOOD, H. (2)
LO/PETRONE, R.A.
KAPYRAN, W.J.
LO-OPN/DONNELLY, P.
LO-PLN-2/KNIGHT, G.W. (3)
HARRINGTON, R.D.
LV/GRUENE, H., DR.
LV-TOM-3/OGLESBY, T.
LS/WILLIAMS, J.J.
LS-ENG-L/GASKIN, R. (4)
LS-TOM-1/BUCKLEY (4)
WILLIAMS (4)
TS/CLARK, R.L. (5)
AP-SYM/MOORE, A.H. (6)
IN/SENDLER, K. (5)
SO/GORMAN, R. (3)
IS-TSM2/CLARK, B.
BEASON, W.P.
PSK/MORSE, A.E.
KSC MISSION DIRECTOR'S OFFICE, R3121 NSO BLDG
GAEC/LOPRESTI, R. (10), R1047 MSOB

MARSHALL SPACE FLIGHT CENTER

MSFC/I-MO-MGR, MISSION OPERATIONS OFFICE (30)

OFFICE MANNED SPACEFLIGHT

MUELLER, G.E., DR.
PHILLIPS, S.C., MAJ. GEN.
SCHNEIDER, W.C.
ALLER, R.O. (12)

DOD MSF SUPPORT OFFICE PAFB, FLA

OLSON, R.G., COL. (5)
FRESE, F.J., JR., COL. MC (2)
DDMS-N/DEARMAN, J., CAPT.
ETOOP-2 PAFB FLA, 32925 (6)

MIT LABORATORIES BOSTON, MASS.

NEVINS, J. (12)
COPPS, E. (2)
SPARS, N.

NORTH AMERICAN ROCKWELL, DOWNEY, CALIF.

POTTS, J.R. CODE AB70 (1)

GRUMMAN AIRCRAFT ENGINEERING CORP., BETHPAGE, NEW YORK

PRATT, R. (35)

C CHANGE CONTROL

REV	ITEM

CHANGE CONTROL

1.0 INTRODUCTION

1.1 PURPOSE

THE PURPOSE OF THIS APPENDIX IS TO DELINEATE CHANGE CONTROL PROCEDURES FOR THE AS-504/104/LM-3 MISSION RULES. THIS WILL INSURE THE PROPER COORDINATION OF CHANGES, PROVIDE A RECORD OR PROPOSED CHANGES (INCLUDING THE RATIONALE FOR MAKING THEM), AND WILL PROVIDE A MEANS FOR PROMULGATING INDIVIDUAL RULE UPDATES BETWEEN REVISIONS (INTERIM CHANGES).

1.2 EFFECTIVITY

DECEMBER 15, 1968

2.0 CHANGE PROCEDURES

2.1 SUBMISSION OF CHANGES

PROPOSED CHANGES ARE SOLICITED FROM ANY INDIVIDUAL OR ORGANIZATION HAVING A VALID INPUT, CHANGES ORIGINATING OUTSIDE THE FLIGHT CONTROL TEAM WILL BE SUBMITTED DIRECTLY TO THE ASSISTANT FLIGHT DIRECTOR (AFD). CHANGES ORIGINATING WITHIN THE FLIGHT CONTROL TEAM WILL BE SUBMITTED TO THE AFD VIA THE PRIME MISSION OPERATIONS CONTROL ROOM (MOCR) POSITION CONCERNED.

2.1.1 FORMAT

PERSONS DESIRING TO SUBMIT A PROPOSED CHANGE WILL COMPLETE ALL ITEMS ON THE FORM SHOWN IN FIGURE C-1 (FORM MUST BE TYPED). ADDITIONAL PAGES MAY BE USED IF THE SPACE PROVIDED IS NOT ADEQUATE. THE COMPLETED ORIGINAL FORM AND ONE COPY WILL THEN BE FORWARDED TO THE AFD.

THE AFD WILL REVIEW THE FORM FOR COMPLETENESS AND PROPER MISSION RULE FORMAT, AND MAKE CORRECTIONS AS REQUIRED. THE ORIGINATOR WILL BE ADVISED OF ANY SUCH CHANGES.

2.2 APPROVAL

2.2.1 COORDINATION

THE ORIGINATOR OF THE CHANGE MAY OBTAIN PRELIMINARY CONCURRENCES. THE AFD WILL, HOWEVER, OBTAIN FORMAL CONCURRENCES OR DISAPPROVALS (VERBALLY OR BY INITIATING) FROM THE NECESSARY PERSONNEL. VERBAL CONCURRENCES WILL BE INDICATED IN THE APPROPRIATE SIGNATURE BOX.

2.2.2 SIGNOFF/DISAPPROVAL

UPON OBTAINING THE REQUIRED CONCURRENCES OR NEGATIVE COMMENTS, THE AFD WILL PRESENT THE PROPOSED CHANGE TO THE FLIGHT DIRECTOR FOR FINAL APPROVAL OR DISAPPROVAL. THE AFD MAY SIGN OFF OR DISAPPROVE PROPOSED CHANGES IN THE ABSENCE OF THE FLIGHT DIRECTOR.

2.2.3 DISAPPROVED CHANGES

IF A CHANGE IS DISAPPROVED THE AFD WILL RETURN THE COPY TO THE ORIGINATOR. THE ORIGINATOR WILL BE RETAINED FOR FUTURE REFERENCE.

2.3 PUBLICATION AND DISTRIBUTION OF INTERIM CHANGES

INTERIM CHANGES WILL BE DISTRIBUTED TO AN ABBREVIATED DISTRIBUTION LIST CONSISTING OF THE MISSION CONTROL TEAM, PERTINENT NASA ORGANIZATIONS, AND THE APPROPRIATE VEHICLE CONTRACTOR(S).

3.0 REVISIONS

3.1 DEVELOPMENT

THE AFD WILL COMPILE THE EFFECTIVE INTERIM CHANGES AND CORRECTIONS OF MINOR TYPOGRAPHICAL ERRORS INTO COMPLETE PAGE CHANGES TO THE BASIC DOCUMENT. ("PEN AND INK" CHANGES MAY BE USED TO CORRECT TYPOGRAPHICAL ERRORS IF THERE ARE NO OTHER CHANGES IN THE PAGE CONCERNED.)

3.2 APPROVAL

SINCE ALL INTERIM CHANGES WILL HAVE RECEIVED PRIOR CONCURRENCES AND APPROVAL, ONLY THE FLIGHT DIRECTOR (OR THE AFD IN THE FLIGHT DIRECTOR'S ABSENCE) WILL BE REQUIRED TO APPROVE REVISIONS.

3.3 PUBLICATION

3.3.1 SCHEDULE

REVISIONS WILL BE MADE ON AN "AS REQUIRED" BASIS.

3.3.2 DISTRIBUTION

REVISIONS WILL BE PRINTED AND DISTRIBUTED THROUGH THE NORMAL ADMINISTRATIVE CHANNELS.

NASA — Manned Spacecraft Center

MISSION RULES

REV	ITEM

NASA-MANNED SPACECRAFT CENTER
MISSION RULE REQUEST/REVISION

DATE _____

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	NOTES/COMMENTS

RATIONALE: ☐ NEW TECHNICAL DATA ☐ CLARIFICATION ☐ TYPOGRAPHICAL ERROR

ORIGINATOR: NAME / ORGANIZATION / EXT	APPROVED: COGNIZANT BRANCH CHIEF	APPROVED: FLIGHT DIRECTOR

AFD:	BSE:	FIDO:	GUIDO:	RETRO:	GNC:	EECOM:	OTHER:

MSC FORM 1555 (JAN 68)

FIGURE C-1.- MISSION RULE PROPOSED CHANGE REQUEST FORM.

END

DATE

FILMED

JUL 10

1972