FINAL

FLIGHT MISSION RULES

APOLLO 9

(AS-504/104/LM-3)

Rev A

Date 2/15/69

DECEMBER 15, 1968

PREPARED BY

FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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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.

Approved by:

[Signature]
Christopher C. Kraft, Jr.
Director of Flight Operations

Concurred by:

[Signature]
George D. Gracey
Manager, Apollo Spacecraft Program Office

[Signature]
R. Scott Hamner
MSFC, Mission Operations Office
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.

APPROVED BY:

CHRISTOPHER C. KRAFT, JR.
DIRECTOR OF FLIGHT OPERATIONS
UPDATE THIS DOCUMENT IN ACCORDANCE WITH THE FOLLOWING INSTRUCTIONS

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# NASA — Manned Spacecraft Center

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**A**

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**TABLE OF CONTENTS**
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 CUTS/NOTES/COMMENTS COLUMN PROVIDES THE FLIGHT CONTROLLER WITH ADDITIONAL INFORMATION CONCERNING THE CONDITION/MALFUNCTION AND/OR RULING.
SECTION I - GENERAL GUIDELINES

NASA - Manned Spacecraft Center

MISSION RULES

**OMSF GENERAL RULES**

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<td>1-1</td>
<td>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 H-0 MA 500-11. PROPOSED CHANGES TO THE PRIMARY OBJECTIVES STATED IN THE MISSION ASSIGNMENTS DOCUMENT SHALL REQUIRE AA/MSF APPROVAL.</td>
</tr>
<tr>
<td>1-2</td>
<td>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.</td>
</tr>
<tr>
<td>1-3</td>
<td>FOLLOWING THE CDT OR FAT, 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.</td>
</tr>
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<td>1-4</td>
<td>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.</td>
</tr>
<tr>
<td>1-5</td>
<td>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.</td>
</tr>
<tr>
<td>1-6</td>
<td>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 SPACEFLIGHT SUPPORT OPERATIONS, OR THE MISSION DIRECTOR MAY REQUEST A HOLD FOR CONDITIONS WITHIN THEIR RESPECTIVE AREAS OF RESPONSIBILITY.</td>
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<td>1-7</td>
<td>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 MRC DIRECTOR OF FLIGHT OPERATIONS. THE MISSION DIRECTOR WILL BE KEPT FULLY INFORMED BY THESE INDIVIDUALS OF PROBLEMS AND PROPOSED SOLUTIONS DURING THE APPROPRIATE PHASES OF THE MISSION.</td>
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<td>1-8</td>
<td>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.</td>
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SECTION 1 - GENERAL GUIDELINES - CONTINUED

NASA - Manned Spacecraft Center
MISSION RULES

REV ITEM

1-9 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.

1-10 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.

1-11 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.

1-12 THE COUNTDOWN WILL NOT BE HELD NOR THE LAUNCH SCRUBBED FOR FAILURE OF DESIRABLE ITEMS.

1-13 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.

1-14 THE COUNTDOWN WILL CONTINUE WHERE POSSIBLE CONCURRENTLY WITH CORRECTION OF AN EXISTING PROBLEM.

1-15 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.

1-16 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.

1-17 THE LAUNCH OPERATIONS MANAGER MAY SEND AN ABORT REQUEST FROM THE TIME THE LAUNCH ESCAPE SYSTEM IS ARMED UNTIL THE SPACE VEHICLE REACHES SUFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER. THE CRITERIA FOR sending AN ABORT REQUEST WILL BE ESTABLISHED IN THE LAUNCH RULES.
SECTION 1 - GENERAL GUIDELINES - CONTINUED

REV ITEM

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.

THE LAUNCH OPERATIONS MANAGER WILL INFORM MCC WHEN THE SPACE VEHICLE CLEAR THE UMBILICAL TOWER BY SAYING "CLEAR TOWER" OVER ONE OF THE LOOPS FROM KSC TO MCC.

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.

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.

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.

THE COMMAND PILOT MAY INITIATE SUCH INFLIGHT ACTION AS HE DEEMS ESSENTIAL FOR CREW SAFETY.

FLIGHT CREW SAFETY SHALL TAKE PRECEDENCE OVER THE ACCOMPLISHMENT OF MISSION OBJECTIVES.


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.

THE DOD MANAGER FOR MANNED SPACE FLIGHT 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 EXPEDIENT RECOVERY OF THE FLIGHT CREW AND SPACECRAFT.

RULE NUMBERS 1-28 THROUGH 1-35 ARE RESERVED

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DEFINITIONS

1-36 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.

1-37 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.

1-38 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.

1-39 PRINCIPAL DETAILED TEST OBJECTIVE: A DETAILED TEST OBJECTIVE WHICH MUST BE ACCOMPLISHED PRIOR TO THE LUNAR LANDING MISSION. ANY PRINCIPAL DETAILED TEST OBJECTIVE NOT SATISFACTORY COMPLETED ON THE ASSIGNED MISSION CAN BE ATTEMPTED ON A SUBSEQUENT MISSION WITHOUT MAJOR IMPACT.

1-40 MANDATORY DETAILED TEST OBJECTIVE: A PRINCIPAL DETAILED TEST OBJECTIVE WHICH MUST BE SATISFACTORY COMPLETED ON THE ASSIGNED MISSION. FAILURE TO DO SO WOULD UNDILY COMPROMISE SUBSEQUENT FLIGHT SCHEDULES AND/OR REQUIRE SUBSEQUENT SPACE VEHICLE RECONFIGURATION.

1-41 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.

1-42 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.

1-43 HIGHLY DESIRABLE (H): 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.

1-44 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.

1-45 PROCEED: CONTINUE IN ACCORDANCE WITH PRESCRIBED COUNTDOWN PROCEDURES.

1-46 HOLD: INTERRUPTION OF THE COUNTDOWN FOR UNFAVORABLE WEATHER, REPAIR OF HARDWARE, OR CORRECTION OF CONDITIONS UNSATISFACTORY FOR LAUNCH OR FLIGHT.
## NASA - Manned Spacecraft Center
### Mission Rules

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<td>1-47</td>
<td>Countdown: The period of time starting with Launch Vehicle Power Up for the launch (or simulated scenario) which includes Service Structure Removal, Launch Vehicle cryogenic tanking, spacecraft closeout, and the terminal count.</td>
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<td>Hold Point: A predetermined point where the countdown may be conveniently interrupted.</td>
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<td>Recycle: The countdown is stopped and returned to a designated point or as specified in the Launch Mission Rules.</td>
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<td>Scrub: The launch is postponed.</td>
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<td>Cutoff: The automatic or manual command to stop the launch sequence after initiation of the &quot;automatic launch sequence start.&quot;</td>
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<td>Liftoff: The event determined by the Instrumentation Unit umbilical disconnect signal and is the point in time when plus time commences.</td>
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<td>Abort: Mission Termination by unscheduled intentional separation of the spacecraft from the launch vehicle prior to orbital insertion.</td>
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<td>Early Mission Termination: Unscheduled intentional mission termination at or after orbital insertion.</td>
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<td>1-55</td>
<td>Measurement: A measurement is a specific data channel of instrumentation monitoring a single function.</td>
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<td>Instrumentation: Instrumentation is the equipment that acquires, transmits and monitors data for performance evaluation of space vehicle and operational support items.</td>
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PART II
1. GENERAL RULES AND SOP'S
### SECTION 1 - GENERAL RULES AND SOP'S

#### NASA — Manned Spacecraft Center

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<td>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.</td>
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<td>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).</td>
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<td>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.</td>
</tr>
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<td>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.</td>
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<td>WHEN A CONFLICT OF FLIGHT PLAN ACTIVITIES OCCURS, THE FLIGHT DIRECTOR WILL DETERMINE THE PRIORITY OF ACTIVITIES.</td>
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<td>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.</td>
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<td>THE AUTOMATIC EDS (TWO ENGINE OUT AND OVERRATE CAPABILITY) WILL BE FLOWN CLOSED LOOP.</td>
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<td>1-8</td>
<td>THE FLIGHT DIRECTOR MAY, AFTER ANALYSIS OF THE FLIGHT, CHOOSE TO TAKE ANY NECESSARY ACTION REQUIRED FOR THE SUCCESSFUL COMPLETION OF THE MISSION.</td>
</tr>
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<td>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.</td>
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**FRD/587 FORM 292 (AN 60)**
1-10 THE SYSTEM 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 "ONLY 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 MSCP GENERAL RULE 1-42).
   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.
### DEFINITIONS

<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-27</td>
<td>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.</td>
</tr>
<tr>
<td>1-28</td>
<td>ATP: AN &quot;ALTERNATE TARGET POINT&quot; IS A STRATEGICALLY LOCATED SET OF COORDINATES CHOSEN TO PROVIDE A SPACECRAFT TARGET POINT MIDWAY BETWEEN PTP'S.</td>
</tr>
<tr>
<td>1-29</td>
<td>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.</td>
</tr>
<tr>
<td>1-30</td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>A. MODE III ABORT BURNS</td>
</tr>
<tr>
<td></td>
<td>B. MODE IV CONTINGENCY ORBIT INSERTION BURNS</td>
</tr>
<tr>
<td></td>
<td>C. APOGEE KICK BURNS</td>
</tr>
<tr>
<td></td>
<td>D. DEORBIT BURNS</td>
</tr>
<tr>
<td></td>
<td>E. RESCUE BURNS</td>
</tr>
<tr>
<td></td>
<td>F. CSI, CDH AND TPI (LM VEHICLE)</td>
</tr>
<tr>
<td>1-31</td>
<td>NON-CRITICAL BURN: A BURN WHICH NEED NOT BE ACCOMPLISHED TO MAINTAIN AN ACCEPTABLE LEVEL OF CREW SAFETY.</td>
</tr>
<tr>
<td>1-32</td>
<td>EARLY STAGING: UNSCHEDULED INTENTIONAL SEPARATION OF THE S-IVB STAGE FROM THE S-11 STAGE.</td>
</tr>
<tr>
<td>1-33</td>
<td>CONTINGENCY ORBIT INSERTION (COI): A SPS PROPELLIVE MANEUVER WHICH WILL PROVIDE CSM INSERTION INTO A SAFE ORBIT (H = 75 NM) IN THE EVENT OF AN SLV FAILURE OCCURRING IMMEDIATELY PRIOR TO INSERTION, OR IN THE EVENT OF DEGRADED SLV PERFORMANCE.</td>
</tr>
</tbody>
</table>
### Section 1 - General Rules and SOP's - Continued

**NASA — Manned Spacecraft Center**

**Mission Rules**

<table>
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<tr>
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<th>ITEM</th>
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<tbody>
<tr>
<td>1-34</td>
<td>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.</td>
</tr>
<tr>
<td>1-35</td>
<td>S-IVB ORBITAL SAFING: A PASSIVATION SEQUENCE IN WHICH S-IVB LOX, LH₂, AND HIGH PRESSURE SPHERES ARE DEPLETED.</td>
</tr>
<tr>
<td>1-36</td>
<td>PRELAUNCH PHASE (PRELNC): THE TIME INTERVAL FROM THE COMPLETION OF THE FLIGHT READINESS REVIEW TO LIFTOFF.</td>
</tr>
<tr>
<td>1-37</td>
<td>FLIGHT PHASE: THE TIME INTERVAL FROM LIFTOFF TO SPLASHDOWN. LISTED BELOW ARE THE MISSION PHASES WHICH COMPRISSE THE FLIGHT PHASE. THE PHASES ARE LISTED BY VEHICLE AND WILL BE USED IN THE PHASE COLUMN OF PEC/TSG FORM 291 TO IDENTIFY THE MISSION PERIOD OF ACTIVITY FOR WHICH A SPECIFIC RULING IS APPLICABLE.</td>
</tr>
</tbody>
</table>

#### A. S-IVB
1. LAUNCH PHASE: FROM LIFTOFF THROUGH INSERTION. (TBD THROUGH TBD)
2. ORBIT PHASE: FROM INSERTION TO CSMS-S-IVB SEPARATION FOR TOAE. (TBD)
3. TDE PHASE: FROM CSMS-S-IVB SEPARATION THROUGH LM EJECTION FROM SLA. (TBD)
4. TRANSFER INJECTION (TLI) PHASE: FROM LM EJECTION TO COMPLETION OF S-IVB SUPPORT. THIS PHASE INCLUDES S-IVB RESTARTS AND ORBIT SAFING. (TBD THROUGH TBD)

#### B. LM
1. UNDOCKED PHASE: THE TIME INTERVALS DURING WHICH THE LM AND CSM ARE UNDOCKED. |
2. UNDOCKED PHASE: THE TIME INTERVAL DURING WHICH A MANNED LM IS SEPARATED FROM CSM FOR STATION KEEPING (MINIMUM 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 CSMS 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 CSMS-S-IVB SEPARATION FOR TOAE. |
3. TDE PHASE: FROM CSMS-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 EMU FOR LIFE SUPPORT. |
6. UNDOCKED PHASE: THE TIME INTERVAL DURING WHICH A MANNED LM IS SEPARATED FROM CSM FOR STATION KEEPING (MINIMUM SEPARATION DISTANCE OF ≥ 500 FT). |
7. Rendezvous Phase: THE TIME INTERVAL FROM THE CSMS SEPARATION MANEUVER FOR MINI-FOOTBALL TO LM/CSM DOCKING AT END OF RENDEZVOUS. |
8. ORBIT (CSM) 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. |
**SECTION 1 - GENERAL RULES AND SOP'S - CONTINUED**

**NASA — Manned Spacecraft Center**

### 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 retro (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 ,25 then the range to go display and the range potential lines are compared to modulate the bank angle. At retro the present bank angle is reversed.

### ALTERNATE MISSION:

Any deviation from the nominal mission timeline where further mission objectives are considered before the end of the mission.

### 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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<table>
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<tr>
<td>APOLLO 9</td>
<td>FINAL</td>
<td>12/15/68</td>
<td>GENERAL RULES AND SOP'S</td>
<td>DEFINITIONS</td>
<td>1-5</td>
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SECTION I - GENERAL RULES AND SOP'S - CONTINUED

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MISSION RULES

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<tr>
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</table>

CRITERIA FOR TARGET POINT SELECTION

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.

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>PRIORITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable weather conditions for recovery operations</td>
<td>1</td>
</tr>
<tr>
<td>Capability of recovery forces</td>
<td>2</td>
</tr>
<tr>
<td>Communication with the spacecraft from a ground station at least 40 minutes prior to deorbit burn</td>
<td>3</td>
</tr>
<tr>
<td>Sufficient daylight for recovery operations</td>
<td>4</td>
</tr>
<tr>
<td>A ground station for post-deorbit burn tracking</td>
<td>5</td>
</tr>
<tr>
<td>Voice contact prior to and during deorbit burn</td>
<td>6</td>
</tr>
<tr>
<td>Post-blackout tracking data available for reentry (assumes pre-blackout acquisition)</td>
<td>7</td>
</tr>
<tr>
<td>Ground stations available to obtain delta v readouts and to pass crew backup guidance quantities</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MISSION</th>
<th>REV</th>
<th>DATE</th>
<th>SECTION</th>
<th>GROUP</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>APOLLO 9</td>
<td>FINAL</td>
<td>12/15/68</td>
<td>GENERAL RULES AND SOP'S</td>
<td>TARGET POINT SELECTION CRITERIA</td>
<td>1-5</td>
</tr>
</tbody>
</table>

REVISED FROM 3RD (REV 32)
SECTION 1 - GENERAL RULES AND SOP'S - CONTINUED

NASA - Manned Spacecraft Center
MISSION RULES

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-30 SEC., ALL MANDATORY ITEMS WILL REVERT TO HIGHLY DESIRABLE ITEMS 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.
LAUNCH ABORTS

1-61 ABBORT REQUEST COMMANDS ARE COMMANDS TRANSMITTED FROM THE MCC OR LCC WHICH ILLUMINATE THE ABBORT REQUEST LIGHT ON THE COMMAND PILOT'S PANEL. THE "ABBORT LIGHT" AND A VOICE REPORT "ABBORT" OVER H/G ARE CONSIDERED TWO CUES FOR THE CREW TO TAKE THE NECESSARY ACTION TO ABBORT THE MISSION. THE GROUND WILL USE TWO INDEPENDENT CUES PRIOR TO TRANSMITTING "ABBORT 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 ABBORT REQUEST COMMAND FOR SPACECRAFT SYSTEMS MALFUNCTIONS, TRAJECTORY DEVIATIONS, AND LAUNCH VEHICLE MALFUNCTIONS IF TIME PERMITS.

1-64 THE FLIGHT DYNAMICS OFFICER WILL INITIATE THE ABBORT REQUEST COMMAND DURING THE FLIGHT PHASE IF THE SPACE VEHICLE EXCEEDS THE FLIGHT DYNAMICS ENVELOPE.

1-65 THE BOOSTER SYSTEMS ENGINEER WILL INITIATE THE ABBORT REQUEST COMMAND BASED UPON LAUNCH VEHICLE TIME-CRITICAL SYSTEMS MALFUNCTIONS THAT WOULD NOT ALLOW A SAFE INSERTION FOR FAILURES OCCURRING FROM LIFTOFF TO 5-WB CUTOFF.

1-66 THE ONLY KSC POSITION THAT WILL HAVE ABBORT REQUEST CAPABILITY IS THE Launch Operations Manager. The Launch Operations Manager May Send An ABBORT 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 ABBORT 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 ABBORT ACTION.

1-67 THE RSO CAN SHUTDOWN THE SLV BY TRANSMITTING THE MFCO COMMAND WHICH ALSO LIGHTS THE ABBORT REQUEST LIGHT IN THE SPACECRAFT. THE MFCO WILL INITIATE AN AUTO-ABBORT 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 5-WB AFTER TRANSMITTING MFCO UPON VERIFICATION OF CUTOFF IF THE DESTRUCT COMMAND IS NOT TO BE TRANSMITTED.
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

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".

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 FDO, 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.

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.
### SECTION 1 - GENERAL RULES AND SOP'S - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

#### REV ITEM 1-72

**EMERGENCY ENGINE SHUTDOWN METHODS.**

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<th>METHOD</th>
<th>STAGE</th>
<th>TIME FRAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTRONAUT</td>
<td>CCW ON THC</td>
<td>S-IC, S-II, S-IVB</td>
<td>T + 30 SEC TO SECO</td>
</tr>
<tr>
<td>ASTRONAUT</td>
<td>S-1/11/1-IVB L/V STAGE SWITCH</td>
<td>S-II, S-IVB</td>
<td>T + 2:33 TO SECO</td>
</tr>
<tr>
<td>RSO</td>
<td>RF CMD (HPCD)</td>
<td>S-IC, S-II, S-IVB</td>
<td>T-0 TO INSERTION</td>
</tr>
<tr>
<td>EDS</td>
<td>2 OF 3 VOTING LOGIC</td>
<td>S-IC</td>
<td>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 SHUTDOWM</td>
</tr>
</tbody>
</table>

#### 1-73

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

#### 1-74

**ABORT MODES:**

**MODE I**

<table>
<thead>
<tr>
<th>BOUNDARY OF APPLICATION</th>
<th>PROCEDURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>REFERENCE AOH 5.1.1.1</td>
</tr>
<tr>
<td>LES ABORT ENABLE (FT-30 MIN) TO GET 42 SEC. (10 K FEET)</td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td>REFERENCE AOH 5.1.1.2</td>
</tr>
<tr>
<td>GET 42 SEC TO 100K FEET ALTITUDE (GET #1 + 50)</td>
<td></td>
</tr>
<tr>
<td>1C</td>
<td>REFERENCE AOH 5.1.1.3</td>
</tr>
<tr>
<td>100K FEET ALTITUDE TO TOWER JETTISON (GET #3+07)</td>
<td></td>
</tr>
</tbody>
</table>

#### 1-75

**MODE II**

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<th>PROCEDURES</th>
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</thead>
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<tr>
<td>TOWER JETTISON (GET #3+07) UNTIL FULL LIFT SPLASHPOINT IS 3550 N.M. CONNABGE</td>
<td>A. REFERENCE AOH 5.1.2.1</td>
</tr>
<tr>
<td></td>
<td>B. MCC PROVIDES</td>
</tr>
<tr>
<td></td>
<td>1. GET WIND AND PITCH AT .04 g16</td>
</tr>
<tr>
<td></td>
<td>2. GET DROGUE</td>
</tr>
<tr>
<td></td>
<td>C. ENTRY IS FULL LIFT</td>
</tr>
</tbody>
</table>

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**MISSION: APOLLO 9**

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<tr>
<td>A</td>
<td>3/15/69</td>
<td>GENERAL RULES AND SOP'S</td>
<td>LAUNCH ABORTS</td>
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#### MISSION RULES

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<td>A</td>
<td>1-76</td>
<td>FULL LIFT SPLASH-POINT BETWEEN 3550 N.M. AND INSERTION.</td>
<td>A. REFERENCE ACM 5.1.2.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. MCC PROVIDES:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. GETI AT S-IVB CUTOFF PLUS 2:05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. DELTA V FOR 3550 N.M. SPLASH-POINT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. BURN DURATION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. GET AND PITCH ATT AT 400K FT.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5. GET DROGUE</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>6. GET MAIN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. MANEUVER IS SCS AUTO.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. ENTRY IS ROLL LEFT 55 DEGREES.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
<th>MODE IV</th>
<th>BOUNDARY OF APPLICATION</th>
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<tbody>
<tr>
<td>A</td>
<td>1-77</td>
<td>CONTINGENCY ORBIT INSERTION CAPABILITY TO INSERTION BASED ON CO1 LINE ON 7 VS V PLOT FOR NEAR NOMINAL ALTITUDE.</td>
<td>A. REFERENCE ACM 5.1.2.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. MCC PROVIDES:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. GETI AT S-IVB CUTOFF PLUS 2:05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. DELTA V REQUIRED TO ACHIEVE PERIGEE &gt;75 N.M.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. BURN DURATION</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>4. PITCH AT GETI</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>C. MANEUVER IS SCS AUTO</td>
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</tbody>
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<table>
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<tr>
<th>REV</th>
<th>ITEM</th>
<th>MODE</th>
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<th>BOUNDARY OF APPLICATION</th>
<th>PROCEDURES</th>
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</thead>
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<td>A</td>
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<td>PRE-APOGEE CUTOFFS, OUTSIDE THE CO1 BOUNDARY, CORRECTABLE TO SAFE ORBITAL CONDITIONS BY A MANEUVER AT APOGEE.</td>
<td>A.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. MCC PROVIDES:</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1. GETI FOR BURN AT APOGEE</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>2. DELTA V REQUIRED TO ACHIEVE &gt;75 N.M.</td>
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<td></td>
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<td></td>
<td></td>
<td>3. BURN DURATION</td>
<td></td>
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<td></td>
<td></td>
<td>4. PITCH ATTITUDE</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>C. MANEUVER IS SCS AUTO</td>
<td></td>
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<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
<th>MODE</th>
<th>CREW ABORT LIMITS</th>
<th>PROCEDURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1-79</td>
<td>MAX Q REGION</td>
<td>(00:35 TO 01:40)</td>
<td>A. AOA &gt;100 PCT AND PITCH, YAW AND ROLL ERROR &gt;5 DEGREES (DISREGARD FOR S-IC CONTROL ENGINE OUT PRIOR TO 30 SECONDS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABORT MODE I (ACTION ONLY AFTER BOTH HAVE REACHED THRESHOLD)</td>
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<td></td>
<td></td>
<td>ABORT MODE I</td>
<td></td>
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<td></td>
<td>B. CUES</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>1. LV GUID LT-ON</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2. LV RATE LT-ON</td>
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### Mission Information

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<tr>
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<td>APOLLO 9</td>
<td>A</td>
<td>2/15/69</td>
<td>GENERAL RULES AND SOP'S</td>
<td>LAUNCH ABORTS</td>
<td>1-11</td>
</tr>
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SECTION I - GENERAL RULES AND SOP'S - CONCLUDED

NASA — Manned Spacecraft Center

MISSION RULES

<table>
<thead>
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<tbody>
<tr>
<td>1-80</td>
<td></td>
<td>A. PITCH AND YAW</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. L/O TO S-IC/S-II STAGING - 4 DEG/SEC</td>
<td>ABORT MODE I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. S-IC/S-II STAGING TO SECO-9 DEG/SEC</td>
<td>ABORT MODE I, MODE II, MODE III, OR MODE IV</td>
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<td></td>
<td></td>
<td>B. ROLL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. L/O TO SECO - 20 DEG/SEC</td>
<td>ABORT MODE I, MODE II, MODE III, OR MODE IV</td>
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1-81 EDS AUTOMATIC ABORT LIMITS (UNTIL MANUAL DEACTIVATION OF TWO ENGINES OUT AUTO AND LV RATES AT 2:00 MIN)

<table>
<thead>
<tr>
<th>REV</th>
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<th>BOUNDARY OF APPLICATION</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>A. RATES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PITCH AND YAW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.0 T ..5 DEG/SEC</td>
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<td></td>
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<td>ROLL</td>
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<td></td>
<td></td>
<td>20.0 T ..5 DEG/SEC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. ANY TWO ENGINES OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. OM TO IU BREAKUP</td>
</tr>
</tbody>
</table>

1-82 S-IVB TANK PRESSURE LIMITS (L/O TO CSM/LV SEP)

<table>
<thead>
<tr>
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<th>ITEM</th>
<th>BULKHEAD ΔP</th>
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<tr>
<td></td>
<td></td>
<td>FUEL &gt; OXID = 26 PSID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OXID &gt; FUEL = 36 PSID</td>
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</table>

1-83 ENGINE FAILURES

<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
<th>PROCEDURES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. SIMULTANEOUS LOSS OF TWO OR MORE ENGINES (S-1C)</td>
<td>ABORT MODE I</td>
</tr>
<tr>
<td></td>
<td>B. SIMULTANEOUS LOSS OF TWO OR MORE ENGINES (S-1I)</td>
<td>ABORT OR EARLY STAGE</td>
</tr>
<tr>
<td></td>
<td>C. S-II INBOARD ENGINE HAUEROVER</td>
<td>ABORT PRIOR TO S-IVB TO ORBIT CAPABILITY, AFTER S-IVB TO ORBIT CAPABILITY, EARLY STAGE</td>
</tr>
</tbody>
</table>

MISSION REV DATE SECTION GROUP PAGE
APOLLO 9 A 2/13/69 GENERAL RULES AND SOP'S LAUNCH ABORTS 1-12
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. TIDEE
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. DODGED APS BURN
10. EVA
11. CSM/LH UNDOCKING
12. SEPARATION MANEUVER
13. PHASING MANEUVER
14. INSERTION MANEUVER
15. LPH STAGING
16. LH UNMANNELED 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 ITS 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 WILL HAVE SUFFICIENT CAPABILITY TO SUPPORT THE MISSION PROFILE; HOWEVER, MISSION TERMINATION WILL BE PLANNED BECAUSE MULTIPLE SIMILAR FAI IURES 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.
### A. Launch Window

Launch window opens at 1600 GMT, based on achieving proper rendezvous lighting and MSFN coverage, and closes at 1903 GMT, based on irretrievable loss of rendezvous lighting conditions.

### B. Launch Window Extension

The launch window was extended by utilizing the 6V budgets of SPS burns 2, 3, 4, and 5 and the docked SPS 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 (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 L.00) 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.

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<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
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<tbody>
<tr>
<td>2-2</td>
<td>PELAUNCH</td>
</tr>
<tr>
<td></td>
<td>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 SBC 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 ANOMALIES EXIST AND ALSO LAUNCH TRAJECTORY DEVIATIONS ARE EVIDENT, THE MISSION MAY BE ABORTED DURING LAUNCH PHASE.</td>
</tr>
<tr>
<td>2-3</td>
<td>LAUNCH</td>
</tr>
<tr>
<td></td>
<td>IF REQUIRED, EARLY S-IVB STAGING MAY BE INITIATED BY THE FLIGHT CREW ONLY AFTER S-IVB-TO-ORBIT CAPABILITY IS OBTAINED.</td>
</tr>
<tr>
<td>2-4</td>
<td>EARLY STAGING</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>2-6</td>
<td>EARLY CSM/S-IVB SEPARATION AND LM EXTRICATION</td>
</tr>
<tr>
<td></td>
<td>A. A S-IVB FAILURE OR SYSTEMS TRENDS 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.</td>
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<tr>
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<td>B. IF THE RANGE SAFETY SYSTEM IS NOT SAFED AND EBM IS ARMED, THE CSM WILL PERFORM A SEPARATION MANEUVER ASAP.</td>
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**FLIGHT OPERATIONS RULES**

**APOLLO 9**

**A** 2/15/69

**NASA - Manned Spacecraft Center**

**MISSION RULES**

**GROUP** GENERAL

**PAGE** 2-2
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.

A. EARLY TOE WILL BE ATTEMPTED FOR S-IVB LIFETIME PROBLEMS WHICH WOULD RESULT IN PREDICTED STAGE FAILURES PRIOR TO THE END OF THE NOMINAL LM EXTRACTION TIME. TOE SHALL NOT BE ATTEMPTED EARLIER THAN SUNRISE ON REV 1.

B. TOE 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.


D. A CSM MALFUNCTION REQUIRING ENTRY INTO 6-4 PTP SHALL NOT PRECLUDE ATTEMPTING TOE ACTIVITY IF THE TOE ACTIVITIES WOULD NOT FURTHER AGGRAVATE THE MALFUNCTION CONDITION.

E. IF NORMAL LM EXTRACTION (CSM/UM UNBILICAL) 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 (PYROTECNIC) WILL BE PERFORMED.


I. THE NORMAL MINIMUM CABIN PRESSURE REDLINE OF 4.0 PSIA FOR TUNNEL/UM PRESSURIZATION SEQUENCES WILL BE WAIVED DURING TOE. FOR TUNNEL OR UM 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.
### Section 2 - Flight Operations Rules - Continued

**NASA — Manned Spacecraft Center**

**Mission Rules**

#### 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 handover 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.

#### B.  \(2-9\) 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.

#### C.  \(2-10\) 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.

#### D.  \(2-11\) Extravehicular Activity

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 legs 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**

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**Apollo 9**

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**FLIGHT OPERATIONS RULES**

**GENERAL**

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SECTION 2 - FLIGHT OPERATIONS RULES - CONTINUED

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MISSION RULES

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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 MANNE D 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.

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 UNDOCKING.

C. CM AND LM SUIT LOOP INTEGRITY IS REQUIRED FOR MANNE D 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 CONTINUE 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.
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 PROPELLION CAPABILITY FOR COMPLETION OF THE RENDEZVOUS IN PROGRESS AND DOCKING.

E. FIFTH 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 VESICLES IN ORDER TO CONTINUE THE RENDEZVOUS.
### 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. MSN WILL CONTINUE MONITORING LM SYSTEMS PERFORMANCE FOR THE REMAINING LM LIFETIME.

**C.** MSN 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 MSN COVERAGE ANTICIPATED, THIS OBJECTIVE MAY NOT BE SATISFIED.

### 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 LV WILL BE RESERVED FOR SPS DEORBIT FROM ANY POINT IN THE MISSION.

**D.** SM-RCS (4 QUAD) AND SM-ORC/RCS HYBRID WILL BE CONSIDERED AS INDEPENDENT DEORBIT METHODS AS LONG AS INDIVIDUAL SM-RCS QUAD AND OME OR SCS INTEGRITY IS MAINTAINED AND SUFFICIENT RCS PROPELLANT IS AVAILABLE.

**E.** THE LM PROPULSION SYSTEMS (OPS OR RCS) MAY BE USED TO PLACE THE CSM IN AN ORBIT (MEAN 80 NM) FROM WHICH A SM-RCS OR SM-ORC/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-ORC/RCS HYBRID
4. LM PROPULSION PLUS SM-ORC/RCS HYBRID

**G.** DEORBIT BURN AND ENTRY MODE PRIORITIES ARE:

- **DEORBIT BURN MODES:**
  1. GEN
  2. SCS AUTO
  3. HORIZON MONITOR MANUAL TVC.

- **ENTRY MODES:**
  1. GEN
  2. EMS
  3. 60 & 6
  4. ROLLING
SECTION 2 - FLIGHT OPERATIONS RULES - CONTINUED

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MISSION RULES

REV ITEM

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<thead>
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<tbody>
<tr>
<td>A. SCS MANEUVER PREPARATION TIME IS:</td>
</tr>
<tr>
<td>1. VALID IMU TO INITIALIZE GDC - PAD DATA PLUS 15 MINUTES.</td>
</tr>
<tr>
<td>2. VERIFICATION OF GDC REQUIRED - PAD DATA PLUS ONE FULL NIGHT PASS FOR OPTICS CHECK, OR HORIZON CHECK, FOR RETROFIRE.</td>
</tr>
<tr>
<td>3. GDC INITIALIZATION WITH OPTICS - PAD DATA PLUS ONE FULL NIGHT PASS.</td>
</tr>
<tr>
<td>4. GDC INITIALIZATION WITH HORIZON - PAD DATA PLUS 30 MINUTES.</td>
</tr>
<tr>
<td>B. AGS MANEUVER PREPARATION TIME IS:</td>
</tr>
<tr>
<td>1. VALID IMU TO INITIALIZE AGS - PAD DATA PLUS 7 MINUTES.</td>
</tr>
<tr>
<td>2. VERIFICATION OF AGS - REQUIRES 20 MIN AND THE FOLLOWING:</td>
</tr>
<tr>
<td>(A) PAD DATA</td>
</tr>
<tr>
<td>(B) INITIALIZED ORDEAL</td>
</tr>
<tr>
<td>(C) LIT HORIZON CHECK AT TIG - 5 MIN.</td>
</tr>
<tr>
<td>3. AGS INITIALIZATION WITH OPTICS</td>
</tr>
<tr>
<td>(A) ONE NIGHT PASS AND CREW READOUT OF STARS UTILIZED, ACT ANGLES A1 AND A2 AND ACT DETENT FOR BODY AXIS ALIGN.</td>
</tr>
<tr>
<td>(B) GROUND COMPUTATION OF REQUIRED PAD DATA.</td>
</tr>
<tr>
<td>(C) PAD DATA +2 MIN.</td>
</tr>
<tr>
<td>C. CMC AND LGC MANEUVER PREPARATION TIME IS:</td>
</tr>
<tr>
<td>1. IMU OFF OR UNKNOWN - ONE FULL NIGHT PASS AFTER IMU WARMUP.</td>
</tr>
<tr>
<td>2. IMU KNOWN AND UNACCEPTABLE - COARSE ALIGNMENT TO PREFERRED ALIGNMENT PLUS ONE FULL NIGHT PASS.</td>
</tr>
<tr>
<td>3. IMU KNOWN AND ACCEPTABLE - PAD DATA PLUS:</td>
</tr>
<tr>
<td>(A) 10 MINUTES FOR RENDEZVOUS MANEUVERS.</td>
</tr>
<tr>
<td>(B) 10 MINUTES FOR ALL OTHER MANEUVERS.</td>
</tr>
</tbody>
</table>

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:

| MODE I |
| (1) "FULL LIFT" |
| (2) GET 400,000 FT |
| (3) PITCH AT ENTRY |
| (4) BLACKOUT TIMES |

| MODE III |
| (1) LIFT |
| (2) GET OF IGNITION |
| (3) AV OF BURN |
| (4) ST OF BURN |
| (5) PITCH AT IGNITION |
| (6) GET 400,000 FT |
| (7) PITCH AT .056 |
| (8) GET OF DROGUE |

*OMITTED IF A BURN IS NOT REQUIRED.*
I. 2-17 DATA PRIORITY GUIDELINES

A. RULES 2-18 THROUGH 2-29 ARE RESERVED.

**SECTION 2 - FLIGHT OPERATIONS RULES - CONTINUED**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
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<td>A</td>
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</table>

(C) MODE IV

1. GET OF IGNITION
2. \( \Delta V \) OF BURN
3. ST OF BURN
4. PITCH ANGLE AT IGNITION

(D) APOGEE KICK

1. GET OF IGNITION
2. \( \Delta V \) OF BURN
3. ST 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 REFSPMAT 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:
   - PHASING
     \[ \Delta V_x = 12.0 \text{ FPS} \]
     \[ \Delta V_y = 10 \text{ FPS} \]
     \[ \Delta V_z = 10 \text{ FPS} \]
   - 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 REFSPMAT WILL BE UPLINKED TO THE CSM AND LM PRIOR TO THE RENDEZVOUS.
4. PRIOR TO RENDEZVOUS, THE ONC 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 CSM OR CSM 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 MANEUVER MUST BE PERFORMED IT IS DESIRABLE TO DO SO ON THE FIRST TPI OPPORTUNITY.
8. AGS ALIGNMENTS AND STATE VECTOR UPDATES (FROM THE ONC) ARE TO BE PERFORMED EACH TIME THE AGS 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 \( \Delta V \) EXCEEDING 20 FPS THE \( \Delta V \) CAN BE "BACKED OUT". IF THE \( \Delta V \) REMAINING IS \( \geq 8 \) FPS THEN RCS MAY BE USED TO COMPLETE THE MANEUVER. VELOCITY ERRORS FALLING BETWEEN THESE LIMITS MAY BE ADDED BY "STAGING" THE DESCENT STAGE AND UTILIZING THE RCS.
SECTI ON 2 - FLI GHT OPERAT I ON S RULES - CONT INUED

NASA — Manned Spacecraft Center
MISSION RULES

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<th>REV</th>
<th>ITEM</th>
<th>ALTERNATE MISSION GUIDELINES</th>
</tr>
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<tr>
<td>A</td>
<td>2-30</td>
<td>A. MAJOR ACTIVITIES WILL BE SCHEDULED FOR ALTERNATE MISSIONS IN ACCORDANCE WITH THE FOLLOWING PRIORITY:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. SUFFICIENT LM EVALUATION TO PERMIT RENDEZVOUS ACTIVITY</td>
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<tr>
<td></td>
<td></td>
<td>2. RENDEZVOUS</td>
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<tr>
<td></td>
<td></td>
<td>• NOMINAL (6 HRS)</td>
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<td></td>
<td></td>
<td>• FOOTBALL (4 1/2 HRS - 2 REVS)</td>
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<td></td>
<td></td>
<td>• FOOTBALL (3 HRS - 1 REV)</td>
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<td>3. DOCKED DPS BURN</td>
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<td>4. STATION KEEPING</td>
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<td>5. UNMANNED APS BURN</td>
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<td>6. EVA</td>
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<td></td>
<td></td>
<td>7. DOCKED SPS BURNS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. IF THE CSM GNCS FAILS, THE SPS BURNS, DOCKED LM ACTIVITIES, STATION KEEPING AND THE UNMANNED APS BURN WILL BE CONDUCTED.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. IF THE CSM PRIMARY COOLANT LOOP FAILS, THE LM RENDEZVOUS WILL BE TERMINATED; ALL OTHER ACTIVITIES WILL CONTINUE.</td>
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<td>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.</td>
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<td>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.</td>
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<td>G. IF THE LM PSNCS FAILS PRIOR TO RENDEZVOUS ALL DPS AND APS MANEUVERS AND THE RENDEZVOUS WILL BE DELETED. LM-ACTIVE STATION KEEPING MINI-BALL WILL BE CONDUCTED.</td>
</tr>
<tr>
<td></td>
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<td>H. IN THE EVENT AN ALTERNATE MISSION IS EXECUTED, AS MANY DTO'S WILL BE ACCOMPLISHED AS POSSIBLE. REF TABLE 2-1, PAGE 2-11, FOR MISSION ACTIVITIES DTO POSSIBILITIES.</td>
</tr>
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### Table 2-1: Mission Activity/DTO Accomplishments

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<thead>
<tr>
<th>Priority</th>
<th>Activity/Effect</th>
<th>LM/SPS/EM</th>
<th>Unmanned</th>
<th>Limited</th>
<th>Docked</th>
<th>DTO Burn</th>
<th>DTO Station</th>
<th>DTO Station/DTO Burn</th>
<th>SPS/EM Burn</th>
<th>Unmanned/SPS/EM Burn</th>
<th>DTO/SPS/EM Burn</th>
<th>DTO/SPS/EM Burn/DTO Burn</th>
<th>DTO/SPS/EM Burn/DTO Burn/SPS/EM Burn</th>
<th>DTO/SPS/EM Burn/DTO Burn/SPS/EM Burn</th>
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<tr>
<td>1 M11.2</td>
<td>DPS Burn Duration Effects and Primary Propulsion/</td>
<td>P</td>
<td>P</td>
<td>P</td>
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<td>C</td>
<td>P</td>
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<td>2 M11.7</td>
<td>LM Environmental and Propulsion Thermal Effects</td>
<td>P</td>
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<td>P</td>
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<td>C</td>
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<td>3 M11.8</td>
<td>LM Structural Integrity</td>
<td>P</td>
<td>P</td>
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<tr>
<td>5 M11.11</td>
<td>Long Duration APS Burn</td>
<td>P</td>
<td>P</td>
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<td>7 M17.9</td>
<td>Landing Gear Deployment/Thermal</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>P</td>
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<td>8 M15.3</td>
<td>LM EPS Performance Determination</td>
<td>P</td>
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<td>P</td>
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<tr>
<td>11 P13.4</td>
<td>PNCs Controlled APS Burn</td>
<td>P</td>
<td>P</td>
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<tr>
<td>12 P11.7</td>
<td>PNCs Attitude/Translation Control</td>
<td>P</td>
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<tr>
<td>14 P12.3</td>
<td>AGS/CSM Attitude/Translation Control</td>
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<td>15 P12.3</td>
<td>CSM Attitude Stability Margin</td>
<td>P</td>
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<td>16 P20.28</td>
<td>LM Active Docking</td>
<td>P</td>
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<td>18 P20.26</td>
<td>CSM Active Docking</td>
<td>P</td>
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<td>PNCs and GCs IMU Performance</td>
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<td>21 P1.9</td>
<td>GCs/TVT Janitor</td>
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<td>24 P20.34</td>
<td>Intraintravehicular Crew Transfer</td>
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<td>LM IMU Inflight Alignment</td>
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<td>31 P1.24</td>
<td>CSM IMU Alignment Accuracy</td>
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<td>34 S7.29</td>
<td>Exhaust Effects/CSM</td>
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<td>36 S1.26</td>
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<td>37 S13.10</td>
<td>APS Burn to Depletion</td>
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<td>38 S20.37</td>
<td>DPS Plume Effect</td>
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<td>39 S20.120</td>
<td>CSM/CSM Electromagnetic Compatibility</td>
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**Legend:**
- P = Partially Complete
- C = Completed
- 1 = CSM ECS/EPB Radiator Heat Rejection
- 2 = Docked SPS
- 3 = Before and After DPS Burn
- 4 = If Staged
## 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-PM-1.

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<td>1</td>
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<td>SPS 1</td>
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<td>1 or 2</td>
<td>SPS 2</td>
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<td>SPS 3</td>
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<td>SPS 8</td>
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<td>TD&amp;E</td>
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<td>LM SYSTEMS EVALUATION</td>
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<td>EXECUTE DOCKED DPS BURN</td>
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<td>3 or 4</td>
<td>PERFORM EVA</td>
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<td>4 or 5</td>
<td>STATION KEEPING (STAGE LM PRIOR TO DOCKING)</td>
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<tr>
<td>4 or 5</td>
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<td>DEORB IT</td>
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<td><strong>Alternate Mission C</strong></td>
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<tr>
<td>3 or 4</td>
<td>PERFORM EVA</td>
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<td>LONG APS BURN CONTINUE MISSION</td>
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<tr>
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<td>UNSAFE DESCENT STAGE</td>
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<td>(DESCENT STAGE SEPARATED PRIOR TO ALTERNATE MISSION)</td>
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<tr>
<td>1 or 2</td>
<td>TD&amp;E</td>
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<td><strong>Alternate Mission D</strong></td>
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<tr>
<td>2 or 3</td>
<td>LM SYSTEMS EVALUATION</td>
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<td>EXECUTE DOCKED DPS BURN</td>
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<td>3 - 5</td>
<td>STAGE DESCENT STAGE LONG APS BURN</td>
</tr>
<tr>
<td>3 - 6</td>
<td>DEORB IT</td>
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</table>

**Note:**
- CSM LIFETIME, NO SPS LM LIFETIME
- CSM LIFETIME, LM LIFETIME
- CSM LIFETIME, EITHER CSM COOLANT LOOP FAILURE

---

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SECTION 2 - FLIGHT OPERATIONS RULES - CONTINUED

NASA — Manned Spacecraft Center
MISSION RULES

RATING: 2-31 (CONT'D)

NOMINAL MISSION PERIOD OF ENTRY

ALTERNATE MISSION E

5
E-SA STATION KEEPING CONTINUE NOMINAL MISSION TIMELINE
E-SB MINI-FOOTBALL RENDEZVOUS CONTINUE NOMINAL MISSION TIMELINE
E-SC FOOTBALL RENDEZVOUS CONTINUE NOMINAL MISSION TIMELINE
E-SO CSM ACTIVE RENDEZVOUS CONTINUE NOMINAL MISSION TIMELINE

TYPICAL FUNCTIONAL FAILURE PRECIPITATING ALTERNATE MISSION

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-SO) 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-SA) LONG APS BURN CONTINUE MISSION

TYPICAL FUNCTIONAL FAILURE PRECIPITATING ALTERNATE MISSION

UNSAFE DESCENT STAGE DPS FAILURE, LM PRIMARY COOLANT LOOP FAILURE, DESCENT OR ASCENT STAGE ELECTRICAL POWER PROBLEMS, PGNCS FAILURE, RENDEZVOUS RADAR FAILURE, ADS LOST.

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<th>RULE NUMBERS 2-33 THROUGH 2-39 ARE RESERVED.</th>
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**SECTION 2 - FLIGHT OPERATIONS RULES - CONCLUDED**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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

#### Section 3 - Mission Rule Summary

**NASA — Manned Spacecraft Center**

**Mission Rules**

**GO/NO-GO Summary**

**Revision 1**

**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 3-1, page 3-21A, for GO/NO-GO summary.

**3-2**

The launch phase will be aborted for:

A. \( S-1C \) 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 EOS 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 \( I \) 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

**3-3**

**Post Insertion GO/NO-GO**

A. The \( S-IVB \) will be NO-GO after insertion or during orbit if any of the following conditions exist:
   1. Impending \( S-IVB \) bulkhead "P" problem
   2. \( S-IVB \) cold HE shut-off 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 NO-GO if any of the following conditions exist:
   1. ECS
      (A) Loss of cabin and suit integrity.

---

**Mission Rule Summary**

**Mission** | **Rev.** | **Page**
--- | --- | ---
**Apollo 9** | **A** | **3-1**
## 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 O₂ manifold, or loss of entry O₂ supplies.
   - **(B)** Loss of all cooling
2. **CRYO**
   - **(A)** Loss of both H₂ or both O₂ 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**
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 O2 MANIFOLD
   (D) LOSS OF SUIT INTEGRITY
   (E) LOSS OF ALL COOLING
   (F) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO
   (A) INSUFFICIENT O2 AND H2 TO SUPPLY CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (SHIFTING 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. GIC
   (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) 6V 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. OH-RCS
   (A) LOSS OF SOURCE PRESSURE - ONE RING
   (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   (C) OH-RCS ARMPED
### SECTION 3 - MISSION RULE SUMMARY - CONTINUED

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**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 O2 MANIFOLD
   - (D) LOSS OF CYCLIC ACCUMULATOR OPERATION
   - (E) POTABLE WATER TANK QUANTITY PLUS FUEL CELL PRODUCTION TO THE NEXT PTP WILL TOTAL <20 LBS
   - (G) LOSS OF URINE DUMP CAPABILITY FOR PTP'S SUBSEQUENT TO LM JETTISON
   - (J) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. **CRYO**
   - (A) INEFFECTIVE O2 AND H2 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. **GNC**
   - (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) PROPPELLANT REMAINING LESS THAN HYBRID DEORBIT REQUIREMENT, IF HYBRID AND SPS DEORBIT AVAILABLE. OTHERWISE PROPPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT

9. **CH-RCS**
   - (A) LOSS OF SOURCE PRESSURE - ONE RING
   - (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   - (C) CH-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.**
### SECTION 3 – MISSION RULE SUMMARY – CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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### 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 O₂ 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 O₂ AND H₂ TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (CIRCLING 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/HSPN)

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

6. **GEC**
   - (A) LOSS OF TWO TVC SERVO LOOPS
   - (B) LOSS OF THREE TVC CONTROL MODES (GEN, SCS AUTO, AND MTVC RATE OMD)

7. **SPS**
   - (A) LOSS OF BOTH GN₂ BOTTLES (<400 PSI)
   - (B) FUEL OR OXIDIZER FEEDLINE TEMPERATURE <2°F
   - (C) FLANGE TEMP >180°F ON PREVIOUS BURN
   - (D) CHAMBER PRESSURE <70 PSI ON PREVIOUS BURN
   - (E) FUEL/OXIDIZER GP <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
   - (J) ∆V 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
## Section 3 - Mission Rule Summary - Continued

**NASA — Manned Spacecraft Center**

### Mission Rules

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**Critical SPS Maneuver Go/No-Go**

A. The CSM will be No-Go if any of the following conditions exist:

1. **G6C**
   - (A) Loss of two TVC Servo Loops
   - (B) Loss of three TVC Control Modes (G&N, SCS Auto, and MTVC - Rate OVD)

2. **SPS**
   - (A) Pressure in either fuel or oxidizer tank <115 psi
   - (B) Loss of both LOX bottles (<400 psi)
   - (C) Fuel or oxidizer feedline temp <22°F
   - (D) Flange temp >80°F on previous burn
   - (E) Chamber pressure >12 psi on previous burn
   - (F) Fuel/Oxidizer gap >2 psi
   - (G) First burn subsequent to docked OOS was <40 sec
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 O2 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 O2 AND H2 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 (FTY 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. GEC
   (A) LOSS OF DIRECT RCS ANY AXIS
   (B) LOSS OF RATE DAMPING ANY AXIS
   (C) LOSS U: NO 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) AV REMAINING LESS THAN SPS DEORBIT REQUIREMENT

8. SH-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. CH-RCS
   (A) LOSS OF SOURCE PRESSURE - ONE RING
   (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   (C) CH-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
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 O₂ 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 O₂ AND H₂ 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) ≥V REMAINING LESS THAN SPS DEORBIT REQUIREMENT

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
### SECTION 3 - MISSION RULE SUMMARY - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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2. **EPS**

- (A) LOSS OF EITHER CRE 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 O₂ TANKS
- (G) LOSS OF ALL H₂O TANKS

4. **COMMUNICATIONS/INSTRUMENTATION**

- (A) LOSS OF CRITICAL ONBOARD DISPLAYS
- (B) LOSS OF ALL VHF COMMUNICATIONS

5. **GUIDANCE AND CONTROL**

- (A) LOSS OF A.T.C. ATTITUDE CONTROL CAPABILITY
- (B) LOSS OF OPS GIMBAL TRIM CONTROL
- (C) LOSS OF X-AXIS ATTITUDE CONTROL
- (D) 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-AXIS ATTITUDE CONTROL
- (B) PROPELLANT LEAKS

C. THE DOKED 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 & (100) 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 DOKED DPS BURN WILL BE NO-GO IF ANY OF THE FOLLOWING EMU CONDITIONS EXIST:

1. **OPS CHECKOUT**

- (A) OPS SOURCE PRESSURE < 3380 PSIA
- (B) OPS REG PRESSURE > 4.0 PSID OR < 3.4 PSID AT 0.1 LBS/HR
- (C) LOSS OF ILLUMINATION OF BOTH GREEN HEATER STATUS LIGHTS

2. **PLSS POS PRESSURE > 850 PSIA**
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 O₂ 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 O₂ AND H₂ TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO FTP PLUS THREE HOURS (OR LIFTOFF 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 (TH 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 (CMU/SFN)
   (C) LOSS OF TWO-WAY VOICE COMMUNICATIONS (CMU/LM)

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

6. GEC
   (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) SV 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 SM DEORBIT AVAILABLE. OTHERWISE PROPELLANT REMAINING LESS THAN SM DEORBIT REQUIREMENT
   (D) LEAK IN ANY FUEL OR OXIDIZER TANK

9. OH-RCS
   (A) LOSS OF SOURCE PRESSURE - ONE RING
   (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   (C) OH-RCS ARMED
### SECTION 3 - MISSION RULE SUMMARY - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<td>B. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST: (CONT'D)</td>
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<td>1. EPS</td>
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<tr>
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<td></td>
<td>(B) LOSS OF THREE OR MORE DESCENT BATTERIES</td>
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<td>(C) LOSS OF TWO OR MORE DESCENT BATTERIES IF EITHER ASCENT BATTERY IS LOST</td>
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<td>(D) LOSS OF BOTH ASCENT BATTERIES</td>
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<td>(E) LOSS OF INTEGRAL AND FLOOD LIGHTS</td>
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<td>2. ECS</td>
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<td>(B) LOSS OF SUIT LOOP INTEGRITY</td>
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<td>(C) LOSS OF BOTH SUIT FANS</td>
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<td>(D) LOSS OF BOTH DEMAND REGULATORS</td>
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<td>(E) LOSS OF PRIMARY AND SECONDARY COOLANT LOOPS</td>
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<td>(F) LOSS OF DESCENT O2 TANK</td>
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<td>(G) LOSS OF BOTH ASCENT TANKS</td>
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<td>(H) LOSS OF ALL H2O TANKS</td>
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<td>(B) LOSS OF UHF DUPLEX CAPABILITY</td>
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<td>(A) PROPELLANT LEAKS</td>
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<td>(B) IMPELLING DPS PROPELLANT VENTING</td>
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<td>5. RCS</td>
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<td></td>
<td>(A) PROPELLANT LEAK</td>
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<td>C. THE EVA WILL BE NO-GO IF ANY OF THE FOLLOWING INTERFACE CONDITIONS EXIST:</td>
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<td>(A) FAILURE OF CH OR LM TO MAINTAIN SEPARATE PRESSURE INTEGRITY</td>
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<tr>
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<td>(B) FAILURE OF LM DEMAND REGULATORS TO MAINTAIN CABIN PRESSURE &gt; 180 PSIA</td>
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<td>(A) LOSS OF TWO-WAY UHF VOICE COMMUNICATIONS BETWEEN THREE CREWMAN (CONFERENCE)</td>
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<td>(B) LOSS OF TWO-WAY VOICE BETWEEN MCC AND BOTH CMP AND COR</td>
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<td>3. THE EVA WILL BE NO-GO IF ANY OF THE FOLLOWING EMU CONDITIONS EXIST:</td>
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<td>(C) BAT VOLTAGE &gt;13V TDC</td>
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<td>2. PGA/PLSS CHECKOUT</td>
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<td>(A) POS &lt;850 PSIA</td>
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<td>(B) PGA PRESSURE &gt;3.0 PSID OR &lt;1.7 PSID, OR EMU PRESSURE DECAY &gt;0.40 PSID/MIN</td>
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<td>(C) BAT VOLTAGE &gt;13V TDC</td>
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<td>(D) FAILURE TO ACTIVATE PUMP OR FAN</td>
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<td>(E) PGA PRESSURE &gt;3.0 PSID DURING LM CABIN DEPRESS</td>
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<td>(F) LOSS OF CRITICAL INSTRUMENTATION</td>
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<td></td>
<td>3. SUBLIMATOR CHECKOUT</td>
</tr>
<tr>
<td></td>
<td>INADEQUATE LCS/LTV COOLING</td>
</tr>
</tbody>
</table>
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 O2 MANIFOLD
   (D) LOSS OF CYCLIC ACCUMULATOR OPERATION
   (E) LOSS OF DECOCKING GO/NO-GO

2. CRYO
   (A) INSUFFICIENT O2 AND H2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS THREE HOURS (DRIFT 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/MONITOREMENT
   (A) LOSS OF INSTRUMENTATION (TH 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. GEC
   (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 DEOBIT METHODS

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

9. CM-RCS
   (A) LOSS OF SOURCE PRESSURE - ONE RING
   (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   (C) CM-RCS ARMED
SECTION 3 - MISSION RULE SUMMARY - CONTINUED

NASA — Manned Spacecraft Center

MISSION RULES

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 O₂ TANKS
   (G) LOSS OF ALL H₂O 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, DROSGE, LM UPPER HATCH

2. COMMUNICATION
   (A) LOSS OF TWO-WAY VOICE COMMUNICATION BETWEEN CSM AND LM
   (B) LOSS OF MORN 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) O₂ SOURCE PRESSURE <538 PSIA
   (B) O₂ 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) PLESS POS PRESSURE <850 PSIA
   (E) PLESS POS PRESSURE <400 PSIA POST EVA (INITIAL CHECKOUT LEAK RATE <0.4 PSIA PER MIN)

2. EVT HAS BEEN ATTEMPTED AND NOT COMPLETED SATISFACTORY WITHIN THE DPS LIFETIME.
SECTION 3 - MISSION RULE SUMMARY - CONTINUED

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MISSION RULES

1-13

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 O2 MANIFOLD
   (D) LOSS OF CYCLIC ACCUMULATOR OPERATION
   (E) LOSS OF PRIMARY GLYCOL LOOP COOLING
   (F) POTABLE WATER TANK QUANTITY PLUS FUEL CELL PRODUCTION TO THE COMPLETION OF RENDEZVOUS WILL TOTAL <10 LBS
   (G) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO
   (A) INSUFFICIENT O2 AND H2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS 2 REV (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 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 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) VV 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
### SECTION 3 – MISSION RULE SUMMARY – CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<th>ITEM</th>
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<tr>
<td>3-13</td>
<td><strong>B. THE LM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:</strong></td>
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<td><strong>1. EPS</strong></td>
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<td>(B) LOSS OF THREE OR MORE DESCENT BATTERIES</td>
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<td>(C) LOSS OF TWO OR MORE DESCENT BATTERIES IF EITHER ASCENT BATTERY LOST</td>
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<td>(D) LOSS OF B-14 ASCENT BATTERIES</td>
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<td>(E) LOSS OF BOTH INVERTERS</td>
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<td>(F) LOSS OF ALL BUS A</td>
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<td><strong>2. ECS</strong></td>
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<td>(A) LOSS OF CABIN PRESSURE INTEGRITY</td>
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<td>(F) LOSS OF PRIMARY H2O FEEDPATH CAPABILITY</td>
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<td>(G) LOSS OF ALL 1/2 TANKS</td>
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<td>(H) LOSS OF TWO OR MORE O2 TANKS</td>
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<td><strong>3. COMMUNICATIONS/INSTRUMENTATION</strong></td>
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<td>(A) LOSS OF ONBOARD CRITICAL DISPLAYS</td>
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<td><strong>4. GUIDANCE AND CONTROL</strong></td>
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<td>(A) LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL</td>
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<td><strong>7. RCS</strong></td>
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<td>(B) REDUNDANT 3-AXIS ATTITUDE CONTROL</td>
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<td><strong>C. THE SEPARATION MANEUVER WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST:</strong></td>
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<td><strong>1. COMMUNICATIONS</strong></td>
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<td>(B) LOSS OF TWO-WAY VOICE COMMUNICATION BETWEEN MPN AND EITHER CSM OR LM</td>
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<td>(C) LOSS OF LM TELEMETRY OR CSM TELEMETRY</td>
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PHASING MANEUVER GO/NO-GO

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

1. ELs
   (A) LOSS OF CABIN INTEGRITY
   (B) LOSS OF SUIT CIRCUIT
   (C) LOSS OF O₂ MANIFOLD
   (D) 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) CONFM. LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO
   (A) INSUFFICIENT O₂ AND H₂ TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS 2 REV (ORBITING 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 (CIMU)
   (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 CAMPING (ANY AXIS)
   (C) LOSS OF TWO DEORBIT METHODS
   (D) LOSS OF CAPABILITY TO PERFORM CRITICAL SPS MANEUVER
   (E) LOSS OF IMU, CM, BOTH DSRT'S, OPTICS OR BOTH DOL'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
## SECTION 3 - MISSION RULE SUMMARY - CONTINUED

**NASA — Manned Spacecraft Center**

### MISSION RULES

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<th>DESCRIPTION</th>
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<td><strong>Landing Module (LM) will be NO-GO if any of the following conditions exist:</strong></td>
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<td><strong>Sequential and Pyrotechnics</strong></td>
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<td>(A) Loss of either pyro system A or B</td>
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<td><strong>ECS</strong></td>
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<td>(A) Loss of cabin pressure integrity</td>
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<td>(B) Loss of suit loop integrity</td>
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<td><img src="image" alt="Cont'd" /></td>
<td>(C) Loss of both suit fans</td>
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<td><img src="image" alt="Cont'd" /></td>
<td>(D) Loss of both H2O separators</td>
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<td>(E) Loss of both demand regulators</td>
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<td>(F) Loss of either primary or secondary coolant loops</td>
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<td>(G) Loss of primary H2O feedpath capability</td>
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<td>(H) Loss of two or more O2 tanks</td>
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<td>(I) Loss of all H2O tanks</td>
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<td><strong>Communications/Instrumentation</strong></td>
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<tr>
<td><img src="image" alt="Cont'd" /></td>
<td>(A) Loss of critical on-board displays</td>
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<td>(A) Loss of redundant 3-axis attitude control</td>
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<td>(B) Loss of PMU</td>
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<td>(G) Loss of ENG ON/OFF capability</td>
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<td>(H) Loss of operational throttle control capability</td>
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<td>(I) Loss of both ADT and COAS</td>
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<td>(A) Propellant leaks</td>
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<td>(B) 3-axis translation control</td>
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**C. The Phasing Maneuver will be NO-GO if any of the following interface conditions exist:**

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<td><img src="image" alt="Cont'd" /></td>
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<td>(A) Loss of two-way voice communication between vehicles with backup</td>
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<tr>
<td><img src="image" alt="Cont'd" /></td>
<td>(B) Loss of two-way voice communications between MSFN and either CSM or LM</td>
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<td><img src="image" alt="Cont'd" /></td>
<td>(C) Loss of LM telemetry or CSM telemetry</td>
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</table>
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 O₂ MANIFOLD
   (D) LOSS OF CIRCULATING O₂ MANIFOLD
   (E) LOSS OF PRIMARY GLYCOL LOOP COOLING
   (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) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO
   (A) INSUFFICIENT O₂ AND H₂ TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT
      GO/NO-GO PTP PLUS 2 REV (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 SPACE OR ON GROUND.
   (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSFN)
   (C) LOSS OF TWO-WAY VOICE COMMUNICATIONS (CSM/LOM)
   (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 DEOBUIT MTHODS
   (D) LOSS OF CAPABILITY TO PERFORM CRITICAL SPS MANEUVERS
   (E) LOSS OF IMU, CMC, BOTH DSKY's, OPTICS OR BOTH POA/1'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 DEOBUIT REQUIREMENT, IF HYBRID
      AND SPS DEOBUIT AVAILABLE, OTHERWISE PROPELLANT REMAINING LESS THAN
      SM DEOBUIT REQUIREMENT.

9. CM-RCS
   (A) LOSS OF SOURCE PRESSURE - ONE RING
   (B) LOSS OF MANIFOLD PRESSURE - ONE RING
   (C) CM-RCS ARMED
**NASA — Manned Spacecraft Center**

**MISSION RULES**

**SECTION 3 - MISSION RULE SUMMARY - CONTINUED**

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<th>REV</th>
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<td>3-15 (CONT'D)</td>
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**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 H2O SEPARATORS
   - (E) LOSS OF BOTH DEMAND REGULATORS
   - (F) LOSS OF EITHER PRIMARY OR SECONDARY COOLANT LOOPS
   - (G) LOSS OF PRIMARY H2O FEED PATH CAPABILITY
   - (H) LOSS OF DESCENT O2 TANK
   - (I) LOSS OF BOTH ASCENT O2 TANKS
   - (J) LOSS OF TWO OR MORE H2O 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 AGS
   - (C) LOSS OF 4X-AXIS TRANSLATION CAPABILITY
   - (D) LOSS OF ORCA OTRACK
   - (E) LOSS OF BOTH FDAS
   - (F) LOSS OF DSG
   - (G) LOSS OF ENS ON/OFF CAPABILITY
   - (H) LOSS OF OPERATIONAL THROTTLE CONTROL
   - (I) LOSS OF ADT AND COAS

6. **DPS/APS**
   - (A) LOSS OF OPERATIONAL DPS AND APS
   - (B) APS PROPELLANT LEAK
   - (C) LESS THAN 160 FPS DPS AV CAPABILITY IF APS IS NOT OPERATIONAL

7. **RCS**
   - (A) LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL
   - (B) LOSS OF 4X-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
**SECTION 3 - MISSION RULE SUMMARY - CONTINUED**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<td>LM STAGING GO/NO-GO</td>
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</table>

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 H2O SEPARATORS
   - (E) LOSS OF BOTH DEMAND REGULATORS
   - (F) LOSS OF EITHER ASCENT O2 TANK
   - (G) LOSS OF BOTH ASCENT H2O 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 4X TRANSLATION CAPABILITY

6. **APS**
   - (A) PROPELLANT LEAK
   - (B)  |

7. **RCS**
   - (A) LOSS OF 4X TRANSLATION CAPABILITY
   - (B) LOSS OF 3-AXIS ATTITUDE CONTROL CAPABILITY
**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 COR 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

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**TABLE 3-1. - GO/NO-GO SUMMARY**

- E/0: WITH CABIN LOSS
- 1 OF 2:
- 1 OF 3:
- 1 OF 4:
- <18 LB AT NEXT GO/NO-GO OR NO POT:
- PRI OR SEC:
- BOTH:
- CLI:
- PRI:
- EO:
- 1 OF 2:
- 1 OF 3:
- 1 OF 4:
- PRI:
- BOTH:
- EO:
- 1 OF 2:
- 1 OF 3:
- 1 OF 4:
- PRI:
- BOTH:
- EO:
CONTINUE IF BOTH SPS AND SM DEORBIT AVAILABLE

CONTINUE IF BOTH SM AND HYBRID AVAILABLE

* ABORT MODE 1 OR 2 ONLY

6-4 AND IVT DPS 1 EVA UNDOCK SEP PHASE INS

1 OF 2 RHC
1 OF 2 SCS/DAP
THC REQ

1 OF 2

1 OF 3 SCS/DAP/MAD

2 OF 3

2 OF 3

ALL REQ

1 OF 2

2 OF 3

1 OF EACH

1 OF 2

<1816 AT NEXT GO/NO-GO OR NO POT

PRI OR SEC

PRI

1 OF 2

BOTH

BOTH

3-21A
SECTION 3 - MISSION RULE SUMMARY - CONTINUED

NASA — Manned Spacecraft Center

MISSION RULES

ASSUMING:
A. TRAPPED PROPELLANT = 20 LBS
   CAI.ING UNCERTAINTY = 25 LBS
   350 LBS — UNUSABLE AND NOT SHOWN ON GRAPHS
B. NO SPS RESERVE

SAVE-R5 (9/68)

1. HYBRID:
   A. PROPELLANT REQUIRED FOR SEPARATION MANEUVER PLUS CM RESCUE OF LH AFTER LH INSERTION.
      INCLUDES VALUE FOR CM AND CM MANEUVERS, TPJ, ACCURACY, BRAKING, DOCKING, AND THE
      HYBRID DECONT. REALINE.
   B. PROPELLANT REQUIRED FOR SEPARATION MANEUVER PLUS SEPARATION MANEUVER PLUS CM RESCUE OF
      LH AFTER LH INSERTION PRIOR TO INSERTION. INCLUDES TPJ, ACCURACY, BRAKING, DOCKING,
      AND THE HYBRID DECONT. REALINE.
   C. PROPELLANT REQUIRED FOR SEPARATION MANEUVER PLUS CM RESCUE OF LH AFTER SEPARATION BUT
      PRIOR TO MANEUVER. INCLUDES LOS CONTROL, BRAKING, DOCKING, AND THE HYBRID DECONT. REALINE.

2. THE EVA WILL BE CONSIDERED FOR DELETION IN ORDER TO MEET THE SEPARATION POINT (E) FOR
   THE FASTBALL RENDEZVOUS.

REQUIREMENTS:

1. ORBIT INSERTION TO LH EXTRACTION
   A. THE ORBIT WILL TERMINATE AT THE TIDE REALINE. THE PROPELLANT IN E WILL ALLOW A CM
      ACTIVELY RENDEZVOUS WITH THE 5-1HYBRID AND ALLOWS ___ LBS FOR I/O ACCOMPLISHMENT. REP
      ALTERNATE MISSION.
   B. THE HYBRID DECONT. REALINE THROUGHOUT THIS PERIOD IS THE PROPELLANT REQUIRED FOR A HYBRID
      DECONT. FROM THE RENDEZVOUS ORBIT M(IH2/IH3) AS THE END OF RENDEZVOUS CM HEAT. IF THE
      CM MUST SEPARATE EARLY FROM THE 5-1HYBRID FOR SAFETY REASONS AND IT IS SUBSEQUENTLY DECIDED
      TO RENDEZVOUS AND ATTEMPT EXTRACTION, THE ONLY APPLICABLE REALINE IS THE HYBRID DECONT.
      REALINE.

2. LH EXTRACTION TO SPS 81:
   A. SAME AS B
   B. SPS 86 TO SPS 81
   C. PROPELLANT REQUIRED FOR A HYBRID DECONT. FROM A 5-102/IH3 CM ORBIT.
   D. SPS 87 TO SPS 81
   E. PROPELLANT REQUIRED FOR A HYBRID DECONT. FROM A 5-202/IH3 CM ORBIT.
   F. IN THE EVENT OF THE LOSS OF ONE SPS ON THE HYBRID ORBIT, THE DECONT. REALINE WILL BE
      INCREASED BY 40 LBS IN THE APPROPRIATE ORBIT TO ALLOW FOR RCS RECOVERY OF A SUBSEQUENT SPS.
      AFTER RENDEZVOUS, EVERY ATTEMPT WILL BE MADE TO STAY ABOVE THE CM RCS REALINE (CM). SPS 46
      WILL BE CONSIDERED FOR EMERGENCY EXECUTION TO MEET THIS OBJECTIVE.

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<td>THE NOMINAL END OF MISSION SPS PROPELLANT MARGIN IS APPROXIMATELY 2100 LBS.</td>
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<td>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 16.1 PERCENT INDICATED PROPELLANT REMAINING.</td>
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<td>THE SPS PROPELLANT REDLINE TO PROVIDE 31 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.</td>
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<td>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.</td>
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### CSM CRYOGENICS AND WATER

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<td>THE NOMINAL END OF MISSION MARGINS FOR CSM CRYOGENICS ARE: H₂ - 10.12 LBS, AND O₂ - 150.3 LBS</td>
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<td>THE MINIMUM REQUIREMENT TO CONTINUE PAST A DAILY GO/NO-GO PTP IS SUFFICIENT CRYOGENICS AND WATER TO SUPPLY FUEL CELL AND ECS DEMANDS FOR THE NEXT DAILY GO/NO-GO PTP PLUS TWO REVOLUTIONS.</td>
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<td>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.</td>
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<td>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.</td>
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</tbody>
</table>

RULE NUMBERS 3-29 THROUGH 3-30 ARE RESERVED.
SECTION 3 - MISSION RULE SUMMARY - CONTINUED

NASA — Manned Spacecraft Center
MISSION RULES

ASSUMPTIONS
A. TRAPPED PROPELLANT = 47.1 LBS
GAGING UNCERTAINTY = 4.3 LBS
84.4 LBS (UNUSABLE AND NOT SHOWN ON GRAPH)
B. OPS RESERVE = 1 REV OF LM ACTIVE STATION KEEPING (22 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

RULES
UNDOCKING-TO-M Assassumption:
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.
### LM DPS

| 3-32 | The nominal APS propellant margin is approximately 7000 lbs. There are no redlines or go/no-go's planned. |

### LM APS

| 3-35 | 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 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 |

| 1-36 | After committing to rendezvous, the LM will perform the rendezvous maneuvers as long as there is power enough to complete that maneuver and poweredown flight through CSM rescue. |

### LM O₂/WATER

| 3-37 | The LM O₂ and H₂O minimum requirements to initiate an active LM mission phase is sufficient O₂/water to meet ECS demands for that phase plus two revolutions. |

| 1-38 | 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, ph.t.
SECTION 3 - MISSION RULE SUMMARY - CONCLUDED

NASA — Manned Spacecraft Center
MISSION RULES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PLSS</th>
</tr>
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<tbody>
<tr>
<td>3-39</td>
<td>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:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ALLOWANCES</th>
<th>PRESSURE (PSIA)</th>
<th>QUANTITY (LBS MASS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. USABLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) PLANNING ALLOWANCE</td>
<td>660</td>
<td>.811</td>
</tr>
<tr>
<td>(2) OPERATIONAL RESERVE</td>
<td>60</td>
<td>0.076</td>
</tr>
<tr>
<td>B. UNS Usable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) MEASUREMENT INACCURACIES</td>
<td>45</td>
<td>0.056</td>
</tr>
<tr>
<td>(2) RESIDUAL</td>
<td>85</td>
<td>0.105</td>
</tr>
<tr>
<td>C. TOTAL</td>
<td>850</td>
<td>1.048</td>
</tr>
</tbody>
</table>

\*\*BASED ON WORSE CASE LEAK RATE .4 PSID/Min AT 8.95 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: |

<table>
<thead>
<tr>
<th>ALLOWANCES</th>
<th>PRESSURE (PSIA)</th>
<th>QUANTITY (LBS MASS)</th>
</tr>
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<tr>
<td>A. USABLE</td>
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<tr>
<td>PLANNING ALLOWANCE</td>
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<td>0.325</td>
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<tr>
<td>B. UNS Usable</td>
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<td></td>
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<tr>
<td>(1) MEASUREMENT INACCURACIES</td>
<td>45</td>
<td>0.056</td>
</tr>
<tr>
<td>(2) RESIDUAL</td>
<td>85</td>
<td>0.105</td>
</tr>
<tr>
<td>C. TOTAL</td>
<td>400</td>
<td>.486</td>
</tr>
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</table>

\*\*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: |

<table>
<thead>
<tr>
<th>POWER (AMP-HR)</th>
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<tbody>
<tr>
<td>1. USABLE</td>
</tr>
<tr>
<td>(A) PLANNING ALLOWANCE</td>
</tr>
<tr>
<td>(B) OPERATIONAL RESERVE</td>
</tr>
<tr>
<td>2. UNS Usable</td>
</tr>
<tr>
<td>MEASUREMENT INACCURACY</td>
</tr>
<tr>
<td>3. TOTAL CHARGE</td>
</tr>
</tbody>
</table>

\*\*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.

MISSION REV ITEM
---
APOLLO 9 FINAL 12/15/68 MISSION RULE SUMMARY CONSUMABLES 3-27
SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS

NASA — Manned Spacecraft Center

MISSION RULES

GENERAL

A. THE FOLLOWING PRELAUNCH REQUIREMENTS DEFINE THE MCC/MSFC 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.
### SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

<table>
<thead>
<tr>
<th>REV</th>
<th>RULE</th>
<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<tbody>
<tr>
<td>A</td>
<td>4-2</td>
<td>COMPUTER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. MDC (IBM 360/75)</td>
<td>PRE LN</td>
<td>MANDATORY</td>
<td>TO PROCESS MANDATORY S/V PARAMETERS AND TRAJECTORY DATA.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. DSC (IBM 360/75)</td>
<td>PRE LN</td>
<td>HIGHLY DESIRABLE</td>
<td>AN DSC (IBM 360/75) IS AVAILABLE AS BACKUP TO THE MDC OR DSC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. CCATS (UNIVAC 494)</td>
<td>PRE LN</td>
<td>1 MANDATORY</td>
<td>ALL DATA ENTERING OR LEAVING MCC MUST BE ROUTED BY CCATS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. CCATS (UNIVAC 494)</td>
<td>PRE LN</td>
<td>1 HIGHLY</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. RTACF - 2</td>
<td>PRE LN</td>
<td>DESIRABLE</td>
<td></td>
</tr>
</tbody>
</table>

| A   | 4-3  | COMMAND                |       |                 |                                                                                     |
|     |      | A. MCCR TOGGLE SWITCHES|       |                 |                                                                                     |
|     |      | 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. MCCR COMMAND PANELS:|       |                 |                                                                                     |
|     |      | EECOM, GUIDO, BSE,   | PRE LN| 1 OF 5 MANDATORY| REQUIRED TO SATISFY RULE 4-21                                                     |
|     |      | TELCOM, CONTROL       |       |                 |                                                                                     |
|     |      | C. MCCR CONSOLE/SITE |       |                 |                                                                                     |
|     |      | SELECT CAPABILITY     |       |                 |                                                                                     |
|     |      | 1. RTC CONSOLE        | PRE LN| 1 OF 2 MANDATORY| REQUIRED TO SITE SELECT A CONSOLE SO THAT COMMANDING CAN BE ACCOMPLISHED           |
|     |      | (CCATS)               |       |                 |                                                                                     |
|     |      | 2. CCATS CMD CONSOLE  |       |                 |                                                                                     |
|     |      | MEC                   |       |                 |                                                                                     |
|     |      | D. FC/MEO SWITCHING   |       |                 |                                                                                     |
|     |      | CAPABILITY            |       |                 |                                                                                     |
|     |      | 1. FLIGHT DIRECTOR    | PRE LN| 1 OF 2 MANDATORY| REQUIRED TO ENABLE MCC OUTPUT COMMANDING                                           |
|     |      | 2. CCATS CMD MEC      |       |                 |                                                                                     |

### NASA — Manned Spacecraft Center

**MISSION RULES**

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<th>PAGE</th>
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<tbody>
<tr>
<td>APOLLO 9</td>
<td>A</td>
<td>2/15/69</td>
<td>GROUND INSTRUMENTATION REQUIREMENTS</td>
<td>MCC</td>
<td>4-2</td>
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</table>

**PREPARED** Form 262 (Aug 62)
### Ground Instrumentation Requirements - Continued

**NASA — Manned Spacecraft Center**

#### Mission Rules

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<th>RULE</th>
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<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<tbody>
<tr>
<td>4-4</td>
<td>TELEMETERY</td>
<td>A. CONSOLE DISPLAY (D/T/V, EVENTS, ANALOGS)</td>
<td>PRE LN</td>
<td>MANDATORY</td>
<td>FOR DISPLAY OF MANDATORY S/V PARAMETERS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. PCM GROUND STATIONS (%)</td>
<td>PRE LN</td>
<td>1 OF 4 MANDATORY, 1 HIGHLY DESIRABLE</td>
<td>FOR DISPLAY OF MANDATORY S/V EVENTS AND ANALOGS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. RECORDING AND PLAYBACK ALDS</td>
<td>PRE LN</td>
<td>BOTH DESIRABLE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. FM - GROUND STATION</td>
<td>PRE LN</td>
<td>1 OF 2 MANDATORY</td>
<td>TO PROVIDE MANDATORY DISPLAY DATA FOR THE MCC Surgeon.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>TRAJECTORY</th>
<th>A. TRAJECTORY DATA PROCESSING</th>
<th>PRE LN</th>
<th>1 MANDATORY</th>
<th>THE TRAJECTORY DATA SOURCES ARE UTILIZED AS FOLLOWS:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. AVAILABLEITY OF ONE INDEPENDENT TRACKING SOURCE (IFP, USB) FROM LIFTOFF TO T+10 MINUTES.</td>
<td></td>
<td></td>
<td>1. INDEPENDENT VERIFICATION OF L/V NAVIGATION.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. IU AND CMC TLM VECTORS FROM LIFTOFF TO INSERTION PLUS 60 SECONDS.</td>
<td></td>
<td></td>
<td>2. PROTECT AGAINST VIOLATION OF LAUNCH ENVELOPE.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. RTCC - DATA SELECT CAPABILITY</td>
<td>PRE LN</td>
<td>1 MANDATORY</td>
<td>REQUIRED FOR MAKING ORBIT GO/NO-GO DECISION</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>REQUIRED TO SELECT BEST AVAILABLE TRACKING SOURCE FOR INPUT TO RTCC FOR ORBITAL DETERMINATION.</td>
</tr>
</tbody>
</table>

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(Figures 707, 708, 291)
### SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

**NASA — Manned Spacecraft Center**

#### MISSION RULES

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<th>REV</th>
<th>RULE</th>
<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<tr>
<td>A</td>
<td>4-6</td>
<td>MCC POWER</td>
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<tr>
<td></td>
<td></td>
<td>A. BUS A₁</td>
<td>PRE LN</td>
<td>MANDATORY</td>
<td>UNINTERRUPTABLE POWER FOR:</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>WIDE BAND CROSSBAR SWITCH</td>
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<td>B. BUS A₂</td>
<td>PRE LN</td>
<td>MANDATORY</td>
<td>UNINTERRUPTABLE POWER FOR:</td>
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<td></td>
<td></td>
<td></td>
<td>D/TV DATA DISTRIBUTORS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. BUS B₁</td>
<td>PRE LN</td>
<td>MANDATORY</td>
<td>20 SECONDS INTERRUPTABLE POWER FOR:</td>
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<tr>
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<td></td>
<td></td>
<td>PLOTBOARDS</td>
</tr>
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<td>D. BUS B₂</td>
<td>PRE LN</td>
<td>MANDATORY</td>
<td>20 SECONDS INTERRUPTABLE POWER FOR:</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>VIDEO SWITCHING MATRIX (VSM)</td>
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**MISSION** | **REV** | **DATE** | **SECTION** | **GROUP** | **PAGE**
---|---|---|---|---|---
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<tr>
<td>A</td>
<td>4-7</td>
<td>DISPLAY</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>A. MOCR D/TV CHANNELS</td>
<td>PRE LN/LN</td>
<td>22 OF 35 MANDATORY TO T-10 MIN. 20 OF 34 MANDATORY AFTER T-10 MIN TO T-20 SEC</td>
<td>GNC - 3, EECOM - 3, RTCC - 1, FDO/GUIDO/RETRO - 4, BSE - 8, SURGEON - 2, TELCOM - 1, CONTROL - 1</td>
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<tr>
<td></td>
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<td>MSK NUMBER</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>GNC (3 CHANNELS)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>1. 0063</td>
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<td></td>
<td>GNC PRIMARY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. 0966</td>
<td></td>
<td></td>
<td>GNC COMMON</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. EXTRA</td>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EECOM (3 CHANNELS)</td>
<td></td>
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<td>4. 0403</td>
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<td>7. ONE CHANNEL TO BE SHARED BY THE FOLLOWING DISPLAYS:</td>
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<td></td>
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</tr>
<tr>
<td></td>
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<td>1613</td>
<td></td>
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<td>GAMMA VS VELOCITY (BEST SOURCE)</td>
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<td></td>
<td>1614</td>
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<td>GAMMA VS VELOCITY (RAW)</td>
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<tr>
<td></td>
<td></td>
<td>2001</td>
<td></td>
<td></td>
<td>(IBO) TM STATUS NO. 1 - DISPLAYS COMPUTER EVENTS, TIMING, INPUT/OUTPUT COMPUTER STATUS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FDO/GUIDO/RETRO (4 CHANNELS)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>8. 0043</td>
<td></td>
<td></td>
<td>FDO LAUNCH DIGITALS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. 0330</td>
<td></td>
<td></td>
<td>RF0 LAUNCH DIGITAL</td>
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<tr>
<td></td>
<td></td>
<td>10. ONE CHANNEL</td>
<td></td>
<td></td>
<td>GUIDANCE INSERTION/INJECTION DIGITALS</td>
</tr>
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<td>BOOSTER (8 CHANNELS)</td>
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<td></td>
<td></td>
<td>12. 1402</td>
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<td>BSE NO. 1</td>
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<tr>
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<td>13. 1403</td>
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<td>14. 1404</td>
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<td>15. 1400</td>
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<td>1401 1 OF 3</td>
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<td>2. ( y ) VS ( v )</td>
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<td>4. ( \psi ) VS ( \psi )</td>
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<td>7. ( h ) VS ( d )</td>
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<td>10. GUIDO ANALOG CHART RECORDERS ONE AND TWO</td>
<td>PRE LN</td>
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<td>NOTE: INDIVIDUAL FLIGHT CONTROL OF DISPLAY CAPABILITY OF TO THE FLIGHT DIRECTOR.</td>
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**NASA — Manned Spacecraft Center**

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**RULE NUMBERS 4-10 THROUGH 4-15 ARE RESERVED.**
### GSFC

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<td>A. ONE UNIVAC - 4902 CAN PERFORM ALL NECESSARY FUNCTIONS, THE SECOND ONE IS BACKUP.</td>
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<td>WB 9 (50.0 KBPS) LINES (2) BETWEEN MGC AND GSFC</td>
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<td>TTY CIRCUITS BETWEEN MGC AND GSFC</td>
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<td>B. EITHER LINE CAN BE SWITCHED TO EITHER UNIVAC - 4902.</td>
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<td>1. TEXT CIRCUITS (TRANSMIT ONLY)</td>
<td>PRE LN</td>
<td>C.1. FOR ACQ MSG, LS CMD</td>
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<td>2. SIX LOW-SPEED (JJ) CIRCUITS</td>
<td>PRE LN</td>
<td>C.2. FOR RECEPTION OF LOW-SPEED RADAR DATA.</td>
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### KSC

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<td>C. WB 9 (50.0 KBPS) LINES BETWEEN MGC AND KSC (2)</td>
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<td>1. TEL IV - 30-FT DISH</td>
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<td>A. EITHER DATA CORE CAN BE SWITCHED TO EITHER ALDS COMPUTER.</td>
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<td>2. C1F ANTENNA, OR</td>
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<td>B. EITHER SDS - 930 CAN RECEIVE INPUTS FROM EITHER DATA CORE AND CAN OUTPUT ON EITHER WB 9 (50.0 KBPS) LINE.</td>
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<td>3. MILA VHF ANTENNA</td>
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<td>C. EITHER CAN BE SWITCHED TO EITHER ALDS COMPUTER.</td>
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<td>E. USB TM FROM THE FOLLOWING:</td>
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<td>1. MILA USB, OR</td>
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<td>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 STATION VIA HARD-LINE TO BACKUP THE MILA VHF ANTENNA. VHF IS THE 5-11'S ONLY SOURCE OF DATA.</td>
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<tr>
<td></td>
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<td>2. MANDY USB</td>
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<td>E. USB IS THE CSM'S ONLY SOURCE OF DATA.</td>
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### Voice Communications:

- That capability required to satisfy Rule 4-5 (trajectory) is mandatory.

### Mission Requirements:

- This capability is defined under GSFC/KSC/MSFN Command Rule 4-18a for launch coverage.
- Tracking:
  - That capability required to satisfy Rule 4-6 (trajectory) is mandatory.
- Voice Communications:
  - That capability required to satisfy MCC Rule 4-9 (communications) is mandatory.
### Section 4 - Ground Instrumentation Requirements - Continued

**NASA - Manned Spacecraft Center**

#### Mission Rules

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<tr>
<td>A</td>
<td></td>
<td>OMD</td>
<td>CCS</td>
<td>PRE LN</td>
<td>HIGHLY DESIRABLE AT BDA OR VAN TO BACKUP CRITICAL SLV FUNCTIONS.</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>TELEMETRY S-IC (VHF)</td>
<td>CCS</td>
<td>PRE LN</td>
<td>HIGHLY DESIRABLE S-IC DATA IS ONLY HIGHLY DESIRABLE SINCE THE MCC IS NOT PRIME FOR REQUESTING AN ABORT FOR S-IC MALFUNCTIONS.</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>S-II(VHF)</td>
<td>PRE LN</td>
<td>MANDATORY FROM LIFTOFF TO S-IVB CUTOFF (APPROX: 8 + 36 SEC) MCC IS PRIME FOR REQUESTING AN ABORT FOR S-II MALFUNCTIONS.</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>S-IVB VHF (CP-1)</td>
<td>PRE LN</td>
<td>1/2 MANDATORY FROM LIFTOFF TO S-IVB CUTOFF PLUS 60 SEC. MCC IS PRIME FOR REQUESTING AN ABORT FOR S-IVB MALFUNCTIONS.</td>
</tr>
<tr>
<td>A</td>
<td></td>
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<td>IU CCS (DP-10)</td>
<td>PRE LN</td>
<td>1/2 MANDATORY FROM LIFTOFF TO S-IVB CUTOFF PLUS 60 SEC.</td>
</tr>
<tr>
<td>A</td>
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<td></td>
<td>IU VHF (DP-1)</td>
<td>PRE LN</td>
<td>1/2 MANDATORY FROM LIFTOFF TO S-IVB CUTOFF PLUS 60 SEC.</td>
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<tr>
<td>A</td>
<td></td>
<td></td>
<td>IU S-BAND (DP-1A)</td>
<td>PRE LN</td>
<td>MANDATORY FROM LIFTOFF THROUGH S-IVB CUTOFF PLUS 60 SEC. FOR ABORT CUES FROM MCC</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>TRACKING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>THAT CAPABILITY REQUIRED TO SATISFY RULE 4-5 (TRAJECTORY) IS MANDATORY.</td>
<td></td>
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<tr>
<td>A</td>
<td></td>
<td>A/G COMMUNICATIONS</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A</td>
<td></td>
<td>1. LIFTOFF THROUGH MILA LOS.</td>
<td>PRE LN</td>
<td>ONE A/G PATH (VIA GSFC OR A/G) VIA GSFC IS MANDATORY TO PROVIDE ABORT RECOMMENDATIONS TO THE CREW.</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>2. POST MILA LOS</td>
<td>PRE LN</td>
<td>ONE A/G PATH VIA GSFC IS MANDATORY TO RELAY APOGEE KICK DATA TO THE CREW.</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>3. VAN OR CYI</td>
<td>PRE LN</td>
<td>ONE A/G PATH IS MANDATORY.</td>
<td></td>
</tr>
</tbody>
</table>

#### A 4-19

**General Orbital Coverage**

IT IS REQUIRED THAT 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.

<table>
<thead>
<tr>
<th>REV</th>
<th>RULE</th>
<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<tbody>
<tr>
<td>A</td>
<td>4-19</td>
<td>OMD</td>
<td>CCS</td>
<td>PRE LN</td>
<td>HIGHLY DESIRABLE CSM USB PRE LN HIGHLY DESIRABLE</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>TELEMETRY S-IVB VHF (CP-1)</td>
<td>PRE LN</td>
<td>1/2 MANDATORY CSM USB PRE LN MANDATORY</td>
<td></td>
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<tr>
<td>A</td>
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<td>IU VHF (DP-1)</td>
<td>PRE LN</td>
<td>1/2 MANDATORY CSM USB PRE LN MANDATORY</td>
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<tr>
<td>A</td>
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<td>IU S-BAND (DP-1A)</td>
<td>PRE LN</td>
<td>1/2 MANDATORY CSM USB PRE LN MANDATORY</td>
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<tr>
<td>A</td>
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<td>TRACKING</td>
<td>C-BAND</td>
<td>PRE LN</td>
<td>BOTH HIGHLY DESIRABLE USB PRE LN</td>
</tr>
<tr>
<td>A</td>
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<td>A/G COMMUNICATIONS</td>
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<td>ONE A/G PATH IS MANDATORY.</td>
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**Mission**

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<td>A</td>
<td>2/15/69</td>
<td>GROUND INSTRUMENTATION REQUIREMENTS</td>
<td>GSFC/KSC/MSFN</td>
<td>4-9</td>
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### NASA — Manned Spacecraft Center

#### MISSION RULES

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<td>A</td>
<td>4-20</td>
<td>REV 1 - CMD (OR HSK FOR USB ITEMS)</td>
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<tr>
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<td>A. CMD CCS</td>
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<td>CSM USB</td>
<td>PRE LN</td>
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<td>B. TELEMETRY</td>
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<td></td>
<td>5-IVB VHF (CP-1)</td>
<td>PRE LN</td>
<td>1 OF 2 MANDATORY</td>
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<tr>
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<td>IU VHF (CP-1)</td>
<td>PRE LN</td>
<td>1 OF 2 MANDATORY</td>
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<td>IU S-BAND (CP-1A)</td>
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<tr>
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<td>CSM (USB)</td>
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<td></td>
<td>C. TRACK C-BAND USB</td>
<td>PRE LN</td>
<td>BOTH HIGHLY DESIRABLE</td>
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<td>D. A/G COMMUNICATIONS</td>
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<tr>
<td></td>
<td>4-21</td>
<td>REV 3/4 (AT APPROXIMATELY 4.5 HOURS) - MAW, RED, GYM</td>
<td></td>
<td>1 OF 3 MSFN SITES MANDATORY</td>
<td>COMMAND CAPABILITY IS REQUIRED TO REMOVE AN INHIBIT WHICH ALLOWS THE 5-IVB RESTART TO BE ACCOMPLISHED.</td>
</tr>
<tr>
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<td>CMD CCS</td>
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**RULE NUMBERS 4-22 THROUGH 4-25 ARE RESERVED**

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**MISSION** | **REV** | **DATE** | **SECTION** | **GROUP** | **PAGE**
---|---|---|---|---|---
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[Page 4-10]
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<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<td>4-26</td>
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<td>RIOMETER NETWORK SITES</td>
<td>PRE LN</td>
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<td>A. LIMA</td>
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</tr>
<tr>
<td></td>
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<td>B. CRO/CYI</td>
<td></td>
<td>1 OF 2 HIGHLY DESIRABLE</td>
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**SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONCLUDED**

**NASA - Manned Spacecraft Center**

**MISSION RULES**

**MISSION** | **REV** | **DATE** | **SECTION** | **GROUP** | **PAGE**
---|---|---|---|---|---
APOLLO 9 | FINAL | 12/15/68 | GROUND INSTRUMENTATION REQUIREMENTS | SPAN | 4-11
8 TRAJECTORY AND GUIDANCE
### SECTION 5 - TRAJECTORY AND GUIDANCE

**NASA - Manned Spacecraft Center**

**MISSION RULES**

<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
</tr>
</thead>
</table>
| 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. VSAFE INCREASING.  
|     |      | E. OVERSPEED CONDITIONS AT INSERTION.  
|     |      | F. VIOLATION OF EXIT HEATING LIMITS. |

| A   | 5-2  | THE LES WILL NOT BE JETTISONED UNTIL MODE II CAPABILITY IS ESTABLISHED BY $T_{FF} \geq 1+40$ 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 $H_p < 4000$ FT.  
|     |      | D. IF ENTERING, UTILIZE LIFT TO AVOID LAND.  
|     |      | E. IF NO SLA SEP OR IF SPS FAILS:  
|     |      | 1. $H_p < 40$ - DO NOT BURN, CM/SM SEP BY $T_{FF} = 1+40$.  
|     |      | 2. $40 < H_p < 75$ - GROUND WILL DECIDE TO USE CM RCS OR CM RCS ASAP OR AT APOGEE TO REDUCE $H_p$ 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. GEN GO AND FULL LIFT IP ON LAND - BURN TO $T_{FF} = 1+40$, RL 90°.  
|     |      | 3. GEN NO-GO AND FULL LIFT IP ON LAND - BURN A REDUCED LV TO MAINTAIN $T_{FF} \geq 1+40$ AFTER C/O AND RL 90°.  
|     |      | B. IF $\Delta T_0 \leq 2$ SECONDS, DO NOT BURN.  
|     |      | C. IF NO IGNITION BY GETI +10 SECONDS, BURN UNTIL GEN SR = 0, RL 55°. (IF UNABLE TO BURN OR TO ZERO FLY RL90°.) ALL THRUSTING WILL BE TERMINATED AT $T_{FF} = 1+40$. |
### MISSON RULES

#### SECTION 5 - TRAJECTORY AND GUIDANCE - CONTINUED

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<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>5-6</td>
</tr>
</tbody>
</table>

The spacecraft gen will be no-go for abort maneuver determination and monitoring for the following:

- **A.** OMC program failure
- **B.** RTCC and OMC Tff difference >50 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 $h > 75$ NM.

Rule numbers 5-8 through 5-19 are reserved for further launch rules.

<table>
<thead>
<tr>
<th>MISSION</th>
<th>REV</th>
<th>DATE</th>
<th>SECTION</th>
<th>GROUP</th>
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<tbody>
<tr>
<td>APOLLO 9</td>
<td>A</td>
<td>2/15/69</td>
<td>TRAJECTORY AND GUIDANCE</td>
<td>LAUNCH</td>
<td>5-2</td>
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PROJ:APOLLO 9

(Rev. 1.07)
### Section 5 - Trajectory and Guidance - Continued

**NASA — Manned Spacecraft Center**

**Mission Rules**

<table>
<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
</tr>
</thead>
</table>
| 5-20 | **Manned Vehicle Orbital Altitude Constraints.**  
A. Real-Time Mission Planning  
Perigee - 81 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-T Translational.  
E. CSM Deorbit Required While Attached to LM or Docking Ring: Maneuver CSM/LM to Posegrade, Heads-Down, Horizon Monitor Attitude; Separate 20 Minutes Prior to Planned Retrofire (or Ground/Crew Agreed Upon Time) with 5 FPS +X Translational. |
| 5-22 | **Spacecraft Computer Timing Updates are Required for Set Errors Greater Than:**  
A. LGC and CMC >0.5 Seconds.  
B. AGS >0.5 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.**
## SECTION 5 - TRAJECTORY AND GUIDANCE - CONTINUED

**NASA — Manned Spacecraft Center**

### MISSION RULES

<table>
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<tr>
<th>MV ITEM</th>
<th>MANEUVER RETARGETING AND STATE VECTOR UPDATES MAY BE REQUIRED WHEN RTCC TRAJECTORY UPDATES CAUSE PLANNED ORBITAL MANEUVERS TO RESULT IN UNACCEPTABLE TRAJECTORY CHARACTERISTICS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-30</td>
<td><strong>THE CMC (CSM) OR LGC (LM) WILL BE NO-GO FOR MANEUVERS FOR ANY OF THE FOLLOWING:</strong></td>
</tr>
<tr>
<td></td>
<td>A. COMPUTER FAILURE.</td>
</tr>
<tr>
<td></td>
<td>B. CMC/IMU ALIGNMENT DISCREPANCY FOR MANEUVER, MONITORING AND ORBIT DETERMINATION.</td>
</tr>
<tr>
<td></td>
<td>1. SEXTANT STAR CHECK: AUTO OPTICS POSITIONING DOES NOT PLACE SELECTED STAR WITHIN 2 DEG OF THE CENTER OF THE TELESCOPE.</td>
</tr>
<tr>
<td></td>
<td>2. HORIZON CHECK ERROR &gt; 5 DEG FOR RETROFIRE.</td>
</tr>
<tr>
<td></td>
<td>C. LGC/IMU ALIGNMENT DISCREPANCY.</td>
</tr>
<tr>
<td></td>
<td>1. AOT ANGLE A1 ERROR &gt; ____ DEG</td>
</tr>
<tr>
<td></td>
<td>2. AOT ANGLE A2 ERROR &gt; ____ DEG</td>
</tr>
<tr>
<td></td>
<td>3. HORIZON CHECK ERROR &gt; ____ DEG</td>
</tr>
<tr>
<td></td>
<td>D. DIFFERENCES BETWEEN CMC/LGC/IND NAV CHECK AFTER A NAV UPDATE FROM GROUND IS:</td>
</tr>
<tr>
<td></td>
<td>1. A &gt; 0.02 DEG</td>
</tr>
<tr>
<td></td>
<td>2. A &gt; 0.02 ING</td>
</tr>
<tr>
<td></td>
<td>3. H &gt; 0.2 NM</td>
</tr>
</tbody>
</table>

### A 5-32

**NON-CRITICAL MANEUVERS WILL BE NO-GO OR TERMINATED FOR:**

| A | 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 | A. ATTITUDE EXCURSIONS > 10 DEG |
|   | B. |
|   | C. ATTITUDE RATES > 5 DEG/SEC |

---

**MISSION**: APOPHO 9

**REV**: A-1

**DATE**: 2/15/69

**SECTION**: TRAJECTORY AND GUIDANCE

**GROUP**: MANEUVER

**PAGE**: 5-4
IF \( t_p < 75 \) and MANEUVER TO RAISE \( t_p \) IS NOT POSSIBLE (REF 5-20B):

A. \( 40 < t_p < 75 \) - EXECUTE SPS RETROGRADE ASAP UNTIL \( t_p < 40 \). IF NO SPS, USE SM-RCS.
B. \( t_p < 40 \) - CM/SM SEP, RETRO WILL RECOMMEND ENTRY PROFILE.

RULE NUMBERS 5-35 THROUGH 5-39 ARE RESERVED FOR FURTHER MANEUVER RULES.
SECTION 5 - TRAJECTORY AND GUIDANCE - CONTINUED
NASA - Manned Spacecraft Center
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 SLIP (ABOVE AND BELOW) RESULTING FROM THE PHASING MANEUVER WILL BE 12 11 NM
E. 2H 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 2 MINUTES AFTER TRACKING ENDS.

A 5-42
THE PNS 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. \( \Delta V_x \leq \pm 2 \) FPS
2. \( \Delta V_y \leq \pm 5 \) 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. \( \Delta V_x \leq \pm 2 \) FPS
3. \( \Delta V_y \leq \pm 5 \) FPS
4. \( \Delta V_z \leq \pm 6 \) FPS
C. CSI AND CDH OUT-OF-PLANE COMPONENTS \( (\gamma) \) WILL NOT BE EXECUTED IF \( \leq 1 \) FPS. IF A PLANE CHANGE MANEUVER OF \( \leq 10 \) FPS IS REQUIRED DURING THE RENDEZVOUS, IT MAY BE SCHEDULED FOR THE LM FOLLOWING CDH, OR CSI/CDH MAY BE REPLACED WITH \( \Delta V_{x,y,z} \) MANEUVER COMBINATION.
### Section 5 - Trajectory and Guidance - Continued

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<tr>
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<td>5-43</td>
<td>THE ORDER OF PRIORITY FOR TPI SOLUTIONS IS LGC, BACKUP CHARTS, CMC. THE LGC SOLUTION WILL NOT BE USED IF DIFFERENT FROM THE CMC BY:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. ΔV x = ±2 FPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. ΔV y = ±5 FPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. ΔV z = ±6 FPS</td>
</tr>
</tbody>
</table>

| A   | 5-44 | THE ORDER OF PRIORITY FOR TPI SOLUTIONS IS LGC, BACKUP CHARTS, CMC, AND GROUND. THE ONBOARD LGC OR CMC TPI SOLUTIONS WILL NOT BE USED IF DIFFERENT FROM THE GROUND BY: |
|     |      | A. ΔV x = ±2 FPS |
|     |      | B. ΔV y = ±5 FPS |
|     |      | C. ΔV z = ±6 FPS |

| A   | 5-45 | A. THE ORDER OF PRIORITY FOR TPI SOLUTIONS IS GEN, BACKUP CHARTS, CMC, GROUND. THE ONBOARD SOLUTIONS WILL NOT BE USED IF DIFFERENT FROM THE GROUND BY: |
|     |      | 1. LGC |
|     |      |   (A) GET1 ±2 MINUTES |
|     |      |   (B) F/A ±2 FPS |
|     |      |   (C) R/L ±5 FPS |
|     |      |   (D) D/V ±6 FPS |
|     |      | 2. CMC |
|     |      |   (A) GET1 ±2 MINUTES |
|     |      |   (B) ΔVx = ±2 FPS |
|     |      |   (C) ΔVy = ±5 FPS |
|     |      |   (D) ΔVz = ±6 FPS |
|     |      | B. THE LGC SOLUTION WILL NOT BE USED IF DIFFERENT FROM THE CMC BY: |
|     |      | 1. GET1 ±2 MINUTES |
|     |      | 2. ΔV x = ±2 FPS |
|     |      | 3. ΔV y = ±5 FPS |
|     |      | 4. ΔV z = ±6 FPS |

RULE NUMBERS 5-46 THROUGH 5-49 ARE RESERVED FOR FURTHER RENDEZVOUS RULES.

**MISSION** | **REV** | **DATE** | **SECTION** | **GROUP** | **PAGE**
|-------------|---------|----------|-------------|-----------|-----------
| APOLLO 9    | A       | 2/15/69  | TRAJECTORY AND GUIDANCE | RENDEZVOUS | 5-7       |
## SECTION 5 - TRAJECTORY AND GUIDANCE - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<tr>
<td>5-50</td>
<td>RETROFIRE MANEUVERS WILL BE PLANNED SUCH THAT TIME BETWEEN GETI AND 400K FT WILL BE ≥ 9 MINUTES.</td>
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<td>5-51</td>
<td>IF $\Delta t_B ≤ 7$ SECONDS, USE SCS AUTO TVC.</td>
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</table>
| 5-52 | PLANNED GEN 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. $H_p > 75$ NM - RETARGET FOR NEXT BEST PTP WITH RCS.
  | B. $40 < H_p < 75$ NM - PITCH UP 50 DEG FROM RETRO ATTITUDE AND BURN SM-RCS USING FOLLOWING PRIORITIES:
    | 1. BURN $H_p$ TO PAD VALUE.
    | 2. BURN MAXIMUM $SM_2V$ AVAILABLE IF $SM-RCS_2V$ INSUFFICIENT TO OBTAIN $40$ NM BURN OM-RCS TO $40$ NM
  | C. $H_p < 40$ NM - REMAIN IN RETRO ATTITUDE AND BURN SM-RCS USING FOLLOWING PRIORITY:
    | 1. BURN $2V$ RESIDUALS.
    | 2. BURN MAXIMUM $SM_2V$ AVAILABLE.
  | NOTE: IF $H_p < 40$ NM TERMINATE ALL THRUSTING BY $T_{ce} = 9$ 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 $2V$ 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 OM-RCS TO OBTAIN $H_p > 40$ NM |
| 5-55 | THE GEN IS NO-GO FOR ENTRY IF:
  | A. CMC VALUE OF DOWNRANGE ERROR ($H_p - R_p$) AT $2g$ DIFFERS $>1100$ NM FROM GROUND VALUE OR $>1130$ 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 $\gamma$ AT 400K ARE OUTSIDE CORRIDOR. GROUND WILL PROVIDE ENTRY PROFILE. |

**RULE NUMBERS 5-56 THROUGH 5-69 ARE RESERVED.**

**MISSION REVL DATE SECTION GROUP PAGE**

| APOLLO 9 | FINAL 12/15/68 | TRAJECTORY AND GUIDANCE | ENTRY | 5-8 |

---
SECTION 5 - TRAJECTORY AND GUIDANCE - CONTINUED

NASA - Manned Spacecraft Center
MISSION RULES

5-70 RANGE SAFETY POLICIES AND CRITERIA ARE SPECIFIED IN AFTR MANUAL CAPETRM 127-1, DATED JANUARY 1, 1969. THE FOLLOWING MISSION RULES CONCERNING SPECIFIC ETA/NASA INTERFACE SUPPLEMENT AFTRM 127-1.

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.

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.

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.

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.

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/IP" WILL BE SENT. "DESTRUCT/IP" WILL BE USED TO TERMINATE THRUST IF AN IP CANNOT BE ESTABLISHED.

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/IP" FUNCTION WILL BE SENT AS NECESSARY ONLY FOR DISPERSION PURPOSES, AND ONLY AFTER FD/FIDO CONFIRMATION OF SATISFACTORY SPACECRAFT SEPARATION.

5-78 IF A SATISFACTORY IP IS ESTABLISHED AND "DESTRUCT/IP" IS DEEMED UNNECESSARY, THE RSO WILL NOTIFY FD/FIDO AND SEND "SAFE" UPON FD/FIDO'S REQUEST.
### SECTION 5 - TRAJECTORY AND GUIDANCE - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<td>RANGE SAFETY</td>
<td>5-10</td>
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#### 5-79
FD/F1DO 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 OVERFLOWED.

#### 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.

#### 5-81
SAFING BY THE RSO WILL BE DONE ONLY IF THE RSO HAS VERIFICATION OF 5-IV3 C/O OR THE FD/F1DO REQUESTS "SAFE". WHEN SAFING IS CONFIRMED, THE RSO WILL STATE TO THE FD/F1DO "SAFING CONFIRMED."

#### 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."

#### 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.

#### 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.

#### 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.

#### 5-86
COORD DATA TO THE CAPE KENNEDY REAL-TIME COMPUTER SYSTEM (RTCS) FOR IP COMPUTATION AND RSO DISPLAY DURING FIRST STAGE BURN ARE HIGHLY DESIRABLE.
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<th>AIRBORNE SYSTEMS</th>
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<tr>
<td>A</td>
<td>5-87</td>
<td>TWO (2) OPERATIONAL RANGE SAFETY COMMAND RECEIVERS ON EACH LAUNCH VEHICLE STAGE (S-IC, S-11, 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.</td>
</tr>
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<thead>
<tr>
<th>REV</th>
<th>ITEM</th>
<th>RANGE SAFETY COMMAND (&quot;ARM/MFCO&quot; AND &quot;DESTRUCT/PD&quot;) WILL HAVE MANDATORY PRECEDENCE OVER ALL OTHER COMMANDS. TIMERS IN THE RCC WILL PROVIDE A 4 SECOND TIME DELAY BETWEEN &quot;ARM/MFCO&quot; AND &quot;DESTRUCT/PD.&quot;</th>
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<tbody>
<tr>
<td>A</td>
<td>5-90</td>
<td>RANGE SAFETY COMMAND (&quot;ARM/MFCO&quot; AND &quot;DESTRUCT/PD&quot;) WILL HAVE MANDATORY PRECEDENCE OVER ALL OTHER COMMANDS. TIMERS IN THE RCC WILL PROVIDE A 4 SECOND TIME DELAY BETWEEN &quot;ARM/MFCO&quot; AND &quot;DESTRUCT/PD.&quot;</td>
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<tr>
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<tr>
<td>A</td>
<td>5-91</td>
<td>TWO (2) PRIVATE, INDEPENDENT, GEOGRAPHICALLY DIVERSIFIED COMMUNICATIONS LINKS BETWEEN THE RSO AND RSO ARE REQUIRED. ONE OF TWO COMM LINKS IS MANDATORY.</td>
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<thead>
<tr>
<th>REV</th>
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<th>TWO (2) OF THE FOLLOWING THREE (3) COMMUNICATIONS LINKS ARE MANDATORY BETWEEN THE RSO AND FD/FIDO:</th>
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<td>5-92</td>
<td>A. RSO LOOP (CAPE 111).</td>
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<tr>
<td>A</td>
<td>5-92</td>
<td>B. RSO PRIVATE LINE (GREENPHONE/YELLOWPHONE).</td>
</tr>
<tr>
<td>A</td>
<td>5-92</td>
<td>C. FLIGHT DIRECTOR LOOP.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>REV</th>
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<th>A COMMUNICATIONS LINK BETWEEN THE RSO AND THE RANGE SAFETY SUPERVISOR (CRSS) AT THE LAUNCH CONTROL CENTER IS MANDATORY.</th>
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<tr>
<td>A</td>
<td>5-93</td>
<td>A COMMUNICATIONS LINK BETWEEN THE RSO AND THE RANGE SAFETY SUPERVISOR (CRSS) AT THE LAUNCH CONTROL CENTER IS MANDATORY.</td>
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<tr>
<th>REV</th>
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<th>A GREENPHONE COMMUNICATIONS LINK BETWEEN THE RSO AND THE LAUNCH VEHICLE TEST CONDUCTOR (CLTC) IS HIGHLY DESIRABLE.</th>
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<td>A</td>
<td>5-94</td>
<td>A GREENPHONE COMMUNICATIONS LINK BETWEEN THE RSO AND THE LAUNCH VEHICLE TEST CONDUCTOR (CLTC) IS HIGHLY DESIRABLE.</td>
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### Section 5 - Trajectory and Guidance - Continued

**NASA — Manned Spacecraft Center**

**Mission Rules**

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<td><strong>A 5-95</strong></td>
<td>Telemetry:</td>
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<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td><strong>A 5-96</strong></td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>A. For RSO display (see ATCH #1)</td>
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<tr>
<td></td>
<td>B. For BRSO display (see ATCH #2)</td>
</tr>
<tr>
<td><strong>A 5-97</strong></td>
<td>Weather:</td>
</tr>
<tr>
<td></td>
<td>Wind restrictions: An annual profile wind restriction of 1.25 sigma (11%) will be in effect for the launch area.</td>
</tr>
<tr>
<td><strong>A 5-98</strong></td>
<td>Ceiling and visibility restrictions: Minimum range safety ceiling 2000 feet with pad visible from 11 NM.</td>
</tr>
</tbody>
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**Appendix**

**Mission**

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### Mission Rules

**Section 5 - SLV-TB1 through TB4/TB4A**

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<td>5-IC Stage Loss of Thrust</td>
<td>LAUNCH</td>
<td>A. CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO.</td>
<td>A&amp;B. CUES:</td>
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**Notes:**

- **A. COOT INUE MISSION.**
- **A&B. CUES:**
- **BSE IN FORM FLIGHT AND FIDO.**
- **B. 1. ABORT.**
- **BSE INFORM FLIGHT AND FIDO AND TRANSMIT ABORT REQUEST (ABORT WILL BE INITIATED AUTOMATICALLY).**
- **2. CONTINUE MISSION.**
- **(A) BSE INFORM FLIGHT AND FIDO.**
- **(B) CAPCOM ADVISE CREW OF POTENTIAL OVERRATE CONDITION.**
- **C. LOSS OF THRUST-ENGINE 3 (THIS RULE APPLIES ONLY FOR THE UNIQUE CASE OF ENGINE 3 THRUST LOSS BETWEEN 0 TO 45 SEC.)**
- **1. VOICE COMM WITH RSO**
- **2. NO VOICE COMM WITH RSO**
- **CONTINUE MISSION.**
- **BSE INFORM FLIGHT AND FIDO.**
- **FLIGHT WILL INFORM 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**
- **2. FLIGHT CONFIRM ENGINE 3 OUT AND NO OTHER KNOWN ANOMALIES BY LITE ACTIVATION**

**Mission Revisions:**

- **Apollo 9 A**
- **Rev: 2/15/69**
- **SLV - TBl through TB4/TB4A**
- **Group: 6-1**

**Group Page:**

- **6-1**
### Mission Rules

**SLV - TBI Through TB4/TB4A - Continued**

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<td>ANY SINGLE ACTUATOR HARD-OVER ANY ENGINE - PITCH OR EYAW</td>
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<td>(TBI + 0 SEC TO TBO + 0 SEC)</td>
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<td>CAPCOM ADVISE CREW OF IMPENDING LOSS OF ATTITUDE CONTROL.</td>
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<td>Loss of attitude control</td>
<td>Launch</td>
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<td>A. 5-IC Burn</td>
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<td>BSE INFORM FLIGHT AND FIDO;</td>
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<td>CAPCOM ADVISE CREW OF IMPENDING LOSS OF ATTITUDE CONTROL.</td>
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<td>B. 5-II Burn</td>
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<td>BSE INFORM FLIGHT AND FIDO;</td>
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<td>CAPCOM ADVISE CREW OF IMPENDING LOSS OF ATTITUDE CONTROL.</td>
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**Cues:**

1. **ACTUATOR POSITION EXCEEDS 15 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 (H69-602; H56-603).**

**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 SP (AAG) LIMIT EXCEEDED
   - (C) PITCH OR YAW RATE LIMIT EXCEEDED

**A. 5-IC Burn**

1. **ANGULAR RATES EXCEED 2 DEG/SEC (VR4-602; VR5-602; VR6-602; VR8-602; VR12-602; VR13-602)**
2. **ATTITUDE ERRORS EXCEED 4 DEG (H69-602; H70-602; H71-602; H54-603; H55-603; H56-603)**
3. **ACTUATOR POSITION INDICATES HARD-OVER (75 DEG) OR ERRATIC ACTUATORS (GI-101 THROUGH GI-104; G2-101 THROUGH G2-104)**

**B. 5-II Burn**

1. **ANGULAR RATES EXCEED 5 DEG/SEC (VR4-602; VR8-602; VR9-602; VR12-602; VR13-602; VR16-602)**
2. **ATTITUDE ERRORS EXCEED 10 DEG (H69-602; H70-602; H71-602; H54-603; H55-603; H56-603)**
### NASA — Manned Spacecraft Center

**MISSION RULES**

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### C. S-IVB BURN

C. BSE INFORM FLIGHT AND FIDO; CAPCOM ADVISE CREW OF IMPENDING LOSS OF ATTITUDE CONTROL.

### 3. ACTUATOR POSITION INDICATES HARDOVER 75 DEG OR ERRATIC ACTUATOR(S) (G8-201 THROUGH G8-204; G9-201 THROUGH G9-204)

### 4. S-IVB BURN MODE DISCRETE REMAINS OFF AT STAGING (K89-602)

### 5. S-IC BURN MODE DISCRETE REMAINS ON AT STAGING (K89-602)

### C. S-IVB BURN

1. ANGULAR RATES EXCEED 5 DEG/SEC (VR4-602; VR8-602; VR9-602; VR12-602; VR13-602; VR6-602)

### 2. ROLL ATTITUDE ERROR >9.5 DEG: PITCH OR YAW ATTITUDE ERROR >10 DEG (HE9-602; H70-602; H71-602; HS4-603; HS5-603; HS6-603)

### 3. ACTUATOR POSITION INDICATES SUSTAINED HARDOVER 15 DEG (G1-603; G2-603)

### 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 >20 DEG/SEC

### 2. ROLL >10 DEG/SEC

### 3. ATTITUDE ERROR >5 DEG

### 4. Q-BALL >3.2 PSID

### B. S-IVB BURN

1. PITCH AND YAW RATES >10 DEG/SEC

### 2. ROLL >10 DEG/SEC

---

**MISSION**: APOLLO 9  
**REV**: A  
**DATE**: 2-15-69  
**SECTION**: SLV - TBI THROUGH TB4/TH4A  
**GROUP**:  
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#### MISSION RULES

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| A   | 6-4  | ROLL PROGRAM FAILS TO INITIATE BY TBI + 12 SEC | LAUNCH | CONTINUE MISSION. | CUES:
|     |      |                       |       | BSE INFORM FLIGHT AND FIDO. | 1. ROLL RATE REMAINS CONSTANT AT APPROXIMATELY ZERO DEG/SEC (VR12-602, VR8-602)
|     |      |                       |       |                        | 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, WH6-602)
|     |      |                       |       |                        | 5. GUIDANCE MODE WORD ONE (MODE CODE 25) BIT D24 (H60-603) |
| A   | 6-5  | PITCH PROGRAM FAILS TO INITIATE BY TBI + 12 SEC | LAUNCH | CONTINUE MISSION. | CUES:
|     |      |                       |       | BSE INFORM FLIGHT AND FIDO THAT VEHICLE WILL CONTINUE VERTICAL FLIGHT AND WILL EVENTUALLY VIOULATE RED LIMITS. | 1. GUIDANCE MODE WORD ONE (MODE CODE 25) BIT D24 NOT SET TO "ONE" (H60-603) |
|     |      |                       |       | FIDO INFORM H50. | 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 (H71-602, H54-603) |

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| A 6-7 | PITCH PROGRAM FAILS TO TERMINATE BY TBI + 2 MIN 37 SEC | LAUNCH | CONTINUE MISSION. | 1. GUIDANCE MODE WORD (MODE CODE 25) BIT D21 NOT SET TO ONE (H60-603) | **CUES:**

#### 1. GUIDANCE MODE WORD (MODE CODE 25) BIT D21 NOT SET TO ONE (H60-603)

- **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.

#### 2. PITCH COMMAND ANGLE CONTINUES TO DECREASE (H60-603)

- **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.

#### 3. PITCH RATE REMAINS APproximately 0.3 DEGREES/SECOND (VR4-602, VR13-602)

- **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.

#### 4. PITCH GIMBAL ANGLE CONTINUES TO DECREASE (H60-603)

- **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.

#### 5. ROLL GIMBAL ANGLE CONTinues to CHange (H60-603)

- **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.

#### NOTE:

- **CUES 1 AND 4 MUST CONCUR WITH CUE 2 AND/OR 3 BEFORE THEY CAN BE INTERPRETED AS INDICATIONS OF FAILURE.**

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**MISSION REV DATE SECTION GROUP PAGE**

APOLLO 9 A 2/15/69 SLV - TBI THROUGH TB4/TB4A 6-5
### Mission Rules

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<td>CONTINUE MISSION</td>
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### 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

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**RULE NUMBERS 6-11 THROUGH 6-15 ARE RESERVED.**

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NASA — Manned Spacecraft Center
MISSION RULES

SECT ION 6 - SLV - TBl THROUGH TB4/TB4A - CONTINUED

REV RULE CONDITION/MALFUNCTION PHASE RULING CUES/NOTES/COMMENTS
A 6-17 S-11 LOSS OF THRUST LAUNCH 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 (013-201 THROUGH 205) 3. LONGITUDINAL ACCELERATION (A2-603)

B. ANY SINGLE ENGINE - FAILURE TO ATTAIN THRUST OR LOSS OF THRUST PRIOR TO NOMINAL S-11 CUTOFF

B.1. ABORT BSE INFORM FLIGHT AND FIDO TRANSMIT ABORT REQUEST. 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, H65-602, H70-602, H71-602) (D) COMMAND ANGLES AND GIMBAL ANGLES (M60-603)

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, H65-603, H70-602, H71-602) (D) COMMAND ANGLES AND GIMBAL ANGLES (M60-603)

B. ANY TWO ENGINES - FAILURE TO OBTAIN THRUST OR LOSS OF THRUST PRIOR DEPLETION SENSORS CUTOFF ARMED (TB3 + 5 MIN 39 SEC)

B.2. ABORT 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, H65-603, H70-602, H71-602) (D) COMMAND ANGLES AND GIMBAL ANGLES (M60-603)

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 (013-201 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 CUT-OFF 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 (013-201 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 (013-201 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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| A   | 6-18 | ITERATIVE GUIDANCE MODE (IGM) FAILS TO INITIATE AT TB3 + 61 SEC | LAUNCH | CONTINUE MISSION | A. BSE INFORM FLIGHT, FIDO AND GUIDANCE.  
B. CAPCOM ADVISE CREW. |
| A   | 6-19 | 5-11 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. GUIDANCE MODE WORD 1 (MODE CODE 25) BIT 014 NOT SET TO ONE (H60-603)
2. PITCH GIMBAL ANGLE REMAINS CONSTANT (H60-603)
3. PITCH COMMAND 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.

RULE NUMBERS 6-22 THROUGH 6-26 ARE RESERVED.

---

**SECTION 6 - SLV - TBI THROUGH TB4/TB4A - CONTINUED**

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**MISSION RULES**
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**SECTION 6 — SLY — TBI THROUGH TB4/TB4A — CONTINUED**

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| 6-27 | 5-IVB SIMBAL SYSTEM FAILURE | LAUNCH | A. CONTINUE MISSION. | 1. BSE INFORM FLIGHT AND FIDO. 2. CAPCOM ADVISE CREW OF POSSIBLE OVER-RATE CONDITION AFTER 5-IVB IGNITION. CREW EXECUTE MANUAL ABORT ON ESTABLISHED LIMITS AFTER 5-IVB IGNITION. | A. ACTUATOR POSITION IS DEG OR GREATER (G1-403, G2-403)  
Note: CREW ABORT LIMITS: THE RATE LIMITS WHICH THE CREW WILL ABORT DURING 5-IVB FLIGHT ARE: A. PITCH OR YAW RATE: 310 DEG/SEC  
B. ROLL RATE 120 DEG/SEC |

A. 5-IVB ENGINE ACTUATOR HANOVER INDICATED PRIOR TO FIRST BURN  
B. 5-IVB LOSS OF STAGE HYDRAULIC FLUID CONFIRMED PRIOR TO FIRST BURN |

| 6-28 | 5-IVB STAGE LOSS OF THRUST | LAUNCH | A. ABORT | 1. BSE INFORM FLIGHT AND FIDO AND RECOMMEND ABORT PRIOR TO 5-115/5-IVB STAGING. | B. 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) |

A. FAILS TO ATTAIN THRUST BY TBI + 10 SECONDS OR TBI + 15 SECONDS (EARLY STAGE SEQUENCE) PLUS 15 SECONDS  
B. 5-IVB PREMATURE SHUTDOWN PRIOR TO 5-IVB FIRST BURN VELOCITY CUTOFF |

**RULE NUMBERS 6-29 THROUGH 6-30 ARE RESERVED.**

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<th>Time Base 5 Fails to Initialize at S-IVB Cutoff</th>
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<td>BSE inform Flight and FIDO and recommend immediate separation to a safe distance.</td>
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**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 TB4 + 13 sec.
   - A. S-IVB engine out "A".
   - B. S-IVB engine out "B".
   - C. S-IVB velocity cutoff.
   - D. Accelerometer loss of thrust indication.

---

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<td>A. At nominal S-IVB first burn velocity cutoff</td>
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<td>A1. BSE inform Flight and FIDO</td>
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<td>B. At TB5 + 10 min 41 sec, TB5 + 11 min 41 sec or TBBA + 14 min 41 sec</td>
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<td>B. BSE inform Flight and FIDO</td>
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**Cues:**
1. Thrust chamber pressure greater than 300 psia (D1-403)
2. Thrust OK switches on (K14-401, K15-401)
3. LVDC failure env bits D24, D25, and D56 set to one (H60-603)
### Mission Rules

**RULE 7-1**

- **Phase:** Orbit
- **Ruling:** Continue Mission.
- **Condition/Malfunction:** 5-1VB U-2 engine start bottle pressure greater than 1500 PSIA for first and second restart (TB 6/8 and TB8A)

**Cues:**
1. GH2 start bottle pressure (D0017-401; D0241-401)
   **Note:** If start bottle pressure reaches 1600 PSIA and cannot be vented to an acceptable level, the S/C should immediately separate to a safe distance.

**Rule Number 7-2 is Reserved.**

**RULE 7-3**

- **Phase:** Orbit
- **Ruling:** Continue Mission.
- **Condition/Malfunction:** 5-1VB cold helium shutoff valves fail to close at:
  - A. First engine cutoff (TBS plus 1.4 sec)
  - B. Second engine cutoff (TB7 plus 1.4 sec)

**A**
- **Condition/Malfunction:** Cold helium shutoff pressure greater than 1200 PSI (D166-403)

**Cues:**
1. Cold helium discharge pressure greater than 1600 PSIA (D109-403)
2. Cold helium bottle pressures decaying (D166-425; 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 required to avoid exceeding LOX tank over pressure limits

**B**
- **Condition/Malfunction:** LOX tank vent valve open and close to maintain ullage pressure below 50 PSIA at ASC LOS

**Cues:**
1. System pressure above 1700 PSIA (D01-403)
2. Reservoir level below 50 percent (L7-403)
3. AFT bus no. 2 current above 20 amps (M02-404)
4. Hydraulics reservoir oil pressure greater than 137 PSI (GH2-403)

**Notes:**
Failure to turn off hydraulic pump depletes AFT No. 2 battery in approximately 30 min. May overheat hydraulic system in approximately 15 min.
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REMARKS:
1. THE DIFFERENCE BETWEEN COMMANDED ATTITUDE (CHI) AND THE ACTUAL VEHICLE ATTITUDE (THETA) IS GREATER THAN 5 DEG AND DIVERSING (H56-603)
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)
3. VEHICLE ANGULAR RATES GREATER THAN 1.2 DEG/SEC AND ARE NOT DECREASING (R4-602; R5-602; R6-602; R7-602; R12-602; R13-602)
4. FLIGHT CONTROL COMPUTER NOT IN CORRECT MODE (K20-602)
5. EMR BITS D26, D25, AND D24 SET TO ONE (H60-603)
6. GUIDANCE STATUS WORD (MODE CODE 26) BITS D16, D18, OR D20 SET TO ONE
7. GUIDANCE FAILURE DISCRETE (CON) MODE CODE 26, BIT 8 SET TO ONE (H60-603)

NOTES:
1. THE SLV YAW GIMBAL (Z-AXIS) IS CRITICAL BEYOND ± 65 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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<td>1. CVS RELIEF OVERRIDE SHUT-OFF VALVE OPEN</td>
<td>1. LH2 ULLAGE PRESSURE (D177-408; D178-408)</td>
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<td>2. VENT THE LH2 TANK PRIOR TO T86 TO A PRESSURE BELOW THE VALUE THAT SATISFIES THE CURVE (SEE BSE PROCEDURES)</td>
<td>3. CVS REGULATOR CLOSED (K134-411)</td>
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<td>3. IF THE LH2 BLOWDOWN IS COMPLETED WITHIN 30 MIN PRIOR TO T86 INITIATE COMMAND</td>
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<td>(A) ULLAGE ENGINES ON</td>
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<td>(B) AFTER 90 SEC OF ULLAGING COMMAND ULLAGE ENGINES OFF. ULLAGING SHOULD BE COMPLETED PRIOR TO THE AMBIENT REPRESSION</td>
<td>2. BLOWDOWN OF LH2 TANK BELOW 19 PSIA WILL RESULT IN A LOSS OF 150 LBM OF USABLE LH2 PROPELLANT PER PSIA</td>
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<td>4. INCREASE ABOVE RESTART LIMITS TO INSURE A COMPLETE BURN</td>
<td>3. CVS NOZZLE PRESSURES SHORTLY AFTER CUTOFF (SEQUENCED OPENING OF CVS)</td>
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<td>A. BOTH LEGS OPEN 15-20 PSIA</td>
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<td>B. ORIFICE ONLY OPEN 4 PSIA</td>
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<td>C. BOTH LEGS CLOSED -0 PSIA</td>
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### RULE 7-7

**CONDITION/MALFUNCTION:** CVS ORIFICE LEG FAILS TO OPEN (TB5 OR TB7)

**PHASE:** ORBIT TLE

**RULING:** CONTINUE MISSION.

**CUES/NOTES/COMMENTS:**

1. CVS NOZZLE PRESSURE (D181-409; D182-409)
2. LH2 TANK CONTINUOUS VENT ORIFICE SHUTOFF VALVE OPEN

### RULE 7-8

**CONDITION/MALFUNCTION:** FAILURE TO TERMINATE APS ULLAGE ENGINE(S) THRUST AT TB5 + 3 MIN 27 SEC, TB7 + 19 SEC, TB8 + 7 MIN 33 SEC OR TB9 + 0 SEC.

**PHASE:** ORBIT

**RULING:** CONTINUE MISSION.

**CUES/NOTES/COMMENTS:**

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.
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<td>B. WATER VALVE OPEN</td>
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<td>8. LVOC TEMP *1 (C55-603)</td>
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*EOS WATER VALVE FAILS TO CYCLE OPEN AND CLOSED.*

A. WATER VALVE CLOSED

1. COOLANT INLET CONTROL TEMP is 64°F or higher, and THE INERTIAL GIMBAL TEMPERATURE IS PREDICTED TO BE EQUAL TO OR GREATER THAN 15°F BEFORE THE NEXT SITE AOS, OR THE LVOC MEMORY TEMPERATURE IS PREDICTED TO BE EQUAL TO OR GREATER THAN 124°F BEFORE THE NEXT SITE AOS.

B. WATER VALVE OPEN

1. COOLANT INLET CONTROL TEMP is 55°F or less, and THE INERTIAL GIMBAL TEMPERATURE IS PREDICTED TO BE EQUAL TO OR LESS THAN 104°F BEFORE THE NEXT SITE AOS, OR THE LVOC MEMORY TEMPERATURE IS PREDICTED TO BE EQUAL TO OR LESS THAN 32°F BEFORE THE NEXT SITE AOS.
### Section 7 - SLV-TB5 and TB7 - Continued

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<td>ENGINE PUMP PURGE FAILS ON AT TB5 + 10 MIN 3 SEC AND TB7 + 10 MIN 3 SEC</td>
<td>ORBIT TLI</td>
<td>CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: ENGINE PUMP PURGE CONTROL VALVE CLOSED.</td>
<td>1. ENGINE PUMP PURGE REGULATOR PRESSURE FAILS TO DECREASE FROM ABOUT 100 PSIA TO ABOUT 10 PSIA. (050-403) 2. AMBIENT BOTTLE PRESSURE DECREASING AT A RATE OF 23 PSI/ MIN (0236-403, 0256-403). NOTE: IF NOT TERMINATED, THE PURGE WILL CAUSE THE DEPLETION OF THE AMBIENT HELIUM PNEUMATIC SUPPLY AT THE RATE OF 23 PSI/ MIN.</td>
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<td></td>
<td>B. MINUS 26 PSID PLUS 36 PSID</td>
<td>ALL</td>
<td>CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION TO A SAFE DISTANCE.</td>
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**Rule Number 7-14 is Reserved**

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<td>S-IVB HYDRAULIC FLUID IS BELOW OR PREDICTED TO DROP BELOW 10 DEG F BEFORE NEXT AOS</td>
<td>ORBIT TLI</td>
<td>CONTINUE MISSION. BSE INFORM FLIGHT AND COMMAND: AUXILIARY HYDRAULIC PUMP FLIGHT MODE ON AND OFF AS REQUIRED FOR THERMAL CONDITIONING</td>
<td>CUES: 1. HYDRAULIC PUMP INLET OIL TEMP (C50-401) 2. RESERVOIR OIL TEMP (C51-403)</td>
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<td>LH2 ULLAGE PRESSURE LESS THAN 18 PSIA DURING ORBITAL COAST (TBS OR TB7)</td>
<td>EARTH ORBIT</td>
<td>CONTINUE MISSION</td>
<td>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.</td>
</tr>
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</table>

**CUES:**

1. FUEL TANK ULLAGE EDS NOS. 1 AND 2 PRESSURE (D0177-408, D0178-408).
2. FUEL PUMP INLET PRESSURE D0002-403). |

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<th>A</th>
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<th>FAILURE TO SAFE THE RANGE SAFETY RECEIVERS AT INSERTION. SAFING IS TO BE ACCOMPLISHED ON SUBSEQUENT PASSES OVER KSC.</th>
<th>ORBIT</th>
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**A. PROPellant DISPERSION SYSTEM NOT ARMED**

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<th>A. CONTINUE MISSION</th>
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<tr>
<td>BSE INFORM FLIGHT AND RECOMMEND RSO SEND SAFE COMMAND</td>
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**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 (M057-411) BETWEEN 2.4 AND 4.5 VOLTS
4. RANGE SAFETY RECEIVER #2 ENABLE (M062-411) 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 REV 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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<td>J-2 ENGINE MAIN FUEL VALVE FAILS TO CLOSE AT S-IVB FIRST OR SECOND CUTOFF.</td>
<td>ORBIT</td>
<td>CONTINUE MISSION.</td>
<td>1. MAIN FUEL VALVE POSITION (G004-401)</td>
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<td>2. MAIN FUEL VALVE OPEN DISCRETE (K118-401)</td>
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<td>3. FUEL PUMP DISCHARGE TEMP (C134-401)</td>
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<td>4. FUEL CIRCULATION PUMP FLOWMETER (F3-406)</td>
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<td>NOTE: NO COMMAND ACTION IS REQUIRED SHOULD FAILURE OCCUR FOLLOWING THIRD S-IVB CUTOFF.</td>
</tr>
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<td>A 7-22</td>
<td>J-2 ENGINE MAIN OXIDIZER VALVE FAILS TO CLOSE AT S-IVB FIRST OR SECOND CUTOFF</td>
<td>ORBIT</td>
<td>CONTINUE MISSION.</td>
<td>1. MAIN OXIDIZER VALVE POSITION (G3-401)</td>
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<td>TLI</td>
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<td>2. MAIN OXIDIZER VALVE OPEN (K120-401)</td>
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<td>3. LOX PUMP DISCHARGE TEMP (C133-401)</td>
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<td>4. LOX CIRCULATION PUMP FLOWMETER (F4-424)</td>
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<td>NOTE: NO COMMAND ACTION IS REQUIRED SHOULD FAILURE OCCUR FOLLOWING 3RD S-IVB CUTOFF.</td>
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### 7-23 S-IVB STAGE PNEUMATIC REGULATOR OUTLET PRESSURE LESS THAN 400 PSIA AND DECREASING IMMEDIATELY AFTER S-IVB CUTOFF (FIRST BURN) | ORBIT | CONTINUE MISSION. | 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 (F3-406) |
|          |                       |       |        | NOTE: NO COMMAND ACTION IS REQUIRED SHOULD FAILURE OCCUR FOLLOWING 3RD S-IVB CUTOFF. |

**CUES:**

- STAGE PNEUMATIC REG OUTLET PRESSURE (G004-403, G247-403)
- IF PNEUMATIC REGULATOR HAS FAILED CLOSED, THE J-2 ENGINE PUMP PURGE WILL DEPLETE PRESSURE DOWNSTREAM OF THE REGULATOR IN 45 SEC
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<td>CONTINUE MISSION.</td>
<td>1. BURNER CHAMBER DOME TEMPERATURE INDICATES 460 DEG R OR LESS (C382-403)</td>
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<td>2. BURNER NOZZLE TEMPERATURE OFF SCALE LOW (C380-403)</td>
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<td>4. AMBIENT PRESSURIZATION MODE SELECT ('K195-404')</td>
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<td>5. BURNER LH2 PRESSURIZATION CO2I TEMPERATURE (C399-403)</td>
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<td>6. BURNER PROPELLANT VALVES POSITIONS (K189-404, K192-403)</td>
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**NOTE:**

THE O2/H2 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.
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<td>CUES: 1. THRUST CHAMBER PRESSURE &lt;300 PSIA (K1-402) 2. THRUST OR SWITCHES OFF (K1-401, K157-401) 3. LONGITUDINAL ACCELERATION &lt;g (VA2-603) 4. TB7/TB9 INITIATED (MODE CODE 26) BIT 20 EQUAL TO ONE (460-603) NOTE: IF THE S-IVB WAS 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 4 MIN 49 SEC, TB9 IS INITIATED.</td>
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Rule numbers 8-5 through 8-10 are reserved.

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<td>2. LH2 TANK REPRESS CONTROL VALVES OPEN ON.</td>
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<td>3. CVS CLOSE.</td>
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<td>B. AT TBB + 7 MIN:</td>
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<td>AMBIENT REPRESS MODE SELECT ON.</td>
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<td>A. LOX TANK REPRESSURIZATION CONTROL VALVES CLOSED</td>
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<td>OR</td>
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<td></td>
<td></td>
<td>B. LH2 TANK REPRESSURIZATION CONTROL VALVES CLOSED</td>
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**CUES/NOTES/COMMENTS**

1. **FUEL TANK HELIUM BOTTLE REPRESSURIZATION PRESSURE (D0020-403, D0243-403).**
2. **LOX TANK REPRESSURIZATION SPHERES PRESSURE (D0088-403, D0254-403).**
3. **LOX TANK ULLAGE PRESSURES (D179-406, D180-406).**
4. **LH2 TANK ULLAGE PRESSURES (D177-408, D178-408).**
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**RULE NUMBER 9-2**

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| 9-3      | Failure of LOX nonpropulsive vent to latch open (T9 + 12 min 45 sec) | TLI  | Continue Mission:  
BSE inform Flight and Command:  
1. LOX NPV valve open and latched.  
2. LOX NPV open  
3. LOX vent valve open.  |
| 9-4      | Failure of S-IVB LOX dump to initiate at T9 + 1 min 30 sec | TLI  | Continue Mission:  
BSE inform Flight and Command:  
Engine main LOX valve open.  |
| 9-5      | Failure of LH2 dump to initiate at T9 + 12 min 50 sec | TLI  | Continue Mission:  
BSE inform Flight and Command:  
Engine main fuel valve open.  |
| 9-6      | Failure of cold helium dump to initiate | TLI  | Continue Mission:  
BSE inform Flight and Command:  
1. Cold helium dump thru burner.  
2. LOX tank flight pressurization shutoff valve open.  |

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## GENERAL

### LAUNCH

Launch will be continued as long as the suit circuit and O₂ 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 O₂ 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.

### TOE

Undocking

Rendezvous

LVT

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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<td>LOSS OF CABIN INTEGRITY: CH PRESSURE VESSEL LEAKAGE SUCH THAT CABIN PRESSURE CANNOT BE MAINTAINED ≥ 4.5 PSIA BY CABIN PRESSURE REGULATORS (1.2 LB/MR TOTAL).</td>
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<td>LOSS OF SUIT INTEGRITY: TOTAL PGA AND SUIT LOOP LEAKAGE &gt; 0.5 PSI/MIN (1.5 LB/HO) DURING PGA SUIT LOOP PRESSURE CHECK.</td>
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<td>LOSS OF SUIT CIRCUIT: INABILITY OF THE SUIT CIRCUIT TO MAINTAIN ADEQUATE CREW COMFORT AND/OR CO2 REMOVAL WITHOUT USING DIRECT O2.</td>
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<td>LOSS OF O2 MANIFOLD: AN O2 MANIFOLD OR REGULATOR FAILURE WITH WHICH THE SUIT CIRCUIT O2 DEMANDS CANNOT BE SUPPLIED FOR ENTRY.</td>
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<td>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.</td>
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<td>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.</td>
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<td>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.</td>
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<td>LOSS OF ALL COOLING: LOSS OF PRIMARY AND SECONDARY LOOP COOLING.</td>
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<td>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.</td>
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RULES 10-3 THROUGH 10-9 ARE RESERVED.
### REV 10-10 O₂ SYSTEM

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<td>A.</td>
<td>Suit flow relief valve will remain closed for duration of flight.</td>
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<td>B.</td>
<td>Normal CSM depressurization with LM manned will utilize the repress pack.</td>
</tr>
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<td>C.</td>
<td>Surge tank will be on line except during LM depressurization or CSM depressurization with the LM manned, when it will be isolated to maintain quantity &gt;500 psia.</td>
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<tr>
<td>D.</td>
<td>The PSS valve will be in off position for orbit.</td>
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<tr>
<td>E.</td>
<td>The suit circuit must be purged of accumulated H₂ once every 6 hours for one minute when all crewmen are suited and the suit circuit is isolated.</td>
</tr>
<tr>
<td>F.</td>
<td>The surge tank and repress pack will normally be recharged simultaneously.</td>
</tr>
<tr>
<td>G.</td>
<td>CSM cabin pressure will not be allowed to drop below 4.8 psia during normal LM depressurization except during TDE.</td>
</tr>
<tr>
<td>H.</td>
<td>The CSM ECS will normally supply all O₂ for consumption and leakage during IVT phases.</td>
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<td>I.</td>
<td>CSM forward hatch will be installed for EVA.</td>
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<td>J.</td>
<td>The flight crew will don suits for the following:</td>
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<td>1.</td>
<td>Inability to maintain cabin pressure above 4.5 psia</td>
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<td>2.</td>
<td>All LM manning and EVA operations</td>
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<td>4.</td>
<td>Glycol leaks in command module</td>
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<td>5.</td>
<td>Fire, smoke, contamination in cabin</td>
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<td>K.</td>
<td>The flight crew will don suits (time and conditions permitting) for the following:</td>
</tr>
<tr>
<td>1.</td>
<td>Loss of suit circuit</td>
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<td>2.</td>
<td>Confirmed leak of glycol in suit circuit</td>
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</table>

### COOLANT MANAGEMENT

A. For simultaneous 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 ~70 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 (CF009) is lost, waste water will be dumped until potable water quantity (CF0010) begins to decrease.  
B. Water dumps will be managed so that CSM-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.**
| REV 10-20 CABIN PRESSURE CANNOT BE RELIEVED | LAUNCH | CONTINUE MISSION | NORMAL RELIEF STARTS AT 50 SECONDS |
| CABIN PRESSURE DECREASING AND/OR < 4.5 PSIA AND: | | | |
| A. SUIT PRESSURE ≥ 3.5 PSIA | LAUNCH | CONTINUE MISSION | |
| 2. ENTER NEXT BEST PTP IF CABIN PRESS NOT RESTORED > 4.5 PSIA. | | | |
| B. SUIT PRESSURE ≥ 3.5 PSIA | LAUNCH | ABORT ASAP | |
| 2. ENTER ASAP | | | |
| C. LOSS OF SUIT CIRCUIT | LAUNCH | ABORT ASAP | |
| 1. OPEN DIRECT O₂ 45 DEG FROM LAUNCH SETTING. | | | |
| 2. ENTER ASAP | | | |
| LOSS OF SUIT CIRCUIT, CABIN STABLE AND > 4.5 PSIA | LAUNCH | CONTINUE MISSION | |
| A. | | | |
| B. TERMINATE PHASE | | | |
| 1. TF CM 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. | | | |
| 3. ENTER NEXT BEST PTP | | | |

**CUES/NOTES/COMMENTS**

- NORMAL RELIEF STARTS AT 50 SECONDS
- C.1. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM CREWMAN)
- A. CORRESPONDS TO 12.6 LB/HR (APPROX. 3 CFM/CREWMAN)
- B.3. WASTE OVERBOARD BLEED = 0.67 LB/HR
- 4. TIME REQUIRED FOR CO₂ PARTIAL PRESSURE TO INCREASE TO 7.6 MM Hg:
  - 1 CREWMAN: 4 HR.
  - 3 CREWMAN: 80 MIN.
### Section 10 - CSM Environmental Control System - Continued

**NASA — Manned Spacecraft Center**

#### Mission Rules

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<td>EVA</td>
<td>B. TERMINATE EVA</td>
<td>C. IF LOST PRIOR TO LM FINAL SEP, TRANSFER ONE OPS BOTTLE TO CM AFTER RENDEZVOUS.</td>
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<td>ALL</td>
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<td>ALL</td>
<td>B. TERMINATE PHASE</td>
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<td>B. CREW MAY ELECT TO DECOMPRESS</td>
<td>B. IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY.</td>
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<td>DOCKED</td>
<td>C. CONTINUE MISSION DO NOT UNDOCK</td>
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<td>E. CONTINUE MISSION</td>
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| 10-28   | LOSS OF O₂ MANIFOLD  | LAUNCH | A. 1. CONTINUE MISSION | A. 2. APPROXIMATELY 3 HOUR ARE REQUIRED TO COMPLETE CABIN O₂ PRESSURE TO 3.5 PSIA, WITH 0.456 LPM HR USAGE RATE (CSM + CABIN LEAK + TANK PRESS BLEED) |
|         |                      | ALL    | 2. ENTER NEXT BEST PTP | |

|         |                      | B. WITH LOSS OF CABIN INTEGRITY | LAUNCH | 1. ABORT ASAP |
|         |                      | ALL    | 2. ENTER ASAP | |

---

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### SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM - CONTINUED

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<td>B. TERMINATE PHASE ENTER NEXT BEST FTP OR ATP</td>
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**MISSION**

- **APOLLO 9**

**REV DATE**

- **A 2/15/69**

**SECTION**

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**GROUP**

- **COOLANT**

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<td>ENTER NEXT BEST PTP. DOFF SUITS AND USE FACE MASKS IF REQUIRED.</td>
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RULE NUMBERS 10-33 THROUGH 10-39 ARE RESERVED.
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| 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 O2 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.  
2. MISSION DURATION WILL BE DETERMINED BY REMAINING LM URINE STORAGE CAPACITY. |
| | 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. |
| | CONFIRMED LEAK IN POTABLE TANK OR UNABLE TO TRANSFER FUEL CELL WATER TO POTABLE TANK | LAUNCH ORBIT (III-V) TODE | 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 | |
| | UNABLE TO VENT SIDE HATCH COUNTERBALANCE MECHANISM | EVA | CONTINUE MISSION | DO NOT OPEN SIDE HATCH |

**MISCELLANEOUS RULES**

Rule numbers 10-45 through 10-49 are reserved.
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<td>PRIM ACCUM. QTY</td>
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</table>
### General

**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 ECS entry.

**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 O2 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 O2 usage in orbit after loss of recharge capability from the cryo system will reduce supply available for entry, landing, and postlanding.

**Loss of a Cryogenic Tank**

Loss of a cryogenic tank is defined as: Pressure cannot be maintained above 150 psia for O2 and 100 psia for H2.

**Minimum Requirement to Continue Beyond a Daily Go/No-Go Point**

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.
SECTION 11 - CSM CRYOGENICS - CONTINUED

NASA - Manned Spacecraft Center

MISSION RULES

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<td></td>
<td>A. MANUAL PRESSURE CONTROL WILL BE USED AS REQUIRED TO MAINTAIN:</td>
</tr>
<tr>
<td></td>
<td>1. TANK PRESSURES GREATER THAN 750 PSIA O₂ AND 200 PSIA FOR H₂</td>
</tr>
<tr>
<td></td>
<td>2. QUANTITY BALANCE WITHIN ± PERCENT O₂ AND 2 PCT FOR H₂</td>
</tr>
<tr>
<td></td>
<td>B. CRYO TANKS WILL BE ALLOWED TO VENT NORMALLY THROUGH TANK RELIEF VALVES.</td>
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<tr>
<td></td>
<td>C. O₂ TANK FANS AND H₂ TANK FANS NORMALLY WILL NOT BE OPERATED IN THE AUTO MODE.</td>
</tr>
<tr>
<td></td>
<td>D. O₂ TANK HEATERS AND H₂ TANK HEATERS NORMALLY WILL BE OPERATED IN THE AUTO MODE.</td>
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<thead>
<tr>
<th>ITEM</th>
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<tr>
<td>11-11</td>
<td>A. ONBOARD CRYOGENIC QUANTITY GAGING IS PRIME. ACCURACY IS ±2.65 PERCENT (±8.48 LBS O₂, ±0.72 LBS H₂) PER TANK.</td>
</tr>
<tr>
<td></td>
<td>B. MCC CALCULATED QUANTITY USING PRESSURE VERSUS TEMPERATURE IS BACKUP.</td>
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RULE NUMBERS 11-12 THROUGH 11-19 ARE RESERVED.
### NASA — Manned Spacecraft Center

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<td>A. CONTINUE MISSION</td>
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<td>B. CONTINUE MISSION</td>
<td>B.1. REF MR 11-4</td>
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<td>MISSION DURATION IS FUNCTION</td>
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<td>OF CRYO REMAINING.</td>
<td>2. REF ALTERNATE MISSION B</td>
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<td>11-21</td>
<td>LOSS OF BOTH O₂ AND/OR H₂ CRYO TANK</td>
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<td>A. REF MR 11-1</td>
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<td>IF LOSS IS O₂ ISOLATE SURGE</td>
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<td>TANK PRIOR TO 800 PSIA.</td>
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<td>ENTER 2-1</td>
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<td></td>
<td>B. TERMINATE PHASE</td>
<td>B. IF 3 FUEL CELLS ARE</td>
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<td>MAXIMUM ORBIT TIME IS 4.75</td>
<td>SEP, SMILES WILL BE</td>
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<td>HRS FOR LOSS OF THREE FUEL</td>
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SECTION 12 - CSM ELECTRICAL POWER SYSTEM

NASA - Manned Spacecraft Center

MISSION RULES

GENERAL

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.

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 (20 FT/SEC CM RF'S) 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.

<table>
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<td>12-1</td>
</tr>
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FED/69-70-P74F (A-65)
### 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 H₂ LOOP IS CONTAMINATED WITH KOH.

### RULE NUMBERS 12-8 THROUGH 12-19 ARE RESERVED

### SYSTEMS MANAGEMENT

#### 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 BETWEEN 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.

### 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 POST-LANDING.

F. A SINGLE BATTERY THAT CANNOT BE RECHARGED WILL NOT BE USED EXCEPT DURING DEORBIT, ENTRY, AND POST-LANDING.

<table>
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<tr>
<th>MISSION</th>
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<td>CSM ELECTRICAL POWER SYSTEM</td>
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<td>12-2</td>
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</table>
FUEL CELL MANAGEMENT

A. FUEL CELL WILL BE "SHUTDOWN" FOR THE FOLLOWING:
   1. SUSTAINED CURRENT OUTPUT LESS THAN 5 AMPS.
   2. FUEL CELL H₂ LOOP IS CONTAMINATED WITH KOH.
   3. REACTANT LEAKAGE JEOPARDIZING MISSION DURATION.

B. FUEL CELL MAY BE "OPEN CIRCUITED" FOR THE FOLLOWING:
   1. SKIN TEMP <92°F.
   2. TCE TEMP 290°F.
   3. FAILURE OF H₂ 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 O₂ PURGES WILL BE DONE AT 12 HOUR INTERVALS. FUEL CELL H₂ 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 H₂ OR O₂ MANIFOLD.

F. EACH H₂ PURGE WILL NORMALLY BE PRECEDED BY 20 MINUTES OF H₂ 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.

INVERTER MANAGEMENT

INVERTERS MAY BE REMOVED FROM LINE FOR ANY OF THE FOLLOWING REASONS:

A. INVERTER TEMP >-100°F.

B. SPACECRAFT LOAD MANAGEMENT
### SECTION 12 - CSM ELECTRICAL POWER SYSTEM - CONTINUED

**NASA — Manned Spacecraft Center**

#### MISSION RULES

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<td><em>LOSS OF ONE FUEL CELL OUTPUT &lt; 5 AMPS</em></td>
<td>LAUNCH ALL</td>
<td>A. CONTINUE MISSION</td>
<td></td>
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<tr>
<td>12-31</td>
<td><em>LOSS OF TWO FUEL CELLS OUTPUT &lt; 5 AMPS EACH</em></td>
<td>LAUNCH</td>
<td>A. CONTINUE MISSION AFTER 2 + 00 GET PERFORM:</td>
<td></td>
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</table>

#### SPECIFIC MISSION RULES

**A. 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. CONTINUE MISSION**

1. REFault PROC EPS-S.
2. REF ALTERNATE MISSION B.

**B. ENTER NEXT BEST PTP**

1. CORRECT REPRINTING FUEL CELL TO BOTH MAIN BUSES.
2. TIE BAT C TO BOTH MAIN BUSES.
3. IF LOSS OF FC 1 AND 3, TIE BAT C TO MAIN B.
4. IF LOSS OF FC 1 AND 3, TIE BAT C TO MAIN B.
5. IF LOSS OF FC 1 AND 3, PERFORM SHUTDOWN.

**C. ENTER NEXT BEST PTP**

1. TERMINATE TO 6 E.
2. SET UP FOR UNMANNED APS BURN MAY BE PERFORMED.
3. ONE ENTRY BATTERY MAY BE USED TO SUPPLEMENT REMAINING FC FOR G&N ALIGNMENT PRIOR TO DEORBIT.

**D. ENTER NEXT BEST PTP**

1. TERMINATE RNDZ.
2. PERFORMANCE CSM/LM FINAL SEP.

**E. ENTER NEXT BEST PTP**

1. TERMINATE RNDZ.
2. SETUP FOR UNMANNED APS BURN MAY BE PERFORMED.
## Section 12 - CSM Electrical Power System - Continued

### NASA — Manned Spacecraft Center

#### Mission Rules

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<td>Loss of Three Fuel Cells</td>
<td>Launch</td>
<td>A.1. <strong>Continue Mission</strong></td>
<td>A.1(A) If total output capability less than 8 Amps at 22 VDC, SMU will be inoperative for CSM/SM separations.</td>
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<td></td>
<td>A. Output &lt; 10 Amps Each</td>
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<td></td>
<td>B. Total Output Capability Insufficient to Support Drift Time Loads</td>
<td>All</td>
<td>2. <strong>Enter Next Best PTP</strong></td>
<td>A.2. 4.75 hours left in orbit before deorbit maneuver.</td>
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<tr>
<td></td>
<td>C. Total Output Capability &lt; 36 Amps at Main Bus Voltage of 26.5 VDC</td>
<td>Launch</td>
<td>2. <strong>Not Applicable</strong></td>
<td>B.1. Enter Next Best PTP.</td>
</tr>
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<tr>
<td>12-23</td>
<td>Loss of Three Fuel Cells Plus One Battery Current 50% of Load or Either Remaining Battery</td>
<td>Launch</td>
<td>A. <strong>Abort</strong></td>
<td>A. Assumes all three fuel cell currents 1.5 and battery C tied to both mains.</td>
</tr>
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<tr>
<td></td>
<td></td>
<td>All</td>
<td>B. <strong>Enter Next Best ATP or PTP</strong></td>
<td>B. 2.4 hours left in orbit before deorbit maneuver.</td>
</tr>
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</table>

Rule numbers 12-24 through 12-39 are reserved.

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**Legend:**
- **Launch:** All applicable
- **Ruling:** Specific conditions and actions
- **Cues/Notes/Comments:** Additional notes and guiding information
<table>
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</table>
| 12-40 | 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 D, TIE BAT C TO MAIN B. |  |
|       | SPS MANEUVER | B. CONTINUE MISSION  
MANEUVER ON REMAINING BATTERY |  |
|       | ALL | C. CONTINUE MISSION  
USE REMAINING TWO (1-3's) DURING SPS BURNS AND ENTRY. |  |
| 12-41 | LAUNCH | A. CONTINUE MISSION  
1. EDS AUTO/OFF TO OFF.  
2. ENTER 2-1 POWERED D/P |  |
|       | SPS MANEUVER | B. CONTINUE MANEUVER  
ENTER NEXT BEST PTP IF AT LEAST TWO BATTERIES (CA-41) BE RESTORED |  |
|       | ALL | C. ENTER NEXT BEST PTP  
IF AT LEAST TWO BATTERIES CANNOT BE RESTORED |  |
| 12-42 | ALL | CONTINUE MISSION  
ROTATE BATTERY C FOR BURNS TO MAINTAIN BALANCED BATTERIES | REF HAN PROC EPS-3  
BATTERY CHARGING NOT REQUIRED FOR NOMINAL MISSION PLUS HYBRID DEBRIBIT AND 18 HOURS POSTANDING WITH ONE BAG FAILURE UPRIGHTING. |

Rule numbers 12-43 through 12-49 are reserved.
### Section 12 - CSM Electrical Power System - Continued

**NASA — Manned Spacecraft Center**

**Mission Rules**

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<td>MAIN BUS TIE MOTOR SWITCH FAILURES</td>
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</tr>
<tr>
<td>A.</td>
<td>ONE MOTOR SWITCH FAILS OPEN</td>
<td>LAUNCH</td>
<td></td>
<td>A.1. CONTINUE MISSION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(A) IF MOTOR SW B/C, TIE BAT C TO MAIN BUS A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(B) IF MOTOR SW B/C, TIE BAT C TO MAIN BUS B</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ALL</td>
<td></td>
<td>A.2. BATTERIES MUST BE CHARGED THROUGH OPEN MOTOR SW. LEAVE BATTERY CB'S CLOSED FOR CHARGING.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ALL</td>
<td></td>
<td>B. CONTINUE MISSION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USE CB'S AS MOTOR SWITCHES</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. IF BOTH MOTOR SWITCHES FAIL CLOSED, BATTERIES CANNOT BE CHARGED.</td>
<td></td>
</tr>
</tbody>
</table>

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**Group**

- **A.2. Batteries must be charged through open motor SW. Leave battery CB's closed for charging.**
- **B. If both motor switches fail closed, batteries cannot be charged.**
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<tr>
<td><strong>A.</strong> FUEL CELL 2 DISCONNECT FROM MAIN A</td>
</tr>
<tr>
<td><strong>B.</strong> FUEL CELL 2 DISCONNECT FROM MAIN B</td>
</tr>
<tr>
<td><strong>C.</strong> MAIN BUS SHORTED &gt;2? AMPS AND FUEL CELLS CANNOT BE DISCONNECTED FROM SHORTED BUS.</td>
</tr>
</tbody>
</table>

### RULING

**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.
- (E) SWITCH TO SECONDARY CMBL SYSTEM.

**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.

**C.1. ABORT**
- (A) PLACE EDS AUTO/OFF TO OFF.
- (B) TIE BAT C TO MAIN BUS B.

### COUS/NOTES/COMMENTS

**A.1.** >25 AMPS SHORT ON MAIN B WILL CAUSE REVERSE DISCONNECT DURING LAUNCH.

**B.1.** >75 AMPS SHORT ON MAIN A WILL CAUSE REVERSE DISCONNECT DURING LAUNCH.

**C.1.** FAILURE OF MOTOR SWITCH TO DISCONNECT FROM SHORTED BUS INDICATED BY FC SHORTED BUS T/B GRAY.

**C.2.** IF FUEL CELL FEED CIRCUIT SHORDED, CLOSE FC REACTANT VALVES.
### SECTION 12 - CSM ELECTRICAL POWER SYSTEM - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<tr>
<td>12-52</td>
<td>LAUNCH</td>
<td>A. BATTERY BUS SHORTED 10 AMPS</td>
<td>A.1. CONTINUE MISSION</td>
<td>A.1. &gt;22 AMPS WILL CAUSE BATTERY BUS VOLTAGE TO BE &lt; MAIN BUS VOLTAGE.</td>
</tr>
</tbody>
</table>

#### A. PLACE EDS AUTO/OFF TO OFF.  
#### B. OPEN ASSOCIATED MAIN BUS TO BAT BUS C.B.  
#### C. TIE BAT C 10 ASSOCIATED MAIN BUS.  
#### 2. ENTER NEXT BEST PTP IF BUS NOT RESTORED |

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<tr>
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<tr>
<td>12-53</td>
<td>BEGIN</td>
<td>B. BATTERY BUS SHORTED 20 AMPS</td>
<td>B. CONTINUE MISSION</td>
<td>REMOVE POWER FROM BUS EXCEPT FOR MANEUVERS AND ENTRY</td>
</tr>
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</table>

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<thead>
<tr>
<th>REV</th>
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<tr>
<td>12-53</td>
<td>LAUNCH</td>
<td>B. SHORT 2.0 AMPS</td>
<td>A.1. CONTINUE MISSION</td>
<td></td>
</tr>
</tbody>
</table>

#### 2. ENTER NEXT BEST PTP OPEN BATTERY BUS TO BATTERY RELAY BUS CB'S. |

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<thead>
<tr>
<th>REV</th>
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<tr>
<td>12-53</td>
<td>BEGIN</td>
<td>B. SHORT 2.0 AMPS</td>
<td>A.2. REF MALF PROC EPS-55R-2</td>
<td></td>
</tr>
</tbody>
</table>

#### 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-55R-2 |

---

**RULING NUMBERS 12-54 THROUGH 12-59 ARE RESERVED.**

### APOLLO 9

**INCL.** 12/15/68  
**CSM ELECTRICAL POWER SYSTEM**  
**DC DISTRIBUTION**  
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<td>12-60</td>
<td>Loss of Two Inverters</td>
<td>Launch, All</td>
<td>A. Continue Mission</td>
<td>A. Ref Malf Proc Place Remaining Inverter On Both AC Buses.</td>
</tr>
<tr>
<td>12-61</td>
<td>Loss of One AC Bus (Two Phases Cannot Be Maintained &gt;95 Vac)</td>
<td>Launch, All</td>
<td>A. Continue Mission</td>
<td>B. Enter Next Best PTP</td>
</tr>
<tr>
<td>12-62</td>
<td>Loss of Both AC Buses</td>
<td>Launch, All</td>
<td>A. Abort Mode I or Mode II 1. Open Direct O₂ for Suit Ventilation. 2. If After Mode II, Enter 2-1 PTP.</td>
<td>B. Enter Next Best PTP or ATP If suited, remove helmet and gloves. If time permits, remove suits. If cabin depressurized, use direct O₂ until cabin is repressurized. A. Ref Mr. ______</td>
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Rule numbers 12-63 through 12-69 are reserved.

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<td>AC BUS 1 C VAC</td>
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<td>BAT B CURRENT</td>
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</tbody>
</table>

**Note:** Use BAT C in lieu of battery with lost inst.
SECTION 13 - CSM COMMUNICATIONS INSTRUMENTATION

NASA — Manned Spacecraft Center

MISSION RULES

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THIS SECTION HAS BEEN DELETED

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

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FED/STD Form 292 (Aug 63)
SECTION 14 - CSM SEQUENTIAL

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 (CD017EX 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

MISSION MISSION

REV REV

ITEM ITEM

DATE DATE

SECTION SECTION

GROUP GROUP

APOLLO 9 APOLLO 9

FINAL FINAL

12/15/68 12/15/68

CSM SEQUENTIAL CSM SEQUENTIAL

GENERAL GENERAL

14-1 14-1
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.
### SECTION 14 - CSM SEQUENTIAL - CONTINUED

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<td>SEQUENTIAL LOGIC BUS A OR B &lt;22 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS</td>
<td>LAUNCH</td>
<td>A. CONTINUE MISSION ENTER BUS 75 BUS NOT RESTORED</td>
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<td>ALL</td>
<td>B. TERMINATE OPERATIONS ENTER NEXT BEST PTP IF BUS NOT RESTORED</td>
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<td>14-21</td>
<td>PYRO BUS A OR B &lt;35 VDC</td>
<td>LAUNCH</td>
<td>A.1. CONTINUE MISSION</td>
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<td>ALL</td>
<td>A.2. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS</td>
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<td></td>
<td></td>
<td>A. SHORTED &gt;10 AMPS</td>
<td>ALL</td>
<td>B. CONTINUE MISSION</td>
</tr>
<tr>
<td></td>
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<td>B. SHORTED &lt;10 AMPS</td>
<td>ALL</td>
<td>B. CONTINUE MISSION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. PYRO BUS TM READS 0 VDC AND PYRO BAT ONBOARD &gt;35 VDC</td>
<td>LAUNCH</td>
<td>C.1. CONTINUE MISSION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ALL</td>
<td>2. ATTEMPT FUNCTION USING SUSPECTED FAILED BUS ONLY: (A) IF FUNCTION NORMAL, CONTINUE MISSION (B) IF FUNCTION DOES NOT WORK NORMALY, ENTER NEXT BEST PTP</td>
<td></td>
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<tr>
<td>14-22</td>
<td>TELEMETRY INDICATES AN EDS VOTE INPUT 1, 2, OR 3</td>
<td>LAUNCH</td>
<td>CONTINUE MISSION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. IF ANY ENTRY BATTERY &lt;22 VDC, EDS AUTO/OFF SWITCH TO OFF</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>B. ALL ENTRY BATTERIES &gt;22 VDC: CHECK CORRESPONDING EDS C.B.'S 1, 2, OR 3 CLOSED</td>
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<tr>
<td>14-23</td>
<td>LET JETTISON MOTOR DOES NOT FIRE</td>
<td>LAUNCH</td>
<td>CONTINUE MISSION ATTEMPT JETTISON PER CREW CHECKLIST EMERGENCY PROCEDURE</td>
<td></td>
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**CUES/NOTES/COMMENTS**

- CD0170X AND/OR CD0123X SYSTEM A, CD0171X AND/OR CD0124X SYSTEM B
- CD0157X AND/OR CD0123X SYSTEM A, CD0171X AND/OR CD0124X SYSTEM B
- CD0132X, CD0133X, AND CD0134X RESPECTIVELY.
- A. BAT C VOLTAGE CAN ONLY BE MONITORED ONBOARD

**PARAMETERS ARE CD0132X, CD0133X, AND CD0134X RESPECTIVELY.**

**IN AL 12/68 CSM SEQUENTIAL SPECIFIC**
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<td>SMJG ACTIVATES PREMATURELY</td>
<td>ALL</td>
<td>ENTER NEXT BEST PTP</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>A. TERMINATE OPERATIONS AND POWER DOWN AFFECTED MAIN BUS. DO NOT ARM AFFECTED PYRO BUS.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. IF UNDOCKED, RETURN TO CSM AND PERFORM CORRUP/FINAL SEP.</td>
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<td></td>
<td>C. REPOWER AFFECTED MAIN BUS AFTER CM/SM SEP.</td>
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<td>14-25</td>
<td>ACTIVATED CM RCS PRESS LOGIC RELAYS.</td>
<td>ALL</td>
<td>CONTINUE MISSION</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A. PRIOR TO CM RCS PRESS: DO NOT ARM RESPECTIVE PYRO BUS. (FOR BOTH INDICATIONS PERFORM SLA SEP WITH SECS ARM CB'S OPEN.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. AT CM RCS PRESS: ARM RESPECTIVE PYRO BUS.</td>
<td></td>
</tr>
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<td>14-26</td>
<td>ACTIVATED SLA DEPLOY LOGIC RELAYS</td>
<td>ALL</td>
<td>CONTINUE MISSION</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A. PRIOR TO SLA SEP: DO NOT ARM RESPECTIVE PYRO BUS.</td>
<td></td>
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<td></td>
<td></td>
<td>B. FOR SLA SEP: ARM RESPECTIVE PYRO BUS FIRST.</td>
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<tr>
<td>14-27</td>
<td>UNABLE TO PERFORM SLA SEPARATION</td>
<td>ORBIT (E-IVD)</td>
<td>ENTER NEXT BEST PTP</td>
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<td>14-28</td>
<td>LOST GROUND TO RESISTER NETWORK FOR LOGIC OR PYRO BUS VOLTS MEASUREMENTS</td>
<td>ALL</td>
<td>CONTINUE MISSION</td>
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<td></td>
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<td></td>
<td>A. ARMING SYSTEM WITH VOLTAGE &gt;30 VDC WILL RESULT IN PERMANENT LOSS OF ALL ANALOG TELEMETRY PARAMETERS.</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td>ARMING SYSTEM WITH VOLTAGE &gt;30 VDC WILL RESULT IN PERMANENT LOSS OF ALL ANALOG TELEMETRY PARAMETERS.</td>
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**RULE**

CD0123X AND/OR CD0124X

**SECTIONS**

CD0173X AND/OR CD0174X

**COMMENTS**

GENERAL INFORMATION

**GROUP**

SPECIFIC

**PAGE**

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<td>ACTIVATED APEX JETTISSION LOGIC RELAYS</td>
<td>ALL</td>
<td>ENTER NEXT BEST PTP</td>
<td>DO NOT ARM PYRO BUSES UNLESS MALFUNCTION HAS BEEN ISOLATED</td>
<td>DETECTED AT SECS POWER UP (CD0025X AND CD0023X)</td>
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<td>14-41</td>
<td>ACTIVATED DROGUE CHUTE DEPLOY LOGIC RELAYS</td>
<td>ALL</td>
<td>ENTER NEXT BEST PTP</td>
<td>DO NOT ARM PYRO BUSES UNLESS MALFUNCTION HAS BEEN ISOLATED</td>
<td>MAY BE DETECTED AT ANY TIME (CE0000X AND/OR CE0002X)</td>
</tr>
<tr>
<td>14-42</td>
<td>ACTIVATED PILOT CHUTE DEPLOY LOGIC RELAYS</td>
<td>ORBIT (SOLO)</td>
<td>ENTER NEXT BEST PTP</td>
<td>DO NOT ARM PYRO BUSES UNLESS MALFUNCTION HAS BEEN ISOLATED</td>
<td>DETECTED AT SECS POWER UP PRIOR TO ENTRY (CE0023X AND/OR CE0024X) WITH ELU BAT A(B) C.B. CLOSED.</td>
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<td>PYRO BUS B VOLTS</td>
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<td>SEQ LOGIC BUS A VOLTS</td>
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<td>EDS ABORT VOTE 3</td>
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<td>MAIN CHUTE DISC A</td>
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<td>MAIN CHUTE DISC B</td>
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<td>EDS ABORT REQ A</td>
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<td>LM CURRENT</td>
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GUIDANCE AND CONTROL

NASA — Manned Spacecraft Center
MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL

LAUNCH

There are no failures of the CSM guidance and control system which are cause for abort.

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. SCS 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 FOAI
   - RATE DAMPING IN ALL THREE AXES (DAP or SCS)

(B) HYBRID DEORBIT REQUIREMENTS:
   - ALL SM DEORBIT REQUIREMENTS (RATE DAMPING MUST BE SCS)
   - ONE 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 DP), SCS AUTO, or direct ullage.

C. The SPS will not be shutdown for an FCSM indication.

DELETED

UNDOCKED

The undocked phase will be deleted or terminated if the G&C systems cannot provide redocking capability. In addition, the guidance and control systems must provide direct RCS and rate damping in each axis and translation capability in the X-AXIS FOR DOCKING/UNDOCKING CONTROL.

RENNuvo

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 AXES
- OPERATIONAL IMU AND CMC
- ONE OPERATIONAL RHC
- ONE OPERATIONAL FOAI

Rule numbers 15-6 through 15-9 are reserved.
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 0.02 ft/sec² and 0.075 deg/hr respectively.

15-12 **LV COUNTER DRIFT**
Should the LV counter drift be >0.01 ft/sec² for an RCS maneuver, the Vs setting will be appropriately biased. Should the drift be >0.1 ft/sec², 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 GPS 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.

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</table>
| 15-20|                                                          | ALL        | CONTINUE MISSION         | A. REF MALF PROC GEC 1,3,3,4  
|      |                                                          |            |                         | 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 REALIGNED IN ADDITION TO THE ABOVE, FOR YAW FAILURE AFTER .05G. |
| 15-21| LOSS OF BOTH BMAG 1 AND 2 IN EITHER PITCH OR YAW CHANNEL | LAUNCH     | A. CONTINUE MISSION      | • REF MALF PROC GEC 1,2,3,4 |
|      |                                                          | ALL        | B.1. TERMINATE PHASE     | A. MTV ACCEL CMD IS ONLY MODE III OR MODE IV SPS CONTROL MODE.  
<p>|      |                                                          |            |                         | B.1. LOSS OF PITCH CHANNEL RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECT TO SING LE FAILURES IN THE G&amp;N SYSTEM. THE YAW LOSS PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO SINGLE FAILURES IN THE GEN SYSTEM. |
|      |                                                          |            |                         | 2. ENTER NEXT BEST PTP   |
|      |                                                          | ENTRY      | C. CONTINUE MISSION      | C. RSI AND SCS FDAI ROLL UNUSABLE WITH YAW CHANNEL FAILURES. |
| 15-22| LOSS OF ROLL BMAG                                       | A. NUMBER ONE | ALL   | A.1. CONTINUE MISSION                      | • REF MALF PROC GEC 1,3,4,5,4 |
|      |                                                          |            |                         | A.1. MANUAL ROLL ATTITUDE CONTROL REQUIRED IN ALL SCS MODES. |
|      |                                                          | B. NUMBER TWO | ALL   | B.1. CONTINUE MISSION                      | 2. NO SCS FDAI ROLL. RSI VALID. |
|      |                                                          |            |                         | 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. |</p>
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<td>All</td>
<td>A. Continue mission</td>
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<td>• Violates hybrid deorbit minimum requirements</td>
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<td>• Ref Malf Proc Sec 1, 2, 3, 4</td>
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<td>Entry</td>
<td>C. Continue mission</td>
<td>C. No SCS FDA: Roll or RSI available</td>
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<td>Loss of either TVC servo loop in either pitch or Yaw axis</td>
<td>All</td>
<td>Continue mission</td>
<td>Select 1 or 2 on TVC gmbl or switch in appropriate axis</td>
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<td>Maintain 20 lbs/quad/axis for hardover recovery for undocked and Hybrid deorbit available</td>
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<td>For hardover recovery for docked SPS maneuvers</td>
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<td>Launch</td>
<td>All</td>
<td>A. Continue mission</td>
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<td>2. No Mode III or IV capability. Limited landing point control in mode III or IV with SM-RCs</td>
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<td>C1. Continue mission</td>
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## SECTION 15 - GUIDANCE AND CONTROL - CONTINUED

### NASA — Manned Spacecraft Center

#### MISSION RULES

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<td>A. CONTINUE MISSION AFTER SP/LETTFROM EMS MAY BE REENABLED WITHOUT LOSS OF AUTO RCS.</td>
<td>• SUSPECTED FAILURE WOULD BE AUTO INHIBIT CIRCUITY.</td>
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<td>A. CONTROL IS REGAINED BY OPENING EMS CB'S.</td>
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<td>B. CONTROL IS REGAINED BY PLACING S/C CONTROL SWITCH TO CMC.</td>
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<td>C. FAILURE VIOLATES MINIMUM CAPABILITY CRITERIA FOR BOTH SM AND HYBRID DEORB.</td>
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<td>15-29 LOSS OF FLIGHT DIRECTOR ATTITUDE INDICATORS</td>
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<td>2.(A) CONTINUE MISSION IF SPS DEORB NOT AVAILABLE.</td>
<td>A.2.(B) REMAINING DEORB METHODS SUBJECT TO THE SAME SINGLE FAILURES IN SCS SYSTEM.</td>
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| 15-30 | LOSS OF AC1 #A | ALL | CANCEL MISSION | | • LOSS OF AC1 #A 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. RHA #2  
  D. GYRO ASSEMBLY #2  
  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 PSY DRIVE #1.  
  • LOSS OF AC1 PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO A SINGULAR FAILURE (AC2 #A). |
| 15-31 | LOSS OF AC2 #A | ALL | CANCEL MISSION | | • LOSS OF AC2 #A RESULTS IN THE LOSS OF:  
  A. REDUNDANT SERVO LOOP POWER  
  B. ALL PROPORTIONAL CONTROL  
  C. RHA #2  
  D. GYRO ASSEMBLY #2  
  E. SCS TOTAL ATTITUDE  
  F. SCS TVC CAPABILITY (AUTO, RATE AND ACCEL)  
  G. RSI  
  H. GPI PSY DRIVE #2  
  • LOSS OF AC2 RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECT TO A SINGULAR FAILURE (AC1 #A). |
<p>| 15-32 | LOSS OF ORBIT RATE DISPLAY (CORDEAL) EARTH AND LUNAR | ALL | CONTINUE MISSION | | REF MALF PROC SCS |</p>
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<td>GROUND AT EITHER SPS SOL DRIVER OUTPUT AND UNABLE TO REMOVE.</td>
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<td>B. CONTINUE MISSION USE OTHER SPS BANK FOR ENGINE OPERATION.</td>
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<td>LOSS OF TRANSLATION HAND CONTROLLER</td>
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Rule numbers 15-36 through 15-40 are reserved.
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**NASA — Manned Spacecraft Center**

**MISSION RULES**

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| A   | 15-50| LOSS OF COMMAND MODULE COMPUTER | 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.

UNDOCKED

C. INHIBIT PHASING MANEUVER REF ALTERNATE MISSION B.

RENDZ

D. TERMINATE AT NEXT EXIT POINT

ENTRY

E. PERFORM BACKUP ENTRY

---

**A**

15-51 LOSS OF DSKY

- A. EITHER MDC OR LEB DSKY

- B. BOTH MDC AND LEB DSKY

ALL

A. CONTINUE MISSION

B.1.(A) CONTINUE MISSION IF BOTH SPS AND SM DE- ORBIT CAPABILITY AVAILABLE.

(B) TERMINATE PHASE AND ENTER NEXT BEST PTP IF EITHER SPS OR SM DEORBIT CAPABILITY NOT AVAILABLE.

UNDOCKED

2. INHIBIT PHASING MANEUVER REF ALTERNATE MISSION B

RENDZ

3. TERMINATE AT NEXT EXIT POINT.

ENTRY

4. PERFORM BACKUP ENTRY

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**REF** WAPL PROC GEN 5

B.2. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS.

C. VIOLATES RESCUE MINIMUM REQUIREMENTS

B.1.(B) VIOLATES HYBRID DE- ORBIT MINIMUM REQUIREMENTS.

B.2. VIOLATES RESCUE MINIMUM REQUIREMENTS

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**NASA - Manned Spacecraft Center**

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<td>CMC warning relay in NAV OK not closed</td>
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<td>A.2.(B) PIPA'S are required for V SENSING IN HYBRID DEORBIT</td>
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**Mission: Apollo 9**

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<td>• REF. MALF PROC GEN 10 CONSTITUTES LOSS OF TVC DAP. REF. ALTERNATE MISSION B</td>
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Rule Numbers 15-56 through 15-59 are reserved.

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</table>
SECTION 16 - CSM SERVICE PROPULSION SYSTEM
NASA - Manned Spacecraft Center
MISSION RULES

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/or COLD 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 BURNS(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 DODED DPS MANEUVER TO PUNGE 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 (16)

B. BACKUP METHOD: FLOW RATE X BURN TIME (31)

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 DODED 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.
SECTION 16 - CSM SERVICE PROPULSION SYSTEM - CONTINUED

MISSION RULES

PROPELLANT MANAGEMENT

A. THE SPS PROPELLANT REDLINE TO PROVIDE A MINIMUM 40-SECOND POST-DOCKED SPS BURN, LM RESCUE, AND DEORBIT CAPABILITY FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT IS 1.14 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 1.1 PERCENT INDICATED PROPELLANT REMAINING.

C. THE SPS PROPELLANT REDLINE TO PROVIDE A DEORBIT CAPABILITY OF 6.20 FPE IS 1.4 PERCENT INDICATED PROPELLANT REMAINING AND IS SUFFICIENT TO ACCOMPLISH DEORBIT FROM ANY POINT IN THE MOST STRINGENT NOMINAL ORBIT.

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.

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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**NASA — Manned Spacecraft Center**

#### MISSION RULES

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<td>A 16-20</td>
<td>SUSTAINED PRESSURE DECAY IN EITHER THE FUEL OR OXIDIZER TANK (COULD BE MELIUM OR FUEL OR OXIDIZER),</td>
<td>LAUNCH</td>
<td>CONTINUE MISSION</td>
<td>REF MALF PROC SPS 1</td>
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<td></td>
<td></td>
<td></td>
<td>1. PLAN RCS DEORBIT INTO PTP 2-1 RCS DEORBIT</td>
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<td>2. IF LAND IP IS UNAVOIDABLE AFTER ABORT, REPRESSURIZE TANKS MANUALLY</td>
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<td>A. COAST</td>
<td>ALL</td>
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<td>B. NON-CRITICAL BURN</td>
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<td>C. CRITICAL BURN</td>
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<td>2. ENTER NEXT BEST PTP RCS DEORBIT</td>
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| A 16-21 | LOSS OF BOTH GN2 TANK Pressures (<400 PSI). | LAUNCH | CONTINUE MISSION | |
|   | | | A. CONTINUE MISSION | |
|   | | | B. 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 | |
|   | | | C. CONTINUE MISSION | |
|   | | | 2. REF ALTERNATE MISSION B | |
|   | | | D. TERMINATE AT NEXT EXIT POINT | |
|   | | | E. ENTER NEXT BEST PTP RCS DEORBIT | |

### Mission Details

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**NASA — Manned Spacecraft Center**

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<td>FUEL FEEDLINE AND/OR OXIDIZER FEEDLINE TEMP &lt;27°F AND UNABLE TO INCREASE.</td>
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<td>B.1. CONTINUE MISSION if both SM and hybrid DE-ORBIT AVAILABLE.</td>
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<td>DOCKED</td>
<td>C.1. CONTINUE MISSION</td>
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<td>RENDZ</td>
<td>D. TERMINATE AT NEXT EXIT POINT</td>
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<td>CSM</td>
<td>E. ENTER NEXT BEST PTP RCS DEORBitt</td>
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<td></td>
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<td>C. MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING.</td>
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<td>ENGINE FLANGE TEMP GOES HIGHER THAN 480°F DURING AN SPS BURN.</td>
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<td>B. TERMINATE BURN INHIBIT FURTHER BURNS.</td>
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<td>B</td>
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<td>C. CONTINUE BURN INHIBIT FURTHER BURNS.</td>
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#### NASA — Manned Spacecraft Center

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<td><strong>A-16-24 UNABLE TO IGNITE SPS</strong></td>
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<td><strong>A-16-25 THRUST CHAMBER PRESSURE &lt;70 PSI CONFIRMED BY OTHER INSTRUMENTATION</strong></td>
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<td><strong>RCS DEORBIT</strong></td>
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<tr>
<td><strong>A-16-26 LACK OF ULLAGE CAPABILITY AFTER STORAGE TANK EMPTY</strong></td>
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<td>MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING</td>
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<td><strong>CONFIRMING INSTRUMENTATION INCLUDES ONBOARD PC METER, CREW, DEGRADED THRUST, FU AND OX INTERFACE PRESSURES, F/O VALVE POSITIONS, FU AND OX TANK PRESSURES</strong></td>
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<td><strong>INHIBIT ALL NON-CRITICAL SPS BURNS</strong></td>
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**Mission Rev.**

**APOLLO 9**

**Date:** 2/15/69

**Section:** CSM SERVICE PROPULSION SYSTEM

**Group:** SPECIFIC

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**NASA — Manned Spacecraft Center**

#### MISSION RULES

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| A 16-27 | FIRST BURN SUBSEQUENT TO DOCKED DPS MANEUVER WAS LESS THAN 40 SEC. | ALL | A.1. INHIBIT ALL BURNS  
2. CONTINUE MISSION IF BOTH SM AND HYBRID DEORB IT AVAILABLE  
3. ENTER NEXT BEST PTP IF EITHER SM OR HYBRID NOT AVAILABLE, RCS DEORB IT. |
| | | DOCKED | B.1. CONTINUE MISSION  
2. REF ALTERNATE MISSION B |
| | | CSM SOLO | C. ENTER NEXT BEST PTP RCS DEORB IT |
| | | | |
| | | | A. IF BURN IS TERMINATED FOR ANY REASON:  
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. |
| | | | B.1. MAINTAIN 30 LBS RCS FOR CSM ACTIVE DOCKING. |
| A 16-28 | BETWEEN FUEL AND OXIDIZER TANK PRESSURES 20 PSI AND UNABLE TO DECREASE. | LAUNCH | CONTINUE MISSION |
| | | A. COAST | A.1(A) CONTINUE MISSION IF BOTH SM AND HYBRID DEORB IT AVAILABLE.  
(B) ENTER NEXT BEST PTP IF EITHER SM OR HYBRID DEORB IT NOT AVAILABLE, RCS DEORB IT. |
| | | DOCKED | 2.(A) CONTINUE MISSION  
(B) REF ALTERNATE MISSION B |
| | | CSM SOLO | 3. ENTER NEXT BEST PTP RCS DEORB IT |
| | | | | B. NON-CRITICAL BURN  
C. CRITICAL BURN |
| | | | | B. INHIBIT OR TERMINATE BURN  
C. CONTINUE BURN |

**APOLLO 9**

**REVISION:** A  
**DATE:** 2/15/69

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**GROUP:** SPECIFIC  
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<td>LEAK OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE OR BOTH HELIUM VALVES FAIL CLOSED.</td>
<td>ALL</td>
<td>A. CONTINUE MISSION PLAN SPS PROFILE TO MAINTAIN 620 FT/SEC FOR SPS DEORBIT.</td>
<td>A. BLOW DOWN 6V REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE.</td>
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A. BLOW DOWN 6V REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE.

RULE NUMBERS 16-30 THROUGH 16-49 ARE RESERVED.

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<td>A. CONTINUE MISSION PLAN SPS DEORBIT TO MAINTAIN 620 FT/SEC FOR SPS DEORBIT.</td>
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<td>B. LV CAPABILITY LESS THAN 620 FT/SEC.</td>
<td>ALL</td>
<td>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</td>
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### Section 17 - CSM SM-RCS

**General Rules**

#### 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.**

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### 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 120 psia.

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**Rule Numbers 17-13 Through 17-19 Are Reserved.**
### SECTION 17 - CSP: SM-RCS - CONTINUED

**NASA — Manned Spacecraft Center**

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### Specific Mission Rules

1. **HE TANK PRESS > HE MANIFOLD PRESS IN AT LEAST THREE QUADS AND HYBRID DEORBIT STILL AVAILABLE**
   - **LAUNCH**
     - B.1.(A) CONTINUE MISSION
   - **ALL**
     - (B) CONTINUE MISSION
   - **TODE**
     - (C)(1) CONTINUE MISSION IF Docked
     - (2) TERMINATE PHASE IF NOT Docked
   - **Docked**
     - (D)(1) DO NOT UNDOCK
   - **UNDOCKED**
     - (E)(1) REDOCK LM ACTIVE
     - (2) REFERENCE ALTERNATE MISSION D
   - **RNDZ**
     - (F) TERMINATE AT NEXT EXIT

2. **HE TANK PRESS > HE MANIFOLD PRESS IN TWO OR MORE QUADS**
   - **LAUNCH**
     - B.2.(A) CONTINUE MISSION
   - **ALL**
     - (B) TERMINATE PHASE AND ENTER NEXT BEST PTP
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#### NASA — Manned Spacecraft Center

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<td>17-21</td>
</tr>
</tbody>
</table>
## GENERAL

### 18-1 LACCH

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 

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 1 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 54V still exists. CM RCS startup prior to CWSM 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 11 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 available propellant for a mode 3 deorbit. Loss of helium supply pressure or helium manifold pressure in both CM RCS rings deletes all entry attitude control capability requiring contingency on RCS spin-up prior to CWSM 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. Availing 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

### 18-10 THRUSTER TEMP CONTROL

CM RCS thrusters will be heated prior to entry for 20 minutes or until the lowest indicated temperature is +20°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: MAF Proc RCS 3

### 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: MAF Proc RCS 4

Rule numbers 18-12 through 18-19 are reserved.
### Specific Mission Rules

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<th>RULE</th>
<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<tbody>
<tr>
<td>18-20</td>
<td></td>
<td>SUSTAINED LEAK IN OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE.</td>
<td>LAUNCH</td>
<td>A. ONE RING</td>
<td>CONTINUE MISSION AND ENTER PTP 5-6</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>ALL</td>
<td>TERMINATE PHASE AND ENTER NEXT BEST PTP</td>
</tr>
<tr>
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<td></td>
<td>B. BOTH RINGS</td>
<td>CONTINUE MISSION AND ENTER PTP 2-3 UNLESS PRIOR TO TOWER JETTISON. IF PRIOR TO TOWER JETTISON, ABORT.</td>
</tr>
<tr>
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<td></td>
<td>ALL</td>
<td>TERMINATE PHASE AND ENTER NEXT BEST PTP</td>
</tr>
<tr>
<td>18-21</td>
<td></td>
<td>SUSTAINED LEAK IN OR COMPLETE LOSS OF HELIUM MANIFOLD PRESSURE (COULD BE EITHER FUEL OR OXIDIZER).</td>
<td>LAUNCH</td>
<td>A. ONE RING</td>
<td>CONTINUE MISSION AND ENTER PTP 5-6</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>ALL</td>
<td>TERMINATE PHASE AND ENTER NEXT BEST PTP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. BOTH RINGS</td>
<td>CONTINUE MISSION AND ENTER PTP 2-3 UNLESS PRIOR TO TOWER JETTISON. IF PRIOR TO TOWER JETTISON, ABORT.</td>
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<tr>
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<td>ALL</td>
<td>TERMINATE PHASE AND ENTER NEXT BEST PTP</td>
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<tr>
<td>18-22</td>
<td></td>
<td>CM RCS IS ARMED FOR ANY REASON</td>
<td>ALL</td>
<td>TERMINATE PHASE AND ENTER NEXT BEST PTP</td>
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Rule numbers 18-23 through 18-49 are reserved.
**SECTION 18 - CSM OM-RCS - CONCLUDED**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<tr>
<th>ITEM</th>
<th>MEAS DESCRIPTION</th>
<th>PCM</th>
<th>ONBOARD</th>
<th>TRANSUDERS</th>
<th>CATEGORY</th>
<th>MISSION RULE REFERENCE</th>
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<td>18-50</td>
<td>CM HE MNFLD A PRESS</td>
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<td>CR0035P</td>
<td>METER/C/W</td>
<td>SEPARATE</td>
<td>M (BOTH)</td>
<td>18-21</td>
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**MISSION** | **REV** | **DATE** | **SECTION** | **GROUP** | **PAGE**
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<td>PREL</td>
<td>10/1/68</td>
<td>CSM OM-RCS</td>
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<td>18-3</td>
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*REV/ED: FORM 90F (MA: 60)*
**SECTION 19 - DOCKING AND UMBILICAL**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<th>REV</th>
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<tbody>
<tr>
<td>19-1</td>
<td>THREE GOOD DOCKING RING LATCHES 120 DEGREES APART ARE REQUIRED FOR AN IVT.</td>
<td></td>
</tr>
<tr>
<td>19-2</td>
<td>THREE GOOD DOCKING RING LATCHES 120 DEGREES APART ARE REQUIRED FOR A DOCKED RCS MANEUVER.</td>
<td></td>
</tr>
<tr>
<td>19-3</td>
<td>THE DOCKED SPS OR DPS BURNS REQUIRE THAT NO MORE THAN THREE DOCKING RING LATCHES BE UNLATCHED.</td>
<td></td>
</tr>
<tr>
<td>19-4</td>
<td>MANNE0 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.</td>
<td></td>
</tr>
<tr>
<td>19-5</td>
<td>WITH FAILURE OF THE CSM FORWARD HATCH PRIMARY LOCK/UNLOCK MECHANISM, THE SECONDARY LOCK/UNLOCK MECHANISM WILL ONLY BE USED TO UNLOCK 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.</td>
<td></td>
</tr>
<tr>
<td>19-6</td>
<td>LOSS OF VISUAL DOCKING AIDS (COAS AND TARGETS) WILL NOT INHIBIT DOCKING, AND UNDOCKING.</td>
<td></td>
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<tr>
<td>19-7</td>
<td>FOR CASES WHERE &quot;FINAL&quot; LM SEPARATION IS NOT ATTEMPTED, THE DOCKING RING WILL BE JETTISONED 20 MIN PRIOR TO RETROFIRE. REF MR 5-21E</td>
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<tr>
<td>19-8</td>
<td>IF THE DOCKING PROBE FAILS TO INDICATE EXTENSION OR IF BOTH TALK BACK INDICATORS* ARE BARBER POLE, TOE WILL BE ATTEMPTED.</td>
<td></td>
</tr>
<tr>
<td><strong>NOTE</strong>: THE ONLY DOCKING PROBE INSTRUMENTATION CONSISTS OF TWO TALK BACK INDICATORS IN THE CSM.</td>
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**MANAGEMENT MISSION RULES**

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**APOLLO 9**

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<td>APOLLO 9</td>
<td>A</td>
<td>2/15/69</td>
<td>DOCKING AND UMBILICAL</td>
<td>DOCKING SYSTEM - GENERAL MANAGEMENT</td>
<td>19-1</td>
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### Specific Mission Rules

**A. 19-20**  
**Failure to Mate LM Umbilical**

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<tr>
<td>A. Plus P23</td>
<td>TDGE</td>
<td>A. CONTINUE MISSION</td>
<td>TDGE</td>
<td>A. P23 IS LOCATED BETWEEN CSM +Y AND +Z AXIS</td>
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<tr>
<td>B. Plus P24</td>
<td>TDGE</td>
<td>B. CONTINUE MISSION</td>
<td>TDGE</td>
<td>B. P24 IS LOCATED BETWEEN CSM -Z AND +Y AXIS. P24 UMBILICAL CONTAINS LM DESCENT BATTERY. DESCENT BATTERY RESET FUNCTION.</td>
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<tr>
<td>C. Both P23 and P24</td>
<td>TDGE</td>
<td>C. PERFORM CSMLM FINAL SEP. REP ALTERNATE MISSION A.</td>
<td>TDGE</td>
<td>C. 5-IVB/ML SEP CANNOT BE ACHIEVED WITHOUT MATING AT LEAST ONE UMBILICAL</td>
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**A. 19-21**  
**Failure to Maintain LM X-Lunar Bus Power from CSM**

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<tr>
<td>Docked</td>
<td>TDGE</td>
<td>1. CONTINUE MISSION: IF UNABLE TO TRANSFER POWER FROM CSM TO LM DESCENT BATTERY, INCREASE LM WITHIN 10 HRS AND TURN LM DESCENT BATTERY ON</td>
<td>LM DESCENT STAGE LIFETIME IS CRITICAL</td>
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<td>Docked</td>
<td>TDGE</td>
<td>MAX LIFETIME OF CRITICAL EQUIPMENT WITHOUT HEATERS IS 10 HOURS</td>
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**A. 19-22**  
**Failure to Achieve 5-IVB/UM Separation**

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<td>TDGE</td>
<td>TDGE</td>
<td>PERFORM CSMLM FINAL SEP. REP ALTERNATE MISSION A.</td>
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**A. 19-23**  
**Failure to Achieve CSM/UM Final Separation**

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<tr>
<td>Docked</td>
<td>TDGE</td>
<td>MUST PERFORM NORMAL UNDOCKING. A. RETRIEVE PROBE AND DROGUE AND INSTALL. B. AFTER UNDOCKING, DEPRESS CSM AND JETTISON PROBE OVERBOARD.</td>
<td>LM MASS MAY HAVE TO BE MODIFIED FOR APS BURN</td>
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**A. 19-24**  
**Failure to Indicate Docking Probe Extend or Both Talk Back Indicators Are Barber Pole.**

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<td>TDGE</td>
<td>A. CONTINUE MISSION ATTEMPT TDGE</td>
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<td>UNDOCKED</td>
<td>UNDOCKED</td>
<td>B. CONTINUE MISSION ATTEMPT DOCKING</td>
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**A. 19-25**  
**Failure to Capture or To Achieve Docking**

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<td>UNDOCKED</td>
<td>UNDOCKED</td>
<td>PERFORM EVT</td>
<td>UNDOCKED</td>
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<td>REV</td>
<td>RULE</td>
<td>CONDITION/FAULT</td>
<td>PHASE</td>
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</table>
| 19-26 | CANNOT REMOVE CSM FORWARD HATCH | TDDE | 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 | TDDE | DOCKED | A. CONTINUE MISSION  
   |  |  |  | B. CONTINUE MISSION  
   |  |  |  | REF ALTERNATE MISSION  
   |  |  |  | B. SPS AND OR 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 MECHANISM 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 | TDDE | 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. |
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/NDZ
   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.

THE PLSS BATTERY IS CONSIDERED TO HAVE A MINIMUM OF 15.3 AMP-HR CAPABILITY. THIS CONSUMABLE IS GAGED BY MONITORING GTB140C AND PROCESSING IN THE RTCC TO OBTAIN AMP-HRS.

THE PLSS PRIMARY OXYGEN SUBSYSTEM (POS) IS CONSIDERED TO HAVE A NOMINAL SOURCE PRESSURE OF 850 PSIA. THIS CONSUMABLE IS GAGED BY MONITORING GTB182P AND PROCESSING IN THE RTCC TO OBTAIN LBS MASS.

THE PLSS FEEDWATER RESERVOIR IS CONSIDERED TO HAVE A NOMINAL LOADING OF 8.3 LBS. THIS CONSUMABLE IS GAGED BY MONITORING GTB154T, GTB196T, GTB182P, GTB110P AND PROCESSING IN THE RTACF TO OBTAIN LBS REMAINING.
### SECTION 20 - EMU/EVA - CONTINUED

**NASA - Manned Spacecraft Center**

**MISSION RULES**

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<th>REV</th>
<th>PAGE</th>
<th>CUE/NOTES/COMMENTS</th>
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</table>
| A   | 20-20| **LOSS OF PRESSURE INTEGRITY**<br>A. PGA PRESS < 3.75 PSIA (T3) AND DECREASING OR PGA PRESS GAUGE OF < 3.2 PSIA AND DECREASING  
B. PGA PRESS > 4.05 PSIA (T2) AND INCREASING OR PGA PRESS GAUGE OF > 3.2 PSIA AND INCREASING  |
|     |      | 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 MULF EMU 5-9, 5-24  
- REF MULF EVA 5-13, 5-23  
- CREW SENSIBLE DETECTION

| A   | 20-21| **LOSS OF OXYGEN VENTILATION**
A. FAN FAILURE  
B. NOXIOUS ODOR  |
|     |      | A. **TERMINATE EVA**  
1. ACTIVATE OPS  
2. OPEN PGA PURGE VALVE  
3. INGRESS S/C ASAP  
B. **TERMINATE EVA**  
1. ACTIVATE OPS  
2. OPEN PGA PURGE VALVE  
3. INGRESS S/C ASAP  |
|     |      | REF MULF EMU 5-14, 5-29  
- CREW SENSIBLE DETECTION

| A   | 20-22| **HUMIDITY CONTROL MALFUNCTION**
A. DEGRADED OPERATION OF WATER SEPARATOR  
B. TOTAL LOSS OF WATER SEPARATOR  |
|     |      | A. **CONTINUE MISSION**  
REDUCE WORK PROFILE TO COMPENSATE FOR INCREASED HUMIDITY  
B. **TERMINATE EVA**  
1. IF DEHUMIDIFICATION IS REQUIRED, ACTIVATE OPS IN PURGE MODE  
2. INGRESS S/C ASAP  |
|     |      | REF MULF EMU 5-14, 5-29  
- CREW SENSIBLE DETECTION

**RULES 20-23 THROUGH 20-29 ARE RESERVED.**

---

**MISSORY**<br>Apollo 9<br>**REV**<br>A<br>**DATE**<br>2/15/69

**GROUP**<br(specific)

**PAGE**<br>20-2
### Section 20 - EMU/EVA - Continued

**NASA - Manned Spacecraft Center**

#### Mission Rules

**Loss of Liquid Transport Loop Thermal Control**

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<tr>
<th>Loss of Liquid Transport Loop Thermal Control</th>
<th>Evacuation (EV)</th>
<th><strong>Ruling</strong></th>
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<tr>
<td><strong>LOSS OF LIQUID TRANSPORT LOOP THERMAL CONTROL</strong></td>
<td><strong>EVA</strong></td>
<td><strong>RULING</strong></td>
</tr>
<tr>
<td>A. Degraded Circulation (&lt; 3.5 lbs/min and decreasing)</td>
<td><strong>EVA</strong></td>
<td><strong>CONTINUE MISSION</strong></td>
</tr>
<tr>
<td>B. Loss of Circulation</td>
<td><strong>EVA</strong></td>
<td><strong>TERMINATE EVA</strong></td>
</tr>
<tr>
<td>C. Degraded Sublimator (Liquid Transport Loop Heat Rejection &lt;1250 BTU/hr in MAX H2O Divert Valve Position)</td>
<td><strong>EVA</strong></td>
<td><strong>CONTINUE MISSION</strong></td>
</tr>
<tr>
<td>D. Sublimator Failure</td>
<td><strong>EVA</strong></td>
<td><strong>TERMINATE EVA</strong></td>
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**Feed H2O Pressure Decay**

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<th>Evacuation (EV)</th>
<th><strong>Ruling</strong></th>
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<td><strong>FEED H2O PRESSURE DECAY</strong></td>
<td><strong>EVA</strong></td>
<td><strong>RULING</strong></td>
</tr>
<tr>
<td>A. Feed H2O Pressure &lt;2.8 psia</td>
<td><strong>EVA</strong></td>
<td><strong>CONTINUE MISSION</strong></td>
</tr>
<tr>
<td>1. <strong>ADJUST WORK PROFILE TO COMPENSATE FOR DEGRADED COOLING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. <strong>IF COOLING IS INADEQUATE, CREWMAN MAY ATTEMPT A WET SUBLIMATOR RESTART</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Feed H2O Pressure &lt;1.6 psia and decreasing</td>
<td><strong>EVA</strong></td>
<td><strong>TERMINATE EVA</strong></td>
</tr>
<tr>
<td>1. <strong>IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS IN PURGE MODE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. <strong>INGRESS S/C ASAP</strong></td>
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**Depletion of POS**

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<td><strong>DEPLETION OF POS</strong></td>
<td><strong>EVA</strong></td>
<td><strong>RULING</strong></td>
</tr>
<tr>
<td>A. POS Press &lt;130 psia</td>
<td><strong>EVA</strong></td>
<td><strong>TERMINATE EVA</strong></td>
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<tr>
<td>A. ACTIVATE OPS</td>
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</tr>
<tr>
<td>B. <strong>INGRESS S/C</strong></td>
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**Mission: Apollo 9**

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<th>Group</th>
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<td>Apollo 9</td>
<td>A</td>
<td>2/15/69</td>
<td>EMU/EVA</td>
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<td>PHASE</td>
<td>RULES</td>
<td>NOTES/COMMENTS</td>
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</table>
| 20-33 | LOSS OF MAIN POWER SUPPLY |  | EVA | A. TERMINATE EVA  
1. ACTIVATE OPS IN A PURGE MODE  
2. INGRESS S/C ASAP | B. REPLACE PLSS BAT CUR FOR ONE OPS FAILS TO CHECK OUT PRIOR TO UNDOCKING.  
C. GT8140C PLSS BAT CUR |
| 20-34 | DEGRADED POWER PROFILE | CUR <2.0 AMP OR CUR >3.0 AMP | EVA | CONTINUE MISSION  
VERIFY PERFORMANCE FAN, PUMP, AND SSC | REF MALF EMU 5-32 - 5-34  
GT8140C PLSS BAT CUR |
| 20-35 | LOSS OF TM |  | EVA | CONTINUE MISSION | |
| 20-36 | LOSS OF ANY CRITICAL INSTRUMENTATION |  | EVA | TERMINATE EVA | REF NW 20-42 |

NOTE: REF SECTION 32 FOR EVA COMMUNICATIONS RULES

RULES 20-37 THROUGH 20-40 ARE RESERVED.
## INSTRUMENTATION REQUIREMENTS

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<tr>
<th>MEAS DESCRIPTION</th>
<th>FN/EM</th>
<th>ONBOARD TRANSUCERS</th>
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<td>FEED H2O PRESS</td>
<td>GT811DP</td>
<td>WARNING TONE (1.5 KHZ)</td>
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<td>LOW FEED H2O PRESS</td>
<td>GT812UW</td>
<td>WARNING TONE (1.5 KHZ)</td>
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<td>PLSS EXG</td>
<td>GT814OC</td>
<td>METER</td>
<td>M</td>
<td>20-21, 22, 29, 31, 34</td>
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<tr>
<td>PLSS BAT OUT</td>
<td>GT8141V</td>
<td>METER</td>
<td>M</td>
<td>20-21, 22, 33</td>
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<tr>
<td>PLSS BAT VOLT</td>
<td>GT8154T</td>
<td>METER</td>
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<td>GT816BP</td>
<td>METER</td>
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<td>PGA PRESS</td>
<td>GT8182P</td>
<td>METER</td>
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<td>GT818BT</td>
<td>METER</td>
<td>M</td>
<td>20-22, 23</td>
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<td>PLSS O2 QTY IND</td>
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<td>METER</td>
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<td>GT818BT</td>
<td>METER</td>
<td>M</td>
<td>20-22, 23</td>
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<tr>
<td>PGA PRESS GAUGE</td>
<td>GT818BT</td>
<td>METER</td>
<td>M</td>
<td>20-22, 23</td>
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<td>LOW PGA PRESS</td>
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<td>METER</td>
<td>M</td>
<td>20-22, 23</td>
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<tr>
<td>OPS PRESS GAUGE</td>
<td>GT818BT</td>
<td>METER</td>
<td>M</td>
<td>20-22, 23</td>
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<td>OPS REG PRESS GAUGE</td>
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<td>METER</td>
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<td>20-22, 23</td>
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<tr>
<td>HEATER STATUS CHECK</td>
<td>GT818BT</td>
<td>GREEN LIGHTS</td>
<td>M</td>
<td>20-22, 23</td>
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**Aeromedical Parameter Reference Section 31.**

**Note:** 1 of 2 OPS REG PRESS GAUGES IS MANDATORY.

### CRITICAL INSTRUMENTATION

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<th>MEAS DESCRIPTION</th>
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<th>MISSION RULE REFERENCE</th>
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<tr>
<td>PLSS O2 PRESS/PLSS O2 QTY IND</td>
<td>GT818BT</td>
<td>METER</td>
<td>M</td>
<td>20-20, 32</td>
</tr>
<tr>
<td>PGA PRESS GAUGE</td>
<td>GT818BT</td>
<td>METER</td>
<td>M</td>
<td>20-20, 32</td>
</tr>
<tr>
<td>LOW VENT FLOW</td>
<td>GT818BT</td>
<td>METER</td>
<td>M</td>
<td>20-20, 32</td>
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</table>

**Aeromedical Parameter Reference Section 31.**

**Note:** 1 of 2 OPS REG PRESS GAUGES IS MANDATORY.
### SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

**NASA — Manned Spacecraft Center**  
**MISSION RULES**

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<thead>
<tr>
<th>RULE</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>A 21-1</td>
<td>TO INITIATE THE FOLLOWING MISSION EVENTS, THE PYROTECHNIC SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. DOCKED</td>
<td>ONE OPERATIONAL PYRO SYSTEM</td>
</tr>
<tr>
<td></td>
<td>B. INSERTION AND/OR NORMAL STAGING</td>
<td>TWO OPERATIONAL PYRO SYSTEMS</td>
</tr>
<tr>
<td>A 21-2</td>
<td>A PYRO SYSTEM IS CONSIDERED LOST IF:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. PYRO BATTERY OPEN CIRCUIT VOLTAGE &lt; 35 VDC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. UNABLE TO ARM SYSTEM</td>
<td></td>
</tr>
<tr>
<td>A 21-3</td>
<td>A PYRO SYSTEM WILL BE DISABLED IF:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. ANY RELAY K2 THROUGH K6 INADVERTENTLY CLOSES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. ANY RELAY K7 THROUGH K15 INADVERTENTLY CLOSES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SYSTEM WILL BE USED FOR APS PRESSURIZATION AND STAGING.</td>
<td></td>
</tr>
<tr>
<td>A 21-4</td>
<td>THE ASCENT AND DESCENT STAGES ARE CONSIDERED RIGIDLY ATTACHED WITH ONLY ONE BOLT/NUT COMBINATION INTACT.</td>
<td></td>
</tr>
<tr>
<td>A 21-5</td>
<td>THE ASCENT AND DESCENT STAGES ARE CONSIDERED NON-RIGIDLY ATTACHED IF THE GUILLOTINE FAILS TO SEVER THE INTERSTAGE UMBILICALS.</td>
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</tr>
</tbody>
</table>

Rule numbers 21-6 through 21-9 are reserved.

### MANAGEMENT MISSION RULES

<table>
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<th>ITEM</th>
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<tbody>
<tr>
<td>A 21-10</td>
<td>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.</td>
</tr>
<tr>
<td>A 21-11</td>
<td>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.</td>
</tr>
<tr>
<td>A 21-12</td>
<td>UNDOCKED STAGING WITH ONE PYRO SYSTEM WILL BE PERFORMED ONLY IF ABSOLUTELY NECESSARY TO MAINTAIN CREW SAFETY.</td>
</tr>
<tr>
<td>A 21-13</td>
<td>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.</td>
</tr>
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</table>
### Specific Mission Rules

<table>
<thead>
<tr>
<th>System(s)</th>
<th>Station</th>
<th>Rule(s)</th>
</tr>
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<tbody>
<tr>
<td>A. ONE SYSTEM</td>
<td>DOCKED</td>
<td>A.1. CONTINUE MISSION</td>
</tr>
<tr>
<td></td>
<td>UNDOCKED</td>
<td>BIT NOT STAGE</td>
</tr>
<tr>
<td></td>
<td>RNDZ</td>
<td>2. SEPARATION - CONTINUE MISSION</td>
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<tr>
<td></td>
<td></td>
<td>DO NOT STAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. PHASING - DO NOT PERFORM INSERTION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO NOT STAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. INSERTION - DELAY STAGING AS LONG AS POSSIBLE</td>
</tr>
<tr>
<td>B. TWO SYSTEMS</td>
<td>ALL</td>
<td>B. CONTINUE MISSION</td>
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<tr>
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<td>DO NOT STAGE</td>
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### 21-21 UNABLE TO ARM PYRO SYSTEM(S)

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<th>Station</th>
<th>Rule(s)</th>
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<tr>
<td>A. ONE SYSTEM</td>
<td>DOCKED</td>
<td>A.1. CONTINUE MISSION</td>
</tr>
<tr>
<td></td>
<td>UNDOCKED</td>
<td>DO NOT STAGE</td>
</tr>
<tr>
<td></td>
<td>RNDZ</td>
<td>2. SEPARATION - CONTINUE MISSION</td>
</tr>
<tr>
<td></td>
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<td>DO NOT STAGE</td>
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<tr>
<td></td>
<td></td>
<td>3. PHASING - DO NOT PERFORM INSERTION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO NOT STAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. INSERTION - DELAY STAGING AS LONG AS POSSIBLE</td>
</tr>
</tbody>
</table>

| B. BOTH SYSTEMS PRIOR TO: | DOCKED | B.1. CONTINUE MISSION |
|                           |           | PERFORM EVA AND DOCKED LM SYSTEMS ACTIVITIES EXCEPT DPS BURN, |
|                           |           | DO NOT UNDOCK |

|           | DOCKED | 2. CONTINUE MISSION |
|           |           | PERFORM EVA AND LM SYSTEMS ACTIVITIES EXCEPT DPS BURN, |
|           |           | DO NOT UNDOCK |

|           | DOCKED | 3. CONTINUE MISSION |
|           |           | PERFORM SINGLE OR DOUBLE FOOTBALL |

|           | RNDZ | 4. CONTINUE MISSION |
|           |           | DO NOT ATTEMPT STAGING |

4. CSM RESCUE MAY BE REQUIRED DUE TO ICES RED-LINES.
**SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC - CONTINUED**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<th>PHASE</th>
<th>RULING</th>
<th>NOTES/COMMENTS</th>
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<tr>
<td>A</td>
<td>21-22</td>
<td>UNABLE TO DISARM PYRO SYSTEM(S)</td>
<td>DOCKED</td>
<td>A. CONTINUE MISSION. DO NOT PERFORM EVA</td>
<td>K1 = MASTER ARM RELAY</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>EVA</td>
<td>B. TERMINATE EVA</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>KNOZ</td>
<td>C. CONTINUE MISSION</td>
<td>STAGE NORMALLY</td>
</tr>
<tr>
<td>A</td>
<td>21-23</td>
<td>RELAY K2 THROUGH K5 (OR K1 THROUGH K5 AFTER APS PRESSED) INADVERTENTLY CLOSED AND CANNOT BE RESET</td>
<td>DOCKED</td>
<td>CONTINUE MISSION</td>
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<td>EVA</td>
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<td>A</td>
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<td>OPEN LOGIC POWER A C/B UNTIL TIME TO STAGE, THEN:</td>
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<td>2. PLACE STAGE SW TO FIRE</td>
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<td>3. PLACE MASTER ARM SW TO ON</td>
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<td>B. SYSTEM B (ASCENT STAGE)</td>
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<td>OPEN LOGIC POWER B C/B UNTIL TIME TO STAGE, THEN:</td>
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<td>2. PLACE MASTER ARM SW TO ON</td>
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**MISSION**

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### SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC - CONTINUED

### NASA — Manned Spacecraft Center

#### MISSION RULES

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<td>A</td>
<td>21-24</td>
<td>A RELAY K7 THROUGH K15 INADVERTANTLY CLOSES</td>
<td>ALL</td>
<td>RELAYS K7 = RCS PRESS K8 = LAND GEAR DEPLOY KBA = LAND GEAR DEPLOY K9 = DPS CRYO H2O PRESS K10 = ASC H2 TANK 1 K11 = ASC H2 TANK 2 K12 = ASC FUEL &amp; OX COMP VALVE K12A = ASC FUEL &amp; OX COMP VALVES (SYSTEM A ONLY) K13 = DPS PU &amp; OX VENT K14 = DPS AMBIENT H2O K15 = DPS PU &amp; OX COMP VALVES</td>
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<td>A. ALL PYRO FUNCTIONS EXCEPT STAGING WILL BE PERFORMED ON SYSTEM B B. ALL PYRO FUNCTIONS EXCEPT STAGING WILL BE PERFORMED ON SYSTEM A</td>
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<td>A</td>
<td>21-25</td>
<td>UNABLE TO STAGE</td>
<td>RNDZ</td>
<td>A. CONTINUE MISSION OPEN LOGIC POWER A C/B UNTIL DPS H2 PRESSURIZATION ACCOMPLISHED</td>
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<td>B. CONTINUE MISSION OPEN LOGIC POWER B C/B UNTIL DPS CRYO H2 PRESSURIZATION ACCOMPLISHED</td>
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<td>C. CONTINUE MISSION 2. PRIOR TO POSITIONING MASTER ARM SW TO ON; CLOSE DESC H2 REG 1 &amp; 2 3. OPEN DESC H2 REG 1 AT T1 OF DPS 1 BURN</td>
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<td>A</td>
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<td>ASCEST AND DESCENT STAGE STILL RIGIDLY TIED TOGETHER</td>
<td>RNDZ</td>
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<td>B. INCOMPLETE STAGING, VEHICLE NOT RIGID</td>
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### RULE NUMBERS 21-26 THROUGH 21-49 ARE RESERVED

### MISSION RULES

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<td>METER</td>
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SECTION 22 - LM ELECTRICAL POWER

NASA - Manned Spacecraft Center

MISSION RULES

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

MISSION REV. DATE SECTION GROUP PAGE
APOLLO 9 A 2/15/69 LM ELECTRICAL POWER GENERAL 22-1
SECTION 22 - LM ELECTRICAL POWER - CONTINUED

NASA — Manned Spacecraft Center

MISSION RULES

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 REV S (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 BUS ES
5. TRACKING LIGHT
6. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR TWO REV S (3.0 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER

H. STAGING (UNOCKED, NORMAL OR DELAYED)

1. CDR AND LMP BUSES
2. BOTH ASCENT BATTERIES OR ONE ASCENT BATTERY IF NO DESCENT ENERGY REMAINS AND DESCENT O2 TANK IS DEPLETED
3. BOTH ASCENT FEEDERS
4. SUFFICIENT AVAILABLE ASCENT ELECTRICAL ENERGY TO POWER THE LM FOR TWO REV S (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 ≥90 AMPS
### SECTION 22 - LM ELECTRICAL POWER - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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RULE NUMBERS 22-7 THROUGH 22-9 ARE RESERVED.

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<td>A</td>
<td>2/15/69</td>
<td>LM ELECTRICAL POWER</td>
<td>GENERAL</td>
<td>22-18</td>
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</table>
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)

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.

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 MANEUVER.

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.
### SECTION 22 - LM ELECTRICAL POWER - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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</table>
| A 22-20 | LOSS OF EITHER DC BUS | ALL | A. DO NOT STAGE  
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 | • REF MALF PROC EPS:  
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 CSM PWR  
8. STAGED CSM PWR  
9. BATTERY  
• LOSS OF DC BUS RESULTS IN LOSS OF ONE PYRO SYSTEM |
| A 22-21 | SHORTED DC BUS FEEDER | ALL | A. CONTINUE MISSION  
DOCKED  
B. ASCENT  
1. CONTINUE MISSION  
2. CONTINUE MISSION  
(A) DO NOT UNDOCK  
(B) DO NOT PERFORM EVA  
(C) POWER AFFECTED BUS FROM OTHER BUS VIA 100 AMP CROSSSTIE 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 | • REF MALF PROC EPS:  
5. UNSTAGED DC BUS W/ BAT FAULT  
6. STAGED DC BUS W/ BAT FAULT  
7. UNSTAGED CSM PWR  
8. STAGED CSM PWR |

**APOLLO 9**  
**DATE:** 2/15/69  
**SECTION:** LM ELECTRICAL POWER  
**GROUP:** SPECIFIC  
**PAGE:** 22-3
## SECTION 22 - LM ELECTRICAL POWER - CONTINUED

**NASA — Manned Spacecraft Center**

### MISSION RULES

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<td>DEFINITE LOSS OF OVER-CURRENT PROTECTION</td>
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<td>NO APPLICABLE MALF PROC REF MR 22-6</td>
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<td>A. DESCENT BATTERIES</td>
<td>ALL</td>
<td>B. CONTINUE MISSION</td>
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<td>B. ASCENT BATTERIES</td>
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<tr>
<td></td>
<td></td>
<td>UNDOCKED</td>
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<td>B.1. DO NOT STAGE UNDOCKED</td>
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<td>RNDZ</td>
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<td>2. CONTINUE MISSION</td>
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<td></td>
<td>DO NOT PERFORM SEPARATION</td>
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<tr>
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<td></td>
<td></td>
<td>RETURN TO VICINITY OF CSM ASAP</td>
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| A   | 22-23| LOSS OF ASCENT BATTERIES | DOCKED | A.1. CONTINUE MISSION | REF MALF PROC EPS: |
|     |      |                        |        |        | 2 STAGED DC BUS |
|     |      |                        |        |        | 4 STAGED DC BUS |
|     |      |                        |        |        | W/BUS FAULT |
|     |      |                        |        |        | 6 STAGED DC BUS |
|     |      |                        |        |        | W/BATTERY FAULT |
|     |      |                        |        |        | 8 STAGED CSM POWER |
|     |      |                        |        |        | 9 BATTERY |
|     |      |                        |        |        |                     |
|     |      | A. LOSS OF ONE ASCENT BATTERY |        |        |                     |
|     |      | DOCKED EVA UNDOCKED 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 O2 TANK DEPLETED |
|     |      |                        |        |        |                     |
|     |      | 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    |                     |
|     |      |                        |        |        | TERMINATE EVA |
|     |      |                        |        |        | TERMINATE LM ACTIVITIES |
|     |      |                        |        | UNDOCKED RNDZ |                     |
|     |      |                        |        | 4. DOCK ASAP |                     |
|     |      |                        |        |        | TERMINATE LM ACTIVITIES |

### MISSION REVISIONS

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### LOSS OF DESCENT BATTERIES

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<th>Ruling</th>
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<tr>
<td>A. Loss of one descent battery</td>
<td>All</td>
<td>A. Continue Mission</td>
</tr>
<tr>
<td>B. Loss of two descent batteries</td>
<td>Docked EVA undocked, RNDZ</td>
<td>B.1. Continue Mission, Do not perform Insertion</td>
</tr>
<tr>
<td>C. Loss of three or more descent batteries</td>
<td>All Docked</td>
<td>C.1. Setup for unmanned APS burn, 2. Continue Mission</td>
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**CUES/NOTES/COMMENTS:**
- Ref Mal F Proc EPS:
  - UNSTAGED DC BUS
  - UNSTAGED DC BUS W/BUS FAULT
  - UNSTAGED DC BUS W/BATTERY FAULT
  - UNSTAGED C&W POWER
  - BATTERY

### LOSS OF INVERTERS

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<td>A. Loss of one inverter</td>
<td>All, RNDZ</td>
<td>A.1. Separation - Continue Mission</td>
</tr>
<tr>
<td>B. Loss of both inverters</td>
<td>Docked RNDZ</td>
<td>B.1. Do not burn DPS, 2. Return to vicinity of CSM ASAP</td>
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**CUES/NOTES/COMMENTS:**
- Ref Mal F Proc EPS:
  - INVERTER

---

**MISSION**

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### NASA — Manned Spacecraft Center

#### MISSION RULES

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<td>10 INVERTER</td>
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<td>DO NOT BURN DPS</td>
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<td>2. CONTINUE MISSION</td>
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<td>3. RETURN TO VICINITY OF CSM ASAP</td>
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<td>EVA</td>
<td>BUS A REQUIRED FOR ONBOARD ATTITUDE READOUT</td>
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<td>2. RETURN TO VICINITY OF CSM ASAP</td>
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- RULE NUMBERS 22-27 THROUGH 22-49 ARE RESERVED.

**MISSING**

- **APOLLO 9**
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- **2/15/69**
- **LM ELECTRICAL POWER**
- **SPECIFIC**
- **22-3C**
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SECTION 23 - ENVIRONMENTAL CONTROL
NASA — Manned Spacecraft Center
MISSION RULES

GENERAL

A 23-1 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 H₂O SEPARATOR (CREW OPTION)
6. ONE COOLANT LOOP
7. SUFFICIENT AVAILABLE LiOH, H₂O AND O₂ 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 H₂O SEPARATOR (CREW OPTION)
6. ONE COOLANT LOOP
7. GREATER THAN 1400 PSIA IN THE DESCENT O₂ TANK PLUS SUFFICIENT O₂ IN ONE ASCENT O₂ 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 H₂O 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 H₂O SEPARATOR (CREW OPTION)
6. ONE COOLANT LOOP
7. TWO OF THREE O₂ TANKS
8. SUFFICIENT AVAILABLE LIOH, H₂O AND ASCENT O₂ TO MAINTAIN THE LM FOR TWO REV (3.0 HOURS) BEYOND THE PLANNED CONTINGENCY LM TO CSM CREW TRANSFER.
E. SEPARATION

1. CABIN PRESSURE INTEGRITY
2. SUIT LOOP/PGA PRESSURE INTEGRITY
3. ONE SUIT FAN
4. ONE DEMAND REGULATOR
5. ONE H₂O SEPARATOR (CREW OPTION)
6. BOTH COOLANT LOOPS
7. PRIMARY H₂O FEEDPATH
8. TWO OF THREE O₂ TANKS
9. SUFFICIENT AVAILABLE LIOH, H₂O AND ASCENT O₂ TO MAINTAIN THE LM FOR TWO REV (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 H₂O SEPARATOR
6. BOTH COOLANT LOOPS
7. PRIMARY H₂O FEEDPATH
8. TWO OF THREE O₂ TANKS
9. SUFFICIENT AVAILABLE LIOH, H₂O AND ASCENT O₂ TO MAINTAIN THE LM FOR TWO REV (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 H₂O SEPARATOR
6. BOTH COOLANT LOOPS
7. PRIMARY H₂O FEEDPATH
8. DESCENT O₂ TANK
9. ONE OF TWO ASCENT O₂ TANKS
10. TWO OF THREE H₂O TANKS
11. SUFFICIENT AVAILABLE LIOH, ASCENT H₂O AND ASCENT O₂ TO MAINTAIN THE LM FOR TWO REV (3.0 HOURS) BEYOND THE PLANNED LM TO CSM CREW TRANSFER.

**IF BOTH H₂O SEPARATORS AND BOTH SUIT FANS ARE FULLY OPERATIONAL AND BOTH ASCENT O₂ TANKS CONTAIN THE REQUIRED CONSUMABLES, THE RENDEZVOUS WILL BE PERFORMED WITHOUT THE DESCENT O₂ TANK. A FAILURE OF ANY OF THESE REQUIREMENTS WILL REQUIRE THE DESCENT O₂ TANK FOR RENDEZVOUS.**
SECTION 23 - ENVIRONMENTAL CONTROL - CONTINUED

NASA - Manned Spacecraft Center
MISSION RULES

REV ITEM

A 23-1 (CONT)

H. STAGING (NOMINAL)
1. CABIN PRESSURE INTEGRITY
2. SUIT LOOP/PGA PRESSURE INTEGRITY
3. ONE SUIT FA
4. ONE DEMAND REGULATOR
5. ONE H₂O SEPARATOR
6. ONE COOLANT LOOP
7. TWO ASCENT O₂ TANKS
8. SUFFICIENT AVAILABLE LIQUID ASCENT H₂O AND ASCENT O₂ TO MAINTAIN THE LM FOR TWO REV'S (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 FA
4. ONE COOLANT LOOP
5. TWO ASCENT O₂ TANKS
6. SUFFICIENT AVAILABLE LIQUID ASCENT H₂O AND ASCENT O₂ TO MAINTAIN THE LM FOR TWO REV'S (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 >4.6 PSIA WITH AN O₂ 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 >0.5 PSI/MIN (1.5 LBS/HR) DURING SUIT LOOP PRESSURE CHECK OR A VISIBLE TEAR IN THE PGA. DURING EVA, INCREASE IN DESCENT TANK QUA TITY USAGE >1.2 LD/HR.

C. LOSS OF COOLANT LOOP
SUSTAINED GLYCOL TEMPERATURE >50°F AND RISING EXCEPT DURING COOLANT LOOP STARTUP AND DRYOUT (SUBLIMATOR LOST) OR GLYCOL PUMP UP >6 PSID (CIRCULATION LOST) OR KNOWN LOSS OF H₂O 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 O₂ TANK
INABILITY TO TRANSFER O₂ FROM DESCENT TANK OR MSFN CONFIRMATION OF LOSS OF DESCENT TANK PRESSURE WITH O₂ MANIFOLD PRESSURE.

F. LOSS OF ASCENT O₂ TANK
(1) MSFN CONFIRMATION OF LOSS OF ASCENT TANK PRESSURE WITH O₂ 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 O₂ <35%, LOSS OF ONBOARD AND MSFN READOUTS.
**Section 23 - Environmental Control - Continued**

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**Mission Rules**

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<td>LOSS OF DESCENT H₂O TANK</td>
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<td>INABILITY TO SUPPLY H₂O TO W/B RESULTING IN RISING GLYCOL AND SUIT LOOP TEMPERATURE (CREW AND MSFN) AND DROP IN H₂O LP (MSFN ONLY)</td>
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| M. | LOSS OF ASCENT H₂O 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 EVACUATION AND WILL NOT BE CONSIDERED FOR NOMINAL OR REDLINE USAGE. |

**Rule Numbers 23-6 Through 23-9 Are Reserved**

**Mission:** Apollo 9  
**REV:** A  
**DATE:** 2/13/69  
**Section:** Environmental Control  
**Group:** General  
**Page:** 23-1C
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<td>PRIMARY GLYCOL LOOP CIRCULATION WILL BE DISCONTINUED AT STARTUP OF THE SECONDARY LOOP BUT MAY BE REINITIATED FOLLOWING SECONDARY LOOP STABILIZATION IF DEEMED NECESSARY.</td>
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<td>IF EITHER ASCENT O₂ TANK IS &lt;95%, IT WILL BE REPLENISHED FROM THE DESCENT O₂ WHEN THE DESCENT TANK QUANTITY &gt;35% AND AS CLOSE TO STAGING AS POSSIBLE.</td>
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<td>PLSS FILL VALVE WILL BE CLOSED, EXCEPT FOR REPRESSURIZING THE PLSS AND FOR MSFN REQUESTED READOUTS OF O₂ MANIFOLD PRESSURE.</td>
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<td>CREW WILL GO TO EGRESS MODE IF INSUFFICIENT O₂ IS AVAILABLE TO MAINTAIN CABIN PRESSURE FOR THE REQUIRED TIME. ADDITIONALLY, A MISSION PHASE WILL NOT BE INITIATED IF THIS CONDITION CAN BE ANTICIPATED.</td>
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<td>CREW WILL BE REQUIRED TO BREATHE PURE O₂ FOR 2 MIN VIA PURGE MODE PRIOR TO EVA.</td>
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**Note:**

RULE NUMBERS 23-15 THROUGH 23-19 ARE RESERVED

**APOLLO 9**

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<td>3. ONE CREWMAN RETURN TO CSM</td>
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<td>4. REMAINING CREWMAN CONNECT TO BOTH CSM AND LM UMBILICALS, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR.</td>
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<td>SUIT FAN(S) FAILURE</td>
<td>ALL</td>
<td>A. CONTINUE MISSION</td>
<td>A. REF MALF PROC ECS: 5 ECS</td>
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<tr>
<td></td>
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<td>A. ONE SUIT FAN</td>
<td>ALL</td>
<td>B. SET UP FOR UNMANNED APS</td>
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<td>B. TWO SUIT FANS</td>
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<td>(A) DO NOT UNDOCK</td>
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<td>(B) DO NOT PERFORM EVA</td>
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<td>(C) ONE CREWMAN RETURN TO CSM</td>
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<td></td>
<td>(D) REMAINING CREWMAN CONNECT TO CSM TRANSFER UMBILICAL, OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR.</td>
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<td>(E) PERFORM SYSTEMS EVALUATION AND DOCKED DPS BURN.</td>
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<td>EVA</td>
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<td>GO TO SUIT PURGE MODE UNTIL CABIN REPRESS COMPLETE.</td>
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<td>(B) LMP RETURN TO NEAREST VEHICLE</td>
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<td>4. DOCK ASAP</td>
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<td></td>
<td>DO NOT STAGE UNDOCKED</td>
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</table>

| A   | 23-23 | LOSS OF H₂O SEPARATOR(S) | ALL   | A. CONTINUE MISSION | A. REF MALF PROC ECS: 5 ECS |
|     |       | A. ONE SEPARATOR | ALL   | B.1. CONTINUE MISSION | |
|     |       | B. TWO SEPARATORS | DOORKEED | 2. CONTINUE MISSION AT CREW OPTION | |
|     |       |                        | EVA   | 3. CONTINUE MISSION AT CREW OPTION | |
|     |       |                        | UNDOCK | 4.(A) SEPARATION - DO NOT PERFORM PHASING | |
|     |       |                        | RNDZ   | (B) PHASING - DO NOT PERFORM INSERTION | |
|     |       |                        |       | (C) INSERTION - DELAY STAGING AS LONG AS POSSIBLE | 

**MISSION**

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<td>DEMAND REGULATOR(S) FAIL OPEN OR CLOE (AUTOMATIC FUNCTION ONLY)</td>
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<td>A</td>
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<td>LOSS OF COOLANT LOOP(S)</td>
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<td>A. PRIMARY LOOP</td>
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<td>A. CONTINUE MISSION ON SECONDARY LOOP</td>
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<td>RDZ</td>
<td>8.1. RETURN TO VICINITY OF CSM ASAP</td>
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<td>2. OPERATE ON SECONDARY LOOP</td>
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<td>EVA</td>
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<td>DO NOT PERFORM EVA, UNDOCKING</td>
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<td>RDZ</td>
<td>4. DOCK ASAP</td>
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<td>(A) CONTINUE GLYCOL CIRCULATION IF POSSIBLE</td>
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<td>(B) POWER DOWN SPACECRAFT FOR LIFE SUPPORT ONLY</td>
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<td></td>
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<td>(C) WAIT CSM RESCUE</td>
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**APOLLO 9**

- REF MR 23-2C, 23-2D, 23-4
- REF Malf PROC ECS: A. PGNS, DSE, DCA, LCA DF1 NOT COOLED BY SECONDARY LOOP
### Section 23 - Environmental Control - Continued

**NASA — Manned Spacecraft Center**

**Mission Rules**

<table>
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<th>Phase</th>
<th>Ruling</th>
<th>CUES/NOTES/COMMENTS</th>
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<tr>
<td>A</td>
<td>23-26</td>
<td>Loss of Primary H2O Feedpath</td>
<td>All</td>
<td>A. Set up for unmanned APS</td>
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<td>Docked EVA</td>
<td>B. Continue mission do not perform separation</td>
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<td>Undocked</td>
<td></td>
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<td></td>
<td></td>
<td>RNDZ</td>
<td>C. Return to vicinity of CSM ASAP</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>23-27</td>
<td>Fire or Smoke in Cabin or Suit</td>
<td>All</td>
<td>A. Troubleshoot/combat fire</td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td>B. Assess damage and transfer to CSM if necessary</td>
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<tr>
<td>A</td>
<td>23-28</td>
<td>Contamination in Cabin</td>
<td>All</td>
<td>Crew may elect to decompress to clear contamination</td>
<td>IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY</td>
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<tr>
<td>A</td>
<td>23-29</td>
<td>Glycol Coolant Leak</td>
<td>All</td>
<td>Transfer to CSM perform docked activities on CSM umbilical and set up for APS burn</td>
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<td>A. Cabin</td>
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<td>A.1. Go to egress operation (closed suit loop)</td>
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<td>2. Purge suit loop with descent O2 if unstaged</td>
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<td>B. Suit Loop</td>
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<td>B. Disconnect from suit loop</td>
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**Rule Numbers 23-30 through 23-49 are reserved.**

**Ref Malfunction:**
- 10 Glycol
- Ref Mr 23-2D
- Ref Malfunction ECS:
- 10 Glycol

**Reference:**
- Apollo 9
- 2/15/69
- Environmental Control

**Group:**
- Specific

**Page:**
- 23-48
## Instrumentation Requirements

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<th>REV</th>
<th>ITEM</th>
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<th>CATEGORY</th>
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<td>A</td>
<td>23-50</td>
<td>Suit Press</td>
<td>GF1301P</td>
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<td>23-1,2,3,20,21,22,23,24</td>
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<td>Cabin Press</td>
<td>GF1571P</td>
<td>WARNING</td>
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<td>Repr. Elec. Open</td>
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<td>CO2 Part Press</td>
<td>GF1521P</td>
<td>METER, CAUTION</td>
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<td>GF9999U</td>
<td>CAUTION, COMP</td>
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<td>O2 Press</td>
<td>GF1580P</td>
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<td>ASC 2 O2 Press</td>
<td>GF5583P</td>
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<td>O2 Manifold Press</td>
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<td>Glycol Pump SP</td>
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<td>Pri H2O Reg SP</td>
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<td>Suit Div. Egress</td>
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**MISSION**

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<td>Instrumentation Requirements</td>
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24 LM/COMM
INSTRUMENTATION
(SEE SECTION 28)
MISSION RULES

THIS SECTION HAS BEEN DELETED

ALL DATA FORMERLY CONTAINED IN THIS SECTION IS NOW IN SECTION 32.
**SECTION 25 - LM GUIDANCE AND CONTROL**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<td>A</td>
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<td>DOCKED</td>
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</table>

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 chord 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-throttleable range.

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<table>
<thead>
<tr>
<th>REV</th>
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<tr>
<td>A</td>
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</table>

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 (AHC)
   2. Either an operational PGNS and AGS where an operational AGS is defined as
      (A) No AGA failure,
      (B) No ASA failure,
      (C) An operational DEGA,
      (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
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 FOAI
   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 ADT 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. 4X AXIS TRANSLATION CAPABILITY

D. STAGING:
   1. OPERATIONAL AGS OR PGNS
   2. 4X AXIS TRANSLATION CAPABILITY

25-4

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.


SECTION 25 - LM GUIDANCE AND CONTROL - CONTINUED

NASA — Manned Spacecraft Center

MISSION RULES

SYSTEMS MANAGEMENT

25-10 IMU

A. The IPVA and IRIG biases will be updated when differences of .020 ft/sec² (.600 cm/sec²) 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.

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 1 (U-V) jets will be inhibited via V65 during docked APS 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 ±14°F and/or a gyro package temp (calculated) of ±20°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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<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
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<th>CUES/NOTES/COMMENTS</th>
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<td>LOSS OF AN OPERATIONAL PGNS</td>
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<td><strong>SPECIFIC MISSION RULES</strong></td>
<td>• REF MAL PROC PGNS 1, ISS WARN</td>
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<td>1. PERFORM DPS BURN MANUALLY</td>
<td>• REF MAL PROC PGNS 2, LGC WARN</td>
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<td>• REF MAL PROC PGNS 9, TEMP</td>
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<td>(B) RNDZ NO-GO</td>
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<td>(C) REF ALT MISSION F</td>
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<td>4. CONTINUE BURN UNLESS PROJECT CONSTRAINTS ARE VIOLATED OR LOSS OF ATTITUDE CONTROL OCCURS</td>
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<td>B. IN AGS CONTROL</td>
<td>RNDZ</td>
<td>B. RETURN TO CSM ASAP</td>
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<td>LOSS OF DSKY</td>
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<td>• REF MAL PROC PGNS 15, ABNORMAL DSKY RESPONSE</td>
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<td>1. RNDZ NO-GO</td>
<td>• REF MAL PROC PGNS 16, MISSING NUMERICS ON DSKY</td>
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<td>• REF MAL PROC PGNS 17, ABNORMAL DSKY PUSH-BUTTON RESPONSE</td>
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<td>D. CONTINUE MISSION</td>
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<td>LOSS OF FAI</td>
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<td>A. ONE</td>
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<td>UNDOCKED</td>
<td>2. CONTINUE MISSION RNDZ NO-GO</td>
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<td>3. RETURN TO CSM ASAP</td>
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<td>B. BOTH</td>
<td>UNMANNED</td>
<td>4. CONTINUE MISSION</td>
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**CUES/NOTES/COMMENTS**

- REF MAL PROC PGNS 1, ISS WARN
- REF MAL PROC PGNS 2, LGC WARN
- REF MAL PROC PGNS 9, TEMP CAUTION

**MISSION**

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<tr>
<th>APOLLO 9</th>
<th>A</th>
<th>2/15/69</th>
<th>LM GUIDANCE AND CONTROL</th>
<th>SPECIFIC - PGNS/CES/AGS</th>
<th>25-4</th>
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## Mission Rules

**Section 25 - LM Guidance and Control - Continued**

### LM Guidance and Control - Specific - PGNS/CES/AGS

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<thead>
<tr>
<th>REV</th>
<th>RULE</th>
<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<td>LOSS OF ADT AND/OR COAS</td>
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<td>25-24</td>
<td>LOSS OF RENDEZVOUS RADAR AND/OR TRANSPONDER</td>
<td>DOCKED</td>
<td>A. CONTINUE MISSION</td>
<td>* REF MAL PROC PGNS 5, HEATER CAUTION</td>
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<td>UNDOCKED</td>
<td>B. CONTINUE MISSION</td>
<td>* REF MAL PROC PGNS 5, RNDZ RDR CAUTION</td>
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<td>RNDZ</td>
<td>C1. PRIOR TO PHASING</td>
<td>* REF MAL PROC PGNS 5, NO TRACK</td>
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<td>RETURN TO CSM ASAP</td>
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<td>CONTINUE MISSION</td>
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<td>D. CONTINUE MISSION</td>
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<td>25-25</td>
<td>LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL</td>
<td>DOCKED</td>
<td>A. CONTINUE MISSION</td>
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<td>UNDOCKED</td>
<td>B. RETURN TO CSM AND DOCK ASAP</td>
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### REV RULE

#### A 25-26

**LOSS OF TRANSLATION CAPABILITY**

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<tr>
<td>A. ULLAGE (+X)</td>
<td>Docked</td>
<td>A.1. CONTINUE MISSION</td>
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<td></td>
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<td>(A) CSM PROVIDE ULLAGE, LM PROVIDE ATT CONTROL</td>
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<td>(B) DO NOT UNDOCK</td>
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<td>(C) REF ALT MISSION D</td>
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<td>UNDOCKED</td>
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<td>2. RETURN TO CSM AND DOCK ASAP</td>
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<td>RNDZ</td>
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<td>3. CSM RESCUE</td>
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<td>UNMANNED</td>
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<td>4. CONTINUE MISSION</td>
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<td>B. EITHER Y, Z, -X TRANSLATION</td>
<td>Docked</td>
<td>B.1. CONTINUE MISSION</td>
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<td>(A) REF ALT MISSION D</td>
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<td>(B) DO NOT UNDOCK</td>
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<td>UNDOCKED</td>
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<td>2. RETURN TO CSM AND DOCK ASAP</td>
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<td>RNDZ</td>
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<td>3. (A) PRIOR TO PHASING: RETURN TO CSM AND DOCK ASAP</td>
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<td>(B) AFTER PHASING: CONTINUE MISSION</td>
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<td></td>
<td>CSM PERFORM TRANSLATION MANEUVERS IF REQUIRED</td>
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<td>UNMANNED</td>
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<td>4. CONTINUE MISSION</td>
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</table>

**25-27 LOSS OF THRUST VECTOR CONTROL**

<table>
<thead>
<tr>
<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
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<tbody>
<tr>
<td>Docked</td>
<td>A. INHIBIT DPS BURN</td>
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<td></td>
<td>IF BURNING, CONTINUE BURN UNTIL ALT ERROR OR RATE LIMIT IS EXCEEDED.</td>
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<tr>
<td>ALL</td>
<td>B. CONTINUE MISSION UNLESS RCS IMPELLMENT CONSTRAINTS ARE VIOLATED</td>
<td></td>
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<tr>
<td>RNDZ</td>
<td>B. RCS IMPELLMENT CONSTRAINTS MAY BE VIOLATED BECAUSE OF RCS OPPOSING THRUST VECTOR OFFSET.</td>
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</table>

**25-28 ENG DOES NOT IGNITE AFTER START PB DEPRESSED**

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<th>PHASE</th>
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<th>CUES/NOTES/COMMENTS</th>
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<tbody>
<tr>
<td>Docked</td>
<td>A.1. SET STOP PB</td>
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<tr>
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<td>(A) DE-ARM DPS</td>
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<td>(B) RESCHEDULE DPS BURN USING DESCENT CMD OVERRIDE SWITCH</td>
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<td>RNDZ</td>
<td>B.1. FOR PHASING BURN, SET STOP PB</td>
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<tr>
<td></td>
<td>(A) DE-ARM DPS</td>
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<td>(B) REF ALT MISSION E-50</td>
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<td>2. FOR BURNS AFTER PHASING, SET STOP PB</td>
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<td></td>
<td>(A) DE-ARM DPS</td>
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<td></td>
<td>(B) RETURN TO CSM ASAP</td>
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<tr>
<td>UNMANNED</td>
<td>C.1. NO-GO FOR APS BURN</td>
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### SECTION 25 - GUIDANCE AND CONTROL - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

<table>
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<tr>
<th>Rule No.</th>
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<th>Phase</th>
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<th>Cues/Notes/Comments</th>
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<tr>
<td>25-29</td>
<td>Loss of Operational AGS</td>
<td>All</td>
<td>Continue Mission</td>
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<tr>
<td>25-30</td>
<td>Dps burn in non-throttle-able range</td>
<td>Docked</td>
<td>A. Prior to Tgo 4 min 1 sec</td>
<td>A.1. At Tgo 4 min 1 sec perform manual shutdown</td>
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<td>2. Continue burn</td>
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<td>B. Between Tgo 4 min 1 sec and Tgo 2 min 21 sec</td>
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<td>C. After Tgo 2 min 21 sec</td>
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<tr>
<td>25-31</td>
<td>Loss of Manual Thrust Control</td>
<td>Docked</td>
<td>A. Zero output</td>
<td>A.1. If burn continues to throttle down point, stop burn manually</td>
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<td>2. Continue mission</td>
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<td>B. Maximum thrust</td>
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<tr>
<td>A</td>
<td>Loss of ACA</td>
<td>All</td>
<td></td>
<td>A. Continue Mission</td>
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<tr>
<td></td>
<td>A. One</td>
<td>Docked</td>
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<td>B. Continue Mission</td>
</tr>
<tr>
<td></td>
<td>B. Both</td>
<td>UnDocked/Undocked/Rndz</td>
<td>Do not undock</td>
<td>C. Return to ces ASAP</td>
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<td>Unmanned</td>
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<td>D. Continue Mission</td>
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**GROUP PAGE**

A 2/15/69

**MISSION**

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<tr>
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<td>LOSS OF TTCA</td>
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<td>A. ONE</td>
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<td>A. CONTINUE MISSION</td>
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<td>B. BOTH</td>
<td>DOCKED</td>
<td>B. CONTINUE MISSION</td>
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<td>UNDOCKED</td>
<td>DO NOT UNDOCK</td>
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<td>C. RETURN</td>
<td>C. RETURN TO CSM ASAP</td>
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<td>TO CSM</td>
<td>REF ALT MISSION D</td>
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<td>D. RETURN</td>
<td>D. RETURN TO CSM ASAP</td>
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<td>E. UNMANNED</td>
<td>E. CONTINUE MISSION</td>
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RULE NUMBERS 25-34 THROUGH 25-39 ARE RESERVED.

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GG2 1 0 7V
GG 2 1 1 0 C
GG2 1 1 2V
GG 2 1 1 3V
GG2 1 37V
GG 2 1 40C
GG2 l lt2V
GG 2 1 43V
GG2 1 67V
GG 2 1 70C
GG21 7 2V
GG2 1 73V
GG 2 2 1 9V
GG2249V
GG2 2 7 9V
GG2 3 0 0T
GG2 3 0 1 T
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GG3 30 5V
GG332W
GG3325V
GG6020T
GG900 1X
GG9002X
GN7563T
GN7621X
GN7 7 23T
GH 1 247V
GH1 248V
GH1 2 49V
GH1 41 9V
GR50 32X
GHllt23V
GR50 36X
GH1 427V
GR5040X
GH1 43 1 V
GRSOltltX
GH1 41 8V
GH1 '+20V
GH1421V
GHl l.t22V
GHl l.t24V
GH1 42 5V
GH1 426V
GH1 428V
GH1429V
GHl l.t30V
GH1 '+32V
GH1 433V
GR5031X
GR5033X
GR5034X
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**Mission Rules**

- LM GUIDANCE AND CONTROL
- SPECIFIC
- INSTRUMENTATION

**Page Reference**: 25-10
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 OXIDIZER 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 TEMPS 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

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)

IN ORDER TO INITIATE AND CONTINUE THE UNDOKED PHASE, THE DPS SUBSYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CONDITION:

NO DPS PROPELLANT LEAK

IN ORDER TO INITIATE AND CONTINUE THE RENDEZVOUS PHASE, THE DPS SUBSYSTEM MUST PROVIDE A SAFE BURN CAPABILITY AND 295 FPS 0V CAPABILITY AND NO DPS PROPELLANT LEAKS.
<table>
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<td>26-11</td>
<td>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).</td>
</tr>
<tr>
<td>26-12</td>
<td>DPS USABLE PROPELLANT IS 17,430.4 LBS.</td>
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<td>TOTAL LOADED 18,039.9 LBS</td>
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<td>TRAPPED 367.5 LBS</td>
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<td>TM ERROR 242.0 LBS</td>
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<td></td>
<td>USABLE 17,430.4 LBS</td>
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<tr>
<td>26-13</td>
<td>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.</td>
</tr>
<tr>
<td>26-14</td>
<td>THE TOTAL ACCUMULATED BURN TIME OF THE DESCENT ENGINE SHALL NOT EXCEED 910 SECONDS OF OPERATION INDEPENDENT OF THRUST LEVEL.</td>
</tr>
<tr>
<td>26-15</td>
<td>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.</td>
</tr>
<tr>
<td>26-16</td>
<td>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.</td>
</tr>
<tr>
<td>26-17</td>
<td>THE DPS ENGINE MUST NOT BE OPERATED IN THE NON-THROTTLE RANGE (65 PERCENT TO FTP) FOR MORE THAN 100 SEC.</td>
</tr>
<tr>
<td>26-18</td>
<td>SUPERCRITICAL HELIUM BURST DISC Rupture DURING MANNED OPERATION WILL NOT DAMAGE SPACECRAFT, ENDANGER CREW, OR EFFECT ATTITUDE CONTROL AND IS THEREFORE AN ALLOWABLE EVENT.</td>
</tr>
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</table>
DPS ENGINE RESTART CAN BE MADE WITH THE FOLLOWING CONSTRAINTS:

<table>
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<tr>
<th>INITIAL BURN</th>
<th>REQUIRED COAST TIME</th>
<th>MAXIMUM RESTART BURN TIME</th>
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<tr>
<td>A. UP TO 190 SECS</td>
<td>10 MINUTES</td>
<td>400 SECS</td>
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<tr>
<td>B. 190 SECS TO 600 SECS</td>
<td>REFERENCE (SEE FIGURE BELOW)</td>
<td>100 SECS</td>
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<tr>
<td>C. GREATER THAN 600 SECS</td>
<td>NO RESTART</td>
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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.
SECTION 26 - LM DPS - CONTINUED

NASA — Manned Spacecraft Center
MISSION RULES

<table>
<thead>
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<tr>
<td>26-20</td>
<td>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.</td>
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<td>26-21</td>
<td>PROPELLANT GAGING</td>
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<td>A. PRIME METHOD: PQGS (TM ONBOARD) 1.3%</td>
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<tr>
<td></td>
<td>B. BACKUP METHOD: GROUND MASS CALCULATION 5.0%</td>
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RULE NUMBERS 26-22 THROUGH 26-29 ARE RESERVED.

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APOLLO 9 | FINAL | 12/15/68 | LM DPS | MANAGEMENT | 26-4

PRO7712 FORM 29C (5/20/65)
### SECTION 26 - LM DPS - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
<th>RULING</th>
<th>CUES/NOTES/COMMENTS</th>
</tr>
</thead>
</table>
| A   | 26-30| LOSS OF OPERATIONAL DPS | DOCKED | A. INHIBIT DPS BURN | 1. STOP BURN, IF IN PROGRESS  
2. REF ALT MISSION E-5C  
B. PRIOR TO PHASING:  
(A) STAGE AT PHASING  
(B) REF ALT MISSION E-1  
2. AFTER PHASING:  
(A) CONTINUE MISSION  
(B) STAGE AT INSERTION |
| A   | 26-31| START TANK LEAK PRIOR TO PRESS | DOCKED | A. CONTINUE MISSION | REF MAL PROC DPS, 3 AND 4 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION  
B. CONTINUE MISSION | 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 | DOCKED | A. START TANK | REF NR 26-1  
REF MAL PROC DPS 3 AND 4 OFF-NOMINAL HELIUM PRESSURE OR PROPELLANT TEMP OR PRESSURE INDICATION  
B. SUPERCRITICAL HELIUM | 1. INLET PRESS <100 PSI  
2. INLET PRESS >100 PSI  
B. CUTOFF BURN ON INLET PRESS  
REF ALT MISSION E AND APS UMNANNED BURN |
| A   | 26-33| OFF NOMINAL SUPERCRITICAL HELIUM PRESS <350 PSI | DOCKED | CONTINUE MISSION | REF MAL PROC DPS 3 AND 4 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION |

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**NASA — Manned Spacecraft Center**

**MISSION RULES**

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| A   | 26-35| DPS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES | DOCKED | A. INHIBIT DPS BURN | REF MAL PROC DPS 1. 3 AND 6 OFF-NOMINAL HELIUM PRESSURE, OR PROPELLANT TEMP OR PRESSURE INDICATION AND APS REG WARNING LIGHT ILLUMINATED. |

| A   | 26-35| DPS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES | UNDOCKED | B. STAGE ASAP | REF ALT MISSION E5: PLUS UNMANNED APS. |

| A   | 26-35| DPS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES | RDNZ | C.1. PRIOR TO INSERTION: |

   (A) STOP BURN IF BURNING |
   (B) STAGE ASAP |
   (C) RETURN TO CSM ASAP |

| A   | 26-35| DPS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES |        | 2. DURING INSERTION: |

   (A) STOP BURN |
   (B) STAGE ASAP |
   (C) COMPLETE MANEUVER WITH LM RES |

| A   | 26-35| DPS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES |        | 3. AFTER INSERTION: |

   (A) STAGE ASAP |
   (B) CONTINUE MISSION |

**RULE NUMBERS 26-36 THROUGH 26-39 ARE RESERVED.**

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# SECTION 27 - LM APS

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<td>DOCKED, EVA, UNDOCKING, SEPARATION, PHASING</td>
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<td>NO APS PROPELLANT LEAKS</td>
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**A 27-2**

INTEGRATION

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**

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<td>APS BULK TEMP</td>
<td>&gt;50°F &lt;50°F</td>
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<td>OX-FUEL ΔT</td>
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<td>3</td>
<td>INLET PRESS</td>
<td>&gt;120-400 PSI</td>
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<td>4</td>
<td>INLET PRESS ΔP</td>
<td>&gt;27 PSIΔ</td>
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<td>TCP</td>
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<td>6</td>
<td>PROPELLANT LEAK</td>
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**UNMANNED**

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<td>OXID-FUEL ΔT</td>
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RULE NUMBERS 27-4 THROUGH 27-9 ARE RESERVED.
SECTION 27 - LM APS - CONTINUED

NASA — Manned Spacecraft Center
MISSION RULES

REV | ITEM | MANAGEMENT |
--- | --- | --- |
A | 27-10 | APS MANNED ENGINE STARTS MUST BE PRECEDED BY A PROPELLENT SETTLING MANEUVER USING 4 JET OR 2 JET ULLAGE, SYSTEM A OR B. |
A | 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 PROPELLENT FOR APS IS 4103.5 LBS. |
| | TOTAL LOADED | 4100.1 LBS |
| | USABLE | 4103.5 LBS |
A | 27-13 | THE MINIMUM IMPULSE OF THE APS ENGINE IS 2202 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. |
A | 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. |
A | 27-15 | PROPELLENT GAGING (NO ONBOARD READOUT) |
| | A. PRIME METHOD: FLOW RATE X TIME (§) |
| | B. BACKUP METHOD: GROUND MASS CALCULATION (§) |

RULE NUMBERS 27-16 THROUGH 27-19 ARE RESERVED.

MISSION | REV | DATE | SECTION | GROUP | PAGE
--- | --- | --- | --- | --- | ---
APOLLO 9 | A | 2/15/69 | LM APS | MANAGEMENT | 27-2
<table>
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<th>PHASE</th>
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<th>CLUES/NOTES/COMMENTS</th>
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<td>A. 27-20</td>
<td>Loss of an operational APS</td>
<td>RNZ</td>
<td>A. STOP BURN IF POSSIBLE</td>
<td>• Ref MR 27-3</td>
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<td>2. INHIBIT FURTHER APS BURNS</td>
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<td>3. PERFORM COM WITH RCS</td>
<td>ASC HE REG APS 3</td>
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<td></td>
<td></td>
<td>B. STOP BURN IF IN PROGRESS</td>
<td>OFF-NOMINAL PROPELLANT</td>
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<td></td>
<td>2. INHIBIT FURTHER APS BURNS</td>
<td>TEMP OR PRESS INDICATION</td>
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</table>

| A. 27-21 | APS HE source temp | ALL | A. CONTINUE MISSION | • Ref M. PROC APS 4 AND 5 |
| | | | POSITION S/C TO REDUCE | OFF-NOMINAL HELIUM PRESSURE, |
| | A. >120°F | ALL | B. CONTINUE MISSION | OR PROPELLANT TEMP OR PRESS |
| | (P 3400 PSI) | | PRESSURIZE APS FROM EFFECTED |URE INDICATION. |
| | B. >140°F | ALL | C. CONTINUE MISSION | • Ref M. PROC APS 4 AND 5 |
| | (P 3500 PSI) | | 1. CLOSE HE REG SHUTOFF | OFF-NOMINAL HELIUM PRESSURE, |
| | C. < -130°F | RNZ | 2. PERFORM APS BURNS IN | OR PROPELLANT TEMP OR PRESS |
| | | | BLOWDOWN MODE |URE INDICATION. |

| A. 27-22 | APS HE source pressure | ALL | A. CONTINUE MISSION | • Ref M. PROC APS 4 AND 5 |
| | A. LEAK PRIOR TO | ALL | B. CONTINUE MISSION | OFF-NOMINAL HELIUM PRESSURE |
| | PRESSURIZATION | | PRESSURIZE EFFECTED TANK(S) | OR PROPELLANT TEMP OR PRESS- |
| | B. SOURCE PRESSURE LESS | | CONTINUE MISSION | URE INDICATION. |
| | THAN ENGINE INLET | | 1. CLOSE HE REG SHUTOFF | • Ref M. PROC APS 4 AND 5 |
| | PRESSURE | | VALVES | OFF-NOMINAL HELIUM PRESSURE |
| | | | 2. CONTINUE MISSION | OR PROPELLANT TEMP OR PRESS |
| | | | (A) CLOSE HE REG SHUTOFF | URE INDICATION. |
| | | | VALVES | • Ref M. PROC APS 4 AND 5 |
| | | | (B) OPERATE IN BLOWDOWN | OFF-NOMINAL HELIUM PRESSURE |
| | | | MODE | OR PROPELLANT TEMP OR PRESS |
| | | | | URE INDICATION. |

| A. 27-23 | APS HE leak between quad check valves and HE SHUTOFF VALVES | ALL | CONTINUE MISSION | • Ref M. PROC APS 1 |
| | | | A. CLOSE HE REG SHUTOFF VALVES | ASC PRESS WARNING LIGHT |
| | | | B. OPEN HE REG SHUTOFF VALVES | ILLUMINATED |
| | | | PRIOR TO EACH BURN | |

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</table>
| A   | 27-24| APS helium/propellant vapor leak downstream of quad check valves | Docked | A. Inhibit APS burn  
1. Stop burn if burning  
2. Check evacuate LM ASAP  
3. Unlock from LM  
4. CSM separate to safe distance | Refer ML proc APS 3, 4, 10D 5, off-nominal helium pressure, or propellant temp. or pressure indication, and any OXY caution light illuminated. |
|     |      |                      | Unlocked/RIDZ | 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 (0 pos) | RNDZ | A.1. Continue burn in progress  
Inhibit further matched APS burns | This indication prior to first APS engine on will be considered a TR failure. |
|     |      |                      | Unmanned   | 2. Continue mission | |

Rule numbers 27-26 through 27-29 are reserved.

Mission: Apollo 9  
Rev: A  
Date: 2/15/69  
Section: LM APS  
Group: Specific  
Page: 27-3A
### Section 27 - LM APS - Concluded

**NASA - Manned Spacecraft Center**

**Mission Rules**

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**Mission: Apollo 9**

**Rev Date:** 1/29/69

**Section: LM APS**

**Group: PreLaunch Instrumentation**

**Page:** 27-4
28 LM REACTION CONTROL SYSTEM
SECTION 28 - LM REACTION CONTROL SYSTEM

NASA — Manned Spacecraft Center

MISSION RULES

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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
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.
### SECTION 28 - LM REACTION CONTROL SYSTEM - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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**MISSION LOG**

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**FOOTNOTE:** FORM COPY (REV 00)
### RULE NUMBERS 28-17 THROUGH 28-19 ARE RESERVED.

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**SECTION 2B - LM REACTION CONTROL SYSTEM - CONTINUED**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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| 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 |
|     |      |                         |       |        | UNDOCKED/RNZD       | C. RETURN TO CSM ASAP | REF ALT MISSION D |
|     |      |                         |       |        | UNMANNED            | D. CONTINUE MISSION |

**28-21 RCS THRUSTER PAIR**

A. ONE PAIR ISOLATED

| DOCKED | A.1. DO NOT UNDOCK | REF ALT MISSION D PLUS EVA |
| UNDOCKED/RNZD | 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 |
| RNZD | 3. CSM RESCUE |
| UNMANNED | 4. DO NOT PERFORM APS DEPLETION |

**28-22 DELETED**

**MISSION** | RVN | DATE | SECTION | GROUP | DATE |
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**SECTION 28 - LM REACTION CONTROL - CONCLUDED**

**NASA — Manned Spacecraft Center**

**MISSION RULES**

**PRELAUNCH INSTRUMENTATION**

**MISSION** | **REV** | **DATE** | **SECTION** | **GROUP** | **PAGE**
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SECTION 29 - SPACE ENVIRONMENT

NASA — Manned Spacecraft Center

MISSION RULES

REV ITEM

29-1 ALL DECISIONS WILL BE BASED ON CONFIRMED MEASUREMENTS AND/OR EVENTS AND PROJECTIONS BASED ON CONTINUOUS 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) EXPRESS THE EFFECTIVENESS OF PARTICULAR TYPES OF RADIATION IN PRODUCING A SIMILAR 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 ARTIFICIAL 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.

MISSION REV DATE SECTION GROUP PAGE
APOLLO 9 FINAL 12/15/68 SPACE ENVIRONMENT GENERAL/MANAGEMENT 29-1
### SECTION 29 - SPACE ENVIRONMENT - CONTINUED

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**MISSION RULES**

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<td>29-10</td>
<td>ANY SOURCE REPORTS A POSSIBLE ARTIFICIAL EVENT</td>
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<td>PROCEED UNTIL VERIFICATION FROM ALL OTHER SOURCES</td>
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| 29-11 | DEFINITE ARTIFICIAL 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 MANEED  
2. CONTINUE MISSION LOWER ORBIT TO THE MINIMUM ALTITUDE THAT CAN BE SUSTAINED. |
| 29-12 | RADIATION CONFIRMED BY PROD 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 | ALL | A. CONTINUE MISSION  
B. CONTINUE MISSION |

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**MISSION**  
APOLLO 9  
**REV**  
**DATE**  
12/15/68  
**SECTION**  
SPACE ENVIRONMENT  
**GROUP**  
SPECIFIC  
**PAGE**  
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### SECTION 30 - RECOVERY

**NASA — Manned Spacecraft Center**

**MISSION RULES**

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<td>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:</td>
</tr>
<tr>
<td></td>
<td>SURFACE WINDS - 25 KNOTS</td>
</tr>
<tr>
<td></td>
<td>CEILING - 1500 FEET</td>
</tr>
<tr>
<td></td>
<td>VISIBILITY - 3 N.MI.</td>
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<td>WAVE HEIGHT - 8 FEET</td>
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### NASA — Manned Spacecraft Center

**MISSION RULES**

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<tr>
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<tr>
<td>30-3</td>
<td>RECOVERY CAPABILITY IN THE LAUNCH SITE AREA AT THE TIME OF LANDING</td>
<td></td>
</tr>
<tr>
<td>30-4</td>
<td>RECOVERY CAPABILITY IN THE LAUNCH ABORT AREA AT LAUNCH</td>
<td></td>
</tr>
<tr>
<td>30-5</td>
<td>RECOVERY CAPABILITY IN THE WEST ATLANTIC AND MID-PACIFIC RECOVERY ZONES DURING THE FIRST 6 REVOLUTIONS WHEN LANDINGS MAY OCCUR.</td>
<td></td>
</tr>
<tr>
<td>30-6</td>
<td>IT IS REQUIRED THAT 18 HOURS OF ON-POWERS MANDATORY</td>
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<tr>
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<tr>
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<td>MANDATORY</td>
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<tr>
<td>PRELAUNCH</td>
<td>HIGHLY DESIRABLE</td>
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<tr>
<td>PRELAUNCH</td>
<td>HIGHLY DESIRABLE</td>
</tr>
<tr>
<td>ORBIT/ENTRY</td>
<td>MANDATORY</td>
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**NOTES:**
- THIS TIME MAY BE REDUCED ONLY TO PROVIDE FOR A MORE FAVORABLE LANDING POINT.

**MISSION** | **REV** | **DATE** | **SECTION** | **GROUP** | **PAGE**
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<td>APOLLO 9</td>
<td>FINAL</td>
<td>12/15/68</td>
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**REV DATE PAGE**
### Section 31 - Aeromedical

**NASA — Manned Spacecraft Center**

**Mission Rules**

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<th>General</th>
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<tbody>
<tr>
<td>31-1</td>
<td>PRELAUNCH</td>
<td>Prior to committing to launch, the following conditions must be met:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. Satisfactory flight crew physiological status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. The minimum cabin oxygen concentration for launch is 60 percent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. The minimum suit oxygen concentration for launch is 95 percent.</td>
</tr>
<tr>
<td>31-2</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>31-3</td>
<td></td>
<td>The potable water pH must be within 6.0 to 8.0 at servicing and final sampling.</td>
</tr>
<tr>
<td>31-4</td>
<td>LAUNCH</td>
<td>There are no medical reasons for aborting during the launch phase other than those conditions intolerable to the crew.</td>
</tr>
<tr>
<td>31-5</td>
<td>ORBIT</td>
<td>Early mission termination for medical reasons fall into two categories:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. Onset of conditions which adversely affect crew safety, health, or function and performance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Failure of spacecraft systems to maintain a physiologically satisfactory environment.</td>
</tr>
<tr>
<td>31-6</td>
<td>WATER PALATABILITY</td>
<td>Crew evaluation of the drinking water taste will be the basis for determining water palatability, even for KOH contamination.</td>
</tr>
</tbody>
</table>

Rule numbers 31-7 through 31-14 are reserved.

**Mission** | **REV Date** | **Section** | **Group** | **Page**
---|---|---|---|---
APOLLO 9 | 12/15/68 | AEROMEDICAL | GENERAL | 31-1
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#### NASA - Manned Spacecraft Center

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<td>31-15</td>
<td>LOSS OR UNREADABLE EKG</td>
<td>LAUNCH</td>
<td>A. CONTINUE MISSION</td>
<td>ARTIFACTS ANTICIPATED DURING LAUNCH,</td>
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<tr>
<td></td>
<td></td>
<td>EVA</td>
<td>B. CONTINUE MISSION</td>
<td>ARTIFACTS ANTICIPATED AT PHASE TRANSFER WHILE IN EVA.</td>
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<tr>
<td></td>
<td></td>
<td>ALL</td>
<td>C. CONTINUE MISSION</td>
<td>MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND TERMINATION OF EVA ACTIVITY.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.</td>
</tr>
<tr>
<td>31-16</td>
<td>ABNORMAL HEART RATE, RHYTHM OR EKG</td>
<td>ALL</td>
<td>CONTINUE MISSION</td>
<td>MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.</td>
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<tr>
<td>31-17</td>
<td>ABNORMAL RESPIRATORY RATE</td>
<td>ALL</td>
<td>CONTINUE MISSION</td>
<td>THE ABNORMAL RATES WILL BE EVALUATED BY THE MCC SURGEON AND EARLY MISSION TERMINATION MAY BE RECOMMENDED IF CORRECTIVE ACTION IS NOT EFFECTIVE.</td>
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<tr>
<td>31-18</td>
<td>ONSET OF SERIOUS MEDICAL PROBLEM</td>
<td>LAUNCH</td>
<td>A. CONTINUE MISSION</td>
<td>CREW MAY ELECT TO ABORT IF INTOLERABLE</td>
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<tr>
<td></td>
<td></td>
<td>ALL</td>
<td>B. CONTINUE MISSION</td>
<td>MCC SURGEON WILL EVALUATE AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.</td>
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**MISSION REV DATE SECTION GROUP PAGE**

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<td>9</td>
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<td>SPECIFIC PHYSIOLOGICAL</td>
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<tr>
<td>31-19</td>
<td>DYSBARISM IN ANY CREWMAN</td>
<td>LAUNCH</td>
<td>A. CONTINUE MISSION</td>
<td>CREW MAY ELECT TO ABORT IF CONDITION IS INTOLERABLE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ALL</td>
<td></td>
<td>B. TERMINATE PHASE</td>
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<td></td>
<td></td>
<td>ENTER NEXT BEST PTP</td>
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</table>

- CHECK SUIT INTEGRITY.
- IF CONDITIONS PERMIT CREW MAY ELECT TO OVER-PRESSURIZE.
- MCC SURGEON WILL EVALUATE AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.

<table>
<thead>
<tr>
<th>REV</th>
<th>RULE</th>
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<tr>
<td>31-20</td>
<td>ORAL TEMP EXCEEDS 101°F DESPITE CORRECTIVE ACTION.</td>
<td>LAUNCH A. IF DUE TO ILLNESS</td>
<td>A.1. NOT APPLICABLE</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>ALL</td>
<td>B. TERMINATE PHASE</td>
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<td>ENTER NEXT BEST PTP</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>B. IF RESULTANT FROM THERMAL OVERLOAD</td>
<td>LAUNCH</td>
<td>2. TERMINATE PHASE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ALL</td>
<td>ENTER NEXT BEST PTP</td>
</tr>
</tbody>
</table>

- MCC SURGEON MAY RECOMMEND EARLY MISSION TERMINATION IF TREATMENT IS UNSUCCESSFUL.

- MCC SURGEON MAY RECOMMEND EARLY MISSION TERMINATION IF TREATMENT IS UNSUCCESSFUL.

## Notes
- Rule numbers 31-21 through 31-24 are reserved.

### Apollo 9 Final 12/15/68
- Section: Aeromedical
- Specific Physiological
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<th>CUES/DATES/CONCERNS</th>
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<td>31-25</td>
<td>INCREASE IN PCO₂</td>
<td>LAUNCH</td>
<td>A.1. CONTINUE MISSION</td>
<td>A. PCO₂ SHOULD DECREASE BY 0.2 MM Hg WITHIN 30 MINUTES.</td>
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<tr>
<td></td>
<td></td>
<td>ALL</td>
<td>2. CONTINUE MISSION</td>
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<td></td>
<td></td>
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<td>CHANGE LIOH CANISTER</td>
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</tr>
<tr>
<td></td>
<td>A.</td>
<td>≥7.6 MM HG</td>
<td>LAUNCH</td>
<td>B.1. CONTINUE MISSION</td>
<td>B.2. LIOH CANISTER WILL NOT BE CHANGED.</td>
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<td>2. CONTINUE MISSION</td>
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</tr>
<tr>
<td></td>
<td>B.</td>
<td>≥7.6 MM HG AND UNABLE TO DECREASE</td>
<td>LAUNCH</td>
<td>(A) OPEN SUITS AND BREATHE FROM CABIN</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>ALL</td>
<td>(B) CHANGE SECOND LIOH CANISTER</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(C) TEST PCO₂ SENSOR</td>
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</tr>
<tr>
<td></td>
<td>C.</td>
<td>≥10 MM HG</td>
<td>LAUNCH</td>
<td>C.1. CONTINUE MISSION</td>
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<td>2. TERMINATE PHASE</td>
<td>ENTER NEXT BEST PIP</td>
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<td>31-26</td>
<td>PCO₂ INSTRUMENTATION FAILURE</td>
<td>ALL</td>
<td>CONTINUE MISSION</td>
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### INSTRUMENTATION REQUIREMENTS

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<tr>
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<th>MEAS DESCRIPTION</th>
<th>ROM</th>
<th>ONBOARD</th>
<th>TRANSUCERS</th>
<th>CATEGORY</th>
<th>MISSION REFERENCE</th>
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<td>31-35</td>
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<td>ELECTROCARDIOGRAM</td>
<td>CJO060 J</td>
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<td>CO₂ PARTIAL PRESSURE</td>
<td>CJO065 P</td>
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<td>SUIT CABIN DELTA PRESS</td>
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<td>ORAL TEMPERATURE</td>
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</table>

MANDATORY TO CABIN CLOSEOUT
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 IPS 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**

LM DFI DATA is mandatory to liftoff, but loss of DFI data will not constrain critical phases (A KSC hold responsibility).

THE MISSION WILL BE CONTINUED WITH THE LOSS OF:

A. Either or Both the CSM and the LM Update link
B. Either or Both the CSM and the LM Caution and Warning System
C. The CSM Data Storage Equipment
D. PLSS Telemetry

S-BAND ONE-WAY RELAY IS EXPLAINED AS:

A. PLANNED - CSM
B. BACKUP - LM

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.
**SECTION 32 - COMMUNICATIONS AND INSTRUMENTATION - CONTINUED**

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</tr>
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<td>A 32-12</td>
<td>TELEMETRY CONFIGURATION</td>
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</tr>
<tr>
<td>A 32-13</td>
<td>CSM VHF/USB MANAGEMENT</td>
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</tbody>
</table>

**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.

**VOICE CONFIGURATION**

A. LM/CSM/MSFN CONFERENCE

1. VHF A SIMPLEX 296.8 MHZ IS PRIME EXCEPT:
   - (A) PRELAUNCH THRU CYI, REV I 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.

**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 RF KDF.

B. LM DFI POSTFLIGHT ANALYSIS DATA WILL BE PREDTECTION RECORDED FOR SPECIFIC EVENTS DURING LM CHECKOUT AND THE Rendezvous.

**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 PH POWER AMPLIFIER WILL BE USED CONTINUOUSLY, EXCEPT DURING HGA TESTS. DURING THIS TEST, BYPASS MODE WILL BE USED.
### SECTION 32 - COMMUNICATIONS AND INSTRUMENTATION - CONTINUED

**NASA — Manned Spacecraft Center**

**MISSION RULES**

#### 32-14 DESE 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 DESE.

B. CM high-bit rate DESE recordings will be made during the following operations:

1. Launch
2. S-IVB/CSM Separation
3. All SPS maneuvers
4. Deorbit maneuver, OVSM separation and entry
5. DTO requirements (TBO)

#### 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 75 seconds before being updated, after orbit insertion.

#### 32-16 LM USB MANAGEMENT

High power mode will be used continuously during PM and PM transmissions except during the steerable antenna test and mode 7 check.

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**RULE NUMBERS 32-17 THROUGH 32-19 ARE RESERVED.**
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<tr>
<th>REV</th>
<th>RULE</th>
<th>CONDITION/MALFUNCTION</th>
<th>PHASE</th>
<th>REPLY</th>
<th>CUES/PACES/COMMENTS</th>
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<td>UNDOCKED</td>
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<td>B. DOCK ASAP</td>
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<td>C. DO NOT PERFORM SEPARATION, PIVOTING, OR INSERTION BURNS. IF AFTER INCENTION, LM PERFORMS ALL MANEUVERS.</td>
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<td>EVA</td>
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<td>LMP ACTS AS RELAY BETWEEN CDR AND CMP</td>
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<td>1. LMP RETURN TO VISUAL VICINITY OF NEAREST CREWMAN.</td>
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<td>3. IF COMMUNICATION NOT REESTABLISHED TERMINATE EVA</td>
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MISSION: APOLLO 9
REV: A
DATE: 2/19/69
SECTION: COMMUNICATIONS AND INSTRUMENTATION
GROUP: SPECIFIC
PAGE: 32-4

REF MALF PROC 5-18, 3-21
LM LOSS OF VHF VOICE COMM NO. 4 UTILIZE TRANSFER UNBILICAL TO MAINTAIN COMMUNICATIONS.

REF MALF PROC 5-18, 5-21
### NASA — Manned Spacecraft Center
#### MISSION RULES

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<td>REF ALTERNATE MISSION B</td>
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<td>AL.TCH</td>
<td>3. LM RETURN TO VICINITY OF CSM ASAP</td>
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<td>2. LM</td>
<td>ALL</td>
<td>2. TRANSFER TO CSM SETUP FOR UNMANNED APS BURN</td>
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- MUST COMPARE GROUND AND ONBOARD SOLUTIONS VIA DSKY AND VOICE UPDATES.
- MUST COMMAND UNMANNED APS BURN IN THE BLIND.
- MANDATORY/DFI DATA WILL BE RETRIEVED.

**A.** RULE NUMBERS 32-24 THROUGH 32-39 ARE RESERVED.

---

**APOLLO 9**

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### SECTION 32 - COMMUNICATIONS AND INSTRUMENTATION - CONCLUDED

#### NASA — Manned Spacecraft Center

**MISSION RULES**

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<td>MANDATORY/DFI DATA WILL BE RETRIEVED.</td>
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<td>3. LM RETURN TO VICINITY OF CSM ASAP</td>
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<td>2. TRANSFER TO CSM</td>
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<td>SETUP FOR UNMANNED APS BURN</td>
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**GROUP PAGE**

- **MISSION:** APOLLO 9
- **REV:** FINA
- **DATE:** 12/15/68
- **SECTION:** COMMUNICATIONS AND INSTRUMENTATION
- **GROUP:** SPECIFIC
- **PAGE:** 32-5
## GSM - INSTRUMENTATION REQUIREMENTS

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<th>ITEM</th>
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<th>METER</th>
<th>TRANSUCERS</th>
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<th>MISSION RULE REF</th>
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<td>CTD Validity Signal</td>
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<td>13-10B, 10E, 11C</td>
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<td>CT0620E</td>
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MISSION: Apollo 9

APOLLO 9 A 2/15/69 COMMUNICATIONS/INSTRUMENTATION GSM - INSTRUMENTATION REQ'S 32-6
### LM - INSTRUMENTATION REQUIREMENTS

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**MISSIO, RULE REFERENCE**

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# Appendix A - Acronyms and Symbols

**NASA Manned Spacecraft Center**

**Mission Rules**

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<td>AC</td>
<td>Alternating Current</td>
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<td>ACAS</td>
<td>Attitude Controller Assembly System</td>
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<tr>
<td>ACCEL</td>
<td>Accelerometer</td>
</tr>
<tr>
<td>ACCL</td>
<td>Accelerator</td>
</tr>
<tr>
<td>ACS</td>
<td>Attitude Control and Stabilization System</td>
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<td>ACT</td>
<td>Actuator</td>
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<tr>
<td>AD</td>
<td>Auxiliary Display Equipment Group</td>
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<td>AEA</td>
<td>Abort Electronics Assembly</td>
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<td>AEL</td>
<td>Abort Engine Liquidation Device</td>
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<td>AIF</td>
<td>Air-To-Ground</td>
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<td>AGS</td>
<td>Apollo Guidance System</td>
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<td>ALIS</td>
<td>Apollo Lunar Instrumentation System</td>
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<td>Alternate</td>
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<td>Angle of Attack</td>
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<td>AGH</td>
<td>Apollo Operations Handbook</td>
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<td>AGT</td>
<td>Alignment Optical Telescope</td>
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<td>Ascent Propulsion System</td>
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<td>Apollo Range Instrumentation System</td>
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<td>Ascent</td>
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<td>Attitude Translation, Controller Assembly</td>
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<td>Block House</td>
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<td>Body Mounted Attitude Gyro</td>
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<td>British Thermal Unit</td>
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<td>Countdown and Status Transmission System</td>
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<td>Coupling Data Unit</td>
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<td>Computer Input Matrix</td>
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<td>Circuit</td>
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<td>Chief Launch Vehicle Test Conductor</td>
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<td>Command Module</td>
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<td>Conference</td>
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**Acronyms and Symbols**

**Mission**

- **Apollo 9**

**Date**

- **17/15/68**

**Group**

- **A-1**
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**ACRONYMS AND SYMBOLS**

**APOLLO 9**

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**NASA — Manned Spacecraft Center**

**MISSION RULES**

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APPENDIX B - DISTRIBUTION LIST

NASA — Manned Spacecraft Center

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**DIRECTOR OF FLIGHT OPERATIONS**
FA KRAFT, C.C., JR. (2)
SJOEBERG, S.A.
ROSE, R.J.
KUKS, W.E.

**FLIGHT CONTROL DIVISION**
FCKRANZ, E.J.
LUNITZ, H.S.
CHARLESWORTH, C.E.
GRIFFIN, G.D.
WINKLER, M.L.
FRANK, M.P.
ROACH, J.W.
BROOKS, M.P.
MILLER, H.G.

**FLIGHT CONTROL OPERATIONS BRANCH**
FC2/ADARIN, C.S.
FENDELL, E.A. (3)
LEWIS, C.R. (9)
EALICK, P.L. (3)
PLATT, W.E. (3)

**CSM SYSTEMS BRANCH**
FC3/ADARIN, A.D.
HUTCHINSON, H.B.
GLOVER, R.D.
LOGE, J.R. (20)
WILLOUGHBY, B.N. (20)
BLAIR, W.L. (2)

**LM SYSTEMS BRANCH**
FCM/NAVIAGN, J.E. (5)
POODY, S.R. (20)
CARLTON, R.L. (23)
EDLIN, F. (5)

**FLIGHT DYNAMICS BRANCH**
FC5/BOSTICK, J.C.
SNAPP, P.C.
LLEWELLYN, J.S. (4)
PARKER, C.B. (4)
PAVELKA, E.L. (4)

**MISSION SIMULATIONS BRANCH**
FC6/SHAEFFER, C.B. (28)

**MISSION CONTROL REQUIREMENTS**
FC7/PETTITT, G.J. (2)

**EXPERIMENTS SYSTEMS BRANCH**
FC8/SALTZ, U.E. (12)

**MSFC FLIGHT CONTROL OFFICE**
I-MI/FAHNER, R.S. (20)

**FLIGHT SUPPORT DIVISION**
FC9/SONEITH, L.C.

**SYSTEMS ENGINEERING BRANCH**
FS2/SATTERFIELD, J.M.

**OPERATIONS SUPPORT BRANCH**
FSW/FRERE, J.A.
SANDOWN, S.D. (15)
RANCAU, E. (2)

**FLIGHT SOFTWARE DIVISION**
FSY/STONES, J.D. (3)
GINSON, T.F. (5)
GAMBAN, J.R. (2)

**MISSION PLANNING AND ANALYSIS DIVISION**
FM/FAHNER, J.P. (3)
HASS, C. (3)
TINDALL, H.W.

**FLIGHT ANALYSIS BRANCH**
FM/ALLEN, C.F. (14)

**ANDING ANALYSIS BRANCH**
FM/BENNETT, F.V.
BOLT, K.M. (22)
GRAVES, C.A.
HAPFORD, J.C. (2)

**MATHEMATICS BRANCH**
FM/MAHDERSON, L.C. (22)

**MISSION ANALYSIS BRANCH**
FM/SBERRY, R. (2)

**RENDÉVOUS ANALYSIS BRANCH**
FM/LEADBERRY, E.C. (2)

**GUIDANCE AND PERFORMANCE BRANCH**
FM/CAHILL, M.

**APOLLO TRAJECTORY SUPPORT OFFICE**
FM33/PARTER, R.
COLLINS, M.

**LANDING AND RECOVERY DIVISION**
FL/AIMECK, J.B. (8)

**DIRECTOR OF FLIGHT CREW OPERATIONS**
CA/SAYLOR, D.K. (2)

**ASTRONAUT OFFICE**
CB/SHAPIRO, A.B. (20)

**FLIGHT CREW SUPPORT DIVISION**
CF/PARKER, R.

**WING OPERATIONS OFFICE**
CF/SHAPIRO, J.B.

**SATELLITE DATA CENTER**
CF/HADLAND, E.D. (15)

**DIRECTOR OF ENGINEERING AND DEVELOPMENT**
EA/FACET, M.A.

**OPERATIONS OFFICE**
EA/ADDISON, E.A.

**PUBLIC AFFAIRS OFFICE**
EA/HANSEN, P.

**APOLLO SPACECRAFT PROGRAM OFFICE**
PA/LIN, G.M.

**PRODUCTION OFFICE**
PA/BROWN, L.E.

**FLIGHT CREW SUPPORT DIVISION**
WP/OLSON, J.

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WP/OLSON, J.

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WA/ADDISON, E.A.

**MISSION CONTROL OFFICE**
WA/DANIELS, E.A.

**SPACECRAFT OPERATIONS DIVISION**
WP/OLSON, J.

**MISSION CONTROL OFFICE**
WP/OLSON, J.

**SPACECRAFT OPERATIONS DIVISION**
WP/OLSON, J.
## APPENDIX B - DISTRIBUTION LIST - CONCLUDED

### NASA — Manned Spacecraft Center

#### MISSION RULES

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APPENDIX C - CHANGE CONTROL

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The purpose of this appendix is to delineate change control procedures for the AS-504/104/LM-3 mission rules. This will include the proper coordinating of changes, provide a record of 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 SELECTED BY A TOTAL OF SIXTEEN ORGANIZATIONS HAVING A VALID INPUT. CHANGES ORIGINATING OUTSIDE THE FLIGHT DIRECTOR'S 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 PRIMARY MISSION OPERATIONS CONTROL ROOM (PMOCR) 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 FORWARD TO THE AFD.

THE AFD WILL COMPLETE 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 OFFICIAL CONCURRENCES OF DISAPPROVALS (VERBALLY OR BY INITIATION) FROM THE RELEVANT PERSONNEL. VERBAL CONCURRENCES WILL BE INDICATED IN THE APPROPRIATE SIGNATURE BOX.

2.2.2 SIGN OFF/DISAPPROVAL

IF AFTER OBTAINING THE REQUIRED CONCURRENCES OR NEGATIVE COMMENTS, THE AFD WILL PRESENT THE PROPOSED CHANGES 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 ADVISED OF 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 CONCERNED.

3.0 REVISIONS

3.1 DEVELOPMENT

THE AFD WILL COMPARE 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.
**Figure C-1: Mission Rule Proposed Change Request Form.**

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**Mission Rule Request/Revision**

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**Rationale:**
- New technical data
- Clarification
- Typographical error

**Originator:**
- Name
- Organization
- Ext

**Approved:**
- Cognizant Branch Chief
- Flight Director

**APOLLO 9**
**Final:** 12/15/68
**Appendix C - Change Control**
**Page:** C-2
END
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1972