



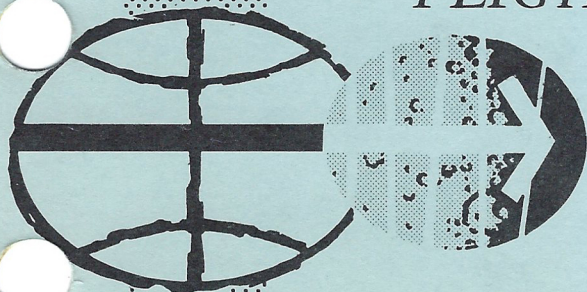
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FINAL FLIGHT MISSION RULES

*APOLLO 13
(AS-508/109/LM-7)*

FEBRUARY 12, 1970

*PREPARED BY
FLIGHT CONTROL DIVISION*



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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CONTROL

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MISSION RULES

SECTION 2 FLIGHT OPERATIONS RULES

REV	ITEM						
		----- ' GENERAL ' -----					
	2-1	PRELAUNCH A. LAUNCH AZIMUTH LIMITATIONS RESTRICT LAUNCHES TO OCCUR BETWEEN 72 DEG. AND 96 DEG. B. THE FLIGHT DIRECTOR WILL EVALUATE WIND SIMULATIONS ALONG THE MODE 1 (TOWER) ABORT TRACK PRIOR TO THE START OF CRITICAL COUNTDOWN ACTIVITIES AND WILL ADVISE THE LAUNCH DIRECTOR OF ANY PREDICTED PERIODS OF LAND LANDING. IF THE FLIGHT DIRECTOR IS UNABLE TO PROVIDE THIS EVALUATION, A LAND LANDING WILL BE ASSUMED AND THE SPACECRAFT WIND CONSTRAINTS FOR LAND IP'S WILL BE APPLIED. THESE CONSTRAINTS (REF LMRD) REQUIRE THAT THE SPACECRAFT NOT BE LAUNCHED OR REMAIN IN A TOWER ABORT MODE IF A TOWER ABORT WOULD RESULT IN A LAND LANDING WITH A HORIZONTAL VELOCITY COMPONENT OF GREATER THAN 54 FEET PER SECOND AT IMPACT. IN ALL CASES, THE LAUNCH DIRECTOR WILL BE PRIME FOR CALLING HOLDS FOR LAND LANDING LAUNCH WIND VIOLATIONS. C. THE LAUNCH WILL NOT BE ATTEMPTED IF THE MINIMUM GROUND INSTRUMENTATION CAPABILITY IS COMPROMISED. (REFERENCE SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS.) CONTINUOUS VOICE, TELEMETRY, AND TRACKING COVERAGE FOR THE SPACECRAFT IS REQUIRED FROM LIFTOFF THROUGH INSERTION PLUS 60 SEC. CONTINUOUS TELEMETRY COVERAGE IS REQUIRED FROM THE SLV FROM LIFTOFF THROUGH INSERTION PLUS 60 SEC. COMMAND IS HIGHLY DESIRABLE FOR BOTH VEHICLES.					
	2-2	LAUNCH IT IS PREFERABLE TO GO INTO ORBIT AND REENTER INTO THE WEST ATLANTIC RATHER THAN PERFORM A LAUNCH ABORT. THEREFORE, THE LAUNCH WILL BE CONTINUED AS LONG AS THE CREW CONDITION IS SATISFACTORY, NO S/C OR SLV PROBLEMS EXIST WHICH JEOPARDIZE CREW SAFETY, AND SUFFICIENT CONSUMABLES, COOLANT, AND ELECTRICAL ENERGY REMAIN FOR AT LEAST ONE REVOLUTION PLUS ENTRY.					
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SECTION 2 FLIGHT OPERATIONS RULES

REV	ITEM
2-11	TRANSLUNAR INJECTION A. THE TLI WILL BE GO IF THE S/C AND L/V SATISFY THE FOLLOWING CRITERIA--- 1. THERE HAVE BEEN NO FAILURES IN THE LAUNCH VEHICLE WHICH RESULTS IN --- (A) A CATASTROPHIC HAZARD. (B) ACHIEVEMENT OF AN S-IVB ENGINE BURN WITH EXPECTED CUTOFF OR SHUTDOWN CONDITIONS DEFINITELY PRECLUDING AN ACCEPTABLE LUNAR MISSION. IN APPLYING THIS CRITERIA TO SPECIFIC MISSION RULES, A NO GO RECOMMENDATION WILL BE REQUIRED IF INSUFFICIENT S-IVB CONSUMABLES OR PROPULSION PERFORMANCE IS AVAILABLE TO ASSURE A FINITE PROBABILITY OF ACHIEVING A CUTOFF ORBIT WITH 65,000 N.M. APOGEE ALTITUDE. 2. THE CSM HAS TOTAL SYSTEMS CAPABILITY WITH REDUNDANCY. REDUNDANCY VERIFICATION IS SUBJECT TO THE NUMBER AND TYPE OF REDUNDANT COMPONENT CHECKS WHICH CAN BE PERFORMED IN EARTH ORBIT. B. THE TLI MANEUVER WILL BE DELAYED UNTIL THE SECOND OPPORTUNITY FOR SUSPECTED FAILURE OF A CRITICAL SYSTEM (PRIME OR BACKUP) (MANEUVER, LIFE SUPPORT, COOLING, POWER, SEQUENTIAL COMMUNICATIONS) WHICH REQUIRES TIME FOR EVALUATION. C. THE TLI MANEUVER WILL BE INITIATED AND CONTINUED UNDER MANUAL CONTROL FOR A SATURN GUIDANCE REFERENCE FAILURE.
2-12	TRANSPOSITION, DOCKING AND EJECTION (TD&E) A. IN THE EVENT OF ADVERSE LIGHTING, ATTITUDES, RATES, OR MECHANICAL ANOMALIES, THE FLIGHT CREW WILL MAKE THE FINAL DECISION TO ATTEMPT DOCKING AND EJECTION. B. THE NORMAL MINIMUM CABIN PRESSURE REDLINE OF 4.0 PSIA FOR TUNNEL/LM PRESSURIZATION SEQUENCES MAY BE WAIVED DURING TD&E. FOR TUNNEL OR LM LEAKS WHICH PREVENT NORMAL PRESSURIZATION, THE CM WILL BE DEPRESSURIZED AS REQUIRED FOR HATCH REMOVAL AND UMBILICAL HOOKUP. C. IF NORMAL LM EJECTION IS NOT SUCCESSFUL, NO ATTEMPT WILL MADE TO MAN THE LM AND "STAGE" TO RECOVER THE ASCENT STAGE.

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SECTION 2 FLIGHT OPERATIONS RULES

REV	ITEM													
	2-13	TRANSLUNAR COAST A. NO MCC WILL BE PERFORMED IF LOI CAN BE TARGETED WITHIN OPERATIONAL CONSTRAINTS. B. TRANSLUNAR COAST WILL BE TERMINATED IF ADEQUATE CONSUMABLES ARE NOT AVAILABLE FOR A CIRCUMLUNAR EARTH RETURN + 12 HRS. C. THE CREW WILL USE THEIR DISCRETION TO MAN THE LM FOR BACKUP COMMUNICATIONS AND RETURN IF CSM COMMUNICATIONS ARE LOST WITH THE MSFN. IF CSM COMMUNICATIONS CANNOT BE MAINTAINED, A LUNAR ORBIT MISSION WILL NOT BE FLOWN. D. A HYBRID TRAJECTORY WILL NOT BE FLOWN UNLESS THE CSM SYSTEMS MEET THE LOI CRITERIA. E. TRANSLUNAR MIDCOURSE CORRECTIONS RESULTING IN A HYBRID TRAJECTORY WILL BE DESIGNED TO MEET LOI TARGETING CONSTRAINTS WHILE RESERVING A CAPABILITY TO PERFORM A RETURN TO EARTH MANEUVER WITH THE DPS ENGINE AS LATE AS 2 HRS AFTER PERILUNE ON THE CIRCUMLUNAR TRAJECTORY.												
	2-14	LUNAR ORBIT INSERTION LOI WILL BE INHIBITED AND A LUNAR FLYBY PERFORMED IF THE CSM DOES NOT SATISFY ANY OF THE FOLLOWING CONDITIONS--- A. FULL CRITICAL SYSTEMS REDUNDANCY. B. ADEQUATE CONSUMABLES FOR MINIMUM LUNAR ORBIT OPERATIONS WITH CAPABILITY TO SUSTAIN A TANK LOSS AND RETURN TO EARTH WITH AN AVERAGE POWER LEVEL OF 40 AMPS. C. SPS PROPELLANT RESERVE CAPABILITY FOR TEI AND TRANSEARTH MCC'S. D. RCS PROPELLANT RESERVE TO ACCOMPLISH TEI CONTROL, TRANSEARTH MCC CONTROL, PTC, AND MINIMUM LUNAR ORBIT OPERATIONS. E. A DPS LOI WILL BE PERFORMED IF REQUIRED TO ACCOMPLISH A LUNAR ORBIT MISSION.												
	2-15	LUNAR ORBIT A. LOI DISPERSIONS 1. IF A STABLE ORBIT HAS NOT BEEN ACHIEVED, A DPS 2 HOUR ABORT WILL BE EXECUTED FOLLOWED BY A SUBSEQUENT DPS MANEUVER IF REQUIRED. 2. IF A STABLE ORBIT HAS BEEN ACHIEVED, AN SPS OR DPS TEI WILL BE PERFORMED AT THE NEXT OPPORTUNITY OR AN ALTERNATE MISSION WILL BE FLOWN. B. DESIGNED REDUNDANT CAPABILITY MUST BE MAINTAINED IN ALL CSM SYSTEMS CRITICAL FOR TEI AND LIFE SUPPORT. C. SUFFICIENT CONSUMABLES MUST REMAIN TO COMPLETE THE NEXT MISSION PHASE WITH CAPABILITY TO SUSTAIN A TANK LOSS AT ANY POINT DURING THE PHASE AND RETURN TO EARTH WITH AN AVERAGE POWER LEVEL OF 40 AMPS. D. THE CSM MUST MAINTAIN AN SPS FUEL RESERVE CAPABILITY FOR THE TEI MANEUVERS AND TRANSEARTH MCC'S. E. THE CSM MUST MAINTAIN RCS PROPELLANT RESERVE TO ACCOMPLISH TEI CONTROL, TRANSEARTH MCC CONTROL, PTC, AND MINIMAL TRANSEARTH OPERATIONS. F. IF NORMAL MISSION OPERATIONS ARE INHIBITED, THE DPS WILL BE USED FOR TEI WHEN THERE IS A CHOICE BETWEEN THE DPS AND SPS.												
	2-16	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.												
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MISSION RULES

SECTION 2 FLIGHT OPERATIONS RULES

REV	ITEM	
2-17	DOCKED LM OPERATION	FOR AN IMPENDING HAZARDOUS SITUATION RESULTING FROM A DESCENT STAGE PROBLEM, THE STAGE WILL BE JETTISONED AND ASCENT STAGE OPERATIONS WILL CONTINUE AFTER THE VEHICLE HAS MOVED TO A SAFE DISTANCE. RULE NUMBERS 2-18 THROUGH 2-20 ARE RESERVED
2-21	CSM/LM UNDOCKING AND SEPARATION	A. A MANNED LM WILL NOT BE UNDOCKED FROM THE CSM WITHOUT INDEPENDENT MANEUVER CAPABILITY OF BOTH VEHICLES TO TERMINATE UNDOCKED ACTIVITIES AND TO ACCOMPLISH DOCKING. THE LM CAPABILITY TO REDOCK MUST STILL EXIST IF THE LM IS REQUIRED TO STAGE. B. EVT CAPABILITY IS REQUIRED FOR MANNED UNDOCKING. C. CREWMEN WILL BE SUITED DURING UNDOCKING AND DOCKING. D. VHF COMMUNICATIONS IS MANDATORY FOR SEPARATION.
2-22	CSM LUNAR ORBIT UNDOCKED	A. UNDOCKING TO PDI 1. LOSS OF REDUNDANT CAPABILITY IN CRITICAL SYSTEMS WILL BE CAUSE TO TERMINATE THE MISSION AND PERFORM TEI ASAP. 2. LOSS OF CSM RESCUE CAPABILITY WILL BE CAUSE FOR TERMINATING THE MISSION AND PERFORMING A LM ACTIVE RDZ ASAP. B. PDI TO LANDING NO CSM FAILURES WILL BE CAUSE FOR ABORT DURING POWERED DESCENT. C. LUNAR STAY FAILURE TO MAINTAIN REDUNDANT CAPABILITY IN SYSTEMS REQUIRED FOR TEI OR LIFE SUPPORT WILL BE CAUSE FOR TERMINATION OF LUNAR STAY.
2-23	RESERVED	
2-24	LM-PDI	FOR PDI, THE LM MUST MEET THE LUNAR STAY WITH EVA CRITERIA, HAVE THE CAPABILITY TO LAND, ASCEND, RENDEZVOUS AND DOCK WITHOUT VIOLATING ANY SPECIFIC MISSION RULES OR REDLINES.

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SECTION 2 FLIGHT OPERATIONS RULES

REV	ITEM	
	2-25	LM-POWERED DESCENT IF A SYSTEMS FAILURE OCCURS AND A CHOICE IS AVAILABLE--- A. EARLY IN POWERED DESCENT WHEN OPS-TO-ORBIT CAPABILITY IS AVAILABLE, IT IS MORE PREFERABLE TO ABORT IN FLIGHT THAN TO CONTINUE DESCENT. REDUNDANT CAPABILITY OF CRITICAL LM SYSTEMS IS REQUIRED TO CONTINUE POWERED DESCENT DURING THIS PERIOD. HOWEVER, FOR FAILURES EFFECTING VEHICLE LIFETIME (CONSUMABLES, COOLANT) CONSIDERATION WILL BE GIVEN TO CONTINUING POWERED DESCENT TO PDI + 6+30 IN ORDER TO ACHIEVE A SHORTER RENDEZVOUS. B. DURING THE REMAINDER OF POWERED DESCENT, IT IS MORE PREFERABLE TO LAND AND LAUNCH FROM THE LUNAR SURFACE THAN TO ABORT. ONLY THOSE SYSTEMS FAILURES OR TRENDS THAT INDICATE IMPENDING LOSS OF THE CAPABILITY TO LAND, ASCEND AND ACHIEVE A SAFE ORBIT FROM THE LUNAR SURFACE, OR IMPENDING LOSS OF LIFE SUPPORT CAPABILITY WILL BE CAUSE FOR ABORT DURING THIS PERIOD.
	2-26	LV-LUNAR STAY A. ONLY THOSE TIME-CRITICAL SYSTEMS FAILURES OR TRENDS THAT INDICATE IMPENDING LOSS OF THE CAPABILITY TO ASCEND AND ACHIEVE A SAFE ORBIT WILL BE CAUSE FOR AN IMMEDIATE ABORT (ANYTIME LIFTOFF) FROM THE LUNAR SURFACE. B. LOSS OF REDUNDANT CAPABILITY IN CRITICAL LM SYSTEMS IS CAUSE FOR ABORT AT THE NEXT BEST OPPORTUNITY.
	2-27	EVA A. FOR THE NOMINAL (TWO-MAN) EVA, TOTAL EMU LIFE SUPPORT SYSTEMS CAPABILITY, EVA TO EVA DUPLEX VOICE, EVA TO MSFN VOICE, AND CRITICAL INSTRUMENTATION FOR BOTH ASTRONAUTS ARE REQUIRED. B. ALL PLANNED EVA'S WILL INCLUDE A 30-MINUTE POST-EVA RESERVE ON EMU CONSUMABLES. C. ALL EVA EXCURSIONS WILL BE LIMITED TO THAT VICINITY OF LM WHICH WILL ALLOW A SAFE 32 MINUTE RETURN TO THE LM WHILE OPERATING ON THE OPS. D. BOTH EVA CREWMEN WILL NOT REMAIN OUTSIDE OF MSFN COMM COVERAGE FOR A PERIOD EXCEEDING 5 MIN. E. FOR THE TWO-MAN EVA, THE CDR WILL ALWAYS EGRESS FIRST AND INGRESS LAST UNLESS THE CDR HAS INITIATED AN OPS PURGE. THIS WILL INSURE THAT THE CDR IS IN THE LEFT PILOT POSITION SHOULD ASCENT BE REQUIRED WITHOUT AN OPPORTUNITY TO DOFF THE EMU'S. F. THE LM WILL NOT BE PRESSURIZED WITH A CREWMAN ON THE SURFACE. G. A VACUUM TRANSFER WILL ONLY BE ATTEMPTED IN AN EMERGENCY. H. IF FAILURES PRECLUDE THE INITIATION OR CONTINUATION OF A TWO-MAN EVA, A ONE-MAN EVA WILL BE INITIATED. ONE MAN EVA'S WILL BE LIMITED TO AN OPERATIONAL RADIUS OF 1000 FEET FROM THE LM. THE PRIMARY OBJECTIVE WILL BE ALSEP DEPLOYMENT WITH ADDITIONAL OBJECTIVES IDENTIFIED IN REAL-TIME. I. BOTH PLSS'S AND OPS'S WILL BE RETAINED UNTIL TWO LIFE SUPPORT UNITS (2 OPS, 2 PLSS, OR 1 PLSS + 1 OPS) HAVE BEEN VERIFIED TO HAVE SUFFICIENT CONSUMABLES TO SUPPORT CEVT. J. THE ACTIVATION OF THE OPS IN THE MAKEUP MODE WILL REQUIRE EXPEDITIOUS COMPLETION OF THE SPECIFIC ACTIVITY BEING PERFORMED FOLLOWED BY IMMEDIATE RETURN TO THE LM. K. THE AMOUNT OF SCIENTIFIC EQUIPMENT & PAYLOAD TAKEN INTO THE ASCENT STAGE WILL BE LIMITED SO AS NOT TO REQUIRE A DEPRESSURIZATION TO JETTISON EXCESS WEIGHT PRIOR TO ASCENT.

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SECTION 2 FLIGHT OPERATIONS RULES

REV	ITEM						
	2-28	ASCENT IN THE EVENT OF PROCEDURAL ERRORS OR SYSTEMS PROBLEMS WHICH RESULT IN LOSS OF SOME CAPABILITY USED FOR ASCENT OR FOR RENDEZVOUS AND WHICH CAN BE CORRECTED IN ONE REV, IT IS BETTER TO DELAY ASCENT FOR ONE REV AND CORRECT THE SITUATION THAN IT IS TO LIFT OFF ON TIME.					
	2-29	RENDEZVOUS SELECTION OF THE ACTIVE VEHICLE FOR RENDEZVOUS AND DOCKING WILL BE DETERMINED BY THE FLIGHT DIRECTOR AND THE FLIGHT CREW BASED UPON CONSUMABLES AND SYSTEMS PERFORMANCE. THE TOTAL LM CAPABILITY WILL BE DEDICATED TO ACCOMPLISHING THE RENDEZVOUS.					
	2-30	TRANSEARTH COAST A. THE STEEP TARGET LINE WILL BE USED FOR MCC'S UNLESS THE VELOCITY AT ENTRY INTERFACE IS LESS THAN 30,000 FPS AND THE G&N IS GO - THEN THE SHALLOW TARGET LINE WILL BE USED. B. MCC'S MAY BE USED FOR LANDING AREA CONTROL PRIOR TO ENTRY INTERFACE MINUS 24 HOURS FOR RECOVERY ACCESS VIOLATIONS, UNACCEPTABLE WEATHER, OR LAND MASSES IN ANY PART OF THE OPERATIONAL FOOTPRINT. C. IF THE FLIGHTPATH ANGLE IS OUTSIDE THE ENTRY CORRIDOR, AN MCC WILL BE EXECUTED AS SOON AS PRACTICAL. D. MCC'S WILL BE ACCOMPLISHED BY THE SPS IF NECESSARY TO MAINTAIN RCS REDLINES.					
	2-31	ALTERNATE MISSION A. E.O. 1. CSM ONLY - APPROXIMATE 100 NM E.O. PHOTOGRAPHY, SPS INCLINATION CHANGE, SPS MNVR TO LOWER APOGEE IF REQUIRED. 2. CSM/LM - LM SYSTEMS POWER UP AND DPS MNVR TO LOWER APOGEE IF REQUIRED, APPROXIMATE 100 NM E.O. PHOTOGRAPHY MISSION, INCLINATION CHANGE. B. L.O. 1. CSM ONLY - LUNAR ORBIT PHOTOGRAPHY, FREE RETURN TRAJECTORY, LOW LUNAR ORBIT. 2. CSM/LM (NO LANDING CAPABILITY) - LM SYSTEMS POWER UP, LO PHOTOGRAPHY, PC MANEUVER, LOW LUNAR ORBIT. C. IN ANY ALTERNATE MISSION WITHIN THE CONSTRAINTS OF PROPELLANT REMAINING AND OTHER OPERATIONAL CONSIDERATIONS SUCH AS CREW SAFETY AND SYSTEMS LIFETIME, THE COMBINED LM ASC/DES STAGES WILL BE DISPOSED OF IN THE FOLLOWING ORDER OF DESCENDING PRIORITY--- 1. LUNAR IMPACT 2. OCEAN IMPACT 3. LUNAR ORBIT					
	2-32	RESERVED					
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3 MISSION RULE
SUMMARY

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MISSION RULES

SECTION 3 MISSION RULE SUMMARY

REV	ITEM						
	3-2	THE S-IVB EARLY STAGING WILL BE USED AFTER 'S-IVB TO COI' CAPABILITY FOR THE FOLLOWING --- S-II GIMBAL ACTUATOR INBOARD HARDOVER S-II ENGINE FAILURES (TIME DEPENDENT) S-IVB COLD HE SHUTOFF VALVE(S) FAILS OPEN (AFTER TWR JETT)					
	3-3	SWITCHOVER TO CSM GUIDANCE WILL BE PERFORMED FOR-- SATURN GUIDANCE REFERENCE FAILURE RULE NUMBERS 3-4 THROUGH 3-10 ARE RESERVED.					
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SECTION 3 MISSION RULE SUMMARY

REV	ITEM						
		THIS SECTION IS A SUMMARY OF THE DATA PRIORITY GUIDELINES BY MISSION PHASE, SLV RULES BY MISSION PHASE, AND SYSTEMS GO/NO-GO CRITERIA ON CHARTS BY MISSION PHASE. THE SUMMARY RULES PLUS THE CHART ARE REQUIRED TO ENCOMPASS EACH PHASE. THE CAPABILITY LISTED IN THE CHARTS ARE THE REQUIREMENTS FOR INITIATION OR CONTINUATION OF A MISSION PHASE OR EVENT. MISSION EVENTS FROM UNDOCKING TO PDI IGNITION REQUIRE THAT THE VEHICLES MEET THE LUNAR STAY WITH EVA CRITERIA AND HAVE THE CAPABILITY TO LAND, ASCEND, RENDEZVOUS, AND DOCK. ----- ' LAUNCH PHASE ' -----					
3-1		THE LAUNCH WILL BE ABORTED FOR THE FOLLOWING REASONS--- A. SLV S-II GIMBAL ACTUATOR HARDOVER INBOARD PRIOR TO S-IVB TO COI CAPABILITY VIOLATION OF AUTO/MANUAL EDS LIMITS S-II ENGINE FAILURES (TIME DEPENDENT) FAILURE OF SECOND PLANE SEPARATION S-IVB LOSS OF HYDRAULIC FLUID (PRIOR TO S-IVB IGNITION) S-IVB LOSS OF THRUST (TIME DEPENDENT) (POSSIBLE COI CAPABILITY) S-IVB LOX TANK PRESS GREATER THAN 50 PSI BEFORE TWR JETT B. CSM 1. ENVIRONMENTAL LOSS OF CABIN AND SUIT PRESSURE LOSS OF CABIN PRESSURE AND SUIT CIRCULATION FIRE/SMOKE IN CM LOSS OF CABIN PRESSURE AND O2 MANIFOLD LEAK 2. ELECTRICAL LOSS OF 3 FUEL CELLS AND 1 BATTERY UNCONTROLLABLE SHORTED MAIN BUS LOSS OF BOTH AC BUSES DURING MODE I OR MODE II 3. PROPULSION SUSTAINED LEAK OR LOSS OF HE PRESSURE (SOURCE OR MANIFOLD) IN BOTH CM-RCS RINGS (MODE I ONLY) C. VIOLATION OF TRAJECTORY LIMIT LINES D. TEAM DISCRETION WILL BE USED FOR--- 1. SUIT/CABIN CONTAMINATION 2. MEDICAL PROBLEMS					
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SECTION 3 MISSION RULE SUMMARY

REV	ITEM						
		----- EARTH ORBIT -----					
	3-11	CSM SEPARATION FROM THE S-IVB (WITHOUT LM EXTRACTION) WILL BE PERFORMED EARLY FOR THE FOLLOWING SLV CONDITIONS (CONSIDERATION WILL BE GIVEN TO EXTRACTING THE LM LATER IF THE CONDITION CAN BE CORRECTED)					
		*S-IVB RANGE SAFETY PROPELLANT DISPERSAL SYSTEM ARMS INADVERTENTLY AFTER INSERTION AND PRIOR TO SAFING					
		*S-IVB LOX TANK PRESS IS GREATER THAN 50 PSI					
		LOSS OF ATTITUDE CONTROL DURING TB5					
		*S-IVB COMMON BULKHEAD DELTA PRESSURE EXCEEDS LIMITS					
		*START BOTTLE GREATER THAN 1800 PSIA					
		*PERFORM SPS MANEUVER TO A SAFE DISTANCE					
	3-12	CSM SEPARATION FROM THE S-IVB (WITH LM EXTRACTION) WILL BE PERFORMED FOR---					
		A. S-IVB NO-GO FOR TLI					
		B. CSM NO-GO FOR TLI BUT GO FOR EARTH ORBIT MISSION					
	3-13	TLI WILL BE INHIBITED FOR---					
		INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVING A 65,000 NM APOGEE ELLIPSE					
		S-IVB ENGINE MAIN LOX VALVE FAILS TO CLOSE AT CUTOFF					
		LOSS OF ATTITUDE CONTROL					
		CONFIRMED ACTUATOR HARDOVER					
		LOSS OF ENGINE HYDRAULIC FLUID					
		MISALIGNMENT RATE BETWEEN THE IU AND IMU IS OUTSIDE LIMITS					
		UNACCEPTABLE DIFFERENCES BETWEEN CMC AND IU PLATFORM VELOCITY COMPONENTS OR TOTAL VELOCITY AT INSERTION					
		UNACCEPTABLE DIFFERENCE BETWEEN MSFN AND IU ORBITAL DECISION PARAMETERS					
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SECTION 3 MISSION RULE SUMMARY

REV	ITEM
3-14	TLI WILL BE TERMINATED FOR --- A. PITCH OR YAW BODY RATES GREATER THAN 10 DEG./SEC B. ROLL BODY RATE GREATER THAN 20 DEG/SEC C. PITCH OR YAW ATTITUDE DIVIATIONS FROM NOMINAL PROFILES EXCEED 45 DEG. D. OVERBURN OF 6 SECS AND VI (PGNS) EQUALS VI (PAD)
3-15	CSM TAKEOVER WILL BE PERFORMED FOR SATURN GUIDANCE REFERENCE FAILURE OR SATURN LOSS OF ATTITUDE CONTROL IN EARTH ORBIT OR DURING TLI. RULES 3-16 THROUGH 3-20 ARE RESERVED.

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SECTION 3 MISSION RULE SUMMARY

REV	ITEM	
		----- ' TD&E ' -----
3-21	TD&E WILL NOT BE PERFORMED FOR---	
	A. PILOTS EVALUATION OF RATES AND ATTITUDES, AND SLA CONFIGURATION NOT ACCEPTABLE.	
	B. THE SLV IS NO-GO FOR---	
	1. VIOLATION OF S-IVB BULKHEAD DELTA P LIMITS	
	2. LOX TANK PRESSURE GREATER THAN 50 PSI	
3-22	THE FOLLOWING ACTIONS WILL BE TAKEN FOR LOSS OF SATURN ATTITUDE CONTROL CAPABILITY---	
	A. TLI CUTOFF TO S/C SEPARATION FROM BOOSTER	'BSE ACTION '1. RECOMMEND SPACECRAFT GUIDANCE TAKE OVER '2. IF SPACECRAFT SEPARATION OCCURS BEFORE 15 MINUTES, COMMAND TD&E MANEUVER INHIBIT. '3. DO NOT COMMAND YAW MANEUVER OR EVASIVE BURN INHIBIT (TB8 INITIATE). '4. COMMAND NON-PROPULSIVE S-IVB SAFEING. 'CREW ACTION 'TAKEOVER CONTROL OF SATURN. '1. IF SUCCESSFUL, MANEUVER TO SEPARATION ATTITUDE AND SEPARATE. CREW DISCRETION FOR DOCKING AND LM EXTRACTION. EVASIVE MANEUVER WILL BE ACCOMPLISHED BY S/C. '2. IF UNSUCCESSFUL - SEPARATE FROM BOOSTER IMMEDIATELY. CREW DISCRETION FOR DOCKING AND LM EJECTION. EVASIVE MANEUVER WILL BE ACCOMPLISHED BY S/C.
	B. S/C SEPARATION TO EVASIVE BURN INITIATE (TB8 INITIATE).	'BSE ACTION '1. IF BEFORE YAW MANEUVER, DO NOT COMMAND YAW MANEUVER '2. DO NOT COMMAND EVASIVE BURN (TB8 INITIATE). '3. COMMAND NON-PROPULSIVE S-IVB SAFEING. 'CREW ACTION '1. CREW DISCRETION FOR DOCKING AND LM EJECTION. '2. EVASIVE MANEUVER WILL BE ACCOMPLISHED BY S/C.
	C. AFTER EVASIVE BURN INITIATE (TB8 INITIATE).	'BSE ACTION '1. TERMINATE ALL PROPULSIVE S-IVB FUNCTIONS INCLUDING LOX DUMP, ULLAGE ENGINE BURNS, AND LH2 CONTINUOUS VENT. ONBOARD PROGRAM WILL ACCOMPLISH NON-PROPULSIVE SAFEING. 'CREW ACTION 'NONE
	RULE NUMBERS 3-23 THROUGH 3-29 ARE RESERVED.	

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SECTION 3 MISSION RULE SUMMARY

REV	ITEM						
		TRANSLUNAR COAST					
	3-30	DURING THE LOI BURN, THE FLIGHT CREW WILL TAKE THE FOLLOWING ACTION---					
		LOI ABORT MODES					
		MODE	TIME	DELTA VM	TYPE ABORT		
		I	0-1+45	0-750	DPS 2-HR DIRECT ABORT DPS 2-IMPULSE CIRCUMLUNAR ABORT EXECUTE TEI (SPS OR DPS) AT NEXT OPPORTUNITY OR ALTERNATE MISSION		
		II	1+45-2+50	750-1245			
		III	2+50-5+57	1245-2815			
		A. ALL ABORT MANEUVERS ARE MCC TARGETED.					
		B. CONTROL LIMITS APPLY AS FOLLOWS---					
		LOI DELTA T	LOI DELTA V	LIMITS			
		0-1+45	0-750	TIGHT			
		1+45-3+50	750-1700	LOOSE			
		3+50-C/O	1700-2815	TIGHT			
		NOTE					
		WHEN APPLYING THE TIGHT LIMITS IF ANY BALL VALVE FAILS TO OPERATE OR CLOSES PREMATURELY, SHUTDOWN GOOD BANK AND---					
		A. IF THRUSTING CEASES-ABORT.					
		B. IF THRUSTING CONTINUES-REENABLE BOTH BANKS AND CONTINUE LOI.					
		RULES 3-31 THROUGH 3-37 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	B	4/9/70	MISSION RULE SUMMARY	TRANSLUNAR COAST	3-6

SECTION 3 MISSION RULE SUMMARY

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SECTION 3 MISSION RULE SUMMARY

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REV	ITEM						
		F. COMMANDED THRUST INCREASING PRIOR TO THROTTLE DOWN OR P63 TGO=80 SEC. G. NO LANDING SITE VISIBILITY BY P64 PLUS 60 SEC. H. NO THROTTLE RECOVERY BY P63/P64 PROGRAM SWITCH PLUS 15 SEC. I. FAILURE TO ACHIEVE FTP BY NOMINAL TIG +31 SEC. (ABORT AT GTC DIVERGENCE). J. FAILURE TO ENTER P64 WHEN TGO EQUALS 60 SECONDS. K. THE FOLLOWING PNGS ALARMS---20105,00214, 20430,20607,21103,01107, 21204,21302,21501,00402 (CONTINUING). NOTE---THE CREW WILL BE ADVISED AND CONSIDERATION WILL BE GIVEN TO TERMINATION OF POWERED DESCENT IF THE TIME BIASED DPS ABORT BOUNDARY IS VIOLATED.					
3-51	LO GATE TO TD	AN ABORT WILL NOT BE PERFORMED FOR A PNGS FAILURE AFTER A PNGS INDICATION THAT THE HIGH GATE TARGETING CONDITIONS HAVE BEEN ACHIEVED.					
		RULE NUMBERS 3-52 AND 3-53 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	A	3/23/70	MISSION RULE SUMMARY	POWERED DESCEN	3-9

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SECTION 3 MISSION RULE SUMMARY

REV	ITEM															
		----- ' EVA PHASE ' -----														
	3-54	GENERAL FOR ANY MALFUNCTION ON A SCIENTIFIC TASK, A MAXIMUM OF 10 MINUTES WILL BE SPENT ON THE CONTINGENCY PROCEDURE BEFORE THE TASK IS ABANDONED WITH THE FOLLOWING EXCEPTIONS--- A. RTG FUELING-- UP TO 20 MUNUTES WILL BE ALLOWED IN EXERCISING RTG FUELING CONTINGENCY PROCEDURES. B. ALSEP PACKAGE 1 TO PACKAGE 2 CABLE CONNECTION-- UP TO 20 MINUTES WILL BE ALLOWED FOR MAKING THE CABLE CONNECTION. C. ALSEP ANTENNA-- UP TO 30 MINUTES WILL BE ALLOWED FOR ANTENNA ERECTION AND ALIGNMENT. BEFORE ABANDONMENT OF ALSEP EXPERIMENT LEVELING TASKS, AN ESTIMATE OF THE OUT OF TOLERANCE CONDITION WILL BE RECORDED.														
	3-55	ALSEP ALSEP DELPOYMENT SITE SELECTION--- THE ALSEP SHOULD BE DEPLOYED IN A LEVEL AREA AT LEAST 300 FEET WEST OF THE LM, OUT OF THE LM SHADOW AND IN THE LARGEST OPEN AREA AVAILABLE. THE FOLLOWING ARE ALTERNATE DIRECTIONS FOR SITE SELECTIONS IN ORDER OF PRIORITY--- A. EAST B. SOUTH C. NORTH														
	3-56	FOR EVA TERMINATION OR OTHER INTERRUPTIONS DURING ALSEP DEPLOYMENT, THE FOLLOWING PREFERRED DEPLOYMENT INTERRUPTION POINTS WILL BE OBSERVED IF PERMITTED BY CREW SAFETY CONSIDERATIONS--- A. ANY POINT PRIOR TO DEFUELING THE FUEL CASK. B. AFTER FUELING THE RTG, THE ALSEP SHOULD BE CARRIED TO THE DEPLOYMENT SITE, PACKAGE NO. 1 SHOULD BE EMPLACED, THE SUBPA-LET SHOULD BE REMOVED FROM PACKAGE NO. 2, AND THE RTG CABLE SHOULD BE INTERCONNECTED. C. DEPLOYMENT MAY BE INTERRUPTED ANY POINT THEREAFTER.														
	3-57	IF ALSEP DEPLOYMENT IS NOT COMPLETED DURING EVA-1 AND THE TASK IS NOT ABANDONED, THE DEPLOYMENT WILL BE COMPLETED DURING EVA-2.														
<table><tr><td>MISSION</td><td>REV</td><td>DATE</td><td>SECTION</td><td>GROUP</td><td>PAGE</td><td></td></tr><tr><td>APOLLO 13</td><td>A</td><td>3/23/70</td><td>MISSION RULE SUMMARY</td><td>EVA PHASE</td><td>3-10</td><td></td></tr></table>			MISSION	REV	DATE	SECTION	GROUP	PAGE		APOLLO 13	A	3/23/70	MISSION RULE SUMMARY	EVA PHASE	3-10	
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REV	ITEM																																														
	3-58	THE DRILL CORE STEM WILL HAVE PRIORITY OVER THE HFE BORE HOLES. THE BORE HOLES WILL BE ATTEMPTED FIRST AND EFFORTS WILL BE TERMINATED SHOULD PROBLEMS ARISE. THE BORE HOLES MAY BE RESUMED AFTER THE CORE STEM HOLE HAS BEEN COMPLETED ALTHOUGH THIS IS A NON-STANDARD OPERATION WITH LIMITED CHANCE OF SUCCESS.																																													
	3-59	THE ALSEP WILL NOT BE ACTIVATED (RTG SHORTING SWITCH ACTUATION, ASTRONAUT SWITCH NO. 1 ACTUATION, AND TRANSMITTER "ON") UNTIL THE CENTRAL STATION AND EXPERIMENTS HAVE BEEN DEPLOYED, OR ATTEMPTS TO DEPLOY AN EXPERIMENT HAVE BEEN ABANDONED WITH THE FOLLOWING EXCEPTION--- DEPLOYMENT OF THE HEAT FLOW EXPERIMENT PROBES WILL NOT BE A CONSTRAINT TO TURN ON THE ALSEP CENTRAL STATION AND OTHER EXPERIMENTS.																																													
	3-60	IF A HARD OBJECT IS ENCOUNTERED WHICH REDUCES DRILL RATE TO LESS THAN 1 SECTION IN 5 MINUTES ON THE FIRST HFE PROBE HOLE OR 1 SECTION IN 10 MINUTES ON THE SECOND HOLE, THE FOLLOWING WILL BE ACCOMPLISHED--- A. IF THE THIRD STEM SECTION IS NOT ATTACHED, WITHDRAW AND START AT DIFFERENT LOCATION. B. IF THIRD STEM IS ATTACHED, CONTINUE FOR 5 MINUTES IF ON FIRST HOLE OR AS LONG AS POSSIBLE ON SECOND HOLE, BUT NOT SO LONG AS TO PRECLUDE ATTEMPTING TO OBTAIN A CORE SAMPLE.																																													
	3-61	TRAVERSE SCIENCE A TOTAL OF 270 PAYLOAD POUNDS IS CONSIDERED AVAILABLE FOR RETURN OF SCIENTIFIC SAMPLES AND CONTAINERS.																																													
	3-62	THE RELATIVE PRIORITIES OF RETURNABLE SCIENTIFIC SAMPLES AND THEIR PRIMARY AND SECONDARY PACKING LOCATIONS ARE AS FOLLOWS--- <table> <tr> <th>SAMPLE</th><th>PRIMARY</th><th>SECONDARY</th></tr> <tr> <td>CONTINGENCY SAMPLE</td><td>ETB-1</td><td>CREW POCKET</td></tr> <tr> <td>DRILL STEM SAMPLE</td><td>SRC-1</td><td>TOTE BAG 1</td></tr> <tr> <td>SELECTED SAMPLES (EVA-1)</td><td>SRC-1</td><td>TOTE BAG 1</td></tr> <tr> <td>DRIVE CORE TUBES (3)</td><td>SRC-2</td><td>TOTE BAG 2</td></tr> <tr> <td>LUNAR ENVIRONMENT SAMPLE</td><td>SRC-2</td><td>TOTE BAG 2</td></tr> <tr> <td>DOCUMENTED SAMPLES (2 WEIGH BAGS)</td><td>SRC-2</td><td>TOTE BAG 2</td></tr> <tr> <td>GAS ANALYSIS SAMPLE</td><td>SRC-2</td><td>ETB-2</td></tr> <tr> <td>MAGNETIC SHIELD SAMPLE</td><td>ETB-2</td><td>X</td></tr> <tr> <td>SINGLE LARGE ROCK</td><td>TOTE BAG 2</td><td>ETB-2</td></tr> <tr> <td>SOIL SAMPLE (15 LBS)</td><td>TOTE BAG 2</td><td>ETB-2</td></tr> <tr> <td>FUEL CONTAMINATION SAMPLE</td><td>ETB-2</td><td>X</td></tr> <tr> <td>SIEVE SAMPLE (IN WEIGH BAG)</td><td>ETB-2</td><td>X</td></tr> <tr> <td>SOLAR WIND COMPOSITION FOIL</td><td>ETB-2</td><td>X</td></tr> <tr> <td>ADDITIONAL 15 POUND SOIL SAMPLE</td><td>ETB-2</td><td>X</td></tr> </table>	SAMPLE	PRIMARY	SECONDARY	CONTINGENCY SAMPLE	ETB-1	CREW POCKET	DRILL STEM SAMPLE	SRC-1	TOTE BAG 1	SELECTED SAMPLES (EVA-1)	SRC-1	TOTE BAG 1	DRIVE CORE TUBES (3)	SRC-2	TOTE BAG 2	LUNAR ENVIRONMENT SAMPLE	SRC-2	TOTE BAG 2	DOCUMENTED SAMPLES (2 WEIGH BAGS)	SRC-2	TOTE BAG 2	GAS ANALYSIS SAMPLE	SRC-2	ETB-2	MAGNETIC SHIELD SAMPLE	ETB-2	X	SINGLE LARGE ROCK	TOTE BAG 2	ETB-2	SOIL SAMPLE (15 LBS)	TOTE BAG 2	ETB-2	FUEL CONTAMINATION SAMPLE	ETB-2	X	SIEVE SAMPLE (IN WEIGH BAG)	ETB-2	X	SOLAR WIND COMPOSITION FOIL	ETB-2	X	ADDITIONAL 15 POUND SOIL SAMPLE	ETB-2	X
SAMPLE	PRIMARY	SECONDARY																																													
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MISSION RULES

SECTION 3 MISSION RULE SUMMARY

REV	ITEM	
3-63	FOR THE LUNAR SURFACE CLOSE-UP PHOTOGRAPHY EXPERIMENT, THE FOLLOWING SPECIFIC TYPES OF FEATURES ARE OF INTEREST---	
	GLASSY FEATURES	
	ROCK-SOIL JUNCTION (UPHILL AND DOWNHILL)	
	UNDISTURBED SURFACE (LEVEL AND SLOPING)	
	SURFACE PATTERNS	
	ROCK SURFACE	
	SMALL CRATERS	
	HOWEVER, NO FORMAL EFFORT WILL BE MADE TO VERIFY COVERAGE OF EACH OF THE ABOVE TYPES OF FEATURES BEFORE ABANDONMENT OF THE LUNAR SURFACE CLOSE-UP CAMERA.	
3-64	CAMERA FRAME COUNTS WILL BE OBTAINED AT A SUFFICIENT FREQUENCY (APPROXIMATELY 30-MINUTE INTERVALS) TO ENABLE ACCURATE CORRELATION OF SAMPLES AND PHOTOS FOR SAMPLE ORIENTATION.	
3-65	LUNAR SURFACE OPERATIONS	
	IN ESTABLISHING THE OPERATIONAL EVA PLAN, THE TRAVERSE PLANS PREPARED BEFORE LAUNCH WILL BE USED AS BASELINES AND MODIFIED AS NECESSARY TO ACCOMMODATE THE ACTUAL LANDING POINT, RADIUS OF OPERATIONS AND TIMELINE CONSTRAINTS, AND SPECIFICALLY INTERESTING FEATURES VISABLE TO THE CREW.	
3-66	THE OPERATIONAL EVA PLAN WILL BE CONSTRAINED TO A MAXIMUM DURATION OF 4 HOURS AND AN OPERATIONAL RADIUS OF 1.75 KM. EXTENSIONS, DETERMINED DURING THE EVA BASED ON CONSUMABLES USAGE RATES AND CREW COMFORT, TO A MAXIMUM OF APPROXIMATELY 5 HOURS MAY BE IMPLEMENTED. PROBABLE EXTENSION POINTS WILL BE AFTER ALSEP DEPLOYMENT (FOR EVA 1) AND AT GEOLOGIC SITES FARTHEST FROM THE LM (EVA 2).	
3-67	THE CREW WILL HAVE PRIME RESPONSIBILITY FOR---	
	A. SELECTION OF SAMPLES TO BE COLLECTED.	
	B. DECISIONS TO DEPART FROM THE OPERATIONAL EVA PLAN TO INVESTIGATE UNEXPECTED OR UNUSUAL FEATURES.	
	C. ON THE SPOT DETERMINATION OF BEST TRAVERSE PATH TO PROVIDE MOBILITY EASE.	
	D. ON THE SPOT DETERMINATION OF ACCESSIBILITY OF FEATURES OF INTEREST.	
	E. SELECTION OF A SUITABLE LOCATION FOR PERFORMING EVA COMMUNICATIONS TEST.	
		MISSION
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SECTION 3 MISSION RULE SUMMARY

REV	ITEM						
		----- ' ASCENT ' -----					
	3-80	ASCENT A. GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR --- 1. THE FOLLOWING PGNS ALARMS---20105,00214, 20430,20607, 21103,01107, 21204,21302, AND 21501. 2. PGNS NAVIGATION ERRORS, DURING ASCENT OR FOLLOWING DESCENT ABORT, THAT RESULT IN ANY OF THE FOLLOWING CONDITIONS--- (A) AGS PREDICTED HP AT INSERTION LESS THAN 40,000 FT (B) AGS PREDICTED HA AT INSERTION GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES. (C) AGS PREDICTED INSERTION WEDGE ANGLES GREATER THAN 1.0 DEG. 3. CONFIRMED PGNS NAVIGATION ERRORS THAT RESULT IN THE FOLLOWING MSFN PGNS VELOCITY DIFFERENCES DELTA VX GREATER THAN +/- 24 FPS DELTA VY GREATER THAN +/- 90 FPS DELTA VZ GREATER THAN +/- 37 FPS B. THE GROUND WILL NOT REQUEST SWITCHOVER AFTER AGS TGO LESS THAN 30 SECONDS. C. DURING ASCENT, THE AGS WILL BE DECLARED NO-GO IF CONFIRMED AGS NAVIGATION ERRORS RESULT IN--- 1. PGNS PREDICTED INSERTION HP LESS THAN 30,000 FT. 2. PGNS PREDICTED INSERTION HA GREATER THAN TARGET VALUE PLUS 40 NM. 3. PGNS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEGREE. RULE NUMBERS 3-81 THROUGH 3-83 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

REV	ITEM
3-84	THE FOLLOWING GUIDELINES WILL APPLY TO LM MANEUVERS--- 1. TRIMMING. A. DESCENT ABORTS/ASCENT - REAL TIME CALLOUT. B. ALL RENDEZVOUS MANEUVERS WILL BE NULLED. C. DOCKED DPS MANEUVERS WILL NOT BE TRIMMED. 2. ALTERNATE MISSION DOCKED DPS MANEUVERS WILL BE COMPLETED VIA AGS TAKEOVER FOR VIOLATION OF THE FOLLOWING LIMITS--- A. ATTITUDE RATES - 10 DEG./SEC. B. ATTITUDE ERRORS - 10 DEG. C. ATTITUDE EXCURSIONS - 10 DEG. 3. ALTERNATE MISSION DOCKED DPS MANEUVERS WILL BE TERMINATED AFTER VIOLATION OF THESE OVERBURN CRITERIA--- A. DPS LOI - 10 SEC AND DELTA V AGS GREATER THAN 10 FPS. B. DPS TEI - 10 SEC AND DELTA V AGS GREATER THAN 2 FPS. C. DPS LOI ABORTS - 10 SEC AND DELTA V AGS GREATER THAN 2 FPS. NOTE--- A CMC DELTA V OF 2 FPS (OVERSPEED) AND 10 SEC OVERBURN IS ALSO A VALID CUE FOR SHUTDOWN.
3-85	THE FOLLOWING TABLE, INCLUDING NOTES AND REFERENCES, SUMMARIZES THE TAKEOVER, RESTART, SHUTDOWN, TRIMMING REQUIREMENTS, AND SPS ENGINE LIMITS FOR ALL SPS MANEUVERS. RULE NUMBERS 3-86 THROUGH 3-89 ARE RESERVED.

SECTION 3 MISSION RULE SUMMARY

[illegible]

SATURN LAUNCH VEHICLE GO/NO-GO CRITERIA

REV B
4/9/70

GO/NO-GO ITEM CONDITION	LAUNCH		EARTH PARKING ORBIT		
	ABORT/SEPARATION	S-II/S-IVB EARLY STAGE	GUIDANCE TAKEOVER	RESTART/TLI INHIBIT	RESTART/TLI TERMINATE
<u>S-IC</u> LOSS OF THRUST (2 OR MORE ENG)	PRIOR TO TBI + 2:00 - ABORT	NO			
<u>IV</u> LOSS OF ATTITUDE CONTROL INERTIAL ATTITUDE REFERENCE FAIL	ABORT (LAUNCH)	NO	ATTEMPT S/C CONTROL TB5 AND TB7 TO TB7 + 15 MIN LAUNCH, EP0 TLI	DURING TB6 TO TB6 + 9 MIN 20 SEC	TLI TERM DURING BURN CREW OPTION AFTER TB7 + 15
<u>S-II</u> LOSS OF THRUST (2 ENG), LOSS OF THRUST (3 OR MORE ENG) ABORT IF PRIOR TO S-IVB TO COI	ABORT	FROM S-IVB TO COI TILL TB3 + 4 MIN 40 SEC AFTER S-IVB TO COI			
ACTUATOR HARDOVER INBOARD	PRIOR TO S-IVB TO COI - ABORT	AFTER S-IVB TO COI AND BEFORE S-II C/O MINUS 30 SEC			
2ND PLANE SEPARATION FAIL	BEFORE TB3 + 66 SEC - ABORT				
<u>S-IVB</u> LOSS OF THRUST	PRIOR TO EP0 - SEPARATE				
LOSS OF HYDRAULIC FLUID PRIOR TO START	INHIBIT START			INHIBIT TLI DURING TB5 AND TB6	
COLD HE FAIL OPEN	SEP FOR LOX PRESS OF 50 PSIA				
INSUFFICIENT PROPELLANT				INHIBIT RESTART	
LOX VLV FAILS TO CLOSE AT 1ST C/O				INHIBIT RESTART	
DESTRUCT SYSTEM ARMS INADVERTANTLY	SEP TO 7000 FT MINIMUM				
FU/OX BULKHEAD ΔP EXCEEDS LIMITS	-26 OR + 36 PSID (ANY TIME)	SEP TO 7000 FT MINIMUM		-26 OR + 36 PSID (ANY TIME)	SEP TO 7000 FT MINIMUM
START BOTTLE PRESS OUTSIDE RESTART LIMITS	SEP > 1800 PSIA			SEP > 1800 PSIA	
LOX CHILLDOWN FAIL				FOR LOX LEAD > 20 SEC - INHIBIT	
S-IVB ACTUATOR HARDOVER	NO START			BEFORE TB6 + 9M 10S (AUX PUMP OP)	

LEGEND:

NO REQUIREMENT

	EARTH ORBIT			TLC		UNDOCK AND SEP	CIRC	POWERED DESCENT		LUNAR STAY		LUNAR ORBIT (POST RNDZ)
	CONT BOOST	CONT E.O.	TLI	TD & E	CONT TLC	CONF L.O./DOI		PDI	PDI TO T/D	PAST T ₁	PAST T ₃ & SUBS	
ECS												
CABIN INTEGRITY	7	CABIN INTEGRITY	→			CABIN INTEGRITY		2				CABIN INTEGRITY
NO FIRE OR SMOKE IN CABIN	→	NO F OR S IN CABIN	→			NO FIRE OR SMOKE IN CABIN		2				NO F OR S IN CABIN
NO O ₂ MANIFOLD LEAKS	7	NO O ₂ LEAKS	→			NO O ₂ MANIFOLD LEAKS						NO O ₂ MANIFOLD LEAKS
MAIN O ₂ REGULATORS	7	1 OF 2	BOTH 3			1 OF 2						1 OF 2
ECS COOLANT LOOPS		1 OF 2 5	BOTH			BOTH		2				1 OF 2 5
ECS RADIATORS		1 OF 2 5	BOTH			BOTH		1				1 OF 2 5
ECS GLYCOL EVAPS												
SUIT INTEGRITY	SI 7											
NO GLYCOL LEAK		→	NO LEAK	→		NO GLYCOL LEAK						NO GLYCOL LEAK
NO EXCESS CAB HUMIDITY		→	NO HUMID	→		NO EXCESSIVE CABIN HUMIDITY		2				NO HUMID
POTABLE H ₂ O TANK		POT										POT
WASTE H ₂ O TANK												
SUIT COMPRESSORS	7	1 OF 2	BOTH			1 OF 2		2				1 OF 2
SUIT CIRCUIT	7	SUIT CIRCUIT	→			SUIT CIRCUIT		2				SUIT CIRCUIT
OVBD DUMPS		→	1 OF 3			1 OF 3						1 OF 3
CRYO												
O ₂ TANKS		1 OF 2	BOTH			BOTH				1 OF 2		BOTH
H ₂ TANKS		1 OF 2	BOTH			BOTH				1 OF 2		BOTH
EPS												
FUEL CELLS	2 0	2 OF 3	ALL			6 6		6		1 OF 3		ALL 6
ENTRY BATTERIES	1 3	2 OF 3	ALL			6 6		6				ALL 6
MAIN BUSES	1 OF 2	→	BOTH			BOTH		2				BOTH
BATTERY BUSES	1 OF 2	→	BOTH			BOTH		2				BOTH
AC BUSES	1 OF 2 6	→	BOTH			BOTH		2				BOTH
BAT RELAY BUSES		BAT RELAY BUS	→			BAT RELAY BUS						BAT RELAY BUS
INVERTERS	1 OF 3 6	→	2 OF 3			2 OF 3		2				2 OF 3
AC 4A (1 AND 2)	1 OF 2	→	BOTH			BOTH		2				BOTH
DOCKING												
DOCKING LATCHES												
GN ₂ BOTTLES						9 OF 12						
SEQ												
SMJC NOT ACTIVATED		SWJC NOT ACT 4	→			SWJC NOT ACT 4						
SEQUENTIAL SYSTEMS		→	BOTH			2 OF 4 8						

1 BASED ON AMOUNT OF WATER AVAILABLE, CONSIDERATION WILL BE GIVEN TO CONTINUING THE MISSION WITH SECONDARY RADIATORS AND PRIMARY EVAPORATORS

2 LM DESCENT STAGE WILL BE RETAINED FOR TEI IF CONDITION NOT MET

3 IF ONE MAIN REG HAS FAILED OPEN AND THE OTHER IS FUNCTIONING NORMALLY, TLI WILL BE PERFORMED

4 NO REQUIREMENT IF SOURCE OF ACTIVATION CAN BE ISOLATED

5 MUST HAVE EITHER PRIMARY OR SECONDARY SYSTEM COMPOSED OF FUNCTIONING LOOP AND CORRESPONDING RADIATORS

6 BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO CONTINUING

7 MUST HAVE CABIN INTEGRITY OR VIABLE SUIT LOOP. ITEMS MARKED BY * ARE REQUIRED TO MAINTAIN VIABLE SUIT LOOP

8 BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO UNDOCKING WITH ONE GN₂ BOTTLE REMAINING IN AN OPERABLE SYSTEM

9 MODE I AND II ONLY; 0 THEREAFTER

LEGEND: XXXX NO REQUIREMENTS

GO/NO-GO ITEM	EARTH ORBIT		TLC		LUNAR ORBIT (BEFORE UNDOCKING)		UNDOCK	CIRC	POWERED DESCENT		LUNAR STAY		LUNAR ORBIT (P RNDZ) CONT L, O,
	CONT BOOST	CONT EO	TLI	TD&E	CONT TLC	NFR LOI	CONT LOI	CONT L.O./DOI	PDI	PDI TO TD	PAST T1	PAST T3 & SUBS	
GNC/SCS													
DEORBIT CAPABILITY		SPS/BU METHOD											
AUTO ATTITUDE CONTROL				3-AXIS									
RATE DAMPING				3-AXIS									
DIRECT RCS				3-AXIS									
BMAGS P,Y													
BMAGS R													
FDAL													
THC													
RHC													
EMS													
CMC													
ISS													
OSS													
OPTICS DAC													
NO SOLENOID DR GND													
TVC SERVO LOOP													
DSKY													
SPS													
FU/OX TANK (W/O LEAK)													
GN2 TANK (W/O LEAK)													
BALL VALVE BANK													
FEEDLINE TEMP > 40° F													
FU/OX DP < 20 PSI													
FLANGE TEMP < 480° F													
Pe > 70 PSI													
ULLAGE CAPABILITY													
HE TANK (W/O LEAK)													
SM RCS													
HE TANK (W/O LEAK)													
NO LEAK BELOW ISO VLV													
PKG TEMP > 55°													
THRUSTERS													
CM RCS													
HE TANK (W/O LEAK)													
MANIFOLD (W/O LEAK)													
NOT ARMED													

① REQUIRES 3-AXIS ATTITUDE CONTROL AND
TRANSLATION 3-AXIS ONE LATERAL AXIS
MAY BE DEGRADED

LEGEND: NO REQUIREMENT

ITEM	UNDOCKING	CIRC	PDI	PDI TO PDI 45+30	PDI 45+30 HI GATE	HI GATE LO GATE	LO GATE TO TD	STAY W/O EVA	2 MAN EVA	1 MAN EVA	LM ACT RNDZ CSI/CDH TPI/TPF	DOCKING
GNC												
1. GUID STEER												
2. 3-AXIS ATT CONT												
PGNS												
AGS												
PGNS RATE CMD OR PGNS AUTO												
AGS RATE CMD ①												
3. 3-AXIS TRANS												
4. FDAL-ATT/RATES/ERR												
5. T/D 40 SEC OF 57% GTC												
6. VHF RING/CSM OPTICS												
7. RR												
8. AOT												
9. LR												
10. DPS AUTO ON												
11. REDNT APS ON ⑤												
12. P&R GDA TRIM												
13. MAN THTL (1 TTAG)												
14. AUTO THTL												
DPS												
1. FU OR OX INLET/ ULLAGE PRESS PSI												
2. AP OX AND FU												
3. PROP TEMP > 50° < 90°												
4. PROP AT < 10° F												
5. PROP QTY > LOW LEVEL/2%												
6. FTP BLOWDOWN CAPABILITY												
7. FU/OX PGGS ΔQ < 13%												
8. 30% EROSION EXCEEDED												
9. NO VENT OX ③												
APS												
1. NO PROP/HE LEAKS												
2. FU/OX INLET PRESS > 62 & < 220												
3. FU/OX AP (EITHER HIGH) < 90												
4. PROP TEMP > 50° & < 90°												
5. PROP AT < 10° F												
RCS												
1. RCS LEAKS												
2. FU/OX MANIF PRESS > 100												
3. PROP TEMP > 40° F < 100° F												
4. 3-AXIS ATT CONTROL												
5. 3-AXIS TRANSLATION												
6. NO IMPINGEMENT LIMITS EXCEEDED												
7. NO PAIR ISOLATED												

- ① AGS RATE CMD MAY CONSIST OF 2 AXIS RATE CMD AND ONE DIRECT, I.E. ONE RATE GYRO FAILED
 ② FOR SINGLE CONTROL MODE LANDING IS CREW OPTION
 ③ < 150 LB CASE WILL BE EVALUATED PRIOR TO T3
 ④ MSFN WILL EVALUATE CAPABILITY TO LAND WITH RESPECT TO PROPELLANT REMAINING
 ⑤ MANUAL IS MANDATORY PLUS EITHER PGNS AUTO OR AGS AUTO

LEGEND:

NO REQUIREMENT

COMMUNICATIONS/INSTRUMENTATION GO CRITERIA

REV A
3/23/70

GO/NO-GO ITEM	EARTH ORBIT		TLC			LUNAR ORBIT (BEFORE UNDOCKING)		UNDOCKING	CIRC	POWERED DESCENT			LUNAR STAY			RENDEZVOUS LM/ACTIVE	LUNAR ORBIT POST RECD
	CONT BOOST	CONT E.O.	TLI	TD&E	CONT TLC	LOI	CONT LOI			PDI	PDI TO PDI +5	PDI+5 TO LO GATE	LO GATE TO T/D	STAY W/O EVA	2-MAN EVA	1-MAN EVA	
USB 2-WAY VOICE COMM		①	CSM			CSM	CONT L.O./DOI ⑤	NOMINAL MISSION	CSM	CSM AND LM	②-②	LM-②		CSM ③ & LM ③	CSM ③ & LM ③	1-MAN EVA	CSM
VHF COMM LM/CSM								SIMPLEX OR DUPLEX									
VHF COMM LM/EVA																	
VHF COMM EVA/EVA																	
MSFN/EVA VOICE																	
CRITICAL INSTRUMENTATION			CSM			CSM			CSM	LM & CSM	LM	LM		LM AND CSM			CSM
LM TELEMETRY										LBR OR HBR	④-④	④-④		LBR OR HBR			
CSM TELEMETRY			HBR OR LBR			HBR OR LBR				HBR OR LBR				HBR OR LBR			HBR OR LBR
CSM SCE			SCE			SCE											

① VHF IS ACCEPTABLE
② CSM RELAY TO LM IS ACCEPTABLE
③ LM RELAY TO CSM IS ACCEPTABLE
④ ADEQUATE DATA TO MAKE FINAL GO/NO GO
TO CONTINUE POWERED DESCENT
⑤ CSM COMM IS REQUIRED FOR DOI

LEGEND: NO REQUIREMENT

EMU GO CRITERIA

REV A
3/23/70

GO/NO-GO ITEM	UNDOCKING	CIRC	POWERED DESCENT				LUNAR STAY (2)		
			PDI	PDI TO PDI+5 +30	PDI+5 +30 TO LO GATE	LO GATE TO T/D	STAY W/O EVA	2-MAN EVA	1-MAN EVA
CRITICAL INSTRUMENTATION								← EMU →	
LCG/LTL COOLING								2 OF 2	1 OF 2
PRIMARY O ₂ SUPPLY(S)	1							2 OF 2	1 OF 2
PLSS O ₂ PRESSURE REG(S)								2 OF 2	1 OF 2
PLSS FANK(S)								2 OF 2	1 OF 2
PLSS BATTERY(S)								2 OF 2	1 OF 2
EMU PRESSURE INTEGRITY								2 OF 2	1 OF 2
OPS O ₂ BOTTLE(S)	1							2 OF 2	1 OF 2
OPS PRESSURE REG(S)								2 OF 2	1 OF 2

- (1) NOMINALLY BOTH OPS'S SOURCE PRESSURES WILL BE CHECKED OUT PRIOR TO UNDOCKING - SHOULD ONE OPS SOURCE PRESSURE FAIL TO MEET THE OPS GO/NO-GO CRITERIA AS DEFINED IN RULE 3-103, A CHECK OF POS PRESSURE WILL BE MADE ON A PLSS TO FULFILL THE RQMT FOR TWO LIFE-SUPPORT UNITS
- (2) SUFFICIENT PLSS AND/OR OPS CONSUMABLES WILL BE RETAINED AT LM LIFTOFF TO SUPPORT A 30 MINUTE CEVA

LEGEND:

NO REQUIREMENT

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MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED

REV	ITEM	
		----- CONSUMABLES -----
3-90	SPS	A. AFTER TD&E AND THE FIRST DOCKED SPS MCC, THE DELTA V REQUIRED TO CONTINUE WITH A LUNAR MISSION IS 5500 FPS (CSM UNDOCKED CAPABILITY). B. THE DELTA V REQUIRED FOR LOI GO IS LOI (FUNCTION OF LAUNCH DAY AND LAUNCH AZ) +2960 FPS (TEI AND TEC MCC'S). C. THE DELTA V REQUIRED FOR GO FOR UNDOCKING IS 3825 FPS. THIS DELTA V INCLUDES--- 700 FPS, LM RESCUE 75 FPS, CIRC 90 FPS, LOPCI 2800 FPS, TEI (APPROXIMATELY 79 HR RETURN) 160 FPS, 3 SIGMA MCC BASED ON SCS CONTROLLED TEI ----- 3825 FPS
3-91	SM RCS	A. THE CSM RESCUE REDLINE INCLUDES--- (1) NOMINAL USAGE FROM LAUNCH TO CSM CIRCULARIZATION BURN. (2) ATTITUDE HOLD FROM CIRCULARIZATION BURN TO LM LIFTOFF (INCLUDED IN THIS PERIOD IS LOPC 1 ULLAGE AND DAMPING). (3) RESCUE ALLOWANCE INCLUDING NOMINAL RENDEZVOUS BUDGET, THREE 10-SECOND 4-JET ULLAGES, AND CSM ACTIVE BRAKING. (4) TWO REVS ATTITUDE HOLD PLUS TEI (ULLAGE AND DAMPING). (5) 7 FPS MCC (1 SIGMA G6N TEI CUTOFF). (6) PTC ALLOWANCE. (7) NOMINAL USAGE FROM MCC 7 TO CM/SM SEP. THE REDLINE DOES NOT INCLUDE CSM SOLO EXPERIMENTS, BOOTSTRAP PHOTOGRAPHY, OR P23'S IN TEC. THE CSM RESCUE REDLINE AT EARTH LAUNCH IS 930 LB. B. VIOLATION OF THE LUNAR ORBIT REDLINE WILL RESULT IN TERMINATION OF LUNAR ORBIT ACTIVITIES. THE LO REDLINE INCLUDES--- 222 LB 2 REVS LO, TEI ULLAGE AND DAMPING, NOMINAL TEC BUDGET 57 LB 20 FPS MCC (3 SIGMA G6N TEI CUTOFF) RULE NUMBERS 3-92 AND 3-93 ARE RESERVED.
	MISSION	REV
	APOLLO 13	A
	DATE	3/23/70
	SECTION	MISSION RULE SUMMARY
	GROUP	CONSUMABLES
	PAGE	3-24

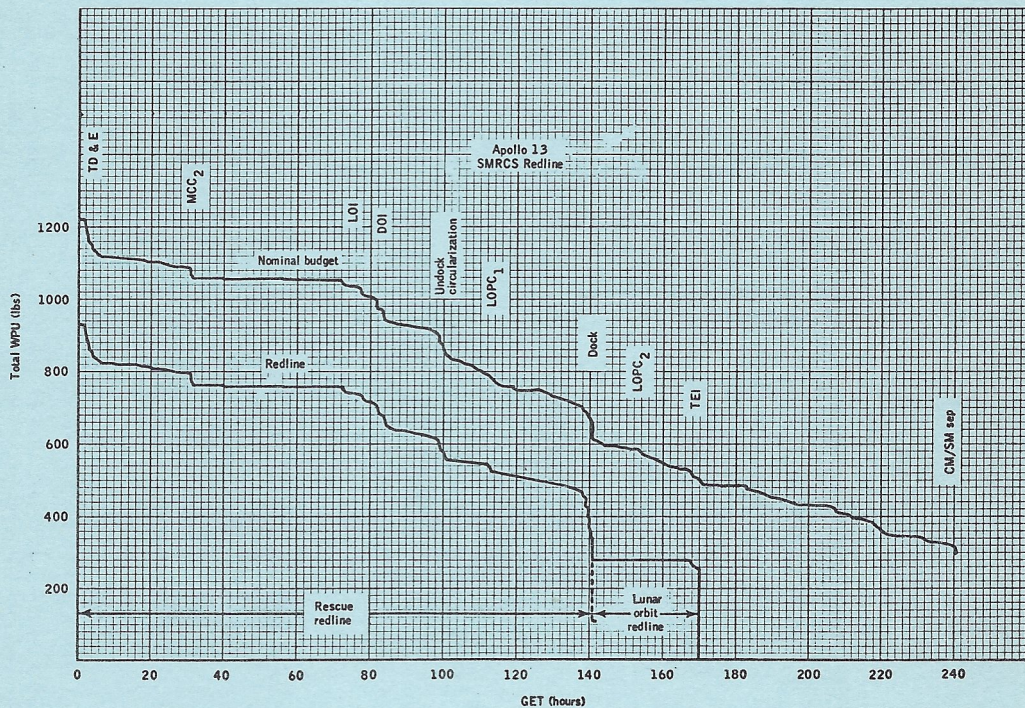
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MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED

REV ITEM

FCD 3-70,25,7A



MISSION

REV

DATE

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APOLLO 13

A

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MISSION RULE
SUMMARY

CONSUMABLES

3-25

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED

REV	ITEM							
	3-94	CSM BATTERY ENERGY AND CRYOGENIC O2 AND H2						
		THE FOLLOWING MINIMUM USABLE ENERGY/QUANTITIES MUST BE AVAILABLE TO INITIATE THE SPECIFIC PHASES.						
			LAUNCH	LOI	UNDOCK	PC-1	PC-2	
		BATT AMP-HOURS	3 BATT	89.5 1	71.7 2	62.7 2	62.7 3	59.2
		REMAINING	2 BATT	56.8	44.4	39.8	39.8	38.8
		O2 (PERCENT EACH TANK)		84	59.4	53.2	50.0	37.8
		H2 (PERCENT EACH TANK)		89.1	64.1	56.5	51.9	38
		NOTES						
		1. ENERGY REQUIREMENT TO PERFORM NOMINAL MISSION WITHOUT CHARGER. REDLINE DOES NOT ALLOW PRE-LOI GIMBAL DRIVE CHECK OR BACKUP SPS BURN PREPS AND REQUIRES POWER DOWN OF ECS RADIATOR HEATERS OVERLOAD SENSING.						
		2. ALLOWS NOMINAL LUNAR STAY, BUT PRECLUDES PC-1 AND PC-2 BURNS.						
		3. ENERGY REQUIRED TO PERFORM PC-1 AND PC-2						
		(A) PRELAUNCH BATTERY REDLINES ARE BASED ON FAILURE OF THE BATTERY CHARGER BEFORE ACCOMPLISHING ANY CHARGING.						
		(B) THE TWO BATTERY REDLINES REFLECT THE ENERGY REQUIRED IN THE TWO LOWEST BATTERIES TO PROVIDE CAPABILITY FOR A SAFE RETURN FROM ANY POINT IN THE MISSION. THE REDLINES ARE BASED ON LOSS OF THE HIGHEST BATTERY SUBSEQUENT TO LOSS OF THE BATTERY CHARGER WITH A TWO-BATTERY ENTRY (WITH G&N) AND 12 HOURS OF POSTLANDING TIME.						
		(C) IF RESCUE IS REQUIRED, THE THREE-BATTERY ENERGY REQUIREMENTS WILL BE RECOVERED BY POWERING DOWN TO A TWO-BATTERY G&N ENTRY.						
		(D) CRYOGENIC REDLINES ARE BASED ON CAPABILITY TO PERFORM NOMINAL MISSION WITH CAPABILITY TO RETURN TO EARTH WITH A 40 AMP AVERAGE POWER LEVEL AFTER LOSS OF ONE CRYO TANK AT PC-2 (WORST CASE TIME FOR FAILURE).						
		RULES 3-95 AND 3-96 ARE RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	A	3/23/70	MISSION RULE SUMMARY	CONSUMABLES	3-26	

MISSION RULES

REV	ITEM
3-97	LM-RCS PROPELLANT GO/NO-GO'S AND REDLINES
	A. ASSUMPTIONS
	1. TOTAL LOADED 633 LBS EQUAL 100 PERCENT
	UNUSABLE
	TRAPPED PROPELLANT 7.3 PERCENT
	GROUND GAGING UNCERTAINTY 6.0 PERCENT

	TOTAL UNUSABLE 13.3 PERCENT
	2. OPS RESERVE
	(A) PRIOR TO TPF - ONE REV LOS TRACKING OF CSM (STAGED) EQUAL 2.5 PERCENT
	(B) AFTER TPF - CSM ACTIVE DOCKING EQUAL 1.0 PERCENT
	B. GO/NO-GO'S
	1. UNDOCKING/SEPARATION---
	PROPELLANT REQUIRED FOR UNDOCKING, DESCENT, ASCENT AND RENDEZVOUS PLUS OPS RESERVE.
	2. PDI
	PROPELLANT REQUIRED FOR DESCENT, ASCENT AND RENDEZVOUS PLUS OPS RESERVE.
	3. IMMEDIATELY AFTER ASCENT
	PROPELLANT REQUIRED FOR NOMINAL LM ACTIVE RNDZ PLUS OPS RESERVE.
	4. CSI
	PROPELLANT REQUIRED FOR REMAINDER OF RNDZ PLUS OPS RESERVE.
	5. CDH
	PROPELLANT REQUIRED FOR REMAINDER OF RNDZ PLUS OPS RESERVE.
	6. TPI
	PROPELLANT REQUIRED FOR REMAINDER OF RENDZVOUS PLUS OPS RESERVE.

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MISSION RULES

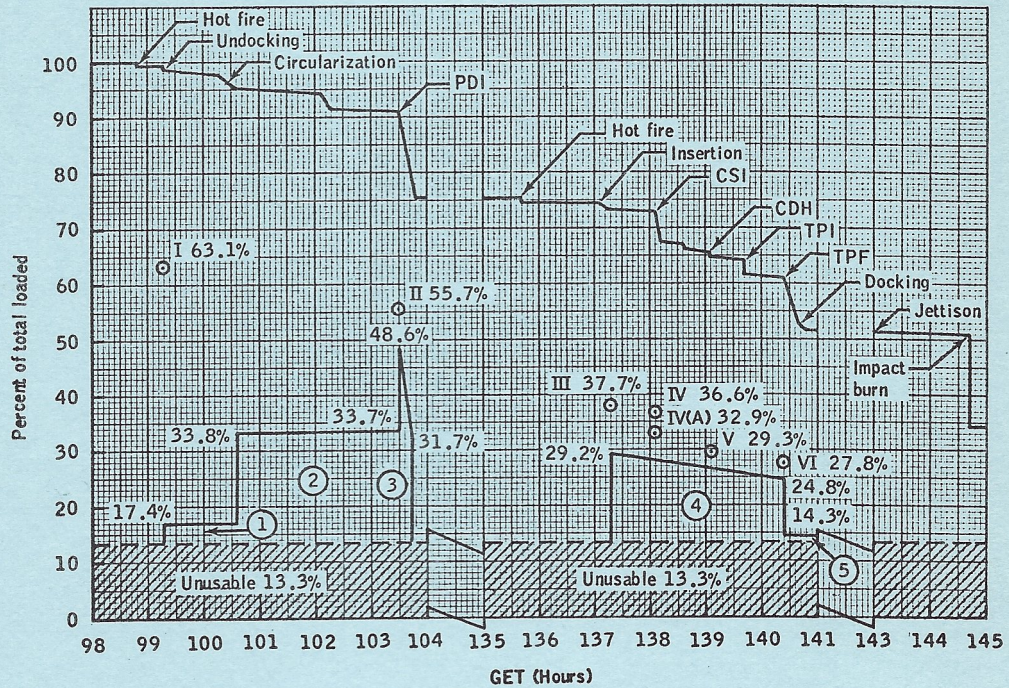
SECTION 3 - MISSION RULE SUMMARY - CONTINUED

REV	ITEM						
	3-97 CONT.	C. REDLINES 1. UNDOCKING TO CIRC PROPELLANT REQUIRED FOR NOMINAL DOCKING PLUS OPS RESERVE 2. CIRCU TO PDI PROPELLANT REQUIRED FOR LOS IN LONGEST ABORT RNDZ WITH OPS ATTACHED UNTIL JUST BEFORE TPF (P=20 MAXIMUM DEADBAND), STAGING, BRAKING, DOCKING PLUS OPS RESERVE. 3. PDI TO TOUCHDOWN PROPELLANT REQUIRED FOR DESCENT, NON ASCENT, LONGEST LOS FOR CSM RESCUE (P=20 MAXIMUM DEADBAND), BRAKING, DOCKING PLUS OPS RESERVE. 4. INSERTION TO TPF PROPELLANT REQUIRED FOR LOS TO TPF, BRAKING, DOCKING, PLUS OPS RESERVE. NOTE RCS REQUIRED DECREASES WITH LESS LOS UNTIL TPF. 5. TPF TO DOCKING PROPELLANT REQUIRED FOR OPS RESERVE. RULE NUMBERS 3-98 THROUGH 3-101 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	A	3/23/70	MISSION RULE SUMMARY	CONSUMABLES	3-28

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MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED



FCD 3-70.25.12

Figure . - LM RCS propellant profile.

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 13	A	3/23/70	MISSION RULE SUMMARY	CONSUMABLES	3-29

MISSION RULES

REV	ITEM
3-102	LM EPS, ECS THE LM EPS AND ECS MINIMUM CONSUMABLE REQUIREMENTS ARE DEFINED AS FOLLOWS---
A.	FROM UNDOCKING TO TOUCHDOWN, THE MINIMUM REQUIREMENTS ARE BASED ON THE TIME TO COMPLETE A LANDING, A 24.5-HR STAY, WITH 1 EVA, ASCENT AND A NOMINAL RENDEZVOUS THROUGH CREW TRANSFER (4.5 HOURS), A TWO HOUR ORBITAL CONTINGENCY AND REDUNDANT ASCENT EPS SOURCES FOR THE RENDEZVOUS. THE TIME TO COMPLETE A LANDING AND THE 24.5-HR LUNAR STAY MAY BE SUPPORTED BY ANY COMBINATION OF DESCENT AND ASCENT CONSUMABLES. IN ADDITION, EACH ASCENT BATTERY, ONE H ₂ O TANK AND ONE ASCENT O ₂ TANK (THE LM CABIN IS CONSIDERED A REDUNDANT O ₂ SOURCE) MUST CONTAIN THE CONSUMABLES REQUIRED FOR LIFTOFF AND NOMINAL RENDEZVOUS THROUGH CREW TRANSFER. THE TWO-HOUR ORBITAL CONTINGENCY, INSOFAR AS ASCENT O ₂ , AND ELECTRICAL POWER ARE CONCERNED, IS CONSIDERED TO BE SATISFIED BY THE REDUNDANCY REQUIREMENT. SHOULD TWO ASCENT H ₂ O TANKS BE AVAILABLE, THE REQUIREMENT FOR LIFTOFF THROUGH CREW TRANSFER CAPABILITY IN EACH TANK WILL SATISFY THE TWO-HOUR ORBITAL CONTINGENCY. IF ONLY ONE TANK IS AVAILABLE, IT MUST ALSO INCLUDE THE TWO-HOUR CONTINGENCY.
B.	FOR THE REMAINDER OF THE LUNAR STAY, THE MINIMUM DESCENT STAGE REQUIREMENTS ARE BASED ON THOSE CONSUMABLES REQUIRED FOR THE SCHEDULED ACTIVITIES DURING EACH DEFINED PHASE, AN ASCENT PREPARATION AND A TWO-HOUR SURFACE RESERVE. THE LAST FOUR HOURS OF THIS REQUIREMENT FOR EPS MUST BE SPLIT-BUS OPERATION. ASCENT STAGE MINIMUM REQUIREMENTS ARE AS STATED ABOVE.
C.	FOR THE RENDEZVOUS, THE MINIMUM REQUIREMENTS ARE THOSE CONSUMABLES NECESSARY TO SUPPORT A LM-ACTIVE RENDEZVOUS THROUGH CREW TRANSFER. SHOULD THESE MINIMUM REQUIREMENTS BE VIOLATED, THE LM WILL BE POWERED DOWN WHILE THE CSM BECOMES THE ACTIVE VEHICLE. HOWEVER, THE LM WILL BE POWERED UP TO PERFORM BRAKING-- SUFFICIENT CONSUMABLES BEING RETAINED FOR THIS PURPOSE.

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MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED

REV

ITEM

3-102
CONT.

	GO/NO GO			STAY/NO STAY	
	UNDOCK	DOI	PDI	LUNAR STAY	
	ROM(1) WITH 25.5-HR STAY	ROM WITH 25.5-HR STAY	ROM WITH 25.5-HR STAY	ROM(2) 24.5-HR WITH 1 EVA	ROM(2) 32.5-HR WITH 2 EVA'S
ASC O2 (LBS EITHER TANK)	1.5	1.5	1.5	1.5	1.5
PLUS					
ASC/DES O2 (LBS)	24.6	24.1	23.4	23.1	31.7
ASC H2O (4)	40	40	40	40	40
PLUS					
ASC/DES H2O (LBS)	145	133	113	108	154
ASC AMP HRS (EACH BAT)	205	205	205	190	190
PLUS					
ASC/DES AMP HOURS	1002	937	819	738	881

(1) ROM = REMAINDER OF MISSION

(2) APPLIED AT T3-60 MIN. I.E. TOTAL SURFACE STAY TIMES ARE 25.5 AND 32.5 HOURS.

(3) LM IS 'STAY' IF SUFFICIENT ASCENT/DESCENT H2O AND ELECTRICAL POWER ARE AVAILABLE TO PROVIDE A T3 LIFTOFF, NOMINAL INSERTION & CSM RESCUE CAPABILITY AS A MINIMUM. LM IS 'STAY' EVEN IF ALL TANKED O2 IS LOST.

(4) ASSUMES ONLY ONE ASCENT H2O TANK AVAILABLE. IF TWO ARE AVAILABLE, EACH MUST CONTAIN 29 LBS.

GENERAL NOTE
VALUES IN TABLE ARE THE REQUIRED
USABLE AMOUNTS. UNUSABLES ARE---

	O2	H2O	A-H
ASC	.37	2.08	11
DES	3.39	16.4	38

(PER TANK OR BATTERY FOR
A FOUR DESCENT/TWO
ASCENT BATTERY
CONFIGURATION)

MISSION	REV	DATE	SECTION	GROUP	PAGE	
APOLLO 13	A	3/23/70	MISSION RULE SUMMARY	CONSUMABLES	3-31	

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MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED

REV	ITEM																																							
3-103	EMU																																							
A.	PLSS AMP HRS, O2, LIOH, & H2O REDLINES																																							
NOMINAL AND ALTERNATE EVAS-THE PLSS AMP-HRS, O2, LIOH, AND H2O REDLINES FOR EACH OF THE NOMINAL OR ALTERNATE EVA'S ARE DEFINED AS THOSE VALUES REQUIRED FOR 30 MINUTES OF POST EVA RESERVE.																																								
B.	PLSS AMP-HR, O2, LIOH AND H2O GO/NO GO'S ARE DEFINED AS THOSE VALUES REQUIRED TO COMPLETE THE EVA (NOMINAL OR ALTERNATE) PLUS THE VALUES REQUIRED FOR 30 MINUTES OF POST EVA RESERVE.																																							
<table><tr><td></td><td colspan="2">GO/NO-GO'S</td></tr><tr><td></td><td>EVA NO. 1</td><td>EVA NO. 2</td></tr><tr><td></td><td>4 HR</td><td>4 HR</td></tr><tr><td>CDR</td><td>868</td><td>868</td></tr><tr><td>POS (PSIA)</td><td>6.5</td><td>6.5</td></tr><tr><td>H2O (LBS)</td><td>13.9</td><td>12.9</td></tr><tr><td>AMP-HRS</td><td>4956</td><td>4956</td></tr><tr><td>LIOH (BTU'S)</td><td></td><td></td></tr><tr><td>LMP</td><td>868</td><td>868</td></tr><tr><td>POS (PSIA)</td><td>6.5</td><td>6.5</td></tr><tr><td>H2O (LBS)</td><td>13.9</td><td>12.9</td></tr><tr><td>AMP-HRS</td><td>4956</td><td>4956</td></tr><tr><td>LIOH (BTU'S)</td><td></td><td></td></tr></table>			GO/NO-GO'S			EVA NO. 1	EVA NO. 2		4 HR	4 HR	CDR	868	868	POS (PSIA)	6.5	6.5	H2O (LBS)	13.9	12.9	AMP-HRS	4956	4956	LIOH (BTU'S)			LMP	868	868	POS (PSIA)	6.5	6.5	H2O (LBS)	13.9	12.9	AMP-HRS	4956	4956	LIOH (BTU'S)		
	GO/NO-GO'S																																							
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	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 13	A	3/23/70	MISSION RULE SUMMARY	CONSUMABLES	3-32	

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MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED

REV	ITEM																
	3-103 CONT.																
1	C.	OPS 02, PLSS 02, H2O AND AMP-HRS GO/NO-GO'S ARE DEFINED AS THOSE VALUES REQUIRED TO COMPLETE A 30-MINUTE CEVA.															
		<table><tr><td colspan="3">CEVA GO/NO-GO TABLE</td></tr><tr><td rowspan="2">OPS</td><td>ACTIVATED</td><td>4600 PSIA/4.8 LBS</td></tr><tr><td>UNACTIVATED</td><td>5380 PSIA/5.6 LBS</td></tr><tr><td rowspan="3">PLSS</td><td>POS</td><td>422 PSIA/0.5 LBS</td></tr><tr><td>H2O</td><td>1.7 LBS</td></tr><tr><td>BAT</td><td>4.8 AMP-HRS</td></tr></table>	CEVA GO/NO-GO TABLE			OPS	ACTIVATED	4600 PSIA/4.8 LBS	UNACTIVATED	5380 PSIA/5.6 LBS	PLSS	POS	422 PSIA/0.5 LBS	H2O	1.7 LBS	BAT	4.8 AMP-HRS
CEVA GO/NO-GO TABLE																	
OPS	ACTIVATED	4600 PSIA/4.8 LBS															
	UNACTIVATED	5380 PSIA/5.6 LBS															
PLSS	POS	422 PSIA/0.5 LBS															
	H2O	1.7 LBS															
	BAT	4.8 AMP-HRS															

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

REV	ITEM						
		----- ! GENERAL ! -----					
20-1	A.	BASELINE REQUIREMENTS (ALL PHASES EXCEPT LAUNCH)					
	1.	TWO-WAY VOICE COMM BETWEEN SPACECRAFT.					
	2.	TWO-WAY VOICE COMM BETWEEN CSM OR LM AND MSFN DURING ALL DOCKED ACTIVITIES AND BETWEEN BOTH SPACECRAFT AND MSFN DURING UNDOCKED ACTIVITIES.					
	B.	LAUNCH					
		THERE ARE NO COMMUNICATIONS FAILURES FOR WHICH THE LAUNCH/ INSERTION PHASE WILL BE TERMINATED.					
	C.	POWERED DESCENT ADDITIONAL REQUIREMENTS.					
		LM VOICE REQUIRED TILL LO GATE. THERE ARE NO CSM COMMUNICATIONS SYSTEMS FAILURES FOR WHICH LM POWERED DESCENT WILL BE TERMINATED.					
	D.	LUNAR STAY ADDITIONAL REQUIREMENTS.					
	1.	FOR TWO-MAN EVA---VOICE COMM BETWEEN MSFN AND ONE EVA PLUS DUPLEX VOICE BETWEEN BOTH EVA CREWMAN.					
	2.	FOR ONE-MAN EVA---VOICE COMM BETWEEN MSFN AND LM OR EVA PLUS DUPLEX VOICE BETWEEN THE LM AND EVA CREWMAN.					
20-2	VHF EVA COMMUNICATIONS PRIORITIES ARE---						
	A.	TWO-MAN EVA					
	1.	PRIME---EVA-1 AR/EVA-2 AR (RELAY MODE-ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE AND DATA FROM BOTH EVA'S TO LM, PLUS THE RECEPTION OF VOICE VIA LM BY BOTH EVA'S)					
	2.	BACKUP---EVA-1 AR/EVA-2B OR EVA-1 A/EVA-2B OR EVA-1 B/EVA-2A (EITHER MODE COMBINATION ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE FROM BOTH THE EVA'S TO THE LM PLUS THE TRANSMISSION OF DATA FROM ONE EVA TO THE LM AND THE RECEIVING OF LM VOICE BY ONE EVA.)					
	B.	ONE-MAN EVA					
	1.	PRIME---EVA-1A OR EVA-2A (ALLOW DUPLEX VOICE BETWEEN EVA AND THE LM PLUS THE TRANSMISSION OF DATA FROM EVA TO LM)					
	2.	BACKUP---EVA-1B OR EVA-2B (ALLOWS DUPLEX VOICE BETWEEN EVA AND LM)					
	RULES 20-3 THROUGH 20-6 ARE RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	COMM & INST	FUNCTIONAL COMM-GENERAL	20-1

MISSION RULES

REV	ITEM	MANAGEMENT					
20-7	VOICE CONFIGURATION	A. LM/CSM/MSFN - VHF DUPLEX B AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR LAUNCH THROUGH CYI, REV 1. VHF SIMPLEX A AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR EARTH ORBIT AFTER CYI, REV 1 LOS. - VHF A SIMPLEX 296.8 MHZ IS PRIME VOICE COMM BETWEEN VEHICLES EXCEPT DURING RANGING WHEN DUPLEX B (CSM) AND DUPLEX A (LM) WILL BE USED. - VHF B SIMPLEX 259.7 MHZ IS BACKUP TO VHF A SIMPLEX 296.8 MHZ. - USB IS PRIME VOICE COMM BETWEEN MSFN AND CSM OR LM. - USB/VHF RELAY IS VOICE COMM BACKUP TO USB BETWEEN MSFN AND MALFUNCTIONED S/C. - NORMAL VOICE COMM WILL USE SIMULTANEOUS MSFN UPLINK TO BOTH VEHICLES. HOWEVER, IF REQUIREMENT SHOULD EXIST, SIMULTANEOUS INDEPENDENT MSFN/CSM AND MSFN/LM COMM MODES WILL BE INITIATED. - THE PRIME CSM/LM COMMUNICATIONS MODE DURING THE LUNAR ORBIT PHASE IS VHF. THE PRIME VHF MODE IS VHF A SIMPLEX UNLESS THIS MODE IS PRECLUDED BY THE USE OF VHF RANGING. DURING LUNAR STAY PHASE THE PRIME CSM/LM MODE IS MSFN RELAY WITH EACH S/C MONITORING THE VHF A FREQUENCY. - THE CSM AND LM WILL TRANSMIT SIMULTANEOUSLY ON VHF AND USB DURING ALL LM POWERED UP PHASES IN LUNAR ORBIT. - IN THE EVENT OF A COMPLETE LOSS OF CSM S-BAND COMMUNICATIONS WITH MSFN, THE LM WILL BE CONFIGURED FOR LM TWO-WAY RELAY AND RETAINED FOR TEI AND TEC. B. LM/CSM/EVA/MSFN - LM TWO-WAY RELAY WITH TWO-MAN EVA IS THE PRIME MODE PLANNED FOR EVA OPERATION. CSM---USB TRANSMIT/RECEIVE ONLY---LM--- TRANSMIT VHF A, RECEIVE VHF A AND B, MSFN CONFIGURED FOR USB RELAY.					
20-8	CSM VHF/USB MANAGEMENT	A. FOR CREW REST PERIODS, CSM S-BAND ANTENNAS WILL BE SELECTED BY GROUND COMMANDS. B. NORMAL CONTROL OF THE S-BAND MODES WILL BE BY GROUND COMMAND. CSM COMMUNICATIONS SWITCH POSITION WILL REFLECT OUT-OF-SITE CONTACT CONFIGURATION.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	B	4/9/70	COMM & INST	FUNCTIONAL COMM-MNG.	20-2

MISSION RULES

REV	ITEM
20-9	LM STEERABLE ANTENNA MANAGEMENT A. DURING ALL PHASES THE STEERABLE ANTENNA TEMPERATURE SHOULD BE MAINTAINED BETWEEN -65 DEG. F AND 185 DEG. F.
21-10	APOLLO COLOR TELEVISION CAMERA MANAGEMENT A. THE COLOR TV CAMERA WILL NOT BE POINTED WITHIN 45 DEGREES OF THE SUN WITHOUT THE LENS CAP IN PLACE. B. THE GROUND WILL MONITOR THE TV PICTURE AND RECOMMEND CAMERA MOVEMENT TO PREVENT IRREVERSIBLE VIDICON TUBE BURNS FROM REFLECTIVE OBJECTS BASED ON THE FOLLOWING LIMITATIONS--- 1. HIGH REFLECTIVITY/CONTRAST--- 15 MINUTES 2. LOW REFLECTIVITY/CONTRAST--- 30 MINUTES C. BETWEEN EVA'S THE TV CAMERA MUST BE LOCATED IN THE SUN CAPPED AND OPERATING TO MINIMIZE THE POSSIBILITY OF FREEZING, AND TO ATTEMPT TO CURE VIDICON BURNS. D. THE TV OPERATION DURING THE EVA-2 TRAVERSE WILL BE DETERMINED IN REAL TIME BASED UPON DIRECTION OF TRAVERSE VERSUS SUN ANGLE IN ORDER TO AVOID SEVERE VIDICON TUBE BURN. E. IF THE THERMAL CONSTRAINTS ON THE TV CAMERA OPERATING TIME IN THE MESA ARE VIOLATED, THE GROUND WILL REQUEST THE CAMERA BE TURNED OFF. F. THE TV CAMERA WILL NOT BE MOVED WITHOUT THE LENS CAP INSTALLED. G. WHEN A BRIGHT OBJECT, WITH A CONTRASTING DARK BACKGROUND IS IN THE FIELD OF VIEW, AN ATTEMPT WILL BE MADE TO ELIMINATE THE OBJECT, FIRST BY REPOSITION OF THE CAMERA AND SECOND BY CHANGING THE ZOOM SETTING. IF THIS CAN NOT BE ACCOMPLISHED, THE ALC SWITCH WILL BE LEFT IN THE PEAK POSITION. RULES 20-11 AND 20-12 ARE RESERVED.

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
				----- SPECIFIC -----				
	20-13	LOSS OF TWO-WAY VHF VOICE COMM BETWEEN SPACECRAFT	'DOCKED 'UNDOCKED 'PRE-PDI 'POWERED DESCENT 'LUNAR STAY	'CONTINUE 'NO GO FOR SEP MNVR 'DOCK ASAP 'NO GO FOR PDI 'CONTINUE MISSION 'CONTINUE MISSION 'CONTINUE MISSION	'REF LM MAL PROC COMM 3, LOSS OF VHF VOICE COMM WITH CSM 'REF CSM MAL PROCEDURE COMM 5 - LOSS OF VHF COMM WITH LM 'NOTE---MSFN RELAY MAY BE UTILIZED			
	20-14	LOSS OF TWO-WAY VOICE COMM WITH MSFN			'REF CSM MAL PROCEDURES 7&8 - LOSS OF CSM VOICE COMM			
		A. CSM ONLY	'LAUNCH 'EARTH ORBIT 'TLC 'DOI 'UNDOCKED/ 'POWERED DESCENT 'LUNAR STAY	'A.1. CONTINUE MISSION 2. ENTER NEXT BLOCK DATA POINT 3. CONTINUE MISSION NO GO FOR LOI 4. CONTINUE MISSION NO GO FOR SEP MANEUVER 5. CONTINUE MISSION 6. CONTINUE MISSION	'A.3 ENTER LM EARLY TO USE LM S-BAND FOR VOICE COMM WITH MSFN. UTILIZE VHF OF VHF RELAY FROM LM. IF UNABLE TERMINATE LUNAR STAY AND PERFORM A DOCKED TEI.			
		B. LM ONLY	'DOCKED 'UNDOCKED 'PRE-PDI 'POWERED DESCENT 'LUNAR STAY	'B.1. CONTINUE MISSION NO GO FOR SEP MANEUVER 2. RETURN TO VICINITY OF CSM NO GO FOR PDI 3.A. PDI TO LO GATE RETURN TO VICINITY OF CSM ASAP B. LO GATE TO TOUCHDOWN CONTINUE MISSION. 5. LM LIFTOFF NEXT ASCENT OPPORTUNITY.	'REF LM MAL PROC COMM-- 4 LOSS OF S-BAND VOICE COMM 5A. S-BAND RECEIVER CANNOT ACQUIRE PHASE LOCK. B.3. CSM RELAY ACCEPTABLE			
	20-15	LOSS OF TWO CSM AUDIO CENTERS	'EPO 'ALL	'CONTINUE MISSION 'NO GO FOR TLI 'CONTINUE MISSION-NO GO FOR LOI				
	20-16	LOSS OF VOICE FROM EVA-2 TO EVA-1	'DUAL 'EVA	'CONTINUE MISSION 'EVA-2 GO TO POSITION 'B'	'EVA-1 HAS EVC-1 EVA-2 HAS EVC-2			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	COMM & INST	FUNCTIONAL COMM-SPECIFIC	20-3	

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	20-17	LOSS OF VOICE FROM EVA-1 TO EVA-2	DUAL EVA	CONTINUE MISSION 1. EVA-2 GO TO POSITION 'A' 2. EVA-1 GO TO POSITION 'B'				
	20-18	LOSS OF DUPLEX VOICE BETWEEN EVA-1 AND EVA-2	DUAL EVA	TERMINATE EVA				
	20-19	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND EVA	DUAL EVA	TERMINATE EVA 1. EVA-2 GO TO POSITION 'A' EVA-1 GO TO POSITION 'B' 2. IF UNABLE TO RE-ESTABLISH COMM EVA-2 RETURN TO LM AND RECONFIGURE COMM 3. IF ABLE TO RE-ESTABLISH COMM, CONTINUE EVA.				
	20-20	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND BOTH LM AND EVA	ALT EVA (ONE-MAN)	TERMINATE EVA 1. RECONFIGURE LM TO RE-ESTABLISH COMM. 2. IF ABLE TO RE-ESTABLISH COMM, CONTINUE EVA.				
	20-21	LOSS OF DUPLEX VOICE BETWEEN LM AND EVA	ALT EVA (ONE-MAN)	TERMINATE EVA 1. RECONFIGURE LM AND EVA TO VHF BACKUP MODE. 2. IF ABLE TO RE-ESTABLISH DUPLEX COMM, CONTINUE EVA.				
		RULES 20-22 THROUGH 20-25 ARE RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	COMM & INST	FUNCTIONAL COMM-SPECIFIC	20-4	

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

REV	ITEM						
		----- ' GENERAL ' -----					
20-26	A. BASELINE REQUIREMENT (ALL PHASES EXCEPT LAUNCH) 1. CRITICAL INSTRUMENTATION (CRITICAL INSTRUMENTATION IS THAT INSTRUMENTATION REQUIRED TO VERIFY MISSION GO/NO-GO CRITERIA) B. LAUNCH THERE ARE NO CSM INSTRUMENTATION FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED. C. POWERED DESCENT ADDITIONAL REQUIREMENTS THERE ARE NO CSM INST. SYS FAILURES FOR WHICH LM POWERED DESCENT WILL BE TERMINATED.						
20-27	THE MISSION WILL BE CONTINUED WITH THE LOSS OF THE--- A. CSM UPDATA LINK B. CSM CAUTION AND WARNING SYSTEM C. CSM DSE D. CSM HIGH GAIN ANTENNA E. CSM FM DOWNLINK F. CSM USB RANGING (PRN) G. VHF RANGING RULES 20-28 THROUGH 20-29 ARE RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	COMM & INSTR	CSM INST - GENERAL	20-5

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
				----- SPECIFIC -----				
	20-35	LOSS OF CSM TM			REF CSM MAL PROCEDURE.			
		A. HBR OR LBR	ALL	A. CONTINUE MISSION	COMM 10 - MSFN REPORTS LOSS OF			
		B. ALL TM	LAUNCH	B.1. CONTINUE MISSION	REALTIME PCM. DSE MAY BE UTILIZED			
			EO	2. ENTER NEXT BEST PTP	FOR TM IF AVAILABLE.			
			LO	3. NO GO FOR LUNAR OPERATIONS				
			POWERED DESCENT	4. CONTINUE MISSION				
			LUNAR STAY	5. LM LIFTOFF AT THE NEXT ASCENT OPPORTUNITY.				
	20-36	LOSS OF CRITICAL INSTRUMENTATION	LAUNCH	CONTINUE MISSION				
			EO	ENTER NEXT BEST PTP NO GO FOR TLI				
			TLC	CONTINUE MISSION NO GO LOI				
			LO	NO GO FOR LUNAR OPERATIONS				
	20-37	LOSS OF ONE CSM PMP POWER SUPPLY	ALL	CONTINUE MISSION				
	20-38	LOSS OF BOTH CSM POWER AMPLIFIERS	EPO	NO GO FOR TLI				
			ALL	CONTINUE MISSION IF HI GAIN ANT IS AVAILABLE				
	20-39	LOSS OF THE SCE	EPO	CONTINUE MISSION NO GO FOR TLI				
			TLC	CONTINUE MISSION NO GO FOR LOI				
			LUNAR ORBIT	CONTINUE MISSION				
			LUNAR STAY	CONTINUE MISSION				
		RULES 20-40 THROUGH 20-44 ARE RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	COMM & INSTR	CSM INST - SPECIFIC	20-7	

MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

REV	ITEM						
		----- MANAGEMENT -----					
	20-50	LM USB/TM MANAGEMENT A. FOR NORMAL LM POWERED UP PHASES, THE LM STEERABLE ANTENNA WITH THE POWER AMPLIFIER WILL BE USED. DURING LUNAR STAY, IF THE ERECTABLE ANTENNA IS USED, THE POWER AMPLIFIER MAY BE TURNED OFF IF HBR TM AND VOICE CIRCUIT MARGINS ARE ADEQUATE. B. DURING PERIODS OF LM OUT-OF-STATION CONTACT (LUNAR FAR SIDE), THE TM BIT RATE WILL BE SWITCHED FROM HBR TO LBR AND TRANSMITTED TO THE CSM OVER VHF B EXCEPT DURING VHF RANGING AND PERIODS OF CRITICAL VOICE COMMUNICATIONS. SYSTEM MONITORING DURING SLEEP PERIODS TBD CREWMEN WILL SLEEP WITH HEADSETS TO MONITOR FOR MASTER ALARMS OR GROUND COMMUNICATIONS. RULES 20-51 THROUGH 20-54 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	COMM & INST	LM INST - MANAGEMENT	20-9

MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 13	FNL	2/12/70	COMM & INST	LM INST - SPECIFIC	20-10

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION CONCLUDED

REV	ITEM							
		----- ' CSM- INSTRUMENTATUON REQUIREMENTS ' -----						
20-60	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF		
	UDL VALIDITY SIGNAL	CT0262V	-	-	HD	20-27A		
	USB RECEIVER AGC	CT0620E	METER	COMMON	HD	20-27,20-7A(9), 20-8B		
	USB RECEIVER AGC	METER	-	-	HD			
	USB RECEIVER ERROR	CT0604F	-	-	HD			
	DSE TAPE MOTION	CT0012X	TB	-	HD	20-27,20-30		
	CTE TIME	CT0145F	-	-	HD	20-31		
	SCE 10 VDC	CT0018V	-	-	HD			
	SCE 5 VDC	CT0017V	-	-	HD			
	SCE 20 VDC	CT0015V	-	-	HD			
	SCE -20 VDC	CT0016V	-	-	HD			
	PCM HI REF 85 PERCENT	CT0125V	-	-	HD			
	PCM HI REF 15 PERCENT	CT0126V	-	-	HD			
		----- ' LM- INSTRUMENTATION REQUIREMENTS ' -----						
20-61	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF		
	PCM OSC FAIL 2	GL0422V	-	-	1 OF 2			
	PCM OSC FAIL 3	GL0423V	-	-	HD			
	CAL 85 PCT	GL0401V	-	-	HD			
	CAL 15 PCT	GL0402V	-	-	HD			
	MET	GL0501W	-	-	HD			
	C&W PWR FAIL	GL4054X	CAUTION	-	HD			
	MASTER ALARM	GL4069X	MASTER ALARM	-	HD			
	DUA STATUS	GT0441X	-	-	HD	20-46		
	S-BND ST PH ERR	GT0992B	-	-	HD			
	S-BND RCVR SIG	GT0994V	METER	-	HD	20-46		
	STEERABLE ANT TEMP	GT0454	METER	-	HD	20-9B,20-50		
	XMTR PO	GT0993	-----	-	HD	20-46,20-55		
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	COMMUNICATIONS AND INSTR	PRELAUNCH REQMTS	20-11	

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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

REV	ITEM						
		----- MANAGEMENT -----					
	21-10	APS WILL NOMINALLY BE PRESSURIZED IMMEDIATELY PRIOR TO 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.					
	21-11	IF UNABLE TO DEPLOY ONE OR MORE LANDING GEAR, A LANDING WILL NOT BE ATTEMPTED. 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 ALTERNATE MISSIONS.					
	21-12	UNDOCKED STAGING WITH ONE PYRO SYSTEM WILL BE PERFORMED ONLY IF ABSOLUTELY NECESSARY TO MAINTAIN CREW SAFETY.					
	21-13	FOR A K1 THROUGH K6 FAILURE, THE GOOD SYSTEM WILL BE DISABLED AND A PYRO FUNCTION, OTHER THAN STAGING, ATTEMPTED (WITH THE MASTER ARM SWITCH OFF) 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.					
	21-14	AN ARMED PYRO SYSTEM(S) THAT CANNOT BE DEARMED IS CONSIDERED UNSAFE FOR THE VIBRATION/SHOCK ENVIRONMENT ASSOCIATED WITH LUNAR TOUCHDOWN.					
		RULE NUMBERS 21-15 THROUGH 21-19 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	LM SEQUENTIAL AND PYROTECHNIC	MANAGEMENT	21-2

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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				----- SPECIFIC -----	
	21-20	LOSS OF---			REF MALF PROC ED---
		A. ONE PYRO SYSTEM	ALL	A. 1. DELAY STAGING AS LONG AS POSSIBLE	1 ED RELAY
			DOCKED	2. CONTINUE MISSION	CSM RESCUE MAY BE REQUIRED DUE TO RCS REDLINES
			UNDOCKED	NO-GO CIRC	
			PRE-PDI	3. DOCK ASAP NO-GO PDI	
			POWERED DESCENT	4. (A) PDI TO PDI + 5+30 ABORT (B) PDI + 5+30 TO TD - CONTINUE MISSION	
			LUNAR STAY	5. LIFT OFF AT NEXT BEST OPPORTUNITY	
		B. TWO PYRO SYSTEMS	ALL	B. 1. DOCK ASAP	
			POWERED DESCENT	2. ABORT	
	21-21	UNABLE TO DISARM PYRO SYSTEM(S)	ALL	CONTINUE MISSION NO-GO PDI	REF MALF PROC ED---
				FOR UNSTAGED OPERATION, PLACE ONE ASCENT BATTERY ON BUS POWERING THE ACTIVE GUIDANCE SYSTEMS.	1 ED RELAY
				STAGE AS REQUIRED IN ORBIT	CSM RESCUE MAY BE REQUIRED DUE TO RCS REDLINE
			POWERED DESCENT	ABORT	
			LUNAR STAY	LIFT OFF AT NEXT BEST OPPORTUNITY NO-GO EVA	

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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	21-22	A RELAY K7 THROUGH K15 INADVERTENTLY CLOSES	ALL		RELAYS K7 - RCS PRES K8 - LAND GEAR DEPLOY K8A - LAND GEAR DEPLOY K9 - DPS CRYO HE PRESS K10 - ASC HE TANK 1 K11 - ASC HE TANK 2 K12 - ASC FUEL AND OX COMP VALVE (SYSTEM B ONLY) K12A - ASC FUEL AND OX COMP VALVES K13 - DPS FUEL AND OX VENT K14 - DPS AMBIENT HE K15 - DPS FUEL AND OX COMP VALVES			
		A. SYSTEM A		A. CONTINUE MISSION OPEN LOGIC POWER 'A' C/B UNTIL AFTER DPS SHE PRESSURIZATION. CLOSE DES PROPULSION FUEL AND OXID VENTS THEN CLOSE LOGIC POWER 'A' C/B.	A AND B - PRIOR TO DPS CRYO HE PRESS, THE FAILED SYSTEM WILL BE DISABLED FOR ALL PYRO FUNCTIONS. SUBSEQUENT PYRO FUNCTIONS WILL BE ACCOMPLISHED USING SYSTEMS A AND B.			
		B. SYSTEM B		B. CONTINUE MISSION OPEN LOGIC POWER 'B' C/B UNTIL AFTER DPS SHE PRESSURIZATION. CLOSE DES PROPULSION FUEL AND OXID VENTS THEN CLOSE LOGIC POWER 'B' C/B.				
		C. BOTH SYSTEMS		C. 1. CONTINUE MISSION 2. PRIOR TO POSITIONING MASTER ARM SW TO 'ON'--- CLOSE DES HE REG 1 AND 2 AND DES PROPULSION FUEL AND OXID VENTS. ALSO, THE DESCENT PROPELLANT ISOL VLV SWITCH MUST BE HELD IN THE FIRE POSITION WHEN THE MASTER ARM SWITCH IS POSITIONED TO 'ON' FOR THE FIRST TIME. 3. OPEN DES HE REG 1 AT TIG OF DPS 1 BURN				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	LM SEQUENTIAL AND PYROTECHNIC	SPECIFIC	21-4	

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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	21-23	UNABLE TO STAGE			THIS RULE ONLY APPLIES TO ALTERNATE MISSIONS			
		A. ASCENT AND DESCENT STAGES STILL RIGIDLY TIED TOGETHER	RNDZ	A. 1. CONTINUE MISSION 2. USE RCS FOR MANEUVERS	A. CSM RESCUE MAY BE INITIATED DUE TO RCS REDLINES			
		B. INCOMPLETE STAGING, VEHICLE NOT RIGID	RNDZ	B. 1. EXECUTE CSM RESCUE 2. GO TO DRIFTING FLIGHT	B. EVT MAY BE REQUIRED BECAUSE OF INABILITY TO DOCK.			
		RULE NUMBERS 21-24 THROUGH 21-49 ARE RESERVED						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	LM SEQUENTIAL AND PYROTECHNIC	SPECIFIC	21-5	

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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC - CONCLUDED

REV	ITEM						
		----- ' PRELAUNCH INSTRUMENTATION ' -----					
	21-50	MEAS DESCRIPTION	PCM	ONBOARD		CATEGORY	MISSION RULE REFERENCE
		ED RLY A K1-K6	GY0201X	SYS A STAGING LIGHT	COMMON CAUTION LIGHT	M	21-1, 2, 3, 13, 20, 21,
						HD	
		ED RLY B K1-K6	GY0202X	SYS B STAGING LIGHT		M	21-1, 2, 3, 13, 20, 21,
		ED RLY A K7-K15	GY0231X	-----		HD	21-1, 3, 22
		ED RLY B K7-K15	GY0232X	-----		HD	21-1, 3, 22
		SELECTED ED BAT VOLT	-----	METER		M	21-1, 2, 20
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	LM SEQUENTIAL AND PYROTECHNIC	PRELAUNCH INSTR	21-6

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM						
		----- ' GENERAL ' -----					
	22-1	TO INITIATE MANNED LM MISSION PHASES, THE ELECTRICAL POWER SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---					
		NOTE -----					
		LM ACTIVE RENDEZVOUS/CONTINGENCY RETURN ASSUMED					
		A. DOCKED WITH HATCH OPEN AND TUNNEL CLEAR					
		1. CDR OR LMP BUS					
		2. TWO DESCENT BATTERIES WITH ASSOCIATED FEEDER OR ONE ASCENT BATTERY WITH ASSOCIATED FEEDER.					
		3. SUFFICIENT AVAILABLE ASCENT OR DESCENT ELECTRICAL ENERGY TO COMPLETE THE PLANNED ACTIVITY PERIOD.					
		B. DOCKED WITH HATCH CLOSED					
		1. CDR AND LMP BUSES					
		2. TWO DESCENT BATTERIES PLUS ONE ASCENT BATTERY OR BOTH ASCENT BATTERIES.					
		3. BOTH ASCENT FEEDERS					
		4. SUFFICIENT AVAILABLE ASCENT OR DESCENT ELECTRICAL ENERGY TO COMPLETE THE PLANNED ACTIVITY PERIOD PLUS A RESERVE OF 1 HOUR.					
		C. UNDOCKED/SEPARATION AND SUBSEQUENT PHASES SEE LM TELMU GO/NO GO CRITERIA - PAGE 3-18.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	LM ELECTRICAL	GENERAL	22-1

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM	
	22-2	DEFINITIONS--- LOSS OF CDR OR LMP BUS A. INABILITY TO MAINTAIN BUS VOLTAGE GREATER THAN 26.5 VDC B. A BUS CURRENT GREATER THAN OR EQUAL TO 90 AMPS LOSS OF AN EPS BATTERY A. BATTERY OUTPUT LESS THAN OR EQUAL TO 2 AMPS WHEN CONNECTED TO A BUS B. TEMPERATURE GREATER THAN OR EQUAL TO 145 DEG F WITH VOLTAGE EQUAL (UNSTAGED CONFIGURATION) OR LESS THAN NOMINAL (STAGED CONFIGURATION), AND CURRENT LESS THAN NOMINAL C. INABILITY TO MEET VOLTAGE REGULATION AT REQUIRED LOAD D. INABILITY TO BE CONNECTED TO A FEEDER DUE TO A MALFUNCTIONED ECA E. BATTERY OPEN CIRCUIT VOLTAGE BELOW 31.8 VDC STEADY STATE LOSS OF A DC BUS FEEDER A. DESCENT - INABILITY TO USE AS A POWER PATH THE ELECTRICAL CONNECTIONS FROM THE OUTPUT TERMINALS OF THE DESCENT ECA'S TO THE DFR B. ASCENT - INABILITY TO USE AS A POWER PATH THE ELECTRICAL CONNECTIONS FROM THE OUTPUT TERMINALS OF THE ASCENT ECA'S TO THE BAT FEED TIE CIRCUIT BREAKERS LOSS OF OVERCURRENT PROTECTION A. DEFINITE LOSS IF--- (1) BOTH CIRCUIT BREAKERS POWERING THE ECA'S FAIL OPEN (ALL DESCENT OR ALL ASCENT BATTERIES, DEPENDENT ON WHICH PAIR OF CIRCUIT BREAKERS FAILED) (2) FAILURE OF AN ASCENT BATTERY NORMAL FEED CONTACTOR B. PROBABLE LOSS IF--- (1) UNABLE TO MEASURE A BATTERY CURRENT BOTH ONBOARD AND ON TELEMETRY (2) UNABLE TO TAKE THE BATTERY OFF LINE LOSS OF AN INVERTER AND/OR ASSOCIATED AC DISTRIBUTION A. AC BUS VOLTAGE LESS THAN OR EQUAL TO 110.5 OR GREATER THAN OR EQUAL TO 120 VAC B. AC BUS FREQUENCY LESS THAN OR EQUAL TO 390 OR GREATER THAN OR EQUAL TO 410 HZ C. POWER CANNOT BE SUPPLIED TO AN AC BUS
	22-3	ANY SPECIFIC EPS MISSION RULE REQUIRING A NEXT BEST OPPORTUNITY LIFTOFF WILL BE CAUSE FOR TERMINATION OF AN EVA. ADDITIONALLY, A CREWMAN WILL RETURN FROM THE EVA TO CORRECT THE FOLLOWING--- A. A DESCENT BATTERY MALFUNCTION REQUIRING THE BATTERY TO BE TAKEN OFF LINE. B. AN INVERTER MALFUNCTION IF THE STEERABLE ANTENNA IS AFFECTED (ASSUMES THE ERECTABLE ANTENNA IS NOT DEPLOYED). RULE NUMBERS 22-4 THROUGH 22-9 ARE RESERVED.

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM						
		----- ' MANAGEMENT ' -----					
	22-10	THE MISSION WILL BE CONTINUED AFTER LIFTOFF WITH THE LOSS OF OVERCURRENT PROTECTION. IF THIS PROTECTION IS LOST PRIOR TO LIFTOFF, A HOLD WILL BE CALLED.					
		A. IF OVERCURRENT PROTECTION IS LOST ON AN INDIVIDUAL DESCENT BATTERY, THE BATTERY WILL BE LEFT ON LINE EXCEPT FOR EVA.					
		B. IF ALL DESCENT OVERCURRENT PROTECTION IS LOST, BOTH ASCENT BATTERIES WILL BE PARALLELED WITH THE DESCENT BATTERIES ON LINE PERIODICALLY TO MONITOR CURRENT AND OBTAIN A CONSUMABLE TREND.					
		C. IF ONE OR BOTH ASCENT BATTERY NORMAL FEED CONTACTORS FAIL OPEN, THE SPACECRAFT WILL BE CONFIGURED WHEN ASCENT STAGE ONLY OPERATIONS ARE REQUIRED, USING THE BACKUP FEEDS ON BOTH ASCENT BATTERIES WITH THE CROSSTIES LEFT OPEN.					
	22-11	THE ASCENT BATTERIES WILL BE PRECONDITIONED FOR---					
		A. ABORT STAGING WITH TWO ASCENT BATTERIES/SPLIT BUS OPERATION - BY REMOVING A MINIMUM OF 2.5 AMP HOURS FROM THE BATTERY ON THE LMP BUS (NORMALLY BATTERY 5) AND A MINIMUM OF 5 AMP HOURS FROM THE BATTERY ON THE CDR BUS (NORMALLY BATTERY 6) IMMEDIATELY PRIOR TO PDI.					
		B. LUNAR L/O OR STAGING DURING COASTING FLIGHT WITH TWO ASCENT BATTERIES/SPLIT BUS OPERATION - BY REMOVING A MINIMUM OF 2.5 AMP HOURS FROM EACH ASCENT BATTERY IMMEDIATELY PRIOR TO DISCONNECTING THE LAST DESCENT BATTERY FROM EACH BUS.					
		C. LUNAR L/O OR STAGING DURING COASTING FLIGHT WITH ONE ASCENT BATTERY/TWO BUS OPERATION - BY REMOVING A MINIMUM OF 5 AMP HOURS FROM THE REMAINING ASCENT BATTERY IMMEDIATELY PRIOR TO DISCONNECTING THE LAST DESCENT BATTERY FROM THE BUSES.					
	22-12	THE BAL LOAD CROSSTIES (30A) WILL BE OPEN FOR MAIN PROPULSION BURNS, STAGING, AND WHENEVER AGS IS IN THE OPERATE MODE WITH BOTH 'AEA' CIRCUIT BREAKERS CLOSED. THE BUS CROSSTIES (100A) WILL NOMINALLY NEVER BE CLOSED.					
	22-13	ELECTRICAL POWER WILL NEVER BE INTENTIONALLY APPLIED TO A SHORT TO HELP DETERMINE ITS LOCATION UNLESS THE FEEDER FAULT LIGHT HAS FAILED. A GOOD BUS WILL NEVER BE CROSSTIED INTO A SHORT OR POSSIBLE SHORT.					
	22-14	THE INVERTERS WILL BE SWITCHED FOR A VOLTAGE LESS THAN OR EQUAL TO 112 VAC OR A FREQUENCY GREATER THAN OR EQUAL TO 402 OR LESS THAN OR EQUAL TO 398 HZ.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	A	3/23/70	LM ELECTRICAL	MANAGEMENT	22-3

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM						
	22-15	BATTERY MANAGEMENT WILL BE PERFORMED ONLY DURING LUNAR STAY PERIODS AND THEN ONLY IF IT CAN PREVENT VIOLATION OF CONSUMABLE REDLINES DUE TO LOSS OF A SINGLE DESCENT BATTERY.					
	22-16	FOR A SHORTED DESCENT FEEDER, THE ASCENT BATTERIES WILL BE PLACED ON NORMAL FEED WITH THE SHORT ISOLATED VIA THE DEADFACE RELAY. OPERATIONALLY THIS RESULTS IN THE LOSS OF ALL REMAINING DESCENT ELECTRICAL ENERGY FOR CONSUMABLE CONSIDERATIONS. THE TWO DESCENT BATTERIES THAT STILL HAVE AN OPERABLE FEED PATH WILL BE USED ONLY IF NECESSARY TO MAINTAIN CREW SAFETY.					
	22-17	WITH THE LOSS OF ONE ASCENT BATTERY, THE REMAINING ASCENT BATTERY WILL BE PLACED ON BOTH NORMAL AND BACKUP FEEDS WITH THE CROSS-TIE CIRCUIT BREAKERS OPENED. ALSO PRIOR TO INITIATING AN ABORT STAGE THE DESCENT ECA C/B'S MUST BE OPENED TO PREVENT THE FAILED BATTERY FROM BEING AUTOMATICALLY PLACED ON LINE THRU ITS NORMAL FEEDPATH.					
	22-18	FOR AN OPEN DESCENT FEEDER OR FOR THE LOSS OF TWO DESCENT BATTERIES ON THE SAME BUS THE CROSS TIE BAL LOAD CIRCUIT BREAKERS WILL BE CLOSED ON THE LUNAR SURFACE AND THE MISSION CONTINUED WITHIN THE CONSUMMABLES BUDGET.					
	22-19	FOR A SHORTED ASCENT FEEDER ON THE LUNAR SURFACE, THE ASCENT BATTERIES WILL NOT BE CONNECTED UNTIL THE NOMINAL TIME TO MEET PRECONDITIONING REQUIREMENTS.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	A	3/23/70	LM ELECTRICAL	MANAGEMENT	22-4

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				----- SPECIFIC -----	
	22-20	LOSS OF EITHER DC BUS			REF MALF PROC EPS---
			ALL	A. DELAY STAGING ALAP	1 UNSTAGED DC BUS
			DOCKED	B. CONTINUE MISSION	2 STAGED DC BUS
				1. DO NOT UNDOCK	
				2. CREWMEN OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR	• LOSS OF DC BUS RESULTS IN LOSS OF ONE PYRO SYSTEM
				3. PERFORM LIMITED SYSTEMS EVALUATION	• LOSS OF EITHER DC BUS DURING DESCENT ENGINE BURNS RESULTS IN THROTTLING TO 100 PERCENT. IF ON INV 2, LOSS OF THE LMP BUS CAUSES THE ENG TO SHUT DOWN.
			UNDOCKED	C. DOCK ASAP/ NO GO CIRC	
			PRE-PDI	D. NO GO PDI/DOCK ASAP	
			POWERED DESCENT	E. ABORT DOCK ASAP	
			LUNAR STAY	F. LIFTOFF AT NEXT BEST OPPORTUNITY	

	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 13	FNL	2/12/70	LM ELECTRICAL	SPECIFIC	22-5	

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-21	SHORTED DC BUS FEEDER			REF MALF PROC EPS---
		A. DESCENT	ALL	A.1. CONTINUE MISSION	1 UNSTAGED DC BUS
			UNDOCKED	2. NO GO CIRC/DOCK ASAP	2 STAGED DC BUS
			PRE-PDI	3. DOCK ASAP	• SEE MANAGEMENT RULE 22-16
			POWERED DESCENT	4. ABORT DOCK ASAP	
			LUNAR STAY	5. LIFTOFF AT NEXT BEST OPPORTUNITY	
		B. ASCENT	ALL	B.1. DELAY STAGING ALAP	• SEE MANAGEMENT RULE 22-19
			DOCKED	2. CONTINUE MISSION	
				(A) DO NOT UNDOCK	
				(B) CREWMEN OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR	
				(C) PERFORM LIMITED SYSTEMS EVALUATION	
			UNDOCKED	3. DOCK ASAP/NO GO CIRC	
			PRE-PDI	4. NO GO PDI DOCK ASAP	
			POWERED DESCENT	5. ABORT DOCK ASAP	
			LUNAR STAY	6. LIFTOFF AT NEXT BEST OPPORTUNITY	

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	22-22	LOSS OF ASCENT BATTERY(S)			REF MALF PROC EPS---			
		A. LOSS OF ONE ASCENT BATTERY	DOCKED	A. 1. CONTINUE MISSION NO GO CIRC DO NOT STAGE UNLESS DESCENT BATTERIES AND O2 ARE DEPLETED	2 STAGED DC BUS 4 STAGED BATTERY			
			UNDOCKED					
			PRE-PDI	2. RETURN TO VICINITY OF CSM ASAP NO GO PDI DO NOT STAGE UNLESS DESCENT BATTERIES AND O2 ARE DEPLETED				
			POWERED DESCENT	3.(A) PDI TO PDI + 5+30 - ABORT DELAY STAGING ALAP (B) PDI + 5+30 TO TD - CONTINUE MISSION				
			LUNAR STAY	4. LIFTOFF AT NEXT BEST OPPORTUNITY				
		B. LOSS OF TWO ASCENT BATTERIES	ALL	B. 1. DO NOT STAGE DO NOT UNDOCK DOCK ASAP IF UNDOCKED	NOTE--- THIS RULE DOES NOT APPLY AFTER PDI + 5+30			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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SECTION 22 - LM ELECTRICAL POWER

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-23	LOSS OF DESCENT BATTERY(S)			REF MALF PROC EPS---
		A. LOSS OF ONE DESCENT BATTERY	ALL	A. CONTINUE MISSION	1 UNSTAGED DC BUS
		B. LOSS OF TWO DESCENT BATTERIES	ALL	B. CONTINUE MISSION	5 UNSTAGED BAT TB ABNORMAL
		C. LOSS OF THREE OR MORE DESCENT BATTERIES	DOCKED	C. 1. DO NOT UNDOCK OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR	NOTE--- SEE MANAGEMENT RULE 22-18. CONSUMABLES DICTATE GO/NO GO FOR REMAINING MISSION PHASES.
			UNDOCKED	2. DOCK ASAP, NO GO CIRC	
			PRE-PDI	3. NO GO PDI DOCK ASAP	
			POWERED DESCENT	4.(A) PDI TO LO GATE - ABORT DOCK ASAP	
				(B) LO GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	5. LIFT OFF AT NEXT BEST OPPORTUNITY	

		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	22-24	LOSS OF INVERTER(S)			REF MALF PROC EPS---		
		A. LOSS OF ONE INVERTER	ALL	A. 1. CONTINUE MISSION	6 INVERTER		
		B. LOSS OF BOTH INVERTERS	DOCKED UNDOCKED PRE-PDI POWERED DESCENT LUNAR STAY	B. 1. CONTINUE MISSION NO GO CIRC 2. DO NOT PERFORM PDI 3.(A) PDI TO LO GATE - ABORT (B) LO GATE TO TD - CONTINUE MISSION 4. CONTINUE MISSION	LOSS OF AC POWER RESULTS IN LOSS OF DPS GIMBALS, RR, S-BND STEERABLE ANT (HBR TM), BOTH FDAI SPHERES, HBR TM IS AVAILABLE FROM AN OMNI ANTENNA AND A 210 FT. MSFN SITE.		
	22-25	LOSS OF AC BUSES			REF MALF PROC EPS---		
		A. LOSS OF BUS A	DOCKED UNDOCKED PRE-PDI POWERED DESCENT/ LUNAR STAY	A. 1. CONTINUE MISSION NO GO CIRC 2. CONTINUE MISSION	6 INVERTER LOSS OF AC BUS A RESULTS IN LOSS OF DPS GIMBAL CONTROL, RENDZ RADAR, AND INTEGRAL LIGHTING LOSS OF AC BUS B RESULTS IN LOSS OF S-BAND STEERABLE ANTENNA (HBR TM) AND NUMERIC LIGHTING, HBR TM IS AVAILABLE FROM AN OMNI ANTENNA AND A 210 FT MSFN SITE.		
		B. LOSS OF BUS B	ALL	B. CONTINUE MISSION	LOSS OF BOTH AC BUSES RESULTS IN THE ABOVE PLUS LOSS OF BOTH FDAI SPHERES AND THE AOT		
		C. LOSS OF BOTH BUS A AND B	DOCKED/ UNDOCKED PRE-PDI POWERED DESCENT LUNAR STAY	C.1. CONTINUE MISSION- NO GO CIRC 2. DO NOT PERFORM PDI 3.(A) PDI TO LO GATE- ABORT (B) LO GATE TO TD - CONTINUE MISSION 4. CONTINUE MISSION			
		RULE NUMBERS 22-26 THROUGH 22-49 ARE RESERVED.					
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SECTION 22 - LM ELECTRICAL POWER - CONCLUDED

REV	ITEM	INSTRUMENTATION REQUIREMENTS					
	22-50	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	MISSION RULE REFERENCE	
		AC BUS FREQ	GC0155F	CAUT	1 OF 2	22-2,5,24,25	
		AC BUS VOLTS	GC0071V	METER, CAUT	M		
		BAT 1 CUR	GC1201C	METER	1 OF 2	M PCM	
		BAT 2 CUR	GC1202C	METER	M PCM		
		LMP BUS VOLTS	GC0302V	METER,CAUT	2 OF 3	22-2,10,14,20,21,22,23	
		BAT 1 VOLTS	GC0201V	METER	M		
		BAT 2 VOLTS	GC0202V	METER	}		
		BAT 5 VOLTS	GC0205V	METER			
		BAT 3 CUR	GC1203C	METER	1 OF 2		
		BAT 4 CUR	GC1204C	METER	M PCM		
		CDR BUS VOLTS	GC0301V	METER,CAUT	2 OF 3	M	
		BAT 3 VOLTS	GC0203V	METER	}		
		BAT 4 VOLTS	GC0204V	METER			
		BAT 6 VOLTS	GC0206V	METER			
		BAT 5 CUR	GC1205C	METER	M PCM	M PCM	
		BAT 6 CUR	GC1206C	METER	M PCM		
		BAT 1 MAL	GC9961U	CAUT, COMP	HD	22-2,10,14,20,21,23	
		BAT 2 MAL	GC9962U	CAUT, COMP	HD		
		BAT 3 MAL	GC9963U	CAUT, COMP	HD		
		BAT 4 MAL	GC9964U	CAUT, COMP	HD		
		BAT 5 MAL	GC9965U	CAUT, COMP	HD		
		BAT 6 MAL	GC9966U	CAUT, COMP	HD	22-2,10,20,21,22,23	
		BATTERY MAL	GL4047X	COMP	HD		
		BAT 1 LOW TAP	GC4362X	FLAG	HD	22-2,10,20,21,23	
		BAT 2 LOW TAP	GC4364X	FLAG	HD		
		BAT 3 LOW TAP	GC4365X	FLAG	HD		
		BAT 4 LOW TAP	GC4368X	FLAG	HD		
		BAT 5 B/U CDR	GC4369X	FLAG	HD	22-2,10,17,20,21,22	
		BAT 6 NORM CDR	GC4370X	FLAG	HD		
		BAT 5 NORM LMP	GC4371X	FLAG	HD		
		BAT 6 B/U LMP	GC4372X	FLAG	HD		
NOTE--- LOSS OF SEVERAL OF THE HD MEASUREMENTS ABOVE WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.							
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							22-10

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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV	ITEM												
	----- ' GENERAL ' ----- 23-1 TO INITIATE THE MANNED LM PHASES THE ENVIRONMENTAL CONTROL SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES--- NOTE LM ACTIVE RENDEZVOUS/CONTINGENCY RETURN IS ASSUMED A. DOCKED WITH HATCH OPEN AND TUNNEL CLEAR 1. COMBINED VEHICLE PRESSURE INTEGRITY 2. ONE LM COOLANT LOOP B. DOCKED WITH HATCH CLOSED 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP INTEGRITY 3. ONE SUIT FAN 4. ONE COOLANT LOOP 5. SUFFICIENT O2, H2O, AND LIQH CONSUMABLES TO COMPLETE THE PLANNED ACTIVITY PERIOD PLUS A RESERVE OF 1 HOUR C. UNDOCKED/SEPARATION AND SUBSEQUENT PHASES SEE LM TELMU GO/NO GO CRITERIA - PAGE 3-18.												
	<table border="1"> <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 13</td> <td>FNL</td> <td>2/12/70</td> <td>LM ENVIRONMENTAL CONTROL</td> <td>GENERAL</td> <td>23-1</td> </tr> </tbody> </table>	MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 13	FNL	2/12/70	LM ENVIRONMENTAL CONTROL	GENERAL	23-1
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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-22	SUIT FAN(S) FAILURE			• REF MALF PROC ECS---
		A. ONE SUIT FAN	ALL	A.1. CONTINUE MISSION	7A ECS
		B. TWO SUIT FANS	DOCKED	B.1. CONTINUE MISSION WITH TUNNEL CLEAR AND ON TRANSFER UMBILICAL OR CW GARMENT W/O SUIT	B. REMOVE HELMET AND GLOVES • REF MALF PROC ECS---
				NO-GO FOR UNDOCKING	4 SUIT FAN
			UNDOCKED	2. DOCK ASAP NO-GO FOR CIRC DO NOT STAGE WHILE UNDOCKED	
			PRE-PDI	3. DOCK ASAP DO NOT STAGE WHILE UNDOCKED	
		POWERED DESCENT		4.(A) PDI TO PDI + 5+30 ABORT DOCK ASAP DO NOT STAGE (B) PDI + 5+30 TO LO GATE ABORT (C) LO GATE TO TD CONTINUE MISSION	PLACE DEMAND REG B TO "DIRECT 02" IMMEDIATELY OR REMOVE HELMETS (MUST BE REMOVED FOR STAGING.)
		LUNAR STAY		5. LIFTOFF AT NEXT BEST OPPORTUNITY	RETAIN PLSS'S FOR ASCENT IF POSSIBLE.
		RNDZ		6. DOCK ASAP	

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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS														
	23-23	DEMAND REGULATOR(S) FAIL OPEN OR CLOSED			• REF MALF PROC ECS---														
		A. ONE REGULATOR	ALL	A. CONTINUE MISSION	3 CABIN PRESS IND HI														
					6 O2 QTY														
		B. TWO REGULATORS	DOCKED/ UNDOCKED/ PRE-PDI POWERED DESCENT LUNAR STAY RNDZ	B.1. CONTINUE MISSION DO NOT UNDOCK NO GO CIRC NO GO PDI CONTINUE MISSION 4. DO NOT DEPRESS CABIN LIFTOFF NEXT BEST OPPORTUNITY 5. CONTINUE MISSION															
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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-25	LOSS OF O2 TANK(S)			
		A. ONE ASCENT TANK	ALL	A. CONTINUE MISSION	
		B. TWO ASCENT TANKS	DOCKED	B.1. DO NOT UNDOCK	
			UNDOCKED PRE-PDI	2. DOCK ASAP NO GO CIRC NO GO PDI DELAY STAGING ALAP	
			POWERED DESCENT	3.(A) PDI TO PDI + 5+30 ABORT DELAY STAGING ALAP	
				(B) PDI + 5+30 TO LO GATE ABORT	
				(C) LO GATE TO TOUCHDOWN CONTINUE MISSION	3(C) ASSUMES DESCENT O2 STILL AVAILABLE
			LUNAR STAY	4. STAY WITHOUT EVA	
			RNDZ	5. CONTINUE MISSION	
		C. DESCENT TANK	DOCKED	C.1. CONTINUE MISSION	
			UNDOCKED/ PRE-PDI	2. DOCK ASAP NO GO CIRC NO GO PDI	
			POWERED DESCENT	3. CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY	

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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	23-27	LOSS OF PRIMARY H2O FEEDPATH	'DOCKED 'UNDOCKED 'PRE-PDI 'POWERED 'DESCENT 'LUNAR 'STAY 'RNDZ	'CONTINUE MISSION 'NO-GO FOR UNDOCKING 'NO GO FOR CIRC 'RETURN TO VICINITY OF CSM '1. PDI TO PDI + 5+30 ABORT '2. PDI + 5+30 TO TD - CONTINUE MISSION 'LIFTOFF NEXT BEST 'OPPORTUNITY 'CONTINUE MISSION	• REF MALF PROC ECS--- 8 GLYCOL			
	23-28	LOSS OF H2O TANK(S) A. ONE ASCENT TANK B. TWO ASCENT TANKS C. DESCENT TANK	'ALL 'DOCKED 'UNDOCKED 'PRE-PDI 'POWERED 'DESCENT 'LUNAR 'STAY 'RNDZ 'DOCKED 'UNDOCKED/ 'PRE-PDI 'POWERED 'DESCENT/ 'LUNAR 'STAY	'A. CONTINUE MISSION 'B.1. CONTINUE MISSION NO GO CIRC 2. RETURN TO VICINITY OF CSM ASAP DO NOT STAGE NO GO PDI 3.(A) PDI TO PDI + 5+30 ABORT DO NOT STAGE (B) PDI + 5+30 TO LO-GATE ABORT (C) LO GATE TO TOUCHDOWN CONTINUE MISSION 4. LIFTOFF NEXT BEST OPPORTUNITY 5. CONTINUE MISSION 'C.1. CONTINUE MISSION 2. NO GO CIRC NO GO PDI 3. CONTINUE MISSION WITH ASCENT CONSUMABLES CAPABILITY	CREW MAY ELECT TO REMOVE PGA'S FOR COOLING.			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
23-29	FIRE OR SMOKE IN CABIN OR SUIT	ALL		TROUBLESHOOT/COMBAT FIRE	REF AOH PROC 5.3.2
				ASSESS DAMAGE AND TRANSFER TO CSM IF NECESSARY	
23-30	CONTAMINATION IN CABIN	ALL		CREW MAY ELECT TO DECOMPRESS	IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY.
23-31	GLYCOL COOLANT LEAK	ALL		TRANSFER TO CSM	REF MALF PROC ECS---
	A. CABIN	ALL		A. PURGE SUIT WITH DIRECT O2	8 GLYCOL
	B. SUIT	ALL		B. DISCONNECT FROM SUIT LOOP	
	RULE NUMBERS 23-32 THROUGH 23-49 ARE RESERVED.				

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SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM						
		----- ' GENERAL ' -----					
	24-1	RESERVED					
	24-2	DEFINITIONS 3-AXIS ATTITUDE CONTROL 3-AXIS ATTITUDE CONTROL IS DEFINED AS THE ABILITY TO CHANGE THE EXISTING VEHICLE ATTITUDE. TO HAVE THIS CAPABILITY THE LM REQUIRES AN OPERATIONAL MANUAL OR AUTOMATIC CONTROL SYSTEM. GUIDANCE STEERING GUIDANCE STEERING IS DEFINED AS THE ABILITY TO CALCULATE THE DESIRED LM THRUST VECTOR DURING A POWERED MANEUVER. AN OPERATIONAL PGNS OR AGS IS REQUIRED FOR GUIDANCE STEERING. OPERATIONAL PGNS AN OPERATIONAL PGNS IS DEFINED AS NO LGC FAILURE, NO ISS FAILURE, NO DSKY FAILURES, AND NO CES FAILURES PREVENTING ATTITUDE CONTROL. A. ANY FAILURE OF THE LGC HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED AN LGC FAILURE. B. ANY FAILURE WITHIN THE IMU, CDU, PTA, OR THE PSA WHICH WOULD CAUSE A PERMANENT LOSS OF THE INERTIAL ATTITUDE AND VELOCITY MEASUREMENT, IS CONSIDERED AN ISS FAILURE. C. ANY FAILURE OF THE DSKY HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED A DSKY FAILURE. D. ANY FAILURE OF THE CES HARDWARE THAT PREVENTS ATTITUDE CONTROL WHILE IN PGNS IS CONSIDERED A CES FAILURE. OPERATIONAL AGS AN OPERATIONAL AGS IS DEFINED AS NO AEA FAILURE, NO ASA FAILURE, NO DEDA FAILURE, AND NO CES FAILURE PREVENTING ATTITUDE CONTROL. A. ANY FAILURE OF THE AEA HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED AN AEA FAILURE. B. ANY FAILURE OF THE ASA HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CAUSE LOSS OF THE VEHICLE ATTITUDE AND VELOCITY MEASUREMENTS IS CONSIDERED AN ASA FAILURE. C. ANY FAILURE OF THE DEDA HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED A DEDA FAILURE. D. ANY FAILURE OF THE CES HARDWARE THAT PREVENTS ATTITUDE CONTROL WHILE IN AGS IS CONSIDERED A CES FAILURE. 3-AXIS TRANSLATION 3-AXIS TRANSLATION IS DEFINED AS THE ABILITY TO CHANGE THE VEHICLE VELOCITY, PLUS OR MINUS, ALONG EACH BODY AXIS. TO HAVE THIS CAPABILITY THE LM REQUIRES ONE TTCA AND AN OPERATIONAL PGNS OR OPERATIONAL CES CIRCUITRY.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	LM GUIDANCE AND CONTROL	GENERAL	24-1

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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM																	
		----- ' MANAGEMENT ' -----																
24-3	IMU	A. IRIG BIAS UPDATES WILL BE ACCOMPLISHED AS FOLLOWS--- 1. INFLIGHT, WHEN GYRO DRIFT IS GREATER THAN OR EQUAL TO $\pm .075$ DEG/HR (5 MERU) 2. ON LUNAR SURFACE, WHENEVER THE GYRO DRIFT IS GREATER THAN OR EQUAL TO $\pm .075$ DEG/HR (5 MERU) AS CALCULATED BETWEEN TWO ALIGNMENTS USING THE SAME OPTION AND ALIGNMENT TECHNIQUE. B. THE PGNS WILL BE CONSIDERED NO-GO WITH A GYRO DRIFT GREATER THAN OR EQUAL TO ± 1.5 DEG/HR (100 MERU). THE MAXIMUM ALLOWABLE VALUE WITHIN THE LGC IS ± 1.93 DEG/HR (128 MERU). C. PIPA BIAS UPDATES WILL BE ACCOMPLISHED AS FOLLOWS--- 1. NO BIAS UPDATES WILL BE ACCOMPLISHED PRIOR TO 30 MIN OF IMU OPERATION. 2. THE INITIAL BIAS UPDATES WILL BE ACCOMPLISHED IF THE ABSOLUTE VALUE IS GREATER THAN OR EQUAL TO ± 0.1 CM/SEC/SEC AND THE DELTA BIAS IS GREATER THAN OR EQUAL TO ± 0.03 CM/SEC/SEC. 3. SUBSEQUENT TO THE INITIAL BIAS UPDATE, UPDATES WILL BE ACCOMPLISHED WHENEVER THE ABSOLUTE BIAS IS GREATER THAN OR EQUAL TO ± 0.1 CM/SEC/SEC AND THE DELTA BIAS IS GREATER THAN OR EQUAL TO ± 0.1 CM/SEC/SEC. 4. PIPA BIAS WILL NOT BE UPDATED WHILE THE LM IS ON THE LUNAR SURFACE. D. PGNS NO-GO FOR PIPA BIAS--- THE PGNS WILL BE CONSIDERED NO-GO IF THE PIPA BIAS EXCEEDS ± 5.06 CM/SEC / SEC (.166 FT/SEC / SEC). THE MAXIMUM LOAD VALUE WITHIN THE LGC IS ± 12.5 CM/SEC / SEC.																
24-4	LGC	A. A MASS UPDATE IS REQUIRED IF THE DIFFERENCE BETWEEN THE GROUND CALCULATION AND LGC VALUE DIFFER BY MORE THAN 200 LBS. B. ALL $\pm(U=V)$ JETS WILL BE INHIBITED VIA V65 DURING DOCKED DPS BURNS. C. DURING DOCKED MANEUVERS, ALL DPS GIMBAL TRIMMING MUST BE DONE AT GREATER THAN 35 PERCENT THROTTLE IN THE AUTO THROTTLE MODE. THE RECOMMENDED SETTING IS 40 PERCENT THROTTLE.																
24-5	RENDEZVOUS RADAR	A. THE RR MUST NOT BE OPERATED UNTIL 2 1/2 HOURS AFTER OPERATE HEATER ACTIVATION AND THE ANTENNA TEMPERATURE (HPM) IS GREATER THAN OR EQUAL TO 10 DEG. F AND THE GYRO PACKAGE IS ESTIMATED TO BE GREATER THAN OR EQUAL TO 15 DEG F. B. THE RR SHOULD NOT BE OPERATED AT AN ANTENNA TEMPERATURE GREATER THAN OR EQUAL TO 145 DEG F AND/OR A GYRO PACKAGE TEMP (ESTIMATED) OF GREATER THAN OR EQUAL TO 200 DEG F. C. IF IT IS ESTIMATED THAT THE RR GYRO PACKAGE WILL EXCEED 200 DEG F (HPM APPROX. 135 DEG F) PRIOR TO COMPLETION OF THE BRAKING PHASE, THE RR SHOULD BE TURNED OFF UNTIL REQUIRED FOR TPI AND BRAKING. D. IF THE ESTIMATED GYRO PACKAGE TEMP SHOULD EXCEED 200 DEG F (HPM APPROX. 135 DEG F) ANYTIME DURING THE BRAKING PHASE, THE AC POWER TO THE RR SHOULD NOT BE TURNED OFF. E. IF THE RR ANTENNA TEMP (HPM) EXCEEDS THE NOMINAL TEMP PROFILE BY 15 DEG F, THE RR SHOULD BE TURNED OFF IF IT IS NOT NEEDED. F. IF THE RR OVEN HEATERS ARE TURNED OFF (BOTH THE PGNS--- RNDZ RDR AND HEATERS---RNDZ RDR OPR OPEN) RR RANGE DATA MUST NOT BE USED UNTIL 17 MIN AFTER RE-ENERGIZING, ASSUMING THE OVEN TEMP HAS DROPPED TO THE COLD RAIL TEMP.																
		<table><tr><td></td><td>MISSION</td><td>REV</td><td>DATE</td><td>SECTION</td><td>GROUP</td><td>PAGE</td><td></td></tr><tr><td></td><td>APOLLO 13</td><td>FNL</td><td>2/12/70</td><td>LM GUIDANCE AND CONTROL</td><td>MANAGEMENT</td><td>24-2</td><td></td></tr></table>		MISSION	REV	DATE	SECTION	GROUP	PAGE			APOLLO 13	FNL	2/12/70	LM GUIDANCE AND CONTROL	MANAGEMENT	24-2	
	MISSION	REV	DATE	SECTION	GROUP	PAGE												
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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM						
	24-6	LANDING RADAR					
		A. THE LR SHOULD NOT NORMALLY BE OPERATED AT AN ANTENNA TEMP LESS THAN + 50 DEG F. HOWEVER, THE LUNAR LANDING MISSION WILL BE ATTEMPTED IF THE ANTENNA TEMP IS ABOVE THE CRITICAL LIMIT OF -15 DEG F (HARDWARE DAMAGE). B. LR ACTIVATION WILL BE DELAYED TO PDI + 4 MIN IF THE LR TEMP IS GREATER THAN 125 DEG F. AT NOMINAL TIG -10 MIN (LR ACTIVATION).					
	24-7	AGS					
		A. THE AGS IS DECLARED NO-GO WITH A TEMPERATURE OF LESS THAN + 40 DEG F OR GREATER THAN + 150 DEG F. B. THE AGS IS DECLARED NO-GO DURING A GYRO AND ACCELEROMETER CALIBRATION IF THE GYRO DRIFT CHANGE IS GREATER THAN 2.00 DEG/HR AND IF THE ACCELEROMETER BIAS CHANGE IS GREATER THAN 0.039 FT/SEC/SEC FROM THE VALUE AT THE START OF THE CALIBRATION. C. THE AGS MUST BE UPDATED WITHIN 7 MINUTES OF A BURN. D. THE AGS CAN BE USED TO PERFORM DOCKED ATTITUDE HOLD CONTROL. E. THE AGS IN PULSE MODE USING ONLY TTCA CONTROL CAN BE USED TO PERFORM A DOCKED BURN.					
		RULE NUMBERS 24-8 THROUGH 24-19 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	LM GUIDANCE AND CONTROL	MANAGEMENT	24-3

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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				----- SPECIFIC -----	
	24-20	LOSS OF GUIDANCE AND STEERING			
		A. OPERATIONAL AGS	ALL	CONTINUE MISSION	• REF MALF PROC AGS--- 1 AGS WARNING LIGHT 2 DEDA RESPONSE IS ABNORMAL
		B. OPERATIONAL PGNS	DOCKED/ UNDOCKED	1. (A) RETURN TO CSM (B) NO-GO FOR CIRC	• REF MALF PROC PGNS--- 1 LGC WARN
			PRE-PDI	2. (A) RETURN TO CSM ASAP (B) NO-GO FOR PDI	2 ISS WARN 3 TEMP CAUTION 4 GIMBAL LOCK
			POWERED DESCENT	3. (A) PRIOR TO HI GATE ABORT (B) AFTER HI GATE (1) LAND MANUALLY (2) NO-GO FOR EXTENDED LUNAR STAY	
			LUNAR STAY	4. ASCEND AT THE NEXT BEST OPPORTUNITY	
			RNDZ	5. (A) SWITCH TO AGS (B) CONTINUE MISSION	
	24-21	LOSS OF FDAI FUNCTIONS (ATT, RATES, ERRORS)	ALL	CONTINUE MISSION CREW OPTION	
	24-22	LOSS OF AOT	ALL	CONTINUE MISSION	

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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-23	LOSS OF RENDEZVOUS RADAR AND/OR TRANSPONDER	DOCKED/ UNDOCKED ALL OTHERS	1. RETURN TO CSM ASAP 2. NO-GO FOR CIRC CONTINUE MISSION	. REF MALF PROC PGNS--- 5 TRACKER 8 RNDZ RADAR CAUTION .8A NO TRACK REF MALF PROC HTRS--- 1C RR TEMP ABNORMAL
	24-24	LOSS OF LANDING RADAR	DOCKED/ UNDOCKED PRE-PDI POWERED DESCENT	1. RETURN TO CSM ASAP 2. NO-GO FOR CIRC 1. RETURN TO CSM ASAP 2. NO-GO FOR PDI 1. PRIOR TO ADEQUATE ALTITUDE UPDATING OF LM STATE VECTORS--- (A) NO-GO FOR LANDING (B) ABORT 2. AFTER ADEQUATE ALTITUDE UPDATING OF LM STATE VECTORS--- CONTINUE MISSION	1. GUIDO TO DECIDE WHEN ADEQUATE UPDATING OF LM STATE VECTORS HAS BEEN ACCOMPLISHED. REF MALF PROC PGNS--- 6 ALT LT 7 VEL LT REF MALF PROC HTRS--- 2 LR TEMP ABNORMAL
	24-25	VHF RANGING/OPTICAL TRACKING A. LOSS OF EITHER B. LOSS OF BOTH RULES 24-26 THROUGH 24-27 ARE RESERVED	ALL DOCKED/ UNDOCKED ALL OTHERS	A. CONTINUE MISSION B.1.(A) RETURN TO CSM ASAP (B) NO GO FOR CIRC 2. CONTINUE MISSION	CSM OPTICAL TRACKING CAPABILITY REQUIRES THE LM TRACKING LIGHT AND THE ABILITY TO VISUALY TRACK.

	MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

SECTION 24 LM GUIDANCE AND CONTROL							
REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	24-28	LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL	'DOCKED/ 'UNDOCKED	'A.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR CIRC			
			'PRE-PDI	'2.(A) RETURN TO CSM ASAP (B) NO-GO FOR PDI			
			'POWERED 'DESCENT	'3.(A) PRIOR TO HI GATE ABORT (B) AFTER HI GATE LANDING IS CREW OPTION			
			'LUNAR 'STAY	'4. ASCEND AT NEXT BEST OPPORTUNITY			
			'RNDZ	'5. CONTINUE MISSION			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV		ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
		24-29	LOSS OF TRANSLATION CAPABILITY			
			A. AUTOMATIC ULLAGE (+X)	DOCKED/ UNDOCKED	A.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR CIRC	A.1. CAN NOT DETECT FAILURE UNTIL LGC COMMANDS ULLAGE
				PRE-PDI	2.(A) RETURN TO CSM ASAP (B) NO-GO FOR PDI	. REF MALF PROC CES---
				POWERED DESCENT	3.(A) PRIOR TO PDI (1) RETURN TO CSM ASAP (2) PDI INHIBITED (3) DO NOT BACK UP ULLAGE MANUALLY (4) NO-GO FOR LANDING (B) AFTER PDI CONTINUE MISSION	1 ABNORMAL VEHICLE DYNAMICS 6 TTCA CMDS ABNORMAL
			B. ALL TTCA TRANSLATION	DOCKED/ UNDOCKED	C.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR CIRC	
				PRE-PDI/ POWERED DESCENT/ LUNAR STAY	2. CONTINUE MISSION	
				RNDZ	3. NO-GO FOR LM ACTIVE DOCKING	

SECTION 24 - LM GUIDANCE AND CONTROL

24-8

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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	24-34	LOSS OF AUTO THRUST CONTROL	ALL	CONTINUE MISSION	• REF MALF PROC CES--- 11 ENG THR AND CMD DO NOT AGREE/ OFF SCHEDULE.			
	24-35	LOSS OF MANUAL THRUST CONTROL	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP 2. NO-GO FOR CIRC	SEE MANAGEMENT RULE 25-13 FOR ALLOWABLE TIME IN NON THROTTABLE REGION.			
			PRE-PDI	1. RETURN TO CSM ASAP 2. NO-GO FOR PDI	• REF MALF PROC CES---			
		POWERED DESCENT		1. DO NOT SWITCH TO MANUAL THROTTLE 2. SELECT OTHER TTCA A. MANUAL THROTTLE CONTROL REGAINED 1. WITHIN ALLOWABLE TIME - CONTINUE MISSION 2. NOT WITHIN ALLOWABLE TIME - ABORT B. NO MANUAL THROTTLE CONTROL 1. PRIOR TO HI GATE - ABORT 2. AFTER HI GATE - CREW OPTION	11 ENG THR AND CMD THR DO NOT AGREE/ OFF SCHEDULE			
	24-36	LOSS OF LUNAR CONTACT LIGHTS	POWERED DESCENT	CONTINUE MISSION				
		RULE NUMBER 24-37 THROUGH 24-39 ARE RESERVED						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 24 - M GUIDANCE AND CONTROL - CONTINUED

REV	ITEM	PRELAUNCH INSTRUMENTATION					MISSION RULE REFERENCE
24-40	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY		
	LGC DOWNLINK	GG0001U	-	-	M		24-20
	PLS TORO REF	GG1040V	-	-	HD		24-20
	2.5 VDC TM BIAS	GG1110V	-	-	HD		24-20
	IMU 28 VAC 800	GG1201V	-	-	HD		24-20
	IRIG SUSP 3.2 KC	GG1331V	-	-	HD		24-20
	IMU STBY	GG1513X	-	-	HD		24-20
	LGC OPR	GG1523X	-	-	HD		24-20
	X PIPA OUT IN PHASE	GG2001V	-	-	HD		24-20
	Y PIPA OUT IN PHASE	GG2021V	-	-	HD		24-20
	Z PIPA OUT IN PHASE	GG2041V	-	-	HD		24-20
	IG SVO ERR IN PHASE	GG2107V	-	-	HD		24-20
	IG IX RSVR OUT SIN	GG2112V	FDAI	COMMON	HD		24-20
	IG IX RXVR OUT COS	GG2113V	FDAI	COMMON	HD		24-20
	MG SVO ERR IN PHASE	GG2137V	-	-	HD		24-20
	MG IX RSVR OUT SIN	GG2142V	FDAI	COMMON	HD		24-20
	MG IX RSVR OUT COS	GG2143V	FDAI	COMMON	HD		24-20
	OG SVO ERR IN PHASE	GG2167V	-	-	HD		24-20
	OG RSVR OUT SIN	GG2172V	FDAI	COMMON	HD		24-20
	OG RSVR OUT COS	GG2173V	FDAI	COMMON	HD		24-20
	PITCH ATT ERR	GG2219V	FDAI	COMMON	HD - PCM		24-20
	YAW ATT ERR	GG2249V	FDAI	COMMON	HD - PCM		24-20
	ROLL ATT ERR	GG2279V	FDAI	COMMON	HD - PCM		24-20
	PIPA TEMP	GG2300T	C&W	SEPARATE	HD - PCM		24-20
	RR SHFT SIN	GG3304V	FDAI	COMMON	HD - PCM		24-23
	RR SHFT COS	GG3305V	FDAI	COMMON	HD - PCM		24-23
	RR TRUN SIN	GG3324V	FDAI	COMMON	HD - PCM		24-23
	RR TRUN COS	GG3325V	FDAI	COMMON	HD - PCM		24-23
	LGC WARNING	GG9001X	C&W	COMMON	HD - PCM		24-20
	ISS WARNING	GG9002X	C&W	COMMON	HD - PCM		24-20
	LR ANT TEMP	GN7563T	TEMP MONITOR	COMMON	HD - PCM		24-23
	RR NO TRACK	GN7621X	C&W	COMMON	HD - PCM		24-23
	RR ANT TEMP	GN7723T	TEMP MONITOR	COMMON	HD - PCM		24-23
	YAW ERR CMD	GH1247V	-	-	M		24-28
	PITCH ERR CMD	GH1248V	-	-	M		24-28
	ROLL ERR CMD	GH1249V	-	-	M		24-28
	JD A4D OUTPUT	GH1419V	-	-	HD		24-27
	RCS TCP A4D	GR5032X	-	-	HD		24-27
	JD B3D OUTPUT	GH1423V	-	-	HD		24-27
	RCS TCP B3D	GR5036X	-	-	HD		24-27
	JD A2D OUTPUT	GH1427V	-	-	HD		24-27
	RCS TCP A2D	GR5040X	-	-	HD		24-27
	JD B1D OUTPUT	GH1431V	-	-	HD		24-27
	RCS TCP B1D	GR5044X	-	-	HD		24-27
	JD B4U OUTPUT	GH1418V	-	-	HD		24-27
	JD B4F OUTPUT	GH1420V	-	-	HD		24-27
	JD A4R OUTPUT	GH1421V	-	-	HD		24-27
	JD A3U OUTPUT	GH1422V	-	-	HD		24-27
	JD B3A OUTPUT	GH1424V	-	-	HD		24-27
	JD A3R OUTPUT	GH1425V	-	-	HD		24-27
	JD B2U OUTPUT	GH1426V	-	-	HD		24-27
	JD A2A OUTPUT	GH1428V	-	-	HD		24-27
	JD B2L OUTPUT	GH1429V	-	-	HD		24-27
	JD A1U OUTPUT	GH1430V	-	-	HD		24-27
	JD A1F OUTPUT	GH1432V	-	-	HD		24-27
	JD B1L OUTPUT	GH1433V	-	-	HD		24-27
	RCS TCP B4U	GR5031X	-	-	HD		24-27
	RCS TCP B4F	GR5033X	-	-	HD		24-27
	RCS TCO A4R	GR5034X	-	-	HD		24-27
	RCS TCP A3U	GR5035X	-	-	HD		24-27
	RCS TCP B3A	GR5037X	-	-	HD		24-27
	RCS TCP A3R	GR5038X	-	-	HD		24-27
	RCS TCP B2U	GR5039X	-	-	HD		24-27
	RCS TCP A2A	GR5041X	-	-	HD		24-27
	RCS TCP B2L	GR5042X	-	-	HD		24-27
	RCS TCP A1U	GR5043X	-	-	HD		24-27
	RCS TCP A1F	GR5045X	-	-	HD		24-27
	RCS TCP B1L	GR5046X	-	-	HD		24-27
	YAW ATT ERR	GH1455V	FDAI	COMMON	HD		24-28
	PITCH ATT ERR	GH1456V	FDAI	COMMON	HD		24-28
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REV	ITEM							MISSION RULE
		MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	REFERENCE	
	24-40 CONT							
		ROLL ATT ERR	GH1457V	FDAI	COMMON	HD	24-28	
		RGA YAW RATE	GH1461V	FDAI	COMMON	M ON BOARD	24-28	
		RGA PITCH RATE	GH1462V	FDAI	COMMON	M PCM/HD	24-28	
		RGA ROLL RATE	GH1463V	FDAI	COMMON	M	24-28	
		AGS SEL	GH1621X	-	-	HD	24-33	
		ROLL PLSD/DIR	GH1628X	-	-	HD	24-33	
		PITCH PLSD/DIR	GH1629X	-	-	HD	24-33	
		YAW PLSD/DIR	GH1630X	-	-	HD	24-33	
		AUTO ON	GH1214X	-	-	HD	24-31	
		APS ARM	GH1230X	-	-	M	24-31	
		ENG FIRE OVRD	GH1286X	-	-	HD	24-31	
		MAN THRUST CMD	GH1311V	METER	SEPARATE	M	24-34, 24-35	
		PITCH GDA POS	GH1313V	-	-	M	24-30	
		ROLL GDA POS	GH1314V	-	-	M	24-30	
		P TRM FAIL	GH1323X	C&W	COMMON	HD	24-30	
		R TRM FAIL	GH1330X	C&W	COMMON	HD	24-30	
		AUTO THRUST CMD	GH1331V	METER	SEPARATE	HD	24-34	
		DPS ARM	GH1348X	-	-	HD	24-32, 24-31	
		VAF: INJ ACT POS	GQ6806H	-	-	HD	24-34, 24-35	
		CES AC PWR FAIL	GL4026X	C&W	COMMON	HD	24-30	
		CES DC PWR FAIL	GL4027X	C&W	COMMON	HD	24-30	
		AGS DOWNLINK DATA	GI0001X	-	-	HD	24-33	
		ASA TEMP	GI3301T	-	-	HD	24-33	
		ASA PWR/AEA FAIL	GL4028X	C&W	COMMON	HD	24-33	
		AUTO OFF	GH1217X	-	-	HD	24-32, 24-31	
		AGS AUTO	GH1641X	-	-	HD	24-27	
		AGS ATT HOLD	GH1642X	-	-	HD	24-27	
		PGNS AUTO	GH1643X	-	-	HD	24-27	
		PGNS ATT HOLD	GH1644X	-	-	HD	24-27	
		LR RNG DATA NO GOOD	GN7521X	C&W	COMMON	HD		
		LR VEL DATA NO GOOD	GN7557X	C&W	COMMON	HD		
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SECTION 25 - LM PROPULSION - DPS

' GENERAL '

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MISSION RULES

SECTION 25 - LM PROPULSION - DPS

REV	ITEM						
	25-11	THE DPS ENGINE WILL NOT NORMALLY BE OPERATED FOR LESS THAN 3.5 SEC. A 2 SEC COAST BEFORE RESTART AT LTP AND A 30 MINUTE COAST BEFORE RESTARTS GREATER THAN LTP IS REQUIRED.					
	25-12	RESERVED					
	25-13	87 SECONDS IN THE NON THROTTABLE REGION (65 PERCENT TO FTP) IS AN ALLOWABLE EVENT AND ALLOWS COMPLETION OF THE NOMINAL MISSION DUTY CYCLE.					
	25-14	FROM A SAFETY STANDPOINT SUPERCRITICAL HELIUM BURST DISC RUPTURE DURING MANNED OPERATION IS AN ALLOWABLE EVENT.					
	25-15	PROPELLANT GAGING A. PRIME METHOD--- PQGS (TM, ONBOARD) (1.3 PERCENT) B. BACKUP METHOD--- GROUND MASS CALCULATION (3 PERCENT FOR GAGING)					
	25-16	IF POWERED DESCENT IS ABORTED DURING DPS INSERTION CAPABILITY OR IF A DOCKED DPS CONTINGENCY IS REQUIRED, THE DES HE REG 1 AND REG 2 VALVES SHOULD BE CLOSED AT A PQGS READING OF 37 PERCENT TO INSURE A LOW ENOUGH TANK PRESSURE TO PREVENT A VIOLATION OF FRACTURE MECHANICS LIMITS FROM HEAT SOAK BACK.					
		RULE NUMBERS 25-17 THROUGH 25-29 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	B	4/9/70	LM PROPULSION -DPS	GENERAL - DPS	25-2

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MISSION RULES

SECTION 25 - LM PROPULSION - DPS

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	25-30	LOSS OF OPERATIONAL DPS (PRIOR TO LOW GATE REF MR 25-2 FOR DEFINITION. AFTER LOW GATE ONLY LOW INLET PRESSURES LESS THAN 150 PSIA)	DOCKED/ UNDOCKED PRE-PDI POWERED DESCENT	A. INHIBIT DPS BURNS B. RNDZ ASAP 1. INHIBIT PDI 2. RNDZ WITH APS C. ABORT STAGE	REF MAL PROC DPS--- 1 DES REG 1A FUEL/OXID PRESS ABNORMAL 2 FUEL/OXID TEMP ABNORMAL 3 HE PRESS ABNORMAL
	25-31	START TANK LEAK PRIOR TO PRESSURIZATION A. FUEL AND/OR OXID ENGINE INLET P GREATER THAN 30 PSIA. B. FUEL AND/OR OXID ENGINE INLET P LESS THAN 30 PSIA.	ALL	A. CONTINUE MISSION INHIBIT FIRING DPS START TANK SQUIB B. CONTINUE MISSION 1. FIRE SQUIB TO START TANK	REF MAL PROC DPS--- 3 HE PRESS ABNORMAL NOTE PRESSURIZATION SYSTEM MAY BE OPENED TO START TANK LEAK. CLOSE PRIMARY HE REG SOV AFTER EACH BURN AND REOPEN AT INITIATION OF EACH BURN.
	25-32	RESERVED			
	25-33	LOSS OF SUPERCRITICAL PRESSURE (DPS IN BLOWDOWN MODE) A. WITHOUT FTP BLOWDOWN CAPABILITY B. WITH FTP BLOWDOWN CAPABILITY	POWERED DESCENT	A. ABORT ABORT STAGE PRIOR TO INLET PRESSURES LESS THAN OR EQUAL TO 150 PSIA. (ULLAGE PRESSURE LESS THAN 160 PSIA.) B. CONTINUE MISSION	REF MAL PROC DPS 3 HE PRESS ABNORMAL REF RULE 25-2.

	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 13	FNL	2/12/70	LM PROPULSION -DPS	SPECIFIC-DPS	25-3	

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MISSION RULES

SECTION 25 - LM PROPULSION - DPS

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	25-34	LEAK BETWEEN SHE SQUIB AND QUAD CHECK VALVES DETECTED---	ALL	A. PRESSURIZE DPS WITH AMB TANK WHILE IN SITE COVERAGE 1. INHIBIT DPS BURNS FOR LEAK RATE GREATER THAN 20 PSI/SEC. 2. IF LEAK RATE LESS THAN 20 PSI/SEC (A) CLOSE HE REG 1 (B) OPEN DES HE REG 1 OR 2 IMMEDIATELY AFTER IGNITION.	REF MAL PROC DPS 1 DES REG 3 HE PRESS ABNORMAL NOTE--- MSFN WILL EVALUATE WHICH REG TO OPEN			
		RULE NUMBER 25-35 RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	LM PROPULSION -DPS	SPECIFIC-DPS	25-4	

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MISSION RULES

SECTION 25 - LM PROPULSION - DPS

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	25-36	93 SEC AFTER LO LEVEL SENSE	POWERED DESCENT	CREW EVALUATION LAND OR ABORT	5 SEC CAPABILITY AT FTP 20 SEC CAPABILITY AT 25 PERCENT THROTTLE			
	25-37	LOW LEVEL CONFIRMS INSUFFICIENT PROPELLANT TO LAND OR DELTA BETWEEN FUEL AND OXIDIZER PQGS READINGS GREATER THAN 13 PERCENT	POWERED DESCENT	A. ABORT B. ABORT STAGE AT DPS DEPLETION	REF MAL PROC DPS 6 DES QTY			
	25-38	PQGS READING 2 PERCENT (EITHER FUEL OR OXID) AND NO VALID TIME ESTIMATE FROM LOW LEVEL	POWERED DESCENT	ABORT ABORT STAGE AT DPS DEPLETION	REF MAL PROC DPS 7 PQGS IND ABNORMAL NOTE--- THE GROUND CALC DPS QUANTITY WILL BE USED IF BOTH THE LOW LEVEL AND PQGS FAIL.			
	25-39	EXCESSIVE PROPELLANT USAGE (PREDICTED MARGIN AT TOUCHDOWN LESS THAN -0.2 PERCENT).	POWERED DESCENT	A. PRIOR TO P64 - CONTINUE MISSION B. AFTER P64 BUT PRIOR TO LO GATE. 1. ABORT 2. ABORT STAGE AT DPS DEPLETION	NOTE---THROTTLEDOWN TIME, THRUST LEVEL, AND SYSTEM PRESSURES ARE SECONDARY CUES WHICH INDICATE OFF NOMINAL DPS PERFORMANCE.			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	LM PROPULSION -DPS	SPECIFIC-DPS	25-5	

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MISSION RULES

SECTION 25 - LM PROPULSION - DPS

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-40	UNABLE TO VENT DPS AFTER LANDING.			
		A. UNABLE TO VENT DPS FUEL TANKS	LUNAR STAY	A. CONTINUE MISSION	
		B. UNABLE TO VENT OXIDIZER TANKS AND GREATER THAN 150 LBS OF OXIDIZER IN EACH OXIDIZER TANK		B. CONTINUE MISSION	
		C. UNABLE TO VENT OXIDIZER TANKS AND LESS THAN 150 LBS OF OXIDIZER IN EACH OXIDIZER TANK		C. STAY UNTIL AT LEAST T-3	NOTE--- STAY TIME DEPENDS UPON OXIDIZER REMAINING IN EACH TANK AND WILL BE DETERMINED REAL TIME.
	25-41	30 PERCENT THROAT AREA INCREASE EXCEEDED	ALL	ABORT STAGE	NOTE--- THROTTLE DOWN TIME, THRUST LEVEL, AND SYSTEM PRESSURES ARE SECONDARY CUES WHICH INDICATE OFF NOMINAL DPS PERFORMANCE
		RULES 25-42 THROUGH 25-49 ARE RESERVED.			

	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 13	FNL	2/12/70	LM PROPULSION -DPS	SPECIFIC-DPS	25-6	

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MISSION RULES

SECTION 25 - LM DPS - CONCLUDED

REV	ITEM	DPS - PRELAUNCH INSTRUMENTATION						MISSION RULE REFERENCE
25-50	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY			
	START TNK PRESS	GQ3015P	HE MON	COMMON	HD			25-31,32,35
	HE REG PRESS	GQ3018P	C&W	COMMON	HD	1 OF 2		25-34,30,35
	HE REG PRESS	GQ3025P			HD	M-PCM		25-34,30,35
	HE PRESS	GQ3435P			HD	1 OF 2		25-33,30,32
	HE PRESS	GQ3436P	PRESS		HD	M		25-33,30,32
	FU TNK 1 QTY	GQ3603Q	QTY	COMMON	HD	1 OF 2		25-37,38,39
	FU TNK 2 QTY	GQ3604Q	QTY	COMMON	HD	M		25-37,38,39
	OX TNK 1 QTY	GQ4103Q	QTY	COMMON	HD	1 OF 2		25-37,38,39
	OX TNK 2 QTY	GQ4104Q	QTY	COMMON	HD	M		25-37,38,39
	FU 1 TEMP	GQ3718T	TEMP MON	COMMON	HD	1 OF 2		25-30
	FU 2 TEMP	GQ3719T	TEMP MON	COMMON	HD	M		25-30
	OX 1 TEMP	GQ4218T	TEMP MON	COMMON	HD	1 OF 2		25-30
	OX 2 TEMP	GQ4219T	TEMP MON	COMMON	HD	M		25-30
	FU PRESS	GQ3611P			M			25-30,31,32,33,35
	OX PRESS	GQ4111P			M			25-30,31,32,33,35
	TCP	GQ6510P	THRUST	COMMON	M-PCM			25-30
	LOW LEVEL	GQ4455X	DPS LOW	COMMON	M			25-36

26 LM APS

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MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV	ITEM	
		APOLLO 13 A 3/23/70 LM PROPULSION GENERAL ----- ' GENERAL ' -----
26-1	RESERVED	
26-2	DEFINITIONS---	
	A. AN OPERATIONAL APS (PREPRESSURIZATION) IS DEFINED AS FOLLOWS---	
	1. DELTA PRESS BETWEEN APS FUEL AND OXID ENGINE INLET PRESSURES LESS THAN 90 PSID.	
	2. DELTA TEMP BETWEEN APS FUEL AND OXID LESS THAN 10 DEG F.	
	3. APS FUEL AND/OR OXID TEMP GREATER THAN 50 DEG F AND LESS THAN 90 DEG F.	
	4. APS FUEL OR OXID INLET PRESSURE GREATER THAN 62 PSIA AND LESS THAN 220 PSIA.	
	5. REDUNDANT PRESSURIZATION PATHS AND NO HELIUM TANK OR HELIUM LINE LEAKS.	
	B. AN OPERATIONAL APS (POST-PRESSURIZATION) IS DEFINED AS FOLLOWS---	
	1. ADEQUATE SOURCE PRESSURE FOR DELTA V REQUIRED AND REDUNTANT PRESSURIZATION PATHS.	
	2. DELTA TEMP BETWEEN APS FUEL AND OXID LESS THAN 60 DEG F FOR BURNS LESS THAN 100 SECONDS AND 10 DEG F FOR BURNS GREATER THAN 100 SECONDS.	
	3. APS FUEL AND/OR OXID TEMP GREATER THAN 50 DEG F AND LESS THAN 120 DEG F FOR BURNS LESS THAN 100 SECONDS AND GREATER THAN 50 DEG F AND LESS THAN 90 DEG F FOR BURNS GREATER THAN 100 SECONDS.	
	4. APS FUEL AND/OR OXID INLET PRESSURES GREATER THAN 115 PSIA. (ULLAGE PRESSURE GREATER THAN 125 PSIA)	
	5. DELTA PRESSURE BETWEEN FUEL AND OXID INLET PRESSURES LESS THAN OR EQUAL TO 15 PSID.	
	RULES 26-3 THROUGH 26-12 ARE RESERVED	
	MISSION	REV
	DATE	SECTION
	GROUP	PAGE
	APOLLO 13 A	3/23/70
	LM	INSTR
	- APS	26-1

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MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV	ITEM						
		SYSTEMS MANAGEMENT					
	26-13	THE MINIMUM IMPULSE OF THE APS ENGINE IS 1257 PLUS OR MINUS 104 LBS - SEC, WHICH CORRESPONDS TO AN ELECTRICAL ON/OFF TIME OF 0.5 SEC.					
	26-14	ONLY PERMISSION APPROVED APS MULTIBURN PROFILES WILL BE EXECUTED, SINCE NO DATA EXISTS TO ALLOW REALTIME SUPPORT FOR EXAMINING APS FREEZING, CHARRING, BACKWALL TEMPERATURE CONSTRAINTS FOR MULTIBURN PROFILES.					
	26-15	PROPELLANT GAGING (NO ONBOARD READOUT)--- A. PRIME METHOD--- APS QTY FROM LGC MASS CALCULATION (THREE PERCENT) B. BACKUP METHOD--- FLOW RATE X TIME (5 PERCENT)					
		RULES 26-16 THROUGH 26-19 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	A	3/23/70	LM PROPULSION - APS	MANAGEMENT	26-2

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MISSION RULES

SECTION 26 - LM PROPULSION - APS

SECTION 26 - LM PROPULSION - APS									
REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING		CUES/NOTES/COMMENTS			
				----- SPECIFIC -----					
26-20		LOSS OF AN OPERATIONAL APS	DOCKED/ UNDOCKED PRE-PDI POWERED DESCENT LUNAR STAY	A. RETURN TO CSM NO-GO FOR CIRC B. RETURN TO CSM ASAP NO-GO FOR PDI C. ABORT USE DPS AS LONG AS POSSIBLE D. ASCEND NEXT BEST OPPORTUNITY		REF MAL PROC APS 1 ASC PRESS 2 FUEL OR OXID TEMP ABNORMAL 2A FUEL OR OXID PRESS ABNORMAL 3 HE PRESS ABNORMAL OR DECR.			
26-21		APS HE SOURCE PRESSURE				REF MAL PROC APS 1 ASC PRESS 3 HE PRESS ABNORMAL OR DECR.			
		A. LEAK PRIOR TO PRESSURIZATION	DOCKED/ UNDOCKED PRE-PDI POWERED DESCENT LUNAR STAY	A. 1. RETURN TO CSM NO-GO FOR CIRC 2. RETURN TO CSM NO-GO FOR PDI 3. ABORT (A) USE DPS AS LONG AS POSSIBLE (B) SELECT ALTERNATE APS HELIUM TANK (C) AFTER APS GOES IN BLOWDOWN, CONFIRMED BY ULLAGE PRESS LESS THAN OR EQUAL TO 160 PSIA, SELECT LEAKING TANK IF PRESS GREATER THAN OR EQUAL TO GOOD TANK PRESS 4. ASCEND NEXT BEST OPPORTUNITY (A) SELECT ALTERNATE APS HELIUM TANK (B) DO NOT ASC FEED (C) AFTER APS GOES IN BLOWDOWN, CONFIRMED BY ULLAGE PRESS LESS THAN OR EQUAL TO 160 PSIA, SELECT LEAKING TANK IF PRESS GREATER THAN OR EQUAL TO GOOD TANK PRESS		NOTE ONE HELIUM BOTTLE CAN SUPPLY SUFFICIENT APS DELTA V CAPABILITY FOR NONLANDING ALTERNATE MISSIONS.			
		B. LEAK AFTER PRESSURIZATION	LUNAR STAY RNDZ	B.1. (A) ASCEND IMMEDIATELY (B) DO NOT ASC FEED 2. CONTINUE MISSION					
		MISSION	REV	DATE	SECTION	GROUP	PAGE		
		APOLLO 13	FNL	2/12/70	LM PROPULSION - APS	SPECIFIC	26-3		

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MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	26-22	APS HE LEAK BETWEEN QUAD CHECK VALVES AND ASC HE REG 1 AND 2 SHUTOFF VALVES	DOCKED/ UNDOCKED PRE-PDI POWERED DESCENT LUNAR STAY RNDZ	A. RETURN TO CSM NO-GO FOR CIRC B. RETURN TO CSM NO-GO FOR PDI C. ABORT (1) USE DPS AS LONG AS POSSIBLE (2) PRESSURIZE WITH ONE BOTTLE IMMEDIATELY PRIOR TO IGNITION (3) USE SECOND HE BOTTLE WHEN APS ULLAGE PRESS GREATER THAN OR EQUAL TO 125 PSIA OR AFTER 330 SEC INTO THE ASCENT BURN D. ASCEND NEXT BEST OPPORTUNITY 1. PRESSURIZE WITH ONE BOTTLE IMMEDIATELY PRIOR TO IGNITION 2. DO NOT ASC FEED 3. USE SECOND HE BOTTLE WHEN APS ULLAGE PRESS GREATER THAN OR EQUAL TO 125 PSIA OR AFTER 330 SEC INTO THE ASCENT BURN E. CONTINUE MISSION CLOSE HE SOV'S	REF MAL PROC APS 3 HE PRESS ABNORMAL OR DECR. NOTE SHORT APS BURNS MIGHT BE POSSIBLE.			
	26-23	APS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES	UNDOCKED PRE-PDI POWERED DESCENT LUNAR STAY RNDZ	A. DOCK ASAP B. DOCK ASAP C. ABORT 1. USE DPS AS LONG AS POSSIBLE D.1. LIFTOFF IMMEDIATELY DO NOT ASC FEED F. CONTINUE MISSION	REF MAL PROC APS 1 ASC PRESS 2A FUEL OR OXID PRESS ABNORMAL 3 HE PRESS ABNORMAL OR DECR.			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	A	3/23/70	LM PROPULSION - APS	SPECIFIC	26-4	

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MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	26-24	APS PROP VALVE MISMATCH (DELTA POS)	ALL	CONTINUE MISSION IF BURNING OR HAVE HAD AT LEAST ONE APS BURN, INHIBIT SUBSEQUENT APS BURNS	THIS INDICATION PRIOR TO FIRST APS ENGINE ON WILL BE CONSIDERED A TM FAILURE
	26-25	APS FU AND/OR OXID LOW LEVEL	ASCENT	A. CONTINUE MISSION 1. OPEN RCS MAINS 2. CLOSE ASC FEED	APS MAL PROC APS 4 ASC QTY
		RULES 26-26 THROUGH 26-29 ARE RESERVED.			

	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 13	FNL	2/12/70	LM PROPULSION - APS	SPECIFIC	26-5	

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MISSION RULES

SECTION 26 - LM APS - CONCLUDED

REV	ITEM							
		===== ' APS - PRELAUNCH INSTRUMENTATION ' =====						
26-30		MEAS DESCRIPTION	PCM	ONBOARD TRANSDUCER	CATEGORY	MISSION RULE REFERENCE		
		APS HE 1 PRESS	GP0001P	HEL MON C&W COMMON	M - PCM	26-20,21,22		
		APS HE 2 PRESS	GP0002P	HEL MON C&W COMMON	M - PCM	26-20,21,22		
		APS HE REG PRESS	GP0018P		HD 1 OF 2	26-20,22		
		APS HE REG PRESS	GP0025P	C&W COMMON	HD M - PCM	26-20,22		
		APS HE 1 TEMP	GP0201T	HEL MON COMMON	HD - PCM	26-21		
		APS HE 2 TEMP	GP0202T	HEL MON COMMON	HD - PCM	26-21		
		APS FUEL TEMP	GP0718T	TEMP COMMON	M - PCM	26-20		
		APS FUEL LOW	GP0908X	C&W COMMON	HD	26-25		
		APS OXID TEMP	GP1218T	TEMP COMMON	M - PCM	26-20		
		APS OXID LOW	GP1408X	C&W COMMON	HD	26-25		
		APS FUEL PRESS	GP1501P	C&W COMMON	M - PCM	26-20,21,22,23		
		APS OXID PRESS	GP1503P	C&W COMMON	M - PCM	26-20,21,22,23		
		VLVS A DELTA POS	GP2997U		HD	26-24		
		VLVS B DELTA POS	GP2998U		HD	26-25		
		APS TCP	GP2010P		HD			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 13	FNL	2/12/70	LM APS	PRELAUNCH INSTR	26-6	

27 LM REACTION
CONTROL SYSTEM

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV	ITEM						
		----- GENERAL -----					
	27-1	RESERVED					
	27-2	DEFINITIONS A. OPERATIONAL RCS SYSTEM 1. AN RCS SYSTEM CONTAINS EIGHT OPERATIONAL THRUSTERS SUPPLIED BY ITS OWN PRESSURIZATION AND PROPELLANT FEED SYSTEM INDEPENDENT OF ASCENT FEED AND CROSSFEED.* 2. FUEL AND/OR OXID MANIFOLD PRESSURES GREATER THAN OR EQUAL TO 100 PSI. 3. FUEL TEMP GREATER THAN OR EQUAL TO 40 DEG F AND LESS THAN OR EQUAL TO 100 DEG F. 4. QUAD TEMP GREATER THAN 119 DEG F. *INDIVIDUAL THRUSTERS REQUIRED FOR DIFFERENT MISSION PHASES WILL BE COVERED SEPARATELY. RULE NUMBERS 27-3 THROUGH 27-9 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 13	FNL	2/12/70	LM REACTION CONTROL SYSTEM	GENERAL - RCS	27-1

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV	ITEM						
		----- ' SYSTEMS MANAGEMENT ' -----					
	27-10	RESERVED					
	27-11	USABLE RCS PROPELLANT IS 548.9 LBS OR 86.7 PERCENT OF TOTAL LOADED					
		TOTAL LOADED 633.0 LBS 100.0 PERCENT					
		TRAPPED AND LOADING					
		ERROR -46.2 LBS - 7.3 PERCENT					
		TM ERROR* -37.9 LBS - 6.0 PERCENT					

		USABLE 548.9 LBS 86.7 PERCENT					
		*BASED ON A GROUND COMPUTATIONAL ACCURACY OF 6 PERCENT.					
	27-12	PROPELLANT GAGING					
		A. PRIME METHOD ---					
		GROUND RCS PROGRAM (6.0 PERCENT)					
		B. BACKUP METHOD---					
		PQMD (ONBOARD READOUT 13.0 PERCENT, GROUND READOUT 10.0 PERCENT)					
	27-13	CROSSFEED					
		THE RCS SYSTEMS SHOULD BE CROSSFEED WHEN NECESSARY TO INSURE THAT NEITHER SYSTEM EXCEEDS ITS RCS CONSUMABLE REDLINE.					
		RULE NUMBERS 27-14 THROUGH 27-19 ARE RESERVED.					
</							

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MISSION RULES SECTION 27 - LM REACTION CONTROL SYSTEM

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				----- SPECIFIC MISSION RULES -----	
27-20	LOSS OF OPERATIONAL RCS SYSTEM A OR B	ALL		A. CLOSE MAINS OF AFFECTED SYSTEM IF LOSS OF SYSTEM RESULTED FROM ANYTHING OTHER THAN ISOLATION OF JETS B. CROSSFEED FROM GOOD SYSTEM DOCKED DO NOT UNDOCK UNDOCKED DOCK ASAP NO-GO FOR CIRC PRE-PDI RETURN TO CSM ASAP NO-GO FOR PDI POWERED ABORT DESCENT ABORT STAGE LUNAR ASCEND NEXT BEST STAY OPPORTUNITY RNDZ CONTINUE MISSION	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL 2 RCS PRESS OR TEMP ABNORMAL 3 RCS A(B) REG
27-21	RCS THRUSTER PAIR A. ONE PAIR ISOLATED			DOCKED A. 1. DO NOT UNDOCK UNDOCKED 2. DOCK ASAP NO-GO FOR CIRC PRE-PDI 3. RETURN TO CSM ASAP NO-GO FOR PDI POWERED 4. CONTINUE MISSION DESCENT/ LUNAR STAY/ RNDZ	REF MAL PROC RCS 4 RCS TCA

MISSION	REV	DATE	SECTION	GROUP	PAGE	
APOLLO 13	FNL	2/12/70	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-3	

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	27-22	DECREASING OR LOSS OF RCS HE PRESSURE	ALL	A. 1. CONTINUE USING BOTH SYSTEMS UNTIL MFLD PRESS IN BAD SYSTEM IS LESS THAN 100 PSI, THEN CLOSE MAINS OF BAD SYSTEM 2. CROSSFEED FROM GOOD SYSTEM	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL WHEN MFLD PRESS DROPS BELOW 100 PSI, THE SYSTEM IS CONSIDERED NON-OPERATIONAL REF RULE 27-2
		DOCKED/ UNDOCKED		B. RETURN TO CSM AND DOCK ASAP NO GO FOR CIRC	
		PRE-PDI		C. RETURN TO CSM AND DOCK ASAP NO-GO FOR PDI	
		POWERED DESCENT/ LUNAR STAY		D. CONTINUE MISSION IF SUFFICIENT BLOWDOWN CAPABILITY EXISTS IN FAILED SYSTEM FOR 6 HOURS OF LINE OF SIGHT AND 5 MINUTES OF ATT HOLD IF THIS CAPABILITY DOES NOT EXIST, ABORT	D.1. REQUIRES 50 LBS (15.8 PERCENT OF TOTAL LOADED IN ONE SYSTEM). D.2. RCS TROUBLESHOOTING WILL NOT BE PERFORMED AFTER HI GATE
		PDI		ASCEND NEXT BEST OPPORTUNITY	
		LUNAR STAY			
		RNDZ		E. CONTINUE MISSION	
	27-23	RCS PROPELLANT LEAK BETWEEN MAINS AND ISOLATION VALVES	DOCKED UNDOCKED	A.1. RETURN TO CSM ASAP 2. NO GO FOR CIRC	REF MAL PROC RCS
		PRE-PDI		B. RETURN TO CSM ASAP 1. NO-GO FOR PDI	1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL
		POWERED DESCENT		C.1. PDI TO HIGH GATE A. ABORT 2. HIGH GATE TO TD A. CONTINUE MISSION	
		LUNAR STAY		D. ASCEND NEXT BEST OPPORTUNITY	
		RNDZ		E. CONTINUE MISSION	

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	27-24	RESERVED			
	27-25	IMPINGEMENT CONSTRAINTS VIOLATED	DOCKED/ UNDOCKED	A. DOCK ASAP NO GO FOR CIRC	REF MAL PROC RCS 1B PQMD ABNORMAL
			PRE-PDI	B. DOCK ASAP NO GO FOR PDI	
			POWERED DESCENT	C.1. ABORT 2. ABORT STAGE AS SOON AS POSSIBLE	
			LUNAR STAY/ RNDZ	D. CONTINUE MISSION	
		RULES 27-26 THROUGH 27-29 ARE RESERVED.			

	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 13	FNL	2/12/70	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-5	

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MISSION RULES

SECTION 27 - LM REACTION CONTROL - CONCLUDED

REV	ITEM	PRELAUNCH INSTRUMENTATION					
		MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY	MISSION RULE REFERENCE
	27-30	RCS 'A' PROP QTY	GR1085Q	QUANTITY	COMMON	HD 10F2	27-23,22,20
		RCS 'A' HE PRESS	GR1101P	PRESS MON C&W	COMMON	HD M	27-23,20
		RCS 'A' REG PRESS	GR1201P	PRESS MON C&W	COMMON	HD-PCM	27-20,22,23
		RCS 'B' REG PRESS	GR1202P	PRESS MON C&W	COMMON	HD-PCM	27-20,22,23
		RCS 'B' PROP QTY	GR1095Q	QUANTITY	COMMON	HD 10F2	27-23,20,22
		RCS 'B' HE PRESS	GR1102P	PRESS MON C&W	COMMON	HD M	27-23,20
		RCS 'A' FUEL TEMP	GR2121T	TEMP MON	COMMON	M-PCM	27-20
		RCS 'B' FUEL TEMP	GR2122T	TEMP MON	COMMON	M-PCM	27-20
		RCS MAIN 'A' CLSD	GR9609U	MAIN SOV	COMMON	HD	
		RCS MAIN 'B' CLSD	GR9610U	MAIN SOV	COMMON	HD	
		RCS 'A' FUEL MFLD PRESS	GR2201P	PRESS MON	COMMON	M	27-20,23
		RCS 'B' FUEL MFLD PRESS	GR2202P	PRESS MON	COMMON	M	27-20,23
		RCS 'A' OX MFLD PRESS	GR3201P	PRESS MON	COMMON	M	27-20,23
		RCS 'B' OX MFLD PRESS	GR3202P	PRESS MON	COMMON	M	27-20,23
		A/B XFEED OPEN	GR9613U	CRSFD	COMMON	HD	
		QUAD 1 'A' TCA ISOL VLV	GR9667U	SYS A QUAD 1	COMMON	HD	27-21
		QUAD 2 'A' TCA ISOL VLV	GR9665U	SYS A QUAD 2	COMMON	HD	27-21
		QUAD 3 'A' TCA ISOL VLV	GR9663U	SYS A QUAD 3	COMMON	HD	27-21
		QUAD 4 'A' TCA ISOL VLV	GR9661U	SYS A QUAD 4	COMMON	HD	27-21
		QUAD 1 'B' TCA ISOL VLV	GR9668U	SYS B QUAD 1	COMMON	HD	27-21
		QUAD 2 'B' TCA ISOL VLV	GR9666U	SYS B QUAD 2	COMMON	HD	27-21
		QUAD 3 'B' TCA ISOL VLV	GR9664U	SYS B QUAD 3	COMMON	HD	27-21
		QUAD 4 'B' TCA ISOL VLV	GR9662U	SYS B QUAD 4	COMMON	HD	27-21
		QUAD 1 TEMP	GR6004T	TEMP MON	COMMON	HD	27-24
		QUAD 2 TEMP	GR6003T	TEMP MON	COMMON	HD	27-24
		QUAD 3 TEMP	GR6002T	TEMP MON	COMMON	HD	27-24
		QUAD 4 TEMP	GR6001T	TEMP MON	COMMON	HD	27-24
		ASC FEED OXID 'A' OPEN	GR9641U	SYS A ASC OXID	COMMON	HD	
		ASC FEED FUEL 'A' OPEN	GR9631U	ASC FUEL	COMMON	HD	
		ASC FEED FUEL 'B' OPEN	GR9632U	SYS B ASC OXID	COMMON	HD	
		ASC FEED OXID 'B' OPEN	GR9642U	ASC FUEL	COMMON	HD	
				SYS B ASC OXID	COMMON	HD	
				ASC FUEL			