

NASA Apollo Program
Historical Information

NASA
Apollo
Saturn V Rocket
Summary Information

Source:
“Saturn V Flight Manual SA-506 (Apollo 11)”

NASA Apollo Saturn V Rocket Summary Information

MSFC-MAN-506

GENERAL DESCRIPTION

SATURN V LAUNCH VEHICLE

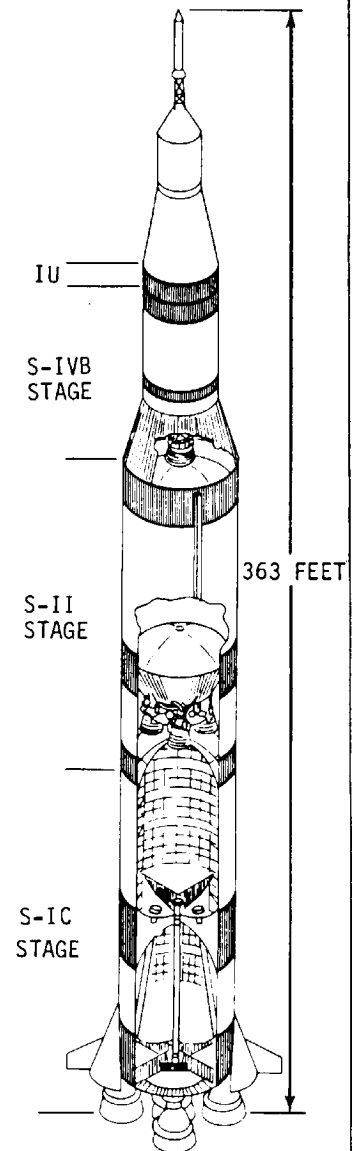
SOLID ULLAGE ROCKET AND RETROROCKET SUMMARY				
STAGE	TYPE	QUANTITY	NOMINAL THRUST AND DURATION	PROPELLANT GRAIN WEIGHT
S-IC	RETROROCKET	8	75,800 POUNDS • 0.541 SECONDS	278.0 POUNDS
S-II	ULLAGE	4	23,000 POUNDS † 3.75 SECONDS	336.0 POUNDS
	RETROROCKET	4	34,810 POUNDS ‡ 1.52 SECONDS	268.2 POUNDS
S-IVB	ULLAGE	2	3,390 POUNDS ** 3.87 SECONDS	58.8 POUNDS

ENGINE DATA					
STAGE	QTY	ENGINE MODEL	NOMINAL THRUST		BURN TIME
			EACH	TOTAL	
S-IC	5	F-1	1,530,000	7,650,000 ††	167.3 SEC
S-II	5	J-2	230,000	1,150,000	382.4 SEC
S-IVB	1	J-2	232,000	232,000	TO BE DETERMINED

STAGE DIMENSIONS			STAGE WEIGHTS	
	DIAMETER	LENGTH	DRY	AT LAUNCH
S-IC Base (including fins)	63.0 FEET	138 FEET	288,800 POUNDS	5,030,500 POUNDS
S-IC Mid-stage	33.0 FEET			
S-II Stage	33.0 FEET	81.5 FEET	92,600 POUNDS	1,050,000 POUNDS
S-IVB Stage	21.7 FEET	59.3 FEET	33,200 POUNDS	262,200 POUNDS
Instrument Unit	21.7 FEET	3.0 FEET	4,230 POUNDS	4,230 POUNDS

SATURN V STAGE MANUFACTURERS	
STAGE	MANUFACTURER
S-IC	THE BOEING COMPANY
S-II	NORTH AMERICAN-ROCKWELL
S-IVB	McDONNELL - DOUGLAS CORP.
S-IU	INTERNATIONAL BUSINESS MACHINE CORP.

NOTE: THRUST VALUES, WEIGHTS, AND BURN TIMES ARE ALL APPROXIMATIONS.



PRE-LAUNCH LAUNCH VEHICLE
GROSS WEIGHT ≈ 6,414,890 POUNDS

- * MINIMUM VACUUM THRUST AT 120°F
- † AT 170,000 FT. AND 70°F
- ‡ NOMINAL VACUUM THRUST AT 60°F
- ** AT 175,000 FT AND 70°F
- †† AT SEA LEVEL

STAGE ELECTRICAL INTERFACE FLOW

IU TO SPACECRAFT

- EDS LIFTOFF
- EDS AUTO ABORT
- +28 VDC FOR EDS
- +28 VDC FOR Q BALL
- S-IVB ULLAGE THRUST OK
- GUIDANCE REFERENCE RELEASE
- AGC LIFTOFF
- Q BALL TEMPERATURE SENSING
- S-II AND S-IVB FUEL TANK PRESSURE
- LV ATTITUDE REFERENCE FAILURE
- LV RATE EXCESSIVE
- EDS ABORT REQUEST
- S-II START/SEPARATION
- STAGE ENGINES OUT

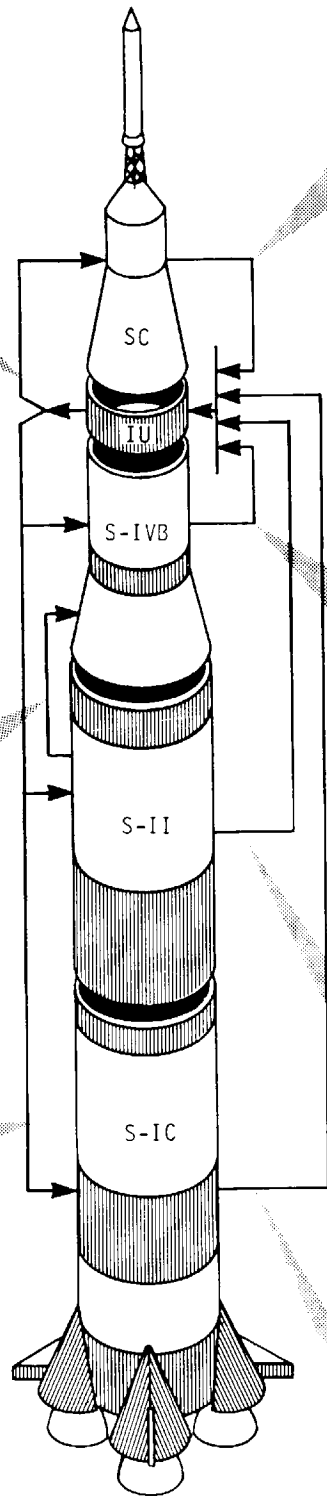
(V) = VISUALLY DISPLAYED

S-II TO S-IVB

- +28 VDC FOR RETRO-ROCKET PRESSURE TRANSDUCER
- S-IVB ENGINE START ENABLE

IU TO STAGES

- STAGE ENGINE ACTUATOR COMMANDS
- STAGE ENGINE ACTUATOR MEASURING VOLTAGES
- +28 VDC FOR SWITCHING AND TIMING
- STAGE SWITCH SELECTOR SIGNALS (VERIFY, COMMAND, ADDRESS, READ, RESET, ENABLE)
- STAGE EDS COMMAND ENGINES OFF
- S-IVB ATTITUDE CONTROL SYSTEM COMMANDS
- TELEMETRY CLOCK AND SYNC.



SPACECRAFT TO IU

- +28 VDC TO EDS
- LV ENGINES CUTOFF TO EDS
- ATTITUDE ERROR SIGNAL
- Q-BALL PITCH AND YAW
- S-IVB ENGINE CUTOFF
- AGC COMMAND POWER
- S-IVB IGNITION SEQUENCE START
- AUTO ABORT DEACTIVATE (M)
- INITIATE S-II/S-IVB SEPARATION (M)
- SPACECRAFT CONTROL DISCRETE (M)
- TRANSLUNAR INJECTION INHIBIT (M)

(M) = MANUALLY INITIATED

S-IVB TO IU

- +28 VDC FOR TIMING
- SWITCH SELECTOR ADDRESS VERIFICATION
- ENGINE ACTUATOR POSITIONS
- ATTITUDE CONTROL RATE GYROS SIGNALS
- ATTITUDE CONTROL ACCELEROMETER SIGNALS
- LOX TANK PRESSURE
- FUEL TANK PRESSURE
- RSCR & PD EBW FIRING UNIT ARM AND ENGINE CUTOFF ON
- ENGINE THRUST OK
- TELEMETRY SIGNALS

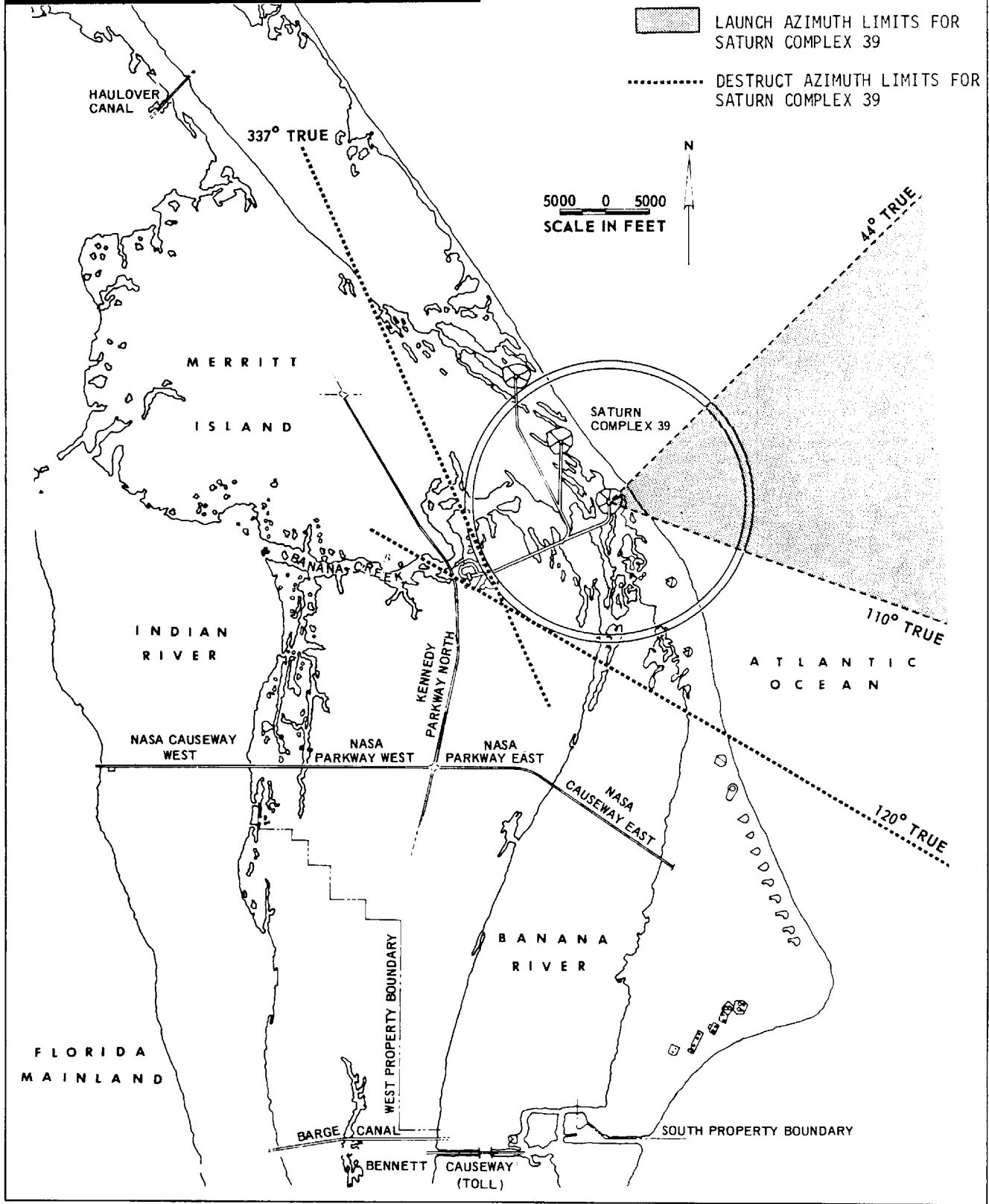
S-II TO IU

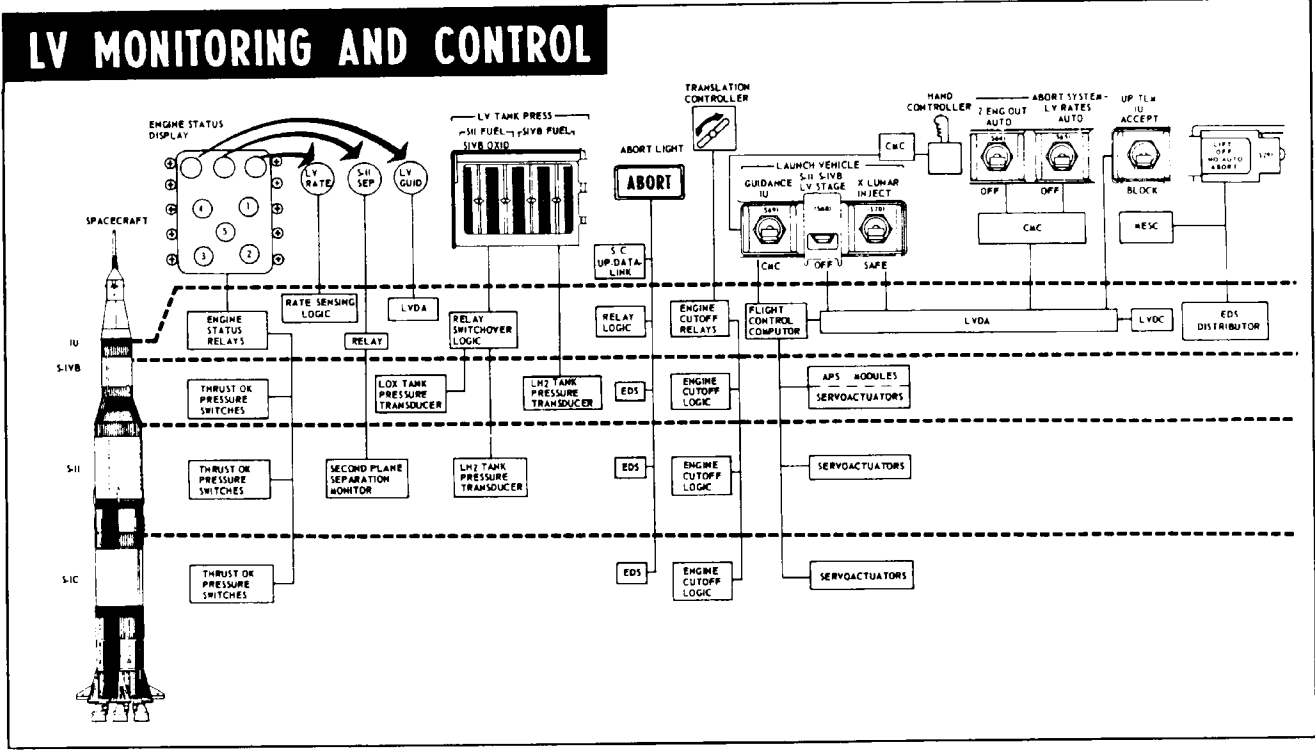
- ENGINE ACTUATOR POSITIONS
- +28VDC FOR TIMING
- S-IC STAGE SEPARATED
- AFT INTERSTAGE SEPARATED
- S-II STAGE SEPARATED
- S-II ENGINE OUT
- S-II PROPELLANT DEPLETION
- SWITCH SELECTOR VERIFY
- FUEL TANK PRESSURE
- ENGINE THRUST OK
- LOX TANK PRESSURE

S-IC TO IU

- ATTITUDE CONTROL ACCELEROMETER SIGNALS
- ATTITUDE CONTROL RATE GYRO SIGNALS
- +28 VDC FOR TIMING
- ENGINES OUT
- OUTBOARD ENGINE CUTOFF
- S-II ENGINES START ENABLE
- SWITCH SELECTOR ADDRESS VERIFY
- S-IC THRUST OK

RANGE SAFETY AZIMUTH LIMITS





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TYPICAL CRITICAL EVENT SEQUENCE, FIRST OPPORTUNITY TLI
(EVENT TIMES FROM LIFTOFF INTO EARTH ORBIT ARE BASED ON AS-505 SIMULATIONS,
EVENT TIMES SUBSEQUENT TO T6 ARE ESTIMATED)

TIME FROM FIRST MOTION (HR:MIN:SEC)	TIME FROM REFERENCE (HR:MIN:SEC)	EVENT	TIME FROM FIRST MOTION (HR:MIN:SEC)	TIME FROM REFERENCE (HR:MIN:SEC)	EVENT
-0:00:17.3 0:00:00.0 0:00:00.4 0:00:01.4	T ₁ -0:00:17.6 T ₁ -0:00:00.4 T ₁ +0:00:00.0 T ₁ +0:00:01.0	Guidance Reference Release First Motion Liftoff Begin Tower Clearance Yaw Maneuver	2:30:26.3 2:30:31.3 2:31:40.0 2:31:43.0 2:31:48.0	T ₆ +0:08:16.3 T ₆ +0:08:21.3 T ₆ +0:09:30.0 T ₆ +0:09:33.0 T ₆ +0:09:38.0	Ullage Engines On Helium Heater Off S-IVB Engine Restart Sequence Ullage Engines Cutoff S-IVB Ignition, Second Burn (Start Tank Discharge Valve Opens)
0:00:09.4 0:00:12.3 0:00:31.3 0:01:05.6 0:01:20.9	T ₁ +0:00:09.0 T ₁ +0:00:11.9 T ₁ +0:00:30.9 T ₁ +0:01:05.2 T ₁ +0:01:20.5	End Yaw Maneuver Pitch and Roll Initiation End Roll Maneuver Mach 1 Maximum Dynamic Pressure	2:31:50.5 2:37:22.0	T ₆ +0:09:40.5 T ₇ +0:00:00.0	S-IVB at 90% Thrust S-IVB Engine Cutoff, Second Burn
0:02:15.0 0:02:37.5 0:02:40.4 0:02:40.9 0:02:41.1 0:02:41.2 0:02:41.8 0:02:42.8 0:02:44.8 0:02:45.4 0:03:10.9 0:03:16.6 0:03:21.3 0:07:41.8	T ₂ +0:00:00.0 T ₂ +0:00:22.5 T ₃ +0:00:00.0 T ₃ +0:00:00.5 T ₃ +0:00:00.7 T ₃ +0:00:00.8 T ₃ +0:00:01.4 T ₃ +0:00:02.4 T ₃ +0:00:04.4 T ₃ +0:00:05.0 T ₃ +0:00:30.5 T ₃ +0:00:36.2 T ₃ +0:00:40.9 T ₃ +0:05:01.4	S-IC Center Engine Cutoff Begin Tilt Arrest S-IC Outboard Engine Cutoff S-II Ullage Rocket Ignition Signal to Separation Devices and S-IC Retrorockets S-IC/S-II First Plane Separation Complete S-II Engine Start Sequence Initiated S-II Ignition (Start Tank Discharge Valve Opens) S-II Engines at 90% Thrust S-II Ullage Thrust Cutoff S-II Aft Interstage Drop (Second Plane Separation) LET Jettison (Crew Action) Initiate IGM S-II Fuel Tank Pressurization Flowrate Step	2:37:22.3 2:37:22.6 2:37:22.8 2:37:23.0 2:37:31.8 2:37:42.0 2:39:02.0 2:39:52.6 2:39:54.8 2:52:22.3 2:52:23.0 2:53:22.0 3:05:22.0 3:18:22.0 3:37:22.0 3:37:22.3 4:00:42.0 4:00:42.3 4:05:22.0	T ₇ +0:00:00.3 T ₇ +0:00:00.6 T ₇ +0:00:00.8 T ₇ +0:00:01.0 T ₇ +0:00:09.8 T ₇ +0:00:20.0 T ₇ +0:01:40.0 T ₇ +0:02:30.6 T ₇ +0:02:32.8 T ₇ +0:15:00.3 T ₇ +0:15:01.0 T ₇ +0:16:00.0 T ₇ +0:28:00.0 T ₇ +0:41:00.0 T ₇ +1:00:00.0 T ₇ +1:00:00.3 T ₇ +1:23:20.0 T ₇ +1:23:20.3 T ₇ +1:28:00.0	LH ₂ Continuous and Nonpropulsive Vents Open Lox Nonpropulsive Vent Open Engine Start Bottle Dump On Cold Helium Bottle Dump On Translunar Injection Begin Orbital Guidance Begin Orbital Navigation Lox Nonpropulsive Vent Closed Engine Start Bottle Dump Off LH ₂ Continuous and Nonpropulsive Vents Closed Cold Helium Bottle Dump Off Maneuver Space Vehicle to CSM Separation Attitude CSM Separation CSM Docking LH ₂ Nonpropulsive Vent Open Cold Helium Bottle Dump On LH ₂ Nonpropulsive Vent Closed Cold Helium Bottle Dump Off CSM/LM Separation from LV
0:08:49.2 0:08:49.9 0:08:50.0 0:08:50.1 0:08:50.2 0:08:53.2 0:08:55.7 0:08:57.8 0:09:02.1 0:11:06.5 0:11:14.2 0:11:14.5 0:11:24.0 0:11:34.5 0:12:13.2 0:12:42.2 0:13:02.5	T ₄ +0:00:00.0 T ₄ +0:00:00.7 T ₄ +0:00:00.8 T ₄ +0:00:00.9 T ₄ +0:00:01.0 T ₄ +0:00:04.0 T ₄ +0:00:06.5 T ₄ +0:00:08.6 T ₄ +0:00:12.9 T ₄ +0:02:17.3 T ₅ +0:00:00.0 T ₅ +0:00:00.3 T ₅ +0:00:09.8 T ₅ +0:00:20.3 T ₅ +0:00:59.0 T ₅ +0:01:28.0 T ₅ +0:01:48.3	S-II Engine Cutoff S-IVB Ullage Ignition Signal to Separation Devices and S-II Retrorockets S-II/S-IVB Separation S-IVB Engine Start Sequence, First Burn S-IVB Ignition (Start Tank Discharge Valve Opens) S-IVB Engine at 90% Thrust S-IVB Ullage Thrust End S-IVB Ullage Case Jettison Begin Chi Freeze S-IVB Cutoff, First Burn S-IVB APS Ullage Engines On Parking Orbit Insertion Begin Orbital Guidance LH ₂ Continuous Vent Open Ullage Engines Cutoff Begin Orbital Navigation Calculations	4:37:22.0 4:37:22.3 4:37:22.6 4:37:22.9 4:49:22.0 4:49:22.3 4:54:22.0 4:54:25.0 4:54:31.0 5:07:22.0 5:11:11.0 5:11:13.0 5:16:12.3	T ₈ +0:00:00.0 T ₈ +0:00:00.3 T ₈ +0:00:00.6 T ₈ +0:00:00.9 T ₈ +0:12:00.0 T ₈ +0:12:00.3 T ₈ +0:17:00.0 T ₈ +0:17:03.0 T ₈ +0:17:09.0 T ₈ +0:30:00.0 T ₈ +0:33:49.0 T ₈ +0:33:51.0 T ₈ +0:38:50.3	Commence S-IVB Translunar Safing LH ₂ Continuous Vent Latched Open S-IVB Pneumatic Bottle Dump On Cold Helium Bottle Dump On Lox Dump On Engine Control Bottle and Ambient Repressurization Bottle Dump On Lox Dump Off Lox Nonpropulsive Vent Latched Open LH ₂ Dump On Cold Helium Bottle Dump Off LH ₂ Dump Off LH ₂ Nonpropulsive Vent Latched Open Engine Control Bottle and Ambient Repressurization Bottle Dump Off
2:22:10.0 2:22:51.3 2:22:52.2	T ₆ +0:00:00.0 T ₆ +0:00:41.3 T ₆ +0:00:42.2	Begin S-IVB Restart Preparations O ₂ H ₂ Burner (Helium Heater) On LH ₂ Continuous Vent Closed	5:24:12.0 5:37:22.6 5:39:12.0	T ₈ +0:46:40.0 T ₈ +1:00:00.6 T ₈ +1:01:40.0	Ullage Engines On S-IVB Pneumatic Bottle Dump Off Ullage Engines Cutoff

FLIGHT DIRECTOR ATTITUDE INDICATOR

ROLL
 + ANGULAR VELOCITY -
 + ATTITUDE ERROR -

PITCH & YAW
 INDEX

ROLL INDEX

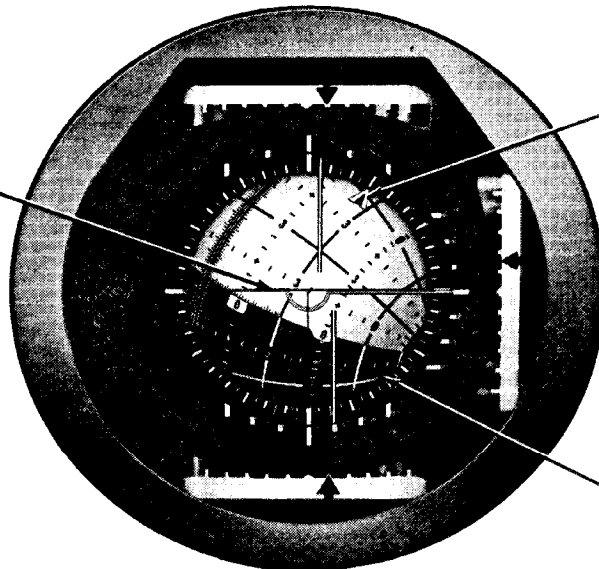
-	P	ANGULAR
ATTITUDE	I	VELOCITY
ERROR	T	
+	C	
	H	

EULER ATTITUDE ON BALL
 PITCH - $\theta = 014^\circ$
 YAW - $\psi = 034^\circ$
 ROLL - $\phi = 330^\circ$

ROLL TOTAL
 ATTITUDE SCALE

NOTE:
 ALL POLARITIES INDICATE
 VEHICLE DYNAMICS

YAW
 + ATTITUDE ERROR -
 + ANGULAR VELOCITY -

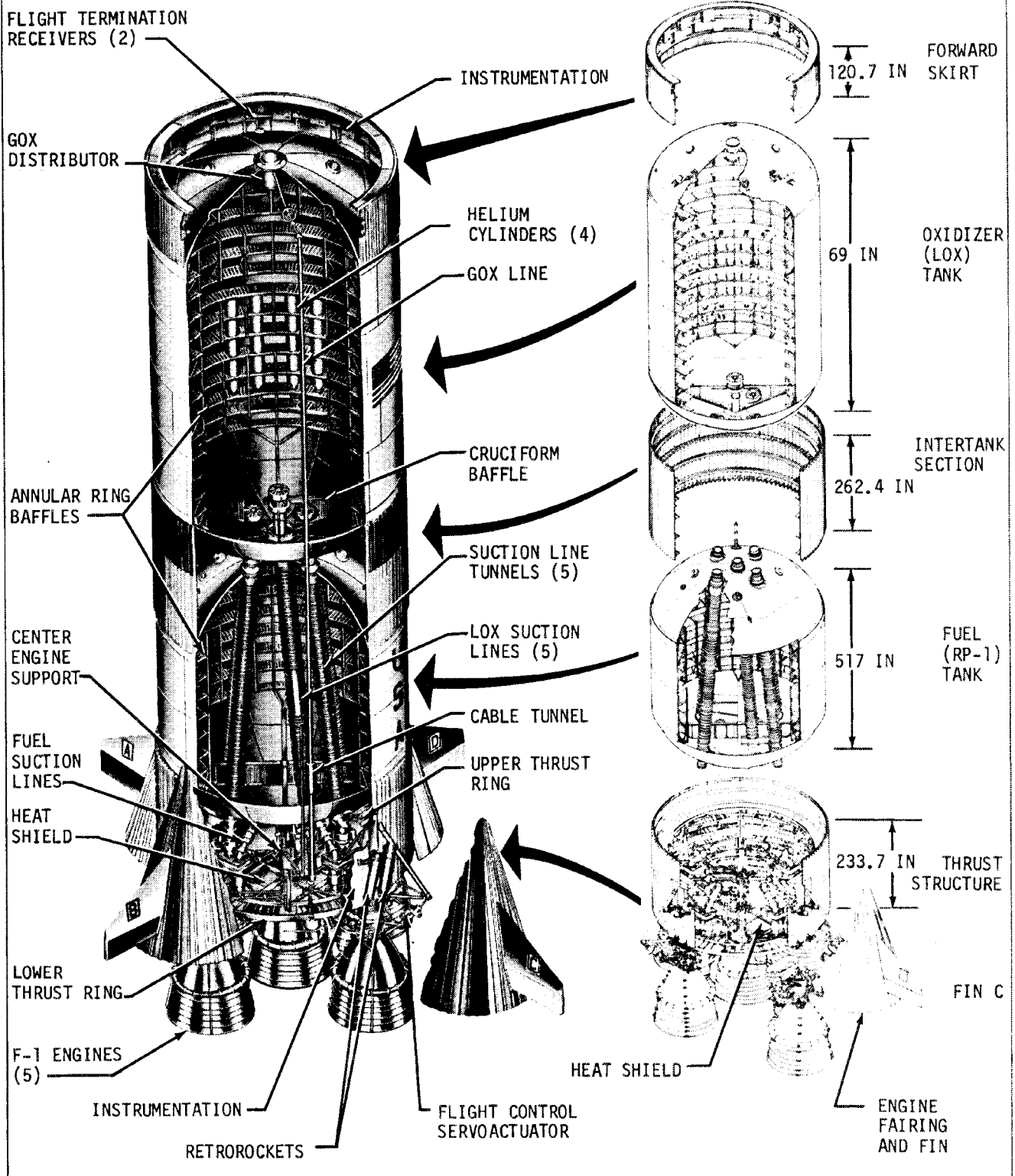


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NOMINAL LAUNCH PHASE VOICE CALLOUTS (BOOST ONLY)			
TIME	STATION	REPORT	EVENT
-0:09	LCC	IGNITION	S-IC IGNITION
0:00	LCC	LIFTOFF	UMBILICAL DISCONNECT
0:01	CDR	LIFTOFF	CMD TO P11 DET START
0:12	CDR	ROLL COMMENCE	ROLL PROGRAM STARTS
0:21	CDR	PITCH TRACKING	PITCH RATE DETECTION
0:31	CDR	ROLL COMPLETE	ROLL COMPLETE
0:42	MCC	MARK, MODE IB	PRPLNT DUMP - RCS CMD
1:50	MCC	MARK, MODE IC	h = 100,000 FT, 16.5 NM
2:00	CDR	EDS MANUAL	EDS RATES - OFF
			EDS ENG - OFF
			EDS AOA - Pc
2:00	MCC	GO/NO GO FOR STAGING	STAGING STATUS-TWR JETT STATUS IF REQUIRED
2:00	CDR	GO/NO GO FOR STAGING	
2:14	CDR	INBOARD OFF	S-IC INBOARD ENG - OFF
2:39	CDR	OUTBOARD OFF	S-IC OUTBOARD ENG - OFF
2:40	CDR	STAGING	S-II LIGHTS OFF
2:41			S-II IGNITION COMMAND
2:44	CDR	S-II 65%	S-II 65%
3:10	CDR	S-II SEP LIGHT OUT	S-II SEP LIGHT OUT
3:16	CDR	TOWER JETT	TOWER JETTISONED
		MARK, MODE II	MAN ATT (P) - RATE CMD
3:21	CDR	GUID INITIATE	IGM STARTS
4:00	CDR	S/C GO/NO GO	
	MCC	GUIDANCE GO/NO GO	IGM LOOKS GOOD
4:30	MCC	TRAJECTORY GO/NO GO	TRAJECTORY STATUS
5:00	CDR	S/C GO/NO GO	
*5:50	MCC	S-IVB TO ORBIT	
		CAPABILITY	
6:00	CDR	S/C GO/NO GO	
7:00	CDR	S/C GO/NO GO	
8:00	CDR	S/C GO/NO GO	
8:33	MCC	GO/NO GO FOR STAGING	STAGING STATUS
8:53	CDR	S-II OFF	S-II LIGHTS - ON
8:54	CDR	STAGING	S-IVB LIGHT - OFF
8:55	CDR	S-IVB IGNITION	S-IVB IGNITION
9:00	CDR	S-IVB 65%	S-IVB 65%
10:00	MCC	MODE IV	
10:05	MCC CDR	S/C GO/NO GO FOR ORBIT	
10:49	CDR	SECO	S-IVB LIGHT ON
10:59	MCC	INSERTION	

*LAUNCH VEHICLE CAPABILITY

S-1C STAGE STRUCTURE



F-1 ENGINE MAJOR COMPONENTS

