

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

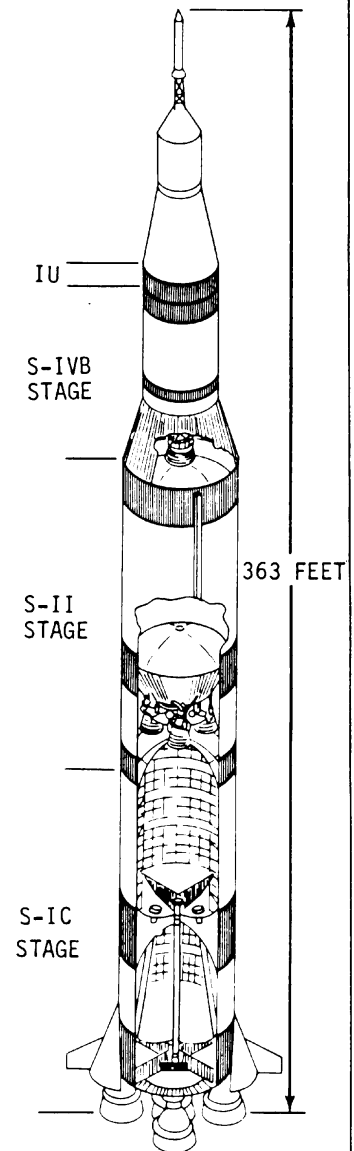
SOLID ULLAGE ROCKET AND RETROROCKET SUMMARY				
STAGE	TYPE	QUANTITY	NOMINAL THRUST AND DURATION	PROPELLANT GRAIN WEIGHT
S-IC	RETROROCKET	8	75,800 POUNDS * 0.541 SECONDS	278.0 POUNDS
S-II	ULLAGE	4	23,000 POUNDS † 3.75 SECONDS	336.0 POUNDS
	RETROROCKET	4	34,810 POUNDS ‡ 1.52 SECONDS	268.2 POUNDS
S-IVB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

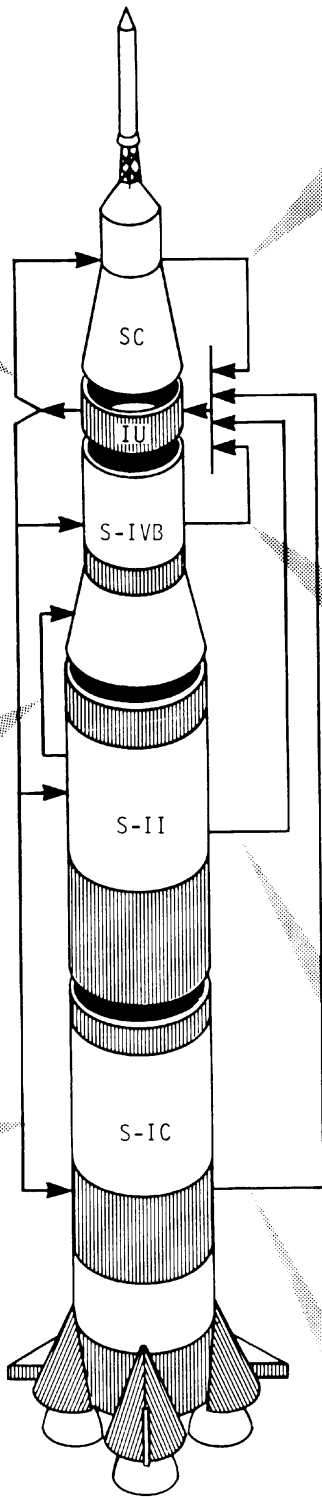
Ⓟ = VISUALLY DISPLAYED

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
- INITIATE S-II/S-IVB SEPARATION
- SPACECRAFT CONTROL DISCRETE
- TRANSLUNAR INJECTION INHIBIT

Ⓜ = 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

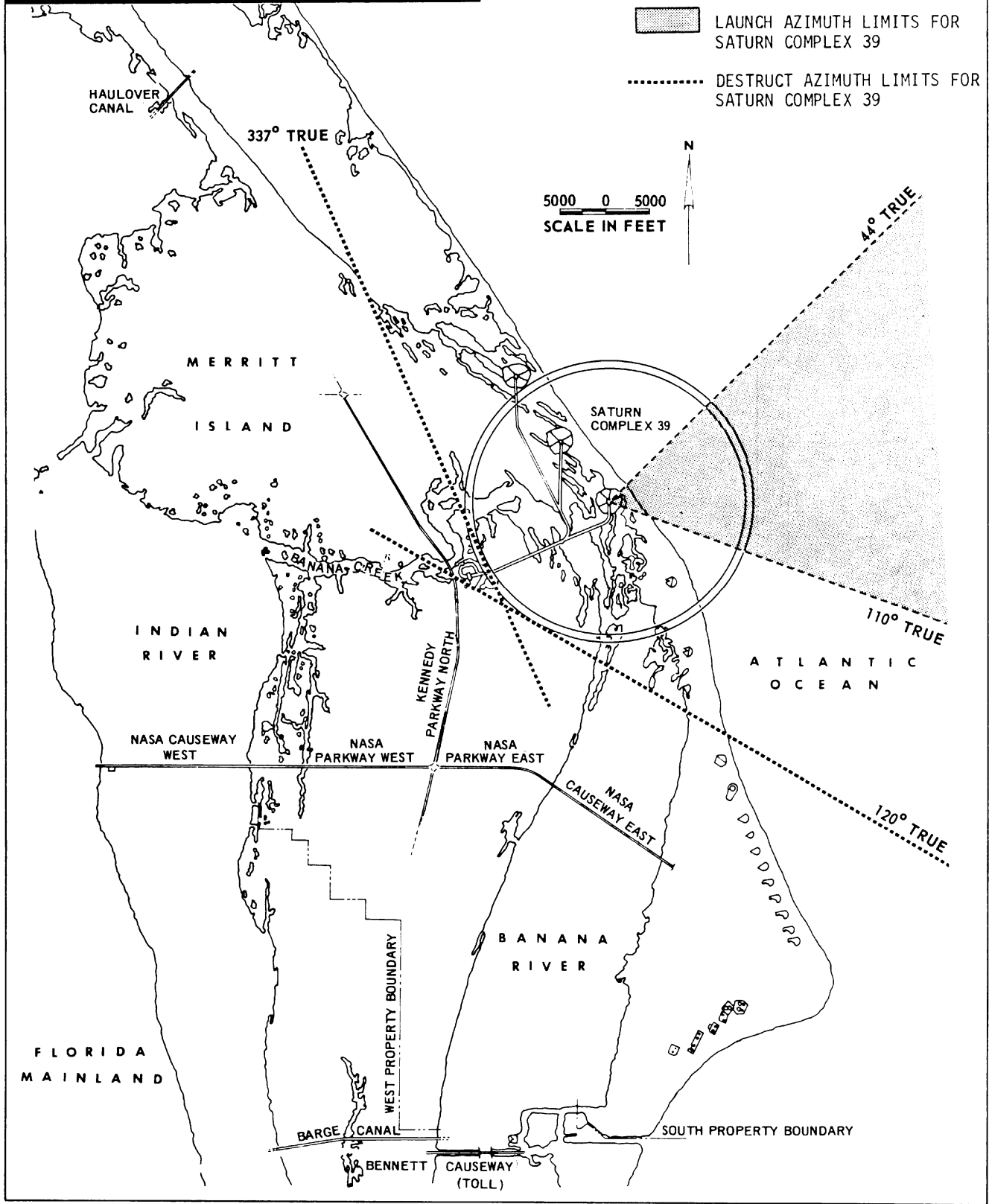
S-II TO IU

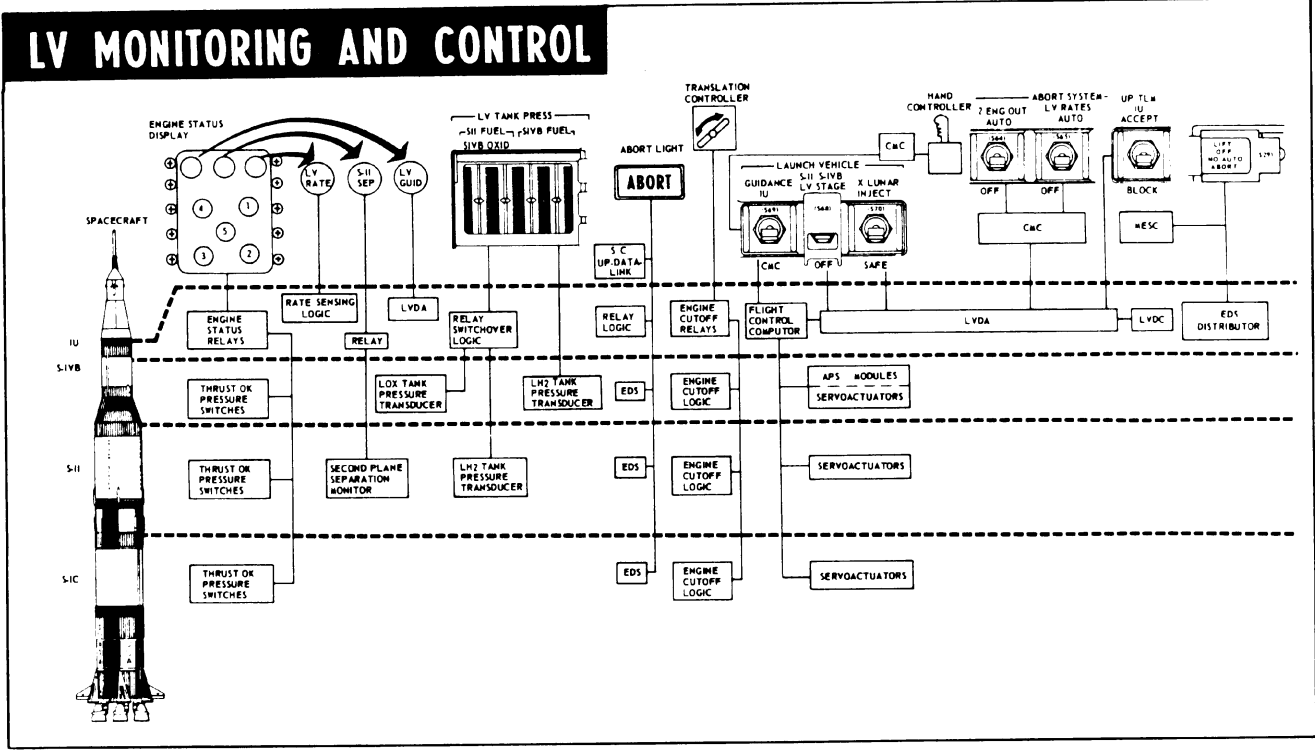
- ENGINE ACTUATOR POSITIONS
- +28VDC FOR TIMING
- S-IC STAGE SEPARATED
- AFT INTERSTAGE SEPARATED
- S-II STAGE SEPARATED
- S-II ENGINE OUT
- S-II PROPELLANT DEPLETION
- SWITCH SELECTOR VERIFY
- FUEL TANK PRESSURE
- ENGINE THRUST OK
- LOX TANK PRESSURE

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) S-IVB at 90% Thrust
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 Engine Cutoff, Second Burn
0:02:15.0 0:02:37.5 0:02:40.4 0:02:40.9 0:02:41.1	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	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	2:37:22.3 2:37:22.6 2:37:22.8 2:37:23.0 2:37:31.8	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	LH ₂ Continuous and Nonpropulsive Vents Open Lox Nonpropulsive Vent Open Engine Start Bottle Dump On Cold Helium Bottle Dump On Translunar Injection
0:02:41.2 0:02:41.8 0:02:42.8	T ₃ +0:00:00.8 T ₃ +0:00:01.4 T ₃ +0:00:02.4	S-IC/S-II First Plane Separation Complete S-II Engine Start Sequence Initiated S-II Ignition (Start Tank Discharge Valve Opens)	2:37:42.0 2:39:02.0 2:39:52.6 2:39:54.8 2:52:22.3	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	Begin Orbital Guidance Begin Orbital Navigation Lox Nonpropulsive Vent Closed Engine Start Bottle Dump Off LH ₂ Continuous and Nonpropulsive Vents Closed
0:02:44.8 0:02:45.4 0:03:10.9	T ₃ +0:00:04.4 T ₃ +0:00:05.0 T ₃ +0:00:30.5	S-II Engines at 90% Thrust S-II Ullage Thrust Cutoff S-II Aft Interstage Drop (Second Plane Separation)	2:52:23.0 2:53:22.0 3:05:22.0	T ₇ +0:15:01.0 T ₇ +0:16:00.0 T ₇ +0:28:00.0	Cold Helium Bottle Dump Off Maneuver Space Vehicle to CSM Separation Attitude CSM Separation
0:03:16.6 0:03:21.3 0:07:41.8	T ₃ +0:00:36.2 T ₃ +0:00:40.9 T ₃ +0:05:01.4	LET Jettison (Crew Action) Initiate IGM S-II Fuel Tank Pressurization Flowrate Step	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 +0:41:00.0 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	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	T ₄ +0:00:00.0 T ₄ +0:00:00.7 T ₄ +0:00:00.8	S-II Engine Cutoff S-IVB Ullage Ignition Signal to Separation Devices and S-II Retrorockets	4:37:22.0 4:37:22.3	T ₈ +0:00:00.0 T ₈ +0:00:00.3	Commence S-IVB Translunar Safing LH ₂ Continuous Vent Latched
0:08:50.1 0:08:50.2	T ₄ +0:00:00.9 T ₄ +0:00:01.0	S-II/S-IVB Separation S-IVB Engine Start Sequence, First Burn	4:37:22.6 4:37:22.9 4:49:22.0 4:49:22.3	T ₈ +0:00:00.6 T ₈ +0:00:00.9 T ₈ +0:12:00.0 T ₈ +0:12:00.3	Open S-IVB Pneumatic Bottle Dump On Cold Helium Bottle Dump On Lox Dump On Engine Control Bottle and Ambient Repressurization Bottle Dump On
0:08:53.2 0:08:55.7 0:08:57.8 0:09:02.1 0:11:06.5	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	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	4:54:22.0 4:54:25.0	T ₈ +0:17:00.0 T ₈ +0:17:03.0	Lox Dump Off Lox Nonpropulsive Vent Latched Open
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 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-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	4:54:31.0 5:07:22.0 5:11:11.0 5:11:13.0 5:16:12.3	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	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

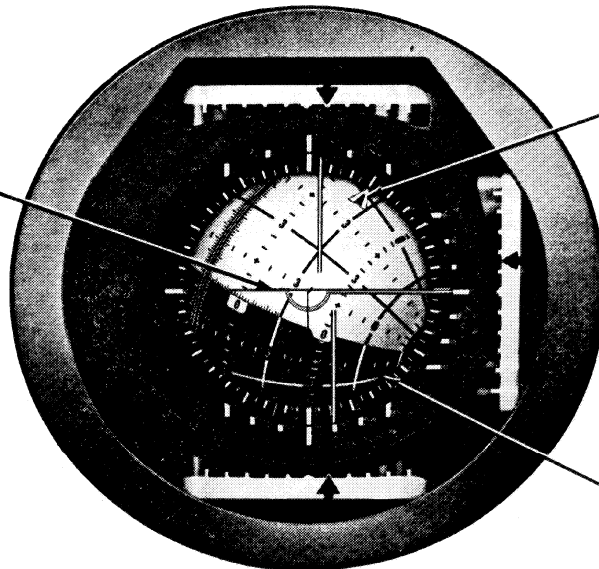
-	P	ANGULAR
ATTITUDE	I	VELOCITY
ERROR	T	
+	C	
	H	

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 -

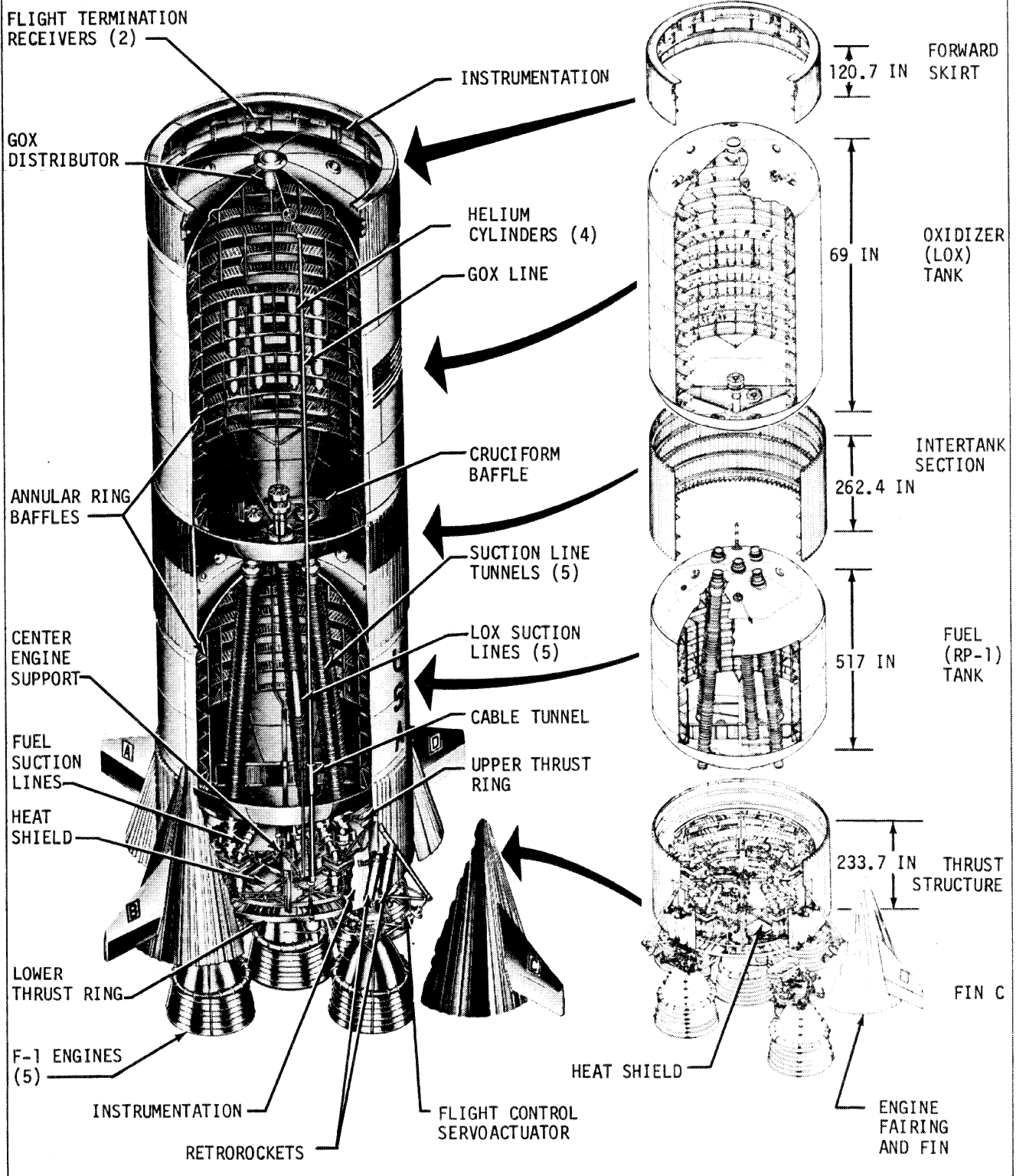


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NOMINAL LAUNCH PHASE VOICE CALLOUTS (BOOST ONLY)			
TIME	STATION	REPORT	EVENT
-0:09	LCC	IGNITION	S-IC IGNITION
0:00	LCC	LIFTOFF	UMBILICAL DISCONNECT
0:01	CDR	LIFTOFF	CMD TO P11 DET START
0:12	CDR	ROLL COMMENCE	ROLL PROGRAM STARTS
0:21	CDR	PITCH TRACKING	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

