ENGINEERING DEPARTMENT

TECHNICAL MANUAL

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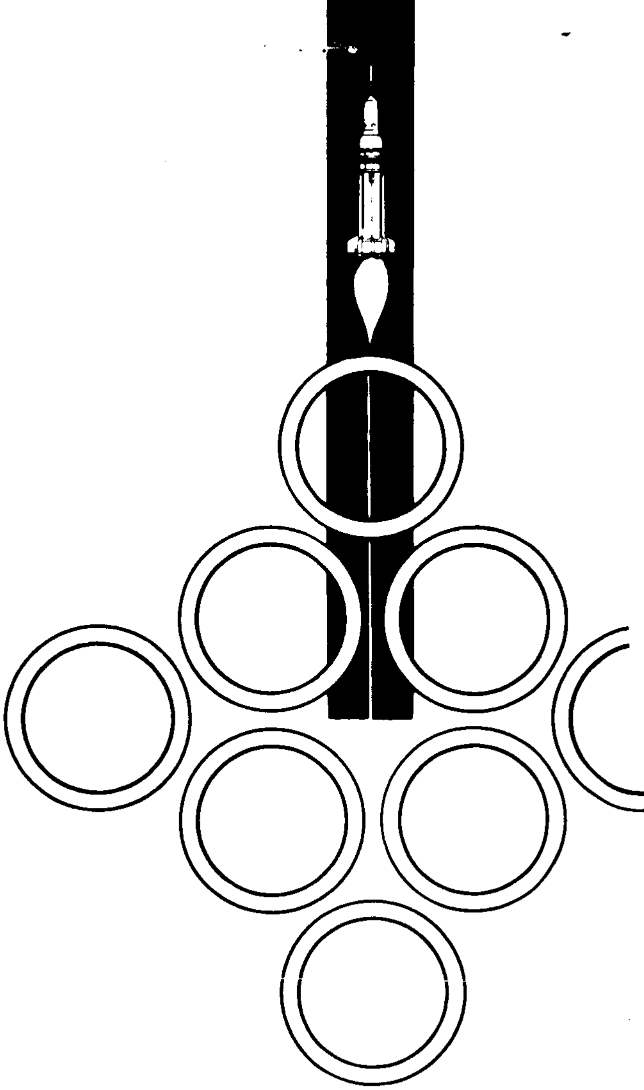

Saturn I

LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION

Volume X

SEPARATION AND FLIGHT TERMINATION SYSTEMS FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS

SPACE DIVISION CHRYSLER CORPORATION

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SATURN I
LAUNCH VEHICLE SA-10
AND
LAUNCH COMPLEX 37B
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VOLUME X
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FOREWORD

This volume is one of a set of eleven volumes that describe mechanical and electromechanical systems of the Saturn I, SA-10 launch vehicle and launch complex 37B. The eleven-volume set is prepared for the Functional Integration Section, Systems Integration and Operations Branch, Vehicle Systems Division, P&VE Laboratory, MSFC, by Systems Engineering Branch, Chrysler Corporation Space Division under Contract NAS 8-4016. Volume titles are listed below:

Volume I	RP-1 Fuel System
Volume II	LOX System
Volume III	LH_2 Fuel System
Volume IV	Nitrogen and Helium Storage Facility
Volume V	Pneumatic Distribution System
Volume VI	Environmental Conditioning Systems
Volume VII	Launch Pad Accessories
Volume VIII	H-1 Engine and Hydraulic System
Volume IX	RL10A-3 Engine and Hydraulic System
Volume X	Separation and Flight Termination Systems
Volume XI	Supplement: Legend and Composite Schematic

The technical content of this volume reflects the most up-to-date design information available from the S-I/S-IB Project Engineer, R-P&VE on June 15, 1964.

System mechanical schematics are provided in section 3 to support the functional description of the system. The index of finding numbers in section 2 provides physical and functional descriptions of components identified on the mechanical schematics.

TABLE OF CONTENTS

Subject

LIST OF ILLUSTRATIONS

SECTION 1

FUNCTIONAL DESCRIPTION

1.1 INTRODUCTION

Inflight separation of the S-IV stage, with instrument unit and payload attached, from the S-I stage is programmed to occur after completion of the S-I stage boost operation. The programmed time of separation is approximately 149.2 seconds after liftoff; however, the precise time of separation is dependant on S-I stage propellant depletion.

The flight termination operation includes shutdown of the S-I stage engines and dispersion of propellant in both the S-I stage and the S-IV stage. This operation is selected by the range safety officer if abnormal flight conditions create a safety hazard.

1.2 SEPARATION SYSTEM

S-I/S-IV stage separation begins with the initiation of the separation signal. This signal is generated after the S-I stage engines have shut down and the launch vehicle is in a coast mode of operation. The separation sequence and the various vehicle functions that are either prerequisite to, or relate directly to S-I/S-IV stage separation are presented as a related time sequence in figure 1-1. In this time sequence, ullage rocket jettison corresponds to the end of the separation operation.

The plane of physical separation is located at the top of the S-IV aft interstage structure at a point corresponding to vehicle station 1146.693 (figure 3-1). The S-IV aft interstage is rigidly fastened to the S-I stage spider beam and remains with the S-I stage after separation.

The separation signal initiates the sequence of events required for programmed inflight separation. The functions required for separation are as follows:

a. Separation bolt frangible nuts split.

b. Ullage rockets on the S-IV stage fire.

c. Retrorockets on the S-I stage fire.

1.2.1 Component Description (Figure 3-1) Major components of the separation system consists of vent panels, separation bolts with frangible nuts, ullage rockets, and retrorockets. These components are described in the following paragraphs.

1.2.1.1 Vent Panels. Fiberglass panels cover eight vent ports which are equally spaced around the base of the S-I aft interstage. A Detonating Cord Assembly E308 is installed along the edge of each fiberglass panel. These eight detonating cords are joined end-to-end with coupling blocks to form a continuous explosive harness. The two harness ends are connected to a detonator block that contains two exploding Brige Wire (EBW) Detonators E353.

The eight vent ports, when opened, vent the GN_2 purge gasses and the various forms of oxygen present in the interstage structure during RL10A-3 engine LOX system chilldown.

1.2.1.2 Separation Bolts with Frangible Nuts. Four bolts with Frangible Nuts E302 are used to join the S-IV stage to the S-IV aft interstage structure at station 1146.693. Explosive Harness Assembly E313 is ignited at both ends by EBW Detonators E351 causing the frangible nuts to split. A spring assembly causes each separation bolt to eject from the S-IV stage. Separation bolts with frangible nuts are also used to jettison Ullage Rocket Motors E290.

1.2.1.3 Ullage Rocket Motors. Four solid propellant Ullage Rocket Motors E290 are mounted on the aft skirt of the S-IV stage, one at each of the four fin lines. The ullage rockets are mounted at a 35-degree cant from vehicle centerline.

The main function of the ullage rockets is to impart forward acceleration to pre-position S-IV stage propellant. The gravity load imposed by the rocket thrust forces S-IV propellant to the RL10A-3 engines prior to ignition. This acceleration also aids in stage separation.

The ullage rockets are ignited simultaneously. However, each ullage rocket is fired by self-contained Igniter E294 that has two electrically activated Initiators E291. Two initiators are used to provide redundant ignition

The ullage rockets are ignited just prior to separation and burn for about 3.5 seconds. After burnout, the ullage rockets are jettisoned by firing two Frangible Nuts E292 that attach each ullage rocket to the S-IV stage. All eight frangible nuts are fired simultaneously through interconnecting Explosive Harness Assemblies E293-1 and E293-2. These explosive harness assemblies are connected to the EBW detonators inside a detonator block assembly which interconnects the EBW detonators with the four sets of frangible nuts. The explosive lead assemblies used in this interconnection are redundant firing mechanisms and assure simultaneous firing even if one EBW detonator fails to operate.

1.2.1.4 Retrorocket Motor Assemblies. Four solid propellant Retrorocket Motor Assemblies B500 are mounted at the top of the S-I stage. The motor nozzles are mounted at a cant of about 11 degrees from the vehicle centerline and are oriented in the direction of the S-IV aft interstage. Retrorocket thrust vectors converge at a point located on the centerline of the S-I stage and produce a retarding force to slow the S-I stage. This slowing action ensures positive S-I/S-IV stage separation and precludes the possibility of stage interaction. Each retrorocket is ignited by self-contained Igniter Assembly B503 with two electrically fired Initiator Assemblies B501 which provides a redundant ignition system. The retrorockets are ignited just after release of the S-IV stage from the S-IV aft interstage structure. A short time delay between release of the S-IV stage and ignition of the retrorocket ensures that propellant in the S-IV stage will not be unseated by deceleration of the S-I stage.

1.2.2 System Operation - S-I/S-IV stage separation starts with a signal from the instrument unit flight computer. The separation signal is initiated after the S-I stage engines have shut down and the vehicle is in a coast mode of operation. The entire sequence of events, starting at vehicle liftoff and ending at ullage rocket jettison (separation sequence complete), is illustrated in figure 1-1. The following paragraphs summarize these events.

1.2.2.1 Operation Prior to Separation Signal. During the time interval between liftoff and initiation of the separation signal (approximately 149.2 seconds), the flight computer controls the operations of the RL10A-3 engines in the S-IV stage, shuts down the inboard engines of the S-I stage, and then shuts down the outboard engines of the S-I stage. These operations, shown graphically in figure 1-1, occur as follows:

a. The hydrogen vent duct purge starts at liftoff and continues. This high flow-rate helium purge maintains a low oxygen concentration in the ducts to eliminate the possibility of explosion during operation of the S-I stage and chilldown of the RL10A-3 engine fuel system.

b. The electropneumatic valves in the S-I stage propellant tank pressurization system are sequentially deactivated as requirements for tank pressurization are reduced.

c. Two solenoid valves operate to connect the propellant tank pressurization GN_2 spheres in parallel with the liquid oxygen/solid oxygen (LOX/SOX) disposal system GN_2 spheres.

d. The separation television camera is turned on.

e. RL10A-3 hydrogen fuel system chilldown is started approximately 109.3 seconds after liftoff and continues for about 41.6 seconds. The gaseous hydrogen (GH_2) produced in the chilldown is vented overboard through the hydrogen vent ducts.

f. Approximately 134.4 seconds after liftoff, the liquid level sensors (B104, volume I and B161, volume II) in the S-I stage propellant tanks are armed.

g. Two seconds after any one of the sensors actuate (low fuel or low LOX level), the flight computer sends the necessary signals to shut down the S-I stage inboard engines.

h. Just prior to S-I stage inboard engine cutoff, RL10A-3 engine LOX system chilldown is started and vent panel EBW Detonators E353 are fired simultaneously. The EBW detonators ignite Detonating Cord Assemblies E308-1 and E308-2, causing the vent panels to be released. LOX/SOX solenoid valves are opened during LOX prestart to admit GN_2 to the RL10A-3 engine area. Four LOX/SOX valves are opened prior to S-I stage inboard engine shutdown and three more are opened after inboard engine shutdown.

i. At separation minus 1.8 seconds (approximately 147.2 seconds after liftoff), a signal from the flight computer electrically interconnects the thrust OK pressure switches of the outboard engines and arms the liquid level sensors (B125-1 and B125-2, volume I) in fuel tanks F-2 and F-4. After this occurs, any one of the following actions will cause the outboard engines to shut down.

   1. Deactivation of any one of the outboard engine thrust OK pressure switches.

   2. Activation of liquid level sensor due to fuel depletion.

   3. Initiation of the outboard engine cutoff signal by the flight computer approximately six seconds after inboard engine cutoff.

j. At separation minus 0.1 seconds, Ullage Rocket Motors E290 are ignited by a signal from the flight computer. Forward thrust of the ullage rockets pre-positions S-IV stage propellant.

1.2.2.2 Operation After Separation Signal. Separation of the S-I and S-IV stages is initiated by the separation signal from the flight computer. The actions associated with stage separation (figure 1-1) occur as follows:

a. The separation signal actuates a control switch to transfer engine control and telemetry signals from the S-I stage to the S-IV stage. Simultaneously, Frangible Nuts E302 are fired to release the S-IV stage from the S-IV aft interstage structure.

b. After a programmed time interval, the retrorockets on the S-I stage are fired. The time interval is required to assure adequate S-I/S-IV stage separation and preclude the possibility that firing the S-I stage retrorockets will unseat the propellant in the S-IV stage. Since ullage rocket operation and retrorocket operation overlap, the two stages rapidly move apart. This assures adequate spacing prior to RL10A-3 engine ignition to prevent S-I/S-IV stage interaction.

c. RL10A-3 engine ignition occurs.

d. At separation plus 20 seconds, Frangible Nuts E292 that secure each ullage rocket are fired and the four ullage rockets are jettisoned to complete the sequence.

1.3 FLIGHT TERMINATION SYSTEM

Launch vehicle flight can be terminated any time after liftoff if the vehicle becomes a safety hazard. Flight termination is accomplished through the use of explosive charges that rupture the vehicle propellant tanks and allow the propellants to disperse. This procedure is designed to minimize the attendant explosion.

The explosive charges are detonated by means of an ultra-high frequency (UHF) command system which operates on a dual-channel network to provide system redundancy. Dispersion of vehicle propellants is initiated by a selected combination of audio tones impressed on the UHF carrier which is transmitted from Cape Kennedy and several down-range stations.

The S-I and S-IV stages have separate and independent flight termination systems; however, the explosive charges in both systems are interconnected until S-I/S-IV stage separation occurs. This interconnection provides for simultaneous dispersion of the propellants in both stages regardless of which stage receives the flight termination signal.

1.3.1 Component Description - Major components of the flight termination system are the command transmitter, receiving antennas, command receiver, command controller, EBW firing unit, EBW detonator, safety and arming device, and primacord and shaped charges. These components are illustrated in figure 3-2 and described in the following paragraphs.

1.3.1.1 Command Transmitter. Command transmitters are provided in sets of three at Cape Kennedy and the down-range stations. Each set provides one transmitter for operation, one for standby, and one for spare. Each transmitter is equipped with an external audio coder to modulate the frequency modulated (FM) carrier with the sequence of tones necessary to initiate flight termination. The transmitters are also equipped with a power amplifier and broad-beam antenna array. The transmitter at Cape Kennedy is equipped, additionally, with a manually operated helix array that is connected directly to the output of the transmitter until a few seconds after liftoff. The helix array is a narrow-beam antenna that is visually aimed through a gunsight arrangement to follow the vehicle at liftoff. The transmitter output is switched from the helix antenna to the amplifier and broad-beam antenna a few seconds after liftoff to provide greater range for possible flight termination command. The broad-beam antenna is manually positioned prior to liftoff and requires no adjustment during vehicle flight.

1.3.1.2 Receiving Antennas. Four command-receiver antennas are mounted on panels near the top of the S-I stage. Two are located above fin I and two are located above fin III.

Four command-receiver antennas are mounted on the S-IV forward interstage assembly at approximately 90-degree intervals.

1.3.1.3 Command Receiver. Two UHF recievers are used in the S-I stage and two are used in the S-IV stage. This provides the backup or redundancy required within each stage and between both stages for failure proof operation. Each command receiver unit has an audio decoder and a power regulator. Automatic gain control at the command receivers on the S-I and S-IV stages is monitored and telemetered to the ground for use in receiver performance determination.

1.3.1.4 Command Controllers. A command controller is connected to each command receiver and controls the command receiver and the associated EBW firing unit. Signals for control of the vehicle and supervisory indications are selected and distributed through this controller.

1.3.1.5 EBW Firing Unit. An EBW firing unit is connected to each EBW Detonator in the S-I and S-IV stages. A transistorized oscillator and transformer network in the unit steps up the 28-volt direct current input to a 2300-volt level. This voltage is then used to charge a one-microfarad capacitor. A flight termination signal from the range safety officer is then required to discharge the capacitor and explode the EBW detonator.

1.3.1.6 EBW Detonator. EBW detonators B509 and E352 each consists of a fine wire embedded in primer explosive and connected across two terminals. A gap in one lead provides an open circuit to prevent stray voltage from causing a malfunction of the EBW detonator. The 2300-volt discharge from the one-microfarad capacitor in the EBW firing unit arcs across the gap to fire the EBW detonator. The shock of this explosion ignites the primer which detonates the primacord.

1.3.1.7 Safety and Arming Device. The S-I stage is provided with Safety and Arming Device B504. The corresponding unit on the S-IV stage is E303. These ground safety devices, which are controlled from the launch control center, isolate the EBW detonators from the primacord and thereby prevent inadvertent detonation of the primacord while the vehicle is on the launch pad.

1.3.1.8 Primacord and Shaped Charges. Primacord (pentaerythrite tetranitrate) and shaped charges are provided on the S-I stage to rupture the fuel and LOX tanks on command from the ground. Two lengths of Primacord, B505-1 and B505-2, circumscribe the S-I stage on the underside of the spider beam 45-degree fairing. Attached to Primacord B505-1 and B505-2 are two Primacord Assemblies B507-2 and four Primacord assemblies B507-3. Each primacord assembly contains a linear shaped charge inside conduit that extends approximately 640 inches down the outside of each of the eight outer propellant tanks (F-1 through F-4, and O-1 through O-4). Primacord assembly B506 extends approximately 240 inches down the side of the center LOX tank (O-C). The entire S-I stage explosive train is connected to EBW Detonators B509 by Primacord Adapter Assembly B508. Primacord and shaped charges are also provided on the S-IV stage to disperse S-IV propellant. The shaped charges used in the S-IV stage contain RDX (cyclotrimethylene trinitramine) explosive. Two Shaped Charge Assemblies, E304 and E309, are enclosed in a tunnel along the outside of the LH_2 tank. Explosive Harness Assembly E310 joins the LH_2 tank shaped charges with Shaped Charge Assembly E307 which encircles the bottom of the LOX tank. The entire S-IV stage explosive train is connected to EBW Detonators E352 by Explosive Harness Assembly E311.

The explosive networks in the S-I stage and the S-IV stage are joined by Explosive Harness Assembly E312. Separation Blocks E305 and E306 break the interconnection at stage separation.

1.3.2 System Operation - Flight termination is initiated by the range safety officer if the vehicle deviates from the assigned mission or otherwise presents a hazardous condition. The flight termination signals are sent by the command transmitter at Cape Kennedy and down-range stations to receiving antennas located on the S-I stage and on the S-IV stage forward interstage. These signals are then sent through an electronic network that demodulates, decodes and routes the signals as required to shut down the vehicle engines and detonate the explosive charges. The explosive charges rupture the propellant tanks and disperse and ignite the propellants. Ignition of the propellants in an unconfined space limits the resultant explosion to a fraction of the possible intensity.

The two-step flight termination sequence, circuit preparation and flight termination, is described in the following paragraphs.

1.3.2.1 Circuit Preparation. Safety and Arming Devices B504 and E303 remain in the safe position mechanically and electrically until liftoff. At liftoff, the umbilical lines disconnect and deenergize a relay in the command controller to complete the circuit between the command receiver and the EBW firing units, making it possible for the range safety officer to arm and activate the flight termination system at his discretion.

1.3.2.2 Flight Termination. The flight termination system in both the S-I and S-IV stages is armed and activated by a two-part FM signal from the ground. The arm portion of the signal causes the engines to shut down, the safety and arming devices to operate to the ARM position, and the capacitors in each of the EBW firing units to charge to 2300 volts. The activate or second portion of the signal is then transmitted to cause the one-microfarad capacitor in each EBW firing unit to discharge across the respective EBW detonators and thus detonate the explosives that rupture the propellant tanks in both the S-I and S-IV stages.

The flight termination sequence is as follows:

a. The flight termination switch is closed in the launch control center.

b. The command transmitter sends an FM, audio coded signal to the vehicle.

c. The receiving antennas transfer the signal to the command receivers.

d. The command receivers demodulate and decode the signal. The separated control signals are then fed to the command controllers.

e. The command controllers initiate engine cutoff through the flight computer and charge the capacitors in the EBW firing unit. The capacitors require about 2.5 seconds to charge to 2300 volts.

f. A second signal then triggers the EBW firing units which explode EBW Detonators B509 and E352.

g. EBW Detonators B509 and E352 ignite Primacord B505, Primacord Adapter Assembly B508, and Explosive Harness Assemblies E310, E311, and E312. This, in turn, ignites Primacord Assemblies B506 and B507, and Shaped Charge Assemblies E304, E307, and E309. The primacord assemblies and shaped charges rupture the propellant tanks in both stages and disperse the propellants.

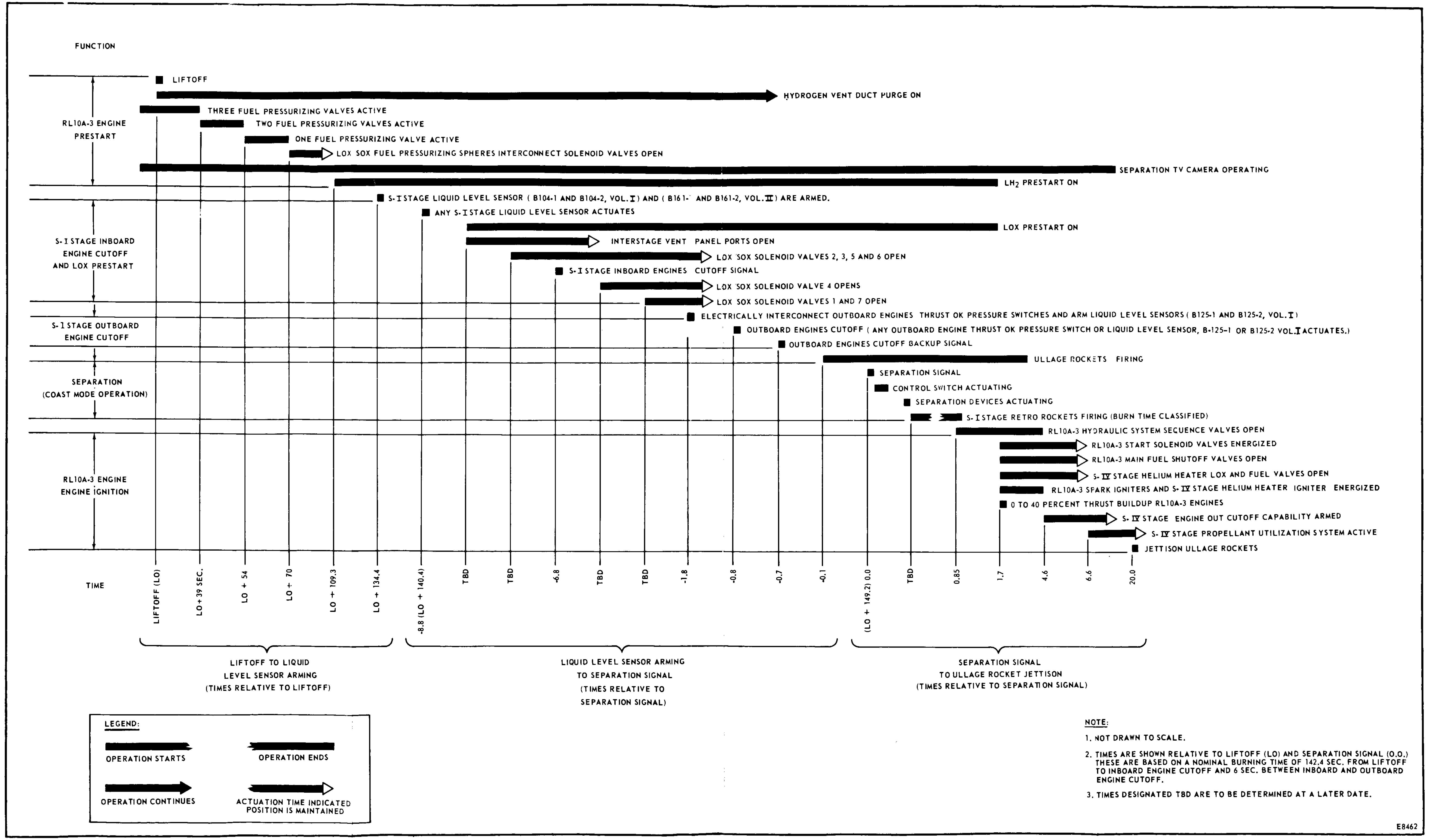

Figure 1-1. S-I Stage/S-IV Stage Separation Sequence

SECTION 2

INDEX OF FINDING NUMBERS

This section contains an alpha-numerical list, by finding number, of the separation and flight termination systems components. The finding numbers listed identify components on system schematic diagrams provided in section 3. Additional columns in the index of finding numbers provide such pertinent information as component description and function, part number, and the supplier's name and part number. A break will occur in the alpha-numeric sequence of finding numbers when a component, or component series is part of another functional system.

The letter prefix of a finding number identifies the component location with respect to either the launch complex or an area of the launch vehicle. The letter prefixes used in this eleven-volume set are listed below.

FINDING NUMBER PREFIX	DESIGNATED AREA
A	Launch complex
B	S-I stage
E	S-IV stage
G	Instrument unit
H	Payload

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
B500-1	1	Retrorocket Motor Assembly	Solid propellant, stage separation	Aerojet General Corp. P/N 3-311696	20C29899	11A32
B500-2	1	Retrorocket Motor Assembly	Solid propellant stage separation	Aerojet General Corp. P/N 3-311696	20C29899	11A33
B500-3	1	Retrorocket Motor Assembly	Solid propellant, stage separation	Aerojet General Corp. P/N 3-311696	20C29899	11A34
B500-4	1	Retrorocket Motor Assembly	Solid propellant, stage separation	Aerojet General Corp. P/N 3-311696	20C29899	11A35
B501	8	Initiator Assembly	Retrorocket ignition	Aerojet General Corp. Model No. AGX-2008 P/N 505850	20C29905	
B502 is not functionally applicable to this system.						
B503	4	Igniter Assembly	Retrorocket ignition	Aerojet General Corp. P/N 363897	20C29904	
B504	1	Safety and Arming Device	S-I stage flight termination	Douglas Aircraft Co. Inc. P/N 1A02446-1	10C11027	
B505-1	1	Primacord	50 grain/ft PETN, 357 in. length	Ensign Bickford Co.	10C11238-11	
B505-2	1	Primacord	50 grain/ft PETN, 412 in. length	Ensign Bickford Co.	10C11238-13	
B505-3	1	Primacord	50 grain/ft PETN, 40 in. length	Ensign Bickford Co.	10C11238-15	
B506	1	Primacord Assembly	50 grain/ft PETN primacord and 100 grain/ft PETN linear shaped charge	Ensign Bickford Co.	10C11239-1	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
B507-1	2	Primacord Assembly	50 grain/ft PETN primacord and 100 grain/ft PETN linear shaped charge	Ensign Bickford Co.	10C11240-1	
B507-2	2	Primacord Assembly	50 grain/ft PETN primacord and 100 grain/ft PETN linear shaped charge	Ensign Bickford Co.	10C11240-3	
B507-3	4	Primacord Assembly	50 grain/ft PETN primacord and 100 grain/ft PETN linear shaped charge	Ensign Bickford Co.	10C11240-5	
B508	2	Primacord Adapter Assembly	60 grain/ft PETN primacord 60 in. length	Ensign Bickford Co.	10C11026	
B509	2	Detonator, EBW	1.40 ± 0.25 grain PETN: S-I stage flight termination	Douglas Aircraft Co. Inc. P/N 7865742-1	10C11028	
B510 through E289 are not functionally applicable to this system.						
E290	4	Rocket Motors, Ullage	4800 lb. max. thrust; solid propellant	Thiokol Chemical Corp TX-280, P/N FR 36192		
E291	8	Initiator	Ullage rocket	Thiokol Chemical Corp P/N TX-346		
E292	8	Nut, Frangible	1/2 in. id., spring loaded; Ullage rocket jettison	Douglas Aircraft Co. Inc. P/N 1A72620-1		
E293-1	2	Explosive Harness Assembly	Two leads per harness; ullage rocket jettison	Douglas Aircraft Co. Inc. P/N 1A00773-507		
E293-2	2	Explosive Harness Assembly	Two leads per harness; ullage rocket jettison	Douglas Aircraft Co. Inc. P/N 1A00773-509		
E294	4	Igniter	ullage rocket	Thiokol Chemical Corp P/N DR 37897		

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
E295 through E301 are not functionally applicable to this system.						
E302	4	Nut, Frangible	9/16 in. 1d, spring loaded; stage separation	Douglas Aircraft Co. Inc. P/N 1A72619-1		
E303	1	Safety and Arming Device	S-IV stage termination	Douglas Aircraft Co. Inc. P/N 1A01446-1		410A20
E304-1	1	Shaped Charge Assembly	100 grain/ft. RDX, 57 in. length	Douglas Aircraft Co. Inc. P/N 3886337-501		
E304-2	1	Shaped Charge Assembly	100 grain/ft. RDX, 53.5 in. length	Douglas Aircraft Co. Inc. P/N 3886337-1		
E305	1	Separation Block Assembly	S-IV stage flight termination	Douglas Aircraft Co. Inc. P/N 1A02315-1		
E306	1	Separation Block Assembly	S-IV stage flight termination	Douglas Aircraft Co. Inc. P/N 4884325-1		
E307-1	2	Shaped Charge Assembly	100 grain/ft. RDX, 50 in. length	Douglas Aircraft Co. Inc. P/N 3886334-501		
E307-2	1	Shaped Charge Assembly	100 grain/ft. RDX, 50 in. length	Douglas Aircraft Co. Inc. P/N 3886333-501		
E308-1	6	Detonating Cord Assembly	PETN, 128.5 in., length, vent panel release	Douglas Aircraft Co. Inc. P/N 4882928-1		
E308-2	2	Detonating Cord Assembly	PETN, 121.5 in. length, vent panel release	Douglas Aircraft Co. Inc. P/N 4882928-501		
E309-1	1	Shaped Charge Assembly	100 grain/ft RDX, 60.5 in. length	Douglas Aircraft Co. Inc. P/N 3886336-501		

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
E309-2	1	Shaped Charge Assembly	100 grain/ft. RDX, 64 in. length	Douglas Aircraft Co. Inc. P/N 3886336-1		
E310	1	Explosive Harness Assembly	60 grain/ft. PETN; aft dome	Douglas Aircraft Co. Inc. P/N 3886335-1		
E311	1	Explosive Harness Assembly	60 grain/ft. PETN; 160 in. length, 2 required; forward interstage	Douglas Aircraft Co. Inc. P/N 3886338-1		
E312	1	Explosive Harness Assembly	60 grain/ft. PETN; aft interstage	Douglas Aircraft Co. Inc. P/N 3886332-1		
E313	1	Explosive Harness Assembly	PETN, 658 in. length, 2 required	Douglas Aircraft Co. Inc. P/N 3883012-503		
E314 through E349 are not functionally applicable to this system.						
E350	2	Detonator, EBW	1.40 (± 0.25) grain PETN; ullage rocket jettison	Douglas Aircraft Co. Inc. P/N 7865742-1		
E351	2	Detonator, EBW	1.40 (± 0.25) grain PETN; stage separation	Douglas Aircraft Co. Inc. P/N 7865742-1		
E352	2	Detonator, EBW	1.40 (± 0.25) grain PETN; S-IV stage flight termination	Douglas Aircraft Co. Inc. P/N 7865742-1		
E353	2	Detonator, EBW	1.40 (± 0.25) grain PETN; vent panel release	Douglas Aircraft Co. Inc. P/N 7865742-1		

SECTION 3

MECHANICAL SCHEMATICS

This section contains mechanical schematics that show the functional arrangement of separation system and flight termination system components listed in section 2.

For a definition of the mechanical symbols used, see MSFC-STD-162A.

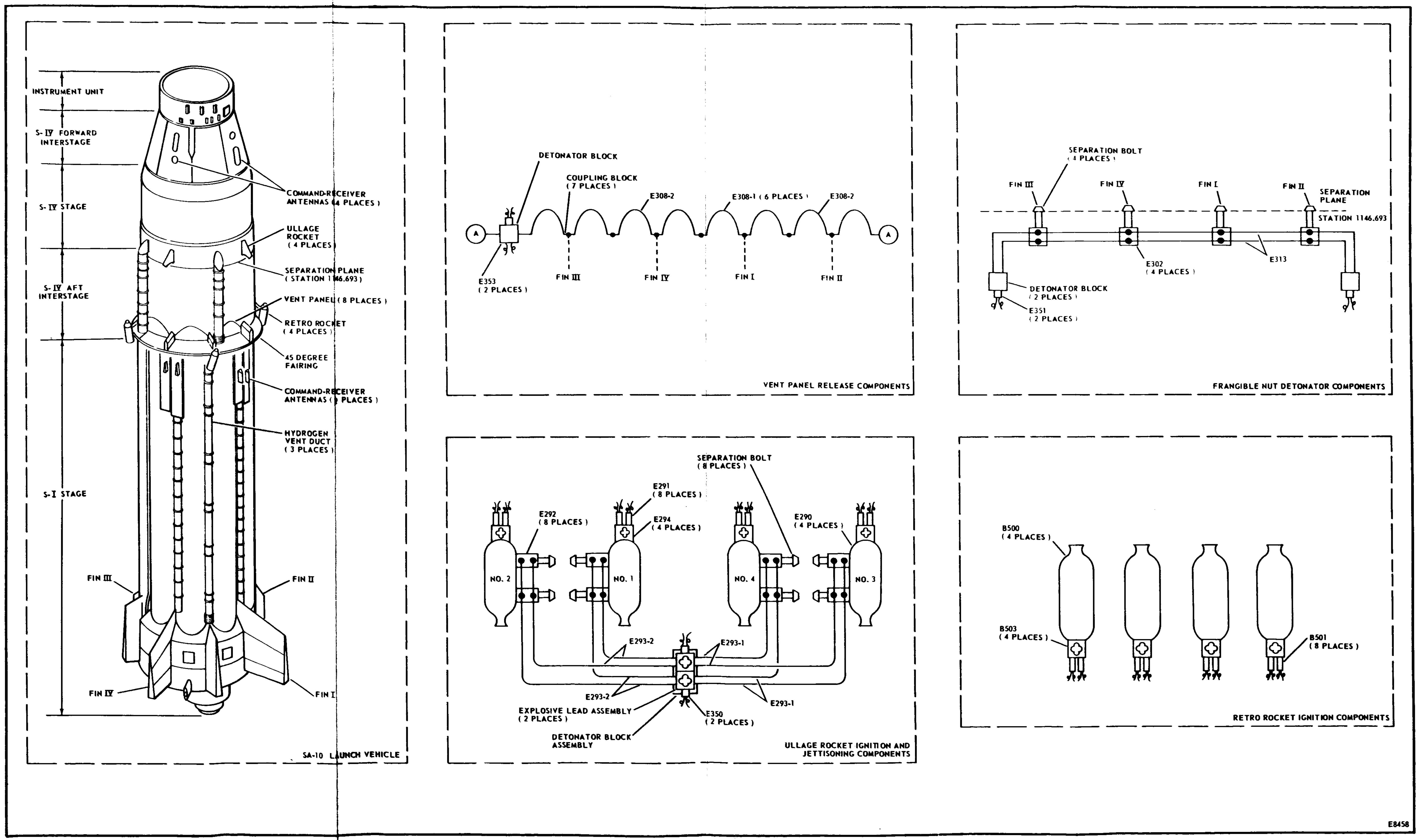

Figure 3-1. Launch Vehicle Separation Components

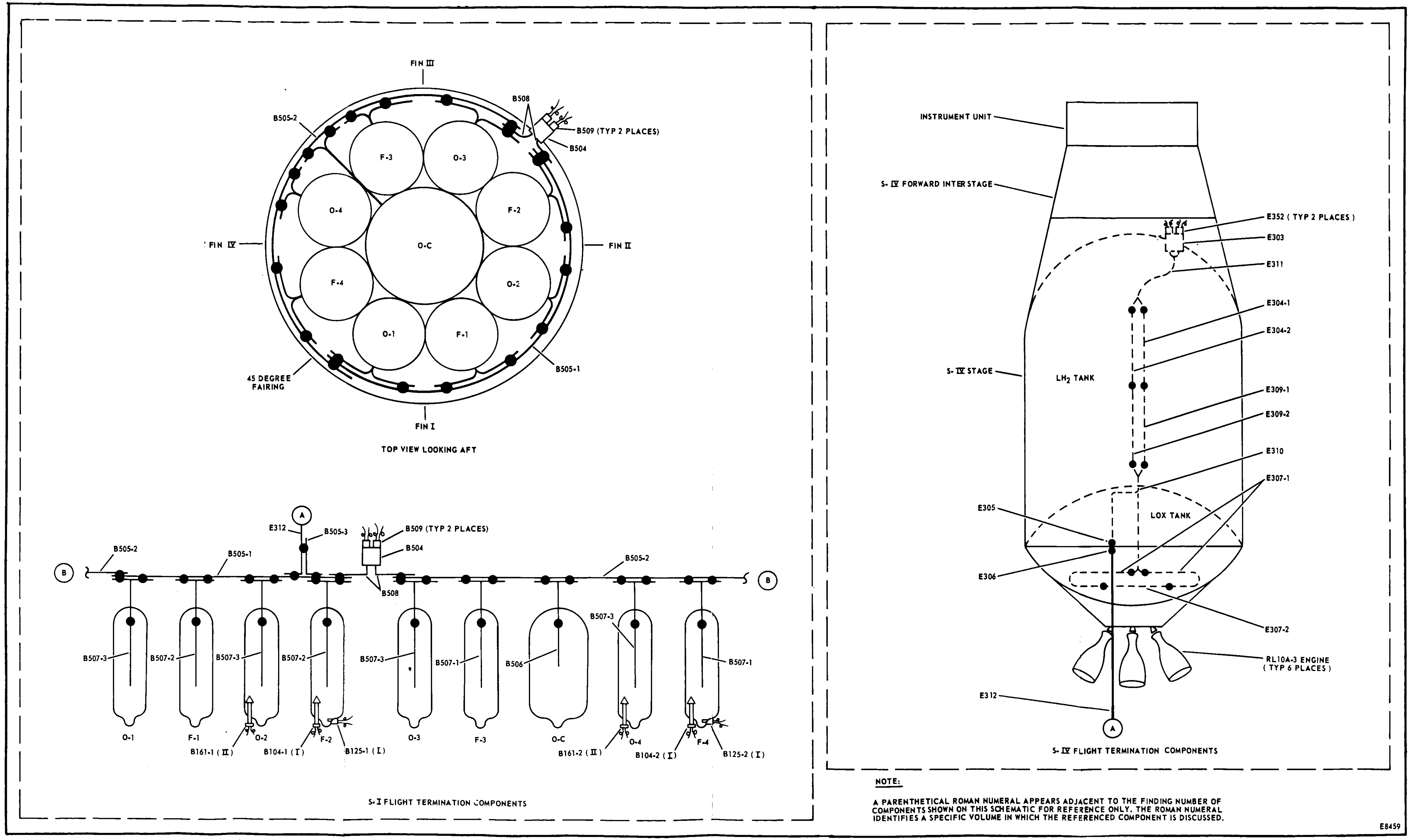

Figure 3-2. Launch Vehicle Flight Termination Components