ENGINE START

1. Engine start is part of the terminal countdown sequence. When this point in the countdown is reached, the ignition sequencer controls starting of all five engines.

2. Checkout valve moves to engine return position.

3. Electrical signal fires igniters (4 each engine).

   a) Gas generator combustor and turbine exhaust igniters burn igniter links to trigger electrical signal to start solenoid of 4-way control valve.

   b) Igniters burn approximately six seconds.

4. Start solenoid of 4-way control valve directs GSE hydraulic pressure to main lox valves.

5. Main lox valves allow lox to flow to thrust chamber and GSE hydraulic pressure to flow through sequence valve to open gas generator ball valve.

6. Propellants, under tank pressure, flow into gas generator combustor.

7. Propellants are ignited by flame of igniters.

8. Combustion gas passes through turbopump, heat exchanger, exhaust manifold and nozzle extension.

9. Fuel rich turbine combustion gas is ignited by flame from igniters.

   a) Ignition of this gas prevents backfiring and burping.

   b) This relatively cool gas (approximately 1,000°F) is the coolant for the nozzle extension.

10. Combustion gas accelerates the turbopump, causing the pump discharge pressure to increase.

11. As fuel pressure increases to approximately 375 psig, it ruptures the hypergol cartridge.

12. The hypergolic fluid and fuel are forced into the thrust chamber where they mix with the lox to cause ignition.

TRANSITION TO MAINSTAGE

13. Ignition causes the combustion zone pressure to increase.

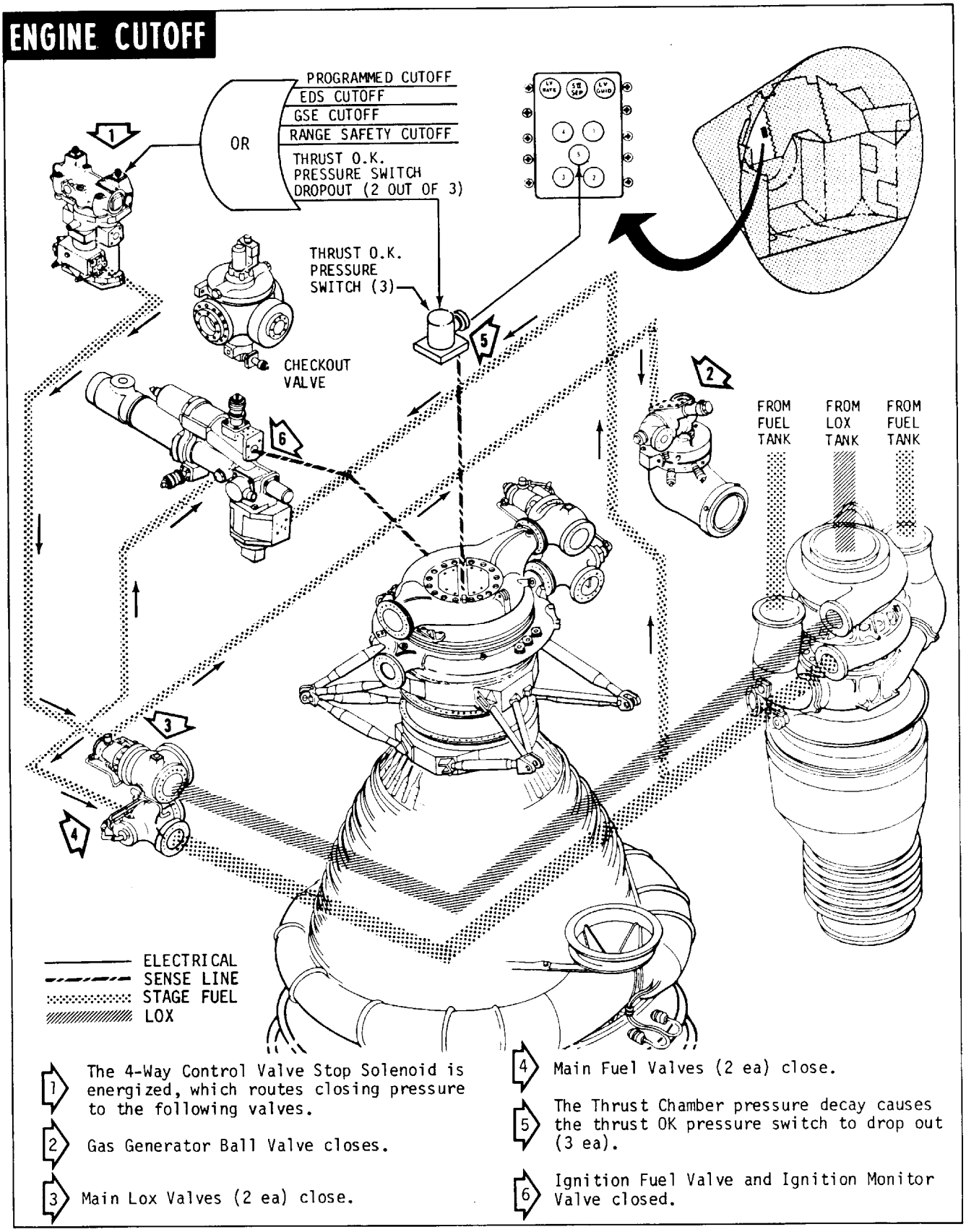
14. As pressure reaches 20 psig, the ignition monitor valve directs fluid pressure to the main fuel valves.

15. Fluid pressure opens main fuel valves.

16. Fuel enters thrust chamber. As pressure increases the transition to mainstage is accomplished.

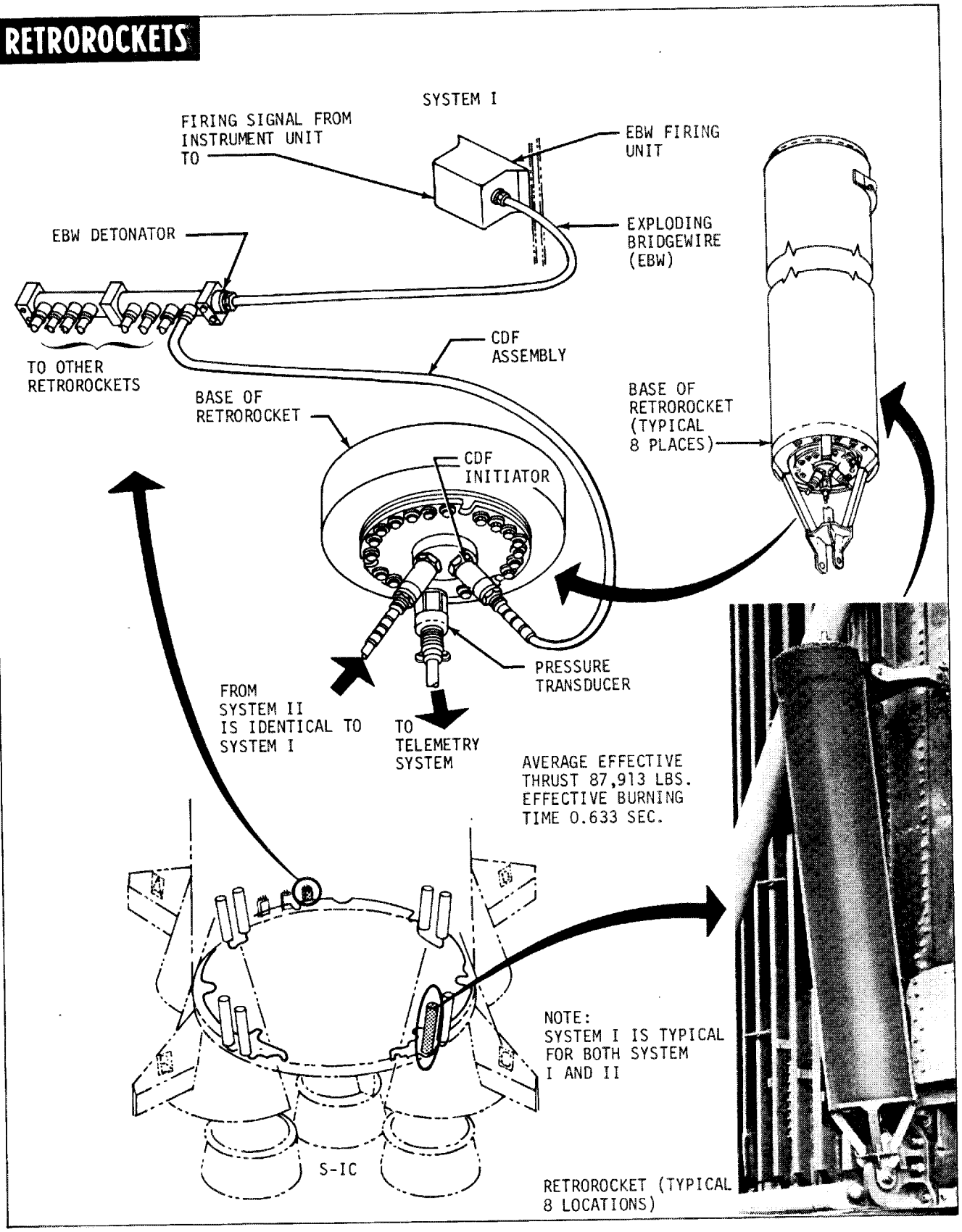
17. The thrust OK pressure switch (which senses fuel injection pressure) picks up at approximately 1060 psi and provides a THRUST OK signal to the IU.

ENGINE CUTOFF

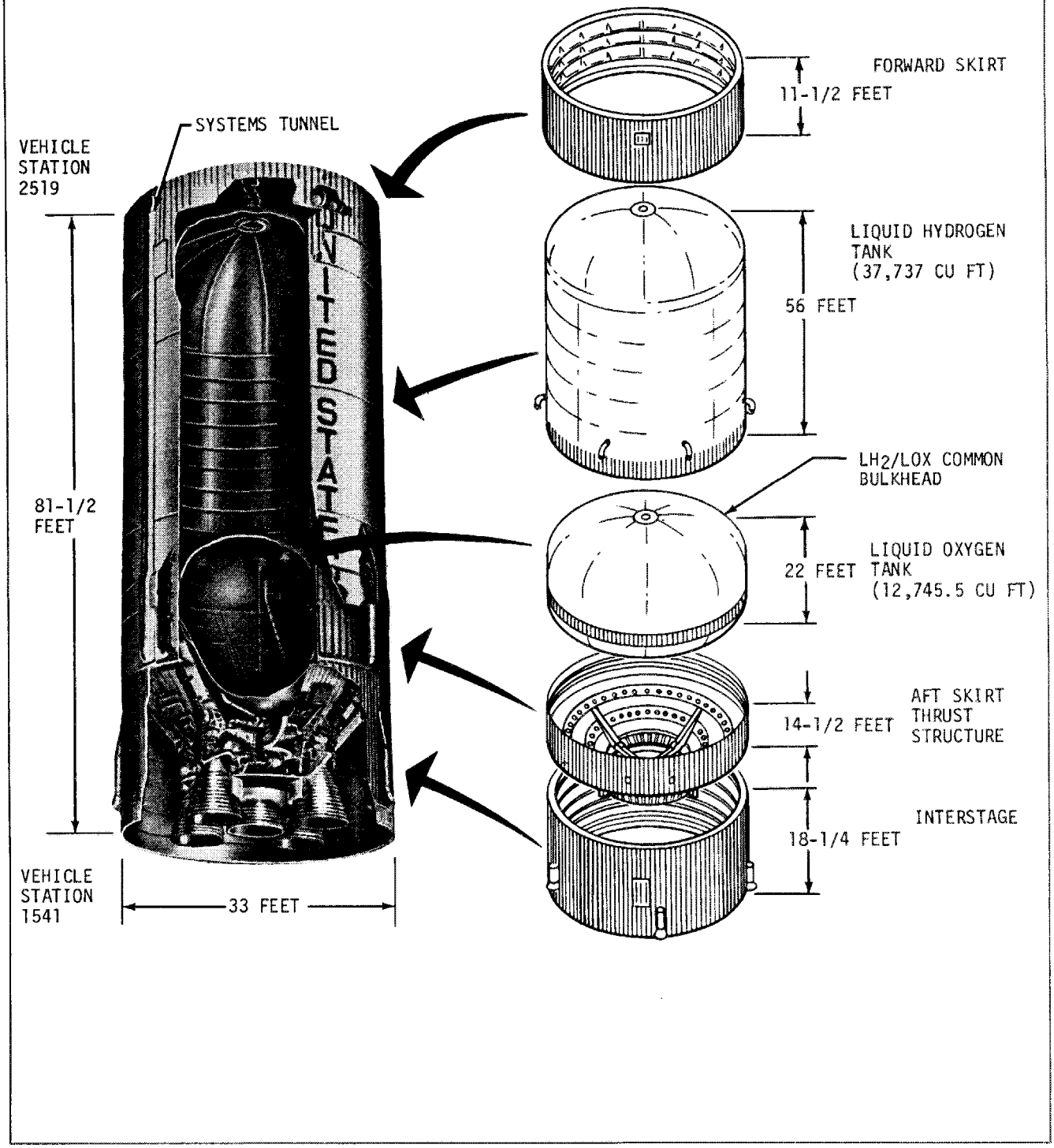


1. The 4-Way Control Valve Stop Solenoid is energized, which routes closing pressure to the following valves.
2. Gas Generator Ball Valve closes.
3. Main Lox Valves (2 ea) close.
4. Main Fuel Valves (2 ea) close.
5. The Thrust Chamber pressure decay causes the thrust OK pressure switch to drop out (3 ea).
6. Ignition Fuel Valve and Ignition Monitor Valve closed.

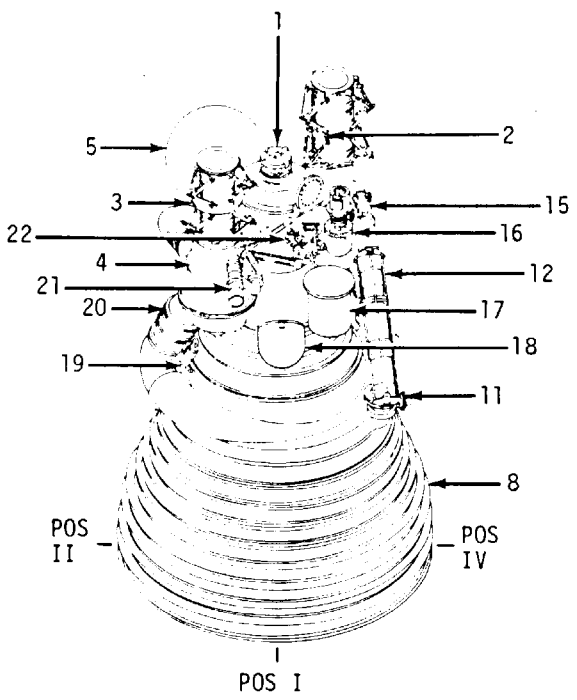
RETROROCKETS

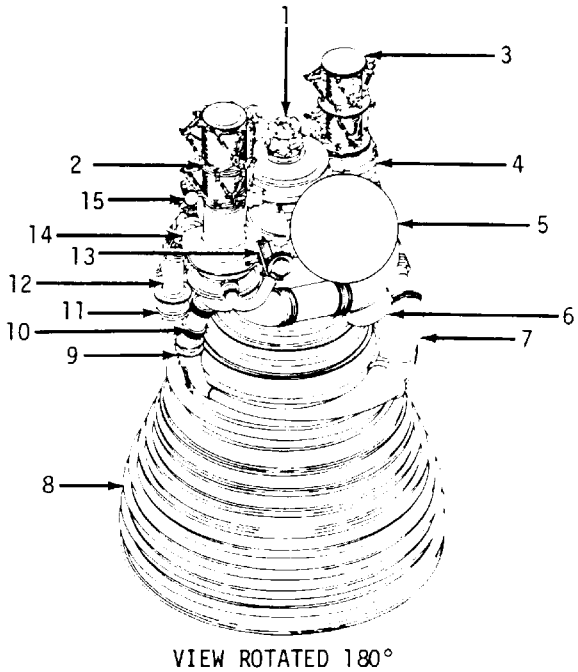


S-II STAGE STRUCTURE



J-2 ROCKET ENGINE

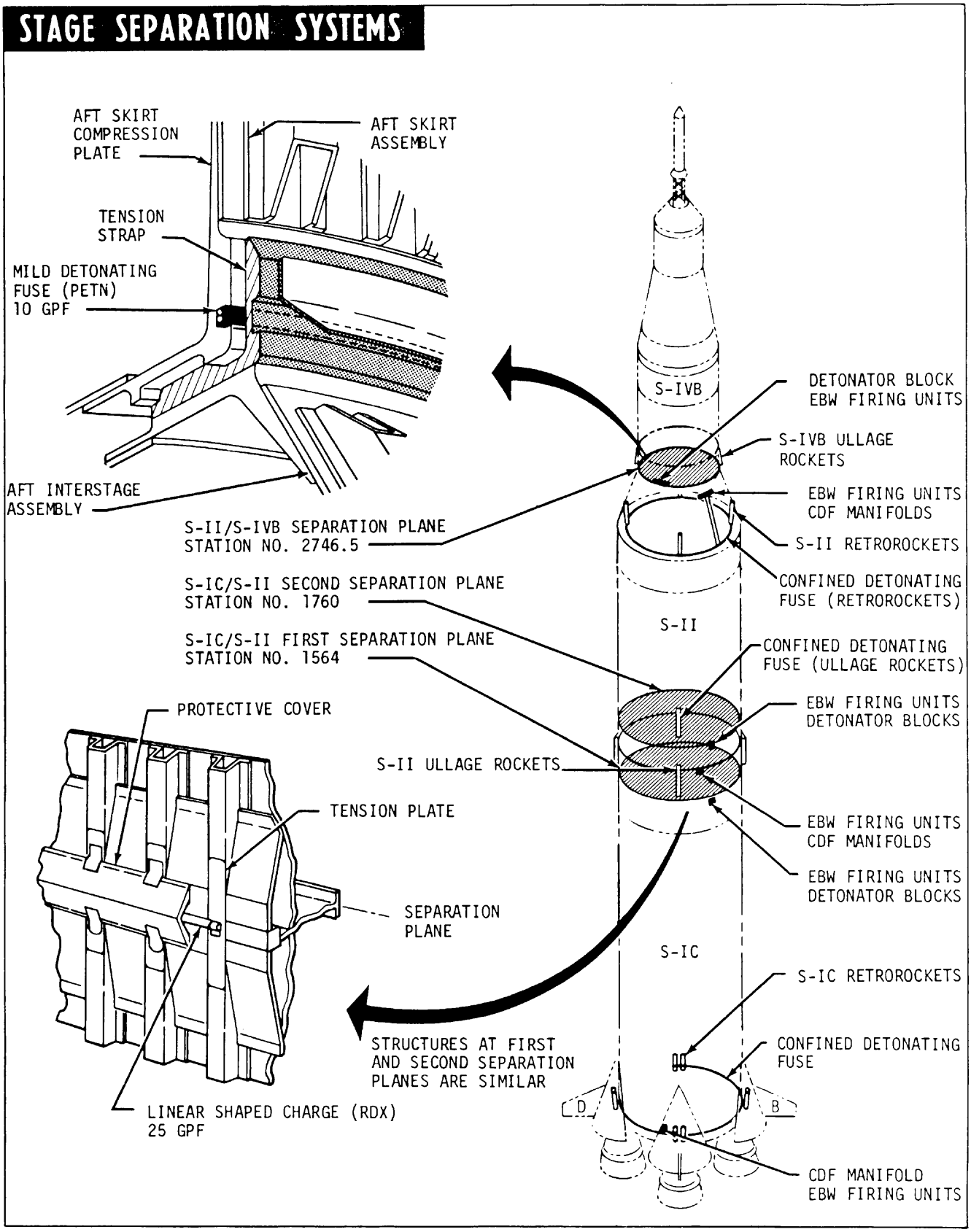




VIEW ROTATED 180°

1. GIMBAL
2. FUEL INLET DUCT
3. OXIDIZER INLET DUCT
4. OXIDIZER TURBOPUMP
5. START TANK
6. AUXILIARY FLIGHT INSTRUMENTATION PACKAGE
7. EXHAUST MANIFOLD
8. THRUST CHAMBER
9. OXIDIZER TURBINE BYPASS VALVE
10. TURBINE BYPASS DUCT
11. MAIN FUEL VALVE
12. HIGH PRESSURE FUEL DUCT
13. START TANK DISCHARGE VALVE
14. FUEL TURBOPUMP
15. FUEL BLEED VALVE
16. GAS GENERATOR
17. ELECTRICAL CONTROL PACKAGE
18. PRIMARY FLIGHT INSTR. PACKAGE
19. ANTI-FLOOD CHECK VALVE
20. HEAT EXCHANGER
21. PROPELLANT UTILIZATION VALVE
22. PNEUMATIC CONTROL PACKAGE

STAGE SEPARATION SYSTEMS



S-IC/S-II AND S-II/S-IVB SEPARATION

S-IC/S-II separation

1. EBW firing units enabled

A ground-latched interlock renders all the EBW firing units on the Saturn V inoperative while the vehicle is on the launch pad. The interlock is released with umbilical disconnect during liftoff, and the subsystem is reset to flight conditions.

2. S-IC/S-II separation ordnance arm

The ordnance-arm command is routed through the S-II switch selector to both the S-IC stage electrical circuitry to supply 28 vdc to the EBW units for first-plane separation and retrorocket ignition, and to the S-II stage electrical circuitry to supply 28 vdc to the EBW units for ullage rocket ignition and second-plane separation.

3. S-IC outboard engine cutoff followed by S-II ullage rocket ignition

4. First plane separation

Second plane separation is enabled by the removal of an electrical interlock during first plane separation.

5. Second plane separation

The second plane separation command is generated by the IU approximately thirty seconds after first plane separation. This delay permits the transient vehicle motion, associated with first plane separation, to dampen out.

The separation command is routed to the S-II switch selector to trigger the ordnance train and ignite the LSC for second plane separation. The LSC detonates, severing the S-II interstage from the S-II stage. The combined effect of vehicle acceleration and the reaction caused by the J-2 engine exhaust plume impingement retards the interstage .

S-II/S-IVB separation

Physical separation is initiated by the IU at the end of the S-II boost phase following shutdown of the five J-2 engines. Separation requires the performance of the following major functions in the sequence described:

6. S-II/S-IVB separation ordnance arm

The ordnance-arm command is routed through the S-II switch selector to both the S-II and S-IVB stage electrical circuitry and carries 28 vdc to the EBW firing units for S-II/S-IVB separation and retrorocket ignition.

7. S-II/S-IVB separation

Four solid propellant S-II retrockets. (figure 5-22) are mounted at equal intervals on the periphery of the S-II/S-IVB interstage structure and are used to retard the S-II stage after separation.

Figure 5-20 (Sheet 1 of 2)

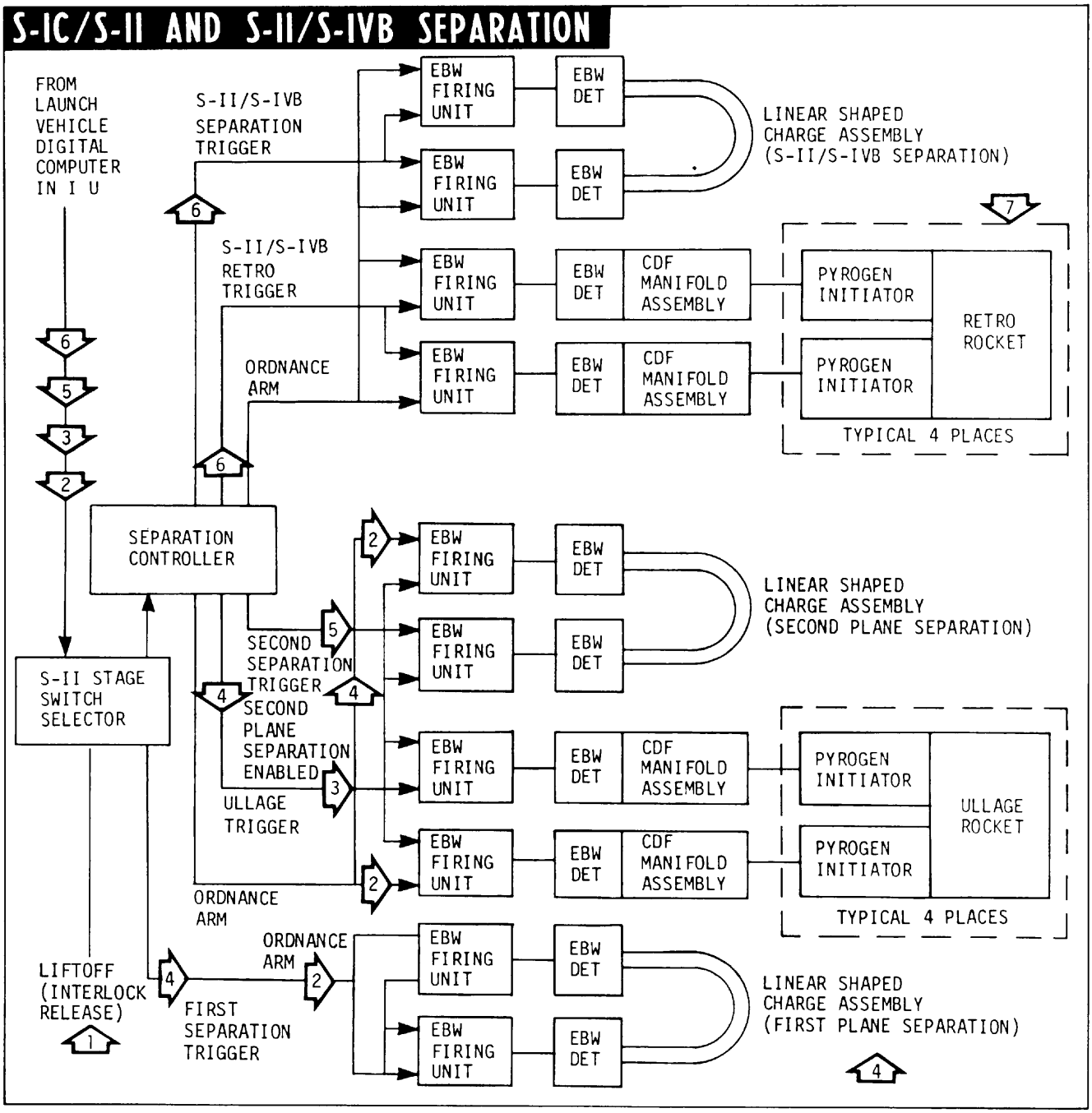
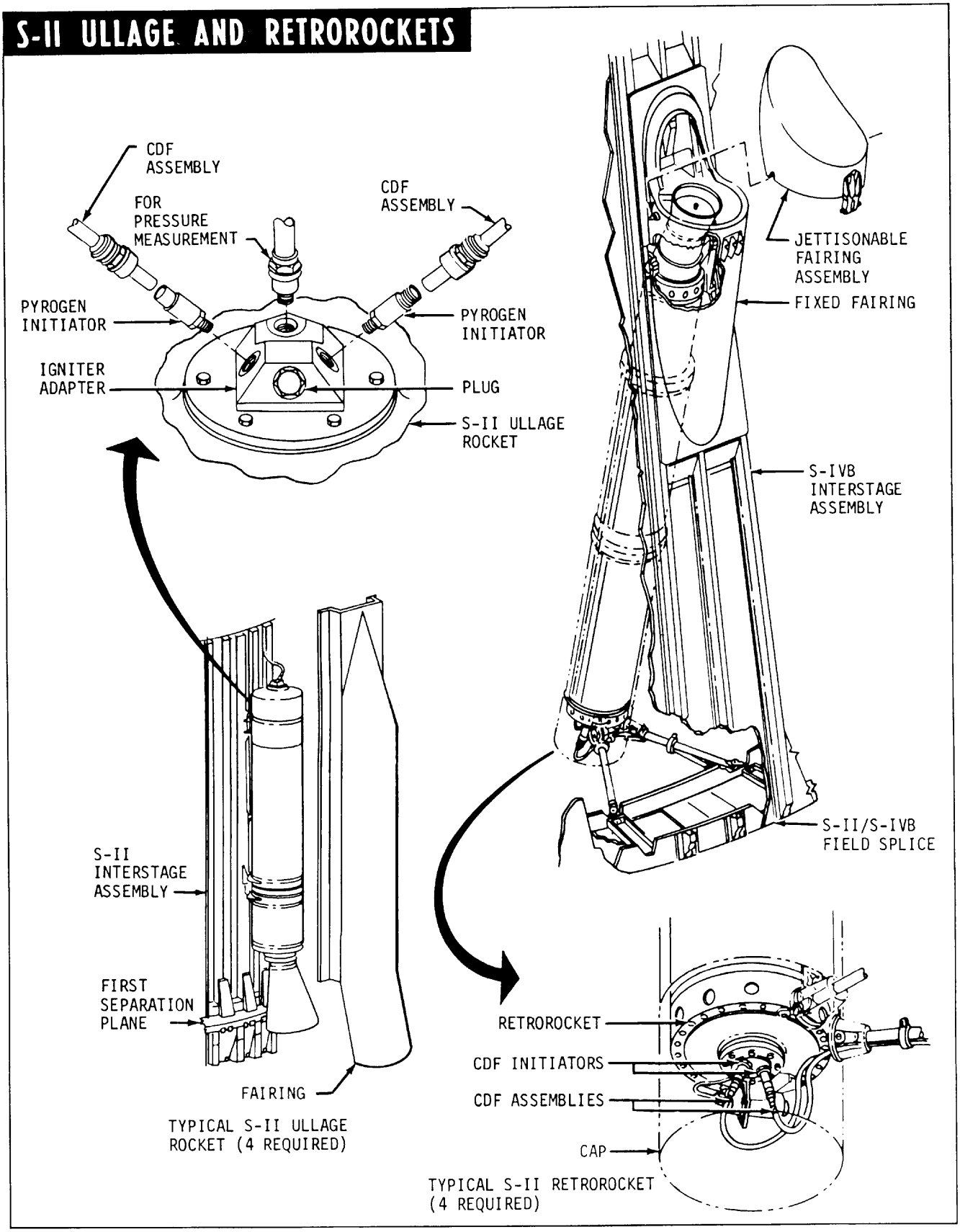
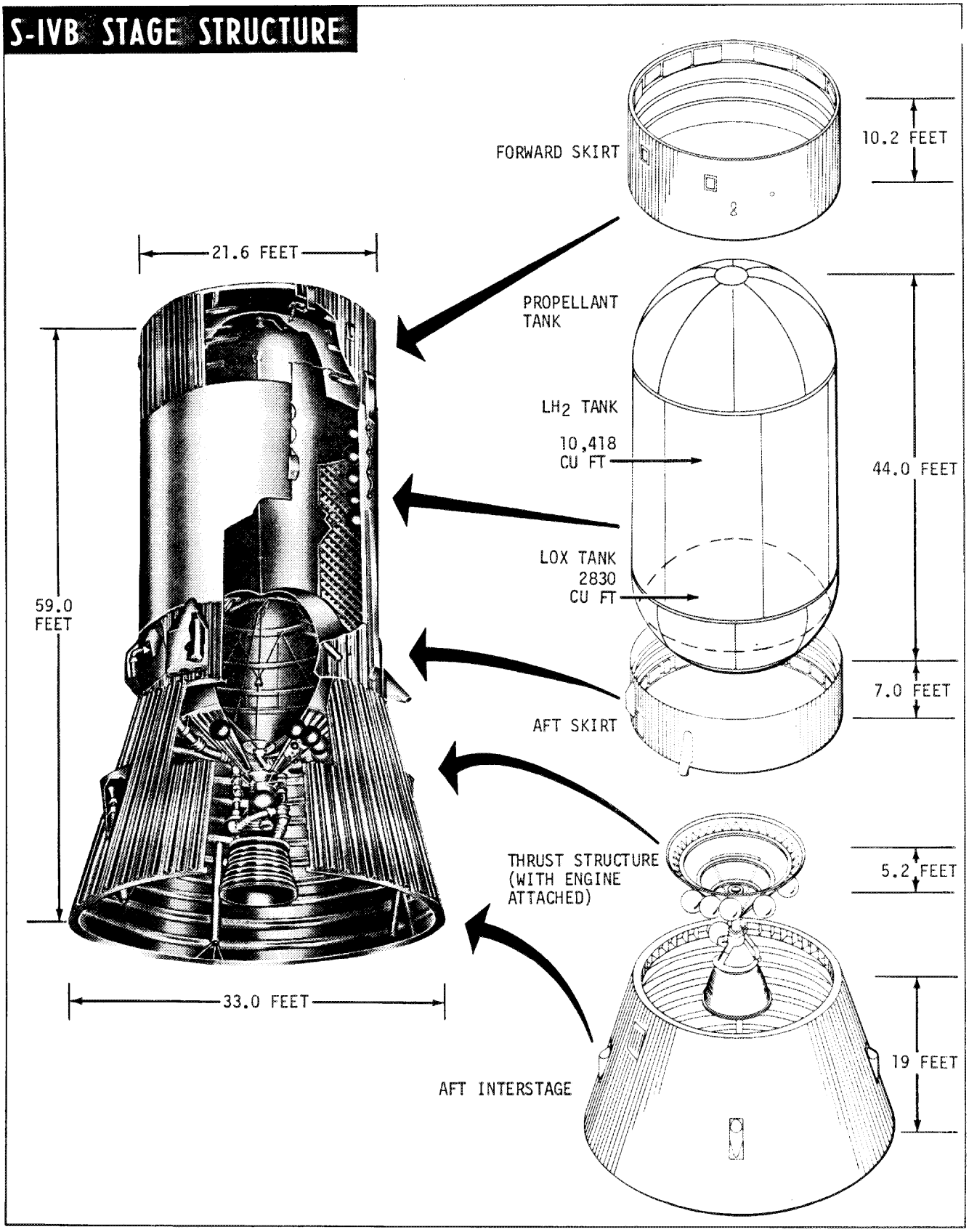


Figure 5-20 (Sheet 2 of 2)

S-II ULLAGE AND RETROROCKETS




S-IVB STAGE STRUCTURE
FORWARD SKIRT
10.2 FEET
21.6 FEET
PROPELLANT TANK
LH2 TANK
10,418 CU FT
LOX TANK
2830 CU FT
44.0 FEET
59.0 FEET
AFT SKIRT
7.0 FEET
THRUST STRUCTURE (WITH ENGINE ATTACHED)
5.2 FEET
AFT INTERSTAGE
19 FEET
33.0 FEET