# Saturn V

## 50th Anniversary Commemorative


Evening, November 8, 1967. AS-501 / Apollo 4, Pad 39A, KSC, FL.

## The Saturn V Launch Vehicle

With a capacity to boost a payload of 260,000 lb. into low Earth orbit, or a 100,000 lb. payload into a lunar trajectory, the Saturn V remains the most powerful launch vehicle yet to leave the Earth's atmosphere. It was capable of placing in orbit a payload more than four times heavier than the future Space Shuttle could lift, and was six times more powerful than the next largest expendable rocket of its day.

The Saturn V was designed by NASA engineers at the Marshall Space Flight Center, (MSFC), in Huntsville, AL, under the direction of Dr. Wernher von Braun. Development began in January, 1962. A total of fifteen vehicles were produced. Thirteen flew missions.

### Characteristics

Overall length: 281 ft. (booster), 363 ft. (with spacecraft). Maximum diameter: 33.0 ft. Weight at liftoff: 6,423,000 lbs. Trans-lunar payload capability approximately 107,350 lbs. Earth orbit payload capability, (two stage configuration); 212,000 lbs.

### Stages

First Stage, (**S-IC**);

Contractor: Boeing
Assembled: New Orleans, LA .
Length: 138 ft.
Diameter: 33 ft.
Weight: 5,022,674 lbs. fueled / 288,750 lbs. dry.
Engines: F-1 (x5) Designed and manufactured by Rocketdyne, Canoga Park, CA.
Propellants: LOX (Liquid Oxygen) / RP-1 (Kerosene.)
Thrust: 7,610,000 lbs. During the production run, the F-1 was redesigned and up-rated in preparation for the later "J Series" of extended lunar missions. These missions carried heavier payloads. With up-rated engines, the S-IC produced 7,724,000 lbs. of thrust.
Burn time: 168 seconds, nominal.

Second Stage, (**S-II**);

Contractor: North American Aviation, (now Rockwell).
Assembled: Seal Beach, CA.
Length: 81.5 ft.
Diameter: 33 ft.
Weight: 1,059,171 lbs. fueled / 79,918 lbs. dry.
Engines: J-2 (x5) Designed: MSFC, Rocketdyne. Manufactured: Rocketdyne, Canoga Park, CA.
Propellants: LOX / Liquid Hydrogen
Thrust: 1,150,000 lbs.
Burn Time: 384 seconds, nominal.

Interstage* (S-IC/S-II);

Ullage Motors: eight, (small); AS-501 through AS-509, two (large); AS-510 through AS-515 .
Thrust: 1,353 lbs. (small), 8,750 lbs. (large).

Third Stage, (**S-IVB**);

Contractor: McDonnell-Douglas
Assembled: Huntington Beach, CA
Length: 58.3 ft.
Diameter: 21.7 ft.
Weight: 260,523 lbs. fueled / 25,000 lbs. dry.
Engine: J-2, (single). Rocketdyne.
Propellants: LOX / Liquid Hydrogen
Thrust: 238,000 lbs.
Orbital Insertion Burn (1st): 147 seconds, nominal.
Trans-Lunar Injection Burn (2nd): 384 sec., varied per mission.

Interstage* (S-II/S-IVB);

Ullage Motors: 2.
Thrust: 8,081 lbs.

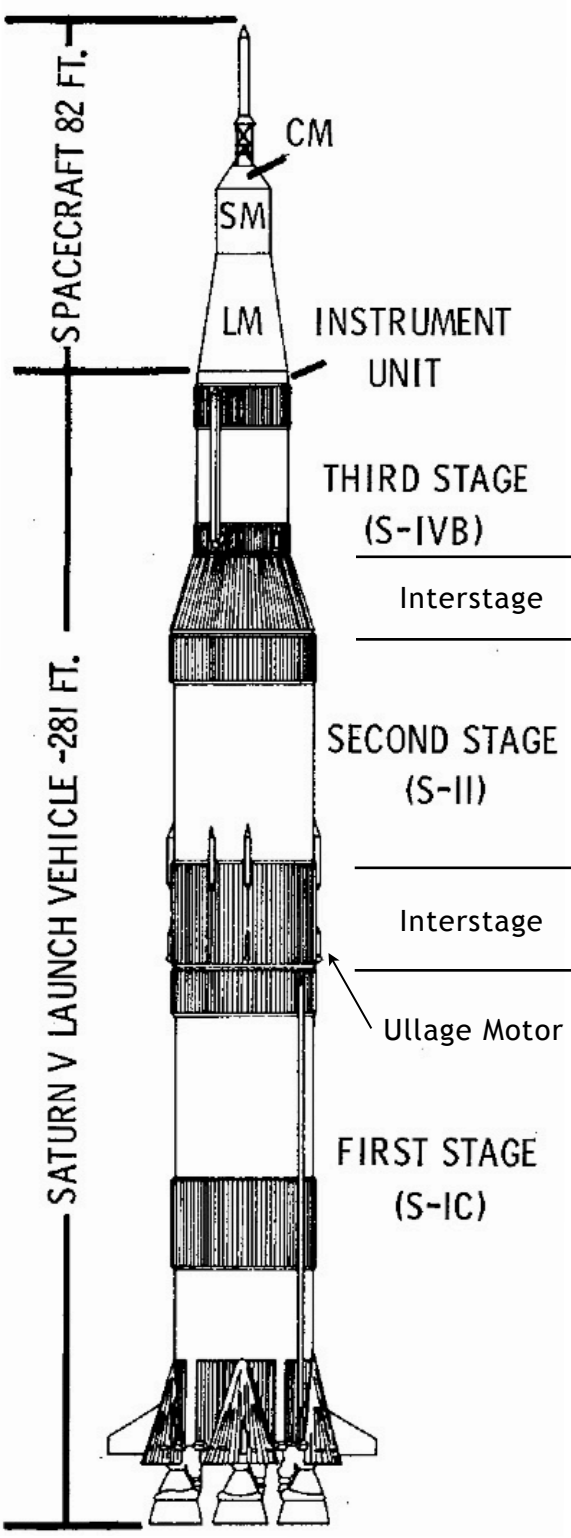
Instrument Unit;

Contractor: IBM
Assembled: Huntsville, AL.
Height: 3 ft.
Diameter: 21.7 ft.
Guidance System: Inertial

* Interstage; a transition cowling, or adapter between stages.

Ullage Motor; a small solid rocket motor attached to the Interstage. During staging, these motors ignite and burn until the upper stage engines have ignited and reached nominal thrust. Their purpose is threefold;

1. Maintain momentum of the remaining vehicle.
2. Force the liquid propellants of the upper stage downward against the engine intake valves.
3. Insure against accidental collision with the tumbling spent stage.




Saturn V Diagram courtesy NASA, Johnson Space Center, online archive.

**List of Saturn V Flights**

1. Vehicle: **AS-501**

   Mission: **Apollo 4**; Prove the integrity of Saturn V and Command Module heat shield. Successful.
   Launched: November 9, 1967, 12:00:01 UT, Complex 39A, Kennedy Space Center, FL
   Payload: Command/Service Module CSM-017. Simulated Lunar Module designated LTA-10R.
   Crew: Unmanned.
   Duration: 8 hrs. 37 min. 9 sec.
   Splashdown: Pacific Ocean.

2. Vehicle: **AS-502**

   Mission: **Apollo 6**; Same as Apollo 4. The S-IC experienced severe vibration. Two S-II engines failed. S-IVB motor failed to re-start for its planned second burn. Vertical oscillation in the S-IC, called 'pogo', caused failures in S-II and S-IVB. An extended Service Module burn compensated, allowing Command Module to complete mission. The S-IC was redesigned to eliminate 'pogo' by injecting helium into fuel lines which damped out vibration. On April 27, 1968, NASA Administrator James Webb ordered the next Saturn V to be prepared to carry a human crew.
   Launched: April 4, 1968, 12:00:01 UT, Pad 39A, KSC, FL.
   Payload: Apollo CM-020, SM-014, Lunar Module Simulator LTA-2R.
   Crew: Unmanned.
   Duration: 9 hrs. 57 min. 20 sec.
   Splashdown: Pacific Ocean.

3. Vehicle: **AS-503**

   Mission: **Apollo 8**; First humans to leave Earth's gravitational field and enter lunar orbit. Successful.
   Launched: December 21, 1968, 12:51:00 UT, Pad 39A, KSC, FL.
   Payload: CSM-103. Ballast to simulate a Lunar Module payload, designated LTA-B.
   Crew: Frank Borman, Cdr. James Lovell, CMP. Bill Anders, LMP.
   Duration: 147 hrs. 00 min. 42 sec.
   Recovered: December 27, 1968, USS *Yorktown*, 8°7.5'N 165°1.2'W, Pacific Ocean.

4. Vehicle: **AS-504**

   Mission: **Apollo 9**; Test of production Lunar Module descent and ascent engines in earth orbit. Full practice of rendezvous and docking procedures necessary for lunar landing. Successful.
   Launched: March 3, 1969, 16:00:00 UT, Pad 39A, KSC, FL.
   Payload: CSM-104, (Gumdrop), LM-3, (Spider).
   Crew: James McDivitt, Cdr. David Scott, CMP. Russell Schweickart, LMP.
   Duration: 241 hrs. 00 min. 54 sec.
   Recovered: March 13, 1969, USS *Guadalcanal*, 23°15'N 67°56'W, Atlantic Ocean, (1,000 mi. east of Cape Canaveral).

5. Vehicle: **AS-505**

   Mission: **Apollo 10**; Full rehearsal of lunar landing maneuvers in lunar orbit. Successful.
   Launched: May 18, 1969, 16:49:00 UT, Pad 39B, KSC, FL.
   Payload: CSM-106, (Charlie Brown), LM-4, (Snoopy).
   Crew: Thomas Stafford, Cdr. John Young, CMP. Eugene Cernan, LMP.
   Duration: 192 hrs. 03 min. 23 sec.
   Recovered: May 26, 1969, USS *Princeton*, 15°2'S 164°9'W, Pacific Ocean.

6. Vehicle: **AS-506**

   Mission: **Apollo 11**; First lunar landing, Sea of Tranquility. Successful.
   Launched: July 16, 1969, 13:32:00 UT, Pad 39A, KSC, FL.
   Payload: CSM-107, (Columbia), LM-5, (Eagle).
   Crew: Neil Armstrong, Cdr. Michael Collins, CMP. Edwin Aldrin, LMP.
   Duration: 195 hrs. 18 min. 35 sec.
   Recovered: July 24, 1969, USS *Hornet*, 13°19'N 169°39'W, Pacific Ocean, (Southwest of Hawaii).

7. Vehicle: **AS-507**

   Mission: **Apollo 12**; Second lunar landing, Ocean of Storms. AS-507 was twice struck by lightning as it left the pad. The crew lost all telemetry and control. As a testament to the integrity of the Saturn V design, they were propelled safely into orbit by the Saturn's inertial guidance system. Once in orbit, telemetry was restored and the mission was successful.
   Launched: November 14, 1969, 16:22:00 UT, Complex 39A, KSC, FL.
   Payload: CSM-108, (Yankee Clipper), LM-6, (Intrepid).
   Crew: Charles Conrad, Cdr. Richard Gordon, CMP. Alan Bean, LMP
   Duration: 244 hrs. 36 min. 25 sec.
   Recovered: November 24, 1969, USS *Hornet*, 15°47'S 165°9'W, Pacific Ocean.

8. Vehicle: **AS-508**

   Mission: **Apollo 13**; Third lunar landing attempt. Mission aborted due to Service Module failure. Crew recovered safely.
   Launched: April 11, 1970, 19:13:00 UT, Pad 39A, KSC, FL.
   Payload: CSM-109, (Odyssey), LM-7, (Aquarius).
   Crew: Jim Lovell, Cdr. Jack Swigert, CMP. Fred Haise, LMP.
   Duration: 142 hrs. 54 min. 41 sec.
   Recovered: April 17, 1970, USS *Iwo Jima*, 21°38'S 165°22'W, Pacific Ocean.

9. Vehicle: **AS-509**

   Mission: **Apollo 14**; Third lunar landing, highlands north of Fra Mauro crater. Successful.
   Launched: January 31, 1971, 21:03:02 UT, Complex 39A, KSC, FL.
   Payload: CSM-110, (Kitty Hawk), LM-8, (Antares).
   Crew: Alan Shepard, Cdr. Stuart Roosa, CMP. Edgar Mitchell, LMP.
   Duration: 216 hrs. 1 min. 58 sec.
   Recovered: February 9, 1971, USS *New Orleans*, 21°1'S 172°39'W, Pacific Ocean, (780 mi. south of Samoa).

10. Vehicle: **AS-510**

    Mission: **Apollo 15**; Fourth lunar landing. First of "J series" extended missions and up-rated Saturn V. Destination; Hadley Rille, Apennine Mountains. Successful.
    Launched: July 26, 1971, 13:34:00 UT, Pad 39A, KSC, FL.
    Payload: CSM-112, (Endeavour), LM-10, (Falcon).
    Crew: David Scott, Cdr. Alfred Worden, CMP. James Irwin, LMP.
    Duration: 259 hrs. 11 min. 53 sec.
    Recovered: August 6, 1971, USS *Okinawa*, 26°17'N 158°8'W, Pacific Ocean, North of Honolulu.

11. Vehicle: **AS-511**

Mission: **Apollo 16**; Fifth lunar landing, Descartes Highlands. Successful.
Launched: April 16, 1972, 17:54:00 UT, Pad 39A, KSC, FL.
Payload: CSM-113, (Casper), LM-11, (Orion).
Crew: John Young, Cdr. Ken Mattingly, CMP. Charles Duke, LMP.
Duration: 265 hrs. 51 min. 5 sec.
Recovered: April 27, 1972, USS *Ticonderoga*, 0°43'S 156°13'W, Pacific Ocean.

12. Vehicle: **AS-512**

Mission: **Apollo 17**; Sixth lunar landing, Taurus-Littrow Valley. Successful.
Launched: December 7, 1972, Pad 39A, KSC, FL.
Payload: CSM-114, (America), LM-12, (Challenger).
Crew: Eugene Cernan, Cdr. Ronald Evans, CMP. Harrison "Jack" Schmitt, LMP.
Duration: 301 hrs. 51 min. 59 sec.
Recovered: December 19, 1972, USS *Ticonderoga*, 17°53'S 166°7'W, Pacific Ocean.

13. Vehicle: **AS-513** (Originally configured for the cancelled Apollo 18 mission.)

Mission: **Skylab 1**; Place Skylab 1 in orbit.
Launched: May 14, 1973, 17:30:00 UT, Pad 39A, KSC, FL.
Payload: Skylab orbital workstation in place of third stage (S-IVB).
Crew: Unmanned.
Duration: 9 min. 50 sec. (Lift-off to orbit).

**December 16, 1976:** Unable to fund Apollo 19 and Apollo 20, NASA Administrator James Fletcher ordered the two remaining Saturn V vehicles, AS-514 and AS-515, to be released to museums. Here is where you can see the remaining Saturn V components;

**U.S. Space & Rocketry Center, Huntsville, AL;** AS-500D made up of S-IC-D, S-II-F/D, S-IVB-D. All components are test stages, never meant for flight. None the less, it is a full scale Saturn V.

**Johnson Space Center, Houston, TX**; S-IC from AS-514, S-II from AS-515, S-IVB from AS-513.

**Kennedy Space Center Visitor Complex, Cape Canaveral, FL**; S-IC-T, (test stage), S-II and S-IVB from AS-514.

**NASA Stennis Space Center, Pearlington, MS**; S-IC from AS-515. The S-IC was first test fired at this location.

**National Air & Space Museum, Washington, DC**; S-IVB from AS-515, (converted to Skylab B backup spacecraft).

**Steven F. Udvar-Hazy Center, National Air & Space Museum, Chantilly, VA,** James S. McDonnell Space Hanger; IBM Instrument Unit.

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**Additional Resources;**


**NASA, Johnson Space Center**; online archives.
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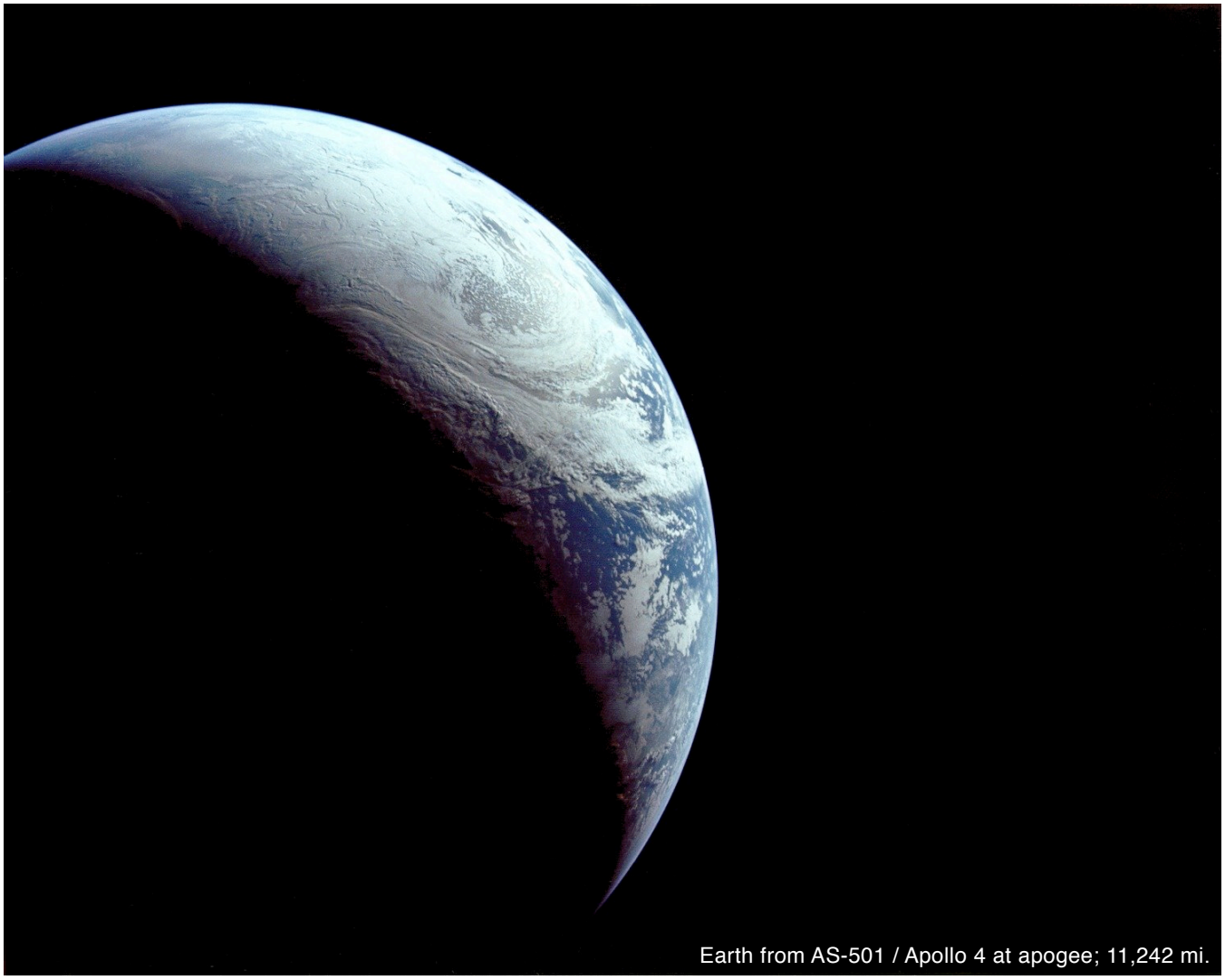
~ Prepared by **Bill Boublitz**, NAR 36860, Section 139, NARHAMS, August, 2017.



Earth from AS-501 / Apollo 4 at apogee; 11,242 mi.

Liftoff of AS-501 / Apollo 4, November 9, 1967.