

APOLLO SPACECRAFT

The Apollo spacecraft comprises the lunar module, the command module, the service module, the spacecraft-lunar module adapter, and the launch escape system. The five parts, 82 feet tall when assembled, are carried atop the launch vehicle.

After the launch escape system and the launch vehicle have been jettisoned, the three modules remain to form the basic spacecraft. The command module carries the three astronauts to and from lunar orbit. The service module contains the propulsion system that propels the spacecraft during the translunar and transearth flights. The lunar module carries two astronauts, the Commander and the Lunar Module Pilot, to and from the moon, and serves as the base of operations during the lunar stay.

LUNAR MODULE

The lunar module will be operated in the vacuum of space; there was no need, therefore, for it to have the aerodynamic symmetry of the command module. The lunar module outer configuration was dictated only by the requirements of component location; cabin configuration was designed to provide a near perfect operating environment for the astronauts.

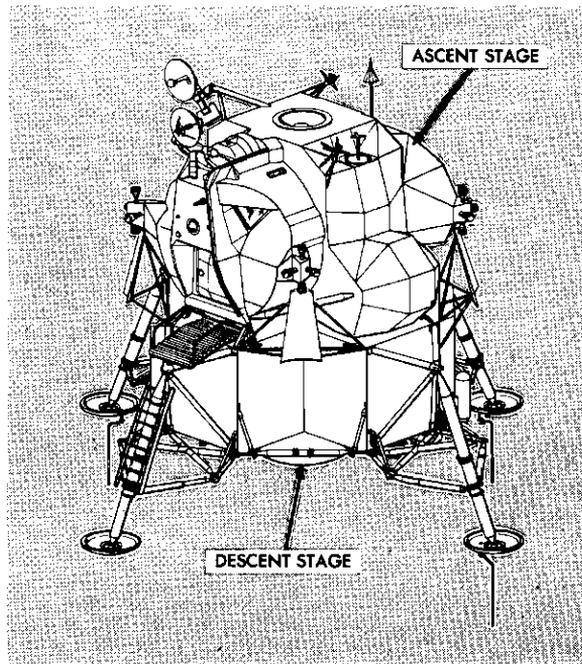
The LM consists of an ascent stage and a descent stage. Both stages perform as a single unit during separation from the CM, lunar descent, and lunar stay. The descent stage serves as a launching platform from which the ascent stage lifts off from the lunar landing site. The ascent stage operates independently during the lunar ascent, rendezvous, and docking phases of the mission.

ASCENT STAGE

The ascent stage is the control center of the LM; it is manned by the Commander, who occupies the left flight station, and the Lunar Module Pilot, who

occupies the right flight station. The astronauts transfer to the ascent stage, through the docking tunnel, after the LM has docked with the CM and both have attained lunar orbit. The ascent stage comprises three major areas: crew compartment, midsection, and aft equipment bay. The cabin, comprising the crew compartment and midsection, has an overall volume of 235 cubic feet.

Because the LM is operated in either the weightlessness of space or in lunar gravity, the cabin contains harness-like restraint equipment rather than the foldable couches provided in the CM. The restraints allow the astronauts sufficient freedom of movement to operate all LM controls while in a relatively upright position.



R-1A

Lunar Module

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DESCENT STAGE

The descent stage is the unmanned portion of the LM; it represents approximately two-thirds of the weight of the LM at the earth-launch phase. In addition to containing the descent propulsion section, the descent stage is designed to:

Support the ascent stage

Provide storage to support the scientific equipment and the lunar roving vehicle used on the lunar surface.

Provide for attachment of the landing gear

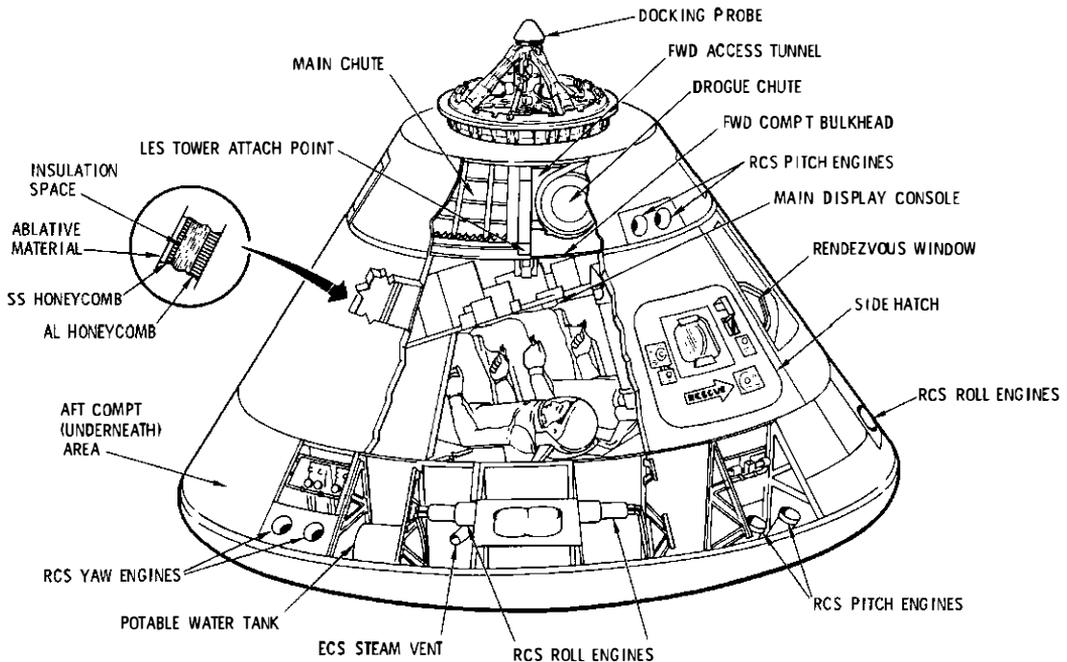
Serve as the ascent stage launching platform

The descent stage is separated into five equally sized compartments that contain descent propulsion section components. The center compartment houses the descent engine; fuel, oxidizer, and water tanks are distributed in the remaining four compartments.

COMMAND MODULE

Dimensions

Height	10 ft 7 in.
Diameter	12 ft 10 in.
Weight (including crew)	13,000 lb
Weight (splashdown)	11,700 lb



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Propellant

245 lb.

Reaction control subsystem
(fuel—monomethylhydrazine;
oxidizer—nitrogen tetroxide)

Function

The command module is the control center and living quarters for most of the lunar mission; one man will spend the entire mission in it and the other two will leave it only during the lunar landing. It is the only part of the spacecraft recovered at the end of the mission.

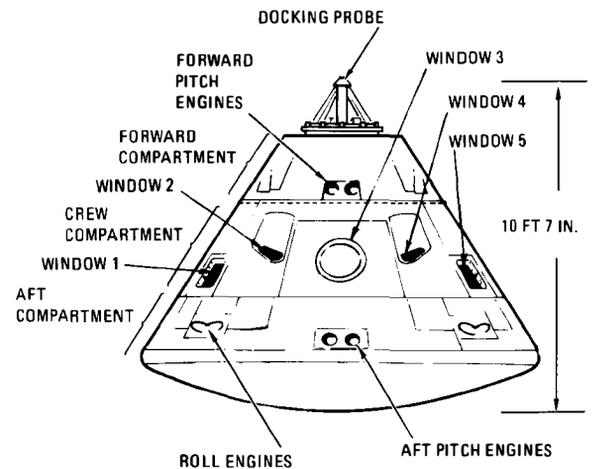
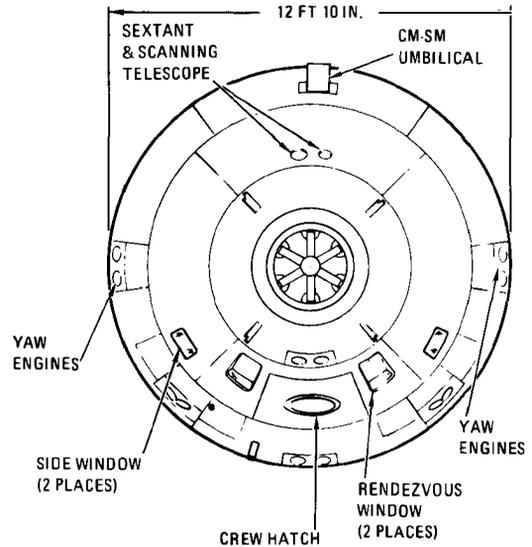
Major Subsystems

Communications
Earth landing
Electrical power
Environmental control
Guidance and navigation
Launch escape
Reaction control
Stabilization and control
Thermal protection (heat shields)

The CM is divided into three compartments: forward, crew, and aft. The forward compartment is the relatively small area at the apex of the module, the crew compartment occupies most of the center section of the structure, and the aft compartment is another relatively small area around the periphery of the module near the base.

During boost and entry the CM is oriented so that its aft section is down, like an automobile resting on its rear bumper. In this position the astronauts are on their backs; the couches are installed so that the astronauts face the apex of the module. In the weightlessness of space the orientation of the craft would make little difference except in maneuvers like docking, where the craft is moved forward so that the probe at the CM's apex engages the drogue on the LM. Generally, however, the module will be oriented in space so that its apex is forward.

Crewmen will spend much of their time on their couches, but they can leave them and move around. With the seat portion of the center couch folded, two astronauts can stand at the same time. The astronauts will sleep in two sleeping bags which are mounted beneath the left and right couches. The sleeping bags attach to the CM structure and have restraints so that a crewman can sleep either in or out of his space suit.



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CM General Arrangement

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Food, water, clothing, waste management, and other equipment are packed into bays which line the walls of the craft. The cabin normally will be pressurized to about 5 pounds per square inch (about a third of sea level pressure) and the temperature will controlled at about 75° F. The pressurization and controlled atmosphere will enable the three crewmen to spend much of their time out of their suits. They will be in their space suits, however, during critical phases of the mission such as launch, docking, and crew transfer.

The astronaut in the left-hand couch is the spacecraft commander. In addition to the duties of command, he will normally operate the spacecraft's flight controls. The astronaut in the center couch is the CM pilot; his principal task is guidance and navigation, although he also will fly the spacecraft at times. On the lunar mission, he is the astronaut who will remain in the CM while the other two descend to the surface of the moon. The astronaut in the right-hand couch is the LM pilot and his principal task is management of spacecraft subsystems.

Although each has specific duties, any of the astronauts can take over the duties of another. The command module has been designed so that one astronaut can return it safely to earth.

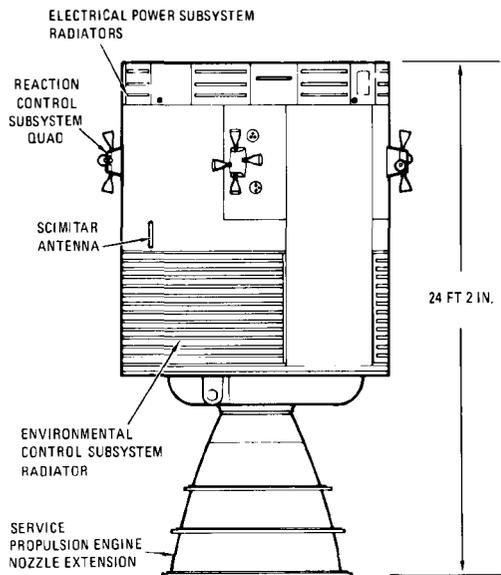
SERVICE MODULE

Dimensions

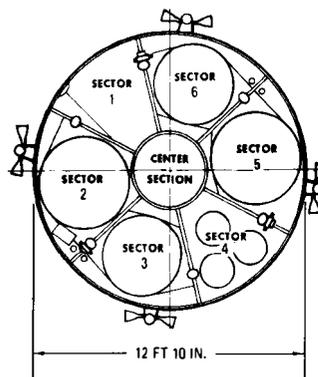
Height	24 ft 2 in.
Diameter	12 ft 10 in.
Weight (loaded)	54,000 lb.
Weight (dry)	13,475 lb.

Propellant

SPS fuel	15,690 lb.
SPS oxidizer	25,106 lb.
RCS	1,342 lb.



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- SECTOR 1 } SCIENTIFIC INST MODULE, OXYGEN AND HYDROGEN TANKS
- SECTOR 2 } SERVICE PROPULSION SUBSYSTEM
- SECTOR 3 } OXIDIZER TANKS
- SECTOR 4 } OXYGEN TANKS, HYDROGEN TANKS, FUEL CELLS, AUX BATTERY
- SECTOR 5 } SERVICE PROPULSION SUBSYSTEM
- SECTOR 6 } FUEL TANKS

CENTER SECTION - SERVICE PROPULSION AND HELIUM TANKS

Service Module

Function

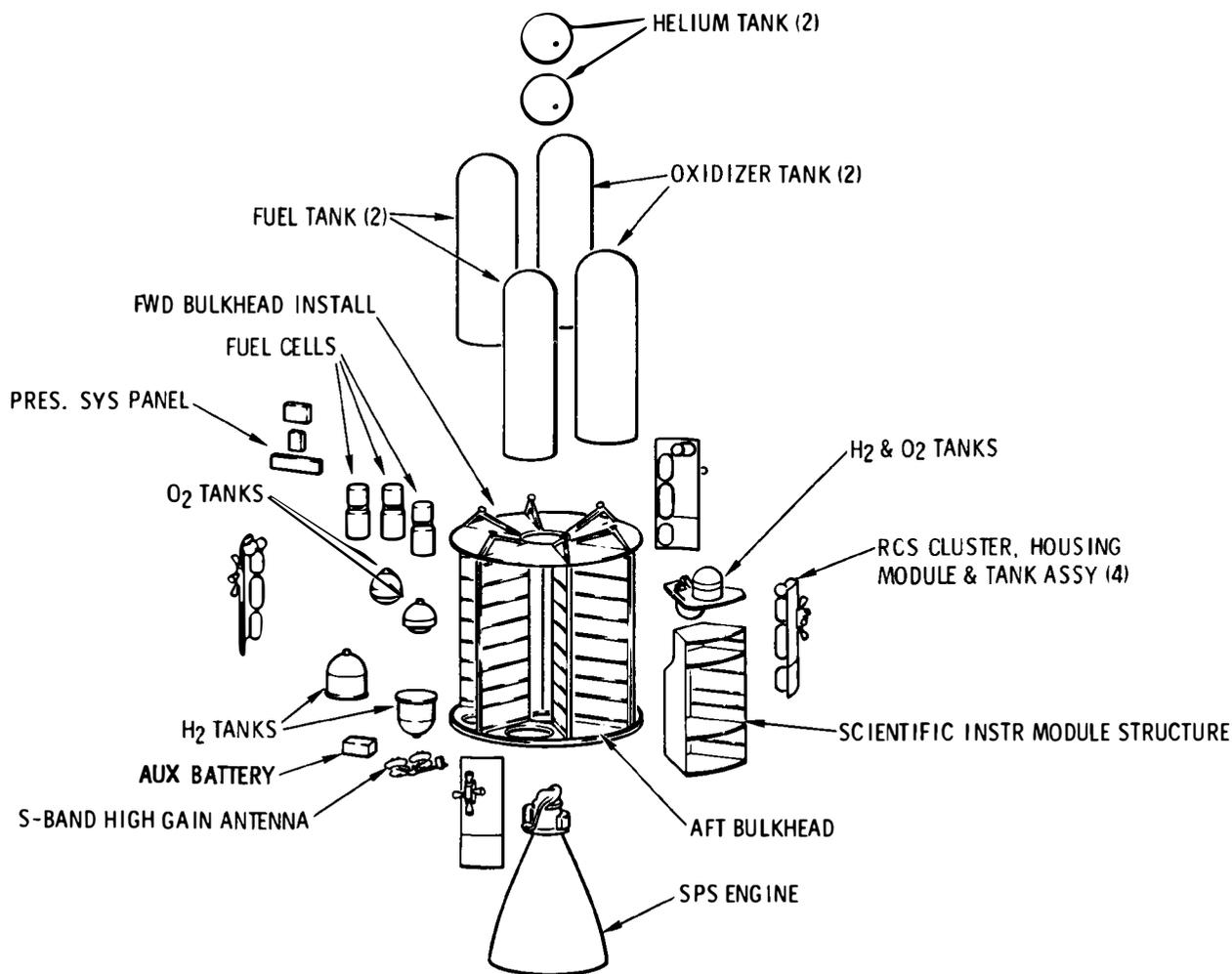
The service module contains the main spacecraft propulsion system and supplies most of the spacecraft's consumables (oxygen, water, propellant, hydrogen). It is not manned. The service module remains attached to the command module until just before entry, when it is jettisoned and is destroyed during entry.

Major Subsystems

- Electrical power
- Environmental control
- Reaction control
- Service propulsion
- Telecommunications
- Scientific Instrument module*

The service module is a cylindrical structure which serves as a storehouse of critical subsystems and supplies for almost the entire lunar mission. It is attached to the command module from launch until just before earth atmosphere entry.

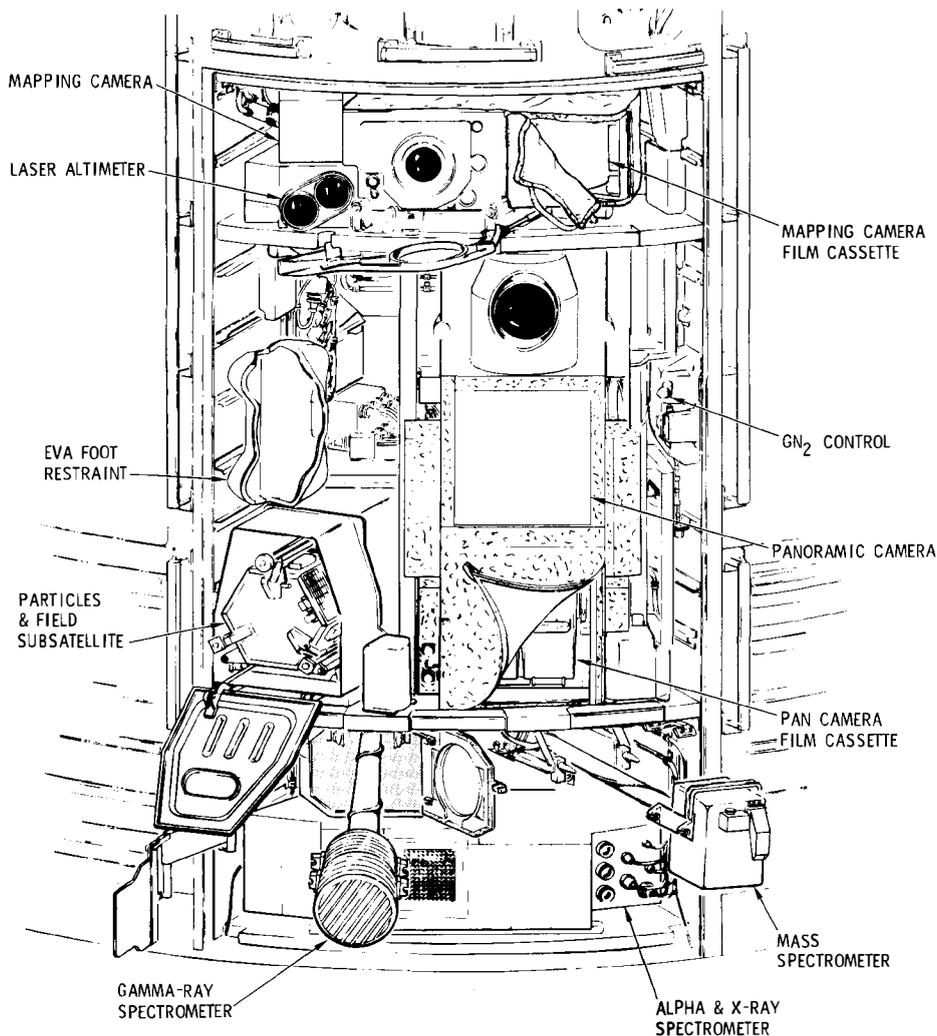
The service module contains the spacecraft's main propulsion engine, which is used to brake the spacecraft and put it into orbit around the moon and to send it on the homeward journey from the moon. The engine also is used to correct the spacecraft's course on both the trips to and from the moon.



Main Components of SM

Besides the service propulsion engine and its propellant and helium tanks, the service module contains a major portion of the electrical power, environmental control, and reaction control subsystems, and a small portion of the communications subsystem.

It is strictly a servicing unit of the spacecraft, but it is more than twice as long and more than four times as heavy as the manned command module. About 75 percent of the service module's weight is in propellant for the service propulsion engine.



SM-2A-2217D

J-Mission SIM Bay, Apollo 15-16

Information in this section relative to the Command and Service Module was provided by North American Rockwell Corporation, Space Division. Complete details on the Command and Service Modules are contained in North American's Apollo Spacecraft News Reference.