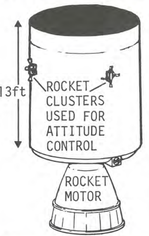
APOLLO—a space-machine for living in

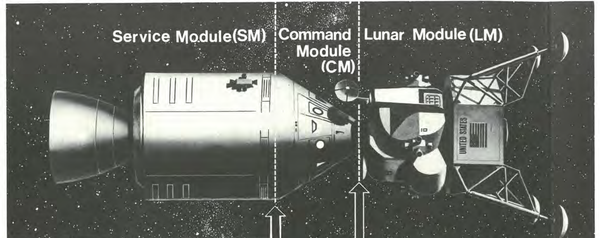


Service Module (SM)

THIS IS Apollo's main power-pack. After the last Saturn missile stage has been jettisoned, the Service Module is the primary propulsion unit. It's stop-and-start engine is used for various vital manoeuvres.

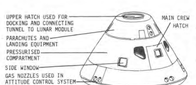
Electrical power, main fuel tanks, main oxygen and water supplies are also housed in the SM.

Apollo has to stay cool. Radiators positioned round the external surface of the SM expel heat made by the spacecraft's systems and the crew's bodies – but they work only when facing away from the sun. For this reason Apollo is rotated slowly under crew control at two revolutions an hour during long periods of the mission.



Command Module (CM)

THIS is the home of the three Lunar astronauts throughout most of the mission. It is a unit only 11 feet high and 13 feet in diameter at its base. It is all that remains on Earth re-entry of the original space vehicle of 363 feet height. And it weighs six tons against the 3,000-plus tons lift-off weight of the Apollo/Saturn assembly.



It is the nerve centre of the mission. For the other nerve centre of the mission, Control on Earth, it is the primary target for communication across thousands of miles in space.

CM has three major components. *First*, the upper-deck – a non-pressurised area housing Earth landing systems, including parachutes. *Second*, the pressurised compartment where the crew live alongside the mission's major controls. *Third*, the lower compartment housing fuel for the positional control systems used, after SM has been jettisoned, to change the attitude of the CM in flight. Beneath these compartments, and forming the base of the CM is the heat shield which guards the module on re-entry into Earth's atmosphere.

CM has five windows for direct observation, external hatch for exit and entry, and a hatch for passage between the CM and the Lunar Module.

CM also carries a TV camera, trained for most of the mission on the astronauts, but capable of manual movement to focus on instrument panel or other targets.

An on-board computer housed in CM makes all crucial calculations for manoeuvre of spacecraft.

Looking through the main hatch into the cramped interior of the CM.

Lunar Module (LM)

TWO MEN will ride down from Lunar orbit to the Moon in the Lunar Module (also known as the LM). They are the Spacecraft Commander and the LM Pilot.

LM is designed to go into orbit round the Moon after separation from CSM (Command and Service Modules), to descend to Lunar surface, to stay if necessary for a maximum 35 hours and to ascend to rejoin CSM.

LM is basically aluminium, made in two sections – Descent Stage and Ascent Stage – and overall is 19 feet 3 inches high at base of its extended landing legs, 29 feet 1 inches wide. Like CM, it has basic environment and control systems.

An upper hatch on LM 32 inches in diameter, is used for transfer of two crewmen to LM and, later, for re-entry to CM from LM. Three windows give the crew visibility for Lunar landing and, later, for docking with CSM.

LM landing gear is retracted until, during Lunar orbit, crew, having entered LM, triggers explosive devices to extend spring-loaded legs which lock into position automatically.

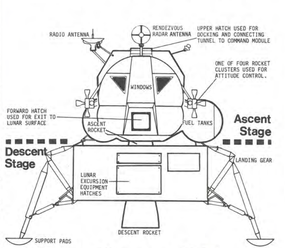
LM's communication systems provide contact between LM and Earth, LM and CSM, and between LM and crewmen on Moon's surface. This system can carry television, voice-recorded tape, non-voice signals, telegraph signals in addition to voice transmissions.

Ascent Stage of LM

DESIGNED to get the astronauts off the Lunar surface and to shelter them while they are on it, this stage contains all the crew controls of the LM. In addition to the crew compartment, it houses the ascent engine, a system for attitude control of the module, fuel tanks, water and oxygen tanks and an environment control unit.

Much equipment is stored in this section of the LM, including extra garments for wear on the Moon's surface (*see Item 3*), food first-aid kit. There are two life support packs for use outside the LM, and batteries and oxygen chargers for servicing them.

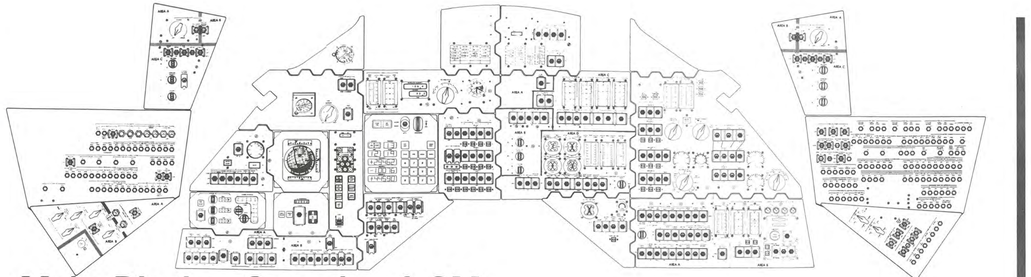
Two vital radar systems in the Ascent Stage are used for Lunar landing and for rendezvous with CSM after leaving the Moon. It is at lift-off from the Moon that the Ascent Stage separates from the Descent Stage of LM, which is left behind on the Lunar surface.



Descent Stage of LM

FINAL DESCENT to the Moon is achieved by using the variable-thrust descent engine in this stage of the LM. It houses also the landing-gear assembly, scientific equipment for use on the Moon, oxygen and helium tanks.

After use as a launch-pad when the Ascent Stage (*see above*) blasts off to carry the astronauts away, it remains on the Moon forever.



Main Display Console of CM

THE 'HEART AND MIND' of Apollo is this complex display console of visual signals, switches and other controls.

There are approximately 800 controls and displays in the Command Module cabin. And the majority are on this console, facing the three crew couches and curving round either side of them. The console is 13 feet long and 3 feet high.

The Spacecraft Commander, on the couch facing the left end of the console, supervises all displays and controls in that sector. He has two major controls among these. *Right hand* control is for rotation of the spacecraft. *Left hand* control is for translation of the spacecraft – side-to-side or up-and-down – into a modified flight path. Combined, these two controls permit any necessary repositioning of the vehicle.

On the right of the console are visual indicators and controls for voice communication, for electrical, fuel and oxygen supplies and other environment factors. The LM Pilot, who lies on the right-hand couch in the CM, is mainly responsible for monitoring them.

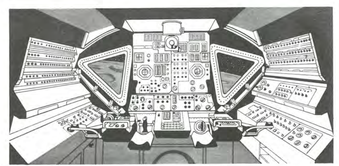
Ahead of the Command Module Pilot, who occupies the centre couch, the console includes controls and indicators for telemetry signals, caution/warning system, fuel system, input and output controls for on-board computer and additional positional control indicators.

All control systems are additionally monitored by Control on Earth using telemetry signals – coded measurements by radio.

A metal frame is clipped over the console's central area during periods of weightlessness. This safeguards against a 'floating' crewman accidentally interfering with controls.

Caution warning systems are built into the console. Light signals, mostly red, burn to denote malfunction or a need for inspection, and windows, each containing a metal plate the same colour as the surrounding console, signal warnings by flipping aside to reveal rectangles containing diagonal black-and-yellow stripes.

As the mission proceeds, various controls and displays become unnecessary. These are phased so that areas of the display console at the extreme left and right are the first to shut down. By the time the CM is approaching re-entry into Earth's atmosphere, only a relatively small central area is needed to control the vehicle.



Interior of the Lunar Module showing instrument console, attitude controls and triangular observation windows.

Water Supply

AT LIFT-OFF Apollo will be carrying only a small amount of drinking water. For the major part of the mission, however, the main water supply will come from the three electric fuel cells aboard the Service Module. These produce drinkable water as a by-product of their power-supply function at a rate of more than one pint an hour.

Further water is produced from used air drawn from the crew's suits and from the cabin atmosphere and from the perspiration and other moisture drawn off from the crewmen's suits and the cabin.

Water is offered to the astronauts at two temperatures – 50°F for drinking and 150°F for reconstitution of dehydrated food. Excess water is discharged into space, where, exposed to space vacuum, it boils and evaporates.

In the CM, crewmen obtain water through a pistol-like dispenser, which jets the water under pressure to defeat the effects of weightlessness. Drinking by the crew is allowed through a small opening in their helmets when their spacesuits are pressurised. This system prevents leakage into the cabin.

Food Supply

APOLLO'S FOOD SUPPLY must be primarily packed with vitamin and calorie value. It must be light in weight and, where possible, compressed – because weight and space limitations are critical in the design of the spacecraft.

Each crewman will be supplied with food in the form of dehydrated juices. Also, bite-size foods will be provided – without refrigeration – and handled and eaten under a condition of weightlessness. This food will be in edible wrappers so it will not need to be unwrapped before eating, thus preventing food-crumbs from 'floating' in the cabin.

Crew members will be provided with four meals a day made up from such items as sausage patties, toast squares, orange-grapefruit juice, tuna salad, beef pot-roast, chicken bites, spaghetti and meat sauce.

To prepare the dehydrated items, a few ounces of water are added by means of a water nozzle which fits into a valve on the food bag. The plastic bag holding the food is re-sealed and kneaded briefly.

Astronauts squeeze the contents, when ready to eat, into their mouths direct from the plastic bags.

Hygiene

1. Each crewman will have a toothbrush. 2. Damp flannels, impregnated with a disinfectant, are available for sponging-down. 3. Urine will be drained automatically from the pressure suits. 4. Defacation will be with the aid of double-layer, germicidal, plastic bags for which there is a storage facility.