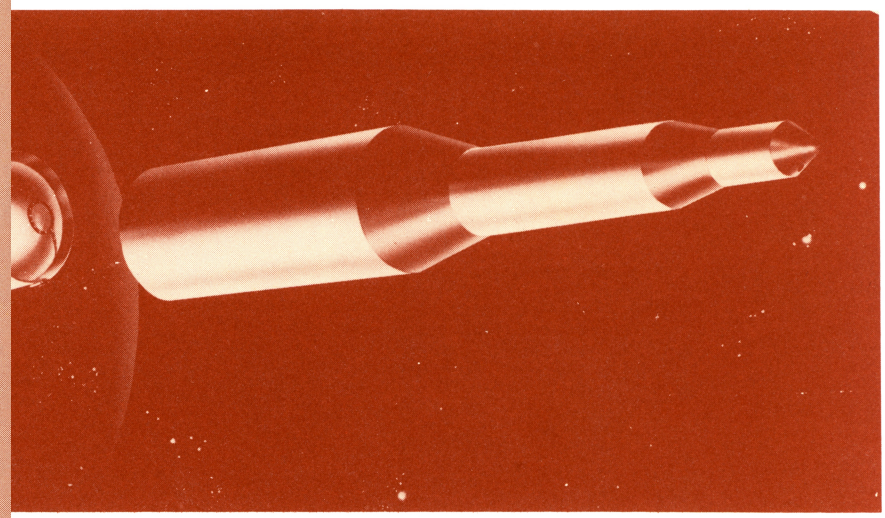
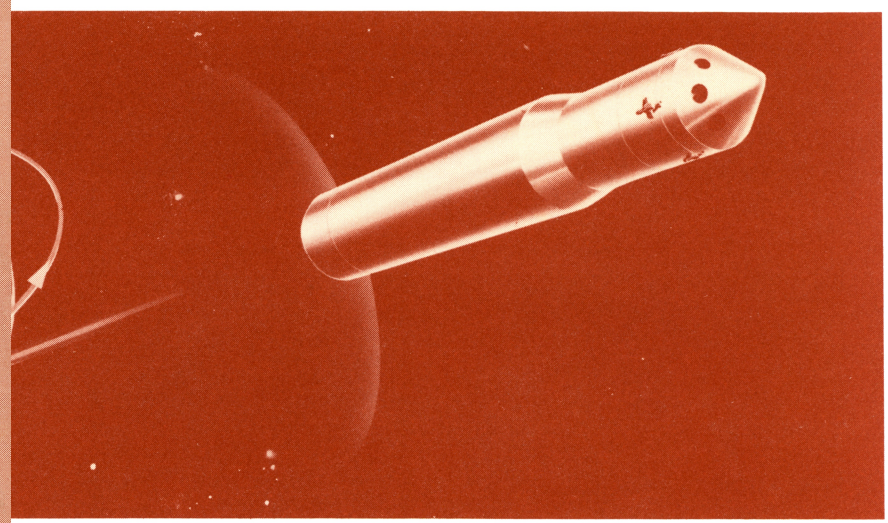
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

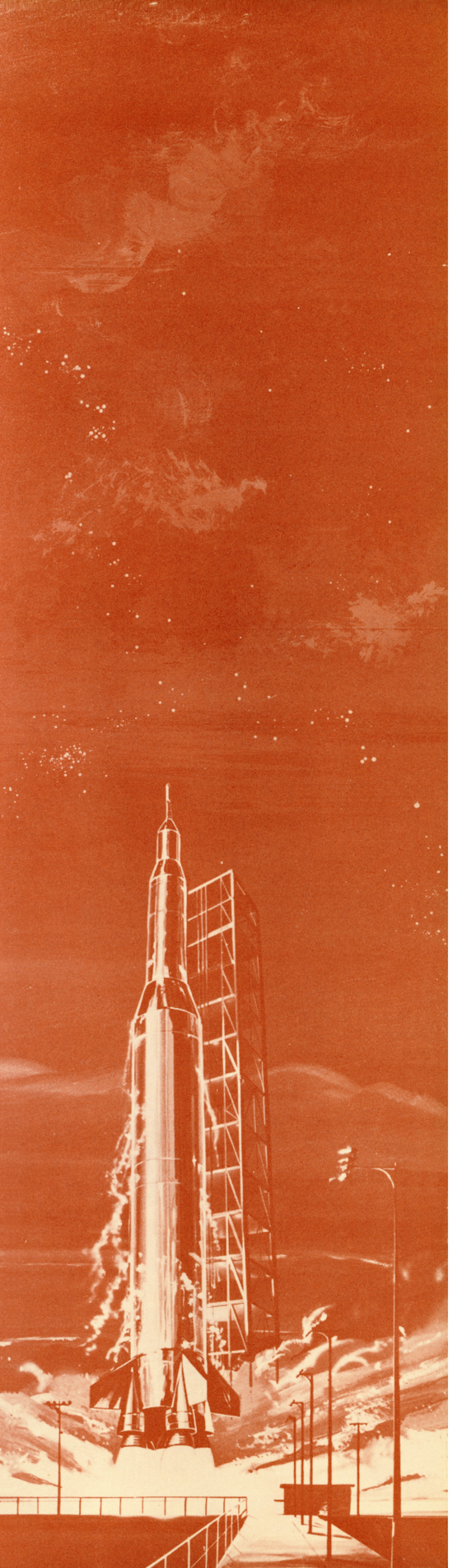


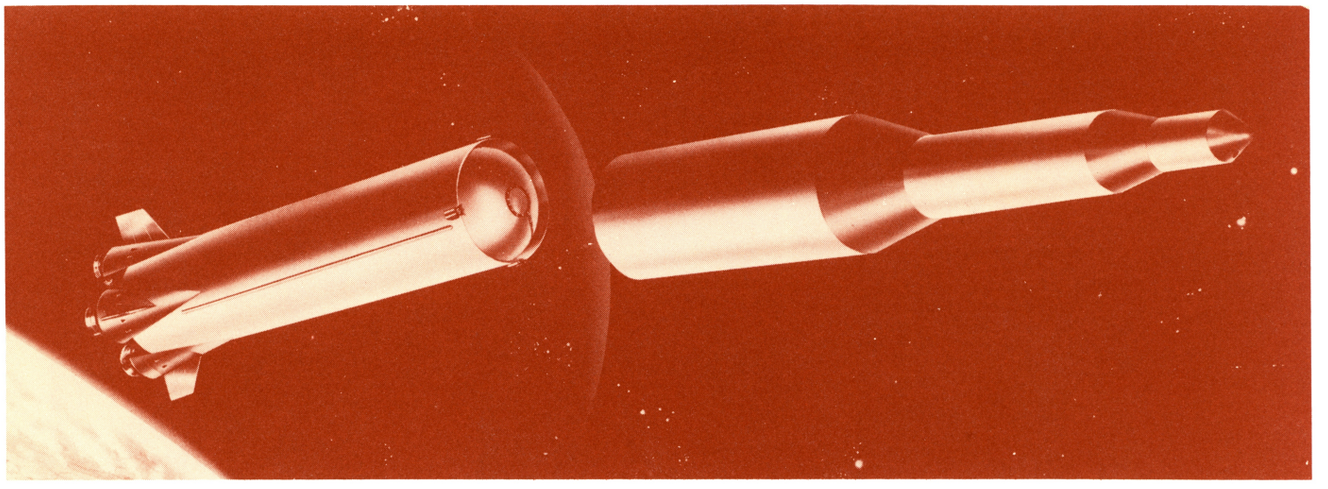


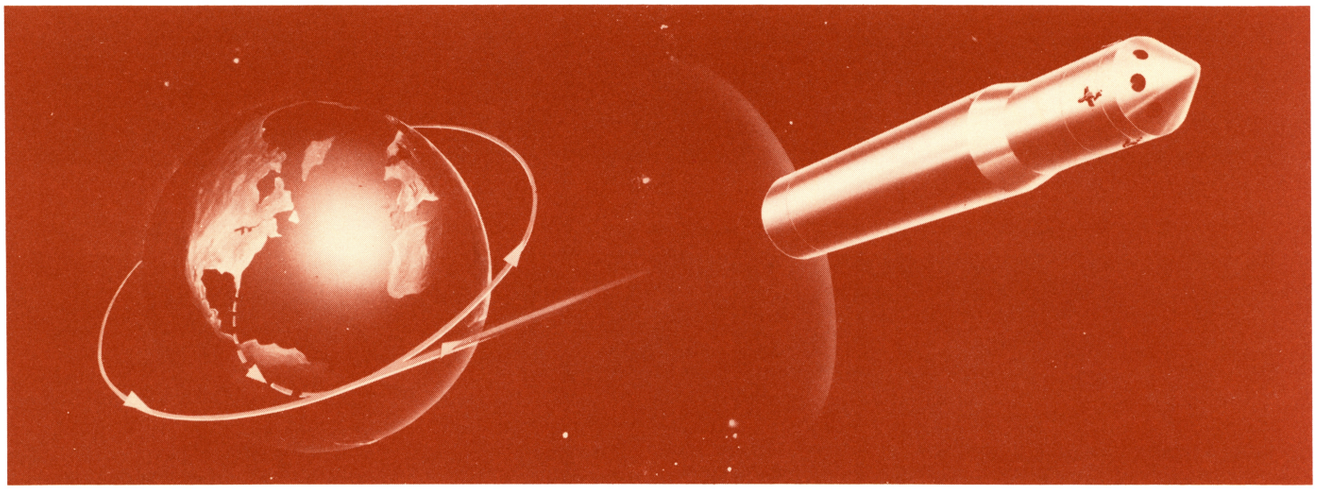
THE SATURN V APOLLO MOON ROCKET

GEORGE C. MARSHALL SPACE FLIGHT CENTER

HUNTSVILLE, ALABAMA







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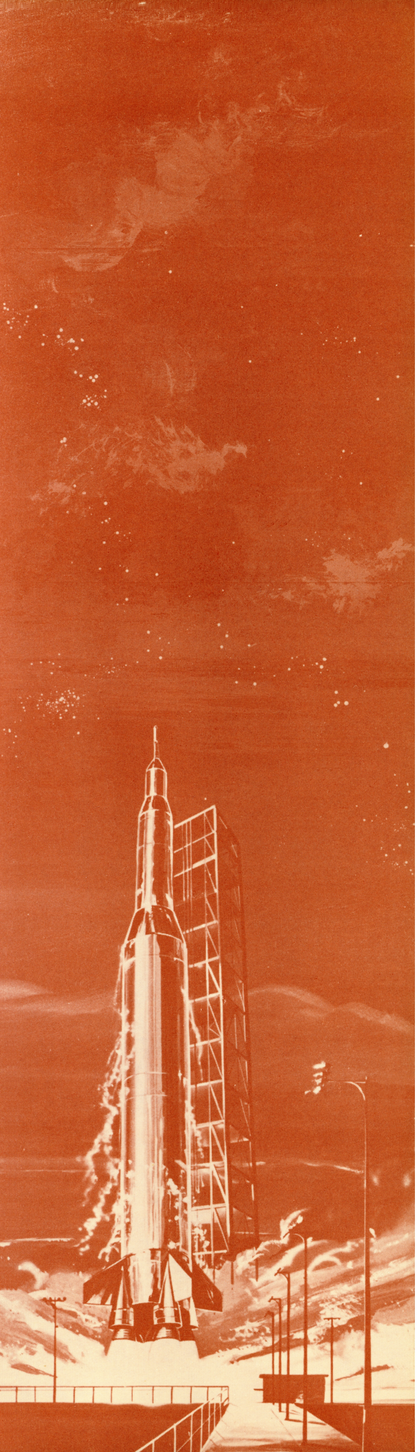


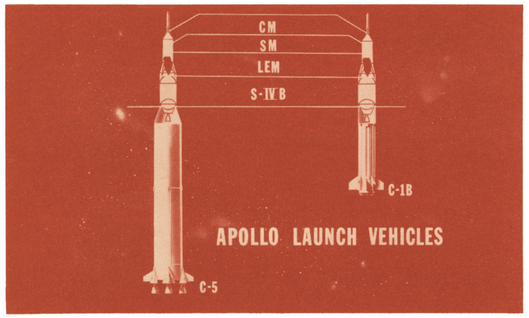
The giant of American space vehicles is the Saturn V, now being developed for the manned lunar landing program of the National Aeronautics and Space Administration.

When the President established a trip to the moon in this decade as a national goal, it called for a launch vehicle much larger than the first Saturn, then under development by the George C. Marshall Space Flight Center at Huntsville, Alabama. Extensive studies for a moon rocket were carried out by the Marshall Center, and development of an advanced Saturn, known as the Saturn V, was approved by NASA on January 25, 1962.

The largest rocket now under development in the United States, the three-stage Saturn V will have more than ten times the weight-lifting capacity of the Saturn I. The Saturn V will orbit the weight of 85 Mercury capsules like John Glenn's. It can place more than 120 tons in earth orbit, or send 45 tons to the moon. The rocket and payload will stand 350 feet high and will weigh more than six million pounds at liftoff.

Its payload will be the three-man Apollo Spacecraft, now being developed under direction of NASA's Manned Spacecraft Center at Houston, Texas.

The first test launching of the Saturn V may come in early 1966, with operational launchings occurring about two years later. Another mission of the Saturn V will be to flight test a nuclear rocket stage, RIFT (Reactor-in-Flight-Test).



The Saturn V will have three stages, designated S-IC, S-II, and S-IVB.

The first stage is under design and development by the Marshall Center, assisted by The Boeing Company. It will be about 138 feet in length and 33 feet in diameter. While the Saturn I has a cluster of nine tanks in its first stage, the Saturn V has only two propellant tanks, one above the other. Liquid oxygen from the upper tank passes through tunnels in the kerosene fuel tank to the engines. Propellant capacity is about 4½ million pounds.

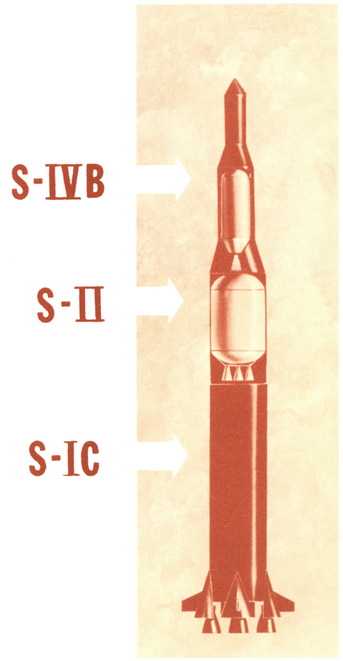
The first stage has five F-1 engines, each one of which will produce 1.5 million pounds of thrust. The F-1, far along in development for NASA by the Rocketdyne Division of North American Aviation, Inc., has been static fired at full thrust for full flight duration, about 2-1/2 minutes. Tests are conducted at NASA's High Thrust Area at Edwards Air Force Base, California.

One engine is rigidly mounted on the stage centerline. The four outer engines, mounted in the shape of a square, can be maneuvered in any direction for controlling the rocket's flight. The five engines gulp 15 tons of propellant a second, generating a total of 7.5 million pounds of thrust.

Non-flight boosters will be built and tested at the Marshall Center. A new static test tower is now under construction at Marshall for captive firing the S-IC stage. Standing 405 feet high and measuring about 160 feet square at the base, the tower will have handling equipment and thrust restraint for vehicles up to 178 feet in length, 48 feet in diameter, and with thrust of 7.5 million pounds.

The first flight unit will be produced by MSFC with Boeing producing the follow-on flight vehicles at the NASA-Marshall Michoud Operations in New Orleans. Early units will be acceptance fired at Huntsville and later units will be phased into the new test facility being prepared at what is called the Mississippi Test Operations located near Gainesville, Mississippi.

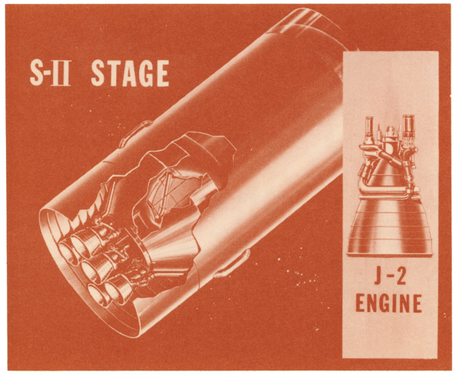
The second, or S-II, stage of the Saturn V by itself would dwarf an intercontinental missile. Eighty-two feet long, it has the same 33-foot diameter as the first stage. The S-II stage is being developed by the Space and Information Systems Division of North American Aviation, Inc., at Downey and Seal Beach California.



F-1 Engine

The five J-2 engines of the second stage will use high-energy liquid hydrogen fuel. Hydrogen offers more pounds of thrust per pound of propellant consumed than any other fuel possible in chemical rockets. It provides about 70 per cent more thrust per pound of propellant than kerosene.

The J-2 engine, which provides 200,000 pounds of thrust, is under development by Rocketdyne at Canoga Park, California. It is test fired at Rocketdyne's Propulsion Field Laboratory in the Santa Susana Mountains.

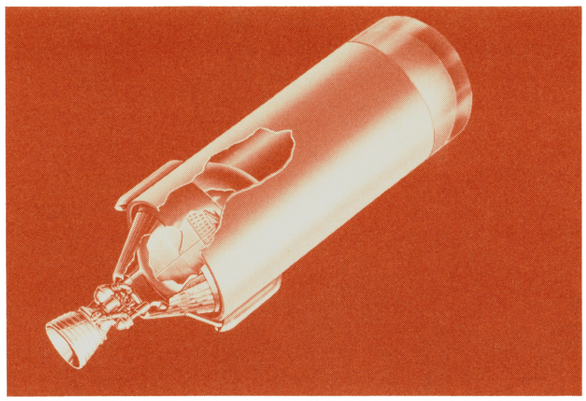


The liquid hydrogen tank, which is three times larger than the oxidizer tank, accounts for almost 75 per cent of the cubic space of the second stage. Liquid oxygen has a temperature of -297 degrees Fahrenheit, and liquid hydrogen is colder--dropping to a frigid -423 degrees. The liquid is so cold that it's a threat to most materials, and tends to boil away to an unusable gas. A honeycomb core helps to insulate a common bulkhead separating the two liquids, preventing the liquid oxygen from being frozen solid by the hydrogen. The hydrogen tank is insulated throughout to maintain boil-off to a minimum during stage fueled condition.

S-II stages assembled at Seal Beach, California, will travel from the West Coast through the Panama Canal to the Mississippi Test Operations in an open-end LSD, landing ship dock. There they will be static fired before being taken around the tip of the Florida peninsula to Cape Canaveral for mating with other stages for flight testing.

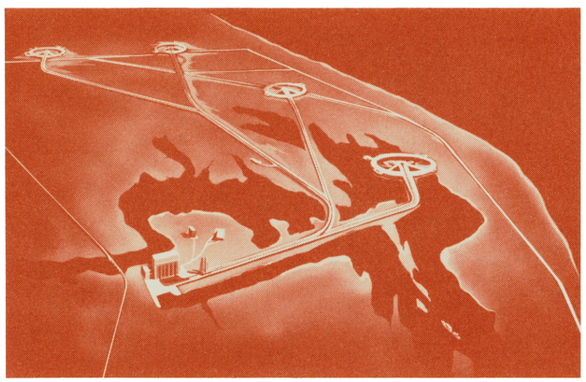
The S-II stage will burn more than 450 tons of fuel in less than seven minutes.

The third stage of the Saturn V, known as the S-IVB stage, will be furnished Marshall by the Douglas Aircraft Company. It will be designed, developed, manufactured and assembled at Santa Monica, California, and static fired at Sacramento.



The S-IVB will measure about 22 feet in diameter and about 58 feet in length. Its one J-2 engine can be moved freely in any direction for pitch and yaw control. Propellant capacity of the stage will be 230,000 pounds, which is consumed in just over seven minutes.

Under terms of its present contract, Douglas will build three ground test stages and furnish 10 flight type stages, two of which are for inert flight, and eight for powered flight.



New launching facilities, known as Launch Complex 39, are under construction at Cape Canaveral for Advanced Saturn flights. This will be NASA's moonport, operated by its Launch Operations Center.

Major elements of the 30,000 acre complex are a building equivalent in height to 48 stories, in which Saturn V will be assembled vertically; possibly four launch sites about 9,000 feet apart along the beach, and more than two miles from the assembly building; an arming tower; a control center; special heavy-load highways; and a canal from the intracoastal waterway.

The three stages of the Saturn V and the Apollo Spacecraft will be assembled and checked out on a launch rack, which also supports its 400-foot umbilical tower. Several vehicles can be assembled at the same time in the building, which will be 524 feet high, more than two city blocks long, and 230 feet wide.

When checkout is completed, a crawler-type vehicle will pick up the launch rack, Saturn V, spacecraft, and tower, and move out of the building. It will exit through what will probably be the world's tallest door, measuring 456 feet high. The entire load will weigh 3,000 tons, and will be balanced during the journey by four load-leveling hydraulic cylinders 90 feet apart, like the bases on a baseball diamond. The crawler vehicle moves on eight tank-type treads, driven by electric motors powered by diesel-driven generators.

During the journey the rocket will be kept balanced by load-leveling cylinders at each corner of the crawler. The same cylinders lower the rack and vehicle onto support blocks on the launch platform.

Four launches of the Saturn V are currently scheduled for 1966, and six are planned for 1967.

NASA's program for the manned exploration of the moon is known as Project Apollo. It is directed at the Washington level by D. Brainerd Holmes. The Lunar Orbital Rendezvous mode was selected by NASA in July, 1962, as the best and least expensive method of meeting the goals established by the President. In this method, a Saturn V will boost the Apollo Spacecraft into a trans-lunar trajectory. It will go into orbit around the moon, and from there two astronauts will descend to the moon's surface in a lunar excursion module (LEM), nicknamed "the bug." After exploration of the moon, they will blast off in the upper portion of the bug, and rejoin the third astronaut, who remained in the circling mothercraft. All three men will then return to earth in Command Module of the spacecraft.

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