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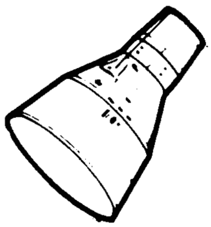

PROJECT: GEMINI 11

(To be launched no earlier than Sept. 9, 1966)

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NEWS NASA
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THREE-DAY
GEMINI 11
MISSION SET

The National Aeronautics and Space Administration will launch Gemini 11 and its Agena Target Vehicle no earlier than Sept. 9 from Kennedy Space Center, Fla.

The three-day mission will include rendezvous and docking with the Agena during the spacecraft's initial revolution, use of a power tool to perform work tasks during extravehicular activity, and maneuvering the spacecraft to an apogee of 865 miles.

Other activities to be performed as time and propellant allow are station-keeping by tethering the spacecraft to the Agena, completion of 12 experiments, some of which will be conducted during a more than two-hour standup EVA, and additional docking practice.

The controlled reentry will be fully automatic. Reentry control commands will be computed and executed by the onboard systems.

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Gemini 11 command pilot is Charles (Pete) Conrad. Pilot is Richard F. Gordon. Backup command pilot is Neil A. Armstrong, and William A. Anders is backup pilot.

Conrad, a Navy commander, was pilot on Gemini 5, the eight-day mission of Aug. 21-29, 1965. Navy Lt. Cdr. Gordon has not yet flown in space. Armstrong, a civilian, was command pilot on Gemini 8, the first space docking mission. Anders is an Air Force captain and has not yet made a space flight.

Launch time for the Gemini Agena Target Vehicle (GATV) is 8:48 a.m. EDT. Gemini 11 is scheduled to lift off at 10:25 a.m. EDT.

The Agena will be launched into a 185-mile circular orbit by an Atlas Standard Launch Vehicle (ASLV). Gemini 11 will be launched 97 minutes later into a 100 by 174-mile orbit from which it will attempt a first-revolution rendezvous with the Agena. Docking is programmed to occur over the United States near the end of the first spacecraft revolution.

Just before the start of Gemini 11's second day in space, Astronaut Gordon will begin his umbilical EVA over Hawaii at 24:08 hours ground elapsed time (GET). He will be linked to the spacecraft by a 30-foot umbilical. His extravehicular activity will include:

-- retrieving the nuclear emulsion experiment (S-9) from the outside of the spacecraft adapter section

-- attaching the Agena tether to the spacecraft docking bar

-- performing the power tool evaluation (D-16)

-- retrieving the hand-held maneuvering unit (HHMU) and the Apollo camera from inside the adapter

-- evaluating the HHMU.

Following the second sleep period, the Agena primary propulsion system (PPS) will "kick" the spacecraft into an 865-mile apogee. The PPS maneuver, a 943-feet-per-second posigrade burn, takes place over the Canary Islands at 40:32 GET. The Gemini-Agena combination reaches apogee about 51 minutes later over Carnarvon.

Gemini 11 will remain in the 185 by 865-mile orbit for the next two revolutions. At 43:56 GET the PPS engine will fire for the second time, a 943 f.p.s. retrograde burn that restores the orbit to 185 miles circular.

At about 46:00 GET the second extravehicular activity, a 140-minute standup, begins over Tananarive. It ends over Hawaii in the 30th revolution at 48:20 GET.

In the 31st revolution at 49:50 GET the spacecraft will translate to about 30 degrees off the local vertical, the Agena PPS engine pointing toward the Earth. The spacecraft will undock and back off to the limit of the tether (100 feet) above the Agena in a nose-down attitude. The Agena will be stabilized in the engine-down position with its longitudinal center-line pointing toward the center of the Earth. Gemini 11 will stabilize itself with its longitudinal axis aimed through the Agena toward the Earth's center.

At this time the spacecraft orbital attitude and maneuvering system (OAMS) and the Agena attitude control system (ACS) will be deactivated. If the spacecraft has been positioned properly and if the relative velocities between the two vehicles do not exceed .2 feet-per-second, a station keeping, gravity gradient stabilized position will have been established to retain both vehicles in their relative positions and attitudes as they circle the Earth.

If this procedure proves impractical, a slow rotation of the tethered Gemini 11 and Agena will be initiated. Centrifugal force is expected to maintain the tautness of the tether, keeping the vehicles at a controlled distance from each other and minimizing the amount of propellant required for the station-keeping maneuvers practiced on previous Gemini missions.

The tether exercise will be completed at 53:00 GET in the 33rd revolution.

As Gemini 11 passes over the east coast of Africa on its 34th revolution a retrograde maneuver will lower the orbit perigee in preparation for retrofire. Magnitude of the maneuver will be determined by the amount of OAMS propellant left. Scheduled time of retrofire is 70:40 GET.

Reentry will be controlled by the spacecraft onboard computer in the automatic mode. The computer and the inertial guidance system (IGS) feed bank-angle commands into the attitude control and maneuver electronics (ACME) which control the reentry thrusters.

The crew will monitor the flight director indicator (FDI) needles during the automatic reentry but will not make manual steering maneuvers. Gemini 11 will be the first American space flight to employ automatic guided reentry. Previous missions have used manual closed-loop guided or unguided ballistic reentry techniques.

Splashdown will occur approximately 30 minutes after retrofire and will be in the West Atlantic recovery area 45-1, some 725 miles east of Cape Kennedy.

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After splashdown and recovery, flight controllers will command a series of Agena maneuvers to evaluate the vehicle's propulsion system. The Agena then will be transferred to a parking orbit for possible use as a passive target on future manned missions.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS)

PREFLIGHT ACTIVITIES AND INTEGRATED COUNTDOWN

Gemini flights are developed by the NASA Manned Spacecraft Center (MSC); Houston, Texas, under the direction of the NASA Headquarters Office of Manned Space Flight in Washington, D.C. The NASA John F. Kennedy Space Center (KSC), Florida, has overall responsibility for preflight testing, checkout and launching of the Gemini and Atlas/Agena vehicles for Gemini missions. After launch, control of the flight is the responsibility of the Mission Control Center, MSC.

Gemini 11 timetable at Kennedy Space Center:

The Gemini launch vehicle (GLV) arrived July 11 (first stage) and the second stage arrived July 13.

GLV was erected at Launch Complex 19 July 22.

Gemini 11 spacecraft arrived at KSC July 6 for receiving inspection, ordnance installation, and assembly checks at Merritt Island.

Atlas standard launch vehicle (ASLV) arrived July 19 and was erected on Launch Complex 14 July 28.

Gemini Agena target vehicle (GATV) arrived July 15, the target docking adapter preceding it July 13.

GATV, docking adapter, and spacecraft underwent "timber tower" tests at KSC Radio Frequency Systems Test Facility July 25.

Docking compatability checks conducted July 25.

Spacecraft and launch vehicle premate tests conducted August 5 at Complex 19 with electrical mating August 5.

Mechanical mating check took place on August 24, simultaneous launch demonstration was to be held August 31, and the simulated flight scheduled on September 1.

Gemini countdown is a combination of countdowns involving Gemini 11 and Agena 11 launch vehicles, the spacecraft and target vehicle, the crew, Houston Mission Control and the worldwide tracking network, the Eastern Test Range, and the Radio-Command Guidance System.

Liftoff for the target vehicle is scheduled for the 95-minute mark in the simultaneous count. The Gemini spacecraft will be launched approximately 97 minutes and 30 seconds later, depending on the exact location and performance of the orbiting Agena. A built-in hold is scheduled at T-3 minutes to adjust Gemini liftoff time to coincide with Agena 11's first pass over the Cape. After the launch sequence adjustments are computed, the count will resume.

Launch Vehicle Countdown

Time	Gemini	Atlas-Agena
F-3 days	Start pre-count	Countdown
F-1 day	Start mid-count	
T-720 minutes	GLV propellant loading	
T-615 minutes		Begin terminal count
T-390 minutes	Complete propellant loading	
T-300 minutes	Back-up flight crew reports to the 100-foot level of the White Room to participate in final flight preparation. Begin terminal countdown, Pilots' ready room, 100-foot level of White Room and crew quarters manned and made ready for prime crew.	
T-255 minutes	Medical examination	
T-240 minutes		Start tower removal
T-235 minutes	Eat	
T-195 minutes	Crew leaves quarters	
T-185 minutes	Crew arrives at ready room on Pad 16.	
T-135 minutes	Purging of suit begins	
T-125 minutes	Crew leaves ready room	
T-120 minutes	Flight crew to Complex 19	
T-119 minutes	Crew arrives at 100-foot level	
T-115 minutes	Crew enters spacecraft	
T-100 minutes	Close spacecraft hatches	
T-95 minutes		Liftoff
T-86 minutes		Insertion into orbit
T-70 minutes	White Room evacuation	
T-55 minutes	Begin erector lowering	
T-20 minutes	Spacecraft OAMS static firing	
T-13 min., 1 sec	Built-in hold	
T-04 seconds	GLV ignition	
T-0 seconds	Lift off	
T+2 minutes, 36 seconds	Booster engine cutoff (BECO)	
T+5:36	Second stage engine cutoff (SECO)	
T+5:56	Spacecraft-launch vehicle separation	
T+6:40	Insertion into orbit	

Reentry

(Elapsed Time from Gemini Lift-Off)

Time	
70:40	Retrofire
70:56	Blackout ended
70:59	Drogue chute deployed (50,000 feet)
71:00	Main chute fully deployed (9,000 feet)
71:05	Spacecraft landing

MISSION DESCRIPTION

Mission information presented in this press kit is based on a normal mission. Plans may be altered prior to or during flight to meet changing conditions.

All orbital parameters in this section are in statute miles. To convert these figures to nautical miles, multiply by .87, to kilometers multiply by 1.61.

Launch

Launch Times -- Atlas/Agena - 8:48 a.m. EDT, Launch Complex 14
Gemini 11 - 10:25 a.m. EDT, Launch Complex 19
(These launch times were established to give optimum lighting conditions for rendezvous.)

Launch Windows -- Gemini 11 is scheduled for an "on time" launch to achieve rendezvous in the first spacecraft revolution. That is, the pane in the launch window allows no significant delay beyond the nominal launch time some 97 minutes after Agena liftoff. A window is available the first day after Agena lift-off, but probably will not be used because of recycle problems and a greater advantage in second-day opportunities. Two windows are available the second day after Agena liftoff. They are at 7:26 a.m. EDT and 9:02 a.m. EDT based on a nominal Agena lift-off. Single windows are available the third and fourth days after Agena liftoff, at 7:32 and 7:38 a.m. EDT respectively.

Each of the Gemini launch windows can be extended to permit rendezvous in a later revolution. Since a rendezvous in the first revolution is desired for this mission, however, the windows probably will not be opened beyond the first pane as long as practical to the success of the overall mission.

Azimuth -- Atlas/Agena will be launched along an 82.0-degree azimuth east of north. Gemini 11 will be launched along a 100.5-degree azimuth east of north. This azimuth will be biased from the 96.918-degree parallel value so that a small amount of Gemini Launch Vehicle (GLV) yaw steering in the second stage will place the spacecraft in the Agena plane at rendezvous and thus eliminate the necessity of a plane change. Equatorial inclination for both vehicles will be 28.87 degrees.

IVAR (Insertional Velocity Adjustment Routine) -- Some 20 seconds after the GLV second stage cuts off (SECO) the spacecraft will separate from it by firing two aft thrusters of the orbital attitude and maneuvering system (OAMS). This normally 30 feet-per-second maneuver will give the spacecraft an insertion velocity of 25,749 fps and place it in an orbit 100-by-174 miles with position about 246 miles behind Agena at a closing rate of 858.3 fps.

Rendezvous

Terminal Phase Initiate (TPI) -- Ninety seconds before first spacecraft apogee (00:49:43 GET) the first maneuver in the rendezvous sequence occurs. Range to the Agena is about 20.5 miles and the spacecraft is about seven minutes into darkness. It is pitched up to 3.1 degrees above the local horizontal and a delta V of 131.2 fps posigrade is initiated by the aft thrusters (over Carnarvon).

Intermediate Corrections -- Agena will travel through a central angle of 120 degrees from TPI to terminal phase final. Two intermediate spacecraft maneuvers are scheduled during this period. These corrections are nominally at 12-minute intervals at central angles of 72 and 24 degrees from TPF. The first is nominally zero, the second 2 fps posigrade.

Terminal Phase Final (TPF) -- The velocity matching maneuver theoretically is 25.5 fps. However, the command pilot will control the final approach by semi-optical techniques, and additional propellant beyond the theoretical amount may be necessary. This posigrade "braking" maneuver should occur at 01:19:52 GET (over Hawaii).

Docking

Docking will be performed by the command pilot at about 01:30:00 GET in daylight over the United States. Subsequent practice dockings will be executed according to the crew's determination of time available, but in general at least one daytime and one nighttime docking will be scheduled.

Extravehicular Activity

The first extravehicular activity programmed for the pilot is scheduled to begin at 23:50 GET over Hawaii. It will be performed on a 30-foot umbilical and is planned nominally for 107 minutes. Upon opening the hatch, the pilot will raise the handrail on the adapter section and will route the HHMU propellant umbilical under the handrail toward the nitrogen valve fitting. He will install the 16mm EVA motion picture camera in its bracket just behind his hatch and will attach the EVA Hasselblad camera to a Velcro patch on the extravehicular life support system (ELSS) chest pack.

Egressing the spacecraft, he will work his way to the Agena Target Docking Adapter, behind which is stored the 100-foot Dacron tether to link Agena and Gemini 11. He will withdraw the spacecraft end of the tether from the storage bag and loop it over the spacecraft docking bar, tightening a clamp to hold the tether in place. He will install the docking bar mirror, then return to the cabin area to change film in the 16mm camera and remount it so the lens points back toward the Power Tool Evaluation experiment worksite on the adapter. He will move back along the handrail, plug the quick-disconnect fitting on one end of the HHMU umbilical into the nitrogen valve fitting, and will commence the D-16 experiment.

The experiment sequence follows: grasp handrail and attach right knee tether to handrail; grasp tool box handle, release lock, and pull tool box handle upward from well until positive lock engages; open tool box and check out power tool; using power tool, tighten instrumented bolt for five seconds; reverse power tool action and loosen bolt; uncrew four worksite bolts.

Stow power tool, turn over worksite and hand-start three bolts; unstow power tool and tighten bolts; stow power tool and remove hand tool to tighten instrumented bolt for five seconds, then loosen bolt and stow hand tool; detach knee tether and remove and check power tool; unscrew three bolts; stow power tool, turn worksite over and hand-start four bolts; unstow power tool and tighten bolts; tighten instrumented bolt for five seconds, then loosen it; repeat instrumented bolt tightening and loosening with hand tool; stow tools, close lid, and stow tool box in adapter well.

Having completed the D-16 Power Tool Evaluation experiment, the EVA pilot will once again change film in the 16mm EVA camera. He will move to the adapter again and evaluate the handrails, insert his umbilical into the adapter guard, photograph the adapter and remove any debris left from spacecraft launch and separation. Using "overhsoe" footholds mounted at the inside rim of the adapter to restrain him, the pilot will open a hatchway into the adapter protective cover and will reach inside to connect a quick-disconnect fitting on the free end of the HHMU line to the receiver fitting on the maneuvering unit. He will unstow the HHMU and Velcro it to the ELSS, then remove the Apollo cameras from inside the adapter and similarly attach them to the ELSS.

On his return to the cabin area to hand the retrieved cameras to the command pilot, the EVA pilot will turn on the nitrogen valve that feeds propellant into the HHMU umbilical. He will move on to the nose of the spacecraft, jettison the docking bar mirror, and go through stabilization and translation evaluation of the hand-held maneuvering unit. Prior to ingress, he will turn off the nitrogen valve, bleed the propellant from the HHMU umbilical by firing the unit in short bursts while he holds on to the handrail. He will return to the cabin and ingress.

During the next revolution both astronauts will load a jettison bag with the EVA umbilical and umbilical bags, the HHMU, camera bracket, debris cutters, wrist mirrors, knee tether and other no-longer-needed equipment for which there is not storage room in the cabin. The bag will be jettisoned through the pilot's hatch as was a similar package on Gemini 10. The ELSS will be jettisoned at the same time, but as a separate unit.

<u>Docked Agena PPS Maneuvers</u>

During the 26th revolution, following the second sleep period, a 943 fps burn of the Agena primary propulsion system will change the docked Gemini/Agena orbit from the 185-mile circular orbit to 185 miles by 865 miles.

This posigrade maneuver will occur at about 40:33 GET over the Canary Islands. The spacecraft should reach its new apogee about 55 minutes later over Carnarvon. Time and position of the maneuver and apogee were selected to minimize the radiation encountered by the spacecraft near apogee during the following two orbits and to provide acceptable retrofire and landing conditions if the flight should be terminated during this period.

The last docked PPS burn will be performed at the beginning of the 28th revolution over Bermuda at 43:56 GET. The retrograde 943 fps maneuver will restore the orbit to 185 miles circular.

Standup EVA

The second extravehicular activity, a 140-minute standup EVA, will begin about 46:00 over Tananarive and will end in the 30th revolution over Hawaii. Experiments to be conducted by the standing pilot will be primarily photographic. The procedure will follow that used by Michael Collins in Gemini 10. The pilot will interconnect his environmental control system (ECS) and electrical hoses with an 18-inch ECS inlet extension, a 24-inch ECS outlet, and a 28½-inch electrical umbilical extension carrying communication and bio-medical instrumentation lines. He will tether himself by a strap that he loops around the left arm restraint of the right-hand seat, passing one end of the tether through a loop on the other end to hold it to the arm restraint. The free end clips to his parachute harness with the same type of attachment used on the 30-foot EVA tether. This standup tether is adjustable at 29, 35 and 42½ inches. The pilot will select the length that best suits his purposes and comfort. One third or less of his body will protrude from the open hatchway during the EVA.

Station-Keeping Exercise

In the 31st revolution at about 49:50 GET the spacecraft will translate the docked configuration to about 30 degrees off the local vertical, the Agena PPS engine pointing toward the Earth. The spacecraft will separate from the Agena and back off to the end of the tether. The spacecraft will be in a nose-down attitude above the target vehicle. Seven to eight minutes later the Agena will be stable in the engine-down position with its longitudinal center-line pointing toward the center of the Earth. Gemini 11 will stabilize itself in a nose-down attitude with its center-line aimed through the Agena toward the Earth's center.

At this time the Gemini orbital attitude and maneuvering system (OAMS) and the Agena attitude control system (ACS) will be deactivated.

If the spacecraft has been positioned properly at the end of the tether and if the relative velocities between the vehicles are not in excess of .2 feet-per-second, a long-term station-keeping position will have been established and will keep the vehicles in the same relative attitude and position as they circle the Earth -- nose-down Gemini above the engine-down Agena, their longitudinal center-lines continuously pointing toward the Earth's center.

If that phase of the exercise does not prove feasible, a slow rotation (one degree per second or less) of the tethered combination will be established by a spacecraft pitch maneuver simultaneous with firing of the forward thrusters. Centrifugal force is expected to maintain the tautness of the tether, keeping the vehicles at a controlled distance from each other and minimizing the propellant required for station-keeping.

The tether is two-inch Dacron webbing. It is stored in a bag located at the back side of the Agena target docking adapter (TDA) docking cone. The bag is covered by an aerodynamic shroud at Agena launch. The Agena end of the tether is looped and sewn through a D-ring fastened by a metal plate to the docking cone. The spacecraft end od the tether is looped and sewn to a metal ring-clamp that slips over the spacecraft docking bar and is tightened to the bar by a screw-down mechanism. A "break link," engineered to part at 800 pounds of pressure, is built into the tether. Pyrotechnics at the base of docking bar, activated from the spacecraft cabin usually just before reentry, blow the bar and tether free at the completion of the experiment.

Separation Maneuver

At completion of the tether exercise during the 33rd revolution, the final separation of 3 fps retrograde will drop the spacecraft below the Agena. This maneuver will occur at 53:10 over Hawaii. Gemini 11 will pull ahead and out of sight of the target vehicle during the following revolutions.

Retrofire Orbit Maneuver

Based on remaining propellant, a retrograde maneuver may be made in the 35th revolution to lower spacecraft perigee. The maximum maneuver that will be made is 134.5 fps to result in a perigee of 100 miles. However, the maneuver is not necessary to successful retrofire and reentry and it will be modified or deleted according to propellant remaining.

Retrofire and Reentry

The Gemini 11 mission will terminate with retrofire nominally at 70:40 GET in the 44th revolution over the Pacific Ocean near Hawaii. Retrofire determination will be made through the spacecraft onboard systems and verified by ground control to evaluate the accuracy of such onboard determination. Reentry will be in the automatic mode. The spacecraft computer and inertial guidance system (IGS) will furnish the attitude control and maneuver electronics (ACME) with commands for bank angles or fixed roll rates to steer the spacecraft to the predetermined landing point.

The Gemini spacecraft's offset center of gravity has been used in previous missions to generate lift and to correct cross-range errors, but always in the manual direct or the rate command mode. Gemini 11 will be the first mission in the program in which reentry guidance is fully automatic.

EXPERIMENTS

Of the 12 experiments that will fly in Gemini 11, only two are new. They are Dim Light Photography (S-30) and Earth-Moon Libration Region Photography (S-29). However, while four others have flown previously -- on Gemini 8 -- they either were not performed or not retrieved because that mission terminated in the seventh revolution. Those four are Mass Determination (D-3), Night Image Intensification (D-15), and Power Tool Evaluation (D-16), neither performed, and Nuclear Emulsion (S-9) which was not retrieved.

The complete list of Gemini 11 experiments is:

1. D-3 -- Mass Determination
2. D-15 -- Night Image Intensification
3. D-16 -- Power Tool Evaluation
4. S-4 -- Radiation and Zero G Effects
5. S-5 -- Synoptic Terrain Photography
6. S-6 -- Synoptic Weather Photography
7. S-9 -- Nuclear Emulsion
8. S-11 -- Airglow Horizon Photography
9. S-13 -- Ultraviolet Astronomical Camera
10. S-26 -- Ion Wake Measurement
11. S-29 -- Earth-Moon Libration Region Photography
12. S-30 -- Dim Light Photography/Orthicon

Descriptions of the experiments follow:

D-3 -- Mass Determination (flown on Gemini 8, not performed): To test a technique and accuracy of a direct contact method of determining the mass of an orbiting object, in this case the Agena Target Vehicle. Experiment sponsor is the Dept. of Defense, United States Air Force. No experiment equipment, other than the normal spacecraft systems, is involved. Spacecraft yaw, roll and pitch rate gyros are in primary mode. Computer is on. Platform is in orbit rate mode. The spacecraft is undocked for calibration, docked for mass determination. Propellant consumption is estimated 30 pounds. Data will be transmitted to the ground for post-flight analysis.

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The calibration translation will be conducted by the spacecraft only. Propellant and cryogenic quantities are recorded, the spacecraft is translated and the velocity change is recorded as are propellant and cryogenic quantities. The mass determination translation is done with the spacecraft and the Agena docked. Quantities are recorded, Agena attitudes are controlled to 0-90-0 degrees by the spacecraft thrusters. The spacecraft translates the docked combination, and velocity and quantity changes are recorded.

<u>D-15 -- Night Image Intensification (flown on Gemini 8, not performed):</u> To test the usefulness and performance of a low-light-level television system as a supplement to unaided vision in observing surface features primarily when such features are in darkness and spacecraft pilots are not dark-adapted. Sponsor is U. S. Naval Air Development Center. Experiment equipment is an Image-Orthicon television camera, camera control unit, portable camera viewing monitor, recording monitor and photographic camera, and the monitor electronics and equipment control unit. The TV camera is mounted in the spacecraft retrograde section. Its lens points into a mirror extending at a 45-degree angle from the bottom of the retro section. The mirror is the only external unit. The camera control unit is mounted in the adapter equipment section, the viewing monitor stowed on the left side of the right-hand footwell and mounted for use under the right-hand control panel. The recording monitor and photographic camera and the monitor electronics and equipment control unit are mounted in the right-hand landing gear well. The system is built by General Electric of Utica, N. Y. The 16mm camera for recording pictures from the monitor is provided by the Dept. of Defense, experiment sponsor. Spacecraft consumables estimated to be used are 165 watts of power average total and 0.75 pounds of propellant per task.

To conduct the experiment, the pilot unstows the viewing panel and attaches it to the underside of his control panel. The system is activated and a 30-minute warmup period initiated. The external mirror is extended. Nighttime targets are acquired and tracked. While the photographic camera records the monitor images, the pilot voice-records his observations of the image on the portable monitor and the command pilot voice-records his observations through the window. Once the mirror is erected in flight, it cannot be retracted. Since it lies in the firing profile of the lower vertical thruster, the mission will be sequenced so that thruster is not required to operate during the experiment. Targets will be selected by the Dept. of Defense, and results of the experiment will be announced by DOD in accordance with that department's policies.

D-16 -- Power Tool Evaluation (flown on Gemini 8, not performed): To evaluate man's capability to perform work tasks in space, including the comparison of ability to work tethered and untethered, and to evaluate the performance of the minimum reaction power tool. Sponsor is the Dept. of Defense, United States Air Force. Equipment involved is the minimum reaction power tool and battery, a hand wrench, the tool restraint box, and the astronaut's knee tether. The equipment is stored in the tool box which is mounted in a well in the adapter section behind the pilot's hatch. The experiment is conducted during the pilot's extravehicular activity and is monitored by the 16mm EVA camera and by torque-vs-time data telemetered from an instrumented bolt on the work site. No electrical power or propellant expenditures are programmed for the experiment.

To conduct the experiment, the EVA astronaut moves to the adapter, pulls the tool box from its well, and withdraws the power tool. The tool box pulls straight up and its lid, holding the worksite bolts, opens about 90-degrees; the box remains attached to the spacecraft and restows in the well after the experiment. The astronaut tightens and loosens bolts in a prescribed pattern, once with his body held to the spacecraft by a nine-inch tether looped around his knee and through the handrail, once without the tether. He uses both the power and the hand wrench during the experiment.

S-4 -- Radiation and Zero G Effects on Blood and Neurospora (flown on Gemini 3): To determine if a synergistic relationship exists between effects of weightlessness and radiation on white blood cells and neurospora. Sponsors are the Office of Space Science and Applications (OSSA) and the Oak Ridge National Laboratories. Experiment equipment is hermetically sealed units containing blood and a radiation source (in one) and neurospora and a radiation source (in the second), a refrigeration unit for the blood sample, and mounting brackets. The blood is from a human volunteer selected by the sponsors; neurospora is pink bread mold; the radiation source is phosphorous 32 beta particles emitting 12.5 millicuries each unit; the hermetically sealed units are aluminum boxes $3\frac{1}{4}$ by $3\frac{1}{4}$ by 1 inch with a $3\frac{1}{2}$-inch operating handle. The refrigeration source, added since the Gemini 3 experiment because of the longer duration of flight, sustains a temperature of 39 degrees plus or minus four degrees F within the blood unit. The blood unit is mounted on the left-hand hatch, the neurospora unit on the left wall of the right footwell. Spacecraft consumables anticipated are 20 watts of power, no propellant. One telemetry analog channel monitors the blood refrigeration unit temperature.

To conduct the experiment, the command pilot activates and deactivates irradiation by means of the operating handle on the blood unit. The pilot similarly activates and deactivates the neurospora irradiation. Both voice-record activation and deactivation.

S-5 -- Synoptic Terrain Photography (flown on Gemini 4 thru 7 and 10): To use aerial photography for high quality photographs for research in geology, geophysics, geography, oceanography, and related fields. Sponsors are OSSA and the Goddard Spaceflight Center. Equipment is the 70mm Maurer camera with 80mm lens (f2.8) and ring sight. Estimated propellant usage for this experiment is 5 pounds.

S-6 -- Synoptic Weather Photography (flown on Gemini 4 thru 7 and 10): To obtain selective high quality color photographs of clouds to study the fine structure of the earth's weather system. Sponsors are OSSA and the National Weather Satellite Center. Equipment is the same as for the Synoptic Terrain Photography. Estimated propellant use is 5 pounds.

S-9 -- Nuclear Emulsion (flown on Gemini 8, not retrieved): To study the cosmic radiation incident on the earth's atmosphere, to obtain detailed chemical composition of the heavy primary nuclei, and to search for rare particles. Sponsors are OSSA and the U. S. Naval Research Laboratories. Equipment is a rectangular package 8½ by 6 by 3 inches weighing 15 pounds, and including the nuclear emulsion film stack, a motor to advance the emulsion, and a timer to regulate the motor. The package is mounted atop the spacecraft retro adapter section prior to launch, is activated at insertion, and is retrieved by the EVA pilot.

The experiment is conducted with the spacecraft in plus or minus 15 degrees of the earth's average magnetic field vector. However, no propellant expenditure is predicted; power expenditure is 38 milliamps (MA) for 0.6 seconds every 60 seconds and 0.54MA for the remaining time in Mode 1, 38MA for 4 seconds and 2.5MA thereafter in Mode 2. The package will be retrieved during EVA and will be stowed on the center-line box in the cabin.

S-11 -- Airglow Horizon Photography (flown on Gemini 9): To measure by direct photography the heights at which atomic oxygen (557A) and sodium (5893A) airglow layers occur in the upper atmosphere. Sponsors are OSSA and the U. S. Naval Research Laboratory. Equipment is 70mm Maurer camera with 50mm lens (f0.95) and interference filter, film magazine with focal plane filters, extended actuator, illuminated camera sight, and adjustable pitch mounting bracket and bracket adapter. The optical sight is installed in the left-hand window, the mounting bracket in the right-hand window. Estimated propellant usage is 24 pounds in docked configuration or 12 pounds in undocked.

S-13 -- Ultraviolet Astronomical Camera (flown on Gemini 10): To test the techniques of ultraviolet photography under vacuum conditions and to obtain ultraviolet radiation observations of stars in wave length region of 2000 to 4000 Angstroms by spectral means. Sponsors are OSSA and Northwestern University. Equipment is the Maurer 70mm camera with UV lens (f3.3) and magazine, objective grating and objective prism, extended shutter actuator, and mounting bracket. For the experiment, the camera is mounted on the centerline torque box to point through the opened right-hand hatch. Propellant expenditure is estimated at 4.5 pounds per night pass. Two night passes will be used to photograph probably six star fields.

S-26 -- Ion Wake Measurement (flown on Gemini 10): To determine and measure the ion and electron wake structure and perturbation of the ambient medium produced by an orbiting vehicle, and to study the changes in the ion flux and wake caused by thruster firings. Sponsors are OSSA and Electro-Optical Systems Inc. Equipment is an inboard ion detector, located in the throat of the Agena target docking adapter (TDA), an outboard ion detector and an electron detector located on the outside back of the TDA, the former about 15 degrees above the horizontal center line, the latter 15 degrees below on the right-hand side, and a programmer located at the top inside of the TDA. Propellant usage is estimated 29 pounds.

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The experiment is conducted with the Agena stabilization control system on the Agena oriented either TDA east or south. The spacecraft platform is aligned and in orb rate, radar is off within 20 feet of the Agena, attitude control is in pulse mode, and the 16mm camera is installed in the left-hand window. Both transverse and linear mapping will be accomplished. Data will be telemetered from the Agena.

S-29 -- Earth-Moon Libration Region Photography (new): To investigate the regions of the L4 and L5 libration points of the earth-moon system to determine the possible existence of clouds of particulate matter orbiting the earth in these regions. Sponsors are OSSA and the U. S. Geological Survey, Center of Astrogeology. Equipment is the Maurer 70mm camera with 50mm lens (f0.95), extended shutter actuator, and the S-11 mounting bracket. Propellant usage is estimated at 8 pounds in docked configuration, 4 pounds undocked. The camera is mounted in the right-hand window, the optical sight in the left. Two night passes will be used for the experiment, one early in the mission, one late in the mission.

The L4 and L5 libration regions are the LaGrangian points of stable equilibrium where centrifugal forces balance gravitational forces; they are located 60 degrees ahead of and 60 degrees behind, respectively, the moon in its orbital path. Theory holds that these regions shift position some 12 to 15 degrees in a 24-hour period and that the balance of centrifugal with gravitational force may hold captive clouds of particles. Comparison of the photographs in relation to the theoretical shift of the libration regions may determine the existence of such clouds.

S-30 -- Dim Light Photography/Orthicon (new): To obtain photographs of various faint and diffuse astronomical phenomena such as airglow layer in profile, brightest Milky Way, zodiacal light at 60-degree elongation, gegenschein (counterglow), and the LaGrangian libration points of the earth-moon system. Sponsors are OSSA, Dudley Observatory, and the University of Minnesota. Equipment will be the D-15 low-light TV system plus the spacecraft optical sight. Propellant consumption is estimated 0.75 pounds per mode. Command pilot and pilot voice-recordings of window and monitor observations will be made as in D-15.

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CREW PROVISIONS AND TRAINING

Crew Training Background

In addition to the extensive general training received prior to flight assignment, the following preparations have or will be accomplished prior to launch:

1. Launch abort training in the Gemini Mission Simulator and the Dynamic Crew Procedures Simulator.

2. Egress and recovery activities using a crew procedures development trainer, spacecraft boilerplate model and actual recovery equipment and personnel. Pad emergency egress training using elevator and slide wire, and breathing apparatus.

3. Celestial pattern recognition in the University of North Carolina's Morehead Planetarium at Chapel Hill.

4. Zero gravity training in KC-135 aircraft to practice EVA. Stowage and donning of EVA equipment is done in aircraft and crew procedures trainer.

   Additional EVA training is performed in 20-foot chamber at vacuum conditions.

5. Suit, seat and harness fittings.

6. Training sessions totaling approximately 15 hours per crew member on the Gemini translation and docking simulator.

7. Detailed Agena and Gemini systems briefing; detailed experiment briefings; flight plans and mission rules reviews.

8. Participation in mock-up reviews, systems review, subsystem tests, and spacecraft acceptance review.

9. Ejection seat training.

During final preparation for flight, the crew participates in network launch abort simulations, joint combined systems test, and the final simulated flight tests. At T-2 days, the major flight crew medical examinations will be administered to confirm readiness for flight and obtain data for comparison with post flight medical examination results.

Gemini 11 Suits

The pressure suit worn by the command pilot will be similar to suits worn on Gemini 4, 5, 6, 8, 9, and 10. The pilot will wear a suit with special thermal protective cover layers for EVA activities.

Command Pilot Suit

The Gemini command pilot's suit has five layers and weighs 23 pounds. The layers are, starting inside the suit:

1. White cotton constant wear undergarment with pockets around the waist to hold biomedical instrumentation equipment.

2. Blue nylon comfort layer.

3. Black neoprene-coated nylon pressure garment.

4. Restraint layer of nylon link not to restrain pressure garment and maintain its shape.

5. White HI-1 nylon outer layer.

Pilot Suit

The pressure suit worn by the Gemini 11 pilot is identical to the Gemini 4 and Gemini 8 pilot suit with the following two exceptions:

1. No extravehicular thermal over-gloves will be worn. Thermal protection for the hands is now integrated in a basic suit glove.

2. The material is now a layer-up of neoprene-coated nylon, the same material as the pressure retention layer.

The Gemini extravehicular suit has seven layers: 1-4 and 7 are identical to the command pilot's suit.

5. Thermal protective layer of seven layers of aluminized mylar with spacers between each layer.

6. Micrometeoroid protective layer.

For extravehicular activity, the pilot will wear a detachable overvisor which has attach points on both sides of the helmet and can be swiveled into position over the face-plate. The inner visor is a polycarbonate material which provides impact and micrometeoroid protection. The outer visor is gold-coated and provides protection for the eyes from solar glare.

When the cabin is depressurized, the suits automatically pressurize to 3.7 pounds per square inch to provide pressure and breathing oxygen for both crew members. The extravehicular suit weighs 33 pounds.

Extravehicular Life Support System (ELSS)

It is a 42-pound rectangular box which is worn on the chest. It provides electrical, mechanical and life support connections between the EVA astronaut and the spacecraft. System is 18 inches high, 10 inches wide and 6 inches deep. It contains an ejector pump for circulation, a heat exchanger for cooling air, and a 30-minute emergency oxygen supply. Controls and a warning system for the emergency oxygen supply are mounted on the top of the unit. The ELSS functions as a suit pressurization and air supply system during EVA.

Hand-Held Maneuvering Unit (HHMU)

This unit is similar to the unit used on Gemini 4 and Gemini 10. The unit provides the extravehicular astronaut with positive control of his attitude and propels him from point to point in space. Nitrogen fuel bottles are located in the adapter section. The fuel is fed to the HHMU through the umbilical.

Major components of the gun include forward and reverse handles, two spring loaded poppet valves, foldable tubes, two one-pound nozzles, and one two-pound nozzle. It weighs about three and half pounds and is stored in the adapter during launch. The unit is 12 inches long by 4½ inches, and 15 inches retracted. Tractor and braking thrust ranges up to two pounds, and the total delta velocity capability of the gun is 84 feet per second.

Umbilical

The umbilical for Gemini 11 includes two fluid transmission hoses, one for oxygen and one for the nitrogen HHMU fuel. When snubbed into the restraint eye at the nose of the spacecraft, the 30-foot umbilical will permit movement to above 20 feet from the spacecraft. Electric power, communications, and bio-instrumentation hardlines also are contained in the umbilical. The hoses are protected from temperature extremes by a wrapping of aluminized Mylar. The umbilical is encased in a sleeve of white nylon.

Medical Checks

At least one medical check will be made each day by each crew member. Performed over a convenient ground station, a check will consist of: oral temperature and food and water intake evaluation.

Body Waste Disposal

Solid Wastes -- Plastic bag with adhesive lip to provide secure attachment to body. Contains germicide which prevents formation of bacteria and gas. Adhesive lip also used to form seal for bag after use and bag is stowed in empty food container box and brought back for analysis.

Urine -- Voided into fitted receptacle connected by hose to either a collection device or overboard dump.

Water Measuring System

A mechanical measuring system has been added to water gun. It consists of a neoprene bellows housed in a small metal cylinder mounted at base of gun. The bellows holds one-half ounce of water. When plunger of gun is depressed, a spring pushes water out of bellows through gun. A counter in right side of gun registers number of times bellows is activated. Each crewman will record how much he drinks by noting numbers at beginning and end of each use of gun.

Food

Number of Meals -- 10 per astronaut for mission.

Type -- Bite-sized and rehydratable. Water is placed in rehydratables with special gun. Bite-sized items need no rehydration.

Storage -- Meals individually wrapped in aluminum foil and polythelene, polyamide laminate. All meals are stored in the right aft food box over the pilot's right shoulder.

Gemini 11 Food Menu
(Three-Day Menu Cycle)

Day 1: Meal A

		Calories
(R)	Fruit cocktail	87
(R)	Toasted oat cereal	91
(B)	Bacon squares (double)	180
(R)	Ham and applesauce	127
(B)	Cinnamon toast	56
(R)	Orange drink	83
(R)	Pineapple grapefruit drink	83
		707

Day 1: Meal B

(R)	Shrimp cocktail	119
(R)	Chicken and gravy	92
(B)	Toasted bread cubes	161
(B)	Fruitcake (Pineapple)	253
(R)	Orange grapefruit drink	83
(B)	Coconut cubes	175
		883

DAY 1: Meal C

		Calories
(R)	Beef pot roast	119
(R)	Potato salad	143
(B)	Cinnamon toast	56
(R)	Chocolate pudding	307
(B)	Brownies	241
(R)	Tea	32
		898

DAY 2: Meal A

(R)	Applesauce	139
(R)	Sugar coated flakes	139
(B)	Bacon squares (double)	180
(B)	Cinnamon toast	56
(R)	Cocoa	190
(R)	Orange drink	83
		787

DAY 2: Meal B

(R)	Pea Soup	220
(R)	Tuna salad	214
(B)	Cinnamon toast	56
(B)	Fruitcake (date)	262
(R)	Pineapple grapefruit drink	83
		835

DAY 2: Meal C

		Calories
(R)	Beef and vegetables	98
(R)	Meat and spaghetti	70
(B)	Cheese sandwiches	158
(R)	Apricot pudding	300
(B)	Gingerbread cubes	183
(R)	Grapefruit drink	83
		892

DAY 3: Meal A

(R)	Peaches	98
(B)	Strawberry cereal cubes	171
(R)	Sausage patties (2)	223
(B)	Cinnamon toast	56
(R)	Orange drink	83
(R)	Grapefruit drink	83
		714

(R) Rehydratable
(B) Bite-size

DAY 3: Meal B

		Calories
(R)	Shrimp cocktail	119
(R)	Beef and gravy	160
(R)	Corn	105
(B)	Toasted bread cubes	161
(B)	Fruitcake (Pineapple)	253
(R)	Orange grapefruit drink	83
		881

DAY 3: Meal C

(R)	Potato soup	220
(R)	Chicken salad	237
(B)	Beef sandwiches	268
(R)	Butterscotch pudding	311
(R)	Tea	32
		1068

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MANNED SPACE FLIGHT TRACKING NETWORK
GEMINI 11 MISSION REQUIREMENTS

NASA operates the Manned Space Flight Tracking Network by using its own facilities and those of the Department of Defense for mission information and control.

For Gemini 11, the network will provide flight controllers:

(1) Radar tracking, command control, voice and telemetry data are available from launch through Gemini spacecraft splashdown in recovery area. Except for voice communications, the network provides the same functions for the Agena as long as electrical power is available.

(2) Verification of the proper operation of the systems onboard the Gemini and Agena target.

Real Time Computer Complex (RTCC)

The RTCC at the Manned Spacecraft Center, Houston, will be the computer center responsible for the control of the entire mission. The RTCC collects, stores, processes, sends, and displays the necessary computer support information required by the flight controllers at the Mission Control Center (MCC)

During the launch (powered flight) phase, the RTCC receives launch trajectory data from Bermuda and the Air Force Eastern Test Range (AFETR) radars via the Cape Kennedy CDC-3600 Real Time Computing Facility (RTCF).

During all phases of the mission, the RTCC receives trajectory and telemetry data from the various sites and stores and processes this information for command and control of the mission. This telemetered information consists of bio-medical, environmental, electrical, command maneuvering, and other spacecraft systems parameters. This information is displayed at the various flight controllers consoles in the MCC where the necessary decisions are made. The flight controllers use the displayed information to generate the necessary voice messages or computer commands the RTCC must transmit to the spacecraft.

NETWORK CONFIGURATION

Stations \ Systems	C-Band Radar	S-Band Radar	Telemetry Receive & Record	Telemetry Real Time Display	Low Speed (TTY) Telemetry Data Transmission	Wide Band Data	High Speed Data	On Site Data Process & Summary	Gemini Launch Vehicle Telemetry	Gemini Launch Vehicle Command	Digital Command System	Voice - Transmit & Receive	Teletype - Transmit & Receive	Flight Control Team Manned	Spacecraft Acquisition Aid System	Skin Track
Mission Control, Houston (MCC-H)				X				X			X	X	X	X		
Mission Control, Kennedy (MCC-K)			X	X		X			X	X	X	X	X		X	
Merritt Island, Fla. (MLA)	X															X
Cape Kennedy, Fla. (CNV)	X	X	X			X			X	X	X	X	X		X	
Patrick AFB, Fla. (PAT)	X												X			X
Grand Bahama Island (GBI)	X	X	X			X			X	X	X	X	X		X	X
Grand Turk Island (GTI)	X	X	X			X			X	X	X	X	X		X	X
Bermuda (BDA)	X	X	X				X				X	X	X		X	
Grand Canary Island (CYI)	X	X	X	X	X			X			X	X	X	X	X	
Kano, Nigeria (KNO)			X									X	X		X	
Tananarive, Malagasy (TAN)			X									X	X		X	
Pretoria, South Africa (PRE)	X												X			
Carnarvon, Australia (CRO)	X	X	X	X	X			X			X	X	X	X	X	X
Woomera, Australia (WOM)	X												X			
Canton Island (CTN)			X									X	X		X	
Kauai, Hawaii (HAW)	X	X	X	X	X			X			X	X	X	X	X	
Guaymas, Mexico (GYM)		X	X	X	X			X				X	X	X	X	
Pt. Arguello, Calif. (CAL)	X	X	1									X	X		X	
White Sands, N. M. (WHS)	X												X		X	X
Eglin, Fla. (EGL)	X												X		X	X
Antigua Island (ANT)	X		X			X			X	X	X	X	X		X	X
Ascension Island (ASC)	X		X									X	X		X	X
Coastal Sentry Quebec (CSQ)			X	X	X			X			X	X	X	X	X	
Rose Knot Victor (RKV)			X	X	X			X			X	X	X	X	X	
Range Tracker (RTK)	X											X	X			X

1. Last two passes prior to reentry.

Tracking

The Gemini mission will require separate tracking of four space vehicles, the Gemini spacecraft, and the Agena Target Vehicle (ATV), Titan II which is the Gemini Launch Vehicle (GLV), and as required, the Atlas Booster (SLV-3) The Gemini Target Vehicle will carry one C-band and one S-band beacon. Skin tracking (radar signal bounce) of the spacecraft, Agena target vehicles, and Gemini launch vehicle throughout orbital lifetime is a mission requirement. The MSFN Wallops Station (WLP) Space Range Radar (SPANDAR) and various facilities of the North American Air Defense Command (NORAD) will be used for this mission. However, NORAD will not track during the rendezvous phase.

Various combinations of spacecraft tracking assignments will be carried out according to individual station capability. Some sites have radar systems capable of providing space position information on both the Gemini and Agena vehicle simultaneously through their Verlort (S-band) and FPS-16 or FPQ-6 (C-band) antennas. Data transmission links, however, have only a single system capability; therefore, priority will be established by the Flight Director or Flight Dynamics Officer according to their needs.

During the first revolution of the Agena (prior to Gemini spacecraft lift-off), all stations will track this vehicle in order to establish its ephemeris (position) as accurately as possible. After Gemini spacecraft lift-off, as a general rule, the C-band radars will track the Gemini spacecraft while the S-band radars will track the Agena Target Vehicle. The sites with dual-tracking capability will track both vehicles simultaneously.

Goddard Space Flight Center Computer Support

NASA's Goddard Space Flight Center, Greenbelt, Md., real-time computing support for Gemini includes the processing of real-time tracking information obtained from the Titan II and Agena systems beginning with mission simulations through Gemini spacecraft recovery and Agena lifetime.

Goddard's computer also will certify the worldwide network's readiness to support Gemini through a system-by-system, station-by-station, computer-programmed check-out method called CADFISS (Computation and Data Flow Integrated Subsystem). Checkout of network facilities also will be performed by Goddard during post-launch periods when the spacecrafts are not electronically "visible" by some stations and continue until the vehicles are again within acquisition range.

Gemini Spacecraft

The spacecraft has two C-band tracking beacons. The model ACF beacon (spacecraft) will be installed in the reentry module and the DPN-66 module beacon (adapter) in the adapter section.

The ACF beacon will be prime for launch, insertion, and reentry phase, using the DPN-66 as a backup for these periods.

Agena Target Vehicle

The Agena target vehicle will contain one C-band and one S-band beacon. The C-band beacon will be a modified DPN-66. The C-band beacon will be prime for Agena Target Vehicle prior to the Gemini launch. The Gemini spacecraft will be the prime target for C-band tracking following launch.

Acquisition Systems

All the sites in the network will receive real-time acquisition messages (pointing data) from the Real Time Computing Center at MSC, Houston. This information will be used to position the telemetry and radar antennas at the proper azimuth for acquisition of the RF signals from the two spacecraft at the time they appear over the horizon. Most sites are also equipped with an acquisition aid system which permits "slaving" the radar antennas to the telemetry antennas or vice versa. Since the telemetry antennas have a much broader beamwidth than the radar antennas, they may acquire the spacecraft RF signal first, making it possible to point the radar antennas in the general vicinity of the spacecraft to insure a rapid radar acquisition.

Mission Message Requirements

Low speed telemetry data (on-site teletype summaries) from flight controller manned stations will be sent to the Houston Mission Control Center.

Bermuda and Corpus Christi transmit Gemini spacecraft or Agena target vehicle PCM telemetry via high-speed digital data to Houston Mission Control Center in computer format. MCC-K/TEL III, Grand Bahama Island, Grand Turk Island, and Antigua will remote Gemini spacecraft and Agena wide-band data to the Houston Mission Control Center in the same manner.

Spacecraft Command System

The prime ground system in effecting rendezvous is the Digital Command System (DCS) located at key stations throughout the worldwide network. Command control of the mission from launch through recovery will as always be provided by the Flight Director at Houston Mission Control Center. Maximum command coverage is required throughout the mission.

Grand Canary Island; Carnarvon, Australia; Hawaii, and the two ships, USNS Coastal Sentry and USNS Rose Knot, are DCS equipped and manned by flight controllers who will initiate all uplink data command transmissions.

Following astronaut recovery, further commands, will be required for the Agena target vehicle. Network Digital Command System support will be continued throughout the Agena target vehicle battery lifetime.

The Texas, Cape Kennedy, Grand Bahama, Grand Turk, Antigua, and Bermuda sites will not be manned by flight controllers. All uplink data command transmissions through these sites will be remoted in real time from Houston Control Center.

In addition to real-time commands and onboard clock update commands, the following digital instructions may be sent:

a. Gemini spacecraft

1. Preretro with maneuver
2. Preretro without maneuver

b. Agena Target Vehicle

1. Maneuver
2. Ephemeris

3. Orbital navigation
4. Maneuver
5. Rendezvous
6. Accelerometer error corrections

3. Engine burn time

<u>Spacecraft Communications</u>

All MSFN stations having both HF and UHF spacecraft communications can be controlled either by the station or by remote (tone) keying from Houston Mission Control Center and from Goddard.

The following sites are not scheduled to have a command communicator (Cap Com) and will be remoted to Houston Mission Control Center:

Cape Kennedy; Grand Bahama Island; Tananarive, Malagasy Republic; Kano, Nigeria; Bermuda; Grand Turk Island; Pt. Arguello, Calif.; Antigua Island; Ascension Island; Canton Island; USNS Range Tracker, and the voice relay aircraft.

<u>Spacecraft Systems Support</u>

The Gemini spacecraft communications systems (antennas, beacons, voice communications, telemetry transmitters, recovery light, and digital command) allows radar tracking of the spacecraft, two-way voice communications between the ground and the spacecraft and from astronaut to astronaut; ground command of the spacecraft; TM systems data transmission, and postlanding and recovery data transmission. The sole link between the ground and the Gemini spacecraft is provided by these systems.

The Agena target vehicle communications systems (antennas, beacons, telemetry transmitters, and digital command system) allows radar tracking of the vehicle from both the ground and the Gemini spacecraft. Ground station and Gemini spacecraft command to the Agena also are accomplished through this system.

<u>Agena Target Vehicle On-Board Systems supported by Network Stations.</u>

Telemetry (Real Time)
Telemetry (Dump)
L-Band Transponder
S-Band Transponder
C-Band Transponder
Command Receiver (Range Safety)
Command Receiver (Command Control)

<u>Gemini Spacecraft On-Board Systems Support by Network Stations</u>

Reentry Module UHF (voice) xmit-Rcv
Reentry Module HF (voice) xmit-Rcv
Reentry Module Telemetry (Real Time)
Reentry Module Telemetry (Dump)
Reentry Module Telemetry (Backup)
Adapter Package L-Band Radar (Telemetry Readouts)
Reentry Module C-Band Transponder
Adapter Package C-Band Transponder
Adapter Package Acquisition Aid Beacon
Adapter Package Digital Command System
Reentry Module UHF Recovery Beacon

Ground Communications

The NASA Communications Network (NASCOM) used for Gemini 10 will be used for Gemini 11. Shore stations for USNS Rose Knot and USNS Coastal Sentry Ship support will be based upon the mission-designated ship positions and predicted HF radio propagation conditions.

Network Responsibility

Manned Spacecraft Center (MSC). The direction and mission control of the Network immediately preceding and during a mission simulation or an actual mission is responsibility of the MSC.

Goddard Space Flight Center. The NASA Office of Tracking and Data Acquisition has centralized the responsibility for the planning, implementation, and technical operations of Goddard Space Flight Center. Technical operation is defined as the operation, maintenance, modification, and augmentation of tracking and data acquisition facilities to function as an instrumentation network in response to mission requirements. About 370 persons directly support the network at Goddard; contractor personnel bring the total network level to some 1500.

Department of Supply, Australia. The Department of Supply, Commonwealth of Australia, is responsible for the maintenance and operation of the NASA station at Carnarvon, Australia. Contractual arrangements and agreements define this cooperative effort.

Department of Defense (DOD). The DOD is responsible for the maintenance and operational control of those DOD assets and facilities required to support Project Gemini. These include network stations at the Eastern Test Range, Western Test Range, White Sands Range, the Air Proving Ground Center, and the tracking and telemetry ships.

ABORT AND RECOVERY

Crew Safety

Every Gemini System affecting crew safety has a backup feature. The Malfunction Detection System aboard the launch vehicle warns the crew of a malfunction in time for escape.

There are three modes of escape:

MODE I Ejection seats and personal parachutes, used at ground level and during first 50 seconds of powered flight, or during descent after reentry.

MODE II Retrorockets salvo fired after engine shutdown is commanded.

MODE III Normal separation from launch vehicle using OAMS thrusters, then normal reentry using computer.

Except for Mode I, spacecraft separates from Gemini Launch Vehicle, turns blunt-end forward, then completes reentry and landing with crew aboard.

Survival Package

Survival gear, mounted on each ejection seat and attached to the astronaut's parachute harnesses by nylon line, weighs 23 pounds.

Each astronaut has:

3.5 pounds of drinking water; Machete; One-man life raft, 3 by 5½ feet, with CO_2 bottle for inflation, sea anchor, dye markers, nylon sun bonnet; Survival light (strobe), with flashlight, signal mirror, compass, sewing kit, 14 feet of nylon line, cotton balls and striker, halazone tablets, a whistle, and batteries for power; Survival radio, with homing beacon and voice transmission and reception; Sunglasses; Desalter kit, with brickettes enough to desalt eight pints of seawater; Medical kit, containing stimulant, pain, motion sickness and antibiotic tablets and aspirin, plus injectors for pain and motion sickness.

Planned and Contingency Landing Areas

There are two types of landing areas for Gemini, planned - where recovery forces are pre-positioned to recover spacecraft and crew within a short time - and contingency, requiring special search and rescue techniques and a longer recovery period.

Planned Landing Areas

PRIMARY	West Atlantic where the primary recovery aircraft carrier is pre-positioned.
SECONDARY	East Atlantic, West Pacific and Mid-Pacific areas where ships are deployed.
LAUNCH SITE	Off-the-pad abort or abort during early phase of flight, includes an area about 41 miles seaward from Cape Kennedy, 3 miles toward Banana River from Complex 19.
LAUNCH ABORT	Abort during powered flight, extending from 41 miles at sea from Cape Kennedy to west coast of Africa.

Contingency Landing Areas

All the areas beneath the spacecraft's ground track except those designated Planned Landing Areas are Contingency Landing Areas, requiring aircraft and pararescue support for recovery within 18 hours from splashdown.

Recovery forces are provided by the military services under the operational control of the Department of Defense Manager for Manned Space Flight Support Operations.

SPACECRAFT AND LAUNCH VEHICLES

Gemini Spacecraft

The Gemini spacecraft is conical, 18 feet, 5 inches long, 10 feet in diameter at its base and 39 inches in diameter at the top. Its two major sections are the reentry module and the adapter section.

Reentry Module

The reentry module is 11 feet high and 7½ feet in diameter at its base. It has three main sections: (1) rendezvous and recovery (R&R), (2) reentry control (RCS), and (3) cabin.

Rendezvous and recovery section is the forward (small) end of the spacecraft, containing drogue, pilot and main parachutes and radar.

Reentry control section is between R&R and cabin sections and contains fuel and oxidizer tanks, valves, tubing and two rings of eight attitude control thrusters each for control during reentry. A parachute adapter assembly is included for main parachute attachment.

Cabin section between RCS and adapter section, houses the crew seated side-by-side, their instruments and controls. Above each seat is the hatch. Crew compartment is pressurized titanium hull. Equipment not requiring pressurized environment is located between pressure hull and outer beryllium shell which is corrugated and shingled to provide aerodynamic and heat protection. Dish-shaped heat shield forms the large end of cabin section.

Adapter Section. The adapter is 7½ feet high and 10 feet in diameter at its base, containing retrograde and equipment sections.

Retrograde section contains four solid retrograde rockets and part of the radiator for the cooling system.

Equipment Section contains fuel cells for electrical power, fuel for the orbit attitude and maneuver system (OAMS), primary oxygen for the environmental control system (ECS), crogenic oxygen and hydrogen for fuel cell system. It also serves as a radiator for the cooling system, also contained in the equipment section.

NOTE: The equipment section is jettisoned immediately before retrorockets are fired for reentry. The retrograde section is jettisoned after retros are fired.

Electric Power System

Gemini 10 will carry two fuel cells for the primary power supply during launch and orbit. The cells consist of three stacks of 32 individual cells. Cryogenic liquid oxygen and hydrogen react to product electrical energy.

Four 45-amp-hour batteries will also be carried in the spacecraft to insure a continuous power supply during reentry and landing. They will also be used during prelaunch and launch, in conjunction with the fuel cells.

Three 15-amp-hour squib batteries will be used in the reentry section for all squib-actuated pyrotechnic separating during the mission.

Propellant

Usable: 940 pounds. Budgeted, no dispersions: 808 pounds.

Rendezvous Radar

Purpose -- to measure range, range rate, and bearing angle to Agena so crew can determine maneuvers necessary for rendezvous.

Location -- small end of spacecraft on forward face of rendezvous and recovery section.

Size -- less than two cubic feet.

Weight -- less than 70 pounds.

Power Requirement -- less than 80 watts.

Auxiliary Tape Memory (ATM) -- The Auxiliary Tape Memory is a 15-track magnetic tape recorder which stores 12,500,000 bits. Data parity, clocking, and computer processing bits are recorded in triplicate. The ATM provides triple redundant storage for approximately 1,170,000 bits for external storage of computer programs. The computer has onboard program capability for launch, rendezvous, and reentry and has 156,000 bits of program storage.

The ATM is a hermetically-sealed unit which contains a mechanical transport assembly mounted on vibration isolators, and an electronic assembly containing the power supply, control logic, record logic, and playback logic.

The tape transport is a flangeless reel, peripheral drive unit which contains 525 feet of one-inch magnetic tape. The magnetic tape is driven by an endless, seamless 3/4-inch wide mylar belt. The peripheral drive belt is in turn driven by two capstans coupled by mylar belts. By not exposing the magnetic tape to drive stresses, its useful life is extended.

The unit weighs 26 pounds, contains 700 cubic inches, and uses approximately 18 watts. The ATM is built by Raymond Engineering Laboratories, Middletown, Conn., under contract to the International Business Machines, Electronics Systems Division, Owego, N.Y., for the prime Gemini contractor, McDonnell Aircraft Corp.

Gemini Launch Vehicle

The Gemini Launch Vehicle is a modified U.S. Air Force Titan II intercontinental ballistic missile consisting of two stages, identical to the launch vehicles used in previous Gemini flights.

	FIRST STAGE	SECOND STAGE
HEIGHT	63 feet	27 feet
DIAMETER	10 feet	10 feet
THRUST	430,000 pounds (two engines)	100,000 pounds (one engine)
FUEL	50-50 blend of monomethyl hydrazine and unsymmetrical-dimethyl hydrazine	
OXIDIZER	Nitrogen tetroxide (Fuel is hypergolic, ignites spontaneously upon contact with oxidizer.)	

Overall height of launch vehicle and spacecraft is 109 feet. Combined weight is about 340,000 pounds.

Modifications to Titan II for use as the Gemini Launch Vehicle include:

1. Malfunction detection system added to detect and transmit booster performance information to the crew.

2. Back-up flight control system added to provide a secondary system if primary system fails.

3. Radio guidance substituted for inertial guidance.

4. Retro and vernier rockets deleted.

5. New second stage equipment truss added.

6. New second stage forward oxidizer skirt assembly added.

7. Trajectory tracking requirements simplified.

8. Electrical hydraulic and instrument systems modified.

Gemini Launch Vehicle program management for NASA is under the direction of the Space Systems Division of the Air Force Systems Command.

Agena Target Vehicle

The Agena target vehicle for Gemini 11 is a modification of the U.S. Air Force Agena D upper stage, similar to the space vehicles which helped propel Ranger and Mariner spacecraft to the Moon and planets.

It acts as a separate stage of the Atlas/Agena launch vehicle, placing itself into orbit with its main propulsion, and can be maneuvered either by ground control or the Gemini crew.

Height (Liftoff)	36.3 feet	Including shroud
Length (orbit)	26 feet	Minus shroud and adapter
Diameter	5 feet	
Weight	7,000 pounds	In orbit, fueled
Thrust	16,000 pounds 400 pounds 32 pounds	Primary propulsion Secondary Engines, Unit II Secondary Engines, Unit I
Fuel	UDMH (Unsymmetrical Dimethyl Hydrazine)	
Oxidizer	IRFNA (Inhibited Red Fuming Nitric Acid) in primary propulsion system; MON (Mixed Oxides of Nitrogen) in secondary propulsion system	
Combustion	IRFNA and UDMH are hypergolic, ignite on contact.	

Primary and secondary propulsion systems are restartable. Main engine places Agena into orbit and is used for large orbit changes. Secondary system, two 200-pound-thrust, aft-firing engines, are for small velocity changes. Two 16-pound-thrust, aft-firing thrusters are for ullage orientation and vernier adjustments. Attitude control (roll, pitch, yaw) is accomplished by six nitrogen jets mounted on Agena aft end.

Modifications to Agena for use as Gemini rendezvous spacecraft include:

1. Docking collar and equipment to permit mechanical connection with Gemini during flight.

2. Radar transponder compatible with Gemini radar.

3. Displays and instrumentation, plus strobe lights for visually locating and inspecting Agena before docking.

4. Secondary propulsion system for small orbital changes.

5. Auxiliary equipment rack for special rendezvous equipment and telemetry.

6. Command control equipment to allow control by Gemini 11 crew or ground controllers.

7. Multi-restartable engine to provide in-orbit maneuver capability.

Agena program management for NASA is under the direction of the Space Systems Division of the Air Force Systems Command.

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Static Charge Device

Three protruding flexible copper fingers are installed on the Agena docking cone to make first contact with the spacecraft. Any charge will be carried to a ground in the Agena and dissipated at the controlled rate. An electrostatic charge monitoring device is also installed in the target docking adapter to measure the potential or difference in charge between the two vehicles.

Atlas Launch Vehicle

The Atlas Standard Launch Vehicle is a refinement of the modified U.S. Air Force Atlas intercontinental ballistic missile, similar to the launch vehicle which placed Project Mercury Astronauts into orbit.

Atlas is a $1\frac{1}{2}$-stage Standard Launch Vehicle, igniting all three main engines on the pad, then dropping off the two outboard booster engines at staging, allowing the single sustainer engine to continue thrusting at altitude, aided by two small vernier engines.

Height	77 feet	Minus Agena Payload
Diameter	16 feet	Lower Booster Section
	10 feet	Tank Sections
	5 feet, 10 inches	Tapered Upper End
Weight	260,000 pounds	Fully fueled, minus Agena payload
Thrust	390,000 pounds 330,000	Total at liftoff Two booster (outer) engines
	57,000 pounds	One Sustainer (center) engine
	Balance	Two small vernier engines for trajectory and final velocity control
Fuel	RP-1, a hydrocarbon resembling kerosene	
Oxidizer	Liquid oxygen at -297 degrees F.	
Combustion	Unlike Titan's hypergolic, spontaneous ignition, Atlas combustion is achieved by forcing propellants to chambers under pressure, burning them in gas generators which drive propellant pump turbines.	

Modifications to the Atlas Standard Launch Vehicle for the Gemini 11 mission include:

1. Special autopilot system for rendezvous mission.

2. Improved propellant utilization system to assure simultaneous depletion of both fuel and oxidizers.

3. Increased thickness of Atlas structure for support of Agena upper stage.

4. Simplified pneumatic system.

5. Retrorockets moved from exterior equipment pods to upper interstage adapter section.

6. Uprated MA-5 propulsion system (used on later Mercury flights.)

7. Modular telemetry kit tailored for each mission.

Atlas Standard Launch Vehicle program management for NASA is under the direction of the Space Systems Division of the Air Force Systems Command.

CREW BIOGRAPHIES

NAME: Charles Conrad, Jr.

BIRTHPLACE AND DATE: Philadelphia, Penn., June 2, 1930.

EDUCATION: Bachelor of Science degree, aeronautical engineering, Princeton University.

MARITAL STATUS: Married the former Jane DuBose of Uvalde, Tex.

CHILDREN: Peter, Dec. 25, 1954; Thomas, May 3, 1957; Andrew, Apr. 30, 1959; Christopher, Nov. 26, 1960.

SPECIAL AWARDS: NASA Exceptional Service Medal and Navy Astronaut Wings.

PROFESSIONAL ORGANIZATIONS: Member, American Institute of Aeronautics and Astronautics; Member, Society of Experimental Test Pilots.

EXPERIENCE: He entered the Navy following his graduation from Princeton University and became a naval aviator. He is now a Navy commander.

Conrad attended the Navy Test Pilot School at Patuxent River, Md., and following completion of that course was a project test pilot in the armaments test division there. He also served at Patuxent as a flight instructor and performance engineer at the Test Pilot School.

He served as a F4H flight instructor and as a safety officer for Fighter Squadron 96 at the Miramar, Cal. Naval Air Station.

He was pilot on Gemini 5 flight which took place in August 1965.

He has logged more than 3,200 flying hours, including more than 2,500 hours in jet aircraft.

CURRENT ASSIGNMENT: Conrad was in the second group of astronauts selected by NASA in September 1962. In addition to participating in the overall astronaut training program, Conrad was command pilot for backup crew on Gemini 8.

NAME: Richard F. Gordon, Jr.

BIRTHPLACE AND DATE: Seattle, Wash., Oct. 5, 1929.

EDUCATION: Bachelor of Science degree in chemistry, University of Washington.

MARITAL STATUS: Married to the former Barbara J. Field of Freeland, Wash.

CHILDREN: Carleen, July 8, 1954; Richard, Oct. 6, 1955. Lawrence, December 18, 1957; Thomas, Mar. 25, 1959; James, Apr. 26, 1960; Diane, Apr. 23, 1961.

EXPERIENCE: Gordon, a United States Navy lieutenant commander, entered aviation training in 1951. After receiving his wings as a Naval Aviator in 1953, he attended All-Weather Flight School and received jet transitional training before reporting to an all-weather squadron at the Jacksonville, Fla., Naval Air Station.

He attended the Navy's Test Pilot School at Patuxent River, Md., in 1957, and served as a flight test pilot until 1960. During this tour of duty, he performed flight test work on the F8U Crusader, F11F Tigercat, FJ Fury, A4D Skyhawk, and was the first project test pilot for the F4H Phantom II.

He served with Fighter Squadron 121 at the Miramar, Cal., Naval Air Station as a flight instructor in the F4H and participated in the introduction of that aircraft to the Atlantic and Pacific fleets.

He was flight safety officer, assistant operations officer, and ground training officer for Fighter Squadron 96 at Miramar.

In May 1961, Gordon won the Bendix Trophy Race from Los Angeles to New York, establishing a new speed record of 869.74 miles per hour and a transcontinental speed record of 2 hours 47 minutes.

He was a student at the U.S. Naval Postgraduate School at Monterey, Cal.

He has logged more than 3,000 hours flying time, more than 2,500 hours in jet aircraft.

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CURRENT ASSIGNMENT: In October 1963, Gordon was named one of the third group of astronauts chosen by NASA. In addition to the regular astronaut training, he is responsible for monitoring cockpit layouts, instrument displays and pilot controls to insure that systems displays are appropriately integrated into cockpit panels. He was selected as the pilot for the backup crew on the Gemini 8 flight.

NAME: Neil A. Armstrong

BIRTHPLACE AND DATE: Wapakoneta, Ohio, August 5, 1930.

EDUCATION: Bachelor of Science degree in Aeronautical Engineering from Purdue University.

MARITAL STATUS: Married former Janet Shearon of Evanston, Illinois.

CHILDREN: Eric, June 30, 1957; Mark, April 8, 1963.

SPECIAL AWARDS: Recipient of the 1962 Institute of Aerospace Sciences Octave Chanute Award, NASA Exceptional Service Medal.

PROFESSIONAL ORGANIZATIONS: Charter member of the Society of Experimental Test Pilots; associate fellow of the American Institute of Aeronautics and Astronautics; member of the Soaring Society of America.

EXPERIENCE: Armstrong was a naval aviator from 1949 to 1952 and flew 78 combat missions during the Korean action.

He joined NASA's Lewis Research Center in 1955 (then NACA Lewis Flight Propulsion Laboratory) and later transferred to the NASA High Speed Flight Station at Edwards AFB, California, as an aeronautical research pilot for NACA and NASA. As an aeronautical research pilot, he was an X-15 project pilot, flying that aircraft to over 200,000 ft. and approximately 4,000 mph. Other flight test work included piloting the X-1 rocket airplane, the F-100, F-101, F-102, F5D, B-47, and paraglider.

He has logged more than 3,400 hours flying time, including 1,900 hours in jet aircraft.

CURRENT ASSIGNMENT: Armstrong was selected as an astronaut by NASA in September 1962. In addition to participating in all phases of the astronaut training program, he served as command pilot of the backup crew for the GT-5 flight. He was command pilot for the Gemini 8 mission, March 16, 1960.

NAME: William A. Anders

BIRTHPLACE AND DATE: Hong Kong, October 17, 1933.

EDUCATION: Bachelor of Science degree from the United States Naval Academy; Master of Science degree in Nuclear Engineering from the Air Force Institute of Technology, Wright-Patterson AFB, Ohio; additional graduate work at Ohio State University.

MARITAL STATUS: Married to the former Valerie E. Hoard of Lemon Grove, Cal.

CHILDREN: Alan, February 1957; Glen, July 1958; Gayle, December 1960; Gregory, December 1962; Eric, July 1964.

PROFESSIONAL ORGANIZATIONS: Member, Tau Beta Pi, the American Nuclear Society, and the American Geophysical Union.

EXPERIENCE: Anders, an Air Force Captain, was commissioned in the Air Force on graduation from the Naval Academy, then received his flight training.

He served as a nuclear engineer and instructor pilot at the Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico. He also had technical management responsibility for radiation shielding and radiation effects programs.

Anders has logged more than 2,500 hours flying time, including 2,200 hours in jet aircraft.

CURRENT ASSIGNMENT: Anders was selected as an astronaut by NASA in the group integrated into the program in October 1963. In addition to participating in the astronaut training program, he has specific responsibilities in environmental systems, radiation and thermal protection.

PREVIOUS GEMINI FLIGHTS

Gemini 1, Apr. 8, 1964

Unmanned orbital flight, using first production spacecraft, to test Gemini launch vehicle performance and ability of launch vehicle and spacecraft to withstand launch environment. Spacecraft and second stage launch vehicle orbited for about four days. No recovery attempted.

Gemini 2, Jan. 19, 1965

Unmanned ballistic flight to qualify spacecraft reentry heat protection and spacecraft systems. Delayed three times by adverse weather, including hurricanes Cleo and Dora. December launch attempt terminated after malfunction detection system shut engines down because of hydraulic component failure. Spacecraft recovered after ballistic reentry over Atlantic Ocean.

Gemini 3, Mar. 23, 1965

First manned flight, with Astronauts Virgil I. Grissom and John W. Young as crew. Orbited Earth three times in four hours, 53 minutes. Landed about 50 miles short of planned landing area in Atlantic because spacecraft did not provide expected lift during reentry. First manned spacecraft to maneuver out of plane, alter its own orbit. Grissom, who made suborbital Mercury flight, is the first man to fly into space twice.

Gemini 4, June 3-7, 1965

Second manned Gemini flight completed 62 revolutions and landed in primary Atlantic recovery area after 97 hours, 56 minutes of flight. Astronaut James A. McDivitt was command pilot. Astronaut Edward H. White II was pilot, accomplished 21 minutes of Extra-vehicular Activity (EVA), using a hand-held maneuvering unit for the first time in space. Near-rendezvous with GLV second stage was not accomplished after use of pre-planned amount of fuel for the maneuver. Malfunction in Inertial Guidance System required crew to perform zero-lift reentry.

Gemini 5, Aug. 21-29, 1965

Astronauts L. Gordon Cooper and Charles (Pete) Conrad, Jr., circled the Earth 120 times in seven days, 22 hours and 56 minutes. Cooper was first to make two orbital space flights. Failure of oxygen heating system in fuel cell supply system threatened mission during first day of flight, but careful use of electrical power, and excellent operational management of fuel cells by both crew and ground personnel, permitted crew to complete flight successfully. Spacecraft landed about 100 miles from primary Atlantic recovery vessel because of erroneous base-line information programmed into onboard computer, although computer itself performed as planned. Plan to rendezvous with a transponder-bearing pod carried aloft by Gemini 5 was cancelled because of problem with fuel cell oxygen supply.

Gemini 7, Dec. 4-18, 1965

Holds current world record for manned space flight as Command Pilot Frank Borman and Pilot James Lovell completed 206 revolutions of the Earth in 13 days, 18 hours, and 35 minutes. On the 12th day of their flight, the Gemini 7 served as target for the Gemini 6 spacecraft on the first successful rendezvous in space. In proving man's ability to operate in space for a period of up to two weeks, the crew of Gemini 7 carried out an ambitious list of 20 experiments including all medical experiments in the Gemini program, a test of laser communications from space, and visual acuity. The Gemini 7 experienced continuous difficulty with the delta p light on the fuel cell system. However, the system performed for the entire mission. The only other problem encountered was the temporary malfunction of a yaw thruster on the spacecraft. Gemini 7 landed in the Atlantic on Dec. 18, making a controlled reentry which brought it within 10 miles of the recovery carrier.

Gemini 6, Dec. 15-16, 1965

The first spacecraft to rendezvous with another spacecraft in orbit. Command pilot Walter Schirra and Pilot Thomas Stafford flew their spacecraft from a 100-by-167 mile orbit into a 185-mile circular orbit, rendezvousing with Gemini 7 over the Pacific Ocean at 5 hrs. 47 min. after liftoff. It demonstrated one of the major objectives of the program, and also paved the way for Apollo Lunar Orbit Rendezvous in the accomplishment of the first manned landing on the Moon.

Gemini 6 was launched on its historic rendezvous mission on the third attempt. On the first try, Oct. 25, the Agena Target Vehicle was destroyed by a hard start of its primary propulsion system. On Dec. 12, the Gemini Launch Vehicle failed to achieve liftoff when an electrical plug connecting the rocket with the pad electrical system dropped out prematurely.

Gemini 8, March 16, 1966

Astronaut Neil Armstrong, command pilot, and David Scott, pilot, completed the first rendezvous and docking with an Agena spacecraft launched into orbit approximately 100 minutes earlier. The planned three-day flight was terminated near the end of the sixth revolution after an electrical short circuit in the Gemini spacecraft caused continuous firing of a roll thruster. The crew undocked from the Agena and activated the reentry reaction control system to regain control of the spacecraft. The crew made a guided reentry and landed in the Pacific Ocean 500 miles east of the island of Okinawa and only approximately five miles from the aiming point. A recovery aircraft was on the scene before splashdown to parachute a recovery team to the spacecraft. The crew and spacecraft were picked up by a Navy destroyer approximately three hours after splashdown.

Gemini 9, June 3-6, 1966

Three separate rendezvous with the Augmented Target Docking Adapter and a 2-hour 10-minute extra-vehicular activity were the primary accomplishments of the seventh manned Gemini flight. Col. Thomas P. Stafford, a veteran of the first U.S. rendezvous mission in Gemini 6, was command pilot for the 3-day flight. Eugene Cernan was pilot and performed the EVA. The flight, originally scheduled for May 17, was postponed two weeks when the Atlas booster which was launching the Agena Target Vehicle developed an electrical short circuit which caused its engines to gimbal hard over and abort the flight. The ATDA was substituted for the Agena and was launched on June 1. Gemini 9 did not launch when a malfunction in the Data Transmitting System, sending data to the spacecraft caused an automatic hold at T-3 minutes. Gemini 9 was launched two days later, and although the shroud had failed to separate from the ATDA which prevented any docking exercises, an initial third orbit rendezvous was achieved, followed by an equi-period rendezvous, and a lunar abort or rendezvous from above on the following day. The EVA was postponed to the following day when Cernan spent more than one orbit outside the spacecraft before visor fogging in his helmet forced termination of the EVA before the Astronaut Maneuvering Unit experiment could be performed. Gemini 9 landed approximately three-and-one-half miles from the recovery carrier in the West Atlantic after 44 revolutions of the Earth.

Gemini 10, July 18-21

Rendezvous and docking, two extra-vehicular activities, docked maneuvers, a dual rendezvous, and a new altitude record were the prime accomplishments of Gemini 10, the eighth manned Gemini flight. Astronauts John W. Young and Michael Collins maneuvered the docked Gemini-Agena 10 to 475 miles altitude in the course of achieving a dual rendezvous with Agena 8. Collins conducted a standup EVA and an umbilical EVA. During the umbilical EVA, Collins used the Hand-Held Maneuvering Unit (HHMU) to maneuver to Agena 8 and retrieve the attached meteroid experiment package. In the 38 hours 47 minutes while Gemini was docked with Agena 10, six maneuvers of the docked configuration using the Agena 10 propulsion system were successfully completed. Gemini 10 splashed down in the Atlantic after completing 43 revolutions, 70 hours 47 minutes after liftoff. Landing was within three miles of the planned landing point.

U.S. MANNED SPACE FLIGHTS

MISSION	SPACECRAFT HRS.			REVS.	MANNED HOURS IN MISSION			TOTAL MANNED HRS. CUMULATIVE		
	HRS.	MIN.	SEC.		HRS.	MIN.	SEC.	HRS.	MIN.	SEC.
MR-3 (Shepard)		15	22	SO		15	22		15	22
MR-4 (Grissom)		15	37	SO		15	37		30	59
MA-6 (Glenn)	4	55	23	3	4	55	23	5	26	22
MA-7 (Carpenter)	4	56	05	3	4	56	05	10	22	27
MA-8 (Schirra)	9	13	11	6	9	13	11	19	35	38
MA-9 (Cooper)	34	19	49	22	34	19	49	53	55	27
Gemini 3 (Grissom & Young)	4	53	00	3	9	46	00	63	41	27
Gemini 4 (McDivitt & White	97	56	11	62	195	52	22	259	33	49
Gemini 5 (Cooper & Conrad)	190	56	01	120	381	52	02	641	25	51
Gemini 7 (Borman & Lovell	330	35	13	206	661	10	26	1302	36	17
Gemini 6 (Schirra & Stafford)	25	51	24	15	51	42	48	1354	19	05
Gemini 8 (Armstrong & Scott	10	42	06	6.6	21	24	12	1375	43	17
Gemini 9 (Stafford & Cernan)	72	20	56	44	144	41	52	1520	25	09
Gemini 10 (Young & Collins)	70	46	45	43	141	33	30	1661	58	39

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PROJECT OFFICIALS

Dr. George E. Mueller	Associate Administrator, Office of Manned Space Flight, NASA Headquarters; Acting Director, Gemini Program
John Edwards	Deputy Director, Gemini Program, Office of Manned Space Flight, NASA Headquarters
William C. Schneider	Gemini 11 Mission Director, Deputy Director, Mission Operations, Office of Manned Space Flight, NASA Headquarters
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Christopher C. Kraft	Assistant Director for Flight Operations, Manned Spacecraft Center, Houston
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Lt. Gen. Leighton I. Davis	USAF, National Range Division, Command and DOD Manager of Manned Space Flight Support Operations
Maj. Gen. V. G. Huston	USAF, Deputy DOD Manager of Manned Space Flight Support Operations; Commander of Air Force Eastern Test Range
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Col. Alfred J. Gardner	USAF, Director, Gemini Target Vehicle Directorate and Agena Directorate Space Systems Division, Air Force Systems Command
Col. Otto C. Ledford	USAF, Commander 6555th Aerospace Test Wing, Space Systems Division at Air Force Eastern Test Range
Col. John G. Albert	USAF, Chief, Gemini Launch Division, 6555th Aerospace Test Wing, Space Systems Division at Air Force Eastern Test Range
Lt. Col. L. E. Allen, Jr.	USAF, Chief, Atlas Division, 6555th Aerospace Test Wing, Space Systems Division at Air Force Eastern Test Range
R. Adm. William C. Abhau	USN, Commander Task Force 140 Primary Recovery Area
R. Adm. R. G. Anderson	USN, Commander Task Force 140.3
R. Adm. Henry S. Persons	USN, Commander Task Force 130 Pacific Recovery Area

SPACECRAFT CONTRACTORS

McDonnell Aircraft Corp., St. Louis, Mo., is prime contractor for the Gemini spacecraft. Others include:

AIResearch Manufacturing Co. Los Angeles	Environmental Control System
IBM Federal Systems Division Electronic Systems Center Owego, N. Y.	Onboard Computer
General Electric Co. West Lynn, Mass.	Fuel Cells
The Eagle Pitcher Co. Joplin, Mo.	Batteries
Northrop Corp. Newbury Park, Cal.	Parachutes
Rocketdyne Division, North American Aviation, Inc. Canoga Park, Cal.	OAMS, RCS
Thiokol Chemical Corp. Elkton, Md.	Retrorocket System
Weber Aircraft Corp. Burbank, Cal.	Ejection Seats
Westinghouse Electric Corp. Baltimore, Md.	Rendezvous Radar System

Atlas contractors include:

General Dynamics, Convair Div. San Diego, Cal.	Airframe and Systems Integration
Rocketdyne Div., North American Aviation, Inc., Canoga Park, Cal.	Propulsion Systems
General Electric Co. Syracuse, N. Y.	Guidance
Burroughs Corp. Paoli, Pa.	Ground Guidance Computer

Titan II contractors include:

Martin Co., Baltimore Div., Baltimore	Airframe and Systems Integration
Aerojet-General Corp. Sacramento, Cal.	Propulsion System
General Electric Co. Syracuse, N. Y.	Radio Command Guidance System
Burroughs Corp. Paoli, Pa.	Ground Guidance Computer
Aerospace Corp. El Segundo, Cal.	Systems Engineering and Technical Direction

Agena D contractors include:

Lockheed Missiles and Space Co. Sunnyvale, Cal.	Airframe and Systems Integration
Bell Aerosystems Co. Niagara Falls, N. Y.	Propulsion Systems
McDonnell Aircraft Corp. St. Louis	Target Docking Adapter

Food contractors:

U. S. Army Laboratories Natick, Mass.	Food Formulation Concept
Whirlpool Corp. St. Joseph, Mich.	Procurement, Processing, Packaging
Swift and Co., Chicago Pillsbury Co., Minneapolis	Principal Food Contractors

Suit contractor:

The David R. Clark Co.
Worcester, Mass.

Approximate Times of Major Events In Nominal Gemini 11 Mission

GET Hours	Event
00	Lift off
	Acquire Target (radar)
	Out-of plane correction
	TPI Burn
01	1st Midcourse
	2nd Midcourse
	TPF-fly formation
	Dock-(S-9 experiment)
02	(D-3 experiment)
	Undock (S-26 experiment)
03	
	Dock
	Undock (fly formation)
04	Dock
	Out-of-plane PPS calibration
05	(S-29 experiment)
06	
	Docking practice
07	Eat period
08	Sleep period
09	
10	
11	
12	

GET Hours	Event
13	
14	
15	
16	Eat period
17	(S-11 experiment) docked
18	(Apollo sump tank photos)
19	
	EVA Preparation
20	
21	
22	
23	
24	Umbilical EVA, Install tether, (D-16 power tool), HHMU evaluation
25	
	End EVA

-more-

GET Hours	Event
26	Post ingress procedures
27	Equip jettison (S-11 exper.)
28	
29	
	(S-29 experiment)
30	
	Eat period
31	
	Sleep period
32	
33	
34	
35	
36	
37	
38	

GET Hours	Event
39	
	Eat period (S-4 experiment)
40	
	Agena PPS burn (750 NM), (S-5, S-6, S-26 experiments)
41	
	(S-11 experiment)
42	
43	
	Agena PPS burn (160 NM)
44	EVA preparations
45	
46	Stand-up EVA, (S-13 experiment)
47	
48	
	End EVA
	Post ingress Procedures
49	
	Tether evaluation
50	Undock
51	

GET Hours	Event
52	
53	Jettison tether
	Final separation from Agena
54	Orbit adjust burn (D-3 experiment)
55	
56	Eat period
	(D-15 experiment)
57	
	Sleep period
58	
59	
60	
61	
62	
63	
64	

GET Hours	Event
65	
	Eat period
66	
	(S-4 experiment)
67	
	(S-30 experiment)
68	
69	
	Pre-retro checks
70	
	Retrofire
71	Splashdown
72	
73	
74	
75	
76	
77	

-more-

LOCAL TIME A.M.	LOCAL TIME P.M.
12:00	12:00
01	01
02	02
03	03
04	04
05	05
06	06
07	07
08	08
09	09
10	10
11	11
12	12

NOTE: Clip the time scales at left and slide them along the scales showing the approximate ground elapsed time of a nominal mission. Place the local time of liftoff opposite the 00 on the GET scale and you will be able to read off the approximate local times of major events.

-end-