NASA

PRESS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: Wednesday AMs
March 17, 1965

RELEASE NO: 65-81

PROJECT: GEMINI-TITAN 3

Launch scheduled no earlier than March 22, 1965

NEWS NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: WEDNESDAY AM'S
March 17, 1965

RELEASE NO: 65-81

NASA SCHEDULES FIRST MANNED GEMINI FLIGHT FROM CAPE KENNEDY

The first United States two-man space flight in a Gemini Spacecraft is scheduled to be launched from Cape Kennedy no earlier than March 22, the National Aeronautics and Space Administration announced today.

Astronauts Virgil I. (Gus) Grissom and John Young make up the crew for the three-orbit flight. Astronauts Walter M. Schirra, Jr., and Thomas P. Stafford are the backup crew. They will replace the prime crew should either member of that team become ineligible for medical or other reasons.

This first manned flight in a Gemini spacecraft is designated Gemini-Titan 3 or GT-3 - Gemini for the spacecraft, Titan II for the launch vehicle.

A successful GT-3 flight will achieve many significant firsts for United States manned space flight program:

-- The first maneuvering or change of orbital plane by the crew.

-- Use of a variable lift capability by the crew during reentry to "fly" to a selected landing area.

The spacecraft will be launched by a two-stage Titan II, a modified U.S. Air Force ICBM, into a 100-150 mile orbit.* It's orbit will take about 90 minutes (orbital period) and range between 33 degrees north and south of the equator. Total flight time is expected to be about four hours and 50 minutes -- from lift-off to landing in the Atlantic Ocean near Grand Turk Island in the West Indies.

The first maneuver will take place near completion of the first orbit as the spacecraft passes over Texas. Small rockets, called thrusters, will be fired to change the orbit to near circular, about 100-107 miles. On the second orbit the thrusters will be fired in a lateral direction causing a slight shift in orbital plane angle. They will be fired in a retro direction again on the third orbit resulting in an elliptical orbit with a low point of about 52 miles.

After firing the retro rockets in the fringes of Earth's atmosphere, the astronauts begin their controlled reentry to the prescribed landing point and recovery by U.S. Naval forces.

Three in-flight scientific experiments are planned for the GT-3 mission. One experiment will test effects of weightlessness on living cells. Another will measure the effect of weightlessness and radiation on human white blood cells.

- more -

* All miles given are statute

In a third experiment, the spacecraft will eject water into the plasma sheath that surrounds it during re-entry and radio signals will be directed through the sheath. Normally, this plasma sheath, an ionized layer of air, causes radio blackout.

The study of cardiovascular effects of space flight which began in Project Mercury will be continued.

Space food experiments, also begun in Project Mercury, will be carried out on the second orbit. Two meals, each containing freeze-dry foods and two bite-sized items, will be carried on the flight. A water gun device will be used for rehydrating the food and drinking.

Gemini is the second phase of America's manned space flight program. It will provide experience in orbital maneuvers, permit long duration flights lasting up to 14 days and be a vehicle for manned scientific investigations in space.

Gemini is named after the constellation containing the twin stars Castor and Pollux.

GT-3 follows two successful unmanned Gemini Launches. GT-1 was launched into orbit Apr. 8, 1964, in a test of booster and guidance systems and proved structural integrity of the spacecraft and booster. GT-2, a sub-orbital flight Jan. 19, 1965, tested the spacecraft at maximum heating rates and demonstrated structural integrity and systems performance throughout flight, reentry and parachute water landing.

Gemini is under the direction of the Office of Manned Space Flight, NASA Headquarters, Washington, D.C., and is managed by NASA's Manned Spacecraft Center in Houston.

Gemini is a national space effort. The project is supported by the Department of Defense in such areas as booster development, launch operations, tracking and recovery.

(Background information follows)

GT-3

PRIMARY OBJECTIVES

1. Demonstrate manned orbital flight in the Gemini spacecraft and further qualify spacecraft and launch vehicle systems for future manned missions.

2. Demonstrate and evaluate operations of the world-wide tracking network with a spacecraft and crew.

3. Evaluate Gemini design and its effects on crew performance.

4. Demonstrate and evaluate capability to maneuver the spacecraft in orbit using the Orbital Attitude and Maneuver System (OAMS).

5. Demonstrate capability to control the reentry flight path and the landing point.

6. Evaluate performance of the following spacecraft systems:

a. Crew station controls and displays
b. Environmental control
c. Gemini space suits
d. Guidance and control
e. Electrical power and sequential
f. Propulsion
g. Communications and tracking

- more -

h. Pyrotechnics

i. Instrumentation

j. Food, water and waste management

k. Landing and recovery

7. Demonstrate systems checkout, prelaunch and launch procedures for manned spacecraft.

8. Recover the spacecraft and evaluate recovery systems.

GT-3

SECONDARY OBJECTIVES

1. Evaluate the following spacecraft systems:

a. Astronaut equipment

b. Biomedical instrumentation

c. Personal hygiene

2. Execute the following experiments:

a. Sea urchin egg growth

b. Radiation and zero-g effects on blood

c. Reentry communications

3. Obtain general photographic coverage in orbit.

MISSION DESCRIPTION

The spacecraft will be launched from Pad 19 on a true azimuth heading of 72 degrees east of north.

Second stage engine cutoff will occur about 533 statute miles from Cape Kennedy at a velocity of about 17,400 miles per hour. Twenty seconds later, engine tailoff will increase the velocity to about 17,500 mph, at which time the crew will separate the spacecraft from the launch vehicle by firing the OAMS thrusters. This will add 10 ft/sec to the velocity and will insert the spacecraft into a 100-150-mile elliptical orbit.

After one orbit, at about one hour, 30 minutes after lift-off, the forward-firing OAMS thrusters will be fired to provide a 66 ft/sec (45 mph) velocity change in an in-plane retrograde attitude to put the spacecraft into a 100-107-mile orbit.

At two hours, 20 minutes after lift-off, during the second orbit, south and north out-of-plane burns totalling 14 ft/sec will be performed. Forward-firing thrusters will be used for the 12 ft/sec burn, followed by a 2 ft/sec burn of the aft-firing thrusters.

FLIGHT DATA

Launch Azimuth -- 72 degrees

Flight Duration -- Approximately 4:50 hours

Initial Orbital Parameters -- 100-150 and 100-107 miles

Reentry Velocity -- About 24,000 ft/sec, 16,450 mph

Reentry Temperature -- Approximately 3000 degrees Fahrenheit on surface of heat shield

Oxygen -- Primary 15.3 pounds, Secondary 13 pounds

OAMS Fuel -- Approximately 300 pounds

Cabin Environment -- 100 percent oxygen pressurized at 5 psi

Retrorockets -- Each of the four retrorockets produces approximately 2500 pounds of thrust for 5.5 seconds. Will fire separately

Landing Point -- Atlantic Ocean, about 60 miles from Grand Turk Island

WEATHER REQUIREMENTS

Recovery capability is based primarily on reports from recovery force commanders to the recovery task force commander at the Mission Control Center.

A weather condition which results in an unsatisfactory recovery condition in a planned landing area will be considered as the basis for a hold or a scrub. The following are guidelines only, and conditions along the ground track will be further evaluated prior to and during the mission.

Launch Area:

Surface winds - 18 knots with gusts to 25 knots.

Ceiling - 5,000 feet cloud base minimum.

Visibility - 6 miles minimum.

Wave height - 5 feet maximum.

Planned Landing Areas:

Surface winds - 30 knots maximum.

Ceiling - 1,500 feet cloud base minimum.

Visibility - 6 miles minimum.

Wave height - 8 feet maximum.

Contingency Landing Areas:

Weather and status of contingency recovery forces will be continually monitored during the countdown and orbital phases of the mission. Recommendations will be made to the Mission Director who will make the go-no-go decision based upon conditions at the time.

Pararescue:

The decision to use pararescue personnel depends upon weather conditions, surface vessel locations, and the ability to provide air dropped supplies until the arrival of a surface vessel. The final decision to jump will be made by the jump-master. Weather guidelines for pararescue operations are:

Surface winds - 25 knots maximum.

Ceiling - 1,000 feet cloud base minimum.

Visibility - target visible.

Waves - 5 feet maximum, swells 10 or 11 feet maximum.

Near the end of the third orbit, a pre-retro burn of 93 ft/sec (63 mph) will be performed with the aft-firing thrusters to put the spacecraft into a reentry elliptical orbit with a perigee of 52 miles. This maneuver will be performed west of Hawaii, 12 minutes prior to the time the retrorockets fire for reentry into the primary landing area near Grand Turk Island.

Retrofire is planned at four hours, 33 minutes and 30 seconds after lift-off. The spacecraft will land about 20 minutes after retrofire.

COUNTDOWN

T minus one day	Spacecraft and launch vehicle prelaunch servicing and checks
T minus 420 minutes	Begin countdown
T minus 400 minutes	Spacecraft power on
T minus 380 minutes	Gemini launch vehicle (GLV) and spacecraft systems check
T minus 330 minutes	Spacecraft command checks with Mission Control Center
T minus 258 minutes	Awaken crew
T minus 220 minutes	Spacecraft/computer memory loading

T minus 190 minutes	Pad clear for GLV ordnance and range command checks
T minus 173 minutes	Begin sensor placement and suiting of crew
T minus 160 minutes	GLV tanks to launch pressure
T minus 145 minutes	Ground test of launch program
T minus 100 minutes	Crew enters spacecraft
T minus 75 minutes	Spacecraft hatch closure. Dismantle White Room
T minus 35 minutes	Erector lowering
T minus 30 minutes	Activate all spacecraft communication links
T minus 20 minutes	Spacecraft to internal power
T minus 6 minutes	GLV-spacecraft final status check
T minus 3 minutes	Update GLV launch azimuth and spacecraft computer
T minus 0	Engine start signal
T plus 1.8 seconds	Thrust chamber pressure switch -- calibrated for 77 per cent of rated engine thrust -- is activated, starting a two-second timer.
T plus 3.8 seconds	Spacecraft umbilicals release, GLV tiedown bolts fire
T plus 4 seconds	Lift-off
Lift-off plus 2 minutes 36 seconds	Staging
LO plus 3 minutes 15 seconds	Fairing jettison
LO plus 5 minutes 38 seconds	SECO (Second stage engine cutoff)
LO plus 5 minutes 58 seconds	Separation maneuver. Confirm orbit.

- more -

GT-3
SUMMARY FLIGHT PLAN

TIME	COMMAND PILOT	PILOT
	Launch	
0:10	Insertion Checklist Align Platform Unstow Equipment	Unstow Equipment Trajectory Update Communications Check Blood Pressure
	Control Mode Check	
0:20	Sea Urchin Egg Exp - Twice	Empty Launch Day Urine Bag Suit Integrity Check
0:30		
0:40	Blood Pressure T/M Calib	Oral Temp
0:50	GO/NO GO Decision	S/C GMT Time Hack Trajectory Update Human Blood Irradiation Exp Start
1:00	RCS Plume Observation	
1:10	Catch-up Mode Check Sea Urchin Egg Exp - Once	Human Blood Irradiation Exp Stop
	Align Platform	
1:20	GO/NO GO Update for Translation No. 1	
1:30		

GT-3
SUMMARY FLIGHT PLAN

TIME	COMMAND PILOT	PILOT
	Control S/C to 0°, 0°, 0°	
	Translation No. 1	
ORBIT 2	Tape Plybk	Trajectory Update Blood Pressure
1 40	Platform Alignment and Caging Check Blood pressure	Food and Waste Evaluation
1 50	Control S/C to 0°, 180°, 0°	
2 00		
2 10	Horizon Scanner Check	
	Control S/C to 90° Yaw	
2 20	Translational Systems Check	
	GO/NO GO Decision Trajectory Update	
2 30	Hor Scan Control Mode Characteristics Check	Suit Integrity Check
2 40	Align Platform	O_2 High Rate Check
2 50	GO/NO GO Decision	Gage Correlation Report
3 00	Tracking Task	Oral Temp Blood Pressure

GT-3
SUMMARY FLIGHT PLAN

TIME	COMMAND PILOT	PILOT
	Tracking Task	SEC Coolant Pump B Check
	Control S/C to 0°, 0°, 0°	PRI Coolant Pump B Check
	Oral Temp	
3 10 — ORBIT 3	Blood Pressure	Trajectory Update
	Landing Area Conditions Update	Tape Plybk
3 20	Platform Stabilization Check	
3 30	Backup CO_2 Sensor Check	Control Mode Characteristics Check
3 40		
		Control S/C to 0°, 180°, 0°
3 50	Sea Urchin Egg Exp - Once	
	Preretro Checklist	Preretro Checklist
		Trajectory Update if required
4 00		
4 10	Align Platform	Update for Translation No. 2 if required
	Translation No. 2	
	Align Platform	
4 20		
	T_R-5 Checklist	
4 30		

GT-3
SUMMARY FLIGHT PLAN

TIME	COMMAND PILOT	PILOT
	T_R-30 Checklist	
	Retrofire	
	Postretro Checklist	
	400K	
4 40	BBO	
		Reentry Communications Exp
	ORBIT 4	
	EBO	
	50K	
	10K	
4 50	Landing	
5 00		
5 10		
5 20		
5 30		
5 40		
5 50		
6 00		

Crew safety is paramount. Gemini represents thousands of hours of design, modification, fabrication, inspection, testing and training. Every component or system critical to crew safety has a redundant (back-up) feature.

Launch

The malfunction detection system (MDS) in the launch vehicle is the heart of crew safety during the powered phase of flight -- lift off to second stage shut down.

This system was designed for the Gemini launch vehicle and had no counterpart in the Titan weapon system. Its function is to monitor Gemini launch vehicle subsystem performance and warn the crew of a potentially catastrophic malfunction in time for escape, if necessary. The MDS monitors engine thrust for both stages, turning rates, propellant tank pressures, staging, Stage I hydraulic pressure, a spacecraft switchover command or engine hardover.

During the powered phase of flight there are three modes for crew escape. These are (1) ejection seats, (2) firing the retrorockets to separate the spacecraft from the launch vehicle, then initiating the spacecraft recovery system, (3) normal spacecraft separation followed by use of the thrusters and retrorockets. For malfunctions dictating retro-abort mode which occur between 15,000 and 70,000 feet, the astronauts will not initiate abort until aerodynamic pressure has decreased to the point where successful separation of the spacecraft from the launch vehicle is assured.

- more -

Escape procedures will be initiated by the command pilot following two valid cues that a malfunction has occurred. The particular malfunction and the time at which it occurs will determine abort procedures as follows:

1. Lift-off to 15,000 feet -- Immediate ejection for all malfunctions.

2. 15,000 to 70,000 feet -- Delayed retro-abort for all malfunctions.

This action consists of arming abort circuits, waiting until aerodynamic pressure has decreased, then salvo firing the four retrorockets to separate from the launch vehicle. This delay requires approximately five seconds.

3. After the launch vehicle is above 70,000 feet, aerodynamic drag will have decreased to the point where no delay between engine shutdown and retro-abort is required for successful separation. Retro-abort will be used until a velocity of approximately 20,700 ft/sec (14,100 mph) is achieved. For rapid malfunctions, retro-abort will be initiated immediately after receipt of two valid cues. For slow malfunctions, retro-abort will be initiated at the next occurring fixed time in order to land near pre-positioned recovery vessels.

4. For velocities exceeding 20,700 ft/sec, but less than orbital velocity minus 300 ft/sec, the normal spacecraft separation abort sequence is used for all malfunctions. The most probable cause of abort at this time would be early shutdown of the booster due to fuel depletion. Also, abort may be requested by ground monitors if the trajectory exceeds acceptable limits. The general abort plan in this flight regime is to separate from the launch vehicle, assume retro-attitude, insert landing area parameters in the spacecraft computer, retrofire, and descend to a planned recovery area.

<u>In-Flight</u>

There are no single point failures which would jeopardize crew safety during in-flight operations. All systems and subsystems have redundant features or there is an alternate mode.

The Environmental Control System (ECS) controls suit and cabin atmosphere, crew and spacecraft equipment temperatures and provides drinking water and a means of disposing of waste water.

The spacesuit itself is a redundant system. Should cabin pressure fail, the spacesuit provides life support.

It is a full pressure suit which works in conjunction with the ECS. Gaseous oxygen is distributed through the suit ventilation system for cooling and respiration and provisions allow the astronaut to take in drinking water while in a hard suit (pressurized) condition.

A 100 percent oxygen environment at 5.0 psia in a pressurized cabin or 3.7 psia in an unpressurized cabin is provided in spacesuit by the ECS. Additional oxygen is available from tanks in the reentry module in case of emergency and for use during reentry.

In event the flight must be terminated before mission completion, the Gemini propulsion systems will permit a controlled landing in a contingency recovery area.

Reentry, Landing and Recovery

The Reentry Control System (RCS) controls the spacecraft attitude during retrorocket firing and reentry. Two complete and independent systems provide 100 percent redundancy. The four retrorockets are wired with dual igniters.

The Orbit Attitude and Maneuver System (OAMS) serves as a redundant safety feature should the retrorockets fail to fire. In case of retrorocket failure the OAMS will have been used to lower the orbit to the point where gravity and atmos-drag would cause spacecraft reentry.

The OAMS is normally used to perform translation maneuvers along three axes of the spacecraft and provide attitude control during orbital phases of the mission.

In GT-3, should the retrorockets fail, reentry will occur near Ascension Island in the South Atlantic.

Parachutes are used for descent following spacecraft reentry. The crew has an excellent view of parachute deployment through the spacecraft windows. If there is a parachute malfunction the crew will eject themselves from the spacecraft and use their personal chutes for landing. Survival equipment is carried on the backs of the ejection seats and remains attached to the astronauts until they land.

Recovery forces will be provided by the military services and during mission time will be under the operational control of the Department of Defense Manager for Manned Space Flight Support Operations.

Planned and contingency landing areas have been established. Planned areas are those where the probability of landing is sufficiently high to justify pre-positioning of recovery forces for support and recovery of crew and spacecraft within given access times.

- more -

Contingency areas are all other areas along the ground track where the spacecraft could possibly land. The probability of landing in a contingency area is sufficiently low that special search and rescue techniques will provide adequate recovery support.

There are four types of planned landing areas:

1. Primary Landing Area -- Landing will occur with normal termination of the mission after three orbits. This area is in the Atlantic Ocean, off Grand Turk Island in the West Indies, approximately 805 miles southeast of Cape Kennedy.

2. Secondary Landing Areas -- in Atlantic Ocean where a landing would occur if it is desirable to terminate the mission after the first or second orbit for any cause. Ships and aircraft will be stationed to provide support. Aircraft will be able to drop pararescue personnel and flotation equipment within one hour after spacecraft landing.

3. Launch Abort Landing Areas -- Along the launch ground track between Florida and Africa where landings would occur following aborts above 45,000 feet and before orbital insertion.

Surface ships with medical personnel and retrieval equipment, and search and rescue airplanes with pararescue personnel, flotation equipment and electronic search capability will be stationed in this area before launch. After the successful insertion of the spacecraft into orbit, some of the ships and planes will deploy to secondary areas to provide support on a later orbit, and the remainder will return to home stations.

4. Launch Site Landing Area -- Landing will occur following an abort during countdown, launch and early powered flight in which ejection seats are used. It includes an area of approximately 26 miles seaward and three miles toward the Banana River from Pad 19. Its major axis is oriented along the launch azimuth.

A specialized recovery force of land vehicles, amphibious craft, ships and boats, airplanes and helicopters will be stationed in this area from the time the astronauts enter the spacecraft until lift-off plus five minutes.

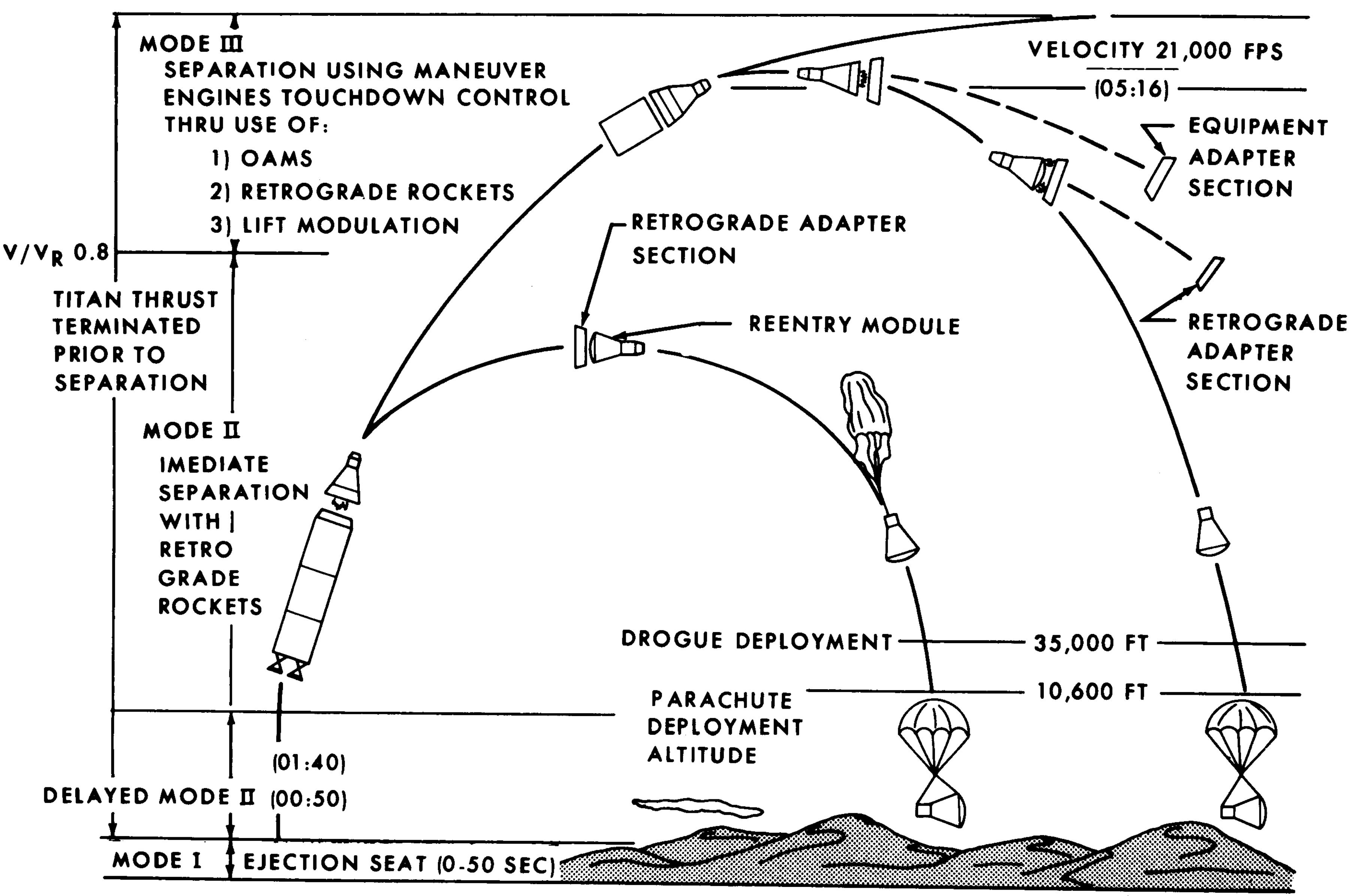
Recovery access time varies from 0 minutes for a water landing to 10 minutes for a land landing. The astronauts will be taken to the Patrick Air Force Base hospital for examinations after pickup.

Contingency Landing Areas:

Search and rescue aircraft equipped with electronic search equipment, pararescue men and flotation equipment will be staged along the ground and sea track so that the spacecraft will be located and assistance given to the astronauts within 18 hours after the recovery forces are notified of the probable landing position.

NASA-S-65-2333

ABORT MODES



SPACECRAFT LANDING SEQUENCE

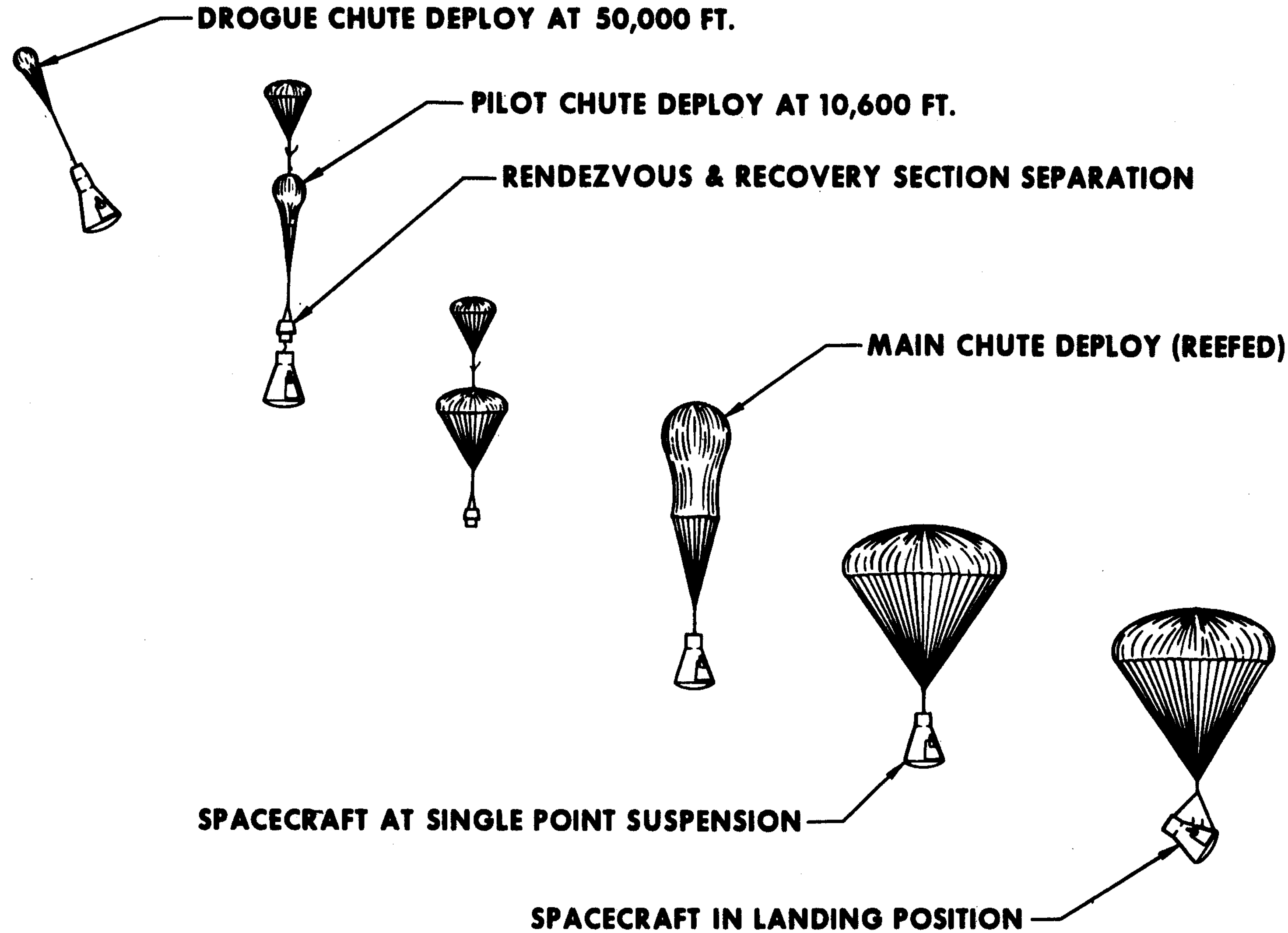


FIGURE 2.9-2

2-16-65

Manned Space Flight Tracking Network

Within weeks after the last manned Mercury mission (MA-9) in May 1963, work began on the $56-million program to reshape the network for Gemini's needs. Tracking network requirements for Gemini missions were quite different from and more demanding than those for Mercury.

Mercury flew one man in one capsule, the network was built with existing or "off-the-shelf" equipment and the spacecraft travelled in a fixed orbital path.

Gemini involves not only a two-man capsule but, on rendezvous missions, an Agena target vehicle; imposing a dual tracking requirement on the stations. Moreover, Gemini astronauts will be able to exercise considerable control over their orbital path and will, in long duration missions, subject airborne and ground systems to tremendous reliability strains. In terms of information to be handled the gear used in the Gemini network will be asked to absorb some 40 times the amount generated by Mercury. Gemini capsule measurements of 275 telemetry items alone are three times those of Mercury.

An industry team (comprised of ITT, Canoga, Bendix, Electro-Mechanical Research, RCA, IBM, AT&T, Collins Radio, Radiation, Inc., and UNIVAC) helped put the Gemini net "on line." By the spring of 1964 the equipments were installed, station staffs were trained and up to strength and the network was exercised by the Saturn I SA-6, GT-1, and Centaur AC-3 missions.

- more -

Some new equipment has been installed, some old equipment modified, a few stations have been dropped from the network, a few added. The most basic change in the network is its language. It has changed from an analog system to a digital system to acquire a data handling capability, a speed and precision which has already out-distanced Mercury's best.

The Manned Space Flight Network for Gemini is composed of tracking and data acquisition facilities around the world, a Mission Control Center at Cape Kennedy and a computing and communications center at Goddard Space Flight Center, Greenbelt, Md. (The Mission Control Center at Houston, Tex., when completed, will be used for many of the flight control and computing functions presently performed at the Mission Control Center, Cape Kennedy, and Goddard Space Flight Center.)

The basic network consists of seven primary land sites; two ships, the Rose Knot Victory and Coastal Sentry Quebec; six additional land stations; and the computing/communications and control centers.

The locations of the land stations are as follows:

Primary Stations	Additional Stations
Cape Kennedy, Fla., and downrange Air Force Eastern Test Range sites.	Kano, Nigeria *Madagascar (Tananarive)
Bermuda	Canton Island
Grand Canary Island	Point Arguello, Calif.
*Carnarvon, Australia	White Sands, N. M.
Hawaii	Eglin AFB, Fla.
Guaymas, Mexico	
Corpus Christi, Tex.	
Two Ships: The Rose Knot and Coastal Sentry	

Other tracking and data acquisition facilities, such as relay aircraft, instrumentation ships, communications, relay stations, etc., will be called up as required and integrated into the basic Network. Also considered part of the network is the Network Engineering and Training Center at Wallops Island, Virginia.

* The station at Muchea, Australia, has been deactivated as a result of the new station at Carnarvon. Also the Zanzibar station was removed and Tananarive, a STADAN station, is supporting in its place.

Network Responsibility

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

Goddard Space Flight Center (GSFC). NASA has centralized the responsibility for the planning, implementation, and technical operations of manned space flight tracking and data acquisition at the Goddard Space Flight Center. Hence, the GSFC has the responsibility for the technical operation of the Network for Gemini. 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.

Weapons Research Establishment (WRE). The WRE, Department of Supply, Commonwealth of Australia, is responsible for the maintenance and operation of the Network stations in 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, and the Air Proving Ground Center.

NASCOM. The entire network is supported by the NASA Communications Network. This Division, a Goddard responsibility, is responsible for the establishment and operation of the world-wide ground communications network that provides teletype voice, and data links between the stations and control centers for the network.

It links 89 stations, including 34 overseas points, with message, voice and data communications. Its circuits and terminals span 100,000 route miles and 500,000 circuit miles.

Also part of NASCOM is the voice communication net.

A sophisticated switchboard system, with multiple dual-operating consoles, enables one operator to devote full attention to any special mission conferences. This system is called SCAMA II (Station Conferencing and Monitoring Arrangement). SCAMA II can now handle 100 lines and can ultimately be expanded to handle 220 lines. Both point-to-point connections and conference arrangements are possible. All lines can be connected into one conference without loss of quality. The SCAMA operator can add conferees or remove them. He also controls which of the conferees can talk and which can listen only.

- more -

The SCAMA currently has 10 times the capability of the network used for Mercury.

One of the most critical functions the world-wide network must perform is that of obtaining data and making high-speed near-real-time computations. During a flight, the tracking data from the Manned Space Flight Network stations are sent via ground communications to the Goddard Space Flight Center, for processing. The development of an extensive computer program was required to handle the tracking data and to make critical computations for the so-called "go or no-go" and retrofire and reentry decision within milliseconds of tracking measurements. At the Goddard Computing Center, three IBM 7094 computers are installed. Two operate in parallel to accept position data in digital form directly from the stations and perform computations for each of the separate flight phases: the launch phase, the orbital phase, and the recovery phase. The other serves as a backup.

The Computing Center also houses various displays and plot board presentations for visual indication of capsule location, velocity, and status of certain critical capsule systems.

The number of people at Goddard, at the stations and at other support groups such as the training center and a logistics depot, totals some 1500 personnel for the entire network.

GT-3 TRACKING NETWORK CONFIGURATION AND STATION CAPABILITY

Stations	Mission Control Center	Merrit Island Launch Area	Ascension Island	Grand Bahama Island	Antigua	Bermuda	Grand Canary Island	Kano, Nigeria	Tananarive, Madagascar	Coastal Sentry, (Quebec)	Carnarvon, Australia	Kauai, Hawaii	Woomera, Australia	Range Tracker (Ship)	Canton Island, (Mid Pacific)	Rose Knot (Victory)	Point Arguello, California	Guaymas, Mexico	White Sands, New Mexico	Corpus Christi, Texas	Eglin Field, Florida	Grand Turk Island
Voice Communications	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Remote Air to Ground Voice Communications				X		X	X	X	X	X	X	X		X	X	X	X	X		X		X
Air to Ground Voice Communications	X			X			X			X	X	X			X	X		X		X		X
Flight Controller Manned	X						X			X	X	X				X		X		X		
High Speed Radar Data	X	X	X	X		X																X
Telemetry Communications	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
RF Command	X			X	X	X	X			X	X	X				X				X		X
Down Range Up Link	X			X	X	X																X
Digital Command System	X						X			X	X	X				X				X		
Gemini Launch Vehicle Command	X			X	X																	X
On Site Data Processor (1218)	X			X	X	X	X			X	X	X				X		X		X		X
Telemetry Real Time Display	X						X			X	X	X				X		X		X		
Telemetry Receiver & Recorder	X			X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Acquisition Aid	X			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C-Band Radar	X	X	X	X	X	X	X				X	X	X	X			X		X		X	X
S-Band Radar						X	X				X	X					X	X		X		

EXPERIMENTS

NASA has scheduled a series of scientific, biological and technological experiments for Project Gemini. These were first undertaken in Project Mercury and involve experiments submitted by NASA, the Department of Defense and the scientific community.

Reentry Communications

An object reentering the Earth's atmosphere from space generates extremely high temperatures. These temperatures ionize the air and create a plasma sheath which surrounds the object and effectively eliminates radio communications with it. Project Mercury manned space flights suffered loss of telemetry and voice communications during reentry.

Research has developed a method for restoring radio communications during this period. It has been determined that injecting fluid into the ionized plasma will decrease the amount of ionization to a level where communications are possible. The technique has been successful for objects with a maximum nose diameter of eight inches and at velocities up to approximately 18,000 feet per second (12,270 mph). This experiment is designed to establish whether the same technique can be applied to a large, blunt, high-velocity vehicle. The experiment was designed by the NASA Langley Research Center, Hampton, Va. and is sponsored by the NASA Office of Advanced Research and Technology. There are three experimenters, Theo Sims, W.F. Cuddihy, and L. C. Schroeder, all of Langley.

- more -

The GT-3 flight offers an opportunity for an engineering experiment under very practical conditions.

During the Gemini reentry, water will be injected in extremely brief, timed pulses at different flow rates into the ionized plasma sheath. Signal levels received will be monitored and recorded for use in evaluating the effectiveness of the different flow rates. For purposes of the experiment, telemetry signal measurements will be sufficient, and there will be no attempt to restore astronaut voice channel communications on this flight.

The experiment consists of a water expulsion system designed to fit on the inside surface of the spacecraft's right main landing gear door. The system is completely self-contained except for the experiment activation switch inside the cabin. Total weight of the equipment serviced for flight is approximately 85 pounds.

As the spacecraft reenters the Earth's atmosphere, the communications blackout will begin at approximately 300,000 feet. At a specified time after retro-fire the pilot (John Young) will flick a switch to start the experiment.

The switch will open a solenoid shut-off valve and allow nitrogen gas pressurization of the water storage tank. It will also start the mechanically run injection sequence timer. This will activate the injection nozzle solenoid valves at their programmed times to allow injection of water into the spacecraft flow field. The water supply will be exhausted in approximately 150 seconds.

Effects of Zero Gravity on the Growth of Sea Urchin Eggs

This experiment is designed to explore the possibility of the existence of a gravitational field effect on cells exposed to low gravity conditions. Cellular effects are more easily detectable in simple cell systems, and this experiment will investigate zero-gravity effects on sea urchin eggs during sensitive stages of development, such as fertilization and cell division. For comparison, a similar series of control samples will be developed simultaneously at the launch site.

The experiment consists of a metal cylinder containing eight separate samples of sea urchin eggs, sperm, and a fixative solution. The capsule is mounted inside the cabin on the left hatch.

At designated times, the eggs and the sperm will be united to start the fertilization and growth process. After a specified time, the fixative solution will be applied to the egg embryo to stop its growth. Rotation of a handle at one end of the cylinder activates either the fertilization or the fixation process. The actual sequence is prearranged by cylinder design.

The cylinder is 3 1/4 inches in diameter and 6 3/4 inches long. It weighs 25.4 ounces.

The experiment will be conducted by the NASA Ames Research Center. Dr. Richard S. Young of that Center is the experimenter. The sponsor is the NASA Office of Space Sciences.

Synergistic Effect of Zero Gravity and Radiation on White Blood Cells

This experiment will be conducted by the Atomic Energy Commission and is sponsored by the NASA Office of Space Sciences. Dr. Michael Bender of Oak Ridge National Laboratory is the experimenter.

The objective is to examine the biological effects of radiation. This is important because of possible radiation exposure during prolonged flights. The experiment will test the possibility that weightlessness interacts with radiation to produce unpredicted effects greater than the sum of their individual effects.

- more -

The experiment will measure the changes in human blood samples exposed to a known quantity and quality of radiation during the zero gravity phase of the mission. For comparison, a similar series of control samples will be exposed simultaneously at the launch site. An analysis also will be made on blood samples taken from the flight crew immediately before and after the mission.

The radiation source will be Phosphorus-32 an isotope which emits only a single beta particle with an average energy of 0.7 mev (million electron volts).

The experiment is housed in a hermetically sealed aluminum box 3.7 inches wide, 1.3 inches deep, 3.8 inches long. It weighs approximately one pound and is located on the right hatch inside the cabin.

Irradiation of the blood samples is initiated manually by twisting a handle on the box.

Cardiovascular Effects of Space Flight

This is a continuation of studies begun during Project Mercury to evaluate the effects of prolonged weightlessness on the cardiovascular system. Astronauts Schirra and Cooper experienced lower than normal blood pressure in the erect position immediately after emerging from the spacecraft.

The experiment will be conducted by the Space Medicine Branch of the Crew Systems Division of the Manned Spacecraft Center and is sponsored by the NASA Office of Manned Space Flight.

Comparisons will be made of the astronauts' preflight and postflight blood pressures, blood volumes, pulse rates, and electrocardiograms. The data will reveal the cardiovascular and blood volume changes due to heat stress, the effect of prolonged confinement, dehydration, fatigue, and possible effects of weightlessness. There are no inflight requirements.

Measurements will be taken before, during, and after a head-up tilt of 80 degrees from the horizontal.

The astronauts will remain in the spacecraft while it is hoisted aboard the recovery vessel. A portable biomedical recorder will be attached to each astronaut before he leaves the spacecraft, and blood pressure and electrocardiogram measurements will be taken. Each astronaut will then egress from the spacecraft and stand on the vessel's deck. Blood pressure and ECG measurements will be recorded automatically before, during, and for a short time after egress. The astronauts will then go to the ship's medical facility for the tilt table tests.

MEDICAL CHECKS

Medical checks will be based on biomedical telemetry and voice communications. This data will be used to evaluate general condition of the crew, blood pressure, and oral temperature.

PHOTOGRAPHY

A 70mm Hasselblad still camera and a 16mm motion picture camera will be available for general purpose photography.

FOOD EVALUATION

Evaluation of flight food packaging and handling is one of the tasks scheduled during the mission. One hour during the second orbit has been provided in the pilot's flight plan to verify food items for use in later Gemini missions.

Two meals of four items each will be aboard the spacecraft. Each meal will be contained in an aluminum foil laminated over-wrap. There will be two rehydrated items and two bite-size items to a meal, sugarless chewing gum, and a wet pack for cleansing hands and face.

The food will be stowed in a box on the left side of the Gemini cockpit. During the second orbit, the command pilot will transfer the meals to the pilot in the right seat who will evaluate each item.

- more -

The rehydrated items will be reconstituted by adding water with a special water gun developed by Manned Spacecraft Center engineers. When the gun is inserted into the nozzle on the food containers it can transfer water into the food without spilling. The bite size items do not need water.

They are coated to prevent crumbling. For cutting open the overwrap, and packaging around bit size items, the astronaut has a special pair of scissors, stowed in a pocket on the left leg of his suit.

After the pilot has reconstituted the food and sampled it, he will go through the food waste disposal procedure. In each package of the freeze-dried food, there is a yellow tablet of food disinfectant in a separate pouch. When it is placed in the food pouch, it acts chemically to prevent spoilage of the remaining food.

All products used during the flight must conform with stringent bacteriological requirements which are higher than normal industry requirements on commercially processed food.

The food formulation concept was developed by the U.S. Army Laboratories, Natick, Mass. Overall food procurement, processing, and packaging was performed by the Whirlpool Corp., St. Joseph, Mich. Principal food subcontractors are Swift and Co., Chicago, and Pillsbury Co., Minneapolis.

Meal A

Beef Pot Roast -- Freeze dried beef cubes in gravy. The item is in bar shape and weighs 27 grams. Formulated from a recipe of cooked diced beef, beef juices and water.

Orange Juice -- Contains 20.7 grams of orange juice crystals and 0.3 grams of orange oil granules. An instant product.

Meal B

Applesauce -- Commercially prepared instant powder. Weighs 42 grams and contains mixture of instant applesauce and instant apple juice.

Grapefruit Juice -- Commercially prepared instant powder. Weighs 21 grams.

Brownies -- Compressed into cubes with no special drying procedure. Has double coating of starch and gelatin. Contents include shortening, bitter chocolate, general purpose flour, chemical leavening, salt, whole fresh eggs, granulated sugar, vanilla flavoring, and midget pecans. Total weight of six cubes is 45 grams.

Chicken bits -- Six pieces, freeze dried. Total weight is 24 grams. Contains diced chicken, water, gravy mix, shortening, and minced onion.

- more -

GEMINI SURVIVAL PACKAGE

The Gemini survival package contains 14 items designed to support an astronaut if he should land outside normal recovery areas.

The package weighs 23 lbs. and has two sections. One section, holding a 3 1/2-pound water container and machete is mounted by the astronaut's left shoulder. The main package, containing the life raft and related equipment, is mounted on the back of the ejection seat. Both packages are attached to the astronaut's personal parachute harness by a nylon line. After ejection from the spacecraft, as the seat falls clear and the parachute deploys, the survival kit will hang on a line, ready for use as soon as the astronaut lands.

Inflated, the one-man life raft is five and one half ft. long and three ft. wide. A CO_2 bottle is attached for inflation. The raft is also equipped with a sea anchor, sea dye markers, and a sun bonnet of nylon material with an aluminized coating which the astronaut can place over his head.

In his survival kit, the astronaut also has a radio beacon, a combination survival light, sunglasses, a medical kit, and a desalter kit assembly. The combination survival light is a new development for the Gemini kit, combining many individual items which were carried in the Mercury kit.

About the size of a paperback novel, the CSL contains a strobe light for signaling at night, a flashlight, and a signal mirror built in on the end of the case. It also contains a small compass.

There are three cylindrical cartridges inside the case. Two contain batteries for the lights. The third contains a sewing kit, 14 feet of nylon line, cotton balls and a striker for kindling a fire, halazone tablets for water purification, and a whistle.

The desalter kit includes eight desalter brickettes, and a processing bag. Each brickette can desalt one pint of seawater.

The medical kit contains a one cubic centimeter injector for pain, and a two cubic centimeter injector for motion sickness. There also are stimulant, pain, motion sickness, and antibiotic tablets and aspirin.

The water container was manufactured at Manned Spacecraft Center by members of the Crew Systems Division. Other items were provided by the following contractors: machete, Case Knife Co., Bradford, Pa.; radio beacon, Sperry Co., Phoenix, Ariz.; sunglasses, Cool Ray Co., Houston, Tex.; combination survival light, ACR Electronics, New York City; medical kit injectors, Rodona Research Corp., Bethesda, Md.; desalter kit assembly, Department of Defense; life raft, Steinthal Co., New York City; CO_2 container, Arde Corp., Paramus, N.J.

GEMINI SPACECRAFT

The Gemini spacecraft is conical shaped and consists of two major assemblies, the reentry module and adapter section. It is 18 feet, 5 inches in length and 10 feet across at the base.

The reentry module is separated into three primary sections: (1) Rendezvous and recovery section (R&R). (2) Reentry control section (RCS); (3) Cabin section.

The R&R section is the forward section of the spacecraft and is attached to the RCS section. Radar equipment is not carried for this flight. Housed in this section are the drogue, pilot and main parachutes.

The RCS section, located between, and mated to, the R&R and cabin sections of the spacecraft. It contains the fuel and oxidizer tanks, valves, tube assemblies and thrust chamber assemblies (TCA). A parachute adapter assembly is on the forward face for main parachute attachment.

The cabin section houses the crew. It is located between the RCS and adapter sections. It will provide proper water flotation attitude. The shape also allows space between it and the outer conical shell for installation of equipment. The outer shell is covered with René 41 shingles with an ablative heat shielf on the blunt end for heat protection.

The adapter consists of a retrograde section and an equipment section. Retrograde rockets and part of the radiator for the cooling system are contained in the retrograde section. The equipment section holds batteries for electrical power, fuel for the orbit altitude and maneuver system, and the primary oxygen for the environmental control system.

The equipment section also serves as a radiator for the spacecraft's cooling system which is contained in the section.

The equipment section is jettisoned immediately prior to retrofire, and the retrograde section is jettisoned after retrofire.

The Gemini spacecraft provides 50 per cent more cabin space than the Mercury spacecraft. Gemini's reentry module is 11 feet high and 7 1/2 feet in diameter at its base, compared to nine feet high six feet in diameter for Mercury.

The Gemini equipment adapter is 7 1/2 feet high and 10 feet in diameter at its base.

Launch weight of the spacecraft is approximately 7,000 pounds. Landing weight of the reentry module is about 4,700 pounds.

Principal structural materials in the reentry module are titanium, with René 41 and beryllium used for shingles. The adapter is constructed mainly of magnesium.

Prime contractor for the Gemini spacecraft is McDonnell Aircraft Corp., St. Louis.

GEMINI LAUNCH VEHICLE

The Gemini Launch Vehicle is a modified Titan II consisting of two stages.

Stage I is 63 feet high, and stage II is 27 feet high. Diameter is 10 feet. Overall length of the launch vehicle including the spacecraft is 109 feet.

Launch weight, including the spacecraft is about 340,000 pounds.

- more -

PROPULSION SYSTEMS OAMS, RCS, RETRO LOCATION IN SPACECRAFT

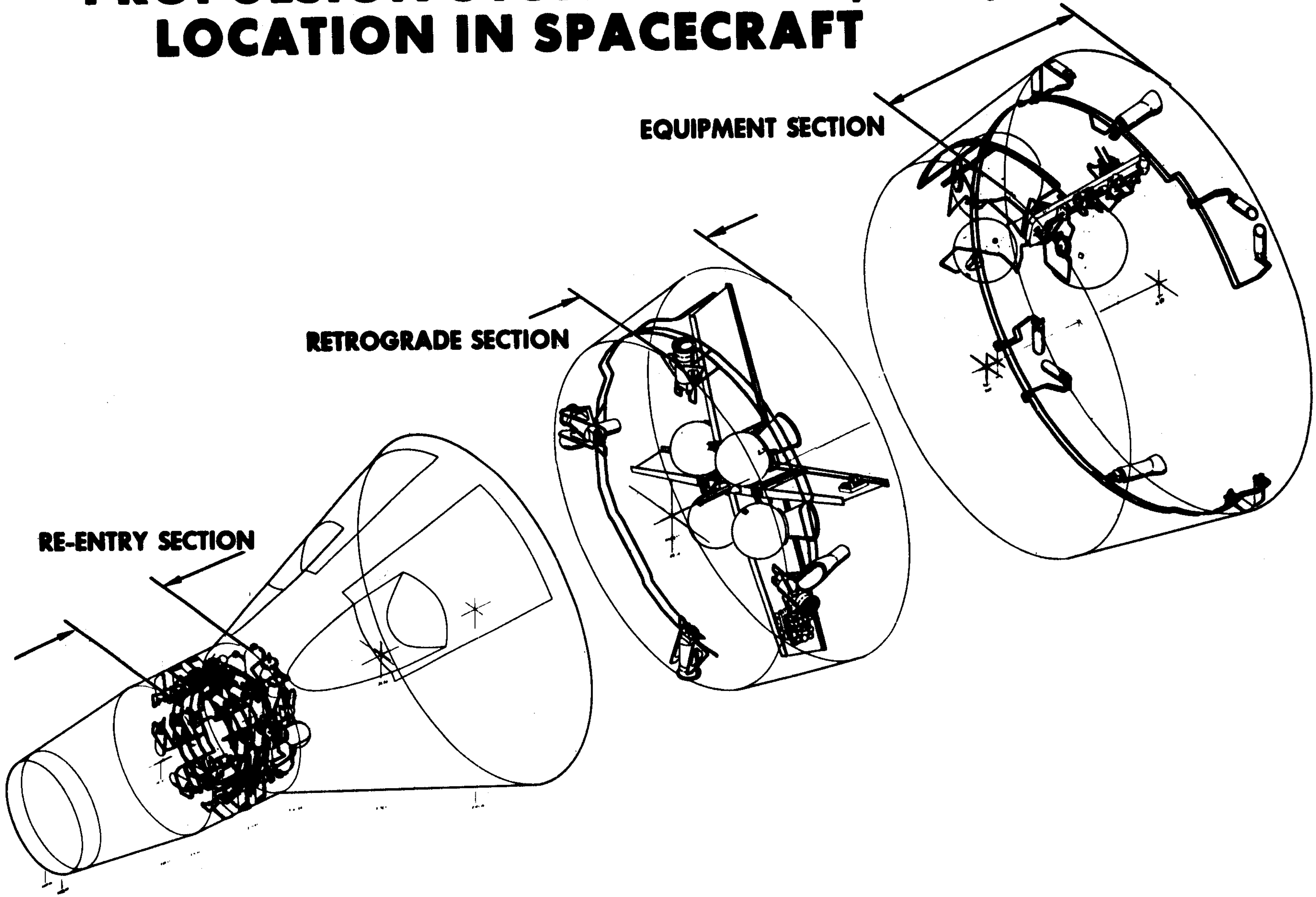
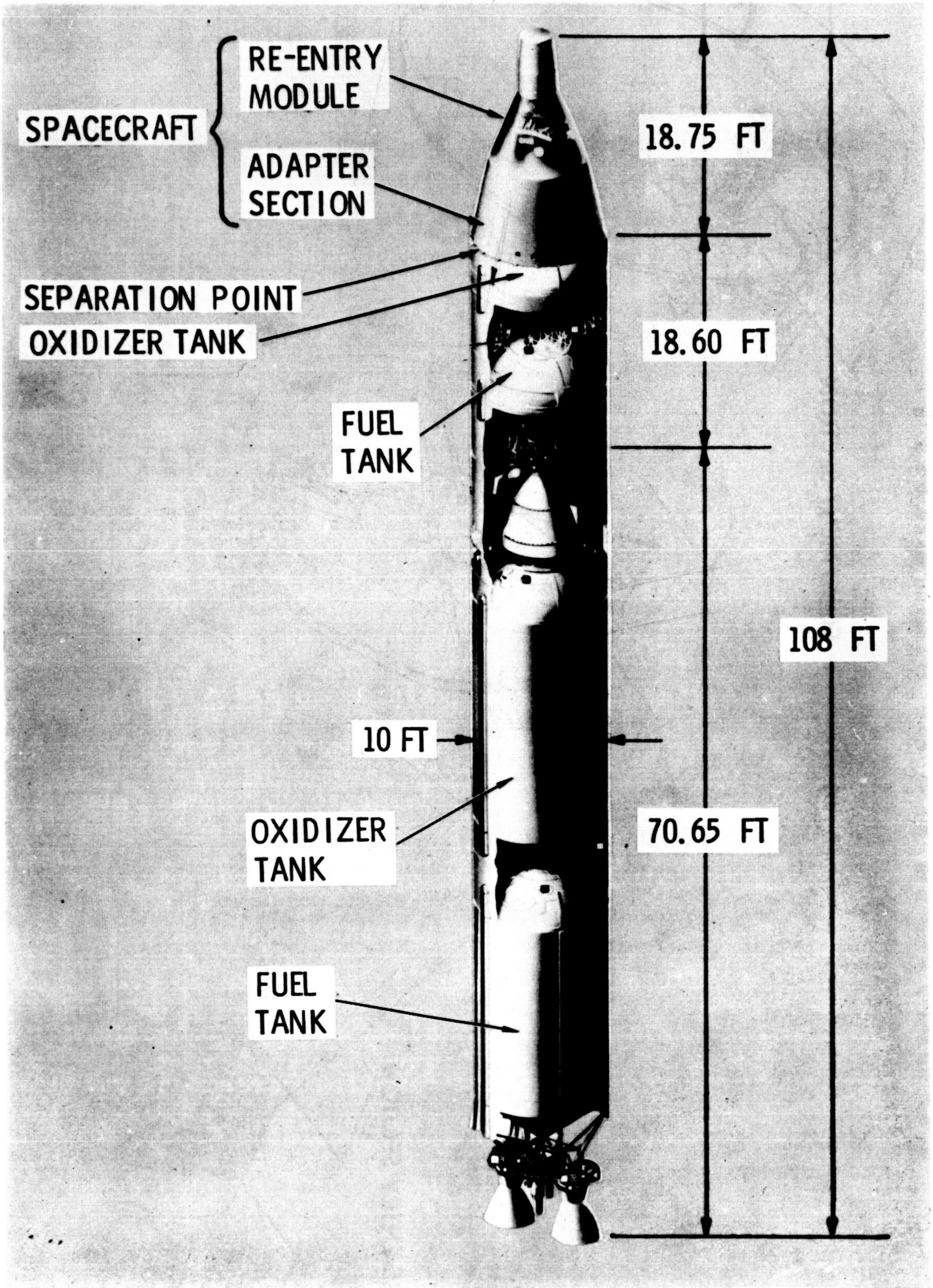


FIGURE 2.5-1

2-16-65

GEMINI LAUNCH VEHICLE



Propulsion is provided by two stage I and one stage II liquid propellant engines which burn a 50-50 blend of monomethyl hydrazine and unsymmetrical-dimethyl hydrazine as fuel, with nitrogen tetroxide as oxidizer.

Stage I engines produce about 430,000 pounds of thrust at lift-off, and the stage II engine produces about 100,000 pounds of thrust at altitude. Fuels are storable for easy handling and hypergolic (ignite on contact with each other), which eliminates the need for an ignition system.

Titan II was chosen for Gemini because of its simplified operation, thrust and availability. The following modifications were made:

a. Additions for a malfunction detection system.

b. Modifications of flight control system.

c. Modification of electrical system.

d. Substitution of radio guidance for inertial guidance.

e. Deletion of retro rockets and vernier bottles.

f. New stage II equipment truss.

g. New stage II forward oxidizer skirt assembly.

h. Simplification of trajectory tracking requirements.

i. Modification of hydraulic system.

j. Modification of instrumentation system.

GLV program management for NASA is under the direction of the Space Systems Division of the Air Force Systems Command. Contractors include: air frame and system integration, Martin, Baltimore (Md.) Division; propulsion systems, Aerojet-General Corp., Sacramento, Calif.; radio command guidance system, General Electric Co., Syracuse, N. Y.; ground guidance computer, Burroughs Corp., Paoli, Pa.; systems engineering and technical direction, Aerospace Corp., El Segundo, Calif.

GEMINI SPACE SUIT

The Gemini space suit which will be used on this mission was designed as a close fitting full pressure suit. The wearer can take off the helmet and gloves in flight. The remainder of the suit is designed for continuous wear. The communications system (earphones and microphones) is an integral part of the suit.

The inner layer of the suit is a rubberized material, and the outer covering is a nylon material.

Air inlet and outlet connections are located at waist level. Oxygen is provided from containers stowed in the spacecraft's adapter section. During reentry, after the adapter section has been jettisoned, astronauts use an oxygen supply located in the reentry module.

The gloves are attached to the suit at a rotating wrist joint which allows full wrist movement. A small battery pack and individual fingertip lights are mounted on each glove so that the astronauts can read instruments on the night side of the Earth while the cabin light is off.

A pocket is located on the inside of each leg between the ankle and knee. The left pocket contains a special pair of scissors for opening food packages, and the right pocket holds a parachute shroud line cutter. The cutter would be used after landing to prevent the astronaut from becoming entangled by parachute lines.

The astronaut dons the suit through a zipper opening which runs from the crotch up the entire back of the suit.

The suit has been developed by MSC's Crew Systems Division. Prime contractor is the David Clark Co., Worcester, Mass.

Each astronaut is provided with three suits. One is for training, the second is worn during the mission, and the third is a back-up.

- more -

CREW BIOGRAPHIES

NAME: Virgil I. "Gus" Grissom

BIRTHPLACE AND DATE: Mitchell, Ind., April 3, 1926

EDUCATION: Bachelor of Science degree in mechanical engineering from Purdue University

MARITAL STATUS: Married to the former Betty L. Moore of Mitchell, Ind.

CHILDREN: Scott, May 16, 1950; Mark, Dec. 30, 1953.

Grissom is a Major in the United States Air Force, and received his wings in March, 1951. He flew 100 combat missions in Korea in F-86's with the 334th Fighter-Interceptor Squadron. He left Korea in June 1952 and became a jet instructor at Bryan, Tex.

In August 1955, he entered the Air Force Institute of Technology at Wright-Patterson Air Force Base, Ohio, to study aeronautical engineering. In October 1956, he attended the Test Pilot School at Edwards Air Force Base, Calif., and returned to Wright-Patterson Air Force Base in 1957 as a test pilot assigned to the fighter branch.

Grissom has logged more than 4,000 hours flying time, including more than 3,000 hours in jet aircraft. He was awarded the Distinguished Flying Cross and the Air Medal with Cluster for service in Korea.

Grissom was named in April 1959 as one of the seven Mercury astronauts. He was the pilot of the Mercury-Redstone 4 (Liberty Bell 7) suborbital mission, July 21, 1961. This flight attained an altitude of 118 statute miles and traveled 302 miles downrange during the 15 minute and 37 seconds mission.

He is responsible for the Gemini group in the Astronaut Office, one of three organizational units in that office. (The others - Apollo and Operations).

He was awarded the NASA Distinguished Service Medal for his Mercury flight.

-more-

NAME: John W. Young

BIRTHPLACE AND DATE: San Francisco, Calif., Sept. 24, 1930

EDUCATION: Bachelor of Science degree in aeronautical engineering from Georgia Institute of Technology

MARITAL STATUS: Married to the former Barbara V. White of Savannah, Ga.

CHILDREN: Sandy, April 30, 1957; John, Jan. 17, 1959

Upon graduation from Georgia Tech, Young entered the United States Navy and is now a Lieutenant Commander in that service. From 1959 to 1962 he served as a test pilot, and later program manager of the F4H weapons systems project, doing test and evaluation flights and writing technical reports.

He served as maintenance officer for all-weather Fighter Squadron 143 at the Naval Air Station, Miramar, Calif. In 1962, Young set world time-to-climb records in the 3,000 meter and 25,000 meter events in the F4B Navy fighter.

He has logged more than 3,200 hours flying time, including more than 2,700 hours in jet aircraft.

Young was among the group of nine astronauts selected by NASA in September 1962. In addition to participation in the overall astronaut training program he has had specialized duties including monitoring development of environment control systems and spacecraft ejection seats and couches.

-more-

NAME: Walter M. Schirra, Jr.

BIRTHPLACE AND DATE: Hackensack, N. J., March 12, 1923

EDUCATION: Graduate of the United States Naval Academy

MARITAL STATUS: Married to the former Josephine Fraser of Seattle, Wash.

CHILDREN: Walter M. III, June 23, 1950; Suzanne, Sept. 29, 1957

Schirra, a Navy Commander, received flight training at Pensacola, Naval Air Station.

As an exchange pilot with the United States Air Force, 154th Fighter Bomber Squadron, he flew 90 combat missions in F-84E aircraft in Korea and downed one MIG with another probable. He received the Distinguished Flying Cross and two Air Medals for his Korean service.

He took part in the development of the Sidewinder missile at the Naval Ordnance Training Station, China Lake, Calif. Schirra was project pilot for the F7U3 Cutlass and instructor pilot for the Cutlass and the FJ3 Fury.

Schirra flew F3H-2N Demons as operations officer of the 124th Fighter Squadron onboard the Carrier Lexington in the Pacific.

He attended the Naval Air Safety Officer School at the University of Southern California, and completed test pilot training at the Naval Air Center, Patuxent River, Md. He was later assigned at Patuzent in suitability development work on the F4H.

- more -

He has more than 3,800 hours flying time, including more than 2,700 hours in jet aircraft.

Schirra was one of the seven Mercury astronauts named in April 1959.

On Oct. 3, 1962, Schirra flew a six-orbit mission in his "Sigma 7" spacecraft. The flight lasted nine hours and 13 minutes from liftoff through landing and he attained a velocity of 17,557 miles per hour, a maximum orbital altitude of 175 statute miles and a total range of almost 144,000 statute miles. The impact point was in the pacific Ocean, about 275 miles northeast of Midway Island. He was awarded the NASA Distinguished Service Medal for his flight.

- more -

NAME: Thomas P. Stafford

BIRTHPLACE AND DATE: Weatherford, Okla., Sept. 17, 1930

EDUCATION: Bachelor of Science degree from United States Naval Academy

MARITAL STATUS: Married to the former Faye L. Shoemaker of Weatherford, Okla.

CHILDREN: Dianne, July 2, 1954; Karin, Aug. 28, 1957

Stafford, an Air Force Major, was commissioned in the United States Air Force upon graduation from the U.S. Naval Academy at Annapolis. Following his flight training, he flew fighter interceptor aircraft in the United States and Germany, and later attended the United States Air Force Experimental Flight Test School at Edwards Air Force Base, Calif.

He served as Chief of the Performance Branch, USAF Aerospace Research Pilot School at Edwards. In this assignment he was responsible for supervision and administration of the flying curriculum for student test pilots. He also served as an instructor in both flight test training and specialized academic subjects. He established basic textbooks and participated in and directed the writing of flight test manuals for use by the staff of students.

Stafford is co-author of the Pilot's Handbook for Performance Flight Testing and Aerodynamics Handbook for Performance Flight Testing.

- more -

He has logged more than 4,300 hours flying time, including more than 3,600 hours in jet aircraft.

Stafford was one of the nine astronauts named by NASA in September 1962. In addition to participating in all phases of the astronaut training program, he has added specific assignments including monitoring design and development of communications and instrumentation systems, insuring that onboard systems are compatible with pilot needs and properly integrated with Mission Control Center systems, the ground operational support system and other communication links.

- more -