# NEWS RELEASE

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## MERCURY-ATLAS 6 AT A GLANCE

MISSION -- Manned orbital flight to (1) evaluate the performance of a man-spacecraft system; (2) investigate man's capabilities in the space environment; (3) obtain the pilot's opinions on the operational suitability of the spacecraft and supporting systems for manned space flight.

LAUNCH DATE -- The flight currently is scheduled no earlier than January 24, 1962. On whatever day, the launch will be attempted between 7:30 a.m. and 12:30 p.m. and may "slip" on a day-to-day basis as required. Launch timing will be planned to provide at least three hours of daylight search time in the probable recovery areas.

FLIGHT DURATION -- Depending on literally thousands of variables, the Mercury Operations Director (Manned Spacecraft Center Associate Director Walter C. Williams) may elect a one, two or three-orbit mission. That decision will be made only minutes before launch and may be changed at any time during the mission. Recovery after one full orbit is planned for about 500 miles east of Bermuda; after two orbits, some 500 miles south of Bermuda; three orbits, about 800 miles southeast of Cape Canaveral, Fla. Each orbit takes about 90 minutes, carrying the craft between 100 and 150 miles altitude, 32 degrees north and south of the equator.

If the mission ends after orbit one or two, the astronaut will be moved to the Kindley Air Force Base Hospital in Bermuda for a 48-hour rest and debriefing. If the mission goes a full three orbits, he will be flown to Grand Turk Island (Bahamas) for a similar operation before being returned to the mainland.

PILOT -- Astronaut John H. Glenn, Jr., 40. A lieutenant colonel in the United States Marine Corps, Glenn has been with NASA for three years on a detached duty basis. Backup pilot for this flight is Astronaut M. Scott Carpenter, 36. (See biographies).

SPACECRAFT -- Bell-shaped, the MA-6 craft -- listed as No. 13 in engineering documents and named "Friendship 7" by Astronaut Glenn -- stands 9½ feet high and measures 6 feet across the base. Spacecraft weight at launch will be about 4,200 pounds; spacecraft weight in orbit (after jettisoning of escape tower) -- 3,000 pounds; on-the-water recovery weight -- 2,400 pounds. Prime contractor for the spacecraft is McDonnell Aircraft Corp. of St. Louis, Mo.

LAUNCH VEHICLE -- A modified Atlas D is used to launch orbital Mercury missions, reaching a speed of 17,500 miles per hour. At launch, booster and spacecraft stand 93 feet tall, including a 16-foot tower above the spacecraft. The tower contains a solid propellant rocket hooked to an abort sensing system. Should trouble develop on the launch pad or in the early boost phase of the mission, the escape system will be triggered -- automatically or by the pilot or from the ground -- to pull the spacecraft away from the booster. The booster is manufactured by the Astronautics Division of General Dynamics Corp.

NETWORK -- The Mercury Tracking Network consists of 18 stations around the world, including two ships, one on the equator in the Atlantic off the coast of Africa and the other in the Indian Ocean. Some 500 technicians man these stations, all of which are in radio or cable communication with the Mercury Control Center at the Cape via the NASA Goddard Spaceflight Center at Greenbelt, Md.

RECOVERY -- More than 20 ships will be deployed in the Atlantic alone to take care of prime and contingency recovery areas. Recovery forces are under the command of Rear Admiral John L. Chew, Commander of Destroyer Flotilla Four. In addition, ships and rescue planes around the world will go into action in the event of an emergency landing. More than 15,000 men will have a hand in the recovery, search and rescue effort.

RESPONSIBILITIES -- Project Mercury, the nation's first manned space flight research project, was conceived and is directed by the National Aeronautics and Space Administration, a civilian agency of the government charged with the exploration of space for peaceful and scientific purposes. Technical project direction for Mercury is supplied by NASA's Manned Spacecraft Center, directed by Robert R. Gilruth at Langley Field, Va., and soon to move to Houston, Texas. The Department of Defense, largely through the Air Force and Navy, provides vital support for Mercury. DOD support is directed by Major General Leighton I. Davis, USAF, Commander of the Atlantic Missile Range. In all, more than 30,000 persons will have a part in this mission, including government and industry.

PROJECT COST -- Total Project Mercury cost through orbital flight is estimated at $400 million. About $160 million will have gone to the prime spacecraft contractor, McDonnell and its subcontractors and suppliers; $95 million for the network operations; $85 million for boosters, including Atlases, Redstones and Little Joes; $25 million for recovery operations and roughly $35 million for supporting research in diverse areas.

MISSION PILOT TASKS -- The MA-6 pilot will perform many control tasks during flight to obtain maximum data on spacecraft performance, his own reactions to weightlessness and stress, and to study the characteristics of the earth and stars from his vantage point over 100 miles above the earth's surface.

The Astronaut will participate actively during the flight. This will include the following tasks:

(1) Manage the operation of all spacecraft systems, particularly the attitude control system, electrical system, environmental control system, and communications systems.

(2) Observe and correct any discrepancies in system operation. Discrepancies will be correlated with telemetered observations received at ground stations.

(3) Monitor critical events during launch, and terminate the mission if necessary.

(4) Maintain a complete navigation log during flight which will enable him to compute his retro-fire time if ground communications should fail. This onboard navigation will include periscope ground sightings which indicate position over ground and altitude.

(5) Ground communications to receive updated retro-fire information, and receive detailed detailed behavior of spacecraft systems as determined from ground telemetry.

(6) Evaluate his physical condition to augment the biomedical data which are telemetered to the ground.

About every 30 minutes, the pilot will make detailed voice reports on spacecraft systems and operations conditions. His own transmissions will include critical information as mode of control, precise attitude, planned retro-fire time, control system fuel, oxygen, and coolant.

## MISSION PROFILE

POWERED FLIGHT -- The manned Mercury spacecraft will be launched atop an Atlas from Cape Canaveral following a two-day split countdown. Technical conditions or weather could, of course, delay the launch from minutes to days.

According to the flight plan, the spacecraft will be launched on a path along the Project Mercury World-wide Tracking Range on a launch heading of about 72 degrees -- just north of east from Cape Canaveral.

An internal programmer in the Atlas will guide the vehicle from liftoff until staging occurs. All of the Atlas liquid-propellant engines are ignited before lift-off.

At staging, about two minutes after lift-off, the two booster engines will drop off and the sustainer and vernier engines will continue to accelerate the vehicle. Staging occurs at an altitude of about 40 miles and a range of about 45 miles from the launch pad.

During the first 2½ minutes of flight, an electronic brain, called the Abort Sensing and Implementation System (ASIS) is capable of sensing impending trouble in the rocket and triggering the escape rocket. The astronaut can also trigger the Mercury escape rocket to pull the spacecraft away from the Atlas.

About 20 seconds after staging, and assuming the flight is proceeding as planned, the 16-foot escape tower and rocket will be jettisoned. Landing systems will be armed. The Mercury-Atlas vehicle will continue to accelerate toward the orbit insertion point guided by ground command guidance.

Until orbital insertion, the abort sensing system will continue to watch for trouble. If significant deviation should occur, the system will actuate circuits to release the spacecraft-to-Atlas clamp ring and fire the posigrade rockets on the base of the spacecraft.

About five minutes after lift-off, guidance ground command will shut down the sustainer and vernier engines. As the engines shut down, the spacecraft-to-booster clamp ring is released automatically and posigrade rockets are fired to separate the craft from the Atlas.

ORBITAL INSERTION -- After a few seconds of automatic damping - getting rid of any unusual motions - the spacecraft will swing 180 degrees so that the blunt face of the craft is turned forward and upward 34 degrees above the horizontal. From that point on during orbital flight, the spacecraft can be controlled in proper attitude automatically or manually by the pilot.

If all goes well, the Mercury spacecraft will be inserted into orbit in the vicinity of Bermuda. By that time the vehicle will be at an altitude of approximately 100 miles and traveling at a speed of about 17,500 miles per hour. At engine cut-off, the craft will have been subjected to more than 7½ "G". Reentry "G" will also reach 7½.

A three-orbit flight will last approximately 4 3/4 hours; a two-orbit flight, 3¼ hours; one orbit, 1 3/4 hours. The Mercury craft will reach a peak altitude (apogee) of about 150 statute miles off the West Coast of Australia and a low point (perigee) of 100 miles, at the insertion point near Bermuda.

REENTRY -- After the desired number of orbits, as the spacecraft approaches the West Coast of North America, retro or braking rockets will be fired to initiate reentry.

Shortly after the retrorockets are fired, the exhausted rocket package will be jettisoned and the spacecraft automatically will assume reentry attitude. "Friendship 7" will begin to encounter more dense atmosphere of the Earth approximately over the east coast at an altitude of about 55 miles. At this point, temperatures will start mounting on the spacecraft's ablation heat shield.

On a nominal mission, peak reentry temperature of about 3,000 degrees F. will occur at 25 miles altitude while the spacecraft is moving at nearly 15,000 miles per hour. All told, the craft will sustain temperatures in this neighborhood for about two minutes.

Almost coincident with the heat pulse is a dramatic reduction in capsule speed. Between 55 miles and 12 miles altitude - covering a distance of 760 miles - spacecraft velocity should go from 17,500 miles per hour down to 270 miles per hour in a little over five minutes.

At about 21,000 feet, a six-foot diameter drogue parachute will be opened to stabilize the craft. At about 10,000 feet, a 63-foot main landing parachute will unfurl from the neck of the craft.

On touchdown, the main chute will be jettisoned. On-board electrical equipment will be shut down, and location aides will be activated.

RECOVERY -- Several new recovery techniques will be tried operationally for the first time in MA-6. If all's well, the astronaut, on leaving the craft via the neck or the side hatch, should be greeted by two frogmen who by that time will have cinched a new flotation belt around the base of the craft. This is to add to the craft's seaworthiness.

Plans call for the frogmen to leap into the water with the quick-inflating belt from one of several recovery helicopters staged off aircraft carriers in the three prime recovery zones. As soon as they have secured the three-foot-high belt, the astronaut will emerge, grab a "horse collar" lift from a hovering helicopter and be whisked up into the copter and to a nearby carrier.

Meanwhile, a smaller ship is to go along side the spacecraft and hoist it onto its deck for transfer to the carrier or direct delivery to the Cape.

# THE MA-6 MERCURY SPACECRAFT

The MA-6 spacecraft is similar to those used in previous Mercury flights. About as big as a phone booth, the interior looks much like the cockpit of a high-performance airplane - only smaller.

Here are some of the major items confronting the pilot:

Instrument Panel - Instruments are located on a main instrument panel, a left console, and a right console. The main panel a left console, and a right console. The main panel is directly in front of the pilot. Navigational and control instruments are located in the left and center sections of the panel and the periscope is located in the center. The right section of the main panel is composed of environmental system gauges and controls, electrical switches, indicators and communication system controls.

Rate Stabilization and Control - Attitude of the Mercury spacecraft is changed by the release of short bursts of superheated steam (hydrogen peroxide) from 18 thrust nozzles located on the conical and cylindrical portions of the craft's surface. Timing and force of these bursts are controlled by one of the following: (1) Automatic Stabilization and Control System (ASCS), or "Auto-Pilot"; (2) Rate Stabilization and Control System (RSCS), or "Rate Command" System (3) the Manual Proportional Control System, a manual-mechanical system, and (4) the Fly-By-Wire (FBW), a manual-electrical system.

The left console includes sequencing telelights and a warning panel, indicators and controls for the spacecraft's automatic pilot (ASCS), environmental control and landing systems. Altogether, there are over 100 lights, fuses, switches and miscellaneous controls and displays.

Cameras- A 16mm camera is installed to the left of the astronaut's head to photograph the instrument panel display from launch through recovery. A pilot observer camera is mounted in the main instrument panel and wil also be operated from launch through recovery.

Periscope - An earth periscope is located approximately two feet in front of the pilot and will provide a 360-degree view of the horizon. The pilot may manually adjust for "low" or "high" magnification. On "low" he will have a view of the Earth of about 1,900 miles in diameter - in "high" the field of view will be reduced to about 80 miles. Altitude can be measured within plus or minus 10 nautical miles. The Mercury-Earth periscope will, in addition, serve as a navigational aid.

Pilot Support Couch - The astronaut's couch is constructed of a crushable honeycomb material bonded to a fiberglass shell and lined with rubber padding. Each astronaut has a flight couch contoured to his specific shape. The couch is designed to support the pilot's body loads during all phases of the flight and to protect him from acceleration forces of launch and reentry.

Restraint System - The restraint system, which consists of shoulder and a chest strap, leg straps, crotch strap, lap belt and toe guards, is designed to keep the astronaut in the couch during maximum deceleration.

Environmental Control System - The environmental control system provides the MA-6 spacecraft cabin and the astronaut with a 100-percent oxygen environment to furnish breathing, ventilation, and pressurization gas required during flight. The system is completely automatic, but in the event the automatic control fails, emergency controls can be used.

The system consists of two individual control circuits (the cabin circuit and the suit circuit), which will normally operate for about 28 hours. Both systems are operated simultaneously. The suit circuit is isolated from the cabin circuit by the astronaut closing the face-plate on his helmet. Unless there is a failure in the cabin circuit causing loss of pressure, the pilot's pressure suit will not be inflated.

Aeromedical Information - Throughout the flight, the physical well-being of the pilot will be monitored. The pilot's respiration rate and depth, electrocardiogram and body temperature will be telemetered to flight surgeons on the ground.

Pilot Communications - The MA-6 astronaut may remain in touch with the ground through the use of high-frequency and ultra-high-frequency radios, radar recovery beacons, and if the situation dictates, a command receiver or a telegraph code key.

Main battery system - Three 3,000 watt-hour batteries and one 1,500 watt-hour battery are connected in parallel to provide power for the complete mission and about a 12 hour post-landing period. A standby backup power system of 1,500 watt-hour capacity is also provided. To further insure reliable operation of the pyrotechnic system, each device has a completely isolated power feed system.

Retro-fire Timer - There will be a timer in the MA-6 spacecraft with three major separate operational components, (1) a standard aircraft elapsed time clock, (2) a "seconds from launch" digital indicator with a manual reset, and (3) a resettable timer and time-delay relay which will initiate the retrograde fire sequence. When the preset time has passed, the relay closes and actuates the retrograde fire signal, at the same time sending a telemetered signal to the ground.

Altimeter - The Mercury barometer altimeter is a single-revolution indicator with a range from sea level to 100,000 feet. The dial face has reference marks at the drogue and main parachute deployment altitudes.

At the top right corner of the main panel are located environmental displays, providing the pilot with indications of cabin pressure, temperature, humidity, and oxygen quantity remaining.

Food, Water, and Waste Storage -"Friendship 7" will carry about 3,000 calories of food - beef and mixed vegatables - and about six pounds of water. The water will be in two flat bottles, each fitted with a tube. The food is in two tubes, about the size of tooth paste tubes. In addition, there will be some quick-energy sugar tablets.

Survival Equipment - The survival package will consist of a on man life raft, desalting kit, shark repellant, dye markers, first aid kit, distress signals, a signal mirror, portable radio, survival rations, matches, a whistle, and ten feet of nylon cord.

A new lightweight, radar-reflective life raft is fabricated of Mylar (for air retention) and nylon (for strength). The three-pound, four-ounce raft features three water ballast buckets for flotation stability and a deflatable boarding end which may be reinflated by an oral inflation tube following boarding. The raft, made of the same material used in the Echo satellite balloon, is international orange.

Pilot's Map - A small cardboard diagram of the MA-6 flight path with recovery forces indicated is contained within a bag suspended beneath the periscope. On the reverse side, the pilot's view through the periscope from maximum altitude is shown. Last minute information on cloud formations and weather phenomena will be marked by Mercury weather experts.

Hatch - The MA-6 spacecraft is equipped with a hatch secured by explosive bolts, just as the pilot's canopy is secured in a high performance aircraft. The astronaut can jettison the hatch by pushing a plunger button inside the spacecraft or by pulling a cable. The hatch may also be removed by recovery teams.

Cylindrical Neck Contents - Above the astronaut's cabin, the cylindrical neck section contains the main and reserve parachute system.

Three parachutes are installed in the spacecraft. The drogue chute has a six-foot-diameter, conical, ribbon-type canopy with approximately six-foot long ribbon suspension lines, and a 30-foot-long riser made of dacron to minimize elasticity effects during deployment of the drogue at an altitude of 21,000 feet. The drogue riser is permanently attached to the capsule antenna by a three point suspension system terminating at the antenna in three steel cables, which are insulated in areas exposed to heat.

The drogue parachute is packed in a protective bag and stowed in the drogue mortar tube on top of a light-weight sabot. The sabot functions as a piston to eject the parachute pack, when pressured from below by gasses generated by a pyrotechnic charge.

The function of the drogue chute is to provide a backup stabilization device for the spacecraft in the event of failure of the Reaction Control and Stabilization System. Additionally, the drogue chute will serve to slow the capsule to approximately 250 feet per second at the 10,000 foot altitude of main parachute deployment.

The reserve chute is identical to the main chute. It is deployed by a flat circular-type pilot chute.

Other components of the landing system include drogue motor and cartridge, radar chaff, barostats, antenna fairing ejector, sea marker packet, and two underwater charges - one attached to and deployed by the antenna lanyard and the other fixed to the spacecraft.

Following escape tower separation in flight, the 21,000 and 10,000 foot barostats are armed. No further action occurs until the capsule descent causes the 21,000 foot barostat to close and activate power to the drogue mortar which ejects the drogue as well as the radar chaff - loosely packed under the drogue chute - to provide a target for radar location.

Two seconds after the 10,000 foot barostat closes, power is supplied to the antenna fairing ejector - located above the cylindrical neck section - to deploy the main landing parachute and an underwater charge, which is dropped to provide an audible sound landing point indication. The ultra-high frequency SARAH radio then begins transmitting. A can of sea-marker dye is deployed with the reserve chute and remains attached to the spacecraft by a lanyard.

On landing, an impact switch jettisons the landing parachute and initiates the remaining location and recovery aids. This includes release of sea-marker dye with the reserve parachute if it has not previously been deployed, triggering a high-intensity flashing light, extension of a 16-foot whip antenna and the initiation of the operation of a high-frequency radio beacon.

If after landing, the spacecraft should spring a leak or if the life support system should become fouled after landing, the astronaut can escape through this upper neck section or through the side hatch.

Impact Skirt - Following deployment of the main landing parachute, the heat shield is released, extending the landing-impact bag to form a pneumatic cushion primarily for impact on land, it is also required for capsule stability after water landings.

The air cushion is formed by a four-foot skirt made of rubberized fiberglas that connects the heat shield and the rest of the capsule. After the main parachute is deployed, the heat shield is released from the capsule and the bag fills with air. Upon impact, air trapped between the heat shield and the capsule is vented through holes in the skirt as well as portions of the capsule which are not completely air tight, thereby providing the desired cushioning effect.

## THE ATLAS LAUNCH VEHICLE

The launch vehicle to be used for the Mercury-Atlas 6 test is an Atlas D model, one of several Atlases especially modified for use in the Mercury flight test program. This vehicle develops 360,000 pounds of thrust and burns Rp-1, a kerosene-like fuel, and liquid oxygen.

Principle differences in the Mercury-Atlas and the military version of the vehicle include: (1) modification of the payload adapter section to accommodate the Project Mercury spacecraft, (2) structural strengthening of the upper neck of the Atlas to provide for the increase in aerodynamic stress imposed on the Atlas when used for Mercury missions, and (3) inclusion of an automatic Abort Sensing and Implementation System (ASIS) designed to sense deviations in the performance of the Atlas and trigger the Mercury Escape System before an impending catastrophic failure.

The Atlas measures 65 feet from its base to the Mercury adapter section and is 10 feet in diameter at the tank section. With adapter section, spacecraft and escape tower, the Mercury-Atlas stands 93 feet tall.

The Atlas is constructed of thin-gage metal and maintains structural rigidity through pressurization of its fuel tanks. For this flight, the Atlas will have a heavier gage skin at the forward end of the liquid oxygen tank, the same as that used in other launches of Atlas space systems.

All five engines are ignited at the time of launch - the sustainer (60,000 pounds thrust), the two booster engines (150,000 pounds thrust each) which are outboard of the sustainer at the base of the vehicle and two small vernier engines which are used for minor course corrections during powered flight. During the first minute of flight, it consumes more fuel than a commercial jet airliner during a transcontinental run.

## ASTRONAUT PARTICIPATION

All seven of Project Mercury's team of astronauts will participate in the MA-6 orbital mission, some as flight controllers from far-flung vantage points around the globe.

Astronauts John H. Glenn, Jr., prime pilot, M. Scott Carpenter, back-up pilot, and Alan B. Shepard, Jr., technical advisor, will be at Cape Canaveral. Astronaut Walter M. Schirra, Jr. will be stationed at the Mercury site at Pt. Arguello, California, and Astronaut L. Gordon Cooper, Jr. will participate from the Mercury tracking station in Muchea, Australia. Astronaut Virgil I. "Gus" Grissom will monitor launch, insertion, landing, and recovery from Mercury's Bermuda station, while Donald K. Slayton will perform spacecraft checkout prior to insertion of the mission pilot.

## THE NETWORK

World-wide Mercury Tracking Stations, including ships in the Indian and Atlantic Oceans, will monitor the MA-6 flight. The Space Computing Center of the NASA Goddard Space Flight Center in Greenbelt, Maryland, will make trajectory computations.

During the flight, information will pour into the Space Computing Center from tracking and ground instrumentation points around the globe at the rate, in some cases, of more than 1,000 bits per second. Upon almost instantaneous analysis, the information will be relayed to the Cape for action.

In addition to proving man's capability for surviving in and performing efficiently in space - and since only two other flights have been made along the world-wide tracking network - the test will further evaluate the capability of the network to perform tracking, data-gathering, and flight control functions.

The Mercury network, because of the man factor, demands more than any other tracking system. Mercury missions require instantaneous communication.

Tracking and telemetered data must be collected, processed, and acted upon in as near "real" time as possible. The position of the vehicle must be known continuously from the moment of lift-off.

After injection of the Mercury spacecraft into orbit, orbital elements must be computed and prediction of "look" information passed to the next tracking site so the station can acquire the capsule.

Data on the numerous capsule systems must be sent back to Earth and presented in near actual time to observers at various stations. And during the recovery phase, Spacecraft impact location predictions will have to be continuously revised and relayed to recovery forces.

An industrial team headed by Western Electric Company recently turned over this $60 million global network to the National Aeronautics and Space Administration.

Other team members are Bell Telephone Laboratories, Inc.; the Bendix Corporation; Burns and Roe, Inc.; and International Business Machines Corporation. At the same time, the Lincoln Laboratory of Massachusetts Institute of Tecnnology also has advised and assisted NASA on special technical problems relating the network.

Concluding contract involved extensive negotiations with Federal agencies, private industry, and representatives of several foreign countries in the establishment of tracking and ground instrumentation.

The network consists of 18 stations. The system spans thr continents and three oceans, interconnected by a global communications network. It utilizes land lines, undersea cables and radio circuits, and special communications equipment installed at commercial switching stations in both the Eastern and Western hemispheres.

The project includes buildings, computer programming, communications and electronic equipment, and related support facilities required to direct, monitor, and provide contact with the nation's orbiting Project Mercury astronaut.

Altogether, the Mercury system involves approximately 60,000 route miles of communications facilities to assure an integrated network with world-wide capability for handling satellite data. It comprises 140,000 actual circuit miles - 100,000 miles of teletype, 35,000 miles of telephones, and over 5,000 miles of high-speed data circuits.

Sites linked across the Atlantic are: Cape Canaveral, Grand Bahama Island, Grand Turk Island, Bermuda, Grand Canary Island, and a specially fitted ship in Mid-Atlantic.

Other stations in the continental United States are at Pt. Arguello in Southern California; White Sands, New Mexico; Corpus Christi, Texas; and Eglin, Florida. One station is located on Kauai Island in Hawaii.

There are two radar picket ships. The Atlantic Ship Rose Knot will be stationed on the equator near the West African coas The Indian Ocean Ship Coastal Sentry will be located midway between Zanzibar and Muchea, Australia.

Stations at overseas sites include one on the south side of Grand Canary Island, 120 miles west of the African Coast; Kano, Nigeria, in a farming area about 700 rail miles inland; Zanziba an island 12 miles off the African coast in the Indian Ocean; two in Australia - one about 40 miles north in Perth, near Muchea, and the other near Woomera; Canton Island, a small coral atoll about halfway between Hawaii and Australia;: one in Mexico near Guaymas on the shore of the Gulf of Mexico; and one in Bermuda, an independent, secondary control center.

Some 20 private and public communications agencies throughout the world provided leased land lines and overseas radio and cable facilities.

Site facilities include equipment for acquiring the spacecraft; long range radars for automatic tracking; telemetry equipment for receiving data on the spacecraft and the astronaut; command control equipment for controlling the manned vehicle from the ground, if necessary, and voice channels for ground-to-air communications. The extensive ground communications system interconnects all stations through Goddard and the Mercury Cont at Cape Canaveral.

Sites equipped with tracking radars have digital data conversion and processing equipment for preparing and transmitting information to the computing system without manual processing, marking a significant achievement - global handling of data on a real-time basis.

One function of the computer is to transmit information regarding the spacecraft's position to Mercury Control Center at the Cape, where it is displayed on the world map in the Operations Room. The computer also originates acquisition information which is automatically sent to the range stations.

During every major Mercury launch, the attention of some 15 NASA flight controllers is focused on dozens of consoles and wall displays in the Mercury Control Center Operations Room. This room is the control point for all information that will flow through the world-wide tracking and communications system. In this room NASA Flight Controllers make all vital decisions required, and issue or delegate all commands.

In the fifty-foot square room, about 100 types of information register at various times on the indicators of the consoles and the high range-status map. Of these 100 quantities, 10 show biomedical condition, approximately 30 relate to life support facilities and about 60 give readings on spacecraft equipment. This information flows in on high-speed data circuits from computers at the Goddard Center, on direct teletype circuits from remote sites, and by booster and spacecraft telemetry relayed over readio and wire circuits.

Three kinds of data start pouring into the computing system as soon as the booster lifts half an inch off the launch pad:

1. Radar data: Triggers the Cape Canaveral IBM 7090 which monitors the spacecraft's flight path and predicts its impact point if the mission must be aborted.

2. Guidance data: Radioed from the spacecraft to a special purpose computer at the Cape.

3. Telemetry data: Reports check points, e.g., lift-off, booster separation.

These data are transmitted from Cape Canaveral to Goddard where IBM 7090's compare the spacecraft trajectory to a predetermined flight path - and flash the results back to Canaveral. This is a "real time" operation - that is, the system receives, moves it over 2,000 miles, analyzes, predicts and displays data so fast that observers and controllers follow events as they happen.

## COMMUNICATIONS INFORMATION

The system carries telephone, teletype and high-speed data (1,000 bits per second) information. It can accept a message from a distant site and delivers it to the final destination - regardless of location - in a little over one second.

Radio teletype facilities use single sideband transmitters, which are less susceptible to atmospheric interference. All circuits, frequencies and paths were selected only after a careful study of data accumulated over 25 years by the National Bureau of Standards on the various propagation qualities of many radio paths.

Submarine cables to London (via New York), to Hawaii (via San Francisco), and to Australia (via Vancouver, B.C.) are included in the Mercury communications network.

The Mercury Voice Network has a twofold mission:

1. Provide Mercury Control Center (MCC) with "real time" information from world-wide tracking stations having the orbiting Mercury spacecraft in view.

2. Provide a rapid means for dealing with emergency situations between MCC and range stations during a mission.

The network is essentially a private line telephone system radiating from GSFC to MCC and the project's world sites.

These lines are used during an orbit mission to exchange verbal information more rapidly than can be done by teletype. Conversations are recorded both at Goddard and Mercury Control Center for subsequent playback. When not used for orbit exercise the circuits are utilized for normal communications operations.

## ASTRONAUT TRAINING PROGRAM SUMMARY

Here are some of the general training activities that the Project Mercury astronauts have undergone since May, 1959.

1. Systems and vehicle familiarization - The seven astronauts were given lectures in the vehicle systems by NASA and several of the contracting companies. NASA Langley Research Center gave them a 50-hour course in astronautics. McDonnell Aircraft Corp. engineers talked to the astronauts on Mercury subsystems. Lectures were given to the astronauts by Dr. William K. Douglas on aeromedical problems of space flight. At the Navy centrifuge in Johnsville, Pa., the astronauts flew the Mercury acceleration profiles. At several Air Force bases they flew brief zero-gravity flight paths. Checkouts of the Mercury environmental system and the pressure suit were accomplished at the Navy Air Crew Equipment Laboratory in Philadelphia. At the Naval Medical Research Institute they became familiar with the physiological effects of high $CO_2$ content in the environment. The Army Ballistic Missile Division and its associated contractors indoctrinated them on the Redstone. The Air Force Space Systems Division and its associated contractors told the astronauts about the Atlas launch vehicle.

2. Star recognition - Each astronaut periodically received concentrated personal instruction on the elements of celestial navigation and on star recognition at the Morehead Planetarium, Chapel Hill, North Carolina. A trainer simulating the celestial view through a spacecraft window permitted astronaut practice in correcting yaw drift.

3. Desert Survival - A 5½ day course in desert survival training was carried out at the USAF Training Command Survival School at Stead Air Force Base, Nevada. The course consisted of survival techniques through lectures, demonstrations, and application in a representative desert environment. The Mercury survival kit was also evaluated during this period.

4. Egress training - During March and April, 1960, open-water normal egress training was conducted in the Gulf of Mexico off Pensacola, Florida. Each astronaut made at least two egresses through the upper hatch (up to 10-foot swells were experienced). Water survival training was also accomplished in August, 1960 and December, 1961 at Langley. Each of the astronauts made underwater egresses, some of which were made in the Mercury pressure suit.

5. <u>Specialty assignments</u> - The astronauts contributed to the Mercury development program by working directly with Manned Spacecraft Center engineers and by attending NASA-McDonnell coordination meetings and booster panel meetings in their specialty areas. Astronaut specialty areas are:

Carpenter - Communications equipment and procedures, periscope operation, navigational aids and procedures.

Cooper - Redstone booster, trajectory aerodynamics, countdown, and flight procedures, emergency egress and rescue.

Glenn - Cockpit layout, Instrumentation, controls for spacecraft and simulation.

Grissom - Reaction control system, hand controller, autopilot and horizon scanners.

Schirra - Environmental control systems, pilot support and restraint, pressure suit, aeromedical monitoring.

Shepard - Recovery systems, parachutes, recovery aids, recovery procedures and range network.

Slayton - Atlas booster and escape system including Atlas configuration, trajectory, aerodynamics, countdown, and flight procedures.

## MERCURY LAUNCH CHRONOLOGY

Two types of Mercury spacecraft have been used in the flight test program. First series of shots used full-scale "boilerplate" models of the capsule to check out booster-spacecraft integration and the escape system. Second phase of the development firing program used Mercury capsules built to production standards.

This is the chronology of test firings:

September 9, 1959: Big Joe. NASA-produced research and development capsule, launched on an Atlas from Cape Canaveral -- test validation of the Mercury concept. Capsule, survived high heat and airload and was successfully recovered.

October 4, 1959: Little Joe 1. Fired at NASA's Wallops Station, Virginia, to check matching of booster and spacecraft. Eight solid-propellant rockets producing 250,000 lbs. of thrust drove the vehicle.

November 4, 1959: Little Joe 2. Also fired from Wallops Station, was an evaluation of the low-altitude abort conditions.

December 4, 1959: Little Joe 3. Fired at Wallops Station to check high-altitude performance of the escape system. Rhesus monkey Sam was used as test subject.

January 21, 1960: Little Joe 4. Fired at Wallops Station to evaluate the escape system under high airloads, using Rhesus monkey Miss Sam as a test subject.

May 9, 1960: Beach Abort Test. McDonnell's first production capsule and its escape rocket system were fired in an off-the-pad abort escape rocket system. (Capsule 1).

July 29, 1960: Mercury-Atlas 1. This was the first Atlas-boosted flight, and was aimed at qualifying the capsule under maximum airloads and afterbody heating rate during reentry conditions. The capsule contained no escape systems and no test subject. Shot was unsuccessful because of booster system malfunction. (Capsule 4)

November 8, 1960: Little Joe 5. This was another in the Little Joe series from Wallops Station. Purpose of the shot was to check the production capsule in an abort simulating the most severe Little Joe booster and the shot was unsuccessful. (Capsule 3)

November 21, 1960: Mercury-Redstone 1. This was the first unmanned Redstone-boosted flight, but premature engine cutoff activated the emergency escape system when the booster was only about one inch off the pad. The booster settled back on the pad and was damaged slightly. The capsule was recovered for re-use. (Capsule 2)

December 19, 1960: Mercury-Redstone 1A. This shot was a repeat of the November 21 attempt and was completely successful. Capsule reached a peak altitude of 135 statute miles, covered a horizontal distance of 236 statute miles and was recovered successfully. (Capsule 2)

January 31, 1961: Mercury-Redstone 2. This was the Mercury-Redstone shot which carried Ham, the 37-lb. chimpanzee. The capsule reached 155 statute miles altitude, landed 420 statute miles downrange, and was recovered. During the landing phase, the parachuting capsule was drifting as it struck the water. Impact of the angle blow slammed the suspended heat shield against a bundle of potted wires, which drove a bolt through the pressure bulkhead, causing the capsule to leak. Ham was rescued before the capsule had taken on too much water. (Capsule 5)

February 21, 1961: Mercury-Atlas 2. This Atlas-boosted capsule shot was to check maximum heating and its effect during the worst re-entry design conditions. Peak altitude was 108 statute miles; re-entry angle was higher than planned and the heating was correspondingly worse than anticipated. It landed 1425 statute miles downrange. Maximum speed was about 13,000 mph. Shot was successful. (Capsule 6)

March 18, 1961: Little Joe 5A. This was a repeat of the unsuccessful Little Joe 5; it was fired at Wallops Station and was only marginally successful (Capsule 14)

April 25, 1961: Mercury-Atlas 3. This was an Atlas-boosted shot attempting to orbit the capsule with a "mechanical astronaut" aboard. But 40 sec. after launching the booster was destroyed by radio command given by the range safety officer. The capsule was recovered and will be fired again. (Capsule 8)

April 28, 1961: Little Joe 5B. This was the third attempt to check the escape system under worst conditions, using a Little Joe booster fired from Wallops Station. Capsule reached 40,000 ft., and this time the shot was a complete success. (Capsule 14)

May 5, 1961: Mercury-Redstone 3. This Redstone-boosted shot carried Astronaut Alan B. Shepard, Jr. on a ballistic flight path reaching a peak altitude of 116 statute mi. and a downrange distance of 302 statue mi. Flight was successful. (Capsule 7)

July 21, 1961: Mercury-Redstone 4. This successful flig carried Astronaut Virgil I. "Gus" Grissom to an altitude of 118 statute miles and 303 miles downrange. The capsule sank despite helicopter recovery efforts. (Capsule 11)

September 13, 1961: Mercury-Atlas 4. This successful flight saw the spacecraft attain orbit for the first time. The craft carried a "crewman simulator" designed to use oxygen and put moisture into the cabin at about the same rate as a man. Craft was recovered as planned about 160 miles east of Bermuda after one orbit. (Capsule 8)

November 29, 1961: Mercury-Atlas 5. The flight successfully carried the chimpanzee Enos through two orbits to a smooth landing. The craft was recovered about 260 miles south of Bermuda. (Capsule 9)