NEWS RELEASE

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400 MARYLAND AVENUE, SW, WASHINGTON 25, D.C.
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MERCURY-ATLAS 9 PRESS KIT

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1. INTRODUCTION

Preparations for the sixth United States manned space flight, Mercury-Atlas 9, planned to extend this nation's manned space flight experience as many as 22 orbits and as long as 34 hours, are in final stages. Designated Mercury-Atlas 9 (MA-9) with Astronaut L. Gordon Cooper at the controls, the flight will be attempted not sooner than May 14.

It will be the fourth Atlas-boosted manned orbital space flight and the first aimed at meeting one of the original objectives of the Mercury program, manned one-day space flight.

Mercury Spacecraft "Faith 7" will be launched between 8:00 a.m. EST (1300 Z) and 10:30 a.m. EST from launch complex No. 14 at Cape Canaveral after a split countdown extending over a two-day period.

Cooper and his spacecraft will be inserted into orbit on a heading of 072.5 degrees true approximately 500 statute miles from the Cape. His altitude will range as low as 100 miles (perigee) to as high as 170 miles (apogee). If the mission continues through the 22nd orbit, retrofire will be initiated about 170 miles southeast of Kyushu, Japan, causing the spacecraft to land about 80 miles southeast of Midway Island. The pilot will remain aboard an

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aircraft carrier in the Pacific for a 48-hour rest and debriefing before returning to Cape Canaveral via Honolulu.

Main objectives of MA-9 are: study the effects of approximately one day in orbital flight on the astronaut; verification that man can function in space as a primary "system" aboard the spacecraft for an extended period of time; and, evaluate the combined performance of the astronaut with a Mercury spacecraft modified for a full-day mission.

As secondary objectives, NASA hopes to obtain the astronaut's in-flight evaluation of the operational suitability of the spacecraft with its supporting elements, and to assess the effectiveness of the Mercury Worldwide Tracking Network and mission support forces during an extended manned orbital flight.

Underlying the entire MA-9 mission is the continued refinement of equipment, systems and procedures leading to the much more ambitious Gemini and Apollo spacecraft flights which will ultimately, and within this decade, land two U.S. astronauts on the moon.

Project Mercury Astronaut L. Gordon Cooper, Jr., an Air Force Major, 36 (born March 6, 1927, in Shawnee, Oklahoma), was named the MA-9 mission pilot on November 14, 1962. Navy Commander Alan B. Shepard, Jr., 39, is his back-up pilot.

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The 14 other astronauts will serve as flight controllers from vantage points around the world, and as trainee observers. Astronaut Walter M. Schirra, Jr., will serve as Cap Com (Capsule Communicator) at Cape Canaveral. Astronaut John H. Glenn, Jr., will serve as Cap Com aboard the Pacific Command Ship, while Astronaut M. Scott Carpenter will be stationed as Cap Com on Kauai Island, Hawaii. Astronaut Virgil I. Grissom will be Cap Com at the Guaymas, Mexico, station.

The nine astronauts, who were selected to augment the original seven astronauts in future Gemini and Apollo flights, will be assigned to Cape Canaveral under the direction of Astronaut Donald K. Slayton for mission orientation. They are: Neil A. Armstrong, Frank Borman, Charles Conrad, Jr., James A. Lovell, Jr., James A. McDivitt, Elliot M. See, Jr., Thomas P. Stafford, Edward H. White, II, and John W. Young.

In evaluating the benefits of extended flight time, NASA officials point out that "the text books on theory have been exchanged for text books on fact."

The upcoming MA-9 flight spacecraft, having shown tremendous flexibility and capability for modification, more closely resembles a true bionics system. The Atlas launch vehicle, having earned additional confidence in its man-rated qualities, has undergone change with its new wiring system. The astronauts

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have changed through their flight training and actual space flight experiences, proving themselves space pilots rather than spacecraft passengers. The Mercury controllers and planners have also changed and taken on new confidence, born of experience, that they can meet the unexpected problems which arise in flight tests.

Extended Mercury missions function at full value for basic science and technology. Scientists are providing astronauts with specific instrumentation in order to combine and exploit the unique capabilities of man with his own scientific sensors and instruments.

Project Mercury is under the technical and operational direction of NASA's Manned Spacecraft Center, Houston, Texas. MSC, Marshall Space Flight Center and Launch Operations Center, are the three NASA centers engaged primarily in manned space flight projects, under the over-all direction and management of the NASA Office of Manned Space Flight, Washington, D. C.

2. ORBITAL TRACK

The orbital track of a 22-orbit mission will carry Astronaut Cooper over more than 100 countries, islands and possessions. On his first orbit, the MA-9 pilot will leave the United States, cross the Atlantic, the African continent, Indian Ocean, Australia, the Pacific, Mexico and the southern United States in an orbit ranging $32\frac{1}{2}$ degrees north and south of the equator. Beginning with the 16th orbit, the spacecraft will follow the earth tracks of the initial orbits.

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3. MA-9 EXPERIMENTS

Experiments scheduled during the MA-9 mission include: aeromedical studies, flashing beacon experiment, dim light phenomenon photographs, horizon definition experiments, radiation measurements, tethered balloon experiment, infrared weather photographs, television system operation, cabin environmental temperature study, HF antenna test, ground light experiment, window attenuation evaluation, and white patch temperature experiment,

MEDICAL STUDIES

OBJECTIVES -- A 22-orbit mission will allow an evaluation of man's cardiovascular system response to extended orbital flight conditions. In addition, observations and measured physiological parameters can be used to assess the adequacy of the spacecraft environment and the function of life support systems. Analysis of this information will insure the pilot's well-being, particularly his medical condition.

REST PERIODS -- Sufficient rest, eating, and drinking periods are scheduled during the flight so that the pilot can maintain the proper hydration, nutrition, and physiological reserves of energy required throughout the mission.

The pilot is allowed a total of eight hours for sleep; this period is scheduled to begin -- at the option of the pilot -- in the ninth orbit during drifting flight. The ground station at Muchea will send a wake-up signal to the spacecraft during the 15th orbit as determined by the Flight Director. The pilot may elect to take a stimulant (Dexadrine) to insure alertness for the remainder of the flight.

URINARY TEST -- A study of the pilot's water balance and kidney function will be made by comparing body weight before and after the flight, by recording water intake during flight, and by analyzing urine samples collected at specific intervals throughout the flight.

BODY TEMPERATURE -- A new oral temperature measuring device for the MA-9 mission consists of a thermister imbedded in a latex probe. The probe is stowed on the right ear muff inside the helmet; the pilot must open the visor to insert the probe under his tongue. Four measurements of temperature are planned during the flight. The instrument has a temperature range of from 75 to 150 degrees F. and will provide a backup indication of suit temperature when not being used for its primary purpose. The oral device replaces a rectal probe used in earlier flights.

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BLOOD PRESSURE -- Blood pressure readings will be taken with a tailored occluding cuff on the upper left arm with a microphone under the lower edge of the cuff and positioned over the brachial artery. The pilot will depress the blood pressure START button on the left instrument panel to inflate the cuff for a reading.

ECG -- The pilot's ECG readings will come from four sensors located on the torso. The pneumograph uses two chest sensors to determine respiration rate. The pneumograph sensors are located at the sixth rib level. Both ECG and respiration are transmitted and recorded automatically.

EXERCISE -- The MA-9 pilot has two periods scheduled during the flight to perform a calibrated exercise study as a measured stress on the cardiovascular system. This exercise will also serve to tone up the body during the long muscular inactivity of the flight. The first of the exercise periods--including the blood pressure measurements--is scheduled to occur during the pass over Australia; it will provide baseline data for medical evaluation early in the flight.

EXERCISE DEVICE -- The pilot's exercise device consists of a conveniently located two-hand grip anchored to the spacecraft structure by stretchable or bungee cord and a loose, nonstretching line to limit the length of travel. Pulling the hand grip full out requires a precise quantity of work measured in foot pounds--60 to 65 foot pounds per pull with one pull

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per second during the exercise periods on the second and seventh orbits. Therefore, accomplishing a specified number of full extensions imposes a calibrated work load on the pilot. Variations in the measured physiological parameters during and after an exercise period will be used to evaluate cardiovascular functions.

FOOD -- The MA-9 food supply will consist of two main types: a ready-to-eat, bite-sized food in sufficient quantity to satisfy all caloric requirements; and the experimental, Gemini-type, dehydrated food and drink prepacked in plastic containers for reconstitution during flight. Preparation of the dehydrated food requires the addition of water--the containers have nozzles through which water is added and through which the food or drink is forced out after hydration. The rehydrated drink will be ready for consumption shortly after the water is added. The rehydrated food will require about five minutes of mixing. Cooper will carry a food supply totaling 2376 calories, including such meals as spaghetti and meat sauce and a beef and gravy dinner.

ADDITIONAL EXPERIMENTS

FLASHING BEACON EXPERIMENT -- The purpose of this experiment is to help evaluate the capability of the pilot in acquiring a flashing beacon light of known intensity at distances of up to 15 miles from the spacecraft in the space environment. This experiment is associated with Gemini and Apollo missions where visual sighting will serve as a means for rendezvous. It is necessary to obtain data on what visual acquisition capabilities are required for sightings at various ranges.

This experiment utilizes two flashing xenon lights. Battery powered, the lights are mounted on opposite sides of a ten-pound, 5.75-inch-diameter sphere. The lights radiate about one flash per second, approximately omnidirectionally, and are designed to equal a star magnitude of plus two -- or about the same magnitude as Polaris (North Star) -- at a distance of six to eight nautical miles.

The sphere is mounted in a cylindrical canister on the retropack in such a way that, when the spacecraft is at a pitch-down attitude of 20 degrees to the horizon, the retropack will be aligned to the proper ejection angle. Under this condition, the sphere will be launched down (10 feet per second) by a spring device at angle of 92 degrees with the flight path.

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This will put the sphere into a slightly different orbit than that of the spacecraft, causing the two to drift apart.

The sphere will be released about 15 minutes before sunset on the third orbit approaching the coast of Africa. The pilot will repeat sightings at ten-minute intervals during the next three night phases and -- if possible -- during the first intervening daylight phase. He will comment on the appearance of the light against the star or Earth background, describe its ease of acquisition, and estimate its relative position from the spacecraft.

DIM LIGHT PHENOMENON PHOTOGRAPHY -- This experiment will gather photographic data of two dim light phenomena which are best observed from outside Earth's atmosphere -- Zodiacal light and the night airglow layer. Photographs of Zodiacal light will help scientists to determine the light's exact origin, geometric distribution, and its usefulness in studying solar radiation and flare activity. Data on the airglow will provide further information on the solar energy conversion processes occurring in the upper atmosphere.

The nature of Zodiacal light is believed to be sunlight reflected from free electrons and large dust particles in the ecliptic plane, distributed outward from the sun in interplanetary space, or in geocentric orbits about Earth. The intensity of the Zodiacal light is relatively weak, and measurements from Earth's surface are inhibited by scattering and absorption of light in our atmosphere. Measurements of corona intensity within two degrees of the sun's disk during solar eclipses show a bright halo; other measurements near the plane of the ecliptic up to 30 degrees ahead of sunrise or behind sunset indicate a possible light intensity relationship to the solar halo. During the MA-9 flight, the pilot will attempt to obtain time exposures on color film covering the ecliptic region after sunset on the 16th orbit between two degrees and 30 degrees from the sun to ascertain if Zodiacal light is a continuous phenomena or if it arises from the two distinct processes.

The airglow consists of a weak continuum in the visible spectrum and has three distinct colors -- yellow from the sodium D lines and green and red lines, the latter two being attributed to "forbidden" transitions in the energy states of atomic oxygen. Recent work in this area of science is reported to indicate that the red occurs near 400 km altitude while the green is prevalent at 90 km. Time exposures using the color film and a modified camera throughout the night phase may return data on the altitudes and intensities of the various strata as well as their change in appearance at different latitudes.

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In order to perform these studies accurately, the pilot will make maximum use of the ASCS (automatic control) so that he can devote most of his attention to the timing of his photographs. Just after sunset, the pilot will begin the first of four sequences of Zodiacal light photographs. The photographs will begin 15 seconds after the sun disappears below the horizon. The airglow will be photographed in sequences throughout the remainder of the night phase with five minute intervals between sequences. Each sequence will consist of three photographs -- a two-minute exposure, a 30-second exposure and a ten-second exposure with a minimum of delay between exposures. At morning twilight, the sequence will be changed to one final series of a 30-second exposure immediately followed by a seven-second exposure taken every two minutes.

Photographic equipment provided for this experiment will consist of a 35 mm camera modified with a special F.6 lens system provided by the University of Minnesota, originator of the proposal for this study. The camera weighs about three pounds including its 50 frames of preloaded and calibrated film.

HORIZON DEFINITION EXPERIMENT (MIT) -- The horizon definition experiment will study Earth's sunlit horizon and atmosphere to determine if it can be used as a reliable sextant reference during the midcourse phase of translunar missions. Photographic test results will be of direct use to the Massachusetts Institute of Technology Instrumentation Laboratory

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in the development of the Apollo guidance and navigation system.

This experiment is a continuing effort to accurately define a suitably invariant horizon line in the atmosphere near Earth's surface that remains independent of changing atmospheric conditions. Photographic observations of Earth's horizon and atmosphere were made on MA-7 through blue and red filters to discover if there is a point of sharp cutoff in either spectral region of the horizon or atmosphere which can be used for accurate navigation sightings, but the results were not completely conclusive. Photographs to be taken on the MA-9 flight will be used to investigate two specific problems to (1) indicate a specific altitude for a well-defined line, and (2) resolve uncertainties arising from the atmospheric scattering of incident sunlight. Useful data will include red and blue filtered, daylight photographs of the horizon and atmosphere taken at even intervals as the spacecraft crosses the sunlit portion of Earth. Photographs will also be taken during a short period of all four quadrants of Earth's surface and, if possible, at a known time when the rising or setting moon would also appear in the picture. The first two series of photographs would provide excellent comparisons of the horizon and atmosphere through varying sunlight-scattering angles.

This experiment requires a 70 mm camera and a magazine containing the red and blue filter strips mounted just ahead of the film plane. MIT will supply this magazine with filters and black and white film suitably calibrated with step-wedge exposures before and after flight for reference during the microdensitometer analysis of results.

The special film magazine will be attached to the camera during the 16th orbit prior to the beginning of the quadrant photographs. The pilot will take eight pictures of the horizon, two in each quadrant as he performs a pitch-down, yawing maneuver. The quadrants will be chosen so that two of the pictures will be taken toward the azimuth of the sun.

During the 21st orbit, when the spacecraft is on automatic control, the pilot will take approximately six or seven sets of three photographs each looking aft. The photographs will be evenly separated in time (about six minutes) so that they cover the entire daylight period.

A sequence of photographs including the moon with the horizon will also be taken, if the occasion conveniently presents itself at any time during the flight.

RADIATION MEASUREMENT EXPERIMENT -- The objective of this experiment is to measure radiation at Mercury orbital altitudes. This will provide a survey of fission electrons trapped in the lower regions of Earth's magnetic field approaching closest to

Earth's surface over eastern South America and the South Atlantic. This will give additional data on the decay of the artifical radiation belt created by high altitude nuclear detonations.

One of two Geiger counters mounted on the retropack will view radiation flux from a hemispherical area. This Geiger counter surveys a region unobstructed by the spacecraft and is unaffected by radiation scattered by the spacecraft structure. The second Geiger counter is shielded to register incoming radiation directly ahead of the heat shield region.

Useful data from these Geiger counters will be recorded any time when the radiation experiment switch is ON, when the tape recorder is running, and when the radiation levels are within the range of the instruments.

Trapped fission electrons spiraling along Earth's magnetic flux lines (with energies below 7 MEV) will be the primary source of the radiation to be measured. When the spacecraft attitudes are known, a crude estimate may be made concerning preferential direction of the incoming radiation. Data obtained should provide a qualitative test of the assumption that radiation near the spacecraft is isotropic or the same regardless of the direction of the measurement.

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A pocket ion chamber(0-200 milliroentgen dosimeter) stowed in the Ditty Bag prior to launch will be secured to the hatch about ten minutes after launch. A radiation detecting film patch will also be attached to the hatch. The ion chamber and the film patch will give a rough measurement of the total interior radiation. The radiation reaching the pilot will be measured by four film patches worn beneath the astronaut's pressure suit -- one inside the helmet near the left ear muff, one on the right thigh, and two in the chest region.

In addition, one photographic emulsion pack will be carried in the spacecraft cabin and will be located above the left instrument panel. This high-energy particle detector has been provided by the U.S. Navy School of Aviation Medicine. The pack contains a stack of eight glass plates coated with photographic emulsion sensitive to protons and galactic cosmic rays. Sufficiently energetic protons trapped in Earth's radiation belts will also be recorded. After the flight, a microscopic inspection of the developed grain density in the emulsion along the ionization path of the incident particles will measure their energy loss through the pack; this can be used as direct or, in some cases, indirect evidence of total particle energy.

TETHERED BALLOON -- The tethered balloon experiment -- attempted first on the MA-7 flight -- has two objectives:

an aerodynamic study and a visual test. The measurement of atmospheric drag on a known aerodynamic shape along the Mercury orbit should provide a more accurate measurement of atmospheric density in that region. Information on aerodynamic stability and damping will also be obtained. Visually, the balloon will provide a conveniently-located space object for tracking and ranging after its release from the towed position.

The balloon and small nitrogen inflation bottle are packaged together in a three-inch-diameter cylindrical container located in the antenna canister under the destabilizing flap. The container door will open, and the deflated balloon and bottle will be ejected by a compressed spring and piston with the 100-foot-long, five-pound test, nylon tethering line between the balloon and a strain gauge beam in the spacecraft. When the package clears the container, a spring-loaded valve on the nitrogen bottle will open, and the balloon will inflate to a 30-inch-diameter sphere in less than one second.

The balloon is fabricated of two-ply Mylar, 0.6 mil thick. It is coated with a flourescent orange Day-Glo finish.

One end of the nitrogen bottle is attached to the balloon while the other end is fastened to a roll of annealed aluminum foil eight feet long. This foil serves as a shock absorber by unrolling during deployment.

The outer end of the tethering line is attached to the shock absorber, and its other end is connected to the free end of a cantilevered strain gauge beam located at the bottom of the balloon container in the spacecraft. Aerodynamic drag on the balloon transmitted through the tethering line causes a pull which is registered by the strain gauge and recorded onboard. (The maximum drag force will occur at perigee and is expected to be on the order of 0.015 pounds.) At the completion of the experiment, the balloon will be cut free and tracked. This will give some idea of fuel usage versus accuracy during precision tracking in space and also will provide the pilot with a known object for estimations of range and appearance.

Balloon deployment is proposed for approximately five minutes after sunrise on the sixth orbit. Prior to deployment, the 16 mm camera with wide-angle lens will be mounted in its bracket and turned on to record the balloon extension sequence.

After deployment, the pilot will pitch down five to ten degrees -- slowly -- in order to observe and comment on motions of the balloon. The balloon should be relatively stabilized within about 90 seconds; the camera will be turned off at this point.

During the towed phase of this experiment, motions of the balloon induced by attitude changes of the spacecraft will be kept to a minimum. The pilot will comment on all observations and spacecraft maneuvering for onboard recording; this will include times, spacecraft attitudes and rates as well as the relative position of the balloon, whether or not the line is taut, period and amplitude of balloon oscillations, apparent color or shape changes, angle of lighting, and its appearance against the sky or Earth backgrounds. The 16 mm camera with wide angle lens will also be used for four or five sequences of the balloon and its motions during the towed phase.

Just prior to the balloon jettison, half way through the seventh orbit, the 16 mm camera with telephoto lens will be started. The precision tracking task requires that the pilot hold the retro attitude horizon scribe mark in the window on the balloon for approximately two minutes as it recedes and drops below the spacecraft. Thereafter, the pilot will note the appearance and ease of sighting from general observations; in about five minutes, the balloon should be near the visual limit on the horizon and nearly three miles away.

INFRARED WEATHER PHOTOGRAPHY -- The series of weather photographs will use infrared film and filters for the study of weather phenomena from orbital altitudes. The ultimate purpose is basic information on infrared reflectance from the Earth-atmosphere and design data for instrumentation going into future meteorological satellites. Film resuts should provide valuable information on spectral characteristics of the cloud and Earth radiances, of sunlight scattering by large aerosols, and of contrast variation with wave length.

A Hasselblad camera with 70 mm film and 80 mm lens will be used for this photography. A holder containing the three filters will be inserted into the magazine loaded with infrared sensitive film. The U.S. Weather Bureau proposed this task and is responsible for processing and sensitometric calibration of the film.

Execution of this experiment is planned during the 17th and 18th orbits; at his own discretion, the pilot may choose additional times. The control mode for this study will generally be drifting flight.

TELEVISION CAMERA EVALUATION -- A special television camera will be carried on this flight for the first time to test its operational value for monitoring the pilot's well being, for obtaining backup readings of the instrument panel indications, and for observing tests, experiments and external phenomena through the spacecraft window. This may determine the need and value of such a technique for obtaining data on future manned space flights.

The ten-pound camera can be hand-held or mounted on a bracket to the right of the pilot's hand controller. A special telemetry transmitter has been added to the spacecraft to transmit the TV output directly to the ground during telemetry contact at selected tracking station sites.

Mercury Control Center, the Pacific Command Ship (south of Japan), and Grand Canary Islands are set up to receive the television output. The TV camera data can be obtained only when the spacecraft is in telemetry contact with a ground station properly equipped to accept the TV signals. In order to obtain adequate picture definition within the space and weight restrictions imposed on the flight equipment, the scan rate has been reduced to 0.5 frames per second. This necessitates special equipment on the ground to reconstruct the picture for immediate viewing. At MCC the flight surgeon will have access to a real-time monitor modified to use the two second scan speed. Five other TV monitors will also see the picture, but they will view it on the standard scan rate after electronic conversion of the telemetered image. In addition, 35 mm film will be used to record the picture on the ground. Both the Pacific Command Ship and Grand Canary will also record the telemetered signal on magnetic tape for later playback. The Pacific Command Ship will also have a real-time display at the two-second scan rate.

The MA-9 pilot will turn the TV camera on at approximately the expected telemetry lock-on time for each pass over Mercury

Control Center, the Pacific Command Ship, and Grand Canary. He may remove the camera from its mounting at any time targets of interest appear during TV contact times or whenever specific views are requested by ground control. In its mounted position, the camera is normally directed at the pilot. The choice of the appropriate lens will depend on subject matter and will be determined during flight by the pilot with advice from the monitoring ground station.

CABIN ENVIRONMENTAL TEMPERATURE STUDY -- This test will yield information on the temperature balance within the spacecraft cabin without the cabin coolant system in operation. This has not been attempted on prior flights. It is predicted that the maximum stable temperature reached without coolant will be within the tolerable limits of the cabin equipment and the pilot; the pilot will be using suit cooling circuit only. This test should provide engineering design data for future heat exchanger systems.

No equipment other than the usual spacecraft systems is required for this test. The test is scheduled for the beginning of the fifth orbit after the cabin has achieved generally stabilized temperatures. The cabin coolant valve will be turned off and cabin temperature monitored by both the pilot and the ground stations. Suit temperature readings will also be monitored and settings adjusted appropriately, since the suit circuit will have to bear an added portion of the heat load.

Prior to the start of the test, the pilot will record cabin air temperature, cabin and suit heat exchanger dome temperatures, suit temperature and the coolant valve settings for both the cabin and the suit. He will then switch the cabin fan off and close the cabin temperature control. At several minute intervals and whenever suit coolant valve changes are necessary, he will record time and the above mentioned temperatures and coolant valve settings. Electrical loads and inverter temperatures will be checked frequently until temperatures are stabilized to insure that no failures are imminent from overheating equipment.

If temperatures remain stable within test limits, the cabin fan and water coolant will remain off until approximately two hours before retrosequence. This will include the rest period, if temperatures remain at a safe level and have been stable for several hours.

HF ANTENNA TEST -- Another first-time experiment, this will provide measurements of antenna polarization and atmospheric effects associated with HF communications between an orbiting vehicle and ground stations. Results will be directly applicable to the vertically polarized HF antenna to be used on the Gemini spacecraft.

The operational procedure for this test requires two HF transmissions from the spacecraft, one with a 28-foot-long antenna in a horizontal position (horizontally polarized), and the other with the spacecraft rolled 90 degrees so that the dipole points toward the center of Earth (vertically polarized). The test of the two orientations will be performed over an area just north of Panama so that the spacecraft is fairly close to receiving stations where reasonable reception and good coverage of the region just beyond line-of-sight are expected.

This test will be conducted a second time 20 minutes later over the South Atlantic in a remote area where long ranges well beyond line-of-sight are required for station contact. About five minutes will be required to make a call in one orientation, then roll 90 degrees and transmit in the other position. During the test periods, all ground stations will record output from the primary HF receivers with horizontally polarized antennas and also from the backup HF receivers with vertically polarized antennas. Ground stations will make no reply or acknowledgement during these tests, but a comparison of recorded signal strengths will be analyzed after the flight to obtain the information on atmospheric effects and polarizations.

GROUND LIGHT EXPERIMENT -- The ground light experiment should provide data on approximately the minimum intensity for a point-source ground light that is visible at spacecraft altitudes. This information will indicate the feasibility of using ground or high altitude lights as navigation fixes for mid-course and near-Earth corrections in Project Apollo. It is also designed to produce rough data on the light attenuation through the atmosphere.

Data from the experiment should be used in conjunction with data from the window attenuation experiment to obtain accurate results. The pilot needs only the extinction photometer and standard light source in the spacecraft. A high intensity xenon light will be located at Bloemfontein in the Republic of South Africa. The three million-candlepower light will be illuminated continuously for three minutes when the spacecraft is within range on the sixth or 21st orbits. The spacecraft will be oriented to observe the light on only one occasion; this will depend on best weather conditions over Bloemfontein for one of the two possible times.

Data from this test will consist of the pilot's time marks, comments and photometer readings. Before and during the mission, the pilot will be given the required pitch and yaw attitudes to put the light in view through the spacecraft window.

After acquisition of the ground light, the pilot will occlude the standard source light, the ground light, and then the standard source in the same manner as during the window attenuation experiment. Several readings will be taken of each light source.

WINDOW ATTENUATION EVALUATION -- The purpose of this experiment is to obtain data for an evaluation of the transmission of light through the spacecraft window.

An extinction photometer (a neutral density, optical wedge) and a calibrated standard light source will be used in this experiment. The readings are to be obtained at opportune moments for the pilot and whenever identifiable stars are in view during either the daylight or night phase. Reading the light level of the standard source before and after the star readings provides a measure of light unrestricted by the window and also establishes the degree of the pilot's dark adaptation. Both values must be known to arrive at valid measurements. The ratio of relative star magnitudes to actual magnitudes gives the window transmissivity. It is also necessary to specify the relative position of the star in the window, because there may be uneven streaking on the outer surface by a residue from the escape tower rockets and because the pilot's line of sight undergoes a variation in angle of incidence for different positions on the window.

During times when higher priority work is not in progress, the pilot will attempt to locate stars that he can positively identify and that will remain in the field of view for several minutes. The night phase of the seventh orbit may provide an ideal opportunity for this experiment since the spacecraft will be in ASCS reentry attitude towing the balloon. Prior to the first reading, the pilot will mount the small standard source light at a predetermined place on the instrument panel. All the readings will be accurately recorded on the onboard tape.

After locating a star, the pilot will use the extinction photometer to occlude the standard light source several times until repeatable readings are achieved. The same procedure will be used on a known star until repeatability is again achieved. The approximate location of the star in the window and estimates of extraneous or internally reflected lighting will also be noted. The standard source will be occluded immediately after the star measurement, and general comments will be recorded.

WHITE PAINT PATCH STUDIES -- The skin temperature test will investigate changes in white paint pigments during reentry heating.

The test of three types of white coatings on the outer surface of the shingles will provide data on changes in pigment reflectivity cuased by reentry heating. The three test panels are six-inch squares baked onto a test shingle located at the small end of the conical section. The three pigments to be tested have a titanium oxide base, a zirconium oxide base,

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and a zinc oxide base. Theoretical calculations indicate that as much as a ten to 15 degree F. lower cabin temperature might be possible for a spacecraft protected with a low absorptivity coating instead of the present dark colored oxide.

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4. MA-9 SPACECRAFT

The MA-9 spacecraft, listed as No. 20 in engineering documents, has been named "Faith 7" by Astronaut Cooper. The pilot says he picked this name for three reasons: (1) It embodies his faith in terms of his belief in God and country; (2) It describes the loyalty he and his fellow workers feel toward the organization and their belief in the manned space effort, and (3) It embodies the confidence that binds together the team making our manned space flights possible. The "7", of course, stands for the original seven astronauts.

The spacecraft stands nine and one-half feet tall and measures six feet across the base. Spacecraft weight at launch will be about 4,000 pounds. Weight in orbit will be about 3,000 pounds, and flotation weight after a normal flight should be approximately 2,400 pounds.

The spacecraft is equipped with a large observation window and an explosive-opened egress hatch.

The prime contractor for the Mercury spacecraft is the McDonnell Aircraft Corporation of St. Louis, Missouri.

FUEL SUPPLY AND USAGE -- The rate of usage of hydrogen peroxide for the Reaction and Control System (RCS) is a critical item in accomplishing a mission of up to 22 orbits. Fuel usage rates are determined basically by the mode used in controlling the attitude of the spacecraft. Manual control uses fuel in greater quantities than the automatic (ASCS) or fly-by-wire (FBW) systems because the manual control systems use the larger thrusters. In terms of fuel economy, past flight experience indicates that the ASCS mode is the most economical of the three control modes, and the manual proportional mode is the most expensive.

However, for a mission of up to 22 orbits, the major part of the orbital time will include "drifting flight" -- none of the attitude control modes will be used, thereby saving the hydrogen peroxide until precise attitude becomes necessary. For this mission, an additional 10 pounds of fuel have been added, bringing the total fuel weight to 66 pounds. A total of 24 pounds of manual control fuel and 42 pounds of automatic mode fuel is available. Fuel is contained in three bladders inside three fuel tanks - which can be interconnected - and is forced out by nitrogen pressurization.

TAPE RECORDER PROGRAMMING -- The spacecraft tape recorder will run continuously from umbilical separation until spacecraft separation plus five minutes; from this point until retrograde minus 30 seconds, the tape recorder is programmed to record one minute of data for every ten minutes of elapsed time. The pilot can switch to continuous recorder operation at any time. The astronaut's voice will always appear on the tape recording in either the continuous, programed or VOX operation mode. After retrograde plus 30 seconds, the recorder will operate continuously until impact plus ten minutes.

MAIN BATTERY SYSTEM -- One 1,500 watt-hour battery and five 3,000 watt-hour batteries are provided and can be interconnected in various ways to provide power for the complete mission and a post-landing period. As part of a "single point failure" analysis, the MA-9 spacecraft telemetry system has been redesigned to utilize two power supplies. An isolated backup power system consisting of the 1500-watt-hour battery is used for critical items and can be initiated by a pilot-operated switch. To further insure reliable operation of the pyrotechnic system, each device has a completely isolated power feed system. For this mission, two 1500- watt-hour batteries used in previous missions have been uprated to 3000-watt-hour capacity.

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ALTIMETER--The Mercury barometric 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, normally 21,000 feet and 10,000 feet, respectively.

ENVIRONMENTAL DISPLAYS--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 AND WATER STORAGE--The primary drinking water supply will contain four pounds of water, and the survival kit will carry another six pounds for a total of ten pounds. In addition, condensate water will be collected and stored by the pilot in drinking water containers--one-pound polyethlyne bags--containing halid tablets.

CLOCK AND RETRO-FIRE TIMER--The main clock in the MA-9 spacecraft has three major separate operational components: (1) a standard aircraft elapsed time clock, (2) an "elapsed time after launch" digital indicator with a manual reset, and (3) a resettable timer and time-delay relay which will initiate the retro-grade 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. There also is a back-up clock.

UMBILICAL DOOR--A spring-loaded mechanism will be utilized for the closing of the spacecraft umbilical door. A green telelight will indicate the closing of the door, while a red light will indicate to the pilot when the door is open; both lights are monitored via telemetry.

SURVIVAL EQUIPMENT--The survival package consists of a one-man liferaft, a desalting kit, shark repellant, dye markers, first aid kit, distress signals, a signal mirror, portable radio beacon, a water container with an explusion-type drinking tube, survival rations, matches, a whistle, ten feet of nylon cord and a hand-held transceiver which will provide communications capability.

A lightweight, radar-reflective liferaft 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 is international orange.

PILOT'S DESK--The MA-9 spacecraft cabin is equipped with work table assembly located in front of the main panel pedestal for work and storage space.

PILOT'S MAP--A small cardboard diagram of the MA-9 flight path with recovery force locations is contained within the pilot's desk until ready for use. Last minute, prelaunch information on cloud formations and weather phenomena will be marked by Mercury weather experts.

HATCH--The MA-9 spacecraft is equipped with an explosive actuated hatch just as a pilot's canopy is secured in high performance aircraft. The astronaut can jettison the hatch by pushing a plunger button inside the spacecraft or by pulling a cable. The explosive charge for the hatch was added as an additional pilot safety device to insure easy and rapid escape if necessary. The hatch may also be removed from the outside by recovery teams.

5. ENVIRONMENTAL CONTROL SYSTEM

The environmental control system (ECS) will provide the MA-9 spacecraft cabin and astronaut's pressure suit with a 100 per cent oxygen environment and pressurization for comfort and safety. The ECS is completely automatic; however, in the event of control failure, emergency controls are provided for use.

Requirements for ECS are to (1) provide breathing oxygen for extended orbital flight, (2) provide adequate body ventilation, (3) remove metabolic products, (4) control cabin temperature within comfortable and safe limits during all phases of the flight, (5) provide cabin and/or suit pressurization in various modes of operation, (6) operate in a zero g condition and in high g acceleration, and (7) function automatically and manually.

One additional 7,500 psi oxygen tank is carried aboard the spacecraft; it is in parallel with the primary oxygen bottle. The addition amounts to about 50% more oxygen than carried in the MA-8 mission.

Smaller suit and cabin freon orifices will provide better balance of ground freon cooling to both the suit and cabin heat exchangers.

Carbon dioxide absorption capacity has been increased with an additional one pound of lithium hydroxide.

REMOVED--Items removed as unnecessary for this flight include the periscope (75 pounds including associated ballast), a backup telemetry recorder, a high frequency telemetry transmitter, and the Rate Stabilization Control System.

CYLINDRICAL NECK CONTENTS--Above the astronaut's cabin, the cylindrical neck section contains the main and reserve parachute system.

These 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 spacecraft 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 or plug. The sabot functions as a free piston to eject the parachute pack when pressured from below by gases 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 control and stabilization system.

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 mortar and cartridge, barostats, antenna fairing ejector, and a sea marker packet.

Following escape tower separation in flight, the 21,000 and 10,000 foot barostats are armed. No further action occurs until spacecraft descent causes the 21,000 foot barostat to close, activating the drogue ejection system.

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 chute if it has not previously been deployed, triggering a high-intensity flashing light, extension of a 16-foot whip antenna and initiation of the operation of a high-frequency radio beacon.

If 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 spacecraft stability after water landing.

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

6. SPACECRAFT LOCATION AIDS

ELECTRONICS AIDS -- (1) A super SARAH beacon will be activated during main chute deployment at 10,000 feet altitude; (2) A SARAH beacon will be activated at the same time as the Super SARAH; (3) A SEASAVE beacon will not be activated at the time of spacecraft landing but will be effective until the antenna is erected at least 10.5 minutes after splashdown; (4) A UHF voice recovery will begin operation at main chute deployment; (5) An HF transmitter, an astronaut voice link, will be activated at the astronaut's discretion; (6) An ultra SARAH, contained in the astronaut's survival kit, can be used -- after egress -- at the pilot's discretion; and (7) A UHF voice transmitter, also contained in the astronaut's survival kit, can be used at the pilot's discretion as a voice link.

VISUAL AIDS -- (1) Flashing Light. Upon landing, an inertial switch activated the flashing light located atop the cylindrical section of the spacecraft afterbody. The flash rate of this light will be one pulse every four seconds. Expected liftime of the light is at least 24 hours. It is primarily a night-light aid and should be visible after dark, depending upon prevailing weather conditions, from a distance of approximately five nautical miles. (2) A dye marker will packaged in a buoyant container located between the reserve parachute and the parachute ejector bag. Upon landing, this container will be ejected from the spacecraft into the water as the reserve parachute is jettisoned. The container will be attached to the spacecraft with a ten-foot lanyard and will leave a green-yellow fluorescent streak in the wake of the spacecraft. (The lifetime of the dye marker is approximately six hours, depending upon the state of the sea.)

ACOUSTICAL AID -- A one-pound SOFAR bomb will be ejected from the spacecraft at the time of main parachute deployment at 10,000 feet altitude; it is set to detonate at a water pressure depth of 3,000 feet.

7. LOW-RESIDUE DIET

The low-residue diet for the MA-9 pilot is tasty and palatable. It contains a great deal of protein, and if the astronaut loses weight it will be because of his strenuous and energy-consuming activity.

Consumption of the low-residue diet is required to begin 96 hours prior to the mission. The basis of the diet is meat, rice, eggs, sugar, small amounts of fruit juices, and tea and coffee. The menu will vary, changing during the final 24 hours before lift-off. (See section #3 for in-flight food.)

8. PILOT COMMUNICATIONS

The MA-9 pilot may remain in touch with ground control through the use of high-frequency (HF) and ultra-high-frequency (UHF) radios, C- and S-band radar beacons, and -- if the situation dictates -- a command receiver and/or a telegraphy-type code key.

The mission pilot's capability to transmit on HF begins when the spacecraft separates from the launch vehicle, terminates after reentry when the main parachute is deployed, and is again resumed after spacecraft landing when the 16-foot HF antenna is erected. (A timer will erect the antenna within a maximum of ten and one-half minutes after spacecraft landing.)

The astronaut's capability to transmit and receive on UHF exists from launch until approximately 24 hours after impact.

Voice relay aircraft will be airborne in the vicinity of recovery areas 180 miles east of Bermuda and 125 miles southeast of Midway island where no communications ships or tracking stations are located. These aircraft will be on station to relay automatically voice communications between the spacecraft and Mercury Control Center.

Telemetry transmitters and the C- and S-Band beacons will be turned off during the major part of some orbits, when the craft is not within communications range of a tracking station. These transmitters and beacons can then be turned on at the proper time by ground command when within proper range.

In conjunction with the numerous out-of-communications areas, more dependence has been placed upon the mission pilot to monitor spacecraft systems during this flight. This will also be the procedure for future missions.

9. MA-9 LAUNCH VEHICLE

The launch vehicle for the MA-9 mission will be the Atlas 130-D, built by General Dynamics/Astronautics of San Diego, California, under United States Air Force direction. The 6555th Aerospace Test Wing, USAF, assisted by GDA and the Aerospace Corporation, is responsible for checkout, technical readiness, and launch of the vehicle.

PREFLIGHT TESTING--The Atlas 130-D arrived at Cape Canaveral on March 18, 1963, aboard an Air Force C-133B transport aircraft and was delivered to the hangar area and transferred to its R&D handling trailer for inspection prior to official acceptance from the contractor.

Certain components of the flight control system, propellant utilization system, and the batteries were removed from the vehicle and rechecked for verification of their flight-readiness condition. These tests were performed in the propellant utilization laboratory located in Hanger "H" and in the Gyro and Battery Laboratories located in Hangar "J." Atlas 130-D was then transported to Mercury-Atlas Complex No. 14 and raised to launch position on March 22.

The MA-9 launch vehicle received a flight acceptance composite test to determine systems and components readiness for flight. This test involved thorough checkout for lack of interference among the vehicle's airborne systems while on internal power. The autopilot-guidance loop was also checked for verification of proper operation. The operation of Atlas pyrotechnics--the destruct package and explosive bolts--was then simulated.

This flight acceptance composite test for the Mercury-Atlas was performed with the Atlas and Mercury spacecraft as close to flight configuration as feasible with the exception that pyrotechnics and propellants were not aboard. The compatibility of all Atlas and Mercury systems was checked to insure that the radio-frequency (R-F) of the spacecraft-launch vehicle was compatible with the Cape R-F for insurance that R-F outputs from both the Mercury and the Atlas will not cause ignition of the pyrotechnics. Checks of launch vehicle airborne systems for interference were performed again with the launch vehicle on internal power and with umbilicals disconnected but with spacecraft umbilicals connected.

10. MERCURY-ATLAS COUNTDOWN

OPERATION--The Atlas 130-D is equipped with baffle injection engines; it requires a hypergolic (self-igniting) start. 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 used for minor course corrections during powered flight.

During the first minute of flight, these Atlas engines consume more fuel than a commercial jet airliner during a transcontinental trip.

Mercury-Atlas Countdown Highlights are as follows:

TIME	
T-one day	Fuel aboard Atlas and spacecraft check and servicing
T-390 Counting (Launch day)	Atlas countdown begins
T-165 Holding	Preflight evaluation for one hour
T-120 Counting	Astronaut enters spacecraft
T-105 Counting	Hatch installed on spacecraft
T-65 Holding	Preflight evaluation for 30 minutes
T-50 Counting	Service tower removed

TIME

T-35 Counting	Start filling liquid oxygen tank
T-5 Counting	Go, No-Go Decision
T-2:10 Counting	Liquid oxygen topping. The slow flow to the tank to compensate for boiloff is stopped and the tank is closed.
T-0:35 Counting	Eject spacecraft umbilical
T-0:18 Counting	Go, No-Go decision; automatic
T-0:00 Counting	Lift-off

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11. POWERED FLIGHT

According to the flight plan, the spacecraft launches on a flight path along the Project Mercury Worldwide Tracking Range on a heading of about 73 degrees -- just north of east from Cape Canaveral. Climbing slowly at first, the Atlas will accelerate faster as it gains momentum and as its propellant load is burned.

A roll program (32.46 degrees counterclockwise), which establishes the correct flight azimuth, is initiated two seconds after lift-off and terminated at launch plus 15 seconds. The pitch program is initiated at this point and continued at almost a constant rate until sustainer/vernier cutoff, guiding the Atlas in an arc to its orbital path.

At staging -- about two minutes after lift-off when the vehicle reaches about 40 miles in altitude and a range of about 45 miles from the Cape -- the two booster engines are shut down and jettisoned. The sustainer and vernier engines continue to accelerate the vehicle.

During the first two and one-half minutes of flight, the ASIS (Abort Sensing Implementation System named above) will be capable of sensing impending trouble in the Atlas and of triggering the escape rocket. The MA-9 pilot will also be able to trigger the escape system to pull his spacecraft from the launch vehicle.

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About 20 seconds after staging -- assuming the flight proceeds as planned -- the 16-foot escape-rocket motor will fire to jettison the tower from the spacecraft. The parachute landing system is then armed for use after reentry. The Mercury-Atlas combination will continue to accelerate toward the insertion point.

After staging and until orbital insertion, the ASIS will continue to "watch" for trouble. If significant deviation occurs, the system will automatically initiate action for releasing the spacecraft-to-Atlas clamp ring and for firing 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; this will occur at the orbital insertion point.

ORBITAL INSERTION -- The Atlas will arrive at its insertion point traveling approximately 17,500 miles per hour (25,700 feet per second). Sustainer and vernier engines will be shut down simultaneously at the instant the Atlas hits this insertion point. About one second later, the spacecraft-to-Atlas clamp ring will be released automatically and the posigrade rockets will be fired to separate the orbital spacecraft from the spent Atlas. The three posigrades will give the spacecraft a

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small increment of additional velocity (about 24 feet per second) to assure against the bumping of the two vehicles later in flight.

The orbital path achieved for the spacecraft by the Atlas will be the result of split-second programing of launch vehicle staging, velocity, pitch-over, yaw control and engine cutoff. The Atlas will accelerate continuously during its powered flight and must arrive at the insertion point traveling at a precise speed, completing its pitchover to an Earth-referenced horizontal flight path at the same moment it reaches that orbital point.

12. EVENTS DURING POWERED FLIGHT

EVENT	TIME (seconds)	ALTITUDE (feet)	SURFACE RANGE (miles)	INERTIAL VELOCITY (feet per second)
Lift-off	0	0	0	1,340
Booster Engine Cutoff	131	202,553	44	10,300
Booster Jettison	134	213,289	48	10,400
Tower Jettison	154	289,399	76	11,100
Sustainer and Vernier Engine Cutoff	305	528,400	437	25,700
Spacecraft Separation	306	528,400	441	25,750

13. MERCURY IN ORBIT

AFTER SEPARATION -- Following separation from the Atlas, the Mercury spacecraft will undergo a few seconds of automatic damping (removal of any attitude changing motions) and will turn around 180 degrees so that the blunt face of the craft turns forward and upward -- 34 degrees above the horizontal. From that point on during orbital flight, the pilot will control the spacecraft in attitude by automatic or manual control or will shut down controls and allow the craft to drift without attitude corrections.

The Mercury spacecraft will be inserted into orbit in the vicinity of Bermuda. The craft will by then have attained an altitude of approximately 100 miles and a speed of about 17,500 miles per hour. At engine cutoff, the craft will have been subjected to more than seven and one-half g -- about the same g as will be produced by reentry.

The Mercury craft will reach an apogee of about 170 statute miles off the West Coast of Australia and a perigee of about 100 miles at the insertion point over Bermuda.

REENTRY -- As the MA-9 spacecraft hurtles around Earth on its final orbit -- twenty-second orbit -- it will approach a point some 170 miles southeast of Kyushu, Japan, near the Pacific Command Ship. At this point, the retrorockets will fire to initiate reentry. (The command ship, located some 275 miles south of Japan, has the capability of firing the retrorockets if necessary.) The automatic attitude control system will hold the spacecraft in proper attitude during the braking maneuver.

In the event of reentry from orbit on one of the Atlantic-landing passes, the retros will fire as the spacecraft approaches the West Coast of the United States.

Shortly after retrofire, the exhausted retropack will jettison and the spacecraft will automatically assume reentry attitude. The Mercury will begin to encounter more dense atmosphere of Earth 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 an altitude of about 25 statute miles while the spacecraft still moves at nearly 15,000 mph. All told, the vehicle will sustain temperatures in this neighborhood for about two minutes. Almost coincident with the heat pulse will be a dramatic reduction in spacecraft speed. Between 55 and 12 miles altitude -- covering a slant distance of about 760 miles -- spacecraft speed should be reduced from 17,500 mph down to 270 mph in a little over five minutes.

At about 21,000 feet, the six-foot-diameter drogue chute will deploy automatically to stabilize the spacecraft. The pilot may elect to deploy the chute manually, however, as high as 40,000 feet. At about 10,000 feet, the antenna fairing above the spacecraft cylindrical section will jettison and the 63-foot ringsail-type main landing parachute will deploy. The impact bag will also deploy, the

SARAH and Super SARAH are activated, and the SOFAR (underwater depth charge)is released.

At impact, the main parachute and reserve chute will jettison. Onboard electrical equipment will then shut down, and additional location aids -- dye marker, seasave beacon, and flashing light, will become activated.

14. OPTICAL TRACKING OF MA-9 LAUNCH

Optical tracking of the MA-9 combination will be part of the total launch instrumentation. Historical documentation and engineering camera coverage remains necessary for analyzing flight test results. These camera observations will be used in conjunction with data from other instrumentation for establishing launch records.

This launch will be made into clear skies, since clouds restrict photographic activity above the cover and since optical tracking is such an integral part of each test.

Engineering data from optical tracking cameras on the ground have been a major asset in launch vehicle and spacecraft research. These data have often provided the only source for establishing accuracy of trajectory or malfunction reasons -- just where the vehicle bent, broke, or caught fire -- for research vehicles.

The need for tracking optics, as used for very early missiles and rockets launch from the Cape, was included as a launch vehicle requirement during early planning stages of Project Mercury.

Types of cameras used will be:

(1) Metric (Measurement) Optics -- This type of camera coverage permits accurate determination of trajectory parameters (position, velocity, acceleration, attitude, etc.).

(2) Engineering Sequential Optics -- This coverage is provided by fixed and by long focal length cameras (tracking telescopes). Details and times of events are obtained in this manner as well as by onboard instrumentation. These data enable NASA scientists to pinpoint where and at what time events happened; they can later be watched in slow motion for detailed observation of powered flight details. They also serve as backup for onboard telemetry.

(3) Documentary Optics -- This coverage provides historical documentation of spacecraft and launch vehicle during powered flight.

The above cameras are located around the launch pad and across Cape Canaveral. Long range tracking cameras are spotted along the Florida Coast to about four miles north of the launch area and some 40 miles south. Clear skies are necessary over these areas for launch.

The areas and cameras along the Florida Coast include the following: False Cape, 180-inch IGOR (Intermediate Ground Optical Recorder) and a Theodolyte; Williams Point, a 35 mm ROTI (Recording Optical Tracking Instrument); Cocoa Beach, a 360-inch IGOR; Melbourne Beach, a 500-inch ROTI; Vera Beach, a 500-inch ROTI; and Patrick AFB, a 360- inch IGOR and a Theodolyte.

The IGOR is a $192,000 instrument including an astrodome and resembling a small observatory. The ROTI, also with an astrodome, costs $580,000 and requires up to three men for operation. The Theodylyte, basically a stand, is priced at $75,000 and requires two operators.

Cameramen will receive instructions from NASA scientists and engineers; their job then will be to return the requested material after a launch. Film is 35 mm and 70 mm with black and white or color film. Photographs from these cameras have included events from as high as escape tower jettison altitude of about 50 miles.

This optical tracking system is planned for future tests of Titan II for Project Gemini research and for Project Apollo launch phases. New developments will be incorporated into the operation as needed.

15. THE TRACKING NETWORK

Worldwide Mercury Tracking Stations, including 19 land stations and four ships at sea, will monitor the MA-9 flight. The Space Computing Center of the NASA Goddard Space Flight Center in Greenbelt, Maryland, will make trajectory computations. (Trajectory computations for Gemini-Titan and Apollo-Saturn programs will be made at the under-construction Mission Control Center of the NASA Manned Spacecraft Center, Houston, Texas.)

During the MA-9 flight, information will pour into the Goddard Space Computing Center from tracking and ground instrumentation points around the globe at a 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.

Tracking sites linked across the Atlantic Ocean are: Cape Canaveral, Grand Bahama Island, Grand Turk Island, Antigua, Ascension Island, East Island (Puerto Rico), Bermuda and Grand Canary Island.

Other stations on around the world are Kano, Nigeria; Zanzibar; Muchea and Woomera (Woomera will operate on radar only for the MA-9 flight), Australia; Canton Island; Hawaii; and Guaymas, Mexico.

Stations in the United States--in addition to the Cape--are at Pt. Arguello in Southern California; White Sands Missile Range, New Mexico; Corpus Christi, Texas; and Eglin Air Force Base, Florida.

The Pacific Command Ship, Coastal Sentry Quebec, will be stationed about 275 miles south of Japan, while the Rose Knot Victor will be in position just north of the intersection of orbits nine and twelve in the South Pacific about 3,000 miles off the coast of Chile.

16. TRACKING AIRCRAFT

It is planned that voice relay and radar tracking aircraft will be used to track the MA-9 spacecraft during the reentry and postlanding phase of the mission. Two C-band radar tracking ships--the Twin Falls Victory, 400 miles east of Cape Canaveral, and the Range Tracker, 800 miles north of Wake Island in the Pacific--will also be on station for radar coverage of reentry. In addition to using their capability of locating the spacecraft, NASA will evaluate their tracking and location capability with respect to future Gemini-Titan and Apollo-Saturn missions.

17. RECOVERY RESPONSIBILITIES

The prime responsibilities of the recovery forces in support of the MA-9 mission are as follows:

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(1) Rapid location of the astronaut and spacecraft after impact, (2) safe retrieval of the astronaut, and (3) collection, preservation, and rapid transmittal of test data and test hardware back to Cape Canaveral.

18. RECOVERY AREAS

Recovery areas for orbits one, two, 16 and 17 lie about 180 miles east of Bermuda. If the mission terminates after orbits three or 18, the spacecraft will land about 360 miles northeast of Cape Canaveral. After orbits four, seven, and 22, the craft will impact some 125 miles southeast of Midway Island (about 900 miles northwest of Honolulu). The recovery area for orbits five, six, 20 and 21 is planned at about 250 miles north-northeast of Midway. Orbit eight ends some 800 miles east-southeast of Honolulu, while the ninth orbit terminates about 250 miles south of Japan, the tenth nearly 180 miles east of Guiuan in the Philippines, the 13th almost 270 miles southwest of Grand Canary, the 14th some 680 miles northwest of the Canaries, and the 15th a little over 1,300 miles east of Bermuda (midway between Bermuda and Grand Canary). Due to low-probability areas along the 12th and 19th orbits, any landing on these orbits will be a contingency landing.

Extending the upcoming mission to 22 orbits necessitates the establishment of the MA-9 primary recovery area to the Pacific Ocean--as listed above--about 80 miles southeast of Midway Island. However, with the possibility that the mission could be terminated prior to the 22nd orbit, deployment of recovery vehicles to primary and contingency recovery areas in the Atlantic and Pacific remains necessary. Twelve ships (ten destroyers, one aircraft carrier and one oiler) are being deployed to the Atlantic under Rear Admiral Harold Bowen, Commander, Destroyer Flotilla Four, and Commander, Task Force 140. In the Pacific, 10 ships (nine destroyers and one carrier) are being sent out under Rear Admiral C. A. Buchanan, Commander, Task Force 130.

In addition, more than 100 aircraft around the world could be called into action in the event of an emergency landing of the MA-9 spacecraft.

LANDING AREAS -- Planned landing areas are defined as areas in which a "short-time" recovery capability should be provided. Location and retrieval vehicles must be on station in planned landing areas to assure retrieval of the astronaut and spacecraft within a specified period of time.

Contingency landing areas are those defined as areas along the orbital track--aside from the above described planned landing areas--in which the spacecraft could land following some component or system failure.

The basic philosophy of recovery for MA-9 is to provide retrieval capability for:

(1) Landings occurring in the event of an abort during the powered phase of flight (planned landing areas).

(2) Periodical landings from orbital flight (planned landing areas).

(3) Landing as a result of extreme emergency during orbital flight (contingency landing areas).

The flight time interval between planned landing areas has been chosen after consideration of spacecraft, network, and recovery factors. The selection of landing areas at spacecraft ground track intersections permits recovery units assigned to one landing area to move about and provide a recovery capability in as many as three other landing areas. The boundaries of these landing areas have been established by probability considerations of such factors as spacecraft control, retrofire-system accuracy, and aerodynamic dispersion effects.

PLANNED LANDING AREAS -- The first planned landing area is the launch site area, an abort landing area which is considered separately because of the special problems introduced by the terrain and shallow water in the vicinity of Cape Canaveral. Landings will occur in this area following an abort initiated after the escape system has been armed and during the first 72 seconds of powered flight. This launch site landing area is four nautical miles in radius, centered on the launch pad and extending offshore 12 nautical miles to the beginning of the next landing area, Area A. Special launch-site recovery forces have been assembled and trained to meet these requirements; a full deployment of these forces is required for MA-9.

AREA A -- This area originates 12 nautical miles seaward of the launch pad and extends along the ground track for a distance of about 610 nautical miles and 30 miles to either side of the ground track. A landing will occur in Area A if an abort is initiated after T plus 72 seconds and prior to about T plus 175 seconds. This time period includes the time at which booster engine staging occurs.

AREA B -- This is essentially an extension of Area A and extends along the ground track a distance of 1,390 nautical miles and extends 15 miles to either side of the ground track. This area will contain a landing which could occur as a result of an abort initiated after T plus 175 seconds but prior to T plus 298 seconds.

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AREAS C, D, E, and F -- These areas also have their major axes oriented along the ground track. Should an abort become necessary during the final portion of powered flight, or during the period shortly before insertion of the spacecraft into orbit, an attempt will be made to land in one of these areas by proper retrofire timing.

REMAINING AREAS -- In the planned landing areas along the ground track, detailed ship positioning is based on probability considerations within a given area in order to minimize actual access times in the majority of situations. The probability associated with a planned landing area is reflected in the recommended minimum recovery force deployment within these areas. Landing areas have been selected at spacecraft ground track intersections to enable the same ships to provide a recovery capability within the access time in more than one landing area.

Throughout the mission, flight progress will be continuously evaluated. If it becomes necessary to terminate the flight before the end of the 22-orbit recovery area, flight control procedure will be utilized to land the spacecraft in planned areas, if at all possible. Periodically during the mission, "Go, No-Go" decisions will be made to determine if the flight should continue; therefore, a higher probability of landing is associated with certain landing areas immediately following these decision points.

CONTINGENCY LANDING AREAS -- All landings in areas other than planned landing areas are considered as contingency land-areas. Preferred contingency areas have been established for emergencies where the MA-9 landing might be deferred long enough to reach a "more desirable" landing site, but which cannot be deferred until one of the planned landing areas can be reached. Principal factors involved in the selection of preferred contingency landing areas are orbital flight time considerations, network support, and recovery factors. The Mercury Worldwide Tracking Network is prepared to select retro-fire times for a landing in one of the preferred areas if conditions warrant.

However, due to the remote possibility that a landing might occur outside either a planned or contingency area, small U.S. and Australian teams are stationed along the orbital track around the globe to locate the astronaut and to recover him. These small units consist of rescue planes and crews capable of homing in on electronic beacons housed within the spacecraft and the pararescue men who will jump from their

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aircraft and aid the astronaut until a surface vessel arrives. These rescue teams are equipped with auxiliary flotation collars and frogman equipment which will enable them to "float" the astronaut and spacecraft for several days if necessary.

A total of 27 of these contingency recovery teams, deployed around the world and connected with Mercury Control Center at the Cape, provide an assurance that all precautions have been taken to insure the safety of a downed Mercury pilot.

19. MEDICAL OPERATIONS

As in the case of each previous Mercury flight requiring medical support, an Operational Bioastronautic Group has been formed to support the MA-9 launch. This group is made up of 129 people including 69 from Air Force, 34 from Navy, 23 from Army, one from the U.S. Public Health Service and two from the Royal Australian Air Force. They include 55 physicians in the recovery force, 17 physicians monitoring aeromedical data and 30 medical technicians at various posts.

The management element of this group is responsible to Col. Raymond A. Yerg, USAF, MC, Assistant for Bioastronautics Department of Defense Representative, Project Mercury Support.

20. MEDICAL RECOVERY OPERATIONS

Medical support for recovery operations is being provided in order to perform the post flight evaluation of the astronaut's condition. The level of medical support necessary at the different recovery areas varies according to the recovery area itself; the most extensive medical support is concentrated in those areas where descent is most probable.

Continuing studies of the physiological effects and hazards of space flight are reflected in changes to the medical support requirements for each mission. For example, current changes reflect a policy of moving the astronaut--if he needs medical help--to the hospital or to medical care rather than vice versa.

MEDICAL SUPPORT PERSONNEL AND EQUIPMENT -- Medical care of the astronaut and medical aspects of the recovery operation is the responsibility of the Director of Medical Operations who exercises this responsibility through special medical teams deployed in support of the mission or by direct communications after recovery.

MEDICAL SUPPORT FOR LAUNCH SITE LANDING AREA -- One representative of the Manned Spacecraft Center's Aerospace Medical Operations Office will serve as Captain of the team designated to aid in removal of the astronaut from his spacecraft in the event of an abort landing in the Cape area. One or two flight surgeons and several other medical personnel will be included in this recovery team. One general surgeon and one anesthesiologist with required surgical technicians and nurses will be standing by at the Forward Medical Area. One medical technician will be provided aboard each LARC and turbocraft stationed in this area.

The Patrick AFB hospital located near Cape Canaveral will support this launch site landing area. The specialty team composing the Mercury staff at this hospital will consist of a general surgeon and anesthesiologist, two surgical technicians and two surgical nurses, and one each of the following: thoracic surgeon, orthopedic surgeon, neurosurgeon, internist, radiologist, neurosurgical technician, orthopedic technician, medical equipment technician, pathologist, urologist, and plastic surgeon.

PLANNED LANDING AREA MEDICAL SUPPORT -- Medical personnel and equipment are required onboard all Mercury recovery ships except those in the launch site landing area. Specialist teams will be alerted to move into certain recovery areas if needed. Ships are required to have one qualified surgeon or anesthesiologist and a medical corpsman or medical technician. Where two ships are assigned to cover any landing area, it is desirable to have a surgeon on one and an anesthesiologist on the other.

Aircraft carriers have both a qualified board surgeon and an anesthesiologist. In addition, a physician from NASA Medical Operations has been assigned to each of these ships and will be in charge of the medical support for recovery operations on that ship and in that area. (Post flight medical evaluation and debriefing will be performed onboard one of these carriers.)

Hospital facilities at Patrick AFB, Florida; Kindley AFB, Bermuda; Lajes AFB, Azores; Tripler General Hospital, Honolulu; Clark AFB, Philippines; U.S. Army Hospital, Okinawa; and Yokosuka Naval Hospital, Japan, have been designated as Mercury support hospitals. At Tripler General Hospital there will be a specialty team comparable to the one described near Cape Canaveral. A KC-135 aircraft on standby at Patrick AFB, Florida, and a C-130 aircraft on standby at Hickham AFB, Honolulu, will be ready to transport all or part of one of the medical specialist teams and approximately 1,000 pounds of equipment to any recovery site if needed.

CONTINGENCY LANDING MEDICAL SUPPORT -- The primary medical monitor at each Mercury tracking station will serve as the NASA Medical coordinator for his area under the direction of the NASA Director of Medical Operations. Local conditions, condition of the astronaut, and availability of medical resources will necessarily dictate details of this segment of the Mercury medical support plans.

21. TRANSPORTATION OF MA-9 SPACECRAFT

After recovery of the MA-9 spacecraft, the vehicle will be delivered to Cape Canaveral as quickly as possible for postflight inspection. Following a normal flight of 22 orbits, the craft will be delivered to Midway Island for further air transport to the Cape. For landings occurring elsewhere in the Pacific, it is planned that it will be transported to Midway Island, Okinawa, or the Philippines--whichever is closest--and on to the Cape.

For landings in the Atlantic, the spacecraft will be delivered to one of the following, whichever is closest: Las Palmas, Grand Canary; Bahia Paria, Azores; St. Georges or the Naval Station, Bermuda; or Cape Canaveral.

23. ASTRONAUT SPECIALTY AREAS

Neil A. Armstrong -- Trainers and simulators

Frank Borman -- Launch vehicles and abort systems

M. Scott Carpenter -- Lunar excursion training

Charles Conrad, Jr. -- Cockpit layout and systems integration

L. Gordon Cooper, Jr. -- Shares responsibility with Alan Shepard for remaining pilot phases of Project Mercury

John H. Glenn, Jr. -- Project Apollo

Virgil I. Grissom -- Project Gemini

James A. Lovell, Jr. -- Recovery systems

James A. McDivitt -- Guidance and navigation

Walter M. Schirra -- Over-all operations and training

Elliot M. See -- Electrical, sequential, and mission planning

Alan B. Shepard, Jr. -- Shares responsibility with Cooper for remaining pilot phases of Project Mercury.

Donald K. Slayton -- MSC Coordinator for Astronaut Activities

Thomas P. Stafford -- Communications, instrumentation and range integration

Edward H. White, II -- Flight control systems

John W. Young -- Environmental control systems, personal and survival equipment

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