REENTRY

AN ORBITAL SIMULATOR

PROJECT MERCURY

FLIGHT MANUAL

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DRAFT

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I. INTRODUCTION

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1. ABOUT

Project Mercury for Reentry is one of the spacecrafts available for flight in the space flight simulator "Reentry – An Orbital Simulator" by Wilhelmsen Studios. It comes with a study level version modelled after the real spacecraft.

The goal of the Mercury spacecraft in Reentry is to mimic the real spacecraft flown by real astronauts. The capsule is modelled after the Mercury Familiarization Manual SEDR 104 (5/20/1962) used by MA-7 (Carpenter) and MA-8 (Schirra) and contains most of the simple and advanced controls from all the different Mercury Capsule configurations, including the satellite clock, the Earth Path Indicator, the electrical system using 3 main fuel cells, two standby and one isolated and so on. The reason for this choice is that this configuration of the spacecraft has all the systems developed for Project Mercury and can fly all the real scenarios.

All training needed to fly the capsule is available in this manual and in-game. If you want to study the spacecraft down to the lowest details, I highly recommended to read the manual by NASA. You can find the manual here: https://www.ibiblio.org/mscorbit/document.html

NOTE
Not all of the components described in this document is simulated. Some might have been simplified or is a placeholder for a future update, while some will never be implemented. They are described because they are needed to complete the descriptions of systems and its operation, or for historical accuracy. This is a computer game meant for the general user, so some simplifications have been made to make it better suited for a computer game.

GET THE GAME

The game can be purchased from https://reentrygame.com/buy - the Mercury Spacecraft is included in this package.

JOIN THE COMMUNITY

An important aspect of virtual space flight is the community – learning to operate these crafts yourself can be very complex. I recommend you join the official "Reentry – An Orbital Simulator" server on Discord, accessible from the in-game menus or http://discord.gg/reentrygame! Ask for help, find multiplayer sessions, get roles for your game progress, share clips, screenshots and meet fellow virtual astronauts and mission controllers.

WHAT IS THIS MANUAL?

This manual contains most of the information you need to successfully master the Mercury Spacecraft in Reentry. This manual is specific to the Mercury Spacecraft. For generic REENTRY information, please see the **Reentry – An Orbital Simulator: User Manual**.

DONATE TO SUPPORT THE DEVELOPMENT OF THE GAME

If you wish to support the development of this game, or if you enjoy playing it, please consider giving a small donation. Creating a game like this is a lot of fun, but also takes up a lot of my spare time and my limited resources to fund it.

Any donations will help me cover costs for development, assets, server hosting, and coffee for staying up late.

You can donate from the Main Menu of the game, or online using PayPal on the following page: http://reentrygame.com/donate

From one space enthusiast to another, thank you again for considering giving a donation!

LEGAL

Images and information in the manual, as well as in the **Project Mercury for Reentry** module is based on information made public by NASA. Images and references from various NASA documents are used.

The images in this guide and game are using public domain images from NASA. https://www.jsc.nasa.gov/policies.html#Guidelines

The information described here is tailored to the simulation and my implementation of the spacecraft for REENTRY. Some systems are simplified or made different due to being used in a computer software.

Both public documents released by NASA and Wikipedia has been used as a reference in my implementation of Project Mercury, as well as writing the education material for the game, including this manual, in-game academy, and mission flow.

This module is subject to change and/or removal at any time.

2. A BRIEF HISTORY

Project Mercury was the first space program of the United States. It started in 1958, and completed in 1963 after six successful manned flights.

It had three main objectives:
1) To orbit a manned spacecraft around Earth
2) To investigate man's ability to function in space
3) To recover both man and spacecraft safely

During the last decade, technology had evolved to allow the long-awaited dream of reaching space. Project Mercury was born on October 7, 1958 and lasted for almost 5 years, ending with Coopers long duration mission where he orbited Earth 22 times.

The six manned flights of Project Mercury provided a lot of research and knowledge on how both technology and humans react to being in the environment of space and zero gravity for long and short durations.

The spaceship was a cone-shaped capsule with room for one pilot. The blunt end was covered with a heat shield to protect it during reentry, and the sharp end had sensors and antennas, as well as an escape tower.

The escape tower was used to separate and take the capsule away from the launch vehicle during abort.

The Mercury program used two launch vehicles: Redstone for suborbital missions and Atlas for orbital missions. The Mercury 7 was the team of the 7 astronauts who was in the Mercury Program.

3. MISSION PROFILES

There are two different types of missions for Project Mercury. The first is a sub-orbital flight where the capsule visits space for a few minutes before reentering again, and the second is orbital mission where the spaceship orbits the Earth.

Sub-Orbital mission

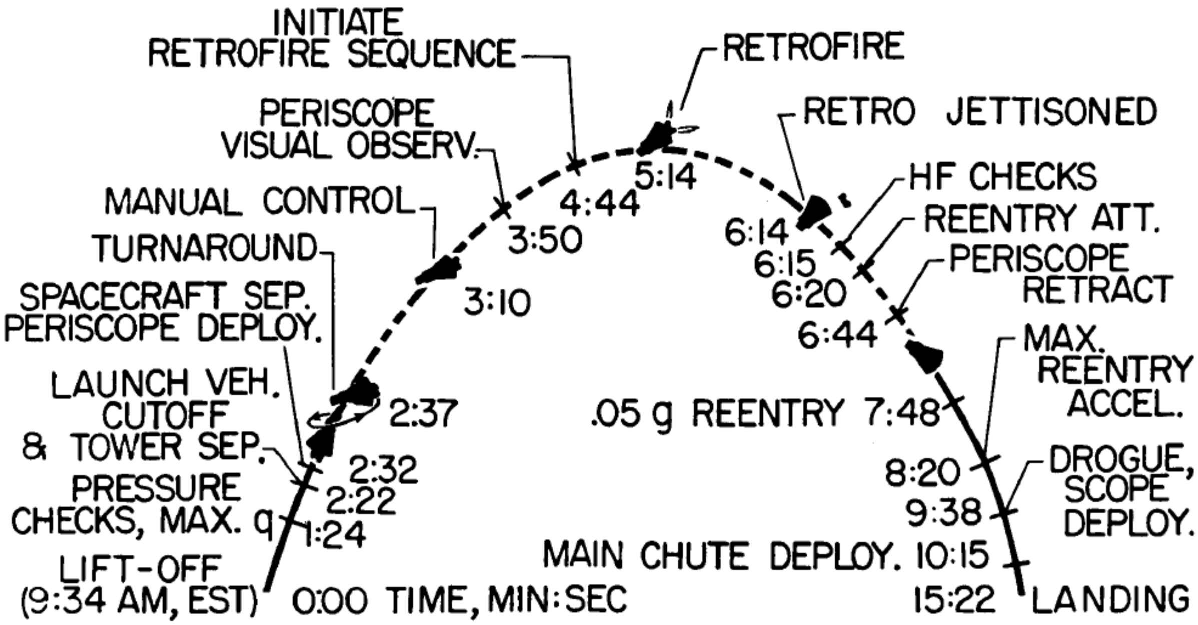


Fig 1.3.1 – Sub-Orbital trajectory, NASA.

Orbital mission

The orbital mission profile is almost identical to the sub-orbital mission with exception of an additional booster stage during ascent, and the time the retrofire happens. The retrofire phase is usually hours into the flight. The ascent stage also takes a few extra minutes due to the increased velocity needed to reach orbital velocity.

4. CONTROLS

When you load a Mercury mission form the Main Menu, you will be seated inside the cockpit. To look around, you can use the mouse while holding in the middle mouse button/scroll wheel. You can use the arrow keys to move the camera around.

Use F5 to F12 to move the camera to predefined spots in the cockpit view. You can use F1 to switch to an external view and F3 to enter orbital view.

There are multiple controls you can interact with in the cockpit, as well as a joystick to orient the spacecraft. This section describes how you can use the mouse/keyboard to interact with these controls.

Tigger Button

Trigger buttons are used to trigger irreversible functions and are protected to avoid accidentally triggering it.

- Left click the protective cover to remove the cover.
- Right click the button to put the protective cover back on.
- Pressing the trigger after removing the cover will execute its function. The button will turn red to indicate that this trigger has been executed

Once the protective cover is removed, the button will look like this. If you left click it in this state, the function will be executed

This state shows how the trigger button is pressed and executed.

Switch

Multiple switches are used to configure various onboard systems. A label is usually describing the function of the switch and what positions it can be set to.

Based on the system, a switch can have the following positions:

- Left, middle, right
- Up, middle, down.

Left click will move the switch leftwards, or upwards, while right click will move it rightwards or downwards.

Fuses
Every fuse has one primary fuse and a secondary fuse for redundancy.

A fuse switch can have three positions:
- Up: Fuse 1 is used
- Middle: OFF, disconnects the system from the power network
- Down being position 2.

Position 1 is the primary fuse, and position 2 is the secondary fuse. Normally fuse 1 is used for all systems unless a malfunction exists.

Selectors
A selector can be rotated to configure a system or select the source sensor an indicator will use.

If can rotate both left and right:
- Right click moves the selection rightwards (counterclockwise).
- Left click moves it leftwards (clockwise).

A selector is usually identified by a label with marks showing what the selector is configured to.

Pull rings
A pull ring is a trigger system that can be pulled to activate a function, like a pyro trigger to separate a stage. These functions are usually irreversible so take caution before pulling any of them.
- Left click to full the ring. This will execute the function.

Handle selectors

The handle selectors are used to toggle a system and can be set to two positions:

- Left mouse button pushes it in.
- Right mouse button pulls it out.

The handle selectors are usually identified by a label on the handle itself, and markings next to it described what it does.

The handle selectors can have different looks, but they all have the same logic to them.

Gauges

Gauges are used to show the status or signal from sensors located throughout the capsule.

A gauge can consist of one or multiple needles showing the current signal, typically the amount of fuel left, oxygen levels, and pressure and temperature of various onboard systems.

Some gauges can be controlled by a selector, where the selector chooses the input/source of the gauge.

Retrograde time control
The retrograde time control panel works the same way as a selector.
Move the handle on the bottom of the panel to adjust the TIME TO RETROGRADE. If works in a cycle, where each cycle lasts one second.

The handle can be set to the following positions:

- OFF: This is the default position. Always leave the handle in the OFF position when you do not want to change the time to retrograde.
- SEC (up): This will increase the time to retrograde with one second for each cycle the handle is in this position.
- SEC (down): This will reduce the time to retrograde with one second for each cycle the handle is in this position.
- MIN (up): This will increase the time to retrograde with one minute for each cycle the handle is in this position.
- MIN (down): This will reduce the time to retrograde with one minute for each cycle the handle is in this position.

This panel will be covered later in the manual.

Temperature control
The temperature adjusters work the same way as selectors and will configure the ECS to increase or decrease temperature.

A label shows what the selector will configure and can typically be set to a number between 1 and 7. 7 is maximum cooling while 1 is minimum cooling.

This will be covered in the Environmental and Control Subsystem (ECS) section of this manual.

Blood pressure
The blood pressure buttons work the same way as a trigger button but can be used frequently. Click once on START to activate it. Leave it on for 30 seconds, then press STOP to deactivate it.

ORIENTATION

Maneuvering is done using the keyboard or a joystick. The input mapping can be configured through the Reentry – An orbital simulator input settings dialogue.

W: Pitch down

S: Pitch up

A: Yaw left

D: Yaw right

Q: Roll left

E: Roll right

TOOLS

T: Flashlight (move it around by using the mouse)

C: Show/Hide Radio Communication menu (circular buttons below the radio panel)

M: Show/Hide Mission Pad

V: Show/Hide view menu

ESC: Show/Hide in-game menu

II. MAJOR COMPONENTS

II. MAJOR COMPONENTS

The Mercury capsule consists of multiple control panel where all fuses, switches and gauges are located. The capsule can contain one pilot who enter through a bolted hatch. The astronaut is seated in a compact cabin within reach of every switch and gauge needed for capsule orientation. A window just above the panel can be used to orient the spaceship based on the surroundings. The capsule got an antenna on the top, and a heat shield on the blunt side.

Once the capsule is separated from the launch vehicle, it has no way of altering the orbit unless the RETRO engines are fired. The RETRO engines are attached to the capsule on the blunt side, just on top of the heat shield. Once the RETROs have fired, it is jettisoned from the capsule, exposing the heat shield for reentry.

During ascent, an escape tower is attached on top of the launch vehicle. It is used to separate the capsule from the launch vehicle during launch emergencies (aborts). Once the capsule reach space, it is no longer needed and is jettisoned from the capsule.

The capsule has one drogue for use when landing. It will correct the attitude of the capsule for landing, as well as decelerating the capsule for main parachute. The main parachute will jettison the antenna and the drogue and slow down the capsule for landing speed. It is attached until landing. A backup reserve chute is used if main chute fails.

A landing bag just under the heat shield will pump up after main chute deploy to reduce shock to the structure and capsule during landing.

1. THE SPACECRAFT

The Mercury Capsule is the spacecraft itself. A launch vehicle (the rocket) carries the capsule from the launch pad to space, where the launch vehicle is separated, and the capsule continues the journey on its own.

The spacecraft is a cone shaped capsule attached to a launch vehicle, with a launch escape tower attached to the top of the capsule. It is mounted to the launch vehicle using an adapter.

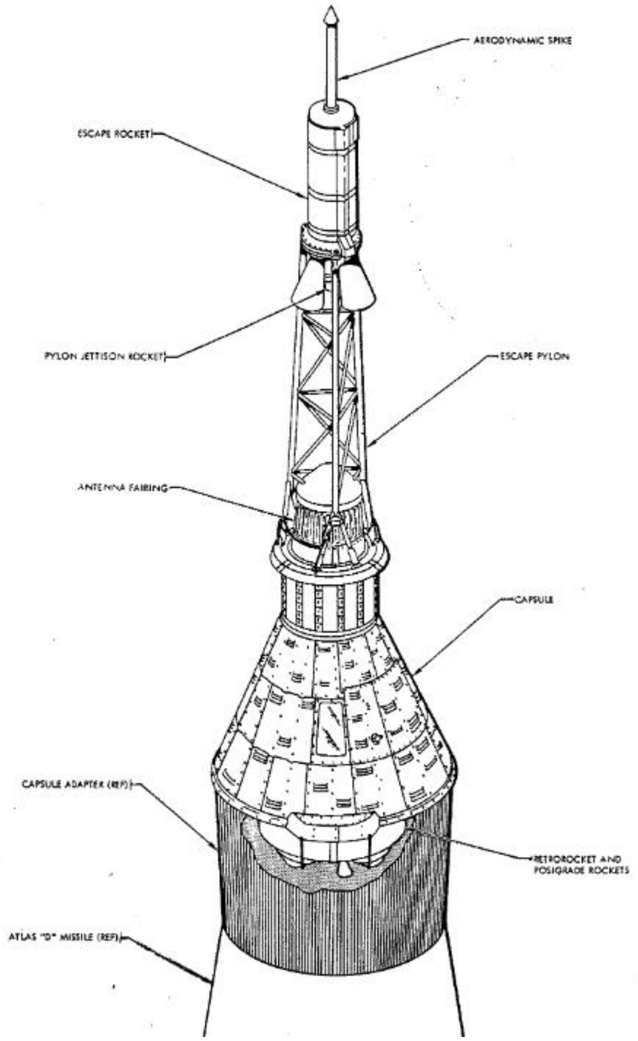


Fig 2.1.1 – Capsule, from the SEDR 104 user manual

During launch and ascent, both the launch vehicle and the launch escape tower will be jettisoned/separated from the capsule, leaving only the capsule. The capsule proceeded with the mission objectives, and reenters back down through the atmosphere and splashes down in the ocean using drogues and parachutes to slow down after the atmospheric reentry.

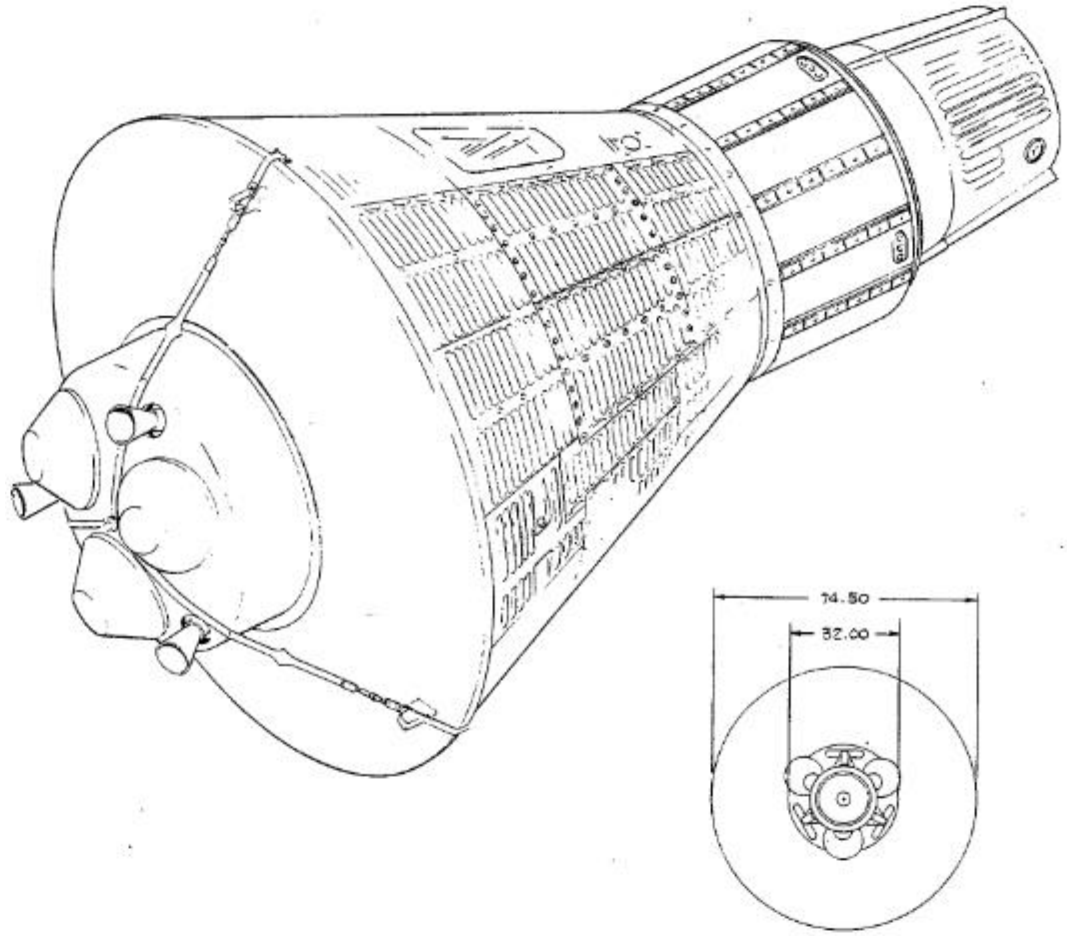


Fig 2.1.2 – The Mercury Capsule after stage separations and launch escape system jettison, SEDR 104 user manual

The capsule is equipped with a retro engine used to slow down the capsule, so it can reenter safely, or get out from an orbit. An antenna module is jettisoned before the drogue is activated during reentry. This antenna is used for radio communication during the mission, and is attached on the sharp side of the capsule.

During reentry, the drogue provides initial drag and attitude correction before the main chutes are activated.

The blunt end of the capsule contains a heat shield used to protect the capsule from the high temperatures during atmospheric reentry, and a landing bag that is activated before splashdown to reduce the structural shock/impact of landing.

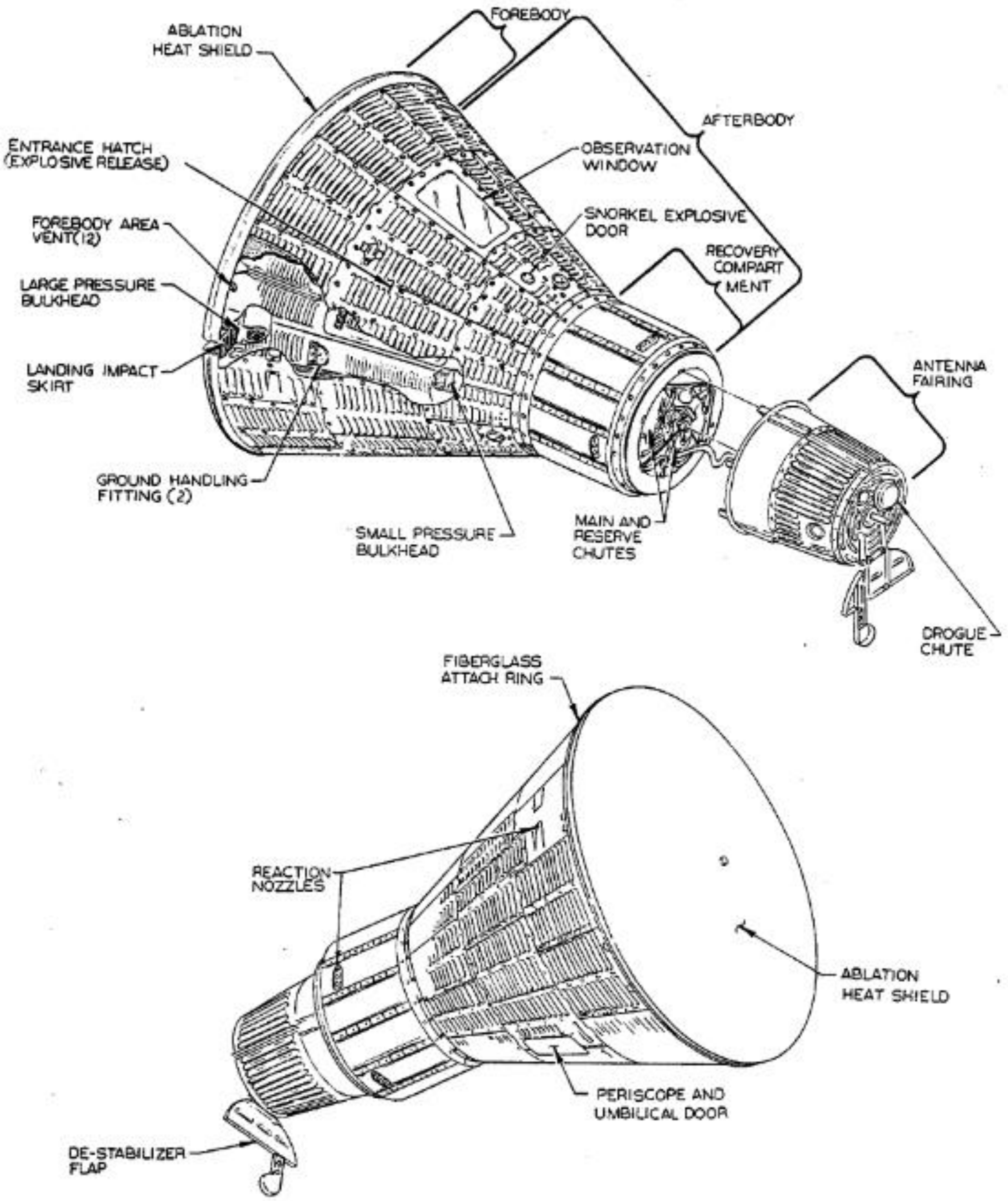
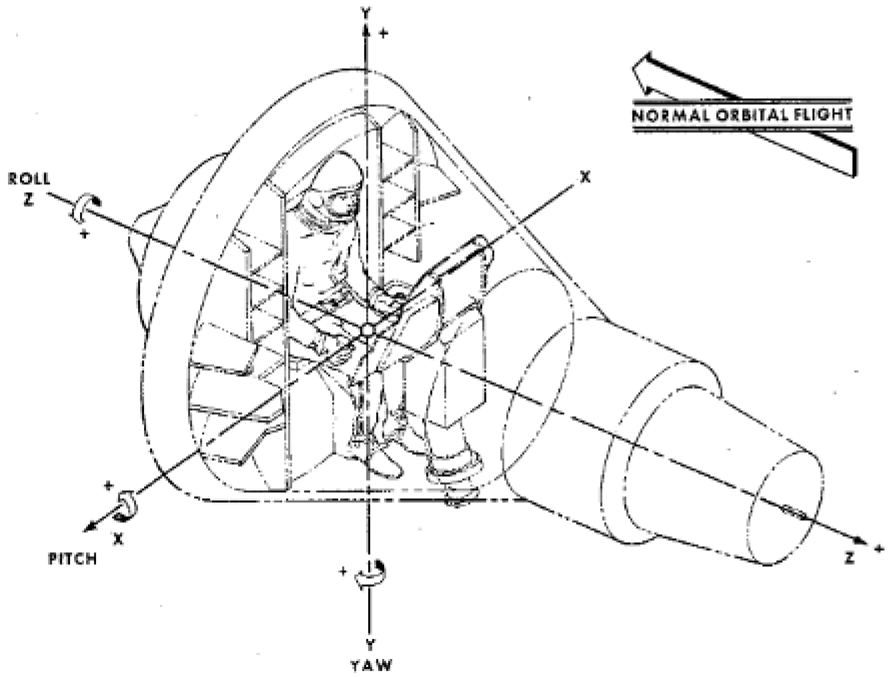


Figure 2.1.3 – Major components of the capsule, SEDR 104 manual

2. ATTITUDE CONTROL

The spacecraft can change attitude in flight using a set of attitude thrusters called the reaction control system (RCS). Using a control stick, or automated systems, the capsule can fire the correct thrusters to rotate and change attitude.



PITCH

PITCH IS DEFINED AS THE ROTATION OF THE CAPSULE ABOUT ITS X-AXIS THE PITCH ANGLE IS ZERO DEGREES (0°) WHEN THE Z-AXIS LIES IN A HORIZONTAL PLANE. USING THE ASTRONAUTS RIGHT SIDE AS A REFERENCE, POSITIVE PITCH IS ACHIEVED BY COUNTERCLOCKWISE ROTATION FROM THE ZERO DEGREE (0°) PLANE. THE RATE OF THIS ROTATION IS THE CAPSULE PITCH RATE AND IS POSITIVE IN THE DIRECTION SHOWN AS ARE THE CONTROL MOVEMENTS WHICH CAUSE IT. THE CONTROL HANDLE MOVES TOWARD THE ASTRONAUT AND THE POSITIVE + PITCH REACTION JET FIRES.

YAW

YAW IS DEFINED AS ROTATION OF THE CAPSULE ABOUT ITS Y-AXIS. CLOCKWISE ROTATION OF THE CAPSULE, WHEN VIEWED FROM ABOVE THE ASTRONAUT, IS CALLED RIGHT YAW AND IS DEFINED AS POSITIVE (+).
THIS MOVEMENT IS PRODUCED BY POSITIVE CONTROL MOTION. THE CONTROL HANDLE IS ROTATED CLOCKWISE (AS VIEWED FROM ABOVE THE ASTRONAUT) AND THE POSITIVE (+) YAW REACTION JET FIRES. YAW ANGLE IS CONSIDERED ZERO DEGREES (0°) WHEN THE CAPSULE IS IN NORMAL ORBITAL POSITION (BLUNT END OF CAPSULE FACING LINE OF FLIGHT). WHEN THE POSITIVE Z-AXIS OF THE CAPSULE IS DIRECTED ALONG THE ORBITAL FLIGHT PATH (RECOVERY END OF CAPSULE FACING LINE OF FLIGHT), THE YAW ANGLE IS 180°.

ROLL

ROLL IS DEFINED AS THE ROTATION OF THE CAPSULE ABOUT ITS Z-AXIS. CLOCKWISE ROTATION OF THE CAPSULE, AS VIEWED FROM BEHIND THE ASTRONAUT, IS CALLED RIGHT ROLL AND IS DEFINED AS POSITIVE (+). THIS MOVEMENT IS INITIATED BY MOVING THE CONTROL HANDLE TO THE RIGHT THEREBY FIRING THE POSITIVE (+) ROLL REACTION JET. WHEN THE X-AXIS OF THE CAPSULE LIES IN A HORIZONTAL PLANE, THE ROLL ANGLE IS ZERO DEGREES (0°).

ACCELEROMETER POLARITY WITH RESPECT TO GRAVITY

WITH THE CAPSULE IN THE LAUNCH POSITION THE Z-AXIS WILL BE PERPINDICULAR TO THE EARTH'S SURFACE AND THE Z-AXIS ACCELEROMETER WILL READ +1 "G".

WITH THE CAPSULE IN AN ATTITUDE SUCH THAT THE Z AND X-AXIS ARE PARALLEL TO THE EARTH'S SURFACE AND THE ASTRONAUT IS IN A HEAD UP POSITION, THE Y-AXIS ACCELEROMETER WILL READ +1 "G".

WITH THE Z AND Y-AXIS IN A PLANE PARALLEL TO THE EARTH'S SURFACE AND WITH THE RIGHT SIDE OF THE ASTRONAUT UP, THE X-AXIS ACCELEROMETER WILL READ +1 "G".

Fig 2.2.1 – Attitude axes, from the SEDR 104 manual

The normal flight direction is with the blunt end going forward, meaning that the retro engines is facing the prograde direction/flight direction. The reason for this is that in the case of an emergency, the retro engines can quickly be ignited to return the capsule back to Earth.

The reaction control system thrusters can change the attitude of the spacecraft in positive and negative Pitch, Yaw and Roll direction, giving full attitude range.

3. CABIN

The cabin consists of one chair for the astronaut, a window, a control panel with all the fuses, instruments and switches needed to operate the spacecraft, a hatch to enter and escape the capsule, and various equipment lockers and so on.

III. LAUNCH VEHICLES

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During Project Mercury, two different launch vehicles was used. Redstone was the first used Launch Vehicle, and was used in the two first manned spaceflights by the U.S. Using the Redstone LV, the spacecraft could enter a suborbital flight above the atmosphere of Earth. The second LV used during Project Mercury was the Atlas. The Atlas was more powerful than Redstone and could launch the Mercury Spacecraft into orbit around Earth.

1. MERCURY-REDSTONE

The Mercury-Redstone Launch Vehicle (LV) was the first American manned space booster. The booster was 25.41 m (83.38 ft) high and carried the spaceship on top of it, including the Launch Escape (the tower on top of the capsule) system.

It was derived from the first stage of the U. S. Army's Redstone ballistic missile named Jupiter-C. It was modified to improve the safety and reliability requirements for human spaceflight.

The U. S. Army's Redstone ballistic missile was chosen by NASA due to being the oldest one in the US fleet. It had been active since 1953 with many successful test flights.

The Mercury-Redstone LV had one stage. It was based on a modified U. S. Army's Redstone ballistic missile stage named Jupiter-C due to its lengthened tanks to carry enough propellant to reach a suborbital trajectory.

The designers of the Mercury-Redstone chose the Rocketdyne A-7 engine. The LV used one of these engines, producing 350 kN (78,000 lbf) of thrust. It was fueled with a 75% ethyl alcohol and 25% water solution. This fuel was not as powerful as the what the Jupiter-C originally used, but it was less toxic in cases of emergencies.

The fuel tank was pressurized using Nitrogen, so an additional nitrogen tank was placed above the fuel and liquid oxygen tanks. Figure 3.1.1 shows the components of the booster.

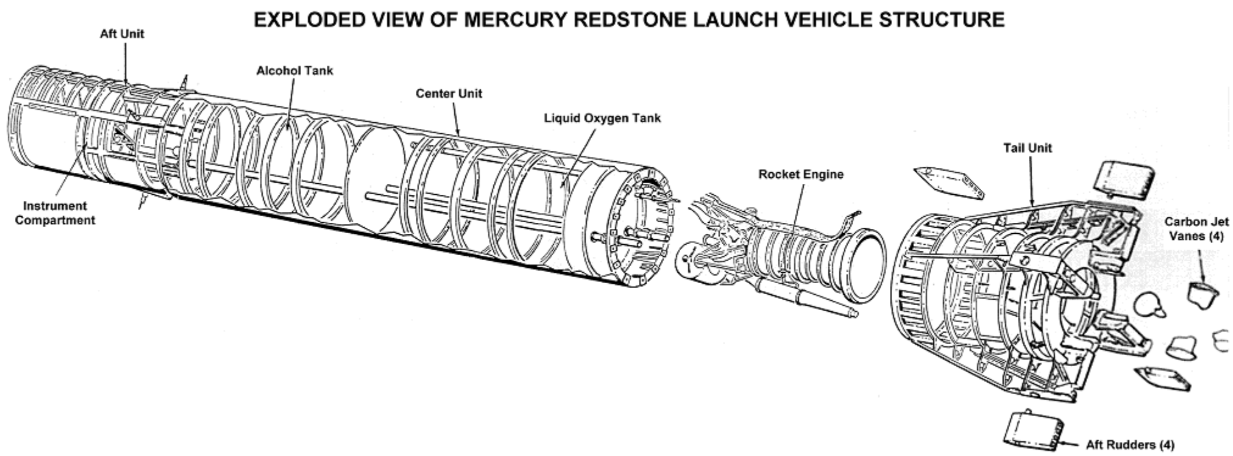


Fig 3.1.1 – Mercury-Redstone LV Structure, https://history.nasa.gov/diagrams/mercury.html

The Aft Unit housed the electronics, instrumentation equipment, guidance system and the adapter where the Mercury Capsule was attached to. When the booster had launched the capsule in a suborbital trajectory, it was separated from the capsule and the capsule would continue on its own.

The Mercury-Redstone LV also had an automated in-flight abort sensing system. In the event of a catastrophic error, the launch escape system would fire its own little engines and pull the capsule away from the malfunctioning launch vehicle.

The abort detection system was also a part of the aft section.

Another section in the Aft unit is a ballast section. This section was there to prevent excess vibrations during launch. Fig 3.1.2 shows a diagram with the booster with the capsule and the launch escape tower attached to it. This is the configuration that was flown on the Mercury-Redstone missions.

The total burn time of the Launch Vehicle was 143.5 seconds, enough to put the capsule in space.

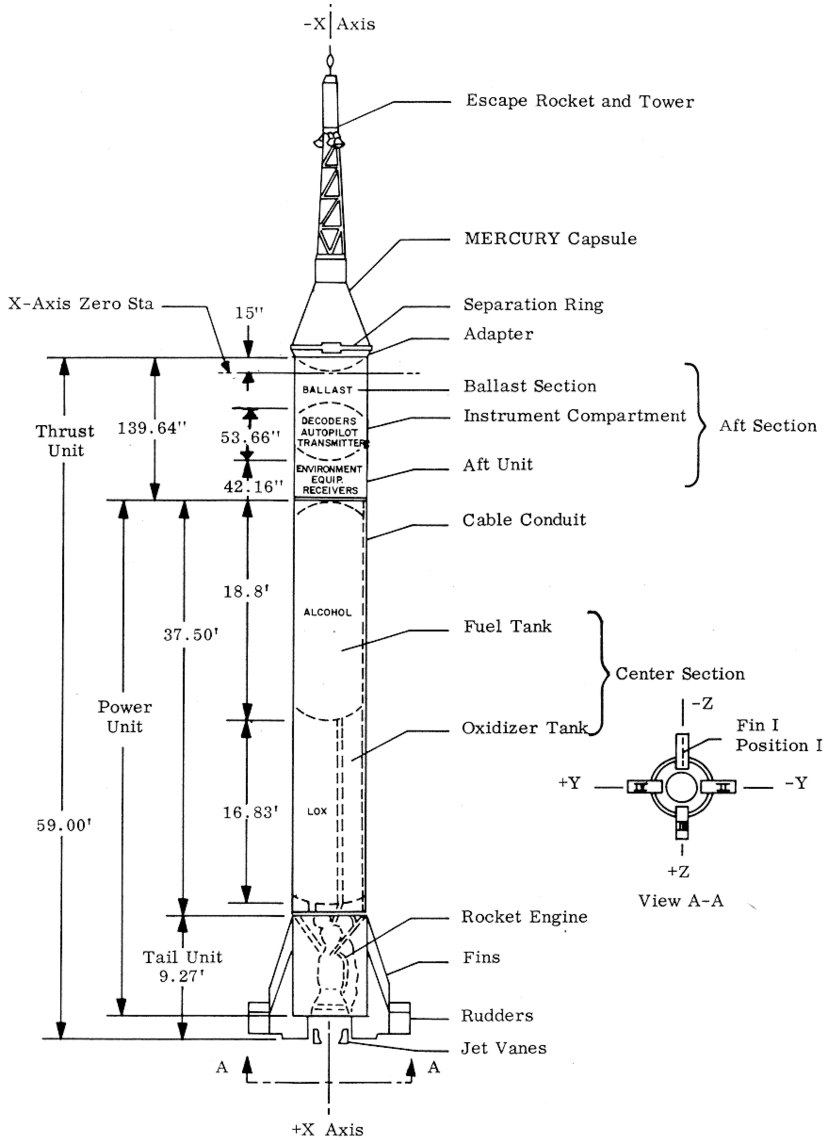
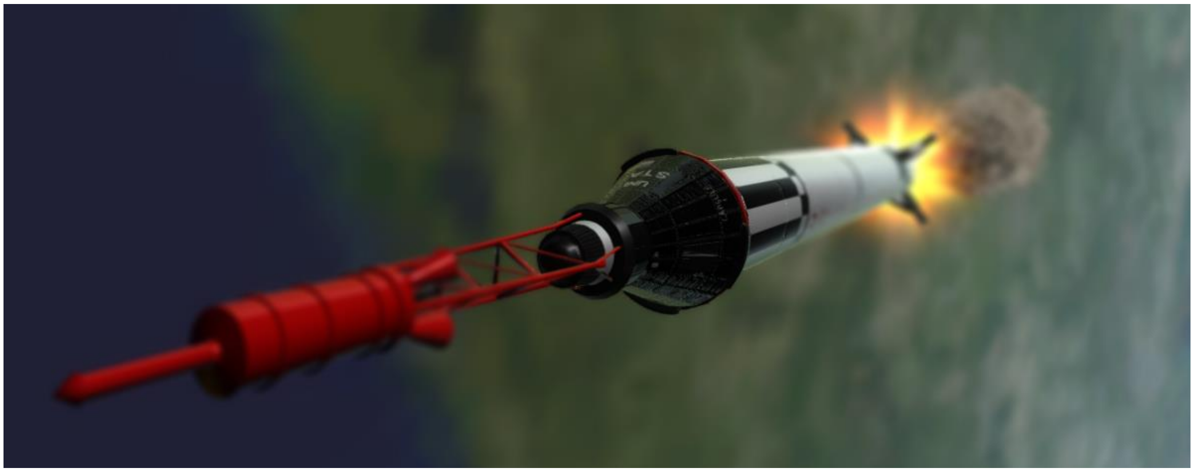
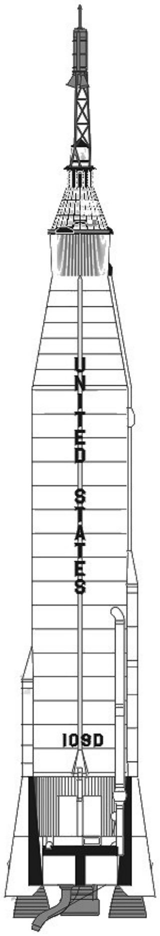


Fig 3.2 – The Mercury-Redstone booster, https://history.nasa.gov/diagrams/mercury.html



2. MERCURY-ATLAS



The Mercury-Atlas Launch Vehicle was much larger than Mercury-Redstone, and was capable of sending an astronaut into a low Earth orbit.

The Mercury-Atlas was a member of the Atlas family of rockets, derived from the SM-65D Atlas missile, manufactured by Convair. It was 28.7 m (94.3 ft) high.

The choice for using Atlas was that it was the only launch vehicle in the US that could put a spacecraft into orbit, with many test flights.

The LV had one and a half stages, with a total of 3 engines. All engines were ignited at lift-off. Two of the engines were attached to the half-stage that was separated after initial boost and was of the type Rocketdyne XLR-89-5 (known as the boosters), producing 1,517.4 kN (341 lbf) of thrust with a burn time of 134 seconds.

The 3rd engine was of the type Rocketdyne XLR-105-5 (known as the sustainer) that produced 363.22 kN (81,655 lbf) of thrust with a burn time of 5 minutes.

In addition to this, there were two Vernier engines on the sides of the launch vehicle used for attitude control. These engines were Rocketdyne LR-101-NA7.

The engines were gimballed, meaning they could slightly change the attitude of the rocket. The verniers were also helping with this during launch and after booster jettison.

The first half-stage (Stage 0) was jettisoned after about two minutes into the flight, where the Vernier engine continued on its own until orbit insertion and capsule separation.

The three main engines used LOX/RP-1 as the propellant and were in the bottom of the rocket. The two booster engines was on each side of the sustainer engine, and was jettisoned with the booster stage to reduce weight during the ascent. The sustainer engine was in the middle and was thrusting throughout the flight. Two verner engines was used to help guidance and balancing.

Figure 3.2.1 shows the layout of the engines, as well as where the two Vernier engines were attached.

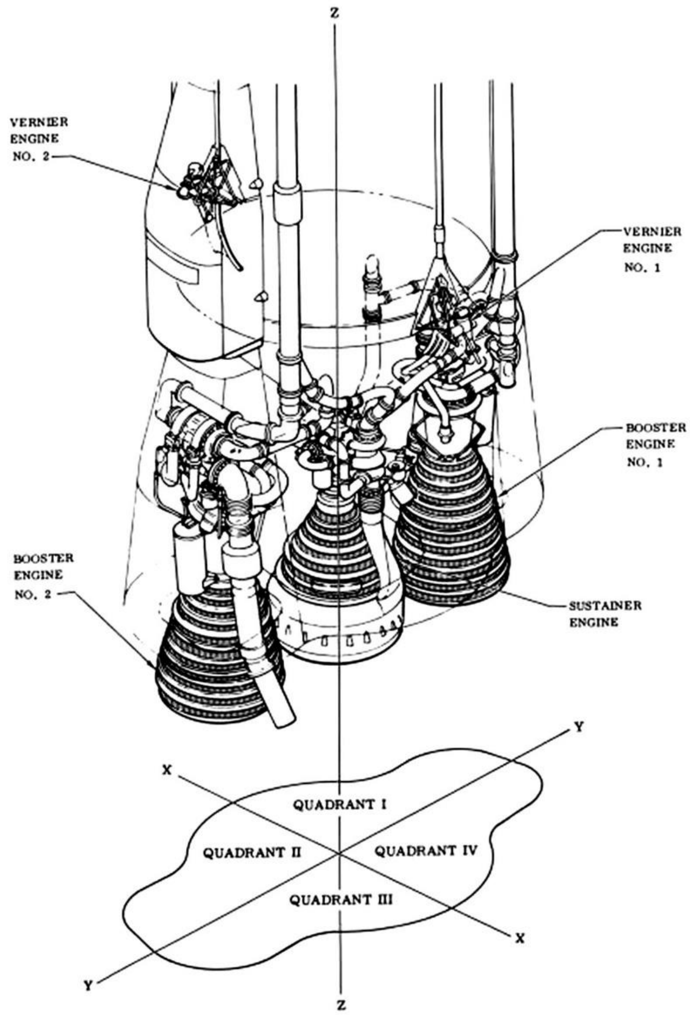


Fig 3.2.1 – Engine setup in Mercury-Atlas - http://www.enginehistory.org/Museums/USSRC/Atlas/0410.jpg

The Mercury-Atlas also contained an adapter where the capsule was attached, as well as instrumentation and guidance. When the sustainer stage had placed the capsule into orbit, it was separated, and the capsule continued its own. As with the Mercury-Redstone, the same abort launch escape tower system was used.

IV. ENVIRONMENTAL CONTROL SYSTEM

IV. ENVIRONMENTAL CONTROL SYSTEM

1. GENERAL

The environment in the pressurized cabin is controlled by the ECS, the Environmental Control System. It is operated through automatic systems as well as manually from the control panel. The ECS provides the astronaut with 100% oxygen during flight and landing.

It has two independent systems, one for the cabin and one for the pressurized suit the astronaut is wearing. It removes odors, CO2 and moisture from the suit circuit, maintains cabin and suit temperature, and provides oxygen and emergency oxygen.

The capsule carries enough oxygen and coolant to sustain life for about 20 orbits.

Figure 4.1.1 shows the ECS panel, it has 7 gauges for reading the ECS status.

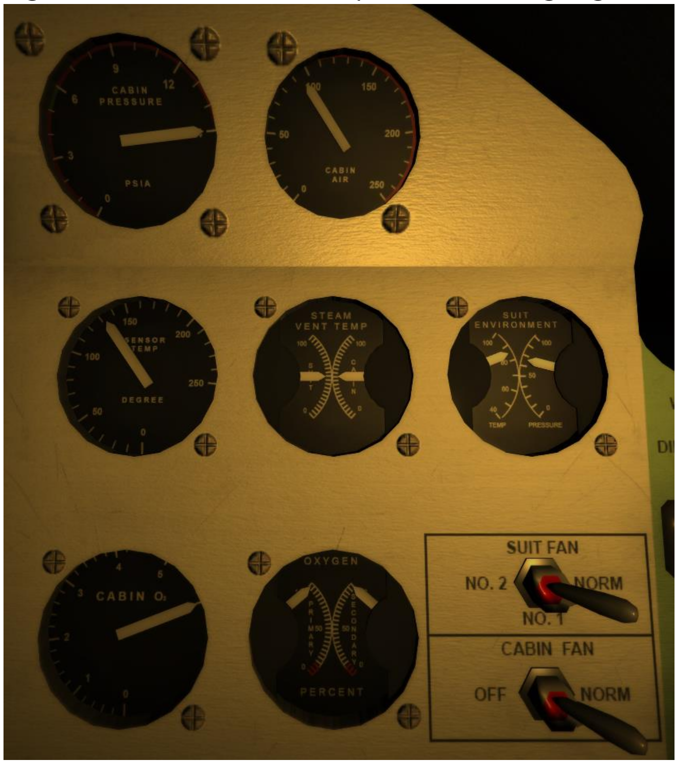


Fig 4.1.1 – ECS Instrumentation

2. OXYGEN

The ECS consist of two oxygen tanks, one primary and one secondary. These two are identical, except the pressure is lower in the secondary, allowing the primary to deplete first before the secondary takes over. When the primary oxygen tank reaches <10%, the secondary tank takes over. This is fully automatic.

The OXYGEN instrument will give you an indication of the amount (percentage) of oxygen left in either of the two oxygen tanks.

The two tanks are equal, and gaseous oxygen is stored at 7500 PSI.

During launch, the cabin is pressurized with 100% pure oxygen at 16 PSI. This pressure will bleed off during ascent. When the pressure reaches 5.5 PSIA, the regulator will seal the cabin and stop the bleeding. The ECS will use the available oxygen in the two oxygen tanks to maintain this pressure for the reminder of the flight.

During decent, the ECS will go to emergency mode, using oxygen to quickly circulate air in the cabin and suit. A snorkel will also provide fresh air from outside. This will quickly deplete the oxygen tanks.

The cabin can be decompressed manually by pulling the decompress handle, and repressurized again using the repress handle. This is good in case of fire or toxic gas.

If the cabin pressure is out of bounds, a cabin pressure warning light will illuminate.

During descent, a SNORKEL is used to open the cabin air inlet so outside air can enter the cabin. This happens automatically but can also be triggered manually by pulling the SNORKEL ring. This is normally used below 20k ft. before landing.

3. COOLING

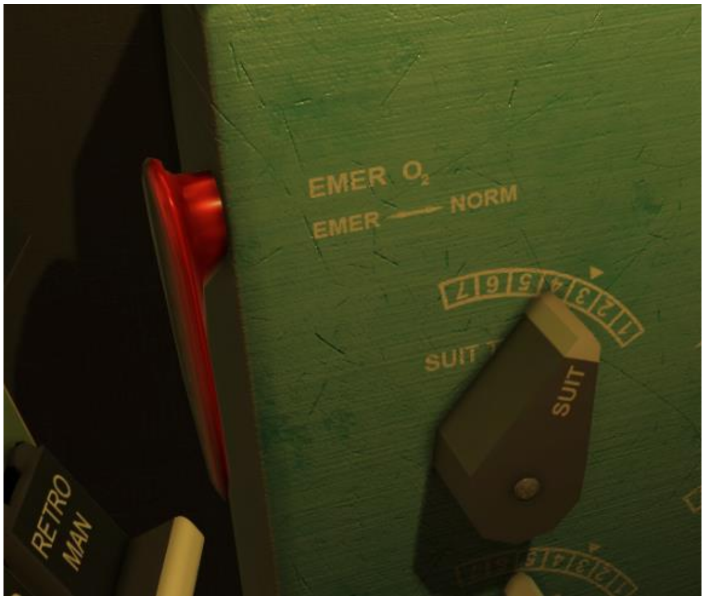
The construction of the cabin is made so it only requires cooling, due to the low heat generating equipment and small pressurized compartment. Air is routed through a heat exchanger to cool the air, and a water-cooling system cools down the equipment. This water is also passed through heat exchangers, and vented overboard.

The heat exchangers temperature can be read using the STEAM VENT TEMP gauge.

For the water-cooling system, two heat exchangers are used. One is for the cabin circuit, and one for the suit circuit. A water coolant tank provides the cooling water, and temperature is controlled on the temperature panel.

Fans are used to force air through the heat exchanger, providing cool air to the system. The cabin circuit has one fan, and the suit circuit has two, one main and one backup. These are operated automatically but can be overridden by the astronaut. If the cabin fan fails, the temperature in the cabin will slowly start to increase. If the suit fan fails, the backup will start automatically.

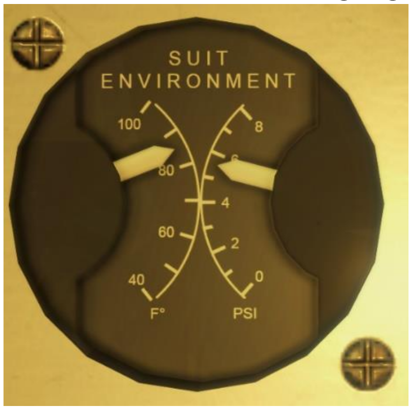
If all the fans fail, an emergency oxygen rate flow is available, and will push oxygen through the circuits at a high rate. This will use the oxygen fast, so if this happens – plan an immediate reentry.



Note: The EMER O2 system is the same system that is automatically triggered after entry.

It is important to monitor the cabin and suit temperature frequently (every 10 minutes), as well as the oxygen quantity and pressure. The CABIN AIR gauge indicates the cabin air temperature, try to keep it below 100 degrees if Fahrenheit.

The SUIT ENVIRONMENT gauge indicates the temperature in the suit circuit.



The fans can be controlled using two switches on the main ECS panel, as well as fuses.

The SUIT FAN switch controls what suit fan is operational. NORM will let the ECS control the FAN operation. No.1 will manually run the primary fan on the suit circuit, and No.2 will run the secondary/backup fan in the suit circuit.

The CABIN FAN switch run the cabin fan. This can be turned off by setting the switch to the OFF position.

A SUIT FAN circuit breaker/fuse controls if any of the fans will be connected to the electrical system.

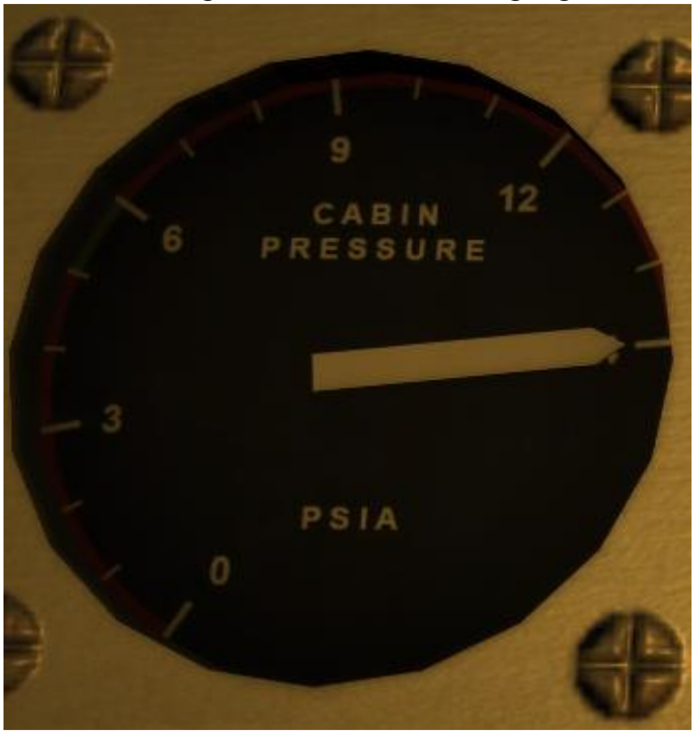
The FANS are using AC power, and is connected to the FANS AC BUS. The FANS AC BUS receives power from the primary or the standby power system. A switch on the electrical panel can be used to connect the FANS AC BUS to the Standby power system if needed.

A carbon dioxide filter and odor filter are installed in the circuit. These uses lithium hydroxide and activated charcoal to function, and excess humidity is removed by a sponge that traps water particles. When this sponge is full, it will automatically be squeezed, and the water will flow into a tank.

The temperatures can be controlled using the temperature control panel on the right side of the cabin, and the main panel. This panel has 3 rotary switches. Operating these is mandatory during the mission. If you are on the dark side of the Earth, less cooling is needed to keep the environment heated. On the sunny side, more cooling is needed to keep the environment cool. The Emergency O2 handle is also on this panel, and is used if the fans and cooling systems malfunction.

4. CABIN PRESSURE

Cabin pressure will bleed during ascent and stabilize at 5.5 PSIA. Cabin Pressure can be monitored using the CABIN PRESSURE gauge:



If the cabin pressure cannot be maintained and falls outside of the operating limit, the CABIN PRESS warning light will illuminate, and a tone will sound. This tone can be muted using the switch next to it.

In the event of a fire, or any other circumstance where you will need to depressurize the cabin, you can do so by using the two T-handles on the left panel.

One is for depressurizing the cabin, and the other is to repressurize it. Keep in mind that repressurizing the cabin needs a lot of oxygen, so pay attention to the oxygen instruments.

5. OPERATION

The ECS is fully automatic, and under normal circumstances you only need to check the vital measurements on ECS instrument panel and configure temperature levels.

4 warning lights with an alarm tone will illuminate when something needs attention.

Pay attention to these.

V. FLIGHT CONTROL SYSTEMS

V. FLIGHT CONTROL SYSTEMS

1. GENERAL

The capsules attitude and stabilization is controlled by the Automatic Stabilization Control System (ASCS), the Horizon Scanners and the Reaction Control System.

Attitude is determined by three gyros indicating pitch, roll and yaw. Three accelerometers are used to detect rate.

Three switches control the ASCS. These can configure the capsule to either be controlled automatically, manually or something in-between.

The ASCS controls the Reaction Control System (RCS). The RCS is a set of thrusters that can change the capsules attitude. It consists of two systems: System A and System B. System A is meant for automatic modes, and system B is meant for manual modes.

Both system A and B has their own independent fuel tank, and can be monitored using the FUEL gauge:

The Horizon Scanners are detecting the attitude relative to the horizon of Earth. The GYROS can be slaved to these scanners, or be set to FREE mode. In FREE mode, the gyros will change based on thrust input. Once in slave, the gyros should snap back to the orientation known by the horizon scanners.

If the FUEL quantity is below 25% in any of the tanks, the FUEL QUAN warning light will illuminate. If is very important to limit the use of fuel during the entire mission.

2. ATTITUDE CONTROL

Attitude is sensed by gyros and accelerometers. Two independent systems are used for attitude control, system A and system B.

ATTITUDE

Attitude is sensed based on your orientation in reference to a stable platform maintained by three gyros. The relative orientation to this platform can be read from the attitude indicators, and the angular attitude rate is sensed by accelerometers and can be read from the attitude rate indicators.

Each axis is identified by a color code. Roll is white, pitch is pink and yaw is tallow. The roll indicator tells you how much you have rolled relative to the stable platform, pitch is your pitch relative to the stable platform, and yaw is your yaw relative to the stable platform. The square in the middle consists of three arrows using the same color coding as the attitude indicators. One long horizontal arrow is your pitch rate, while the top vertical arrow is roll rate and the bottom is yaw rate.

HORIZON SCANNER & GYROs

The GYROs are free, and any stable platform can be set by caging the gyros. Most of the attitude requirements during the mission is relative to Earth. The nominal orbit attitude is -34 pitch, 0 yaw and 0 roll. This means that you need to pitch your spacecraft to -34 relative to Earth.

The Earth is detected using Horizon Scanners. These scanners constantly keep track of the Earth horizon, and the gyros can be slaved to maintain this as the stable platform.

The GYRO switch controls your GYRO settings.

GYRO NORM slaves your gyros to the Horizon Scanners, FREE lets the GYROs move based on attitude rate changes, and GYRO CAGE cages the gyros, and returns them to 0,0,0 and keeps them there regardless of attitude or attitude changes.

The spacecraft supports orientation 360 degrees in all axes. However, the GYROs don't like this. Moving the spacecraft outside of the gyro operation range will cause them to drift or become unstable. This will give you wrong readings on the attitude indicator.

When performing operations outside of the gyro limit, it's advisable to either set the gyros to free, or cage them.

This will make you have to realign the gyros again manually.

Gyro Operations Limits
Pitch: -130 degrees to 90 degrees
Yaw: 250 degrees to 70 degrees
Roll: -80 degrees to 80 degrees

If your GYROs drift, become unstable or stops working, you can use the window as a platform reference, as well as the periscope. It's important to frequently use the gyroscope and window to learn where the horizon is relative to the lines so you know what attitude these indicate.

The MANEUVER switch can be used to power down the GYROs.

SYSTEM A

This system is the AUTOMATIC system, and its fuel is dedicated to the automatic flight controls. There are three automatic flight modes: Automatic Stabilization & Control System, AUX DAMP, and Fly-By-Wire

Automatic Stabilization & Control System
The ASCS mode orients the spacecraft based on mission phase and the sequencer. It can enter damp mode that damps the attitude rates (like after capsule separation), orient the capsule to

orbit attitude, reentry attitude and so on. The Orbit attitude is the base attitude used through orbital flight.

AUX DAMP
The AUX DAMP mode will damp out any attitude rates. It will try to hold the spacecraft's orientation in place. This is good if you just want the spacecraft to maintain a given orientation.

Fly-By-Wire
This system is an electrical orientation system that enables you to use the attitude control stick to change attitude. The thrusters are fired based on what direction to push the control stick.

SYSTEM B

System B is the MANUAL system. It uses fuel from the MANUAL fuel tank. It can use variable thruster power, and can be used in two different main modes: Manual Proportional and Rate Stabilization & Control System.

Manual Proportional
You use the attitude control stick to adjust the attitude, and provided variable attitude acceleration. This is the only mode that don't require any electrical power to function.

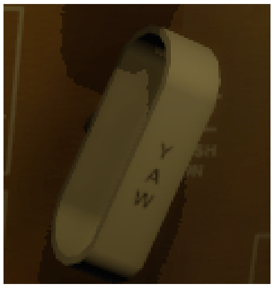
Rate Stabilization & Control System
Uses the ASCS as well as the manual control to change the attitude.

3. FLIGHT MODES

In section 5.2 we already looked at a few different flight modes. There are more flight modes available using the two flight mode switches mentioned above, and 4 push/pull handles.

These handles can be used to combine the different modes. The main handle is MANUAL, which is needed to enter the MANUAL modes.

The MANUAL handle switches between the manual (DIRECT) thrusters and the automatic, and the three white handles, one for each axis, is used to cut the fuel supply from the automatic system to these axes. This can be used to let the ASCS control two of the axes, while you control the other.



This section will describe the switch configurations needed to enter the various main flight modes. You can be creative and use others that's not been described here as well.

The first switch is named ASCS switch, the 2nd is named RSCS switch and the last is named GYRO switch.

1: FULLY AUTOMATIC

The fully automatic mode is using the ASCS only, and provides no manual control. Remember, this mode can fail or the sensors/systems can fail so pay attention and be ready to take over if something happens.

CONFIGURATION

ASCS to NORM
RSCS to AUTO
MANUAL handle to PUSH

2: FLY-BY-WIRE

The Fly-By-Wire control mode enables you to control the attitude in the automatic mode, thus using fuel from the automatic fuel tank.

CONFIGURATION

ASCS to FLY-BY-WIRE
RSCS to AUTO
MANUAL handle to PUSH

3: MANUAL PROPORTIONAL

The MP control mode enables you to control the attitude manually, thus using fuel from the manual fuel tank.

CONFIGURATION

ASCS to AUX or AUTO
RSCS to RATE COMD
MANUAL handle to PULL DIRECT

The ASCS switch can be used to enable AUX damping, or not.

4: RATE COMD

This mode allows you to control the attitude of the spacecraft, but when not stick input is detected, the ASCS will fire the thrusters needed to stop the rates.

CONFIGURATION

ASCS to AUX or AUTO
RSCS to RATE COMD
MANUAL handle to PUSH RATE COMD

VI. RETROGRADE ROCKET SYSTEM

VI. RETROGRADE ROCKET SYSTEM

1. GENERAL

The RETROs are three engines designed to decelerate the capsule in preparation for reentry. It's a critical part of the spacecraft where a lot can go wrong.

In short, the retros are the only equipment the spaceship has that can alter the Orbit itself. The RCS can only controls changes orientation, but the velocity direction remains unchanged.

A lot of caution is needed while operating the retro engines. If you fire them in the wrong orientation, you might alter the orbit in such a way that you never get back to Earth, or reenter too steep and burn up in the atmosphere. The timing of when you fire the retros are also important as it defines where you will land on Earth. You want to fire them so you land in a recovery zone.

The retrograde sequence can be started automatically by the internal sequencer and TIME TO RETRO, or manually by the astronaut.

The three engines will fire for 10 seconds each, with a 5 second time delay between each of them.

Once fired, the RETROs will automatically be jettisoned (if RETRO Auto Jett switch is armed), or manually by the astronaut.

Due to the importance of these engines, never arm the auto retro squibs unless you plan to jettison them soon, and ensure you have control over the respective fuses. It's a good practice to open and close the fuses based on need. Without the retro engines, you will not have any way of returning to Earth.

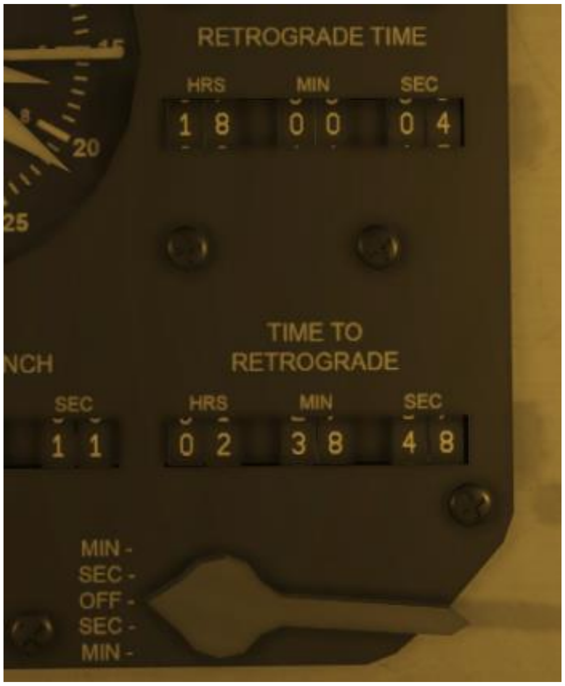
2. OPERATION

The three retrograde engines are located on the Retrograde Package attached to the blunt end of the capsule. It's attached to the Heat Shield by three straps and explosive bolts. 60 seconds after retrograde, the bolts are detonated and a spring assembly pushes the pack away from the capsule. Each engine is directed relative to the center of gravity to keep the spacecraft stable during retrograde, but some attitude rate can occur.

Each rocket delivers about 1000 pounds of thrust for 10 seconds. When they receive the retrofire signal, the No.1 engine will ignite and fire for 10 seconds. 5 seconds after ignition of No.1 engine, No.2 will fire for 10 seconds. 5 seconds after No.2 has ignited, No.3 fires for 10 seconds. Total engine-on time is 20 seconds.

The pack also hosts three smaller engines. These are named the posigrade engines and will fire automatically when the capsule is separated from the launch vehicle in the prograde direction. These are only fired for about one second to move the capsule away from the LV.

The retrograde engines are fired either automatically based on the TIME TO RETRO timer (Tr). This timer can be set manually, or by the ground station through radio commands.



The RETRO SEQUENCE will start when Tr is reached, or manually by pressing the protected RETRO SEQ trigger given that the EMER RETRO SEQ fuse is ON.

Left click the protective cover to remove the cover and press the trigger. Once the SEQUENCER initiates the RETRO SEQUENCE, this light will illuminate. At this point you will need to maneuver the capsule in RETROGRADE attitude, and the FIRE RETRO signal is given 30 seconds after.

The RETRO DELAY switch lets you choose if the RETRO FIRE signal will happen immediately when the RETRO SEQ has started, or INSTANTLY. NORM is preferred as it gives you time to verify, and use the automatic sequencer to complete the next steps. Use INST only in emergencies.

The RETRO ATT will illuminate orange if you are in the wrong attitude and green if you are in the correct attitude. The FIRE RETRO trigger will not automatically happen if you are in the wrong attitude.

The switch next to this light allows automatic RETRO ATT event handling to the sequencer. If you put this to bypass, the retros will FIRE regardless of attitude. This is not desired as firing in the wrong direction will make a safe reentry impossible.

With the attitude control mode set to ASCS, the ATTITUDE SELECT switch will orient the spacecraft to the selected attitude. RETRO is used before and during retro fire.

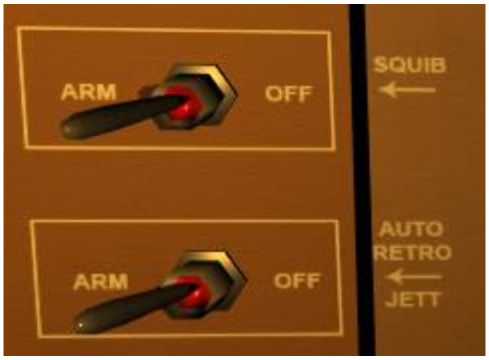
30 seconds before the FIRE RETRO signal is given, a warning light with a tone will trigger to let you know that the engines will soon trigger. At this time, ensure everything is correct, panels are configured, and that the attitude is right just to be sure.

When the correct attitude is reached and the RETRO SEQ timer reaches 0, the engines will fire given that the RETRO MAN (optional), and NO.1,2,3 RETRO RCKT are ON.

The FIRE RETRO light will be red 10 seconds before the FIRE SIGNAL is given and will switch to green when the retros has fired. If you are not using autopilot here, the RETROS will push the orientation and build up rates. Keep this under control manually.

When the retros have fired, it's time to jettison the retro pack as it's no longer needed. To do this, the AUTO RETRO JETT switch and the SQUIBs must be set to ARM.

If one of the retros didn't fire due to fuse settings, you can fire it again by enabling the fuse and pressing the manual FIRE RETRO trigger.



60 seconds after the retro fire, the signal to jettison the retros will be given. To manually jettison the retros, you can use the trigger button next to it. The light will turn red two seconds before jettison, and green when complete. The EMER RETRO JETT and RETRO JETT fuses must be on for this to happen.

3. RETROGRADE TIMING

The timing of the retro grade fire event varies depending on the altitude and velocity when they are fired, and where in the Orbit you currently are. Missions have preset retrograde times, but these will most likely change. Ground will do this for you, or you can do it manually using the clock.

Basically, the lower the altitude, the faster you are going relative to Earth due to the smaller orbit (lower orbit period). At this point, the retros will need to be fired earlier. If you are far out, you are going slower and the retros can be fired later.

Generally, the retros are fired about 3000nm miles before the splashdown location.

The Retrograde Time Control panel is used to modify the time to retrograde. The handle can be held in the MIN and SEC positions to adjust the time.

VII. SEQUENCER

VII. SEQUENCER

1. GENERAL

The sequencer is a system that controls all the automatic events, and the sequencer status can be read using the column of lights on the left side of the panel. It indicates what state the capsule is in, what state is being executed, what is completed, and what has failed.

The sequencer consists of various sensors, switches, relays, and time delays to function correctly. It's the state machine of the spacecraft. The sequencer applies power to the various systems, such as the FIRE RETRO signal, or the release of the chutes. It also detects when you separate from the LV, and what mode the ASCS needs to be in.

Tower Separation is the first stage and indicates if tower has separated. Capsule separation is the next and indicates if the capsule is separated from the LV. The next set is for RETROs, .05g (atmosphere is detected), DROGUE and MAIN chutes.

Each stage can be manually executed by the astronaut, but the sequencer is usually fully automatic.

2. EVENTS

The sequencer is operated by using the sequencer panel. Each stage has a light and might have switches or trigger buttons to manually control or aid the sequencer. The sequencer is controlled by the Programmer, so the Programmer fuse must be on for it to operate. Fig 7.2.1 shows the Sequencer stages.

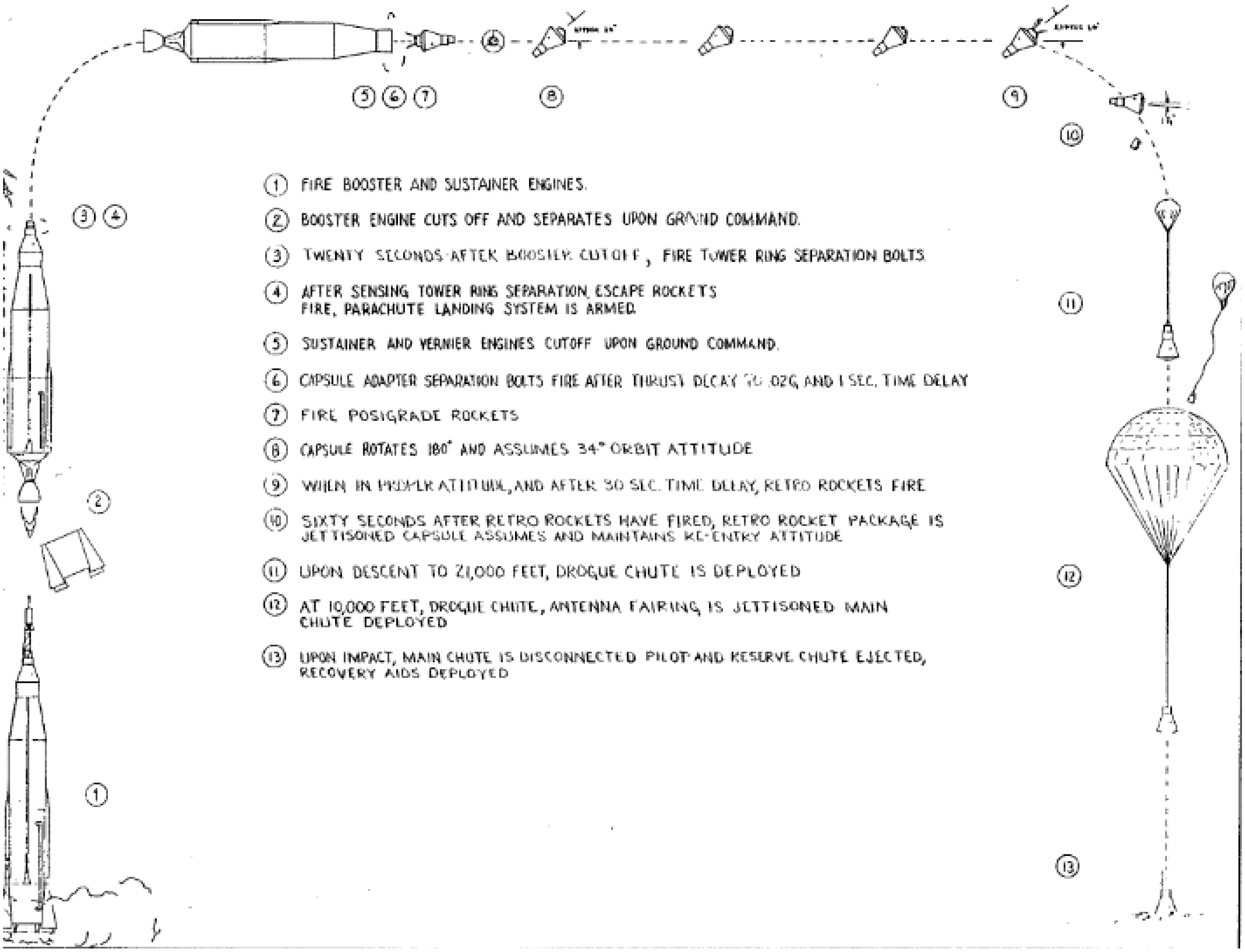


Fig 7.2.1 – Sequencer stages, from the SEDR 104 manual

At launch, the sequencer will fire the boosters and the sustainer engines. At the right time, the booster engine cutoff will happen (BECO) and it will be jettisoned. 20 seconds after BECO, the tower will be jettisoned, and the TOWER JETT light will illuminate, and the landing system will be armed. Then the sustainer engine will initiate cutoff and the capsule will be separated after a short delay. At cutoff, the posigrade engines will fire to clear some distance from the launch vehicle. At this point, the ASCS is asked to enter the damp mode, and then perform a 180 yaw turn to attain orbit attitude.

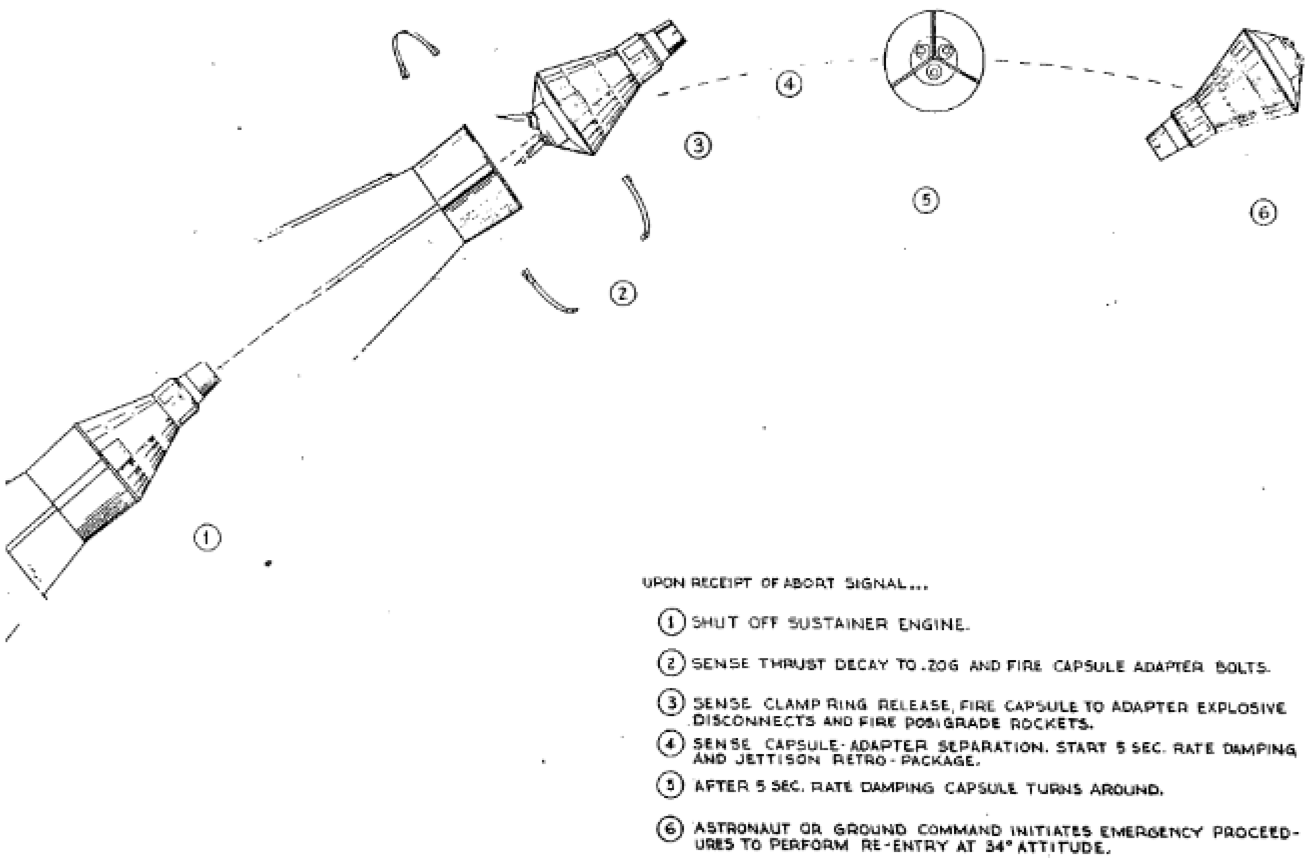
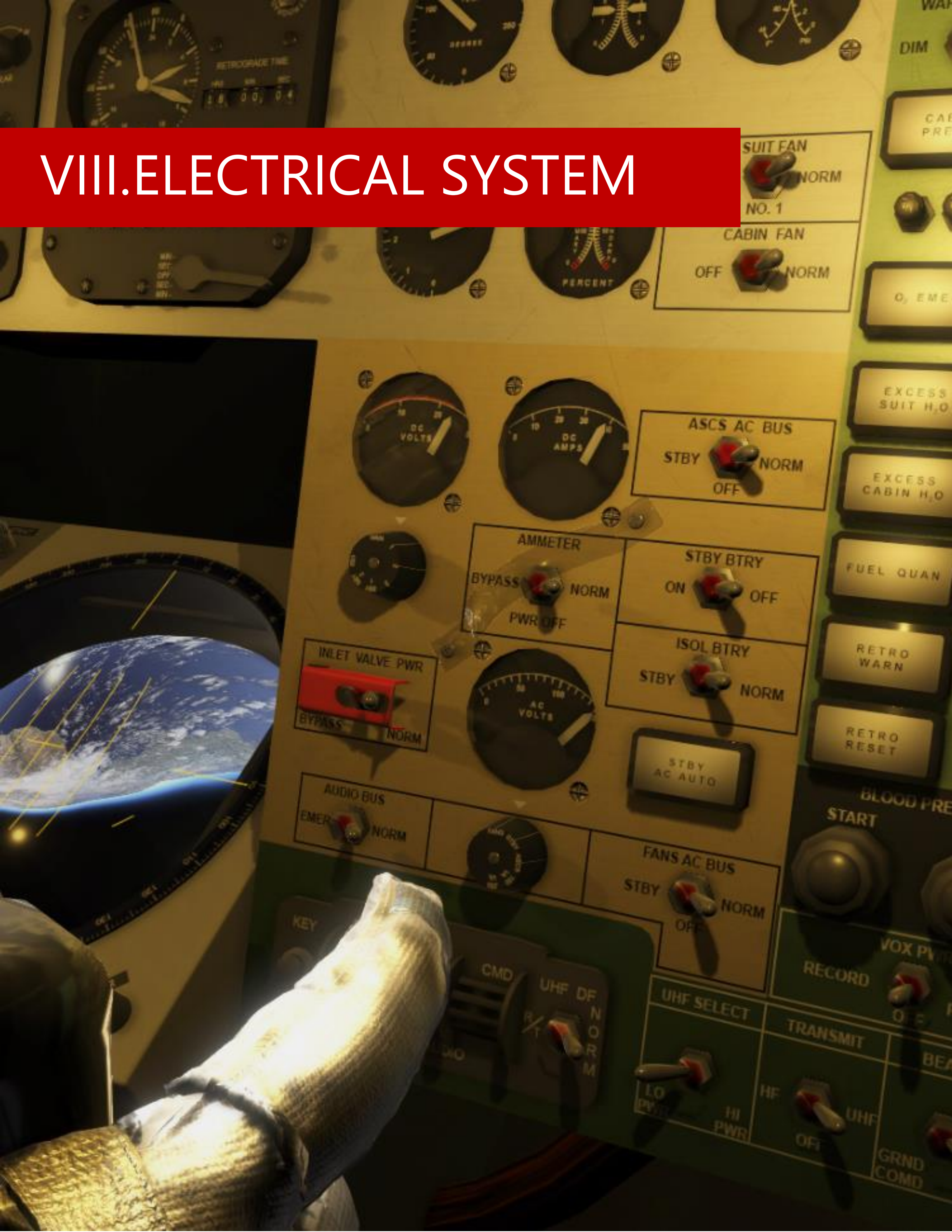


Fig 7.2.2 – Sequence during SECO and Capsule turnaround, from the SEDR 104 manual

The retro sequencer will start at the given retro time, and 30 seconds later, then retrograde fire signal will be given. If everything is in order, the retros will fire, and then jettisoned 60 seconds later. At 21.000 ft. the drogue will be deployed, and the snorkel will be opened.

At 10.000 ft. the main chutes will be deployed, releasing the drogue and jettisoning the antenna, as well as releasing the heat shield and filling the landing bag.

VIII.ELECTRICAL SYSTEM



VIII. ELECTRICAL SYSTEM

1. GENERAL

The capsule uses both DC and AC power to operate correctly. The DC system is powered by three 3000 watt-hour batteries in series. Two Standby 1500 watt-hour batteries are also available in case of main battery failures.

A 1500 watt-hour Isolated battery is also available for squib firing and the emergency audio bus.

Prior to launch, power is received through an umbilical connection (external power).

During failures and emergences, the main DC bus can be connected to the standby DC bus. The Isolated Bus can also be connected to the standby bus. This provides to possibility to reconfigure the electrical system to power the main DC bus using the standby batteries and/or the isolated battery.

AC power is created by inverters of 150 and 250 volt-amperes each. Two systems require AC power: The ECS FANS bus and the ASCS bus.

A standby 250-volt-ampere inverter can be used in case of failures. If this happens, a warning light will on the panel will let you know - this is fully automatic. Switching the FANS AC or ASCS AC switch from NORM to STBY position control what inverter they are connected to.

The ammeter can be used to see how much ampere is being drained from the batteries, the voltmeter can be used to see the status of each battery, and the inverter load. Fuses can turn on or off systems, as well as switches to balance or reduce load on batteries. Battery capacity check can only be done with GROUND by a telemetry radio command.

2. DC POWER

The Main Batteries are connected to the Main DC bus through a battery bus. The STBY BTRY switch ties the standby battery bus directly to the Main DC bus. If the Standby Batteries are connected, both the Main batteries and the Standby batteries are powering the Main DC bus.

The Isolated Battery is connected to the Isolated Battery bus, powering the Squib Bus and an Emergency Audio bus. The Squib Bus powers the pyros needed for staging and sequencing. If this fails, the Isolated bus can be tied to the Standby bus for power using the ISOL BTRY switch.

The AUDIO BUS switch can tie the AUDIO BUS to the ISOLATED Battery.

The DC Amps load on the various batteries and the Main bus can be read using the Ammeter.

,

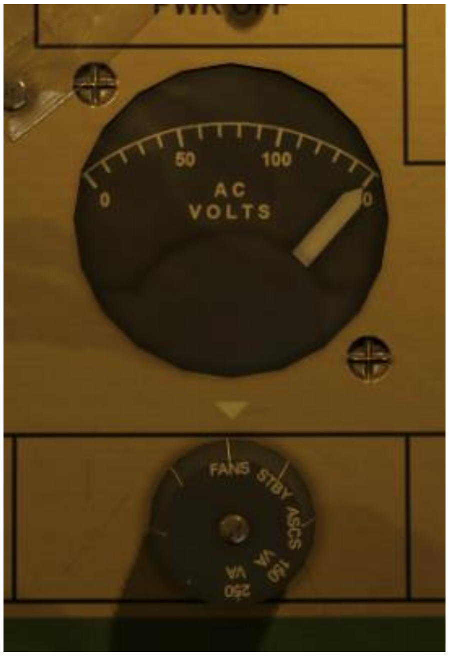
The DC Volts indicates the voltage of the selected system, meaning if it's producing power, and how much it produces. The system that you want to look at can be changed using the DC selector. MAIN shows the volts and load on the MAIN DC bus, 1,2,3 shows battery status, SBY 1,2 shows standby battery status and ISO shows the Isolated Battery status. If a voltage is low, something is wrong. The voltage should display a value around 24 volts.

The DC amps shows the load on the system. Turning on or off systems will increase/reduce the power load on the power sources.

The AMMETER switch can either be bypassed (to conserve power if needed) or operate normally in the NORM position.
CAUTION: Powering the AMMETER OFF will remove power to the entire MAIN DC bus.

3. AC POWER & INVERTERS

Three INVERTERs produce AC power to operate the ASCS AC Bus and the FANS AC bus. The three inverters are the Standby Inverter (250 VA), Main Inverter (150 VA, Fans) and another Main Inverter (250VA, ASCS). AC Volts on the various components can be read by the AC VOLTS gauge, controlled by the AC VOLTS selector rotator switch.



The ASCS AC BUS switch can be used to switch the ASCS AC Bus from the main inverter to the standby inverter.

The FANS AC BUS switch can be used to switch the FANS AC Bus from the main inverter to the standby inverter.

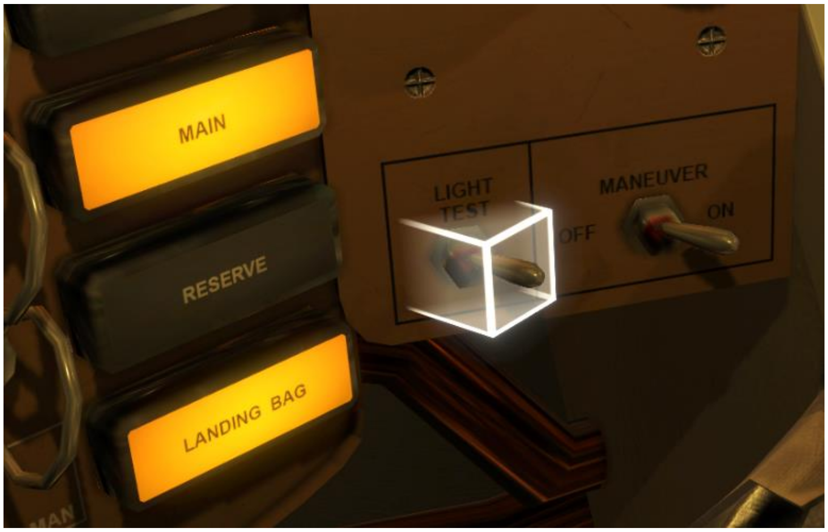
The STBY AC AUTO light will illuminate if the Standby Inverter is being used.

4. LIGHTS

Multiple light bulbs are located on the cockpit panels. The chance that any of them might fail is small, but the event can be catastrophic. If a light turns off during a system failure, or turns on during normal operations when it should not – a wrong reaction can be triggered.

To ensure that all the lights are functional, you can perform a light bulb test using the LIGHT TEST switch. Middle is normal state, while the right is to test all red lights, and left is to test all green lights. Left will also illuminate the red bulbs where no green light exists.

The switch can be found next the MANEUVER switch on the lower left central panel.



There are two cabin lights. One on the left side and one on the right side. Clicking the light itself when it's on will apply or remove a red filter. The CABIN LIGHT switch allows you to select what light is on or off.

5. FUSES

There are is a huge range of fuses, and for the beginners it's best to just leave them on unless told otherwise by the checklists.

Each fuse switch has three positions. Position 1 is UP, OFF is middle and 2 is down. Each fuse has two fuses, No.1 and No.2, for redundancy.

All the fuses are located on two different panels. One on the left side, and one on the right side. All of the fuses are functional, so you should spend some time locating each, and understanding what system they belong to.


PHASE
SHIFTER
EMER CAP
SEP CNTRL
EMER ESCAPE
RCKT
TOWER SEP
CONTRL
EMER TOWER
SEP
EMER TOWER
JETT
EMER POSGRD
AUX BCN
NO 1 RETRO
RCKT
NO 2 RETRO
RCKT
NO 3 RETRO
RCKT
EMER RETRO
SEQ
EMER RETRO
JETT
ASCS .05 G
EMER .05 G
EMER DROGUE
DEPLOY
EMER MAIN
DEPLOY
RESERVE DEPLOY
EMER
RESERVE DEPLOY
EMER
LAND BAG
EMER
RESCUE AIDS
PERI SCOPE
COMV RCVR A
TRIM HI-FREQ


SUIT FAN
INVR-CONTRL
OFF
RETRO JETT
RETRO MAN
PRO-GRAMR
BLOOD PRESS
BEACON

IX. COMMUNICATION

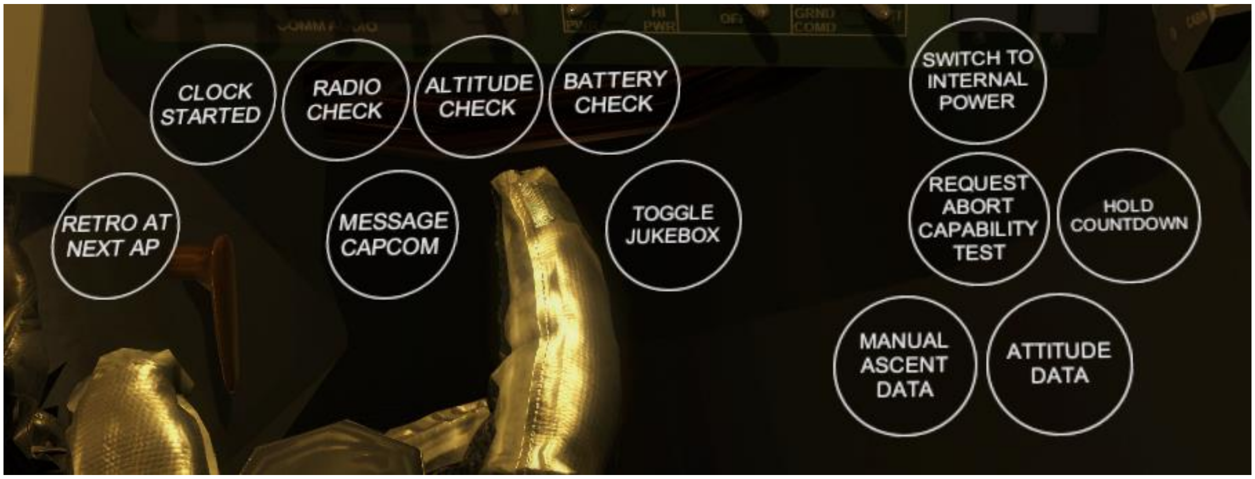
IX. COMMUNICATION

1. GENERAL

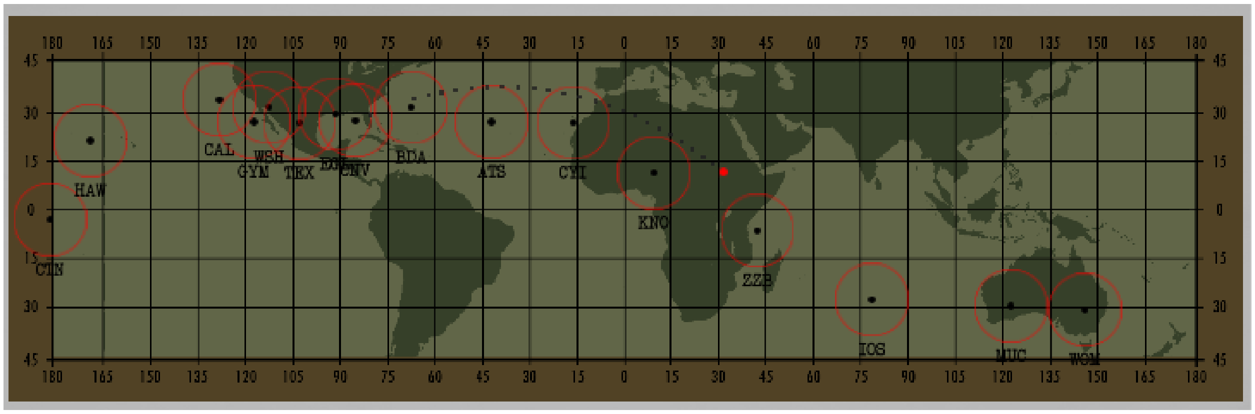
The capsule has three antennas that is used for communication. One HF (High-Frequency) for backup and reentry use, and two identical UHF (Ultra High-Frequency) antennas for primary use. One high powered amplified UHF antenna is used as primary, and in case of failures, a low powered normal UHF antenna is used. The best range is the amplified UHF antenna.

2. OPERATION

The C key on the keyboard will bring up the Radio Command menu, and you can select what commands to send to GROUND. If GROUND sends you a message, it can be read in the communication window.



There are many ground stations around the Earth that will be used when in range.



Always ensure (if possible) a communication link with ground is active. You can check connection status by a radio command. If no reply, change radio settings to backup UHF or HF and try again.

Telemetry is also seen by ground and you can check status based on this, like battery status and so on. If they can't see telemetry, you can change telemetry settings and try again.

A map is available showing you what stations are nearby. Remember, the green ring is an indicator, and the range is usually stretching a bit longer than what it indicates.

The Radio is operated using the panel below the Electrical Control Panel.

The UHF switch selects what UHF system you want to use. Either the Main HI PWR antenna, or the backup LO PWR antenna. The HI PWR UHF antenna has the longest range.

The Transmit switch selects if the HF radio system should be used, or the selected UHF antenna.

Beacon sends out a continues beacon signal for recovery and tracking.

VOX can also be used instead of the C key to bring up the radio command menu.

X. NAVIGATIONAL AIDS

X. NAVIGATIONAL AIDS

1. GENERAL

The Mercury Capsule comes with a set of equipment that can be used to aid you while operating the spacecraft, and orient the spacecraft if the GYROs or the attitude indicators would fail. This includes the Periscope located in the lower part of the center panel, a satellite clock, the Earth Path Indicator, an Altimeter and a longitudinal altimeter.

2. THE PERISCOPE

The Periscope is a tool that can aid you in orienting the spacecraft, check the drift and motion relative to Earth. The periscope is retracted during launch and descent, and extended for the rest of the mission.

An automatic system or a handle can be used to turn it on or off. A black filter can be applied to avoid any light to enter the cockpit. Colored filters are also available. The periscope panel contains all the controls needed to control it. One knob is used to move bars around the globe to measure the altitude, one for turning the drift lines, one to apply magnification and apply a filter to the light entering the cockpit. A retract light is illuminated when the periscope should be retracted.

Both the FILTER and MAGNIFY knob is added to this panel in Reentry due to accessibility. Fig 10.2.1 shows the periscope components. Note that some of the features is not yet implemented.

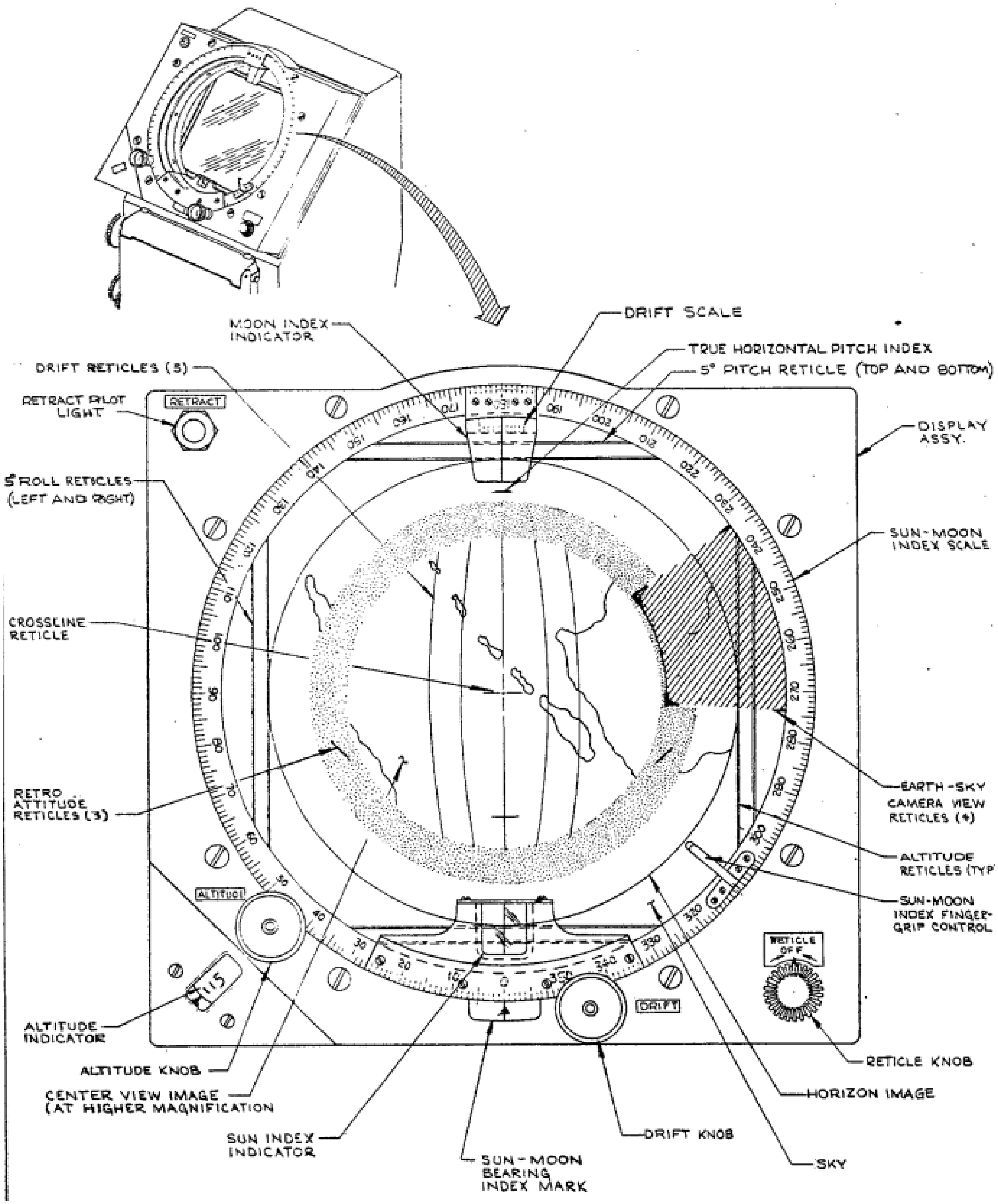


Fig 10.2.1 – The Periscope, from SEDR 104 manual

The position of Earth can help you understand the attitude. If it's centered, the roll and yaw is level. If it's on the indicated lines on the globe screen, you are in retrograde attitude. The position of Earth in the vertical axis indicates your pitch.

3. OPERATION

The periscope will extend and retract automatically. However, if manual control is preferred, set the Retract Periscope switch on the Sequencer to MAN:

Next, use the handle next to the periscope to extend and retract as you wish:

When the periscope is extended, a cover on the capsule hull is open, exposing the camera.

It is important that this cover is closed during ascent and reentry. Failure to close this will be catastrophic.

XI. REENTRY & LANDING

XI. REENTRY & LANDING

The landing sequence is completely automatic, but manual override controls can be used to do this manually. Landing consists of a few stages, the retrograde phase, the reentry phase and the landing/recovery phase, figure 11.0.1 shows this.

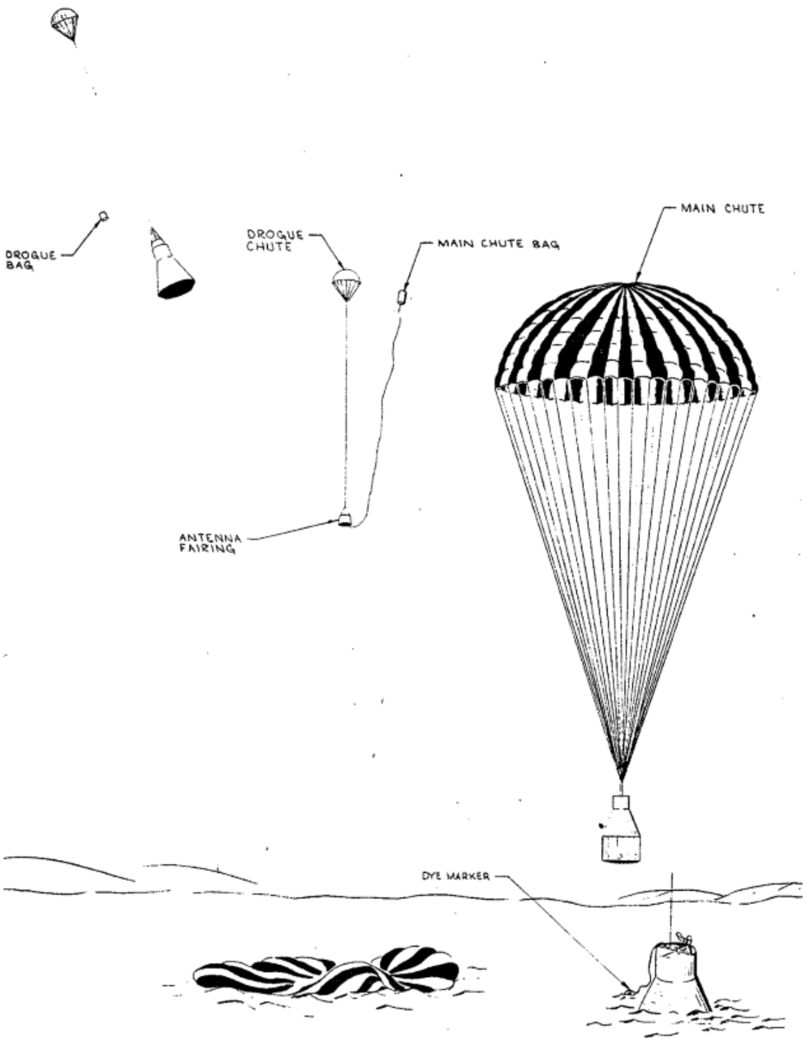


Figure 11.0.1 – Landing, from SEDR 104 manual

1. RETROGRADE

The retrograde rockets can be fired in multiple ways. As indicated in chapter VI, the retrograde rockets are fired either by automatically or manually. Once the retrograde rockets have fired, the reentry phase of the mission has started and the spaceship has no additional ways to alter the orbit.

The retrograde rockets are jettisoned after the retro fire, exposing the headshield.

2. REENTRY

Before reentry, the ATTITUDE SELECT switch is places to the REENTRY position. If the capsule is automatically controlled by the ASCS, the attitude will be change to the reentry attitude. Please note that the ASCS can fail and you should be ready for manual control during reentry.

If manual control is being used, this attitude must be attained and maintained manually.

At this time, the 0.5g sensor is waiting to detect the atmosphere. Once the atmosphere is detected, a 10 deg/s roll is established.

If this sensor is not functional, the .05G state may be initiated manually but pressing the .05G trigger button manually. If manual control, the rotation should either be avoided and done manually.

3. LANDING

The automatic landing system consist of a drogue parachute used to decelerate and stabilize the capsule, a main parachute used to decelerate the capsule to a landing speed, and a landing bag that will inflate before impact to reduce the impact force.

There are two baroswitches, one is for 10.000 ft. and another for 21.000 ft. The 21.000 ft. baroswitch will trigger the deployment of the drogue chute, while the 10.000 ft. baroswitch will release the drogue and deploy the main chute.

The Drogue is automatically deployed, but can manually be deployed during an emergency by pushing the DROGUE trigger button.

A snorkel is used to allow air to enter the cabin during the landing phase. This is also automatically opened, but can manually be opened by pulling the SNORKEL trigger ring.

The main chute is automatically deployed, but can manually be deployed using the MAIN trigger ring, and if this is malfunctioning, a reserve chute is also available and can be deployed by pulling the RESERVE trigger ring.

When the main chute is deployed, the antenna and the drogue are released.

The landing bag is also automatically deployed, but can be inflated manually using the landing bag switch.

This switch has three positions. AUTO will let the sequencer control it. OFF will turn it completely off, and MAN will inflate if manually. If manual control is desired, set it to OFF and then to MAN when you need to inflate it.

Figure 11.1.1 shows the sequence of the parachute's manual deploy.

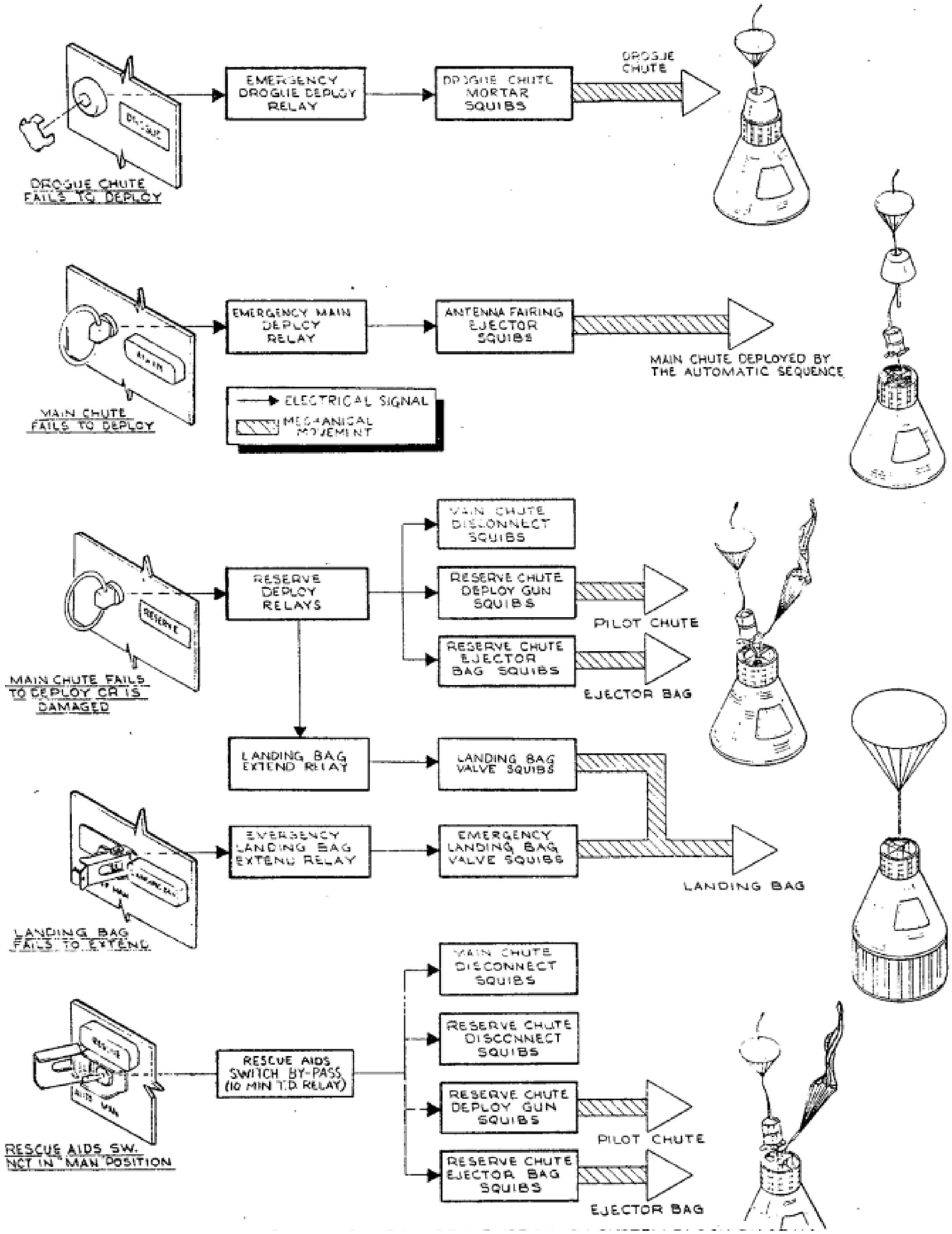


Fig 11.1.1 – Emergency landing flow, from SEDR 104 manual

An overview of the landing and recovery systems can be seen in Figure 11.1.2.

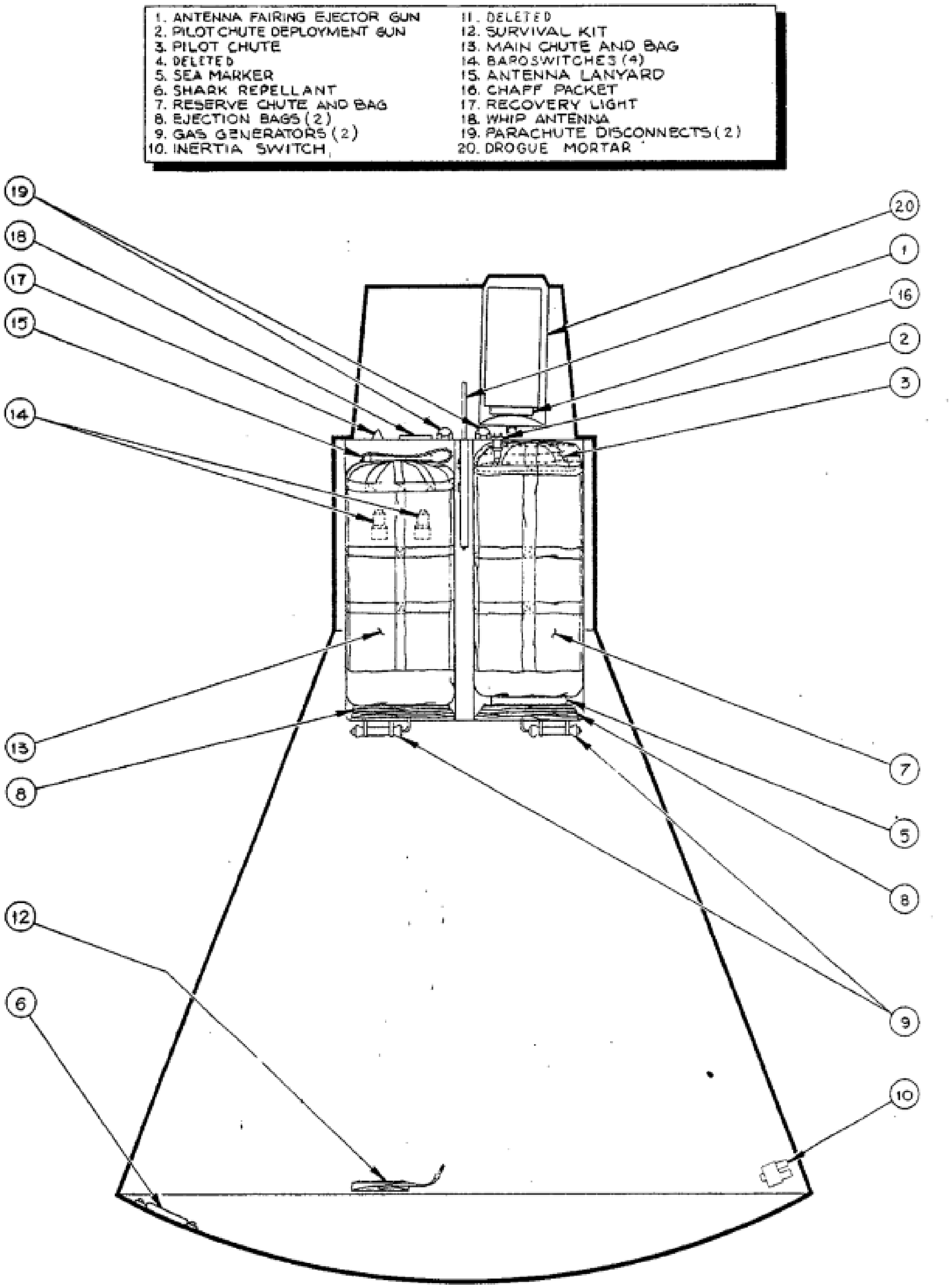
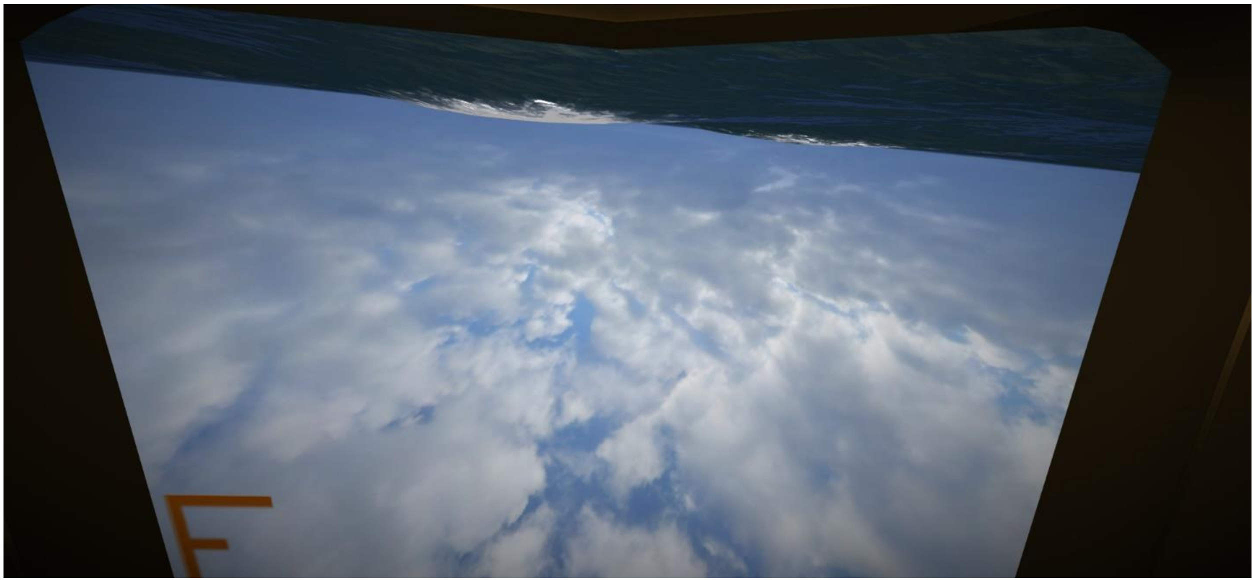


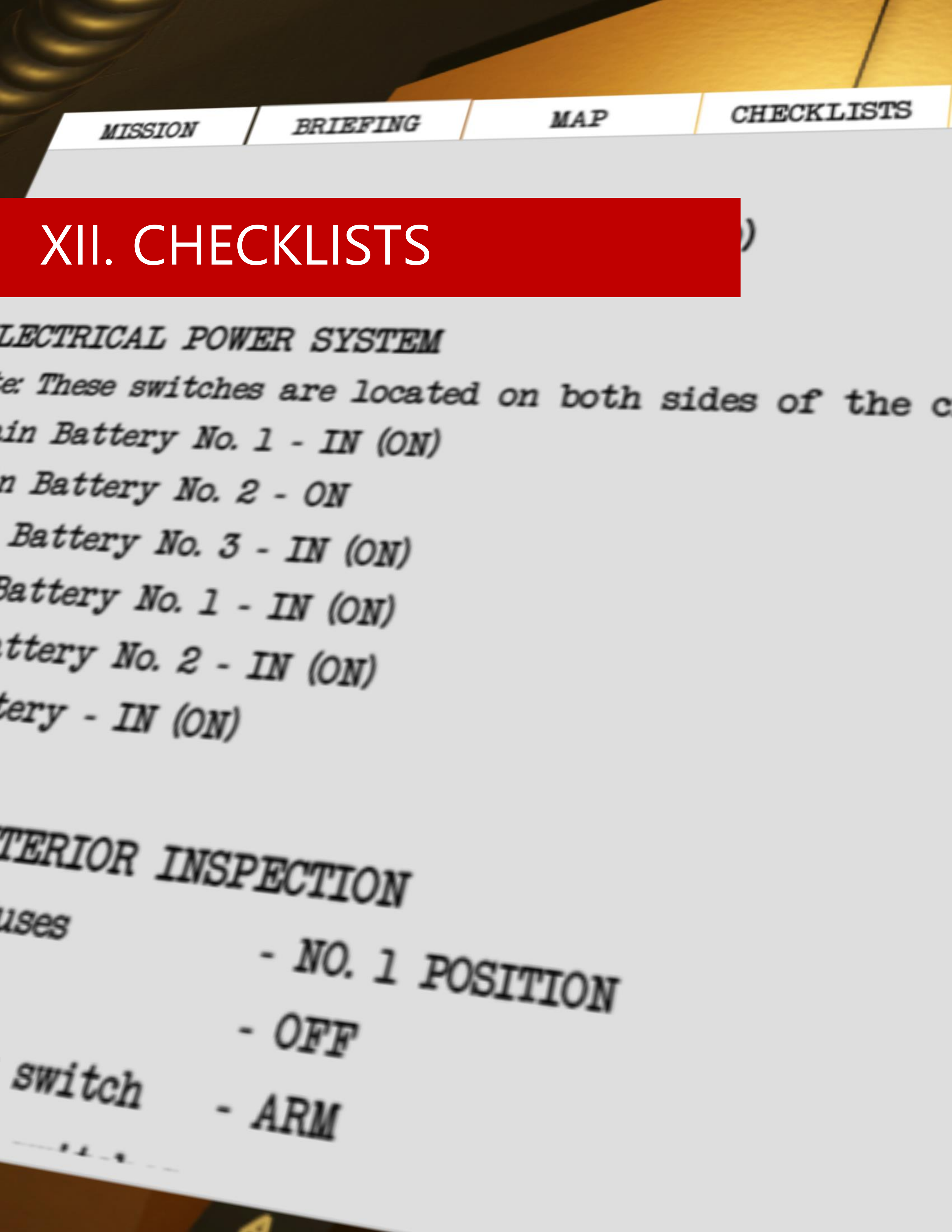
Figure 11.1.3 – Landing and Recovery systems, from SEDR 104

Not all of these systems are modelled or simulated in REENTRY, but the entire sequence can be followed based on the checklists.

When the capsule touches the water, the chute is automatically cut and landing aids are deployd. From here, the mission is complete and you can press ESC and end the Simulation Session.



XII. CHECKLISTS

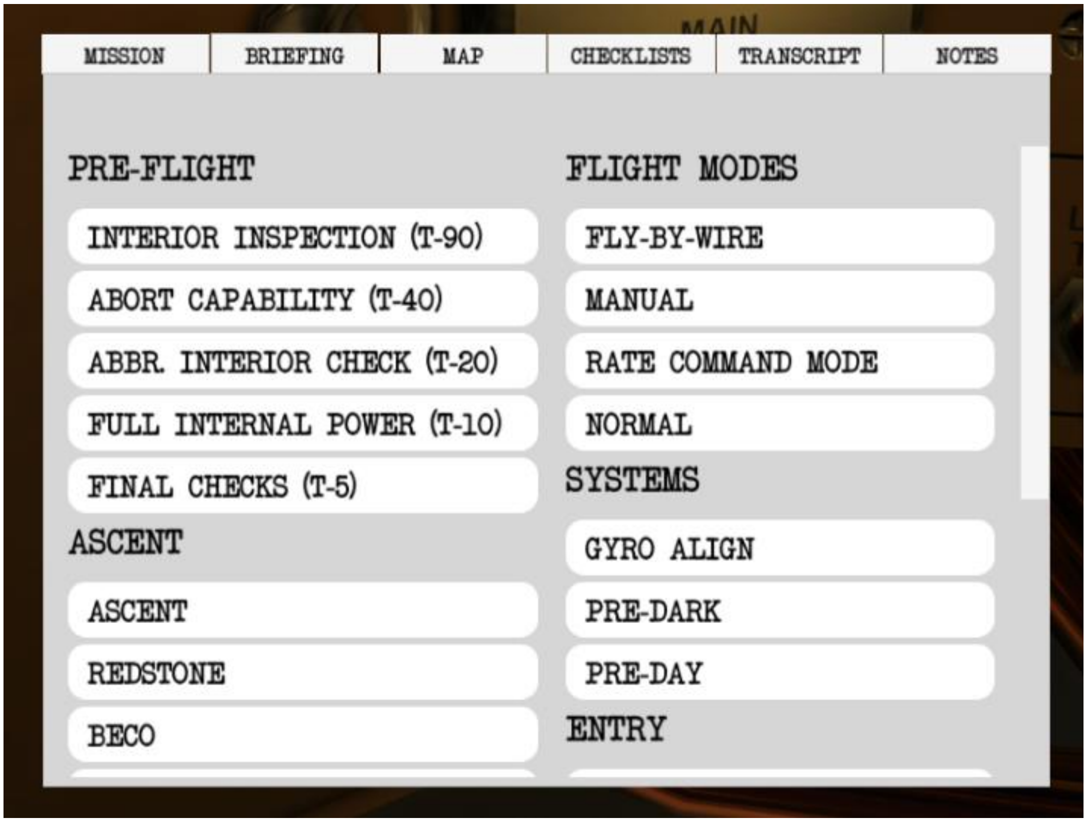


XII. CHECKLISTS

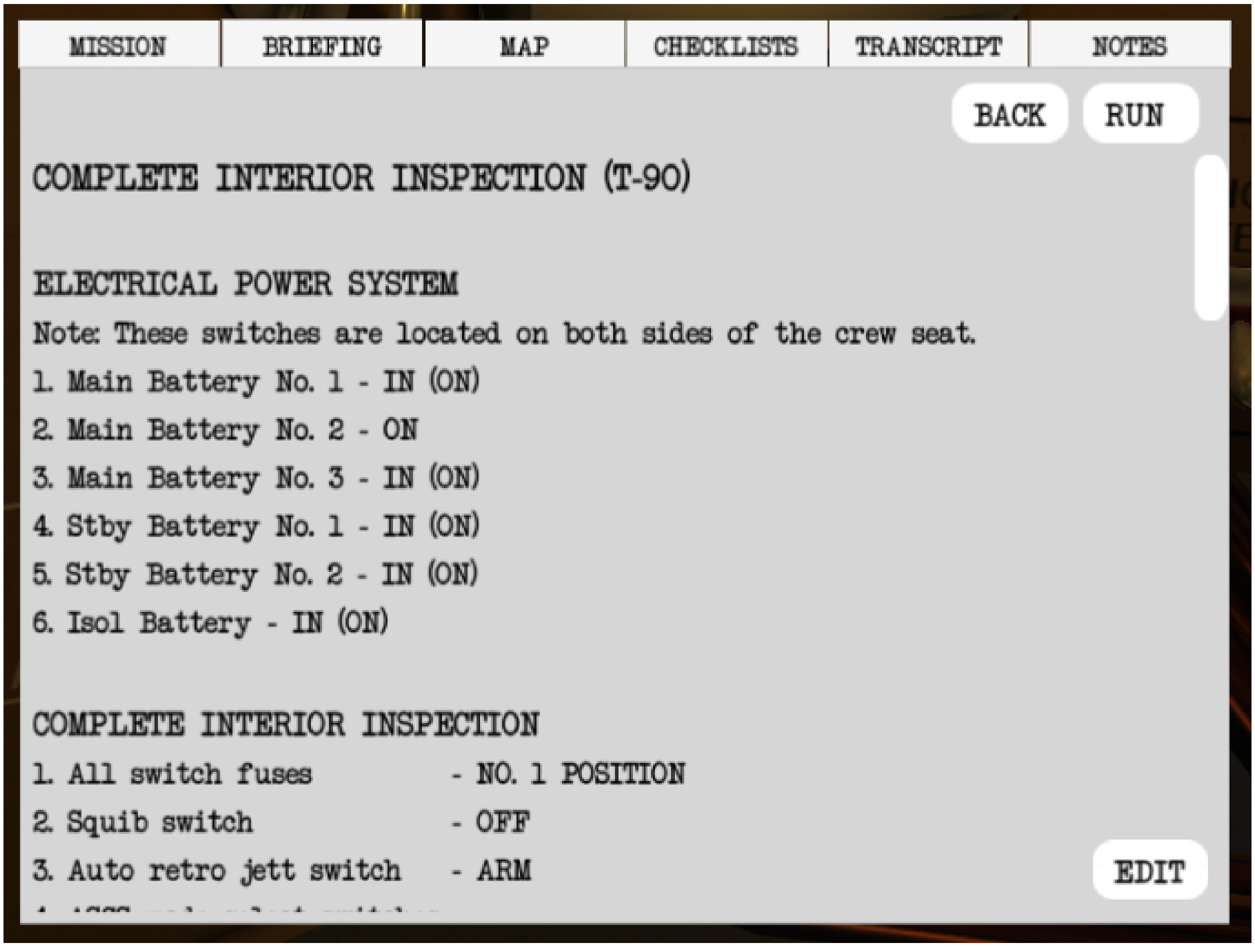
1. GENERAL

The checklists are available from the in-game Mission Pad menu. The in-game menu version is always up-to-date, so if you notice any difference between this and what you see in-game, the in-game instructions are to be followed.

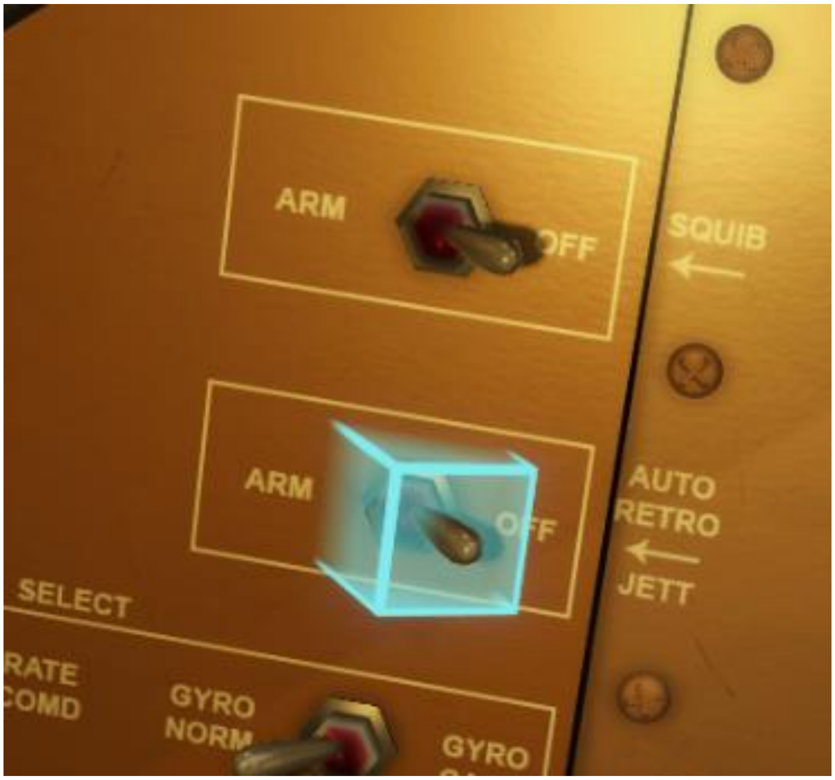
You can always export all the checklists form the game to a text file using the following console command from a Mercury mission: "cl -export"
This will export the checklists into "C:\Users\<your user>\AppData\LocalLow\Wilhelmsen Studios\ReEntry\Export\ChecklistsAsFile\Mercury.txt"



The following checklists can be accessed using the checklist menu. Click on the checklist you want to access, and it will take you to it. Two buttons are available on the selected checklist view, BACK and RUN. Back will take you to the checklist menu, and RUN will run the checklist with a highlighter to show where to click on most of the instructions, with exception of the optional steps or side-steps.



The highlighter will mark the switch that is in the wrong position.



The checklist guide will help you through the checklist.

The green bar will highlight the current step. Set the switch to the correct position and it will automatically proceed to the next item when/if a step is complete.

If the green bar is flashing, it means that a manual step is required. In this case, you will need to press the checkmark when you have performed the requested action to proceed.

Clear All will stop the currently executing checklist.

2. CHECKLISTS

PREFLIGHT CHECKLIST

COMPLETE INTERIOR INSPECTION (T-90)

ELECTRICAL POWER SYSTEM

Note: These switches are located on both sides of the crew seat.

1. Main Battery No. 1	- IN (ON)
2. Main Battery No. 2	- ON
3. Main Battery No. 3	- IN (ON)
4. Stby Battery No. 1	- IN (ON)
5. Stby Battery No. 2	- IN (ON)
6. Isol Battery	- IN (ON)

COMPLETE INTERIOR INSPECTION

1. All switch fuses	- NO. 1 POSITION
2. Squib switch	- OFF
3. Auto retro jett switch	- ARM
4. ASCS mode select switches	
a. ASCS switch	- NORM
b. RSCS switch	- AUTO
c. Gyro switch	- GYRO NORM
5. Control fuel handles	- IN
a. Manual fuel handle	- PUSH RATE COMD
b. Roll fuel handle	- PUSH ON
c. Yaw fuel handle	- PUSH ON
d. Pitch fuel handle	- PUSH ON
6. Retro delay switch	- INST

7. Photo lights switch	- ON
8. Cabin lights switch	- BOTH
9. TLM-LO freq switch	- ON
10. Rescue switch	- AUTO
11. Launch Contl switch	- OFF
12. Jett Tower Ring	- IN
13. Sep Capsule Ring	- IN
14. Retro Att switch	- AUTO
15. Fire Retro Push Button	- GUARD INSTALLED
16. Jett Retro Push Button	- GUARD INSTALLED
17. Retract Scope switch	- AUTO
18. Snorkel Ring	- IN
19. Main Ring	- IN
20. Reserve Ring	- IN
21. Landing Bag switch	- AUTO
22. Control Fuel Qty gauges	- CHECK
a. Auto Fuel	- 100%
b. Manual Fuel	- 100%
23. Rate of Descent	- 0 FT/SEC
24. Altimeter	- CHECK
25. Satellite clock	
a. Time of Day	
b. Time from launch	- ZERO
c. Time to Retrograde	
26. Attitude/Rate ind.	- CHECK
a. Rate indicators	- CENTER
b. Attitude indicators	- CHECK

27. Time Zero Cover	- REMOVE
28. Cabin pressure	- CHECK
29. Cabin Air temp	- CHECK
30. Suit Env. Indicator	- CHECK
31. Oxygen Quantity	- CHECK
a. Primary	- 100%
b. Secondary	- 100%
32. Suit Fan switch	- NORM
33. Cabin Fan switch	- NORM
34. DC Volts knob	- MAIN
35. Ammeter switch	- PWR OFF
36. ASCS AC Bus	- NORM
37. Stby Btry switch	- ON
38. Isol Btry switch	- STBY
39. Inlet Valve Pwr switch	- NORM
40. Audio Bus switch	- NORM
41. AC voltmeter	- 115 VOLTS (109v-121v)
42. VOX Pwr switch	- OFF
43. UHF DF switch	- NORM
44. UHF select switch	- HI PWR
45. Transmit switch	- OFF
46. Beacon switch	- GRND COMD
47. All Audio Tone switches	- ON
48. Warning Lights switch	- BRIGHT
49. Emer O2 switch	- NORM
50. Suit Temp selector	- TO MARK
51. Cabin Temp selector	- TO MARK

52. Inverter Temp selector - TO MARK

53. Maneuver - ON

This spins up the gyros. Please allow 5 minutes spin-up time.

ABORT CAPABILITY (T-40)

1. Ammeter Switch - NORM
2. Capsule Squib Switch - ARM
3. DC Selector - ISOL.
4. REQUEST ABORT CAPABILITY TEST
5. Monitor bus voltage, battery current and Abort light.

ABBR. INTERIOR CHECK (T-20)

1. All left panel fuses - NO. 1 POSITION
2. Squib switch - ARM
3. Auto retro jett switch - ARM
4. ASCS Mode Select switch - NORM
5. RSCS Mode Select switch - AUTO
6. Retro delay switch - NORM
7. Rescue switch - AUTO
8. Press Reg Handle - IN
9. Retro Att switch - AUTO
10. Retract Scope switch - AUTO
11. Landing Bag switch - AUTO
12. Control Fuel

a. Auto Fuel: ___

b. Manual Fuel: ___

13. Cabin Pressure Indicator: ___
14. Cabin Temp Indicator: ___
15. Suit Temp Indicator: ___
16. Suit Press Indicator: ___
17. Primary Oxygen: ___
18. Secondary Oxygen: ___
19. Suit Fan switch - NORM
20. Cabin Fan switch - NORM
21. DC Volts knob - MAIN
22. Ammeter switch - NORM
23. ASCS AC Bus Switch - NORM
24. Stby Btry switch - ON
25. Isol Btry switch - STBY
26. Inlet Valve Pwr switch - NORM
27. Audio Bus switch - NORM
28. Fans AC Bus switch - NORM
29. VOX Pwr switch - OFF
30. UHF DF switch - NORM
31. UHF Select switch - HI PWR
32. Transmit switch - OFF
33. Beacon switch - CONT
34. Emer O2 handle - NORM

FULL INTERNAL POWER (T-10)

1. Monitor capsule battery voltage and current while the Blockhouse switches to external power.
2. Request Blockhouse to remove external power
   Use the Tools Menu (default mapping: [C]) below radio panel
3. Isol Btry switch - NORM
4. Stby Btry switch - OFF

FINAL CHECKS (T-5)

(Approx. T-5 to T-0)

1. Launch Control switch - READY
2. Suit Temp - TO MARK
3. Cabin Temp - TO MARK
4. Inverter Temp - TO MARK
5. Transmit - UHF
6. Perform Radio Check on UHF
7. Verify Time Zero Button - COVER REMOVED
   WARNING: Do not depress the time zero button
8. DC Volts knob - 1
9. Squib switch - ARM
10. Auto Retro Jett switch - ARM

ASCENT

1. Monitor Abort Light

2. Monitor Isolated Battery Voltage
3. Monitor Cabin Pressure
    a. Will go from 15 to 5.5
4. Monitor DC Voltage
5. Monitor DC Ammeter
6. Monitor AC Voltage

At Engine Cutoff:

If Redstone Rocket Launch:

Start REDSTONE Ascent Checklist

If Atlas Rocket Launch:

Start BECO Checklist

ASCENT/REDSTONE

1. Jett Tower	- GREEN (appx. T+2:10 and 20 sec after MECO)
2. Sep Capsule	- GREEN (appx. 15 sec after Tower Jett)
3. Auto Retro Jett switch	- OFF
4. Retro Jett Fuse switch	- OFF
5. Emer Retro Jett Fuse switch	- OFF

Start ORBIT Checklist

ASCENT/BECO (ATLAS)

1. Jett Tower	- AMBER

2. Jett Tower - GREEN (appx. 20 sec after BECO)
3. Auto Retro Jett switch - OFF
4. Retro Jett Fuse switch - OFF
5. Emer Retro Jett Fuse switch - OFF

Start SECO Checklist

ASCENT/SECO

At SECO:

1. Sep Cap - AMBER, then GREEN

Start ORBIT Checklist

ORBIT

1. DC Volts knob - MAIN
2. Landing Bag switch - OFF
3. Retro Delay switch - NORM
4. Emer Retro Seq Fuse - OFF
5. Emer Drogue Deploy Fuse - OFF
6. All instruments - CHECK

If out-of-range from radio station, set UHF PWR - HI for longer reach

FLIGHT MODES

FLY-BY-WIRE

1. ASCS switch	- FLY-BY-WIRE
2. RSCS switch	- AUTO
3. Manual Fuel Handle	- PUSH RATE COMD

4. Use handcontroller to desired attitude

MANUAL

1. Manual fuel handle	- PULL DIRECT
2. ASCS switch	- AUX ON
3a. If aux damping is desired,	
RSCS switch	- AUTO
3b. If aux damping is not desired,	
RSCS switch	- RATE COMD

RATE COMMAND MODE

1. Manual fuel handle	- PUSH RATE COMD
2. RSCS switch	- RATE COMD

3. Use handcontroller to maintain desired rates and attitude

NORMAL MODE

1. ASCS switch	- NORM

2. RSCS switch - AUTO

3. Manual Fuel Handle - PUSH RATE COMD

SYSTEMS

GYRO ALIGN

WARNING: Use ONLY if errors in GYRO

1. Gyro - GYRO CAGE

2. Attitude - 0, 0, 0

Maneuver the attitude to the 0,0,0 attitude, using window reference, eyesight, or periscope.

3. Gyro - NORMAL or FREE

HORIZON CHECK

1. Attitude - RETROGRADE

Align the spacecraft with the retrograde horizon. You can also use the marks on the periscope

The readings should read about 0, 0, 0

If not, realign the gyros

PRE-DARK

1. Cabin Light switch - BOTH

2. Photo Lights - OFF

3. Red filters on cabin light - [Click on the lights]

4. Red scope filter - ON

5. Warning lights - DIM

6. Thruster warmup procedure:

(a) Enable MANUAL flight mode:

Pitch UP followed by pitch DOWN

Roll RIGHT followed by roll LEFT

Yaw RIGHT followed by yaw LEFT

(b) Enable FLY-BY-WIRE flight mode:

Short-burst pitch UP and DOWN - full stick travel

Short-burst roll RIGHT and LEFT - full stick travel

Short-burst yaw RIGHT and LEFT - full stick travel

(c) ASCS mode and check for proper attitude orientation and holding within limits

7. After entry into dark side, filters - as desired

PRE-DAY

1. Cabin Light switch - BOTH

2. Photo Lights - ON

3. White filters on cabin light - [Click on the lights]

4. Red scope filter - OFF

5. Warning lights - BRIGHT

6. Thruster warmup procedure:

(a) Enable MANUAL flight mode:

Pitch UP followed by pitch DOWN

Roll RIGHT followed by roll LEFT

Yaw RIGHT followed by yaw LEFT

(b) Enable FLY-BY-WIRE flight mode:

Short-burst pitch UP and DOWN - full stick travel

Short-burst roll RIGHT and LEFT - full stick travel

Short-burst yaw RIGHT and LEFT - full stick travel

(c) ASCS mode and check for proper attitude orientation and holding within limits

7. After entry into dark side, filters - as desired

ENTRY

PRE-RETRO (TR-30)

Approximately 30 minutes before retro time (Tr-30mins):

1. Cabin Temp - COLD
2. Suit Temp - COLD
3. Inverter Temp - COLD

Approximately 15 minutes before retro time (Tr-15mins):

4. Emer Retro Seq. Fuse - ON
5. 1, 2, 3 Retro Rckt Fuse - ON

6. Emer Retro Jet Fuse	- ON
7. ASCS .05G Fuse	- ON
8. Emer .05G Fuse	- ON
9. Periscope Fuse	- ON
10. Cmd Rcvr A Fuse	- ON
11. TLM Hi Freq Fuse	- ON
12. Squib switch	- ARM
13. Auto Retro Jett switch	- OFF
14. TLM Lo Freq switch	- ON
15. Transmit switch	- UHF
16. BCN switch	- CONT
17. Retro Jett Fuse	- OFF
18. Retro Man Fuse	- ON
19. Attitude Select	- RETRO
20. Maintain Retro attitude	

RETRO

At Tr -5 Mins:

"5 Min To Retrograde" light	- ILLUMINATED

At Tr +0 Secs:

1. "Retro Seq" telelight	- GREEN
2. "Retro Att" telelight	- GREEN

At Tr +20 Secs:

1. "Retro Warn" telelight - AMBER & Audible Tone

4. Crosscheck attitude indicator, periscope and window

5. "Fire Retro" telelight - AMBER while firing

6. "Fire Retro" telelight - GREEN once completed

RE-ENTRY

1. Fire Retro Green:
   a. Auto Retro switch - ARM
   b. Retro Jett Fuse - ON
   c. Emer Retro Jett Fuse - ON
2. Jett Retro Telelight goes green 60 seconds after Retro Fire signal.
3. Attitude Select - RE-ENT
4. Check correct attitude
5. Monitor attitude indicator until .05G
6. .05G Telelight - GREEN
7. Rate indicator shows 10*/SEC roll rate

LANDING

1. Emer Drogue Fuse - ON (BEFORE 30,000 FT)
2. At 21,000 ft. check drogue chute deployment
3. At appx. 20,000ft, Snorkel Ring - PULL
4. Emer O2 handle - EMER
5. Landing Bag switch - AUTO
6. At 10,000 ft, "Main" light - GREEN
7. UHF/DF switch - R/T

8. Press Reg Handle - PULL

9. "Landing Bag" Telelight - GREEN

After Impact:

1. ASCS AC Bus switch - OFF

2. Photo Lights switch - OFF

EMERGENCY PROCEDURES

LAUNCH AND ASCENT

WARNING

If ISOL. BUS is lost, an abort is not possible.

Abort Prior to Tower Jettison

1. Abort handle - CTRL+SHIFT+Z
2. "Sep Capsule" telelight - GREEN
3. "Jett Tower" - GREEN
4. "Jett Retro" - GREEN
5. Check that the ASCS positions the capsule in retrograde attitude. Use manual control if needed.
    a. ATTITUDE SELECT - RETRO
    b. RETRO ATT - AUTO
    c. SQUIB - ARM
    d. AUTO RETRO JETT - ARM
6. Monitor altimeter and complete normal landing procedures with manual override if needed.

Start LANDING Checklist

Abort After Tower Jettison

1. Abort handle - CTRL+SHIFT+Z
2. "Sep Capsule" telelight - GREEN
3. Check that the ASCS positions the capsule in retrograde attitude. Use manual control if needed.

a. ATTITUDE SELECT	- RETRO
b. RETRO ATT	- AUTO
c. SQUIB	- ARM
d. AUTO RETRO JETT	- ARM

4. Fire the retrograde rockets when in retro attitude and ready.

5. Monitor altimeter and complete normal landing procedures with manual override if needed.

Start LANDING Checklist

TOWER FAILS TO JETTISON

1. Jett Tower ring	- ACTUATE
2. If tower fails to jettison:	
a. Emer Twr Sep fuse switch	- NO. 2
b. For normal jettison,	
Emer Escape Rkt fuse switch	- NO. 2.
c. On aborts,	
Emer Twr Jett fuse switch	- NO. 2.
3. If escape rocket still does not fire,	
Abort handle	- CTRL+SHIFT+Z

CAPSULE FAILS TO SEPARATE FROM BOOSTER

1. Sep Capsule ring	- PULL
2. If capsule fails to separate on abort before staging,	
Emer Escape Rkt fuse switch	- NO. 2

ORBIT

ABORT FROM ORBIT

1. In the event an emergency requiring an immediate abort:

    a. Emer Retro Seq Fuse Switch - ON

    b. Retro Seq Button - DEPRESS

    or Fire the retros manually

2. If conditions permit:

    a. Select recovery area.

    b. Compute retrograde time.

    c. If time permits, reset retrograde clock.

    d. If there is insufficient time, 30 seconds before retrograde time,

    Retro Seq button - DEPRESS

    or Fire the retros manually

3. Start PRE-RETRO Checklist

STABILIZATION SYSTEM EMERGENCY OPERATION

Failure of Automatic Mode

If the automatic mode fails and the capsule is tumbling, switch to Rate Command to stop the tumbling and use manual control to return the capsule to desired attitude

1. Use rate command to stop any tumbling.
   a. Manual fuel handle - PUSH RATE COMD
   b. RSCS switch - RATE COMD
   c. Stop tumbling
   d. Reposition capsule to orbit attitude

2. Switch to manual mode.
   a. Manual fuel handle - PULL DIRECT
   b. ASCS switch - AUX DAMP
   c. If ASCS damping is desired,
      RSCS switch - AUTO

3. Auto control fuel gauge - CHECK

Failure of Fly-By-Wire

Failure of fly-by-wire may occur in conjunction with failure of the automatic mode. If it occurs without failure of the automatic mode, there is probably an electrical malfunction in the control system fly-by-wire switches, ASCS switch, or associated circuits. Return to automatic mode, unless it has also failed, or switch to manual mode.

1. Auto control fuel gauge - CHECK
2. ASCS switch - NORM
3. If the automatic mode also has failed,
   manual control fuel handle - PULL DIRECT
4. Manually maintain proper attitude

Failure of Rate Command

If rate command fails in orbit, switch to manual or fly-by-wire mode if manual control is desired, or to automatic mode. During retrograde, have manual control fuel handle pulled and be prepared to switch to manual AND fly-by-wire if the automatic mode also fails.

1. Manual control fuel handle - PULL DIRECT
2. RSCS switch - AUTO
3. ASCS switch - AS DESIRED

   Switch to normal, aux-damp, of fly-by-wire as desired.

ENVIRONMENT CONTROL SYSTEM EMERGENCY OPERATION

Cabin Pressurization

In the event the cabin becomes depressurized, it is only necessary to have the faceplate closed (automatic in Reentry). The cabin may be depressurized to eliminate smoke, fumes, or fire. The cabin can be depressurized at any time as long as the faceplate is closed.

In the event of cabin depressurization, cabin oxygen flow will automatically be shut off when cabin pressure drops to approximately 4.0 psia. The remaining oxygen can be lost overboard if the cabin is leaking and the cabin pressure remains above 4.0 psi. Therefore, depressurize the cabin if a leak is discovered or if oxygen consumption is excessive. If the cabin was depressurized by pulling the Decomp "T" handle, the cabin can be pressurized by pushing the handle IN and pulling Repress "T" handle. This will pressurize the cabin in 5 minutes or less and consume O2 from the active bottle. When the cabin pressure reaches 5 psi, push Repress "T" handle IN.

Cabin Depressurization

1. Decomp "T" handle - PULL
2. Monitor cabin pressure

Cabin Repressurization

1. Decomp "T" handle - PUSH
2. Repress "T" handle - PULL
3. Monitor cabin pressure.

    At 5 psi cabin pressure,

        Repress "T" handle - PUSH

Emergency Oxygen

In the event the suit pressure drops below 4.0, the emergency oxygen rate valve automatically opens and the suit circuit shutoff valve closes to prevent oxygen flow through the impurity removers, temperature control units, and the suit fans. The emergency oxygen rate valve may be opened at any time by actuating the Emer O2 lever on the right console. This action supplies oxygen for cooling and pressurizing the suit as well as supplying oxygen for breathing. The "O2 Emer. Flow" light will illuminate whenever the emergency oxygen rate valve of suit circuit shutoff valve operates manually or automatically. During emergency rate operation, the oxygen supply duration is greatly reduced because oxygen is exhausted overboard.

1. To transfer to emergency oxygen:

Emer O2 lever	- EMER

2. To return to normal operation:

a. Emer O2 lever	- NORM
b. Suit Fan switch	- NORM

Alternate Suit Fan

If the No. 1 suit fan fails with the Suit Fan switch in the NORM position, the No. 2 fan will automatically cut in to provide suit ventilation. Either fan may also be selected by placing the Suit Fan switch in the No. 1 or No. 2 position. If the No. 1 fan fails, and the No. 2 fan does not cut in automatically, place the Suit Fan switch in the No. 1 position, and the suit Fan fuse in the No. 2 position. If No. 1 fan operation is not regained, placing the Suit Fan switch in the No. 2 position will energize the No.2 Fan direct, circumventing the fuse switch. If it is impossible to regain suit fan operation, actuate the Emer O2 lever on the right console to provide ventilation.

If the No. 1 suit fan fails and No. 2 does not switch in automatically:

1. Suit Fan switch - NO. 1
2. Suit Fan fuse switch - NO. 2
3. If NO. 1 fan remains inoperative:

   Suit Fan switch - NO. 2

4. If NO. 2 fan is inoperative,

   Emer O2 lever - EMER

WARNING

Suit ventilation, either by fan or by emergency oxygen, must not be lost for more than 30 seconds or CO2 buildup in the helper will become dangerously high.

ELECTRICAL SYSTEM EMERGENCY OPERATION

Main Battery Failure

Failures on one or more main batteries may be detected by periodically checking voltage of each battery every 30 seconds. If any battery shows less than 18 volts, turn that battery off.

1. If any battery is below 18 volts

   Turn applicable battery - OFF

2. If Main Bus voltage is below 18 volts:

a. Check all bus and battery voltages

b. Turn off all low priority equipment

Standby Battery Failure

The only indication of standby battery failure will be by periodic checks. If Standby battery failure is detected, turn that battery off. If the main batteries also fail, place the Audio Bus switch to EMER to permit the isolated battery to maintain communications. The isolated battery also supplies the isolated squib bus to assure sufficient power to fire all squibs as well as the retrograde rockets. The isolated battery may also be connected to the main bus through the Standby Battery switch if the Isolated Battery switch is placed in the STBY position.

If standby battery failure is detected:

1. Failed Battery switch - OFF

2. Check voltage of main and isolated batteries.

3. If main batteries are low, shut off all non-essential equipment.

If the main batteries also fail:

4. If radios are needed,

Audio Bus switch - EMER

5. If main bus power is needed:

a. Isol Btry switch - STBY

b. Stby Btry switch - ON

WARNING

The isolated battery should not be used to supply other busses unless absolutely necessary and then only for essential equipment since it supplies the alternate power source for firing retrograde rockets and the recovery system pyrotechnics.

Isolated Battery Failure

If the isolated battery fails, the isolated squib bus can be powered from the standby battery by placing the Isol Btry switch to STDBY. Immediate retrograde is not necessary unless the main batteries are also low.

1. Isol Btry switch - STBY
2. Check all battery voltages.
3. Before retrograde

    Isol Btry switch - STDBY

Complete Electrical Failure

Failure of the ammeter or the Ammeter switch can cause complete electrical failure by removing the ground for all capsule batteries. If all capsule power is suddenly lost, place the Ammeter switch to BYPASS to provide an alternate ground for the batteries.

Inverter Failure

If either main inverter fails with both AC Bus switches in the NORM position, the standby inverter will automatically supply power to the failed AC bus and illuminate the "STBY AC Auto" light. Determine which inverter failed by placing the ASCS AC Bus switch to STBY and monitoring the Standby AC Auto telelight. If the light goes out, the ASCS bus inverter has failed. Leave the ASCS AC Bus switch in STBY if ASCS inverter has failed; if not, return the switch to NORM, and place the Fans AC Bus switch in the STBY position. This provides for illumination of the Standby AC Auto telelight if the remaining inverter should fail.

When STBY AC Auto light illuminates and it is desired to determine which inverter has failed, observe the following procedure:

1. ASCS AC Bus switch - STBY
2. If STBY AC Auto telelight goes out, ASCS inverter has failed. Leave the ASCS AC Bus switch in the STBY position so that failure of the Fans AC Inverter may be detected by re-illumination of the STBY AC Auto light.
3. If STBY AC Auto telelight remains illuminated, Fans inverter has failed. Place the ASCS AC Bus switch

in NORM, and Fans AC Bus switch in STBY. STBY AC Auto light should go out.

COMMUNICATIONS SYSTEM EMERGENCY OPERATION

If no voice or radio messages can be sent or received, one of the available communication systems may have failed.

1. Check position of capsule relative to ground station.

   Capsule may be out of range of all ground stations.

2. Check operations of UHF Hi and Hi freq, and HF systems.
3. Audio Bus switch - EMER will connect the Audio Bus

   to the Isolated Battery

WARNING

Do not place the audio bus to EMER unless it is absolutely necessary because of the excessive drain on the isolated battery.

FIRE OR FUMES

Any fire inside the capsule will probably be an electrical fire. Therefore, attempt to determine the cause of the fire and turn off the affected equipment. The cabin can be depressurized to extinguish any fire and eliminate fumes.

1. If fire or fumes are severe,

   Decomp "T" handle - PULL

2. Attempt to determine the source of fire or fumes

3. If source of fire or fumes can be determined, turn off affected equipment.

4. If affected equipment can be turned off, repressurize cabin.

5. Initiate retrograde as soon as convenient.

RETROGRADE

RETROGRADE SEQUENCE

If the "Retro Seq" telelight fails to illuminate at retrograde time, the retrograde sequence can be started by depressing the Retro Seq button or the Fire Retro button. Depressing the Retro Seq button will start the normal retrograde sequence while depressing the Fire Retro button will fire the retrograde rockets. Use the Retro Att By-Pass switch to bypass correct retrograde during attitude failures.

FAILURE TO ATTAIN RETROGRADE ATTITUDE

1. Check attitude indicator and periscope to determine if capsule is in retrograde attitude.

2. If capsule is in the retrograde attitude:

a. Retro Att switch - BYPASS

b. Fire Retro button - DEPRESS

3.If the capsule is not in the retrograde attitude:

a. Manual fuel handle - PUSH RATE COMD

b. RSCS switch - RATE COMD

c. ASCS switch - FLY-BY-WIRE

d. Use hand controller to position capsule in the retrograde attitude.

e. If attitude permission circuit is operating, the retrograde rockets will fire 30 seconds after initiating retro sequence or as soon as the capsule if in the retrograde attitude, if over 30 seconds.

RETROGRADE PACKAGFE FAILS TO JETTISON

The retrograde package is jettisoned 60 seconds after retro fire is initiated.

If it fails:

1. Jett Retro button - DEPRESS

2. If Retrograde package does not jettison:

a. Retro Jett fuse switch - NO. 2

b. Emer Retro Jett fuse switch - NO.2

3. Jett Retro button - DEPRESS

ASCS CANNOT MAINTAIN RE-ENTRY ATTITUDE

If ASCS does not reposition capsule to correct re-entry attitude when Attitude switch is set to RE-ENTRY:

1. Manual fuel handle - PUSH RATE COMD
2. RSCS switch - RATE COMD
3. Retract Scope switch - MAN
4. Use hand controller to position the capsule in the re-entry attitude.
5. RSCS switch - AUTO
6. Use periscope to see if ASCS will maintain re-entry attitude.
7. If ASCS will maintain re-entry attitude:

   Retract Scope switch - AUTO.
8. If ASCS will not maintain re-entry attitude:

   a. RSCS switch - RATE COMD

   b. As soon as the ".05g Switch" telelight illuminates

      Retract Scope switch - AUTO.

   c. Check that RSCS initiates 7 degree/sec slow roll.

LANDING

DROGUE CHUTE FAILURE

Drogue chute failure can be detected by the lack of opening shock and by a visual check through the window. Failure of the Emer Drogue Deploy fuse will fail the Drogue Override button.

1. Drogue button - DEPRESS
2. If drogue chute does not deploy:
    a. Emer Drogue Deploy fuse switch - NO. 2
    b. Drogue button - DEPRESS

MAIN CHUTE FAILURE

Main chute deployment failure can be detected by the lack of opening shock, a visual check through the periscope and window, and no decrease in rate of descent.

If the main chute does not deploy properly or is damaged:

1. Reserve deploy ring - PULL

LANDING BAG FAILS TO DEPLOY

1. Landing Bag switch - MAIN
2. Emer Land Bag fuse switch - NO. 2