

OXO-5052  
COPY 2 OF 3

OPERATOR'S MANUAL  
FOR Q-BAY PACKAGE TYPE 1

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ABSTRACT

This document contains operating instructions and general system information for Q-Bay Package Type I, prepared as part of, and constituting the effort on W.O. 5441 of SPO 71945.

## TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
1	Q-BAY PACKAGE TYPE 1, SYSTEM DESCRIPTION	1
2	Q-BAY PACKAGE TYPE 1, CONTROL PANEL	6
3	Status Switch	10
4	V/H Option Switch	12
5	Timer Switch	12
6	Q-BAY PACKAGE TYPE 1 AND VEHICLE RELATIONSHIPS	13
7	Power	13
8	Attitude	13
9	Q-BAY PACKAGE TYPE 1 OPERATION	17
10	Typical Mission Profiles of Q-Bay Package Type 1	17
11	Q-Bay Package Type 1 Failure	17
12	Failure Procedure	20
13	Control Panel Indicators, Pre-Flight Check	21
14	Control Panel Emergency In-Flight Checkout	21
15	MISSION OBJECTIVES	21
16.	PHOTOGRAPHY WITH AID OF PERISCOPE WIDE FIELD	22
17	MISSION RESULTS	22
18	DATA RECORDING	22

## LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1	Aerial Panoramic Photography	2
2	System Type 1 Ground Coverage Format, Straight and Level Flight	3
3	Q-Bay Package Type 1, Physical Description	4
4	Q-Bay Package Type 1, System Dimensions	5
5	Operational Control Panel, Q-Bay Package Type 1	7
6	Q-Bay Package Type 1 Control Panel Location	8
7	Q-Bay Package Type 1 and Vehicle Attitude Relationships, Caged Condition	14
8	Vehicle and Q-Bay Package Attitude Relationships, Uncaged Condition	15
9	Typical Mission Profiles of Q-Bay Package Type 1	18
10	Q-Bay Package, Mission Profile	19
11	Q-Bay Package Type 1 Frame Format Relationship to Ground Coverage Pattern	23
12	Data Recording on Film	24

## LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
1	Control Panel Controls and Indicators	9

OPERATOR'S MANUAL  
FOR Q-BAY PACKAGE TYPE 1

1. Q-BAY PACKAGE TYPE 1, SYSTEM DESCRIPTION

Q-bay Package Type 1 is an aerial panoramic camera system with the mission of obtaining photographs of the earth from an airborne vehicle.

The camera system photographs the earth transverse to the vehicle line of flight. Two identical cameras are employed to accomplish the photography — a forward camera and an aft camera.

Photographic coverage of the camera system is represented in Figure 1. The forward camera scans the earth from 67 degrees to the left of nadir to 21 degrees to the right of nadir. The aft camera scans the earth from 21 degrees to the left of nadir to 67 degrees to the right of nadir. Each mission can provide 2500 nautical miles of flight line coverage on 1980 frames and 60 miles (or 134 degrees) total transverse coverage. The scan overlap provides full stereo viewing of mission results for all points on each frame format. See Figure 2.

The Q-bay Package Type 1 consists of two major assemblies — a stable platform and a supporting frame assembly. See Figures 3 and 4. The stable platform is an aircraft type structure that contains both camera systems and associated subsystems, and the stabilization system. The stabilized

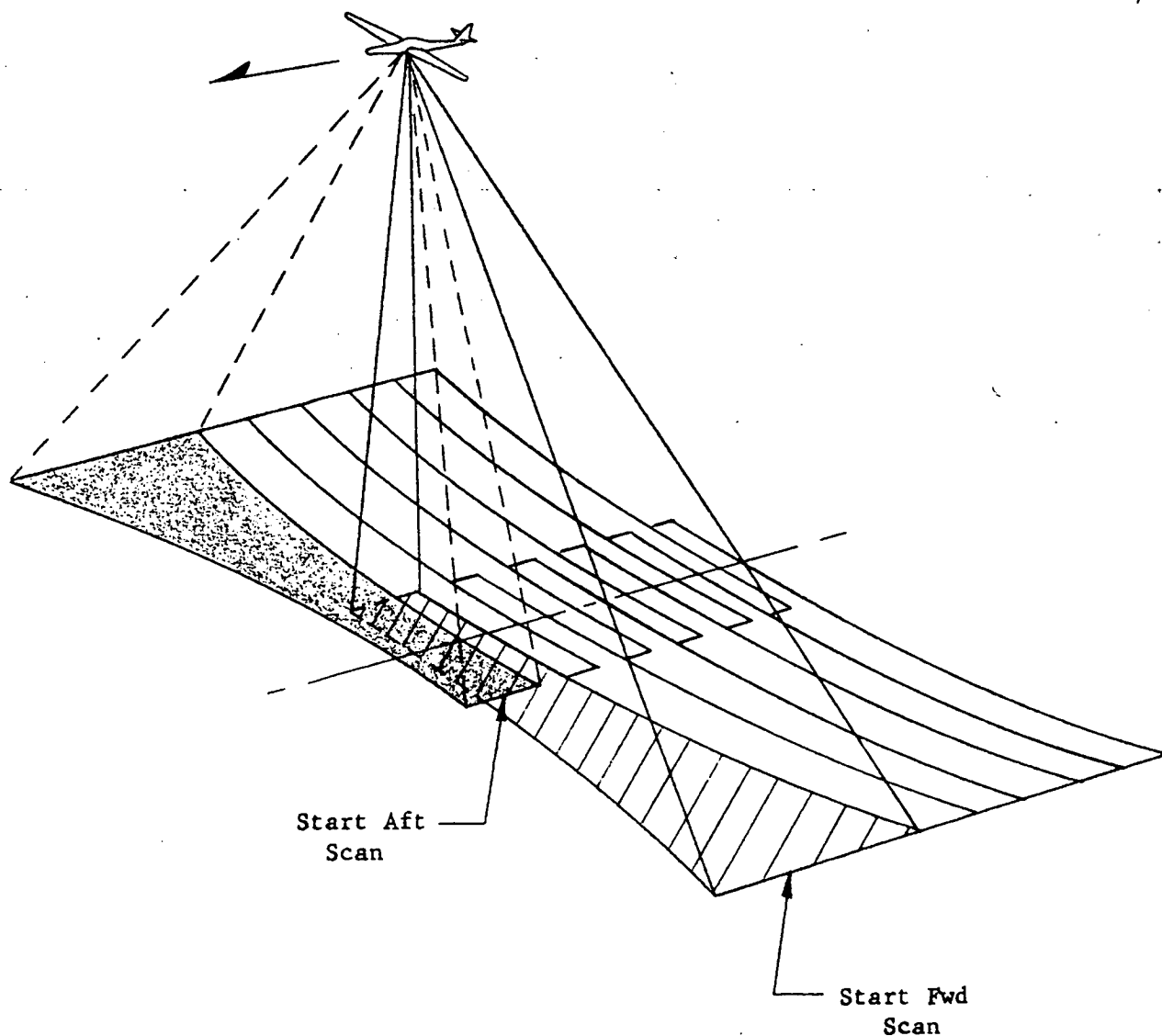


Figure 1. Aerial Panoramic Photography

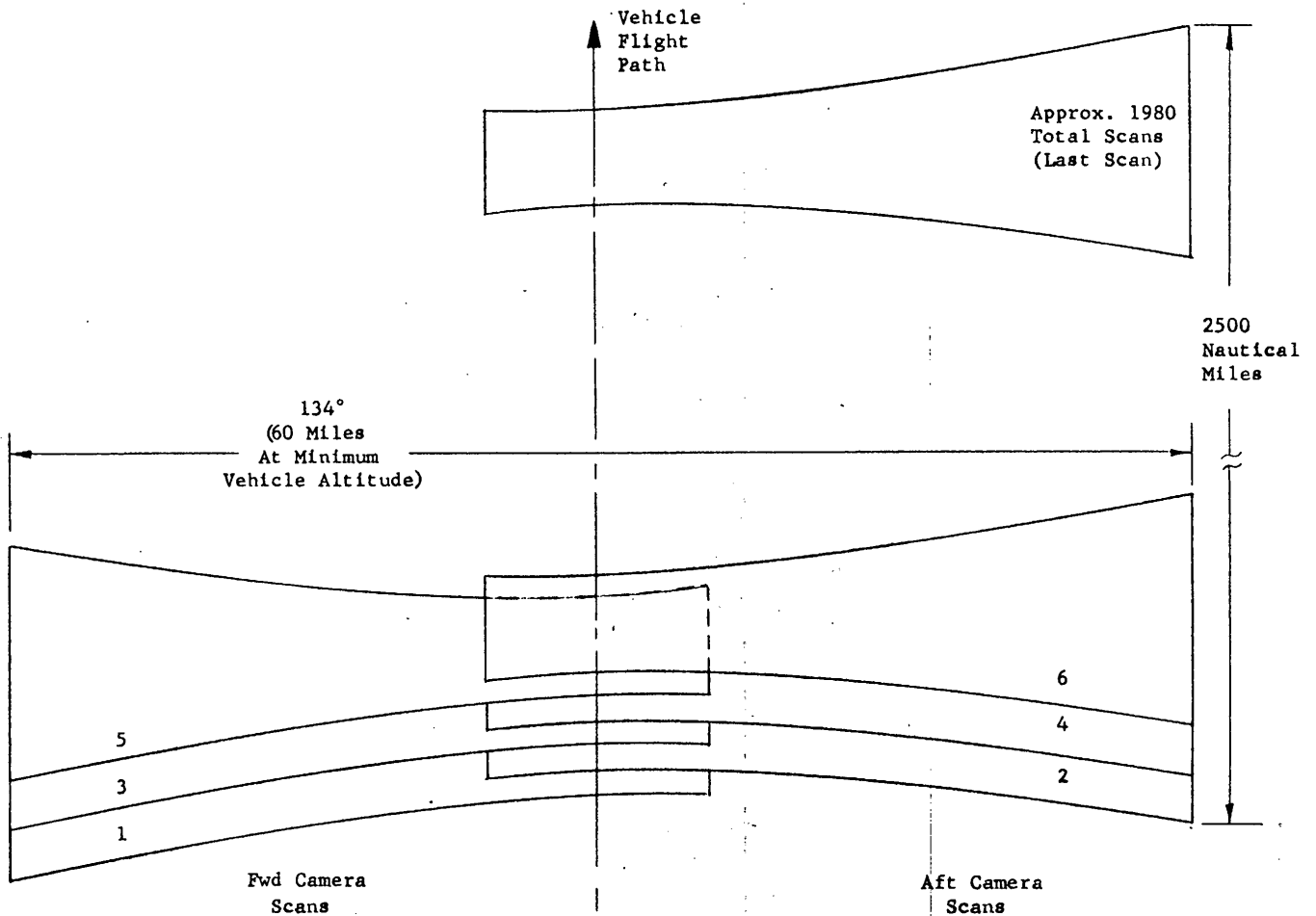


Figure 2. System Type 1 Ground Coverage Format, Straight and Level Flight

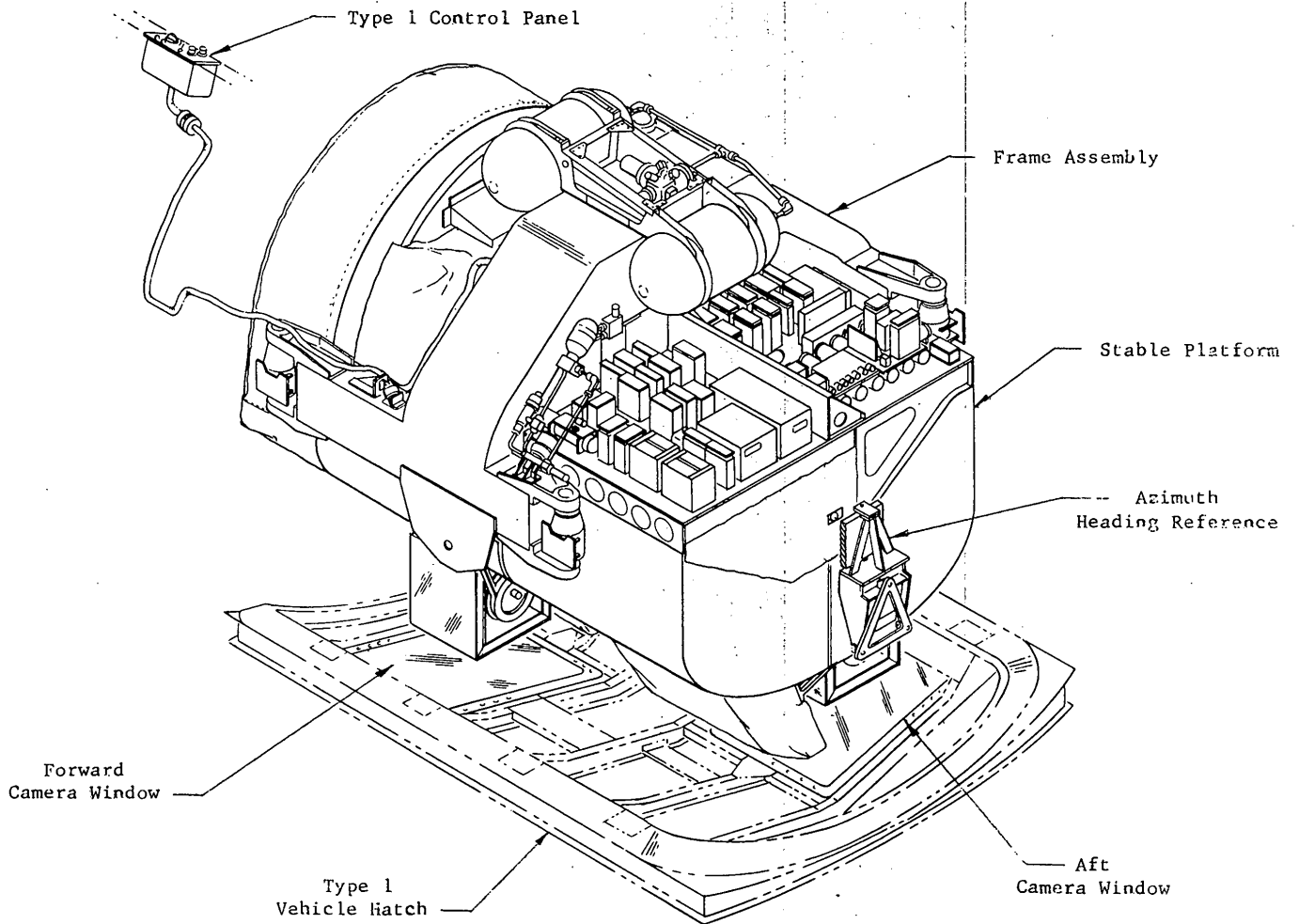


Figure 3. Q-Bay Package, Type 1, Physical Description



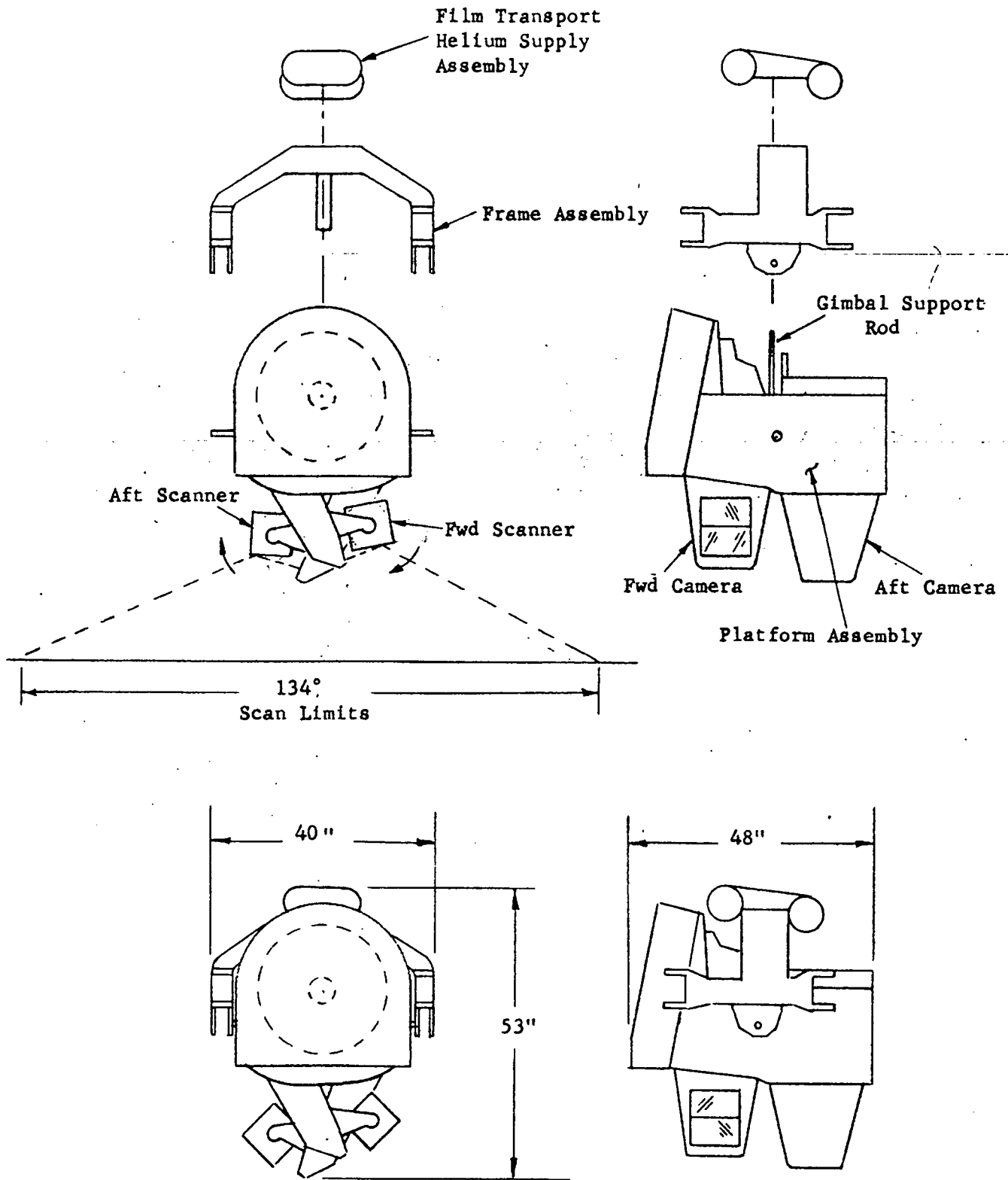


Figure 4. Q-Bay Package Type 1, System Dimensions

platform is gimbal supported at its center of gravity through a gimbal support rod that is fixed to the frame assembly. The frame assembly is installed directly in the Q-bay at four isolation shock mounts.

The platform is normally in either one of two conditions: caged or uncaged. In the caged condition, the platform is locked to the frame and therefore fixed with respect to the vehicle (except for 3/8-inch isolator freedom). In the uncaged condition, the platform is freely suspended from the gimbal support rod and is allowed to stabilize with respect to rate and verticality. The caging system provides an effective means to quickly and automatically change the condition of the platform.

## 2. Q-BAY PACKAGE TYPE 1 CONTROL PANEL

The control panel for Q-bay Package Type 1 is shown in Figure 5. The panel is located on the left side, rear portion of the vehicle cockpit console, and occupies an area approximately 6 inches by 3 inches. See Figure 6.

The large Status selector switch, Figure 5, controls the operation of the package. The smaller V/H option selector switch controls the V/H input for camera functions. The TIMER-OFF toggle switch controls the data recording on the film and the automatic exposure control programmer. Three indicators are: CAGED (RED); STBY 2 (AMBER); and OPR (GREEN). Control panel switches and indicators are listed in Table I.

Q-bay Package Type 1 failure is indicated by a Q-BAY EQUIP OUT indicator (RED) located on the warning panel center console. This will be discussed later.

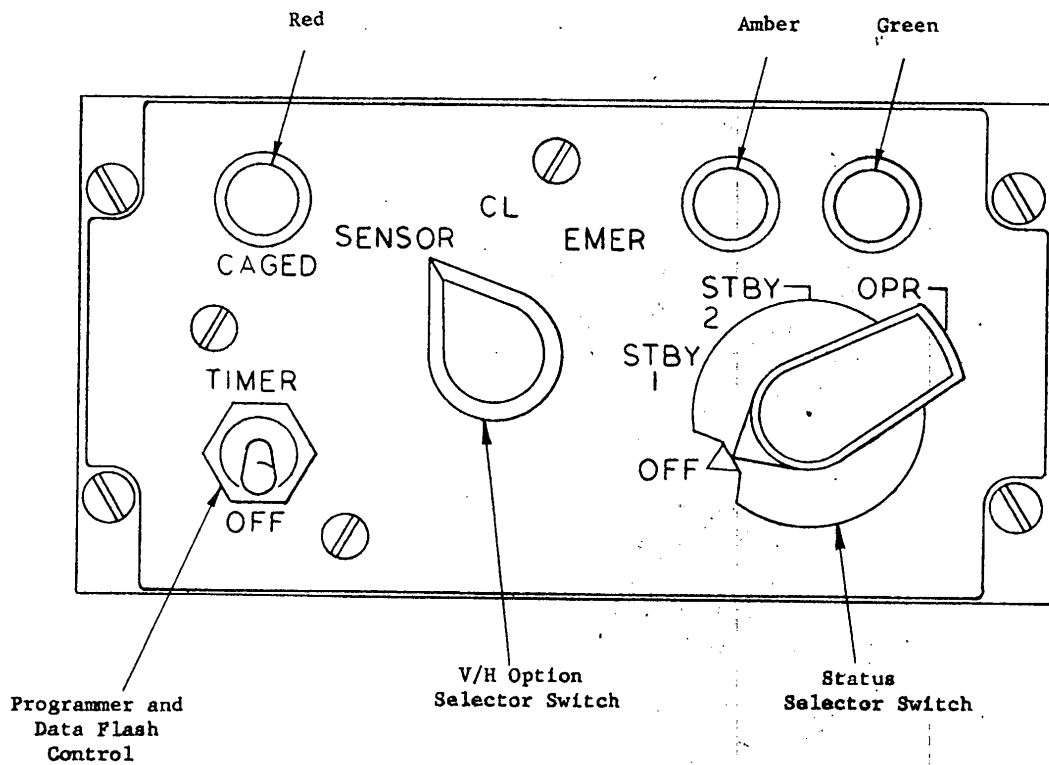


Figure 5. Operational Control Panel, Q-Bay Package Type 1

TO BE SUPPLIED  
BY  
VEHICLE PEOPLE

Figure 6. Q-Bay Package Type 1 Control Panel Location

TABLE I. CONTROL PANEL CONTROLS AND INDICATORS

CONTROL	POSITION	FUNCTION	INDICATORS
STATUS switch (4-position rotary selector switch)	OFF	Shuts down all systems in Q-Bay Package Type 1.	No indicators lighted on control panel.
	STBY 1 (scan idle mode) and (system warm up mode)	Energizes scanner drives. Scanner cubes rotate at constant idle velocity to maintain even surface temperature due to thermal gradients. Data recording stepping motors are energized. Energizes system electronics for warm up of system to even temperatures and permits gyros to attain proper rpm.	No indicators lighted on control panel.
	STBY 2 (Data Flight Recorder Mode)	Turns on Magnetic Data Flight Recorder when first employed. Thereafter identical to STBY 1.	CAGED (RED) -- OFF STBY 2 (AMBER) -- ON OPERATE (GREEN) -- OFF
	OPERATE (photography mode)	All system functions in operate condition. Photography takes place. Platform may be caged or uncaged.	CAGED (RED) -- ON or OFF STBY 2 (AMBER) -- OFF OPERATE (GREEN) -- ON
V/H OPTION (3-position selector switch)	SENSOR (V/H sensor)	Provides a corrected V/H signal for camera operation determined by scene viewed by V/H sensor.	Not Applicable
	CL (Clouds)	Switches out V/H sensor input and, therefore, provides an uncorrected nominal V/H signal for camera operation predetermined for a normal vehicle ground speed and nominal altitude above ground scene. Used during conditions of cloud cover to prevent false V/H information from controlling system operation.	Not Applicable
	EMER (Emergency)	Provides an uncorrected nominal V/H signal for camera operation predetermined for an emergency vehicle ground speed and emergency altitude above ground scene. Used in event of loss of one engine.	Not Applicable
TIMER (2-position toggle switch)	OFF	Prevents system exposure program tape and data flash from operating. Used during preflight system checks.	Not Applicable
	TIMER	Turns on exposure programmer and allows data flasher to operate. (Data information will be recorded on film during OPERATE condition only.) Timer must be turned on at a pre-selected time, usually during refueling.	Not Applicable

3. STATUS SWITCH. The status switch is a 4-position selector switch. Positions and functions are:

a. STBY 1 position - The STBY 1 position energizes the forward and aft camera scanner drives, the gyro spin motors, and all electronic subsystems for system warmup.

- (1) The scanner cubes are exposed to heat via the vehicle windows; as a result, the scanner optical elements may tend to expand. Thermal expansion of the optical elements is evenly maintained, and possible deformation of the optical surface is prevented by having the scanner cubes rotate at a constant idle velocity prior to a mission-run.
- (2) The STBY 1 position also energizes the Q-bay Package data recording mechanism stepping motors. The stepping motors must be synchronized with the INS inputs to reflect correct latitude, longitude, and ground speed. The INS (Inertial Navigation System) and the data recording stepping motors are synchronized prior to take-off. At that time the data recording mechanism readouts follow INS signals. Data information, however, is not recorded on the film until the TIMER switch is placed to the TIMER position.
- (3) The STBY 1 position of the STATUS switch also places critical system electronic packages in a warmup condition. Q-bay Package Type 1 is a critically aligned assembly; both mechanically and electronically. Thermal stabilization of all critical components is achieved for proper operation of the overall system by placing the STATUS switch in the STBY 1 mode prior to take off. STBY 1 also energizes the gyro spin motors to allow time for them to reach proper rpm.

b. STBY 2 position - The STBY 2 position energizes the magnetic data flight recorder and maintains all of the conditions determined by STBY 1.

The flight recorder tapes critical system functions for post flight evaluation of overall system operation. The STBY 2 position thus maintains the magnetic data flight recorder in operation during intermittent operation of the Type 1 equipment .

c. OPR position - The OPR (operate) position of the STATUS switch places the package into the photography mode. When the STATUS switch is placed in OPR, the following events normally occur:

- (1) The system "starts up". The GREEN indicator lights. Film is transported through each camera, all phasing and synchronism of components occurs, and photography takes place. Time from initial start-up to normal operating speed requires approximately 1-1/2 minutes.
- (2) The system will uncage if the vehicle attitude is within discrete attitude limits. The RED caged indicator will not light. - or -
- (3) The system will remain caged if the vehicle attitude is not within discrete attitude limits. The RED caged indicator will light.

d. OFF position - The OFF position of the STATUS switch shuts down the entire Q-bay Package Type 1 equipment.

#### CAUTION

The OFF position is equipped with a special detent to prevent accidental placement of the STATUS switch to the OFF position. The STATUS switch must be simultaneously pushed in and turned, to place switch from STBY 1 to OFF position.

4. V/H OPTION SWITCH. The V/H option switch controls the V/H inputs to the camera system. Three types of V/H inputs are provided for three different flight conditions. These are:

a. SENSOR position. The SENSOR position is the normal position for the V/H OPTION switch. This position is selected during normal flight conditions and cloudless weather conditions.

b. CL (Clouds) position. The CL (Clouds) position is selected during normal flight conditions where partial cloud cover intermittently obstructs the ground scene.

c. EMER (emergency) position. The EMER (emergency) position is selected during abnormal flight conditions when one vehicle engine is out and an emergency vehicle altitude is necessary.

5. TIMER SWITCH. The timer toggle switch controls the data flasher and the camera exposure programmer. The main purpose of the timer is to permit the operator to control the operation of the exposure programmer during a mission, and thus assure that camera operation during preflight checks will not inadvertently cause the data chamber to record the operational base coordinates on the film.

NOTE

Data flasher can operate only when the TIMER switch is in the TIMER position and the STATUS switch is in the OPR position. Exposure Programmer will operate when the TIMER switch is in the TIMER position and the STATUS switch is in STBY 1, STBY 2, or OPERATE position.



6. Q-BAY PACKAGE TYPE 1 AND VEHICLE RELATIONSHIPS

Q-bay Package Type 1 is dynamically influenced by the vehicle under normal conditions in two ways:

- a. Power Inputs
- b. Vehicle Attitude

7. POWER. Q-bay Package Type 1 normally derives its power from vehicle inverter number 2. Power requirements and input configurations are such that operation of the package should not be affected by the loss of one engine or by switching inverters.

8. ATTITUDE. Photographic performance of Q-bay Package Type 1 depends upon platform attitude. Platform attitude should be level in pitch and roll and parallel in azimuth with the vehicle line of flight.

The Q-bay Package Type 1 is installed in the vehicle such that in the caged condition the platform is level in pitch and roll when the vehicle is at a nominal cruise attitude of +7 degrees in pitch and 0 degree in roll. See Figure 7.

Q-bay Package Type 1 will uncage in the operate mode only when the platform is coarse level -- within  $\pm 2$  degrees on true vertical. The vehicle must be within  $\pm 2$  degrees in pitch and roll of its nominal cruise attitude as shown in Figure 8.

In the uncaged condition, the Q-bay Package will stabilize with respect to rate and verticality and will automatically align itself with

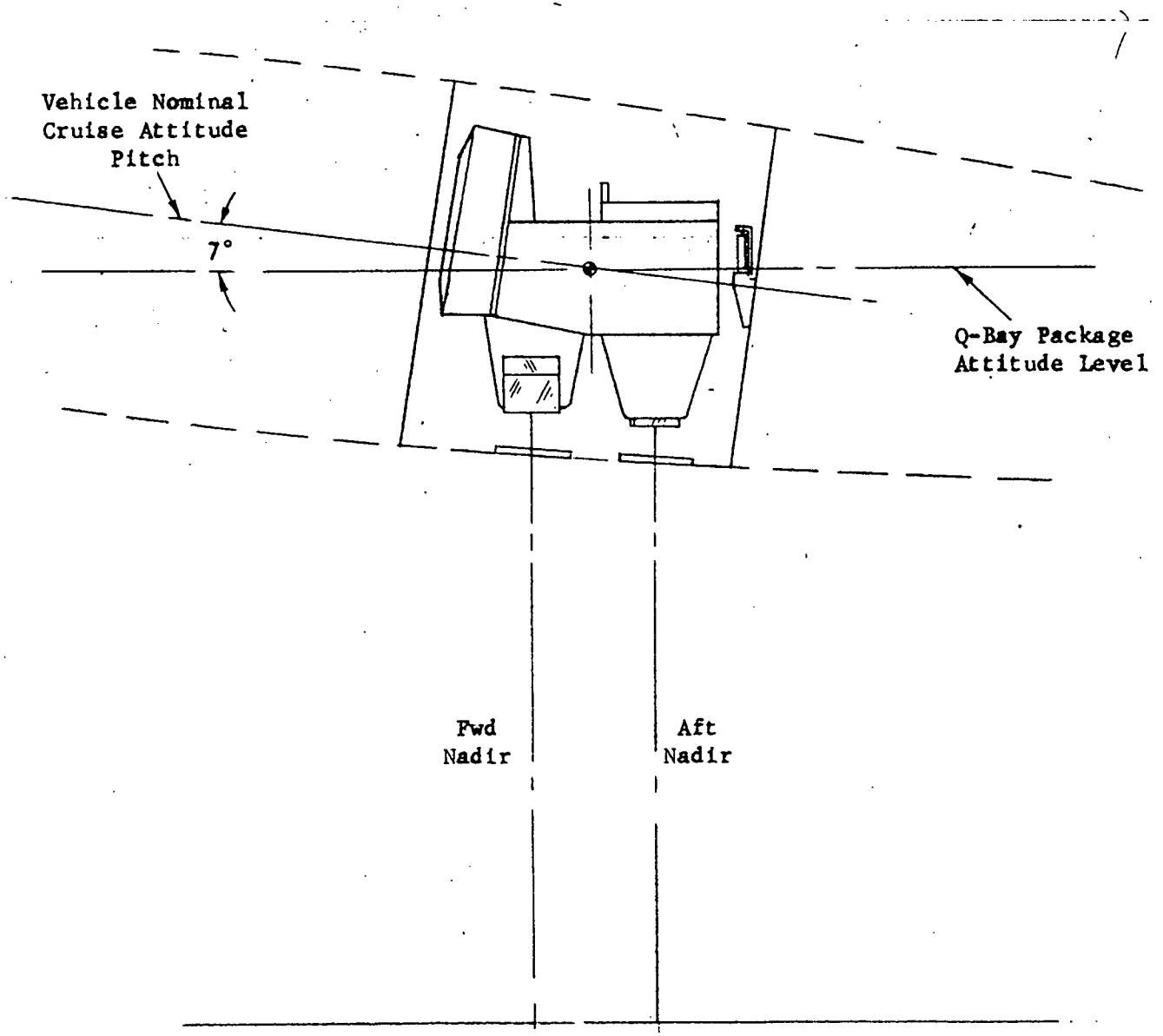


Figure 7. . Q-Bay Package Type 1 and Vehicle Attitude Relationships, Caged Condition

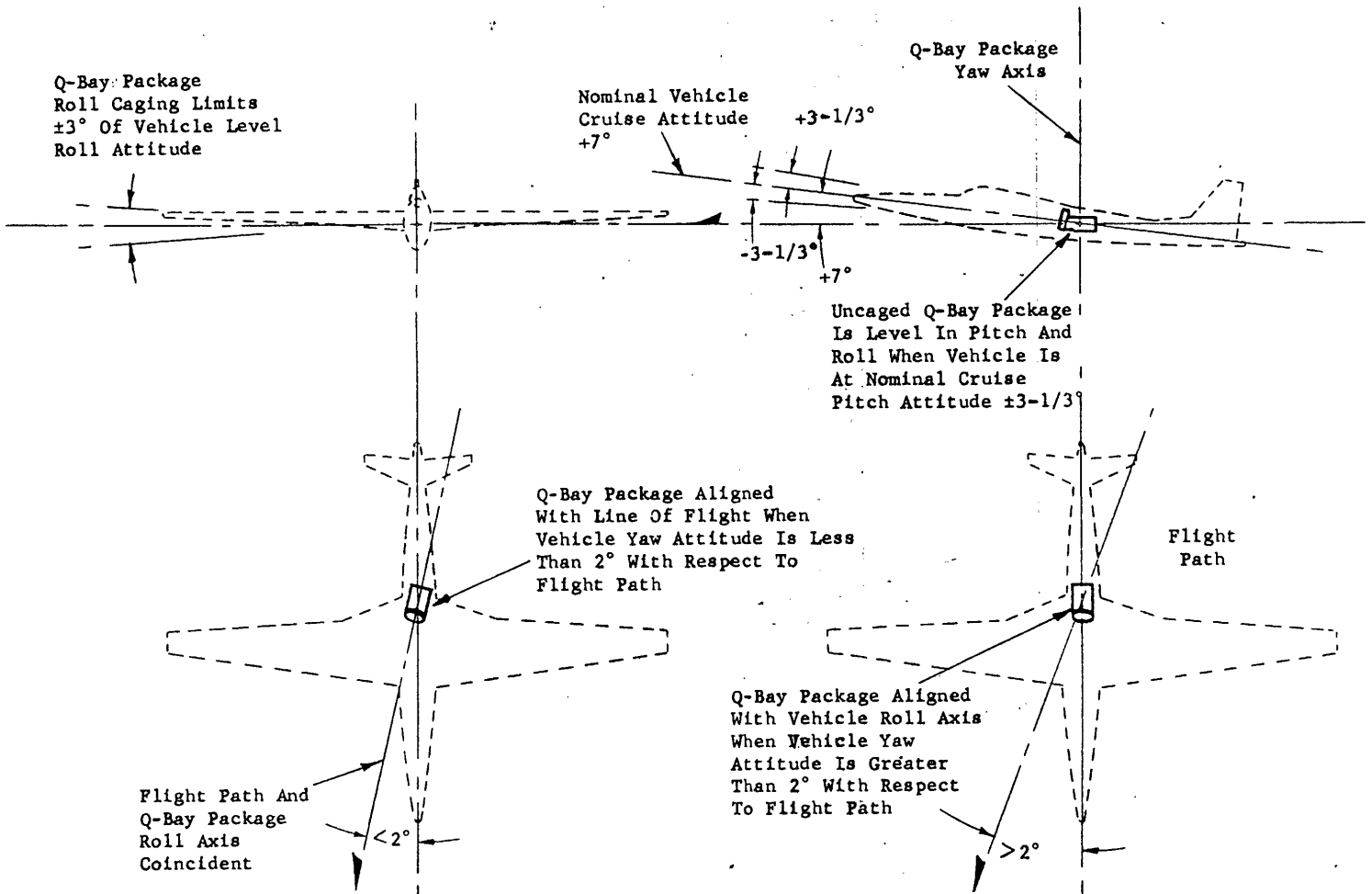


Figure 8. Vehicle And Q-Bay Package Attitude Relationships, Uncaged Condition

respect to the vehicle flight path. The package will remain uncaged and stabilized within the following vehicle attitude limits: (See Figure 5)

Pitch	$7^{\circ} \pm 3\text{-}1/3^{\circ}$
Roll	$0^{\circ} \pm 3^{\circ}$
Yaw	$0 \pm 2^{\circ}$

The Q-bay Package frame physically prevents the stabilized platform from exceeding the above limits. When any limit has been reached, a corresponding clearance switch will close and cage the platform.

In the caged condition, the Q-bay Package is fixed with respect to the vehicle and is level in pitch and roll only when the vehicle attitude is:

Pitch	$+7^{\circ}$
Roll	$0^{\circ}$
Yaw	---

During a normal mission-run, the Q-bay Package is expected to uncage and cage possibly more than once due to vehicle attitude perturbations that exceed the platform caging limits. Uncaging is accomplished by a compressed helium supply of limited quantity. When the supply is exhausted, the platform will not uncage.

It is possible for the platform to experience at lease 25 uncaging and caging cycles during one mission. Should the number of caging cycles exceed 25 at any time during the mission, then the possibility exists that the platform will remain caged for the remainder of the mission.

9. Q-BAY PACKAGE TYPE 1 OPERATION

Q-Bay Package Type 1 does not operate continuously throughout the entire mission. The package may be operated continuously for a portion of the mission, or it may be operated intermittently for an extended portion of the mission. The flight plan will normally indicate the exact operating procedure.

The package will operate properly and should be operated when required either in a caged condition or an uncaged condition. Best photographic performance, however, can be expected in the uncaged, self-stabilized mode. When the package is being operated in the caged condition, vehicle attitude rates directly affect the photographic performance. Vehicle flight should be kept as smooth as possible and changes in vehicle attitude should be accomplished as smoothly as possible. This will minimize photographic degradation.

10. TYPICAL MISSION PROFILES OF Q-BAY PACKAGE TYPE 1. Two typical Q-Bay Package Type 1 mission profiles are shown in Figure 9. Mission 1 shows continuous operation of the package for a segment of the entire mission. Mission 2 shows intermittent operation of the package for arbitrary portions of the mission. In practice, the package will always be placed in the standby 1 mode at sometime during the final pre-flight check. The package will always start the mission in the standby 1 mode. Specific flight instructions will state the exact sequence of operation of the status switch for the standby 2 and operate modes, as shown in Figure 10.

11. Q-BAY PACKAGE TYPE 1 FAILURE. The Q-BAY EQUIP OUT indicator (RED) on the warning panel will light in the event of the Q-bay Package Type 1 failure. The Q-BAY EQUIP OUT indication on the warning panel can occur only when the

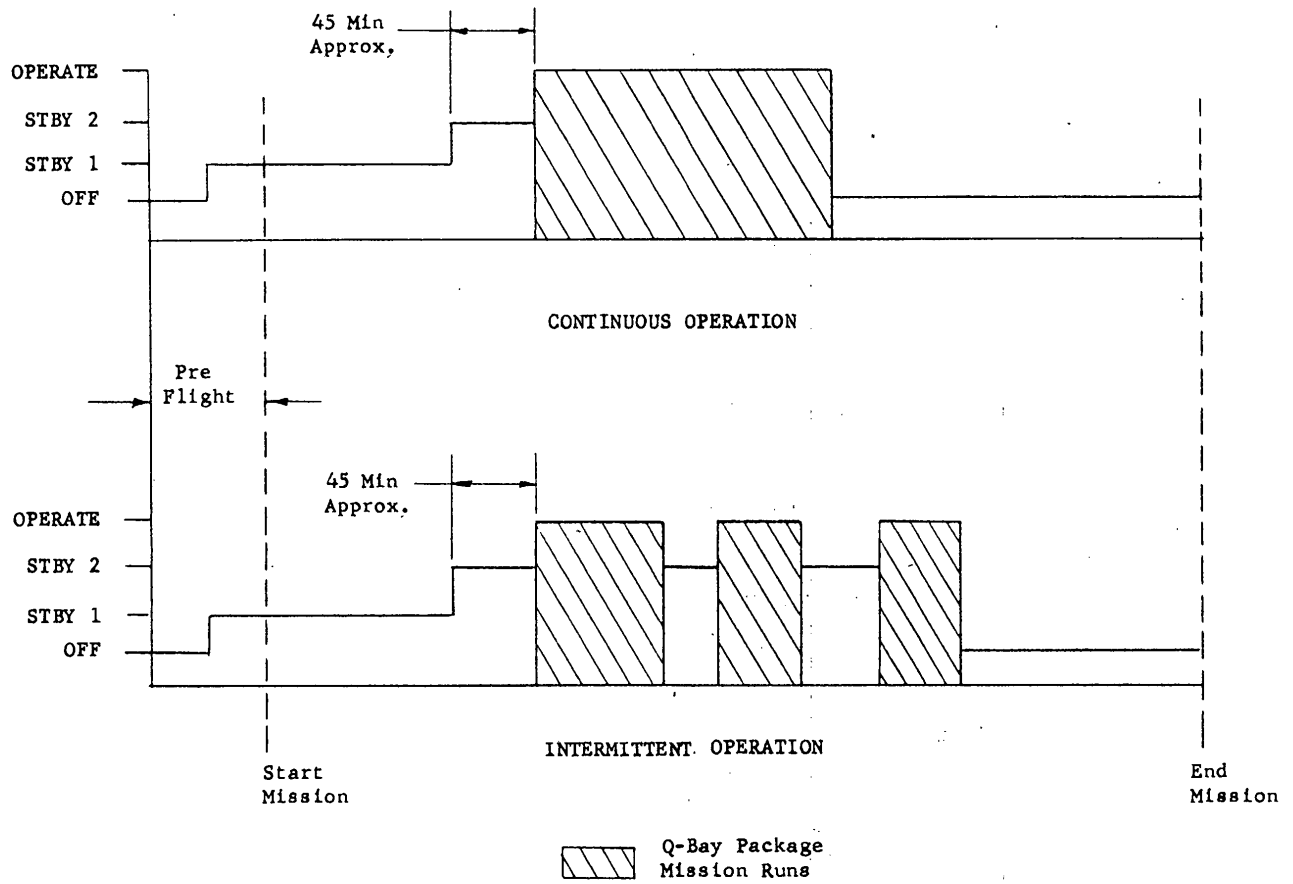


Figure 9. Typical Mission Profiles Of Q-Bay Package Type 1

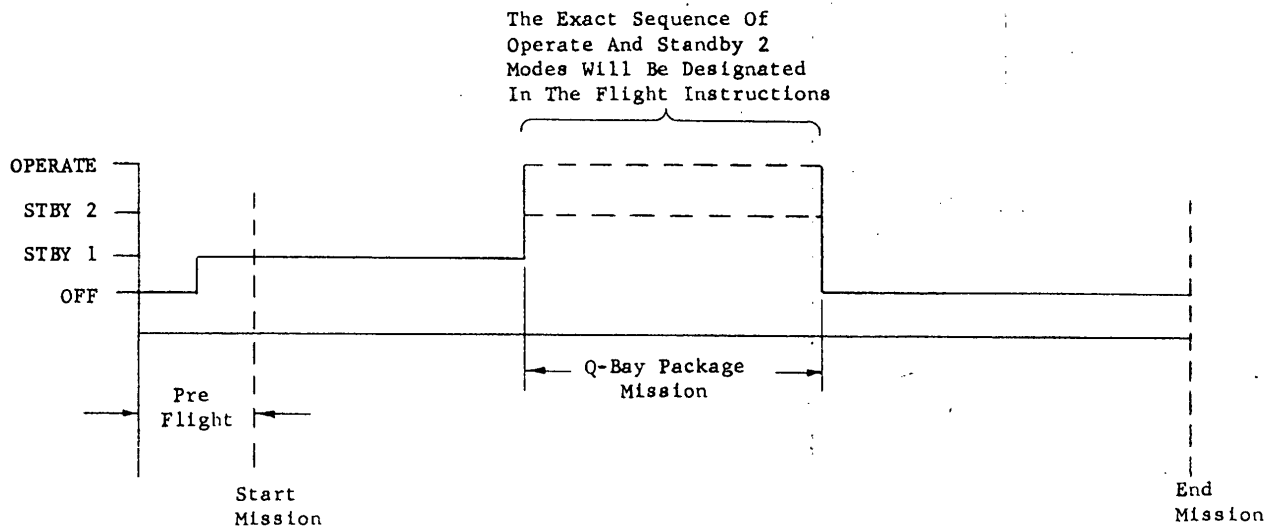


Figure 10. Q-Bay Package, Mission Profile

status switch is in the OPR position. When a Q-BAY EQUIP OUT indication occurs, the package will automatically switch from the operate mode to the standby 2 mode; the green OPR indicator will go out and the amber STBY 2 will light.

12. FAILURE PROCEDURE. Should the Q-bay Package fail during normal operation, the following procedure is recommended:

a. Place the STATUS switch from the OPR position to the STBY 2 position. The Q-BAY EQUIP OUT light on the warning panel will go out. On the control panel, the amber STBY 2 light will continue to light.

b. Wait 15 seconds.

c. Place STATUS switch to OPR position. One of three possible indications will occur:

(1) If the Q-BAY EQUIP OUT light lights immediately, place the STATUS switch to the OFF position.

(2) If the Q-BAY EQUIP OUT light does not light immediately, but does light after a noticeable time (approximately 3 to 30 seconds) return the STATUS switch to the STBY 2 position and wait 15 seconds. Then place the STATUS switch to the OPR position and observe the Q-BAY EQUIP OUT indicator. If the Q-BAY EQUIP OUT indicator lights, then the STATUS switch should be placed to the OFF position.



- (3) If the Q-BAY EQUIP OUT light does not light within 30 seconds, then the package can be considered operational.

13. CONTROL PANEL INDICATORS, PRE-FLIGHT CHECK. All three control panel indicators are of the press-to-test type. All three indicators should be checked during the pre-flight checkout.

14. CONTROL PANEL EMERGENCY IN-FLIGHT CHECKOUT. Any indicator on the control panel that is suspected of malfunction during system operation should be pressed-to-test. If indicator fails to light when pressed, lamps should be changed if possible.

15. MISSION OBJECTIVES

Ideally, a mission-run will be flown in a great circle route; the Q-bay Package will operate in an uncaged condition all of the way; the mission flight path will be exactly as expected; and the photographic results will include the area of earth desired.

However, circumstances may be during a mission-run that the flight path is not as expected, or the Q-bay Package has been operating caged most of the way.

Caged operation requires the utmost attention. Vehicle attitude rates must be kept low, — the vehicle must be flown as smoothly as possible to minimize photographic degradation. If flight path correction is necessary during a mission run, again, vehicle attitude rates should be minimized during flight path correction.

16. PHOTOGRAPHY WITH AID OF PERISCOPE WIDE FIELD

System operation, in most cases, will be programmed according to time and earth coordinates. However, circumstances could be that the operator is responsible for determining photographic coverage through use of the periscope.

If an object to be photographed appears on the periscope wide field at a time when the Q-bay Package is in the STBY 2 mode, the package must be placed into the OPERATE mode within 20 seconds after the object's first appearance on the periscope wide field. If the STATUS switch is not placed to the OPR position within the object's first 20 seconds of visibility on the periscope, then the object will probably not be within the photographic field of view during the time of photography.

17. MISSION RESULTS

Q-bay Package Type 1 provides matched sets of panoramic photographs in the format shown in Figure 11. Paired photographs, one forward scan and the corresponding aft scan, appear with the associated data information recorded in an area between them. Approximately 990 such paired photographs with recorded data can be expected from a full film supply of 5000 feet. Film width is 6.6 inches. Individual frame dimensions are 6.4 inches by 27.8 inches.

18. DATA RECORDING

Vehicle ground speed, latitude, longitude, Greenwich Mean Time, and the mission flight number are recorded for each frame. See Figure 12. A CAGED Status indication is also provided, indicating whether the Q-bay Package was caged or uncaged for any particular frame.

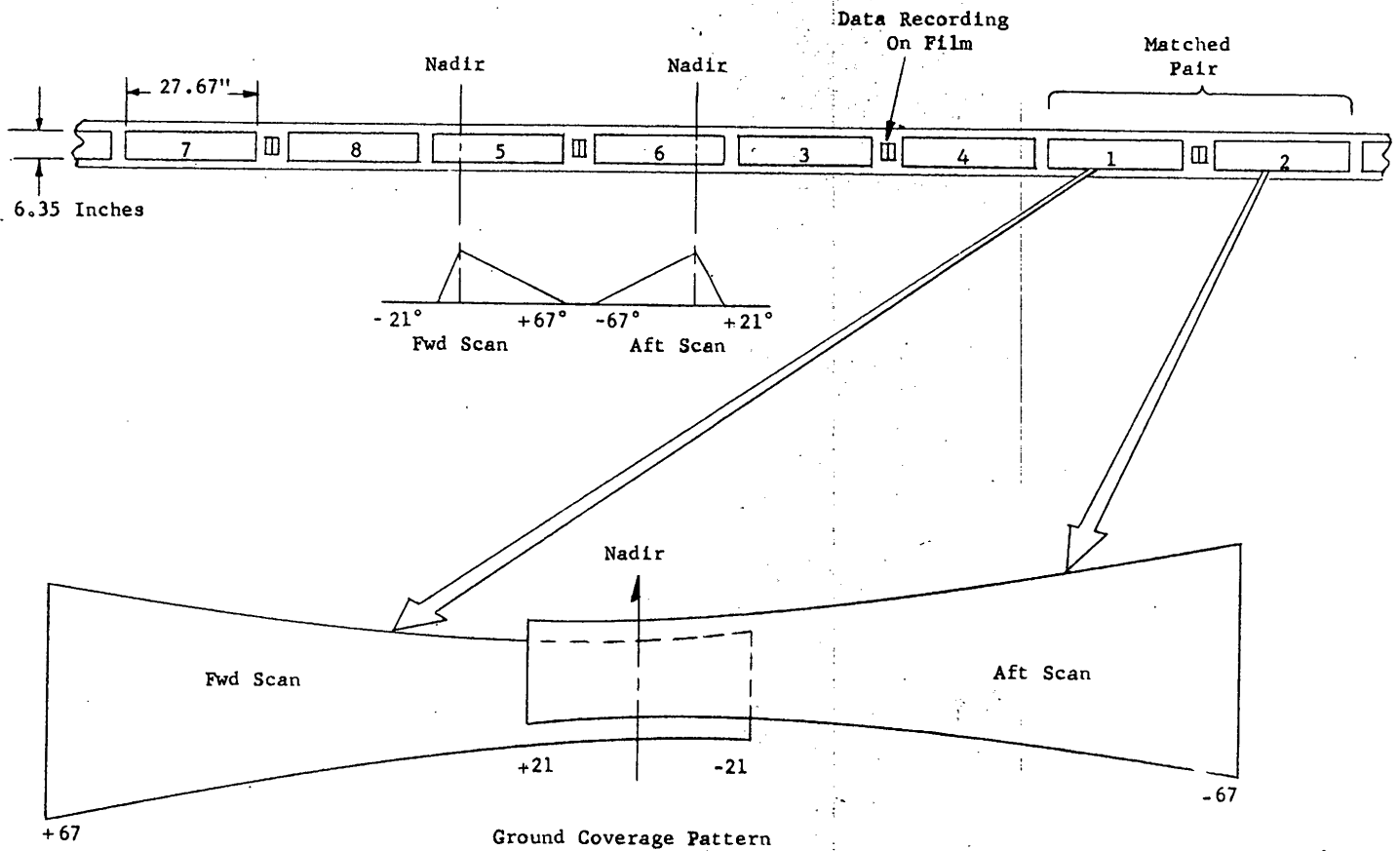


Figure 11. Q-Bay Package Type 1 Frame Format Relationship To Ground Coverage Pattern

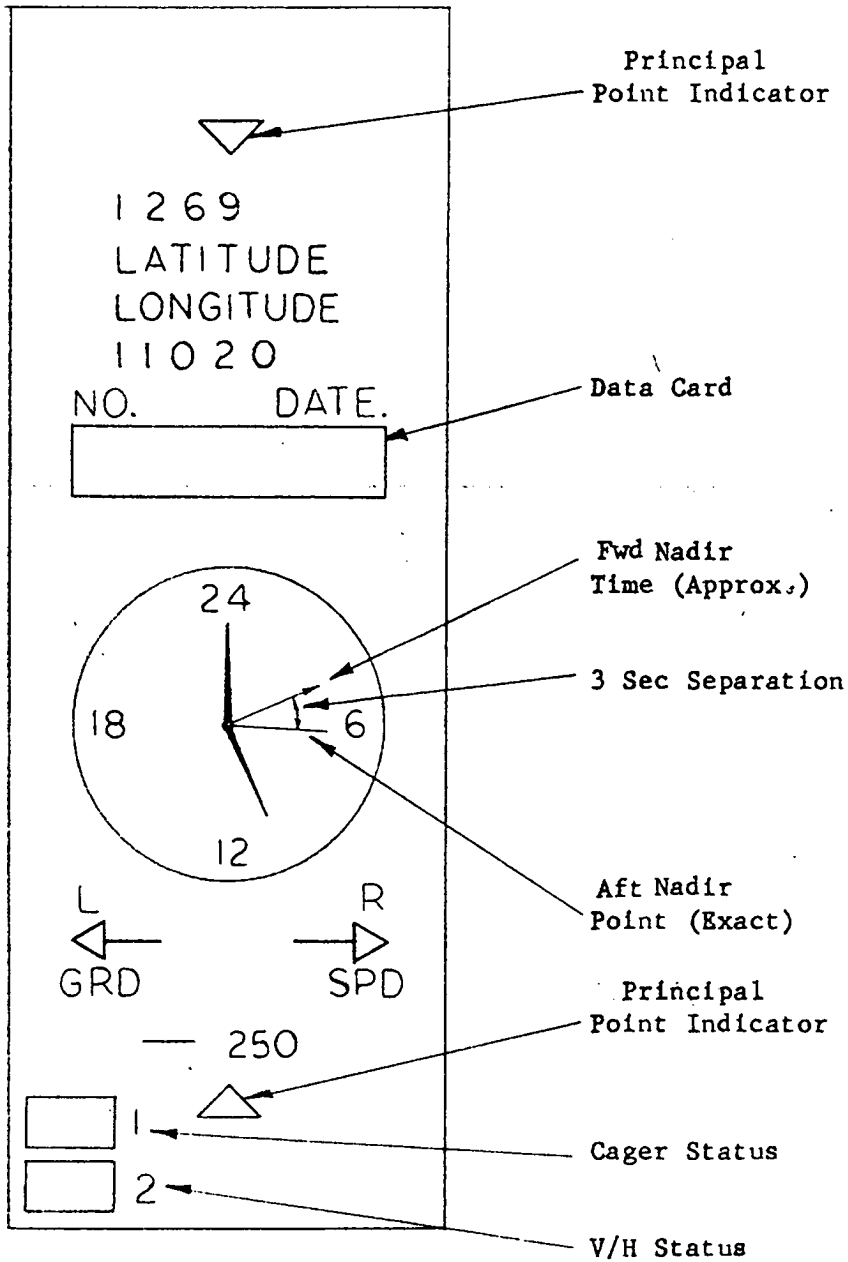


Figure 12. Data Recording On Film