3.8 (Continued)

The most directly related study was done in the School of Aerospace Medicine (SAM) 2-man Space Cabin Simulator, Reference 3.8-4. Two Air Force pilots were confined for 30 days in a chamber providing 190 cubic feet per man. The mission plan called for operational tasks approximately 50 percent of the time. Some decrement in work capacity occurred during the period. Inter-crew compatibility was satisfactory where incidents that elicited hostility were minimized. The most recent study (Ref. 3.8-5) involved six pilots (attired in pressure suits) who spent 34 days in a space cabin simulator providing 167 cubic feet per man. The crew members were required to perform operational tasks 50 percent of the time. Preliminary results indicate that there were not major problems. It should be noted that an allotment of 167 cubic feet per man in a large crew is probably equivalent to 200 cubic feet per man in a two man station where there is less opportunity to share space.

Based on this analysis of the space requirements, the mission section on the Agena for the long duration mission should provide a free space minimum volume allotment of 150 cubic feet per man. As shown on the concept presented in Figure 3.8-1, the access tunnel/living quarters provides a volume of approximately 230 cubic feet. This should be adequate since one crew man should remain on duty in the Gemini cabin at all times.

The long duration mission discussed offers a number of appealing aspects including:

A. Utilization of existing Gemini (GLV) Atlas/Agena/TDA equipment to the maximum extent possible.

B. Development of E.V. operation.

C. Utilization of an inflatable tunnel developed under Air Force Contract.

D. Accomplishment of structural assembly in space.

3.8 (Continued)

Mission stay times are shown in Figure 3.8-7 for three assumptions: (1) water included for pressure suit environment, (2) water included for shirtsleeve environment, and (3) water assumed produced by fuel cells.

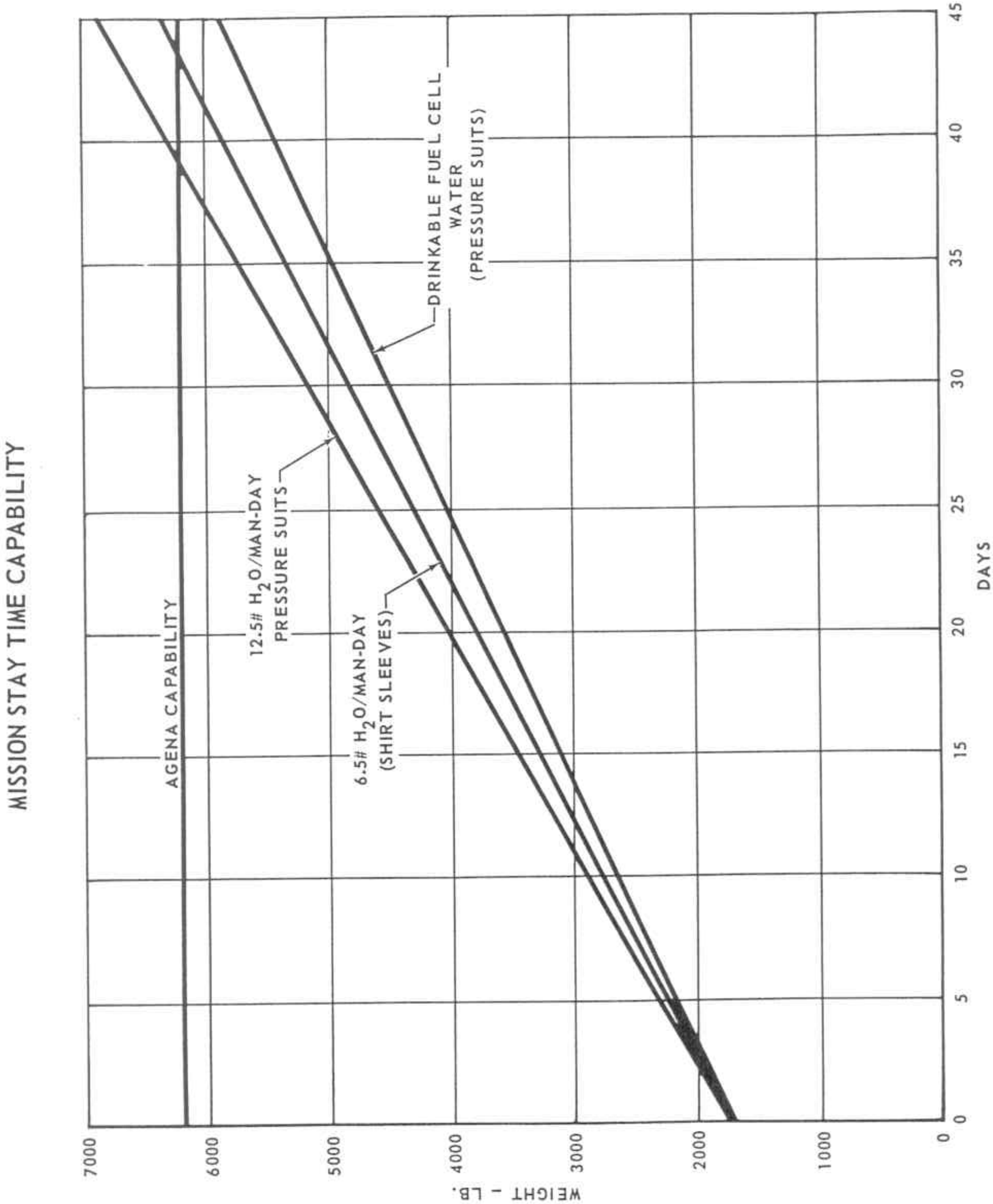
MISSION STAY TIME CAPABILITY
AGENA CAPABILITY
12.5# H_2O/MAN-DAY PRESSURE SUITS
6.5# H_2O/MAN-DAY (SHIRT SLEEVES)
DRINKABLE FUEL CELL WATER (PRESSURE SUITS)
WEIGHT – LB.
0 1000 2000 3000 4000 5000 6000 7000
DAYS
0 5 10 15 20 25 30 35 40 45

FIGURE 3.8-7

3.9 Land Landings - Two approaches to land landing are presented in Section 2.9. Four other approaches considered but ruled out because they involve extensive change to Gemini, are also discussed. Further descriptions of all six approaches are presented in the following paragraphs.

3.9.1 Landing Rocket Suspended from Parasail Risers - Design changes required to the parasail version of Gemini to incorporate a landing rocket suspended from the parasail, as shown in Figures 3.9-1 and 3.9-2, are as follows:

A. Rendezvous radar is omitted, or relocated, and the parasail cannister changed to allow for installation of the landing rocket in the rendezvous and recovery (R&R) section. Some structural changes are also needed in this section.

B. A device for controlling the deployment of the landing rocket is installed in the R&R section.

Areas requiring thorough analysis before a landing scheme of this type is pursued for Gemini are as follows:

A. Landing rocket deployment effects on spacecraft stability. Particular attention should be given to study of the directional stability of the spacecraft during and following rocket deployment.

B. Effects of plume impingement on the spacecraft and supports.

C. Possibility of burned out rocket motor collision with spacecraft.

3.9.2 Cloverleaf Landing System - Design changes required to incorporate a cloverleaf landing system, as shown in Figure 3.9-3, are as follows:

A. The recovery section is modified to accommodate the cloverleaf installation. At this time, it is believed the changes required are not extensive.

B. A control system, different from the Gemini parasail control system, is located in the top centerline torque box.

PRESENT PARASAIL LANDING CONFIGURATION

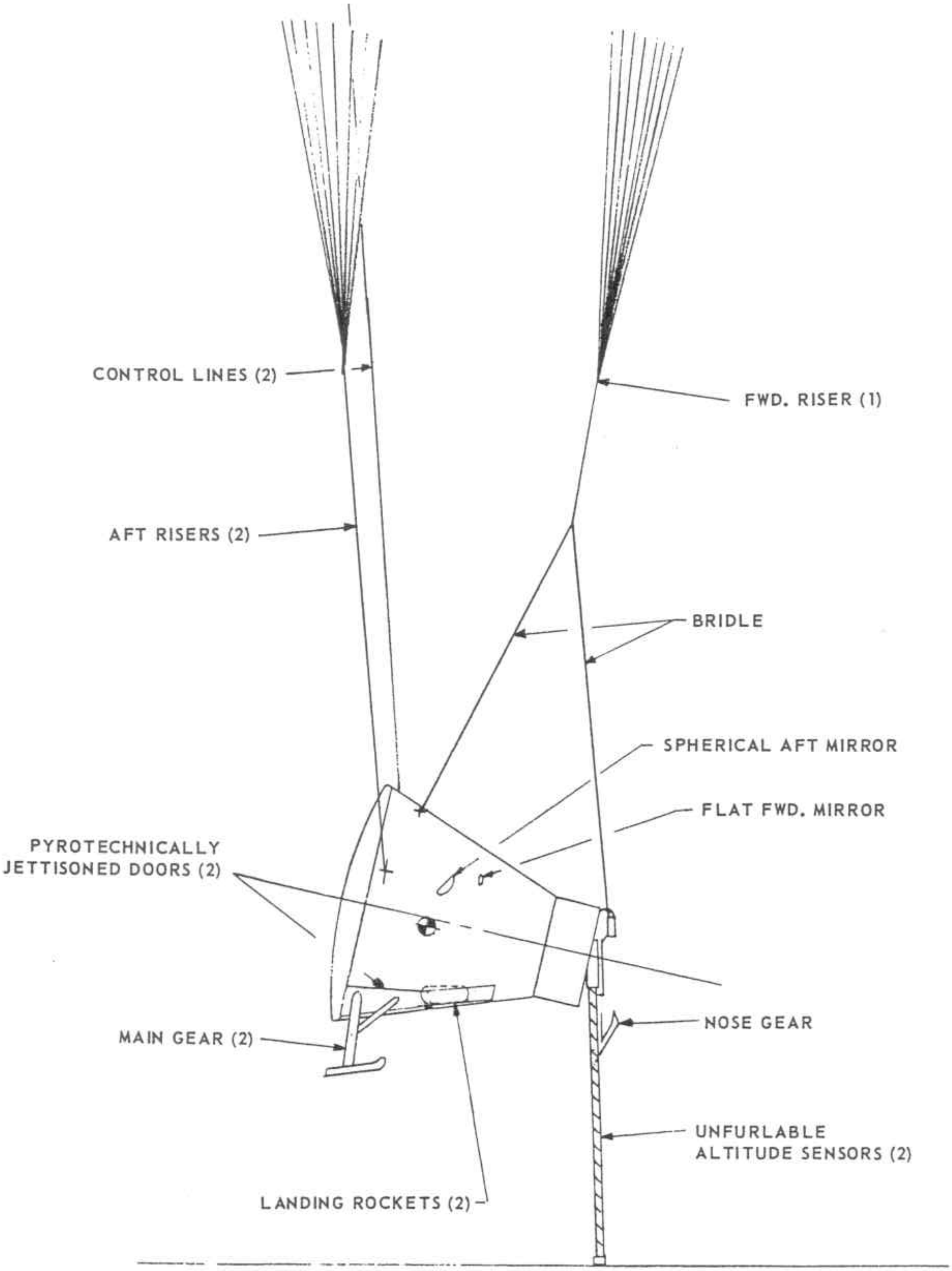

FIGURE 3.9-1

PARASAIL LANDING CONFIGURATION
WITH SUSPENDED LANDING ROCKET

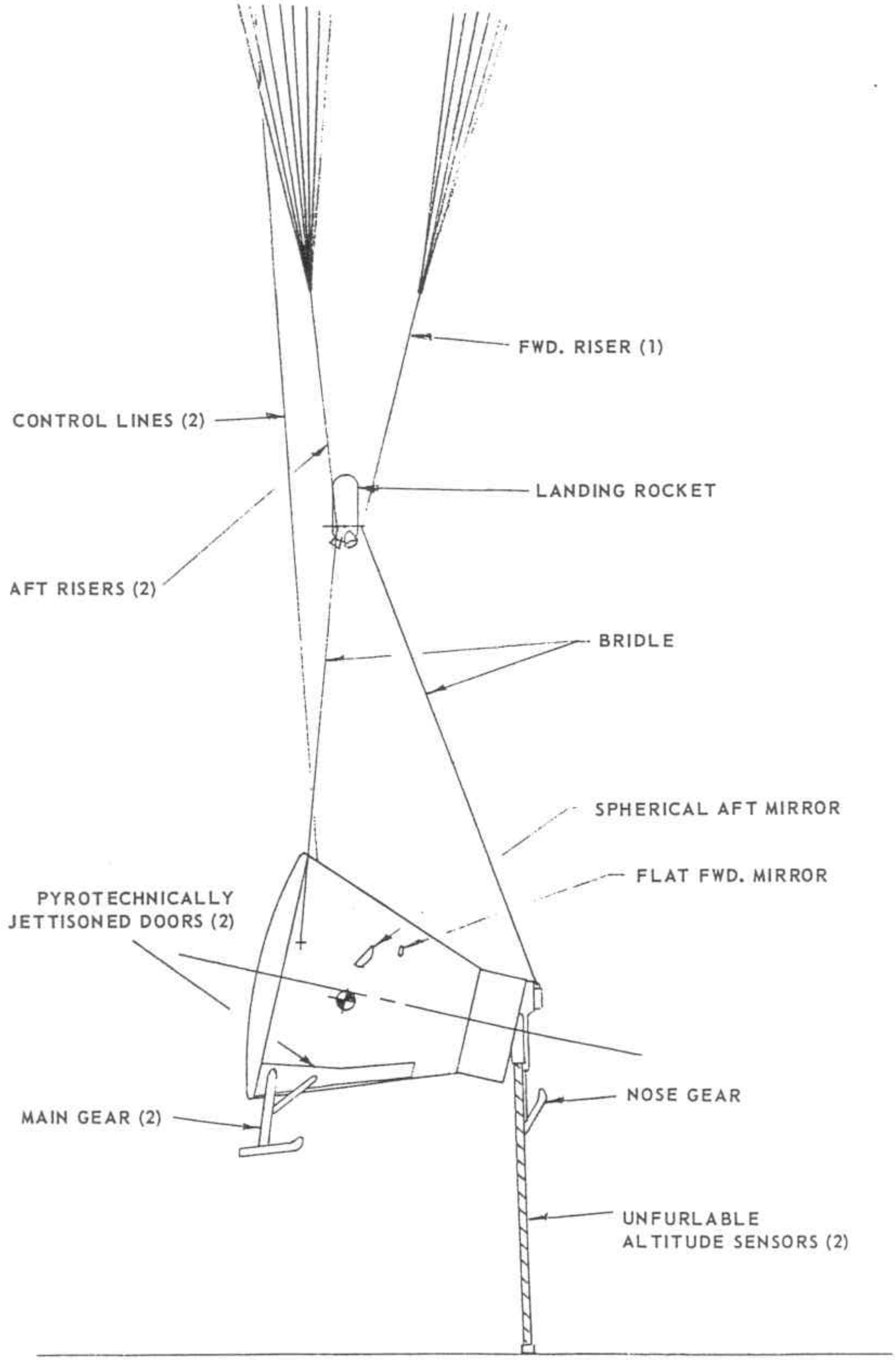

FIGURE 3.9-2

CLOVERLEAF LANDING CONFIGURATION

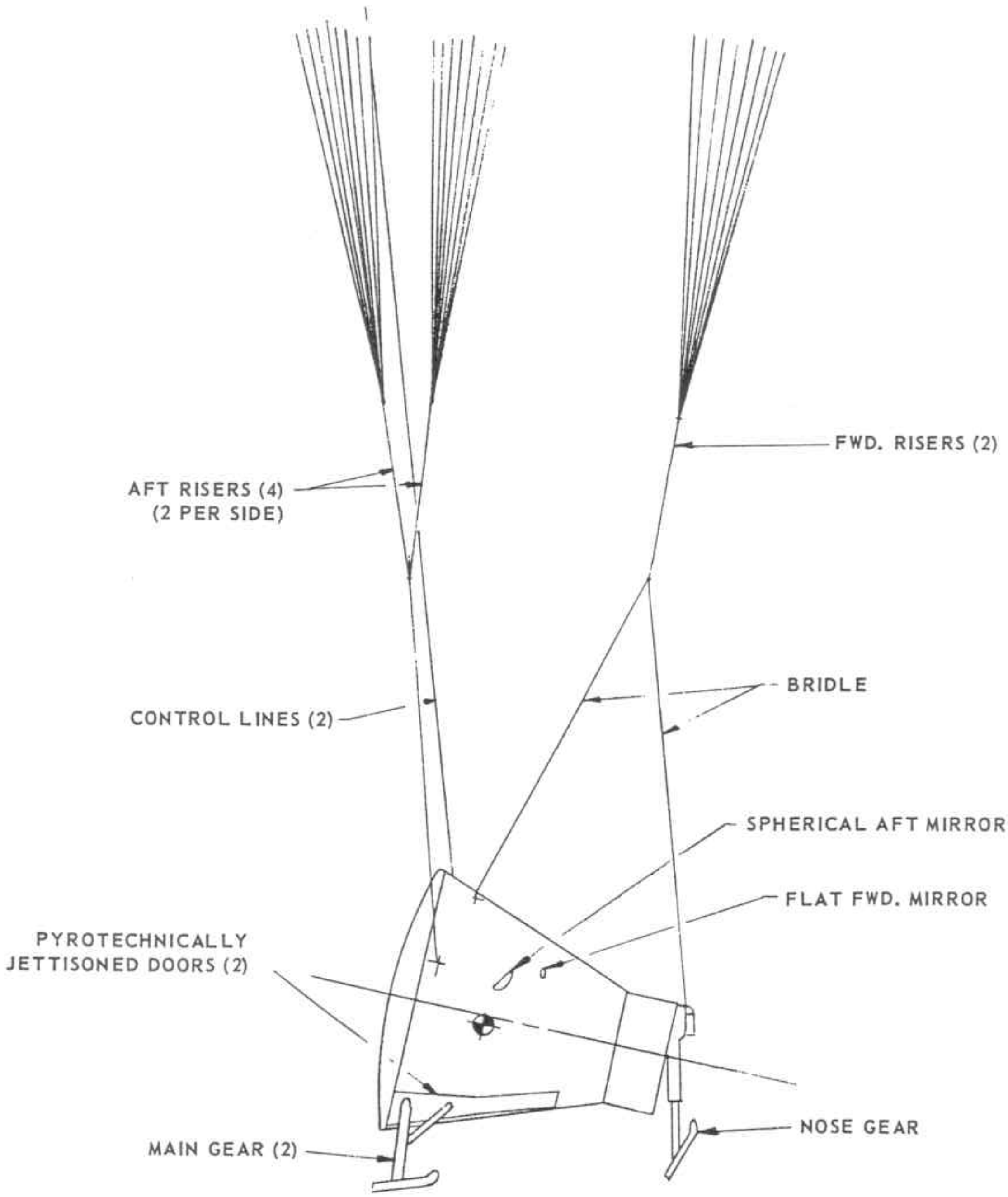

FIGURE 3.9-3

3.9.2 (Continued)

Development of the cloverleaf is in the initial stages and looks promising, but more data is required in the areas applicable to Gemini.

Areas which should be thoroughly investigated in the development of this type of landing system are as follows:

A. Reefing requirements necessary to keep cloverleaf deployment loads below the 16,000 pound limit load of Gemini are to be determined.

B. Control forces required are considerably higher than that of the Gemini parasail and therefore may require a different design approach from that used for the parasail.

The Gemini landing gear design parameters, also used for the cloverleaf analyses, are shown in Table 3.9-1.

TABLE 3.9-1
GEMINI LANDING GEAR DESIGN PARAMETERS

MAXIMUM GROUND WIND VELOCITY – 30 FPS.
LANDING AREA BEARING STRENGTH – 200 PSI MINIMUM.
TOUCHDOWN AREA TO BE CLEAR OF OBSTACLES LARGER THAN TWO INCHES HIGH.
ALLOWABLE IMPACT VELOCITY – 15 FPS FOR NOSE DOWN OF –16 DEGREES, 13 FPS FOR NOSE UP OF 12 DEGREES.
GROUND SLOPE – 5 DEGREES MAXIMUM IN ANY DIRECTION.
LIMIT DEPLOYMENT LOAD – 16,000 LB.

The cloverleaf chute being considered for application to Gemini has a wetted equivalent diameter of approximately 100 feet and horizontal velocity control from 10 to 24 fps. Maximum descent velocity would be approximately 26 fps, with a range at landing of 13-14 fps.

The estimated weights for the various configurations are shown in Table 3.9-2.

TABLE 3.9-2

WEIGHT SUMMARY
LAND LANDING CONFIGURATIONS

ITEM	GEMINI PARASAIL CONFIG. (LB.)	ALTERNATE PARASAIL CONFIG. (LB.)	CLOVERLEAF (LB.)
REMOVE:	(-618)	(-618)	(-618)
RADAR	-88	-88	-88
OAMS TANKS & PRESSURANT	-44	-44	-44
OAMS PROPELLANT	-288	-288	-288
DOCKING SYSTEM	-19	-19	-19
PARACHUTE SYSTEM	-159	-159	-159
ROLL BAR, FLOTATION AIDS IN RCS SECT.	-20	-20	-20
ADD:	(619)	(644)	(577)
PARASAIL	269	269	-
LANDING ROCKETS	93	93	-
LANDING GEAR	236	236	236
EQUIPMENT RELOCATION	21	21	21
CLOVERLEAF	-	-	300
ROCKET DEPLOYMENT MECHANISM	-	15	-
R & R STRUCTURAL MODIFICATION	-	10	20
BALLAST ADJUSTMENT	(-16)	(-12)	(-60)
TOTAL SPACECRAFT WEIGHT CHANGE	-15	+14	-101

3.9.3 Impact Bags - Installation of an impact bag between the large pressure bulkhead and heat shield, plus the installation of a toroidal impact bag around the recovery section, was investigated for application to Gemini. The arrangement is shown in Figure 3.9-4.

The descent system used for land landings requires sufficient controllability to permit maneuvering in the landing area. For this reason a parasail was selected as the descent system.

The cylindrical aft impact bag is designed to attenuate the descent velocity and the toroidal impact bag to stop any tumbling which may occur. This system is not adversely affected by variations in impact area sliding coefficients of friction since tumbling is assumed to occur.

Behavior of the spacecraft upon impact and its physical and psychological effects upon the crew may prove this system to be an undesirable landing scheme for manned vehicles.

3.9.4 Cable and Spike Landing Schemes - Alternate approaches for using a cable attached to a spike for horizontal velocity attenuation are shown in Figures 3.9-5 and 3.9-6. The re-entry module is maneuvered into a suitable landing area where the spike attached to the cable is driven pyrotechnically into the ground.

The method shown in Figure 3.9-5 employs an impact bag for vertical velocity attenuation. After the cable has been anchored to the ground, the glide chute is trimmed to behave as a parachute and the spacecraft continues its descent, drifting with the wind. A winch mounted in the spacecraft reels in the cable slack, until the cable is perpendicular to the flight path. The spacecraft then follows an arc defined by the cable. Upon impact with the ground horizontal velocity has been attenuated.

IMPACT BAG LANDING SYSTEM

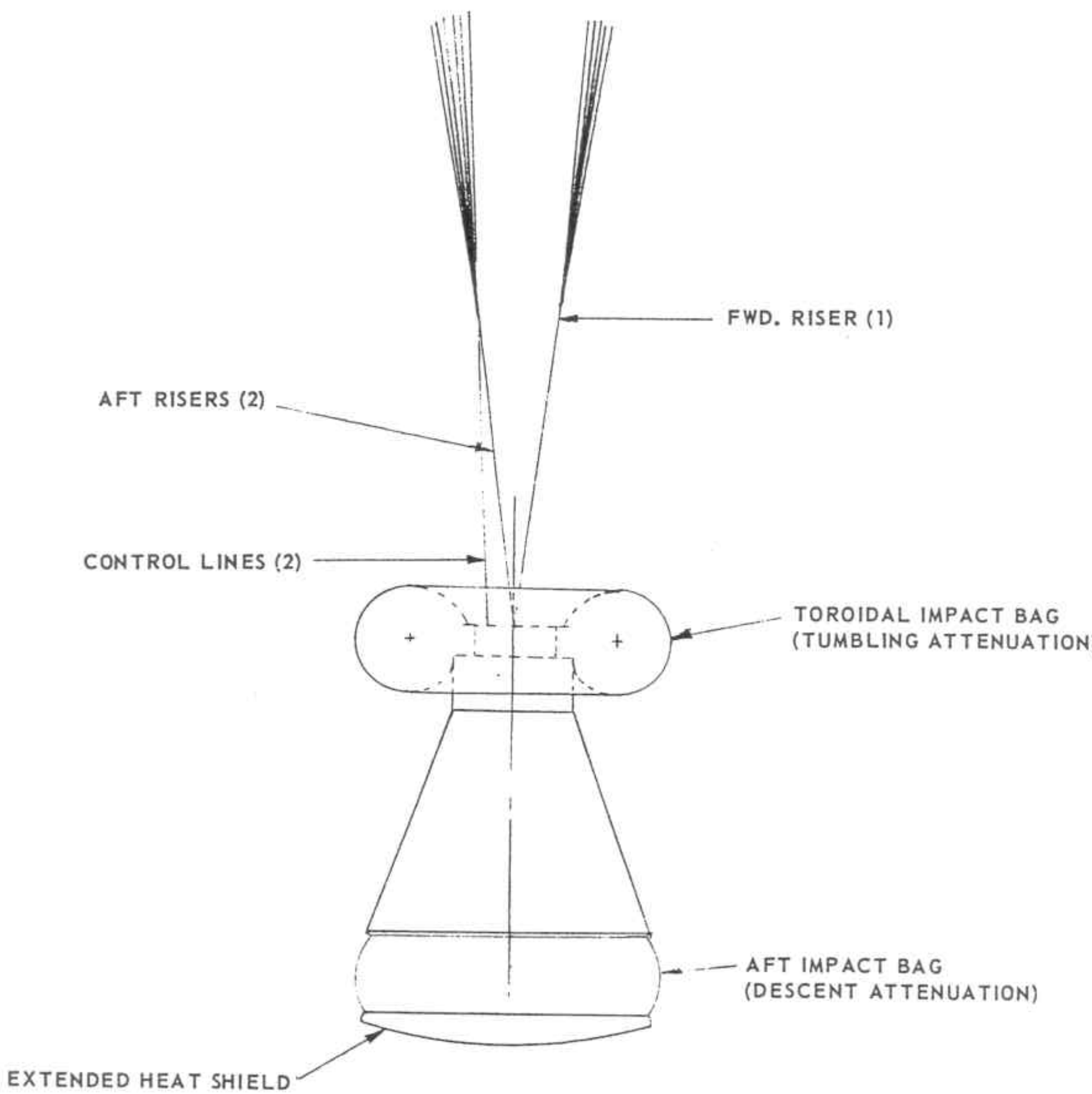

FIGURE 3.9-4

CABLE – SPIKE & IMPACT BAG

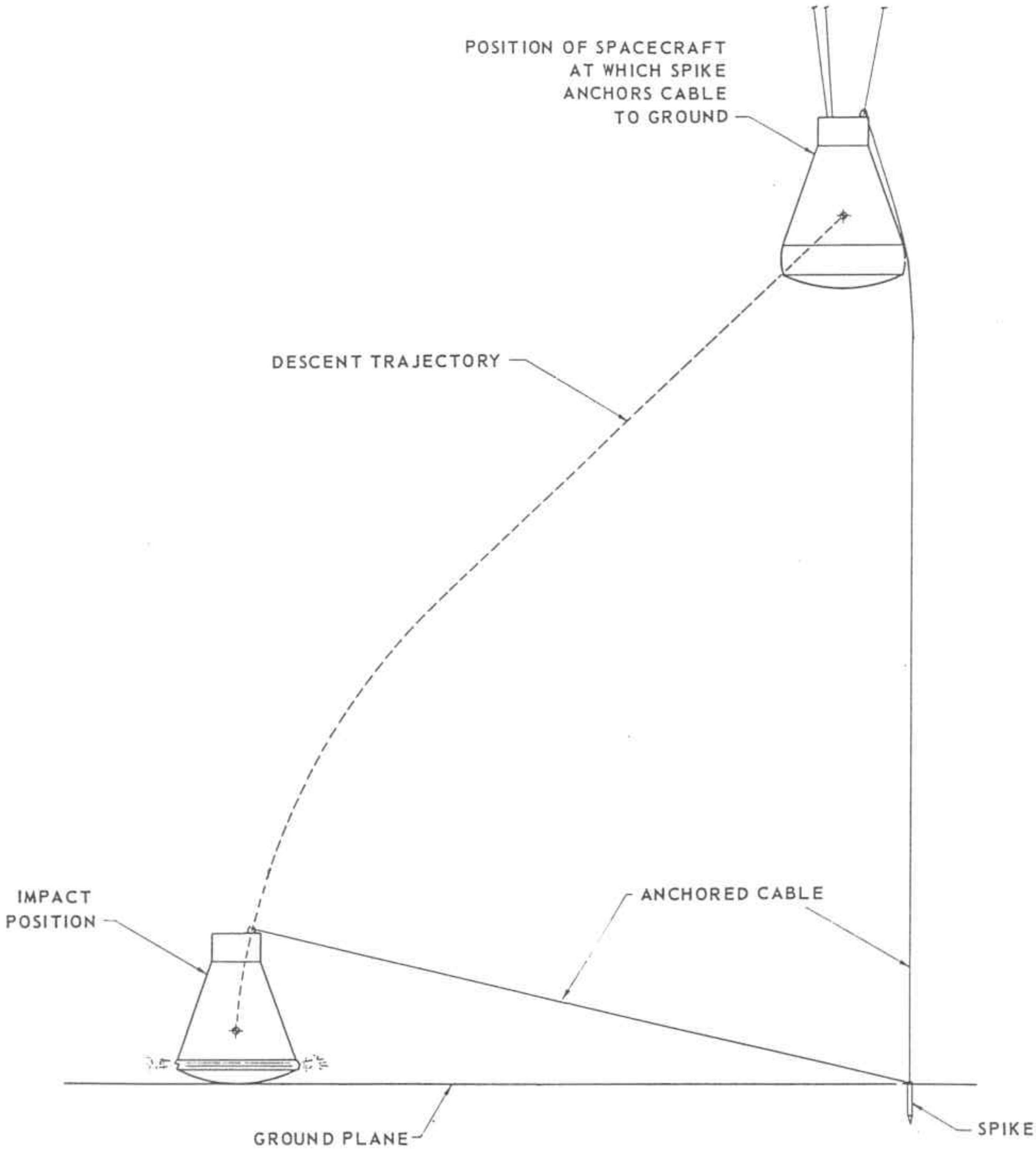

FIGURE 3.9-5

3.9.4 (Continued)

The method shown in Figure 3.9-6 employs a landing rocket and passive attenuation between the large pressure bulkhead and heat shield for vertical velocity attenuation. After the cable has been anchored to the ground, the cable is maintained taut with a minimum force until the landing rocket attitude sensor initiates landing rocket ignition and engages the cable load brake located on the spacecraft. The amount of cable tension applied by the load brake depends on the length of cable extended, i.e., cable length is dependent upon horizontal velocity. The horizontal velocity is then dissipated in the load brake and the spacecraft impacts without horizontal velocity.

3.9.5 <u>Horizontal and Vertical Landing Rockets</u> - A landing rocket arrangement which uses horizontal firing rockets for horizontal velocity attenuation and a vertical firing rocket for vertical velocity attenuation is illustrated in Figure 3.9-7. The same altitude sensing system used to ignite the vertical rockets is used to ignite the horizontal rockets. The number of horizontal rockets fired depends on the relative ground speed of the re-entry module. The ground speed would be determined either by crew judgement or automatically by radar. The attenuation system could be used in conjunction with a parasail descent system.

3.9.6 <u>Larger Landing Gear</u> - Providing a larger gear with increased strength and stroke is not applicable to Gemini without beefing up the landing gear support structure. The landing gear support structure fittings are integral parts of the Gemini structure. Therefore, modification of the present landing gear to increase its capability to accommodate the higher descent velocities associated with the parasail landing system would require extensive redesign of the re-entry module.

CABLE – SPIKE & LANDING ROCKET

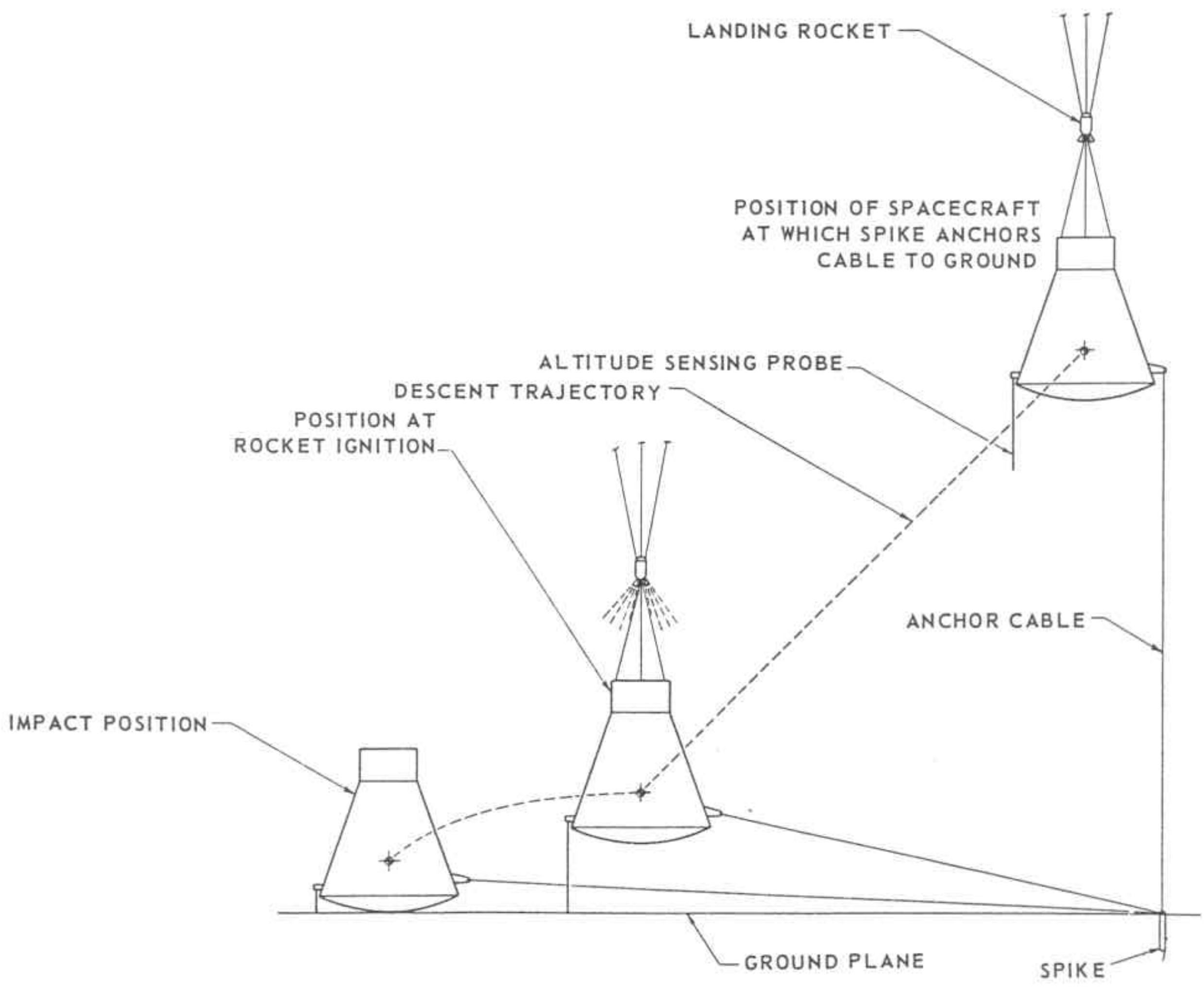

FIGURE 3.9-6

HORIZONTAL & VERTICAL LANDING ROCKETS

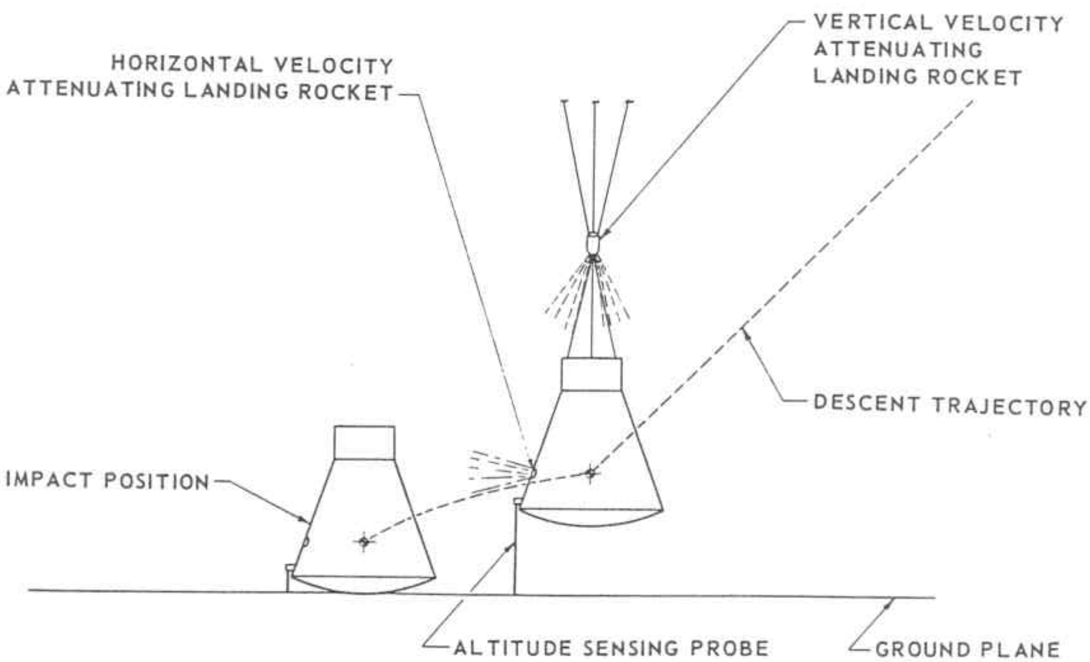

FIGURE 3.9-7

4. MISSION SUMMARY, COSTS, AND SCHEDULES

4.1 Mission Summary - The major experiment hardware and equipment changes, significant development tasks, and estimated acquisition time are summarized in Table 4.1-1. Compatibility with currently contracted spacecraft with respect to schedule, other experiments and to hardware and mission requirements are also indicated.

4.2 Costs - The estimated experiment incremental costs are presented in Table 4.2-1. These costs, in current dollars, are derived using standard MAC cost analysis procedures and are based on documented cost records of comparable efforts.

The McDonnell portion of the launched cost for a particular experiment may be obtained by adding to the experiment cost the contract price of the Gemini spacecraft utilized and the appropriate launch vehicles. If a new spacecraft is required to be built outside the current contract period, the estimated cost to be added to the experiment cost is twenty-five million. Spacecraft refurbished during and outside the current contract period are estimated to cost five million and fifteen million, respectively.

Experiment costs are based on the experiments being incorporated in the basic Gemini with a parachute recovery system and rendezvous capability, except for except for experiment 9A. The cost of this experiment is additive to the contract change proposal, submitted by MAC for a parasail configuration without rendezvous capability.

4.3 Schedules - The schedules for the various experiments, based on an assumed go-ahead of 1 July 1965, are presented in Figures 4.3-1 through 4.3-13. These schedules are predicated on past Mercury and Gemini experience.

The manufacturing flow times and subsequent deliveries are fixed in relation to estimated availability of experimental or developed system hardware, costs, facilities, AGE, and selection of spacecraft structure, (existing, new or refurbished).

4.3 (Continued)

Continued investigation and further analysis may affect changes in estimated availability of determining factors, and consequently vary target delivery dates of spacecraft for respective experiments.

TABLE 4.1-1
MISSION SUMMARY

NO	TITLE	EQUIPMENT	WEIGHT - LB.	HARDWARE CHANGES	DEVELOPMENT TASKS	ACQUISITION TIME (MONTHS)	COMPATIBLE WITH
1	RENDEZVOUS WITH UNMANNED SATELLITE	Augment OAMS for self-inject – 2 additional sets of OAMS tanks and propellant – 4 additional 100 lb. thrusters; augment retro – 4 additional retro rockets	1923	Modify adapter to accommodate additional OAMS and retro (approximately 150 lb. additional structural weight).	Extensive computer studies of injection, rendezvous, and retro maneuvers. Structural tests of adapter and installations. Develop OAMS fuel system	20	None
2	ONE MAN GEMINI – EARTH SURFACE MAPPING	Panoramic cameras (2) Horizon camera Color cameras (2) Viewfinder	300	Remove RH crew station, LH crew member 7-day supplies, OAMS propellant, and experiments. Add bulkhead between seats, automatic hatch actuator, camera mounts, horizon sensor, and control panel.	Qualify panoramic camera, horizon camera, and viewfinder. Develop automatic hatch actuator, and horizon camera extension system.	24	None
3A	ONE MAN GEMINI WITH ASTRONOMICAL TELESCOPE (MOUNTED IN ADAPTER)	26 inch diameter optical system	560	Remove RH crew station, LH crew member 9-day supplies, OAMS propellant, and experiments. Modify retrograde rocket beams. Add fine attitude control system, horizon sensor, data recording device, hatch in heat shield, adapter tunnel, telescope rotating device, telescope mounts, fuel cell for gyro packages, and adapter extension.	Qualify hatch in heat shield, retrograde rocket impingement, retrograde rocket beams, and telescope fairing. Develop 26-inch diameter optical system, fine attitude control system, adapter tunnel seal, tunnel to telescope interface, and telescope rotating device.	30	None
3B	ONE MAN GEMINI WITH ASTRONOMICAL TELESCOPE (MOUNTED IN RE-ENTRY VEHICLE)	16-inch diameter optical system	400	Remove RH crew station, LH crew member 9-day supplies, OAMS propellant, and experiments. Add fine attitude control system, horizon sensor, data recording device, bulkhead between seats, automatic hatch actuator, telescope mounts, fuel cell for gyro packages.	Develop 16-inch diameter optical system, fine attitude control system, and automatic hatch actuator.	24	None
4A	ARTIFICIAL GRAVITY EXPERIMENT (SOLID COUPLE TO EXPENDED STAGE II OF GLV)	Angular velocity display gyro with rate range > 40 degrees/second (92 lb. of available propellant required for 0g – 1g – 0g maneuver)	7	Mount angular velocity display and gyro	Qualify gyro and angular velocity display. Develop restraint system for repositioning crewman for eyeballs down or in acceleration. Conduct attitude control and stability analysis. Determine physiological limitations of mission. Determine mission communication restraints.	11	S/C 10, 11, 12 Experiment 5, 6 and 7
4B	ARTIFICIAL GRAVITY EXPERIMENT (SOLID COUPLE TO AN AGENA)	Angular velocity display gyro with rate range > 40 degrees/second (128 lb. of available propellant required for 0g – 1g – 0g maneuver)	7	Mount angular velocity display and gyro	Qualify gyro and angular velocity display Conduct attitude control and stability analysis Determine physiological limitations of mission Determine mission communication restraints	11	S/C 10, 11, 12 Experiments 5 and 7
4C	ARTIFICIAL GRAVITY EXPERIMENT (CABLE COUPLE TO AGENA OR EXPENDED STAGE II OF GLV)	Angular velocity display and gyro, cable and cable reeling system (drum and motor) (approximately 200 lb. of available propellant required for 0g – 1g maneuver)	127	Mount angular velocity display and gyro Mount cable and associated equipment (for Stage II of GLV – approximately 20 lb. structure) (For Agena – separate Agena section adjacent to target docking adapter is required. Approximately 75 lb. structure)	Qualify gyro and angular velocity display Conduct attitude control and stability analysis Determine physiological limitations of mission Determine mission communication restraints Develop cable system and installation Conduct structural tests, dynamic model tests and extensive analog simulation study	15	S/C 12 Experiment 5 and 7
5	SIMULATION OF LEM RENDEZVOUS	5A. Add LEM equipment to Gemini to perform computations and radar observations (computer and power supply IMU and radar) 5B. Modify Gemini equipment to simulate LEM rendezvous	223	Install LEM computer and power supply, IMU and radar	Extensive digital computer simulations To develop operational computer program Define crew operations and provide crew training	17	S/C 11, 12 Experiments 4, 7 and 9B
6	STRUCTURAL ASSEMBLY IN ORBIT	40 ft. diameter erectable antenna ECS umbilical and miscellaneous handles	715	Install antenna and fairing to Gemini (include structural beef-up to Gemini – structural weight approximately 100 lb.)	Wind tunnel tests of launch configuration Develop erectable antenna Conduct structural tests of antenna installation for launch loads	16	S/C-12 Experiments 4A and 9
7	PROPELLANT TRANSFER	Add to Gemini Propellant tanks Pressurant tank flow meters Gauging systems Transfer lines Add to Agena Propellant tanks Propellant Pressurant tank Pressurant	100 300 —	Modify Gemini for installation of propellant tanks and pressurant tank Modify Agena for installation of propellant tanks and pressurant tank	Qualify propellant transfer system Develop extravehicular activity capability, propellant centrifugal separator, and propellant retention device	24	Experiments 4, 5, and 9B
8	LONG DURATION MISSION	Agena mission section: Expandable living quarters ECS extension and living quarters circulation Additional electrical power Drinking water, food and containers Breathing O_2, bottles and mounts Agena structure Docking adapter	5850	Add hatch in hatch and launch fairing (approximately 34 lb.)	Wind tunnel tests of launch configuration Develop tunnel and living quarters Develop mission section Hatch in hatch and fairing structural tests	18	None
9A	LAND LANDING PARASAIL	Parasail Landing rocket Landing gear Rocket deployment mechanism	644	Remove radar, OAMS tanks, and pressurant, OAMS propellant, docking system, parachute system, roll bar, flotation aids in RCS, and adjust ballast. Modify R & R section for installa-	Qualify landing system Parasail Rocket ejection mechanism Landing rocket Landing gear Develop parasail, landing rocket	24	Experiment 6

[illegible]		[illegible] propellant required for 0g - 1g - 0g maneuver)			[illegible] physiological limitations of mission Determine mission communication restraints		[illegible]
4	ARTIFICIAL GRAVITY EXPERIMENT (CABLE COUPLE TO AGENA OR EXPENDED STAGE II OF GLV)	Angular velocity display and gyro, cable and cable reeling system (drum and motor) (approximately 200 lb. of available propellant required for 0g – 1g maneuver)	127	Mount angular velocity display and gyro Mount cable and associated equipment (for Stage II of GLV – approximately 30 lb. structure) (For Agena – separate Agena section adjacent to target docking adapter is required. Approximately 75 lb. structure)	Qualify gyro and angular velocity display Conduct attitude control and stability analysis Determine physiological limitations of mission Determine mission communication restraints Develop cable system and installation Conduct structural tests, dynamic model tests and extensive analog simulation study	15	S/C 12 Experiment 3 and 7
5	SIMULATION OF LEM RENDEZVOUS	5A. Add LEM equipment to Gemini to perform computations and radar observations (computer and power supply IMU and radar) 5B. Modify Gemini equipment to simulate LEM rendezvous	223	Install LEM computer and power supply, IMU and radar	Extensive digital computer simulations To develop operational computer program Define crew operations and provide crew training	13	S/C 11, 12 Experiments 4, 7 and 9B
6	STRUCTURAL ASSEMBLY IN ORBIT	40 ft. diameter erectable antenna ECS umbilical and miscellaneous handles	715	Install antenna and fairing to Gemini (include structural beef-up to Gemini – structural weight approximately 100 lb.)	Wind tunnel tests of launch configuration Develop erectable antenna Conduct structural tests of antenna installation for launch loads	16	S/C-12 Experiments 4A and 9
7	PROPELLANT TRANSFER	Add to Gemini Propellant tanks Pressurant tank flow meters Gauging systems Transfer lines Add to Agena Propellant tanks Propellant Pressurant tank Pressurant	100 300	Modify Gemini for installation of propellant tanks and pressurant tank Modify Agena for installation of propellant tanks and pressurant tank	Qualify propellant transfer system Develop extravehicular activity capability, propellant centrifugal separator, and propellant retention device	24	Experiments 4, 5, and 9B
8	LONG DURATION MISSION	Agena mission section: Expandable living quarters ECS extension and living quarters circulation Additional electrical power Drinking water, food and containers Breathing O_2, bottles and mounts Agena structure Docking adapter	3850	Add hatch in hatch and launch fairing (approximately 24 lb.)	Wind tunnel tests of launch configuration Develop tunnel and living quarters Develop mission section Hatch in hatch and fairing structural tests	18	None
9A	LAND LANDING PARASAIL	Parasail Landing rocket Landing gear Rocket deployment mechanism	644	Remove radar, OAMS tanks, and pressurant, OAMS propellant, docking system, parachute system, roll bar, flotation aids in RCS, and adjust ballast. Modify R & R section for installation of parasail, landing rocket, and rocket deployment mechanism. Modify re-entry vehicle for installation of landing gear (approximately 430 lb. removed)	Qualify landing system Parasail Rocket ejection mechanism Landing rocket Landing gear Develop parasail, landing rocket, and landing gear	24	Experiment 6
9B	LAND LANDING – CLOVERLEAF CHUTE	Cloverleaf chute landing gear	377	Remove radar, OAMS tanks and pressurant, OAMS propellant docking system, parachute system, roll bar, flotation aids in RCS, and adjust ballast. Modify R & R section for installation of cloverleaf chute. Modify re-entry vehicle for installation of landing gear (approximately 678 lb. removed)	Develop 100 ft. diameter cloverleaf chute and landing gear.	30	Experiments 5, 6 and 7

TABLE 4.2-1
ADVANCED MISSIONS

SUMMARY OF ESTIMATED COSTS
(MILLIONS OF DOLLARS)

EXPERIMENT AND COST ITEM	FIRST UNIT COST	EACH ADDITIONAL UNIT COST
1. RENDEZVOUS WITH AN UNMANNED SATELLITE		
a. OAMS MODIFICATIONS	3.70	.27
b. NEW ADAPTER STRUCTURE	3.60	.55
c. GUIDANCE SYSTEM-COMPUTER STUDIES, PROGRAMMING AND MODIFICATION	2.75	–
d. NEW RETRO ROCKET SYSTEM	.80	.09
e. MISCELLANEOUS SYSTEM CHANGES	2.70	.23
f. SUPPORT (AGE, SPARES, MISSION PLANNING, SPACECRAFT SYSTEMS TESTS, GROUND TEST, PUBLICATIONS, SPECIFICATIONS, REPORTS)	6.20	.61
	19.75	1.75
2. ONE MAN GEMINI-EARTH SURFACE MAPPING		
a. CAMERAS	2.35	.45
b. HORIZON SENSOR	1.20	.05
c. ANCILLARY STRUCTURAL MODIFICATIONS	2.15	.20
d. MISCELLANEOUS SYSTEM CHANGES	1.45	.17
e. SUPPORT	3.15	.48
	10.30	1.35
3. ONE MAN GEMINI WITH ASTRONOMICAL TELESCOPE		
3A (MOUNTED IN ADAPTER)		
a. 26" DIAMETER OPTICAL SYSTEM	4.30	.55
b. FINE ATTITUDE CONTROL SYSTEM	16.30	.70
c. HORIZON SENSOR	1.20	.05
d. FUEL CELL	1.55	.13
e. ADAPTER EXTENSION AND TUNNEL	4.50	.42
f. ANCILLARY STRUCTURAL MODIFICATIONS	.95	.67
g. MISCELLANEOUS SYSTEM CHANGES	7.50	.63
h. SUPPORT	17.00	1.75
	53.30	4.90
3B (MOUNTED IN RE-ENTRY VEHICLE)		
a. 16" DIAMETER OPTICAL SYSTEM	3.50	.44
b. FINE ATTITUDE CONTROL SYSTEM	16.30	.70
c. HORIZON SENSOR	1.20	.05
d. FUEL CELL	1.55	.13
e. ANCILLARY STRUCTURAL MODIFICATIONS	2.15	.20
f. MISCELLANEOUS SYSTEM CHANGES	6.30	.40
g. SUPPORT	14.00	1.08
	45.00	3.00
4. ARTIFICIAL GRAVITY EXPERIMENT		
4A (SOLID COUPLE TO STAGE II OF GLV)		
a. ADD NEW RATE GYRO	1.60	.07
b. MODIFY CREW DISPLAYS	.45	.05
c. MISCELLANEOUS SYSTEM CHANGES	.50	.05
d. SUPPORT	1.20	.08
	3.75	.25

4B (SOLID COUPLE TO AGENA)		
SAME AS 4A ABOVE	3.75	.25
4C (CABLE COUPLE TO AGENA OR STAGE II OF GLV)		
a. CABLE SYSTEM	8.60	.80
b. MODIFY ATTITUDE CONTROL SYSTEM	3.30	.15
c. MODIFY CREW DISPLAYS	.45	.05
d. MISCELLANEOUS SYSTEM CHANGES	2.85	.30
e. SUPPORT	6.80	.70
	22.00	2.00
5. SIMULATION OF LEM RENDEZVOUS		
5A (UTILIZE LEM EQUIPMENT)		
a. LEM COMPUTER AND IMU	7.50	1.75
b. LEM RADAR	1.50	.42
c. GEMINI TDA (MODIFIED)	1.60	.50
d. MISCELLANEOUS SYSTEM CHANGES	2.40	.23
e. SUPPORT	4.00	1.60
	17.00	4.50
5B (UTILIZE GEMINI EQUIPMENT)		
a. GEMINI EQUIPMENT MODIFICATION	3.90	1.60
b. SUPPORT	2.10	.90
	6.00	2.50
6. STRUCTURAL ASSEMBLY IN ORBIT		
a. ANTENNA	5.20	.55
b. SUPPORT STRUCTURE AND STRUCTURAL BEEF-UP	3.00	.39
c. ECS PROVISIONS	2.50	.07
d. OAMS TCA DISASSEMBLY PROVISIONS	.25	.02
e. MISCELLANEOUS SYSTEM CHANGES	.60	.12
f. SUPPORT	5.20	.60
	16.75	1.75
7. PROPELLANT TRANSFER		
a. PROPELLANT TRANSFER SYSTEM	9.30	.60
b. AGENA STRUCTURAL MODIFICATIONS	2.00	.20
c. MISCELLANEOUS SYSTEM CHANGES	2.80	.20
d. SUPPORT	6.40	.50
	20.50	1.50
8. LONG DURATION MISSION		
a. AGENA MISSION MODULE	9.80	1.60
b. LIVING QUARTERS AND ACCESS TUNNEL	6.80	1.30
c. RE-ENTRY VEHICLE ADDITIONAL EQUIPMENT	2.80	.15
d. MISCELLANEOUS SYSTEM CHANGES	5.40	.95
e. SUPPORT	11.20	2.00
	36.00	6.00
9. LAND LANDING		
9A (PARASAIL)		
a. PARASAIL SYSTEM CHANGES	2.10	.02
b. LANDING ROCKET	1.00	.16
c. MISCELLANEOUS SYSTEM CHANGES	.10	.05
d. SUPPORT	1.40	.12
	4.60	.35
9B (CLOVERLEAF CHUTE)		
a. CLOVERLEAF CHUTE	9.00	.10
b. CHUTE CONTROLS	.90	.03
c. MISCELLANEOUS SYSTEM CHANGES	.50	.02
d. SUPPORT	4.80	.05
	15.20	.20