ORBITAL PERIOD vs. ALTITUDE
(INCLUDING OBLATENESS EFFECTS)

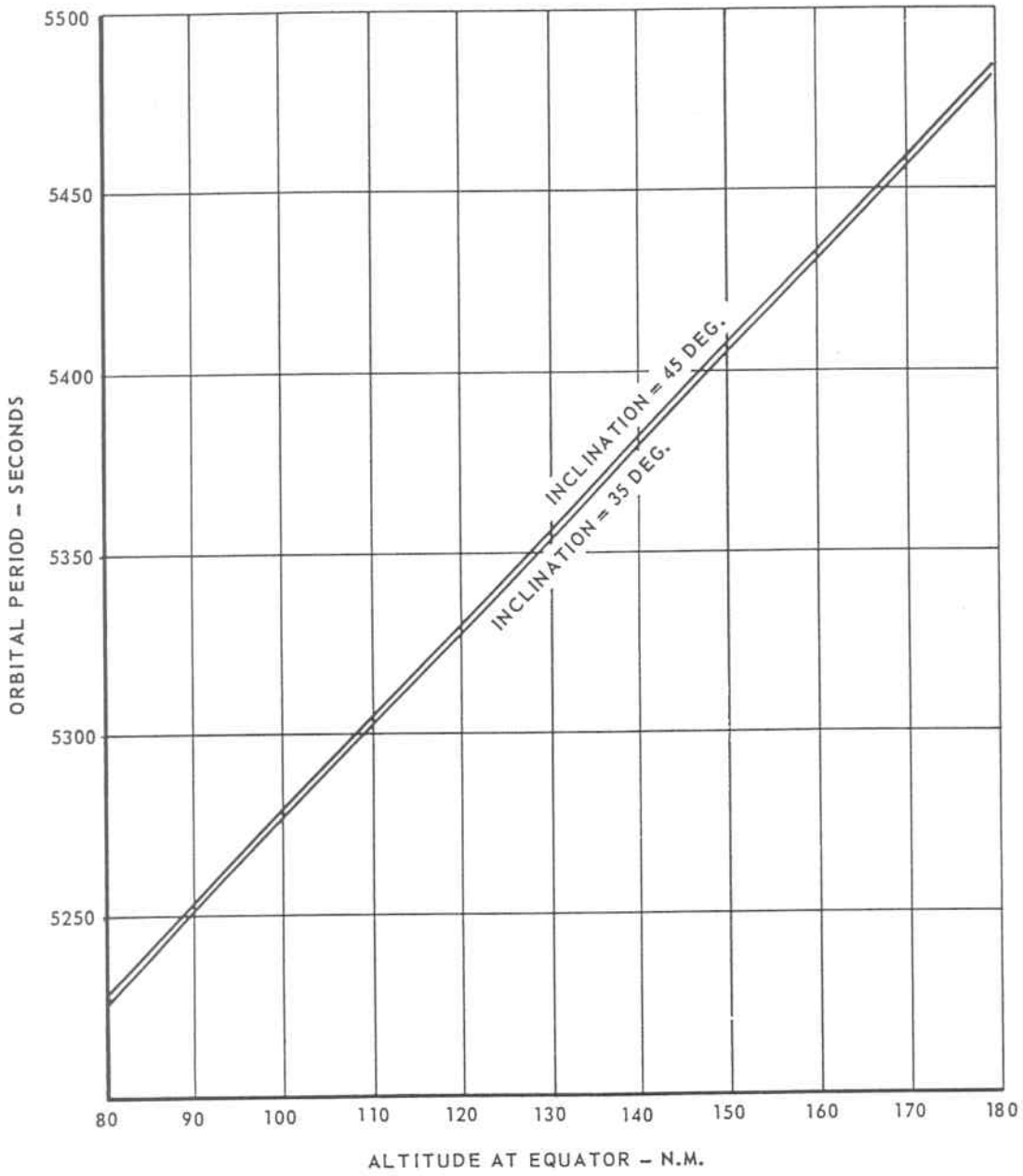


FIGURE 3.2-3

PERCENT OVERLAP vs ALTITUDE

CAMERA FIELD = ±45 DEGREE CROSSTRACK
ZERO DEGREE LATITUDE NO ORBIT DECAY

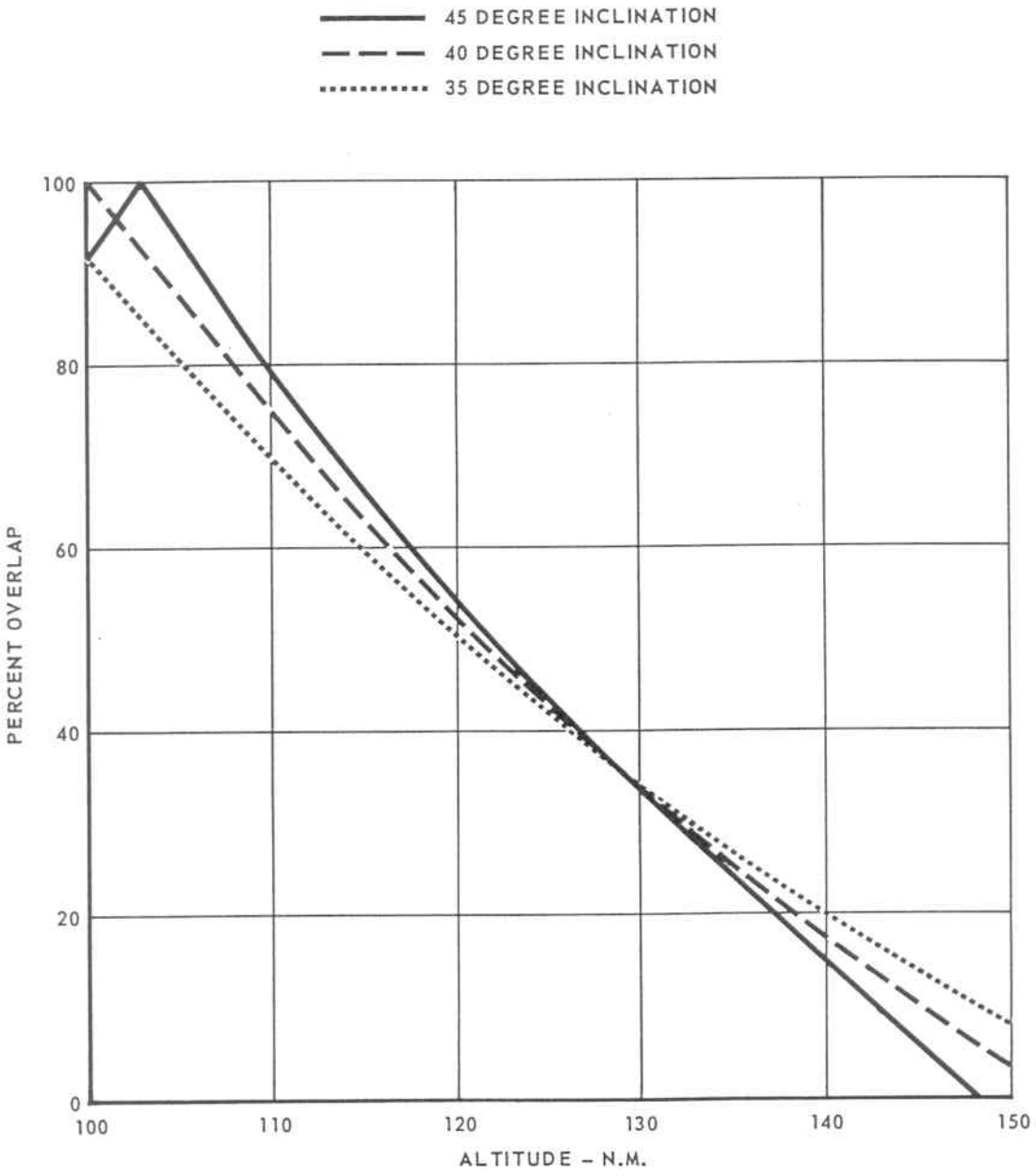


FIGURE 3.2-5

MISSION DURATION vs ALTITUDE

FULL COVERAGE AT ZERO DEGREE LATITUDE
NO ORBIT DECAY
CAMERA FIELD = ±45 DEGREE CROSSTRACK

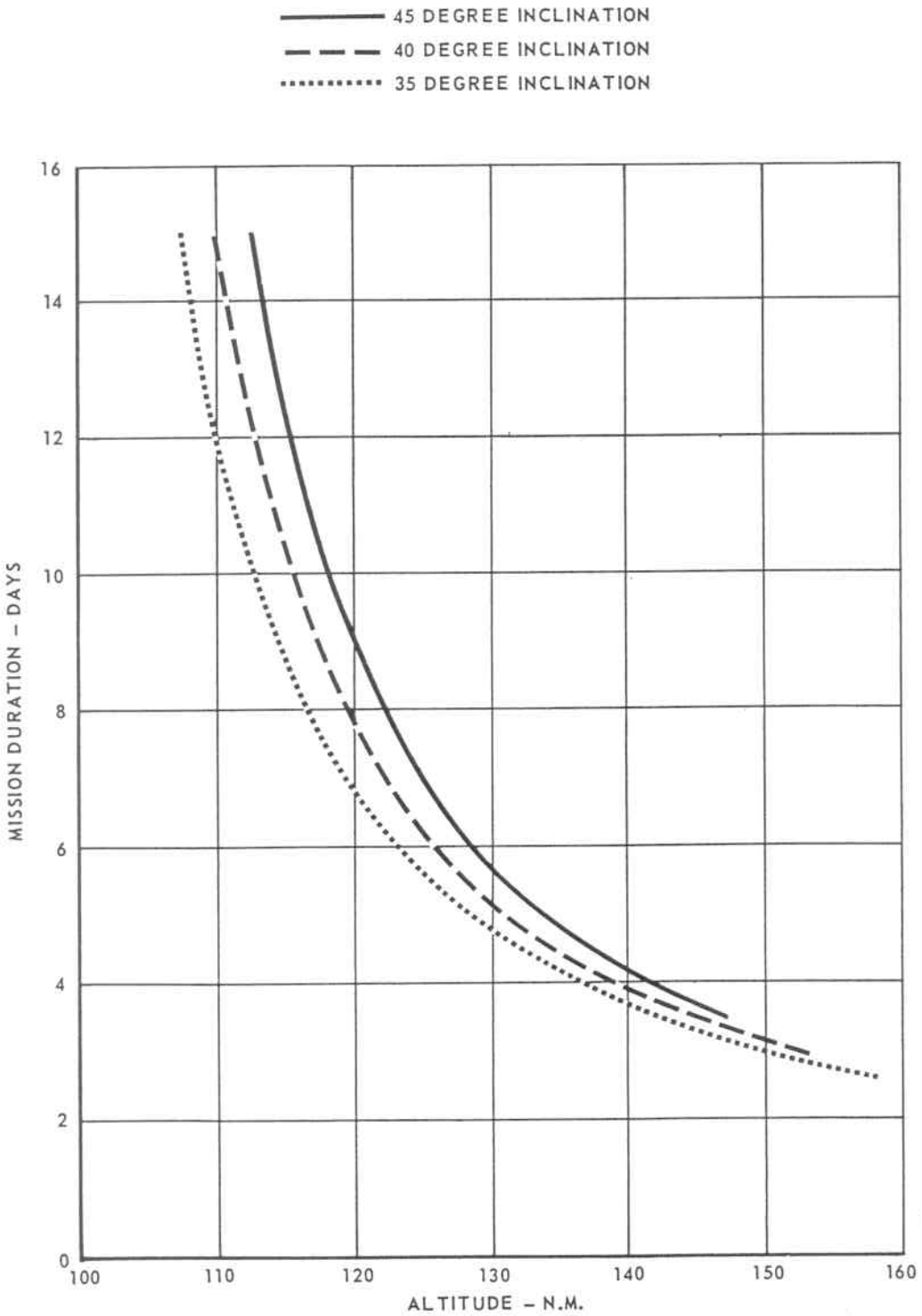


FIGURE 3.2–6

TABLE 3.2-2

WEIGHT STATEMENT

ONE MAN GEMINI EARTH SURFACE MAPPING
7 DAY MISSION

RE-ENTRY MODULE (1 MAN-5 DAYS)	4,169
Δ 2 DAYS FOOD	3
Δ 2 DAYS H_2O	32
BULKHEAD	37
CAMERA SYSTEMS MOUNTING	300
MOUNTING	70
	4,611
ADAPTER	2636
ADD: Δ 2 DAYS O_2	7
REMOVE: RSS PROPELLANT	-54
	2,589
TOTAL LAUNCH WT. =	7,200 LB.

GLV WEIGHT-IN-ORBIT CAPABILITY

INSERTION AT 87 N.M. PERIGEE
-3σ PERFORMANCE

NOTE: ONE-MAN GEMINI EARTH SURFACE MAPPING VEHICLE LAUNCH WEIGHT IS 7200 LB.

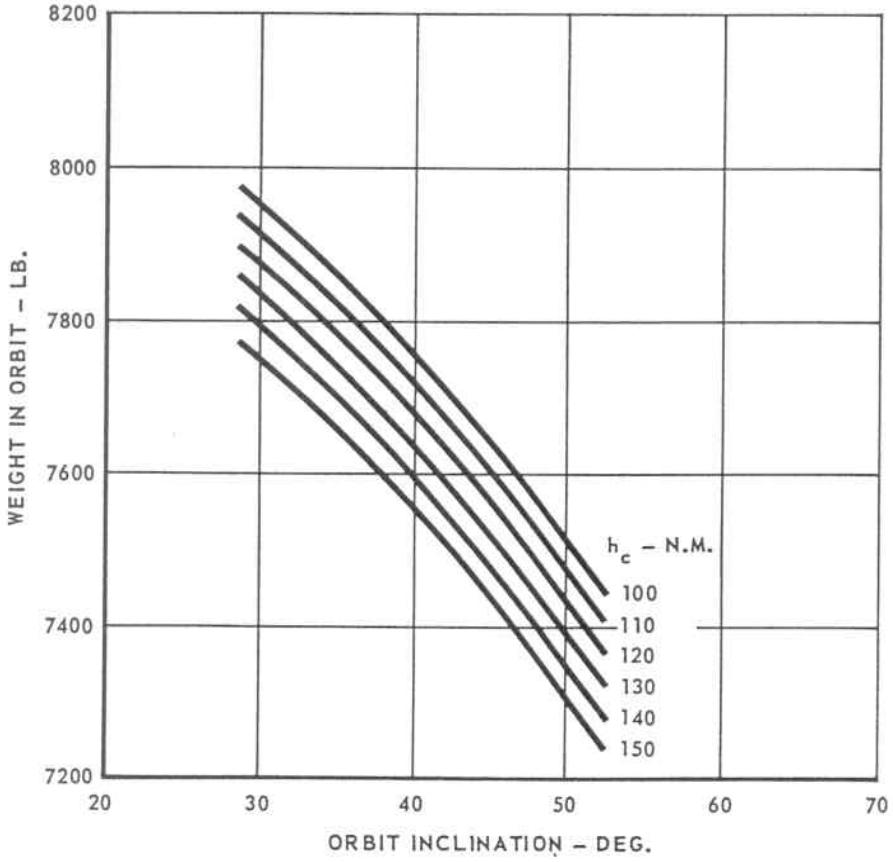


FIGURE 3.2-7

3.2.3 (Continued)

Two basic installation areas for the mapping system are shown in Table 3.2-3. The first allows installation of the two 13 inch focal length cameras in the R.H. crewman's compartment. However, a maximum reel diameter of 18 inches limits the film carried in a single load to that indicated in the illustrative system example. The second installation shown, wherein the camera system is mounted in the adapter, permits an increase in film load to a maximum reel diameter of 24 inches. This reel is retrievable by EVA. The spacecraft weight for the adapter mounted configuration has not been calculated in detail. However, it is estimated to be well within the capability of the GLV.

During mapping, attitude excursions in pitch and roll as sensed by a horizon sensor, are $\pm 1^{\circ}$ while attitude rate is maintained within 0.1°/second. Yaw attitude is sensed visually through the viewfinder and manually controlled to within $\pm 2^{\circ}$ and 0.1°/second.

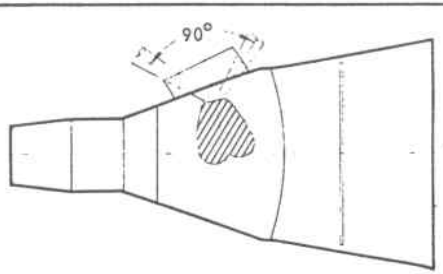
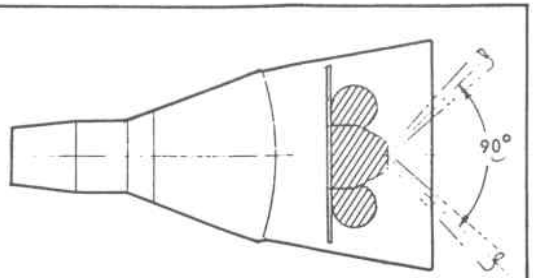
A horizon scanner mounted on the horizon camera head is utilized to maintain pitch and roll attitude. The orientation of the spacecraft during mapping operations precludes the use of the Gemini horizon sensors as presently mounted.

3.2.4 Additional Data - A lens data sheet for the proposed 13 inch panoramic camera design, reproduced with the permission of Itek Corporation, is given in Figure 3.2-2. The lens is in production as a member of a family of near diffraction limited designs. Of particular interest are the outstanding resolution and negligible distortion.

The theoretical resolution loss of a diffraction limited camera at f/3.5 due to linear image motion (rate) during the exposure is shown in Figure 3.2-8. At a 120 n.m. altitude, nadir V/h is approximately 2°/second. A 10% IMC error reduces system resolutions at the stated contrasts by a negligible amount.

TABLE 3.2–3

EARTH SURFACE MAPPING
ONE MAN GEMINI

		
MISSION DURATION (DAYS)	7	7
CAMERAS INSTALLED	13 IN. FOCAL LENGTH f/3.5 PANORAMIC (2) 52 MM FOCAL LENGTH f/3.5 COLOR (2) 10 IN. FOCAL LENGTH f/10 HORIZON RECORDING	13 IN. FOCAL LENGTH f/3.5 PANORAMIC (2) 52 MM FOCAL LENGTH f/3.5 COLOR (2) 10 IN. FOCAL LENGTH f/10 HORIZON RECORDING
ALTITUDE (N.M.)	120	120
VEHICLE WEIGHT (LB.)	7200	–
FILM CARRIED (FT.) (ALL 70 MM)	12,500 – (PANORAMIC CAMERAS) 850 – (COLOR CAMERAS) 1550 – (HORIZON CAMERA)	16,500 – (PANORAMIC CAMERAS) 1100 – (COLOR CAMERAS) 2050 – (HORIZON CAMERA)
CAPSULE MODIFICATIONS	REMOVAL OF RIGHT HAND SEAT REMOVAL OF RIGHT HAND WING INSTRUMENT PANEL ADDITION OF MISSION EQUIPMENT ADDITION OF PRESSURE WALL RIGHT HAND HATCH MODIFIED FOR AUTOMATIC CONTROL	REMOVAL OF RIGHT HAND SEAT MODIFIED PRESSURE BULKHEAD STRUCTURE
ADAPTER MODIFICATIONS	NONE	ADDITION OF MISSION EQUIPMENT EQUIPMENT RE-ARRANGED
MAJOR TECHNICAL PROBLEMS	NONE	NONE

SENSITIVITY TO IMAGE MOTION SMEAR
13 INCH PANORAMIC MAPPING CAMERA

- SO-206 FILM
- 1/1000 SECOND EXPOSURE DURATION
- 120 N.M. ALTITUDE

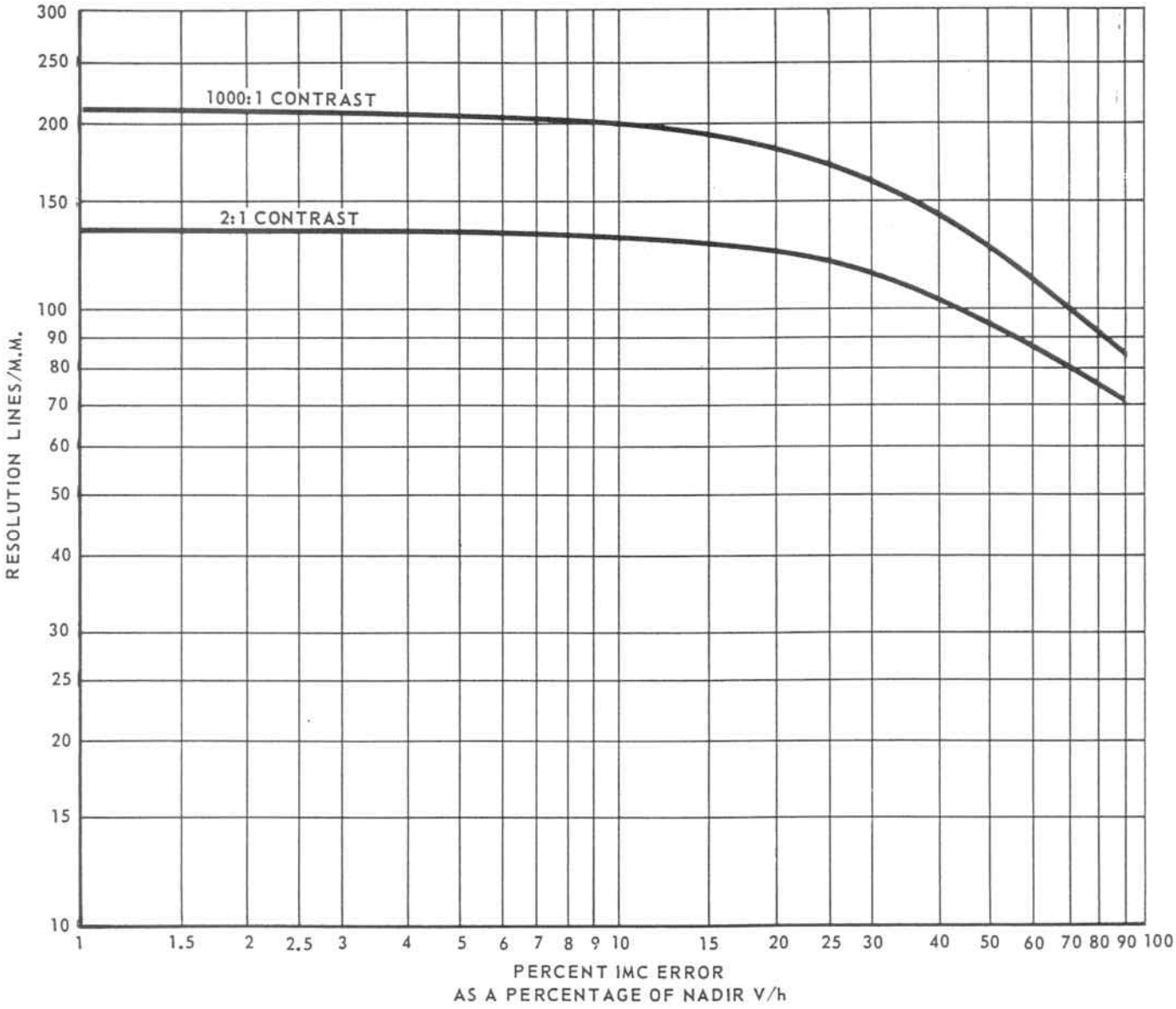


FIGURE 3.2-8

3.2.4 (Continued)

The earth area mapped as a function of altitude with the two stated film quantities and a constant 10% overlap, is shown in Figure 3.2-9.

A power system design summary if contained in Table 3.2-4. Two fuel cell sections are used because the requirements for the mission load are slightly greater than single cell capability. The summary is based on a camera running load duration of 4.5 hours.

EARTH AREA MAPPED AS A FUNCTION OF ALTITUDE

OVERLAP FORWARD AND LATERAL OF 10%

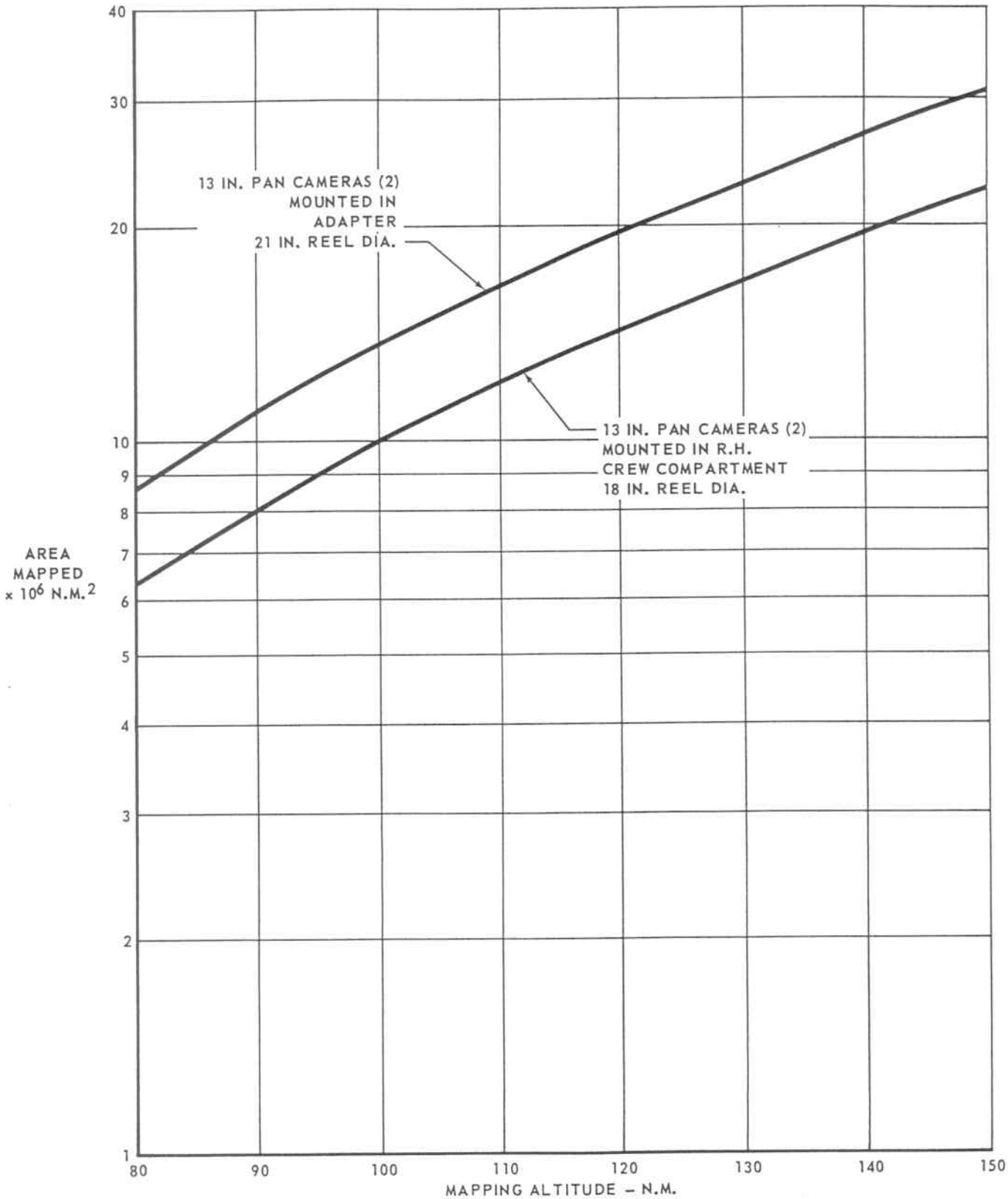


FIGURE 3.2–9

TABLE 3.2-4

ELECTRICAL POWER SYSTEM SUMMARY
ONE-MAN GEMINI EARTH SURFACE MAPPING

PEAK POWER SUMMARY	WATTS
GEMINI EQUIPMENT STEADY LOADS	382
GEMINI EQUIPMENT INTERMITTANT LOADS	387
MAPPING CAMERAS	250
PEAK LOAD POWER	1,019
DIODE AND DISTRIBUTION LOSS	81
PEAK FUEL CELL OUTPUT POWER	1,100 WATTS

7-DAY MISSION ENERGY SUMMARY	WATT-HOURS
GEMINI EQUIPMENT	73,000
MAPPING CAMERAS – 4.5 HR. USAGE (BASED ON 120 N.M.)	9,300
TOTAL LOAD ENERGY	82,300
DIODE AND DISTRIBUTION LOSSES	6,600
TOTAL MISSION FUEL CELL OUTPUT ENERGY	88,900 WATT-HOURS

7-DAY MISSION SUMMARY

FUEL CELL SECTIONS – GENERAL ELECTRIC: 2 SECTIONS
FUEL CELL REACTANTS – H_2 AND O_2: 110 LB.
REACTANTS TANKAGE: 14-DAY GEMINI TANKS
RE-ENTRY BATTERIES: FOUR – SAME AS 14-DAY GEMINI

3.3 One Man Gemini with Astronomical Telescope - The material in this section supports the choice of orbit altitude, attitude, telescope size, and spacecraft configuration for carrying out astronomical measurements and for developing systems and techniques for manned telescope operation.

3.3.1 Telescope Weight - The weight analysis which shows that 560 lbs. are available for a telescope in a one-man Gemini with a five day mission at 200 nautical miles is summarized in Tables 3.3-1 and 3.3-2. The GLV payload performance, shown in Figure 3.3-1, is used to determine the weight available for the telescope system at other altitudes, as shown in Figure 3.3-2. The use of a 32.5 degree inclination orbit instead of 28.5 degrees will reduce the payload by about 70 lbs.

The dependence of the telescope system weight on aperture diameter is shown in Figure 3.3-3. The range in weight for a fixed aperture diameter corresponds to the us of different spectrometers or accessories with the telescope. The maximum aperture di meter curve, Figure 3.3-4, was determined by using the minimum weight curve in Figure 3.3-3 and the available weight curve in Figure 3.3-2. For altitudes of 180 to 200 nau tical miles, which are used to obtain low aerodynamic torques to permit precise pointing, the maximum telescope aperture is approximately 26 inches.

3.3.2 Telescope Installation - The GLV launched one-man Gemini offers many possi bilities for installation of an astronomical telescope. The primary possibilities are: (1) a gimbaled 26 inch diameter telescope in the adapter for a mission with an orbit altitude of 180 to 200 na. mi., (2) a 16 inch diameter telescope (with pointing mirror) in the right hand side of the re-entry module for a mission with an orbit altitude of about 200 to 255 na. mi., and (3) a body fixed 40 inch diameter by 93.5 inch long telescope in an extended adapter for a mission with a 100 to 120 na. mi. altitude. The pointing stability of the telescope is greatly improved for the 180 na. mi. to 200 na. mi. altitude in comparison to the 100 na. mi.

TABLE 3.3-1

WEIGHT OF ONE-MAN GEMINI WITH ASTRONOMICAL TELESCOPE

ALTITUDE: 200 N.M.

	WEIGHT-LB.
RE-ENTRY MODULE MODIFICATIONS	(46)
ADD:	
HEAT SHIELD HATCH	36
HORIZON SENSOR	10
ADAPTER MODULE MODIFICATIONS	
ADD:	(898)
EXTENSION SECTION	67
TUNNEL	29
FUEL CELL (MINUS TOTAL FUEL REDUCTION)	4
RETROROCKET BEAM REDESIGN	5
TELESCOPE	560
TELESCOPE MOUNT	43
FINE ATTITUDE CONTROL SYSTEM	190
REMOVE	
EXCESS OAMS PROPELLANT	(-53)
TOTAL MODIFICATIONS	891
ONE-MAN GEMINI SPACECRAFT WITHOUT TELESCOPE	6,805
ONE-MAN GEMINI LAUNCH WEIGHT WITH TELESCOPE	7,696
OAMS FUEL FOR CIRCULARIZATION	-185
ONE-MAN GEMINI WEIGHT IN ORBIT	7,511
GLV CAPABILITY	7,570
MARGIN	59

TABLE 3.3-2

WEIGHT COMPARISON OF TWO-MAN AND ONE-MAN GEMINI WITHOUT TELESCOPE

	WEIGHT OF TWO-MAN GEMINI (14 DAYS) LB.	WEIGHT REMOVED OR ADDED LB.	WEIGHT OF ONE-MAN GEMINI (5 DAYS) LB.
RE-ENTRY MODULE			
STRUCTURE	1,473	(-22)	1,451
HATCH ACTUATOR		-22	
HEAT SHIELD	349		349
RE-ENTRY CONTROL SYSTEM	542		542
RETROGRADE SYSTEM	7		7
LANDING SYSTEM	213		213
INSTRUMENTATION AND NAVIGATION EQUIPMENT	130	(-12)	118
ATTITUDE DIRECTION INDICATOR		-8	
FLIGHT DIRECTION INDICATOR		-2	
MISCELLANEOUS		-2	
ELECTRICAL POWER	264		264
COMMUNICATIONS	62		62
ENVIRONMENTAL CONTROL	390	(-72)	318
SECONDARY O_2		-7	
SECONDARY O_2 PACKAGE		-20	
SECONDARY O_2 MOUNTS		-1	
LiOH		-44	
TELE-INSTRUMENTATION	191	(-3)	188
BIO-MED TAPE RECORDER		-3	
RECOVERY SYSTEM	30		30
RENDEZVOUS SYSTEM	27		27
CREW AND SURVIVAL	989	(-465)	524
CREWMAN AND SUIT		-190	
SEAT AND PYRO		-161	
CATAPULT		-28	
EGRESS KIT		-26	
SEAT BACK-UP		-23	
CIRCUITRY		-2	
FOOD		-30	
FOOD STORAGE		-5	
EXPERIMENTS	66	(-66)	
BALLAST ADJUSTMENT	18		18
WATER MANAGEMENT SYSTEM FROM ADAPTER		(+58)	58
TOTAL	4,751	-582	4,169
ADAPTER MODULE			
STRUCTURE	439		439
RETROGRADE SYSTEM	383		383
ELECTRICAL POWER SYSTEM	565		565
COMMUNICATIONS SYSTEM	20		20
ENVIRONMENTAL CONTROL SYSTEM	421	(-78)	343
PRIMARY O_2		-78	
TELE-INSTRUMENTATION	109		109
ORBIT ATTITUDE AND MANEUVER SYSTEM	777		777
CREW AND SURVIVAL	239	(-239)	
DRINKING WATER			
WATER TANK			
EXPERIMENTS	175	(-175)	
ADAPTER MODULE TOTAL	3,128	-492	2,636
RE-ENTRY MODULE TOTAL	4,751	-582	4,169
SPACECRAFT TOTAL	7,879	-1,074	6,805

GEMINI LAUNCH VEHICLE PERFORMANCE

- INSERTION AT 87 N.M. PERIGEE
- PERFORMANCE: -3σ
- ORBIT INCLINATION: 28.5 DEG.

NOTE: WEIGHT IN CIRCULAR ORBIT = ALLOWABLE SPACECRAFT WEIGHT AFTER CIRCULARIZATION.

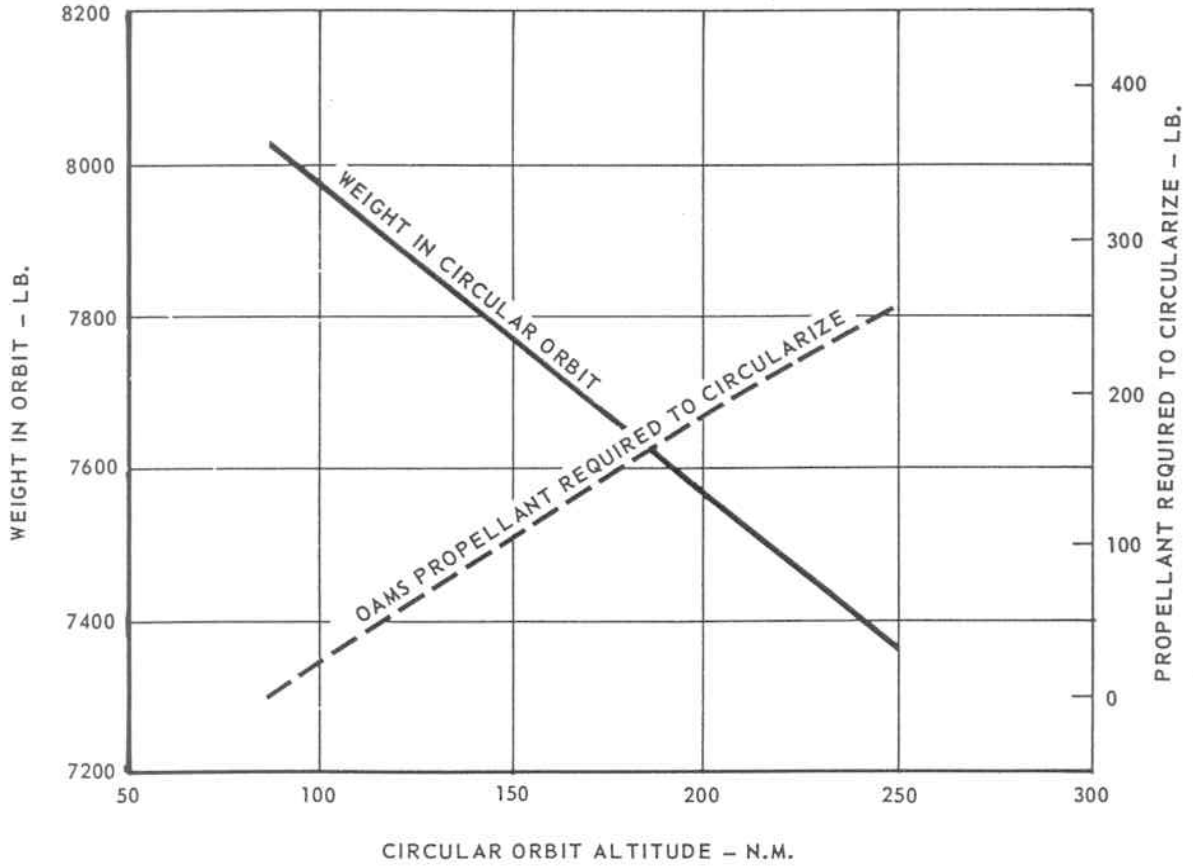


FIGURE 3.3–1

PAYLOAD WEIGHT AVAILABLE FOR THE ASTRONOMICAL TELESCOPE SYSTEM

THE ASTRONOMICAL TELESCOPE SYSTEM WEIGHT INCLUDES THE TELESCOPE STRUCTURE, OPTICS, AND INSTRUMENTATION BUT DOES NOT INCLUDE THE 190 LB. ALLOTTED TO THE FINE ATTITUDE CONTROL SYSTEM.

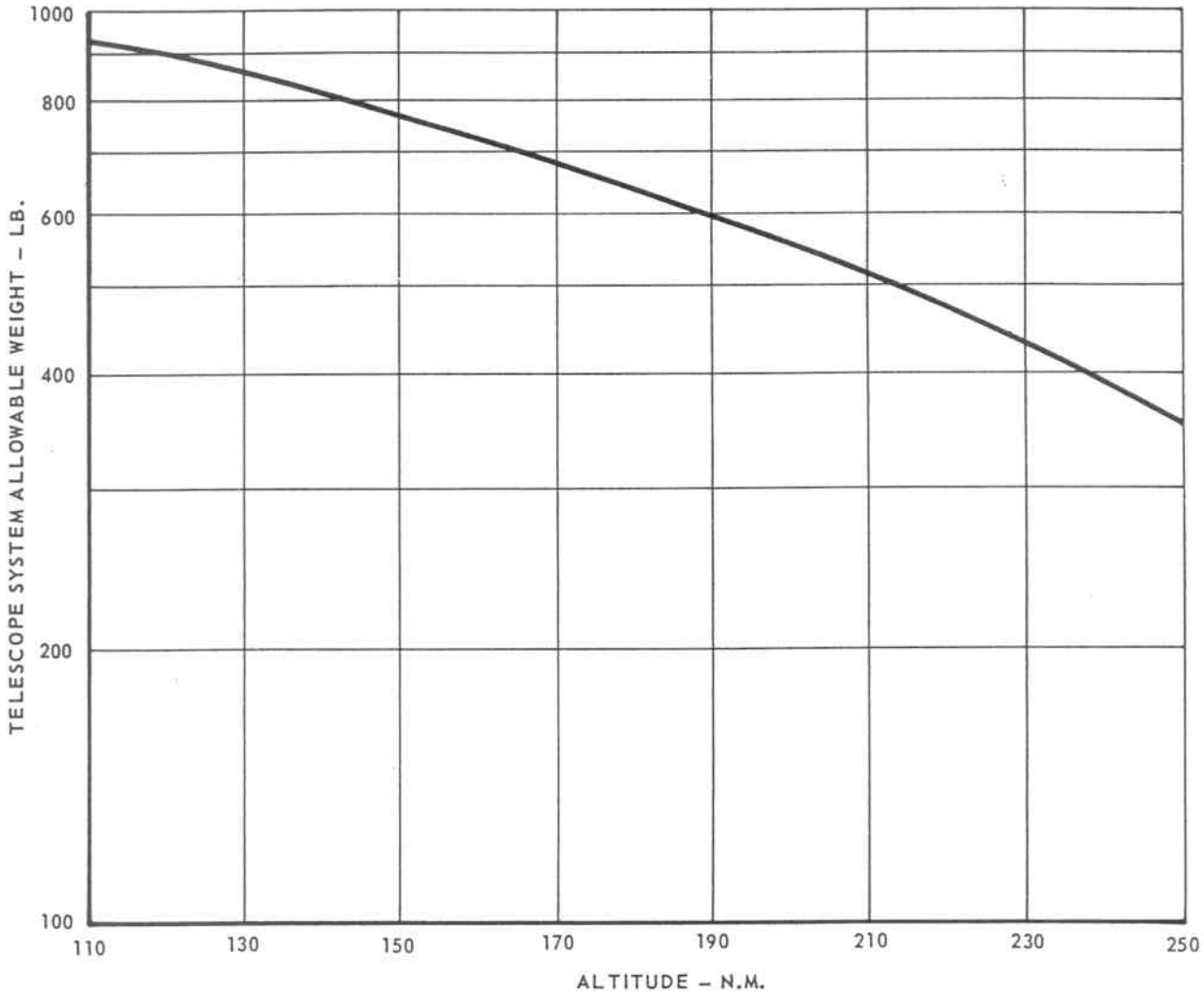


FIGURE 3.3–2

ASTRONOMICAL TELESCOPE WEIGHT

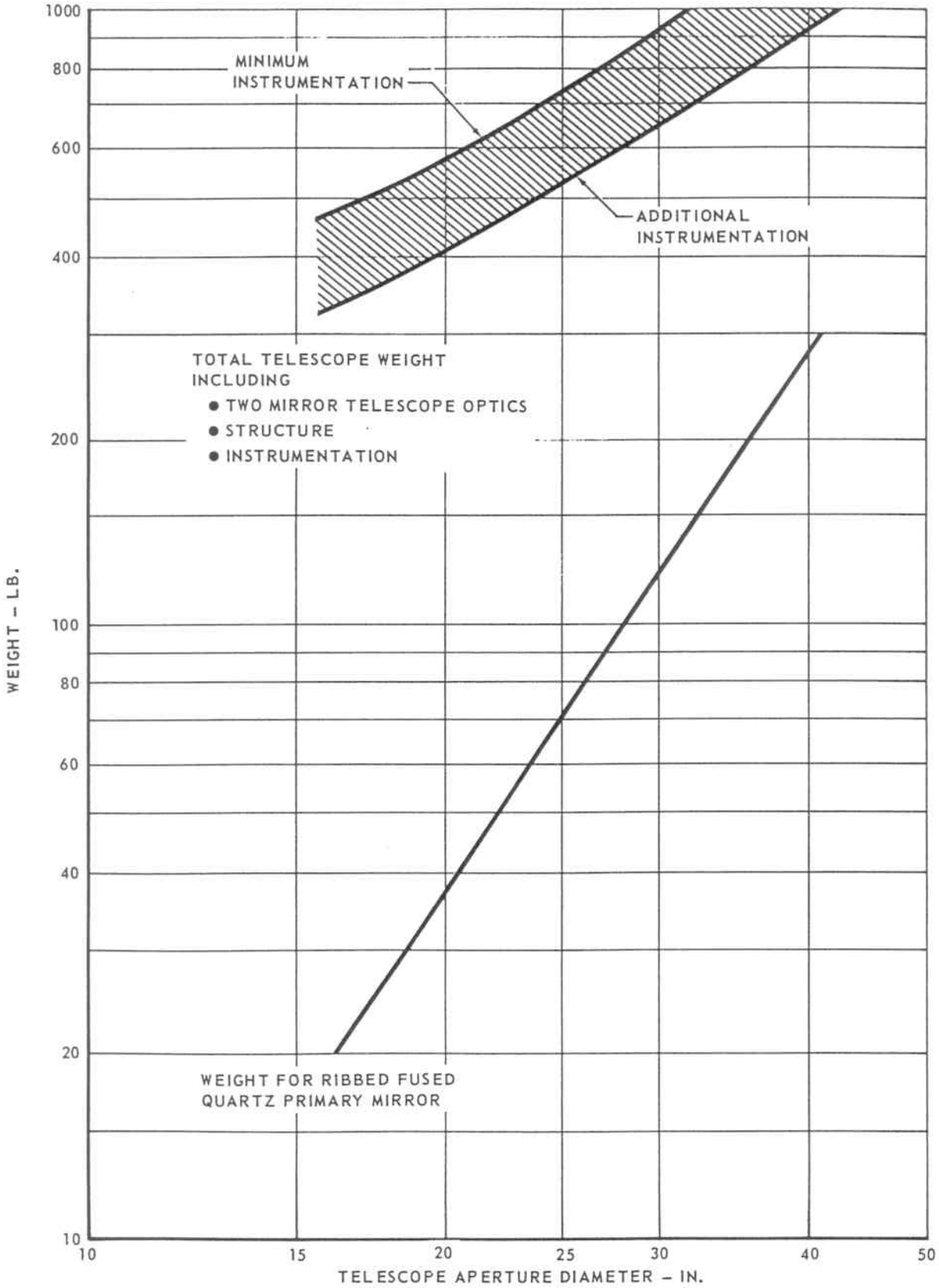


FIGURE 3.3–3

MAXIMUM APERTURE DIAMETER
OF THE TELESCOPE

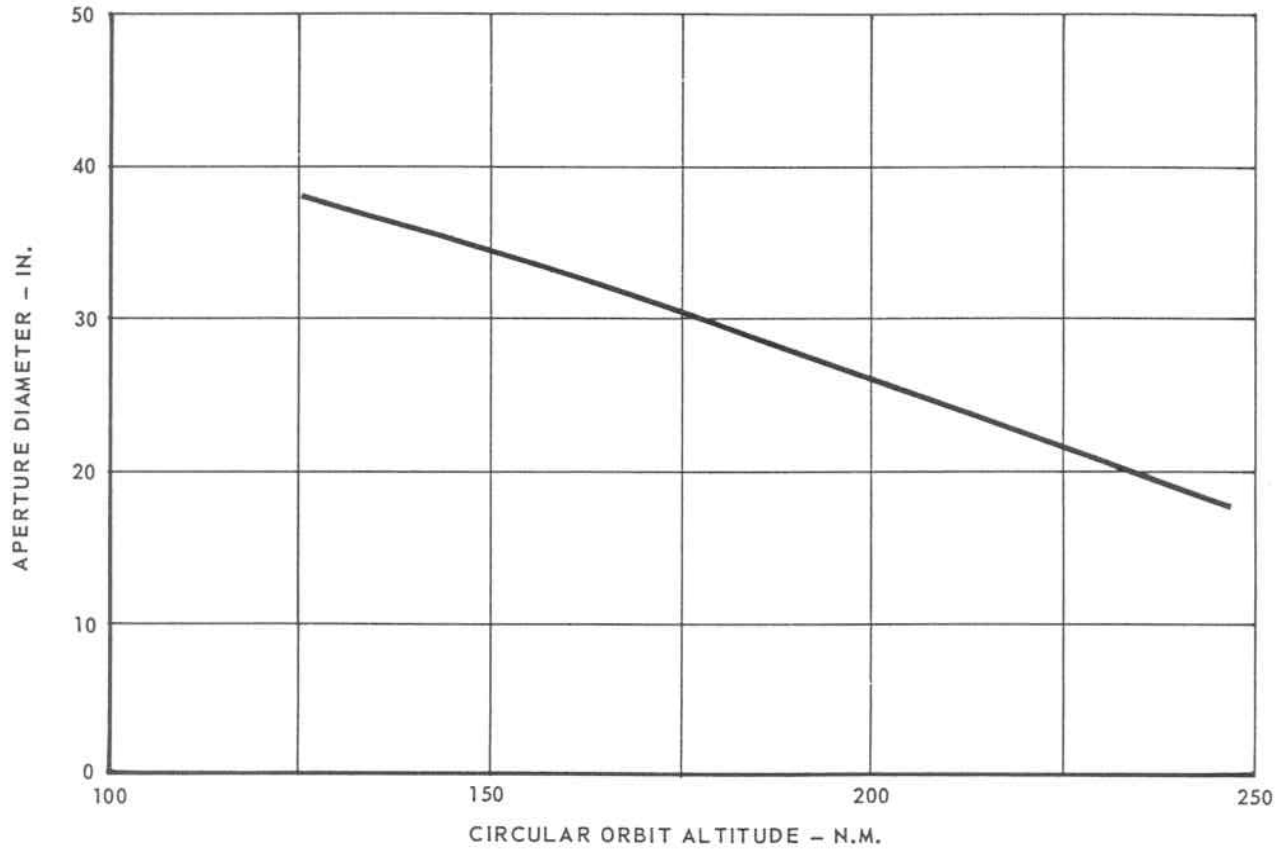


FIGURE 3.3-4

3.3.2 (Continued)

to 120 na. mi. altitude because of the smaller aerodynamic disturbance torques. The 40 inch telescope is thus limited to measurements not requiring precise pointing. The 26 inch diameter telescope has a better light gathering power and better resolution than the 16 inch telescope. However, the spacecraft modification required for the 26 inch telescope are more extensive. With an adequate schedule for development, the 26 inch diameter telescope is thus the choice for best performance. The installation of the 26 inch diameter telescope in the adapter is shown in Figure 3.3-5.

Five telescope installation approaches, the equipment limitations associated with each, and an indication of the degree of complication are shown in Figure 3.3-6. The heat shield hatch used for the first four approaches is included since it should be qualified by 1967. The telescope size limit is primarily due to the length. The telescope shown in Figure 3.3-6 is the OAO Goddard Experimental Package type.

The telesceope diameter can be increased in each case if an instrumentation section, shorter than the Goddard Experimental Package spectrometer, is used. The inclusion of a blow out door in the adapter side wall structure, which is necessary for two of the telescope installations, requires a re-routing of the radiator tubes.

A telescope with an aperture diameter of 12 to 16 inches can be mounted in the right hand side of the re-entry module, as shown in Figures 3.3-6 and 3.3-7. A bulkhead is added so that the right hand hatch can be opened without depressurization of the left hand astronaut section. The space available in the right hand side of the re-entry module, for telescope installations other than that shown in

ONE MAN GEMINI WITH ASTRONOMICAL TELESCOPE

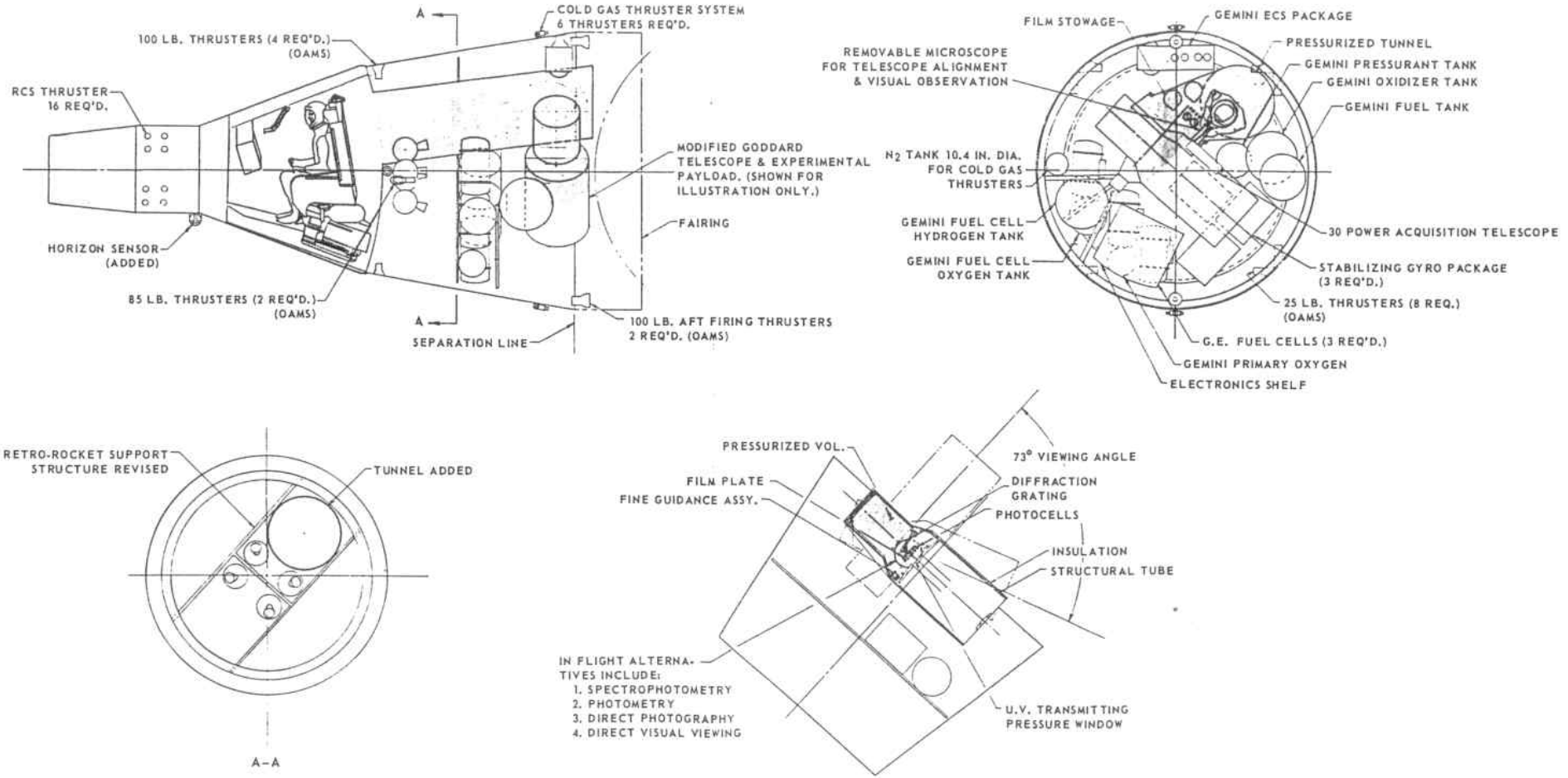


FIGURE 3.3-5