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REQUIREMENT SPECIFICATION

J3 PAYLOAD SYSTEM

CORONA J PROGRAM

CR-13 THRU CR-16

15 JANUARY 1968

Approved [redacted] Date
LMSC-A/P

Approved [redacted] Date
~~ITEK~~ LMSC A/P

Approved [redacted] Date 2/1/68
GENERAL ELECTRIC

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Contracting Officer Representative

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1.0 SCOPE

This specification defines the requirements for the CORONA "J3" Satellite Search and Surveillance System, Serial CR-13 thru 16.

1.1 General

The term "J3" Payload System includes the Panoramic Camera, DISIC, Recovery, and Space Structure subsystems. The requirements for design, fabrication, test, preparation for delivery, design maintenance, and operations support of the J3 Payload System are included in this document. Additional design requirements are specified in the Electrical Interface Specifications; T3-5-019, T3-5-020, T3-5-021, and T3-5-023.

2.0 APPLICABLE DOCUMENTS

The following documents, of the latest issue, form a part of this specification to the extent specified herein.

<u>Specification</u>

T3-6-012	Acceptance Test Specification, Light leakage
T3-6-063	Test Spec for Acceptance & Qual of J-3 P/L System
T3-5-021	J-3 DISIC Electrical Interface Specification
T3-4-508	DCS, Triple Parallel Output Clock Generator F Type
T3-5-019	Electrical Interface Specification, "J3"
T3-7-020	DCS, Storage Register, Type I
T3-6-002	General Environmental Specification
	Process Specification for Film Type 3400
T3-6-073	Process Specification for Film Type 3404
	Process Specification for Film Type SO 230

T3-6-075	Process Specification Film 3401
	Process Specification for Film Type SO 380
T3-5-020	Elect. Interface Spec J-3 SRV System
T3-4-505	General A/P Storage and Handling Specification
T3-5-023	Tracking, T/M, Commands, Pwr & Pyro Interface Spec
S0010-02-0022	System Design Specification - SRV
[redacted]	Process Specification Film 4400
[redacted] Exhibit	Performance Specification (DISIC) Subsystem
LMSC 6117	Gen. Environmental Spec for Agena Satellite Program
LMSC 447969	EMI Control Agena System Electrical Interface
LMSC 1412815	Radiographic Inspection of Semiconductors
LMSC 1415131	Programmer, Type VIII
LMSC 1417161	Model 39205 Vehicle, Program [redacted]
LMSC 1419071	Program [redacted] Satellite System Specification
LMSC 1324217	Interface, Payload/Vehicle - Mechanical
Itek DCS-397-1	DCS Panoramic Camera Subsystem
Itek 65-020-03-D3	Itek Lens Design Specification
Itek 78550	Main Supply Spool
Itek 78549	Take-up B
Itek 78548	Take-up A
Itek 78900	Interface Take-up
Itek 78969	Constant Rotator Profile
T33-800	Payload to Agena Final Assembly

T33-600	Payload Assembly Complete
T33-101	"J3" Interface, Nose Cone, Sta. 0.0 to 86.0
T33-102	"J3" Interface, Nose Cone, Sta. 86.0, Aft
47R196829	Vehicle Assembly - Satellite Recovery
6K617	Space Vehicle Assy. - Modification
T33-104	"J3" Interface - SRV-W/S, T/U, etc.
T33-105	"J3" Interface - SRV-General
T33-106	"J3" Interface- DISIC Supply Cassette
T33-107	"J3" Interface - DISIC Instrument Mount
T33-108	"J3" Interface - DISIC Stellar Baffle
T33-109	"J3" Interface -DISIC Exit Housing and Tuna
T33-112	"J3" Interface- Main Supply Cassette: Exit,IR and T/U Rollers
T33-113	"J3"Interface - Main Door Boot
T33-114	"J3" Interface- Main Instr. Elec. Conn. Location
Itek 78600	Format
Itek 78555G1	Main Instrument No. 1 (Aft looking)
Itek 78554G1	Main Instrument No. 2 (Fwd. looking)
Itek 78547	Intermediate Roller Assembly
N.Y.(57-OM-)1	DISIC Subsystem
Itek 78552	Aux. Structure
QTS-397-1	Qualification Test Specification, J-3 Pan Cam Module
QTS-397-2	Qualification Test Specification, Take-up B.
QTS-397-3	Qualification Test Specification, Main Supply

QTS-397-4	Qualification Test Specification, Intermediate Roller
QTS-397-5	Qualification Test Specification,Petzval Lens
QTS-397-6	Qualification Test Specification, Supply Spool
ATS-397-1	Acceptance Test Specification, J-3 Pan Cam Module
ATS-397-2	Acceptance Test Specification, Take-up A
ATS-397-3	Acceptance Test Specification, Take-up B
ATS-397-4	Acceptance Test Specification, Main Supply
ATS-397-5	Acceptance Test Specification, Petzval Lens
65-020-03-D3	Itek Lens Design (New Lens)
65-003-03-A1-M1	Itek Lens Design (Old Lens)

Military Documents

MIL-STD-150A	Photographic Lenses
TO-0025-203	Standard Functional Criteria for the Design and Operation of Clean Rooms

3.0 REQUIREMENTS

The requirements of this specification shall apply to the system configuration noted in paragraph 1.1.

3.1 Functions

Following a launch and injection into orbit by the Booster SLV-2G and LMSC 39205 Vehicle, the Payload System shall be capable of providing twenty (20) days of photo reconnaissance (10 days nominal for each recovery) within the first twenty (20) days of planned orbital life. After a prescribed number of orbits, the two recoverable portions of the reconnaissance system shall be ejected at separate times and within a predetermined area.

3.2 System Design

The design of the system is predicated upon the design provisions of drawing T-33-600 and shall be compatible with the operational requirements. Maximum launch weight shall be 1810 pounds.

3.3 System Operation

3.3.1 Operating Environment

The Payload System shall operate in orbital vacuum conditions existing in altitudes ranging from 80 to 200 nautical miles under direct solar radiation. A pressure make-up unit for corona discharge suppression shall be utilized and shall be capable of maintaining pressures of 50 microns in the instrument barrel during instrument operation over the time required for expenditure of standard film. Photographic operation shall normally occur at altitudes of

80 to 120 nautical miles. Requirements may dictate missions as high as 200 nm, however design tradeoffs should be aligned to the 80 nm to 120 nm range of altitudes.

3.3.2 Payload Orbit Operations

During active orbit life, the system shall be capable of being programmed for any portion of the ground track on any orbit except during the recovery maneuver or A to B switchover. However the V/H Programmer will be Programmed normally for descending operations. Duty cycle limits specified in para. 3.4.1.1 and 3.4.3.1 shall apply. Such predetermined operation shall be independent of increasing or decreasing orbit altitude. Capability for early A to B transfer shall be provided for the panoramic cameras and the DISIC subsystem and each subsystem transfer shall be independently controlled by a secure command.

3.3.2.1	Orbital Parameters
Period:	88 to 91.5 minutes
Perigee Height:	80 - 110 nm
Injection Height:	80 - 140 nm
Perigee Latitude:	20 - 60 degrees north descending
3.3.2.2	Launch Parameters
Inclination Angle:	60 to 110 degrees
Weight:	Maximum 1810 pounds

3.3.3 System On-Orbit Power

The System shall receive the following electrical energy from the LMSC 39205 Agena vehicle power source. Camera contractors shall furnish a power summary for the full

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operating range of the camera subsystems to indicate the power consumption of components and subsystems. Power requirements shall be based on a 20 day active mission with the following power supplied to the "J3" subsystems interfaces:

(1.) Unregulated D.C. Power:

No Load: +22 to +29.5 VDC

(2.) No Regulated DC shall be supplied

(3.) AC Power: 400 $\pm$ 0.008 cycles, Single Phase

No Load: 113.7 to 117.3 volts RMS

Average Load: 111.7 to 115.3 volts RMS

(4.) Electrical Interface:

Electrical Interface Specifications, applicable to the CR13-16 payloads, shall apply and shall be used for additional descriptions or clarification of power requirements.

3.4 System Description

The system shall consist of the following major items:

(1.) 70 mm Panoramic Camera Subsystem

(2.) DISIC Subsystem

(3.) Space Structure Subsystem

(4.) Two Modified Mark 5A Recovery Subsystems

3.4.1 Panoramic Camera Subsystems

The Panoramic Camera Subsystem shall consist of two Panoramic Cameras mounted in nominal 30° converging stereoscopic configuration, horizon cameras, film supply cassette, film take-up cassettes, intermediate roller assembly.

The IR Assembly shall incorporate monitors on the rollers and the signals shall be conditioned and telemetered by LMSC. The main Panoramic camera assembly including aux. structure and associate electronics shall weigh less than 350 pounds. The main supply (including support structure and two empty spools) shall weigh less than 75 pounds. Each J3 take-up cassette assembly shall weigh less than 23 pounds. Radiation shielding shall not be supplied. The Panoramic camera subsystem shall be furnished GFE to LMSC and shall have a minimum operational life of 100,000 cycles for test and flight. The required camera subsystem handling dollies and camera check out consoles shall also be furnished as GFE to LMSC. The Panoramic Camera Subsystems shall operate from 21 to 29.5 VDC Unregulated Power measured at the subsystem interface.

3.4.1.1 Panoramic Camera

The two Panoramic Cameras shall be capable of operating simultaneously to generate stereoscopic photography or separately to generate monoscopic photography. The camera subsystem shall have a sustained operational capability of 20 minutes operation for each orbit. The cameras shall be in phase at beginning of each stereo operation and shall be counter-rotating to reduce vehicle perturbations and to meet the requirements for momentum unbalance stated in paragraph 3.4.1.8. The cameras shall follow the V/H signal to ± 1% RMS.

3.4.1.2 Resolution

The panoramic cameras shall demonstrate a minimum dynamic resolution of 130 lines per millimeter with a W/21 filter for the aft looking, even numbered, camera and 150 lines per millimeter with a W/25 filter for the forward looking, odd numbered camera utilizing a 2:1 contrast (density difference 0.30 + .05 - .00) test target with the standard target pattern and 100% FMC match, Other requirements for this test are as follows:

a. Collimator: Focal length 120", Aperture 10" (min.)

b. Film: Kodak Emulsion Type, 3404

c. Filter: Aft looking W21; Fwd. looking W-25.

d. Film Processing: Per T3-6-073.

e. Exposure Time: 1/400-1/500 sec. (Test only)

f. Temperature: Test specimen, test equipment and ambient temperature shall be 70° F. ± 10° F. during the testing to establish resolution. R/H shall be less than 50%.

g. Lens: The lens shall be Petzval type with the following characteristics: Aperture, f/3.5; focal length-24" Field of View 6°, Spectral Range .6000-.7100, central wave length .6500, back focus 0.264 ambient. The lens shall provide a minimum resolution of 240 1/mm high Contrast (1000:1) and 180 1/mm low contrast (2:1) when measured on Mann Bench with EK 3404 film and a Wratten 25 filter. It shall also provide a resolution of 150 1/mm low contrast (2:1) and a minimum resolution of 240 1/mm high contrast (1000:1) when measured on a Mann Bench with EK 3404 film and a Wratten 21 Filter.

3.4.1.3 Calibration

3.4.1.3.1 Lens Rotation

The calibration of the lens by Itek Corporation shall be performed such that the axis of cell rotation is positioned with respect to the rear nodal point of the lens system so as to minimize degradation due to image smear under orbital vacuum conditions as specified in para. 3.3.1. See paragraph 3.4.1.6 for Panoramic Geometry Calibration.

3.4.1.3.2 Lens Distortion

The distortion in the plane of best definition shall be less than the following:

At a position plus or minus one degree from the optical axis, the distortion shall not be greater than plus three microns. At a position plus or minus two degrees from the optical axis, the distortion shall not be greater than six microns. At a position plus or minus three degrees from the optical axis the distortion shall not be greater than nine microns.

3.4.1.3.3 Lens Alignment

The angular location of the principal ray of each panoramic camera at format center shall be calibrated to the respective horizon camera's principal rays. The camera systems shall be capable of maintaining the alignment to within

$\pm$ 60 arc seconds. The calibration shall be performed with equipment accurate to within $\pm$ 2 arc seconds.

3.4.1.3.4 Pan Convergence Angle

The stereo convergence angle of the two panoramic cameras shall be determined at a defined scan position angle to within $\pm$ 60 arc seconds. The calibration shall be performed with equipment accurate to within $\pm$ 2 arc seconds.

3.4.1.3.5 Horizon Camera Calibration

The principal point of each horizon camera shall be calibrated with respect to the intersection of the horizon fiducials to within 25 microns.

3.4.1.3.6 The focal length of each horizon camera lens shall be determined to 100 microns.

3.4.1.4 Lens Focus

(1) The lens system shall be focused for orbital vacuum condition by Itek Corp.

(2) The image plane/film plane separation shall not exceed $\pm$ 0.001 inches (1.5° max. gradient across the longitudinal axis of the lens cell) over a temperature range of 40° F. to 100° F. when the camera subsystem is in flight configuration.

3.4.1.5 FMC Calibration

The camera contractor shall provide for a system of object space FMC by nodding the camera about an axis perpendicular to the axis of scan. The orthogonality of the nod and scan rotations shall be within 120 arc seconds.

3.4.1.6 Panoramic Geometry

The Panoramic cameras shall provide a means to obtain a relationship between points on the format and corresponding ground points. The objective of the calibration is to provide equipment and procedures which make it possible to recover, for any image point, two coordinates, the scan angle α and the along trackangle β to within $\pm$ 4 seconds of arc (1 sigma level). The design goal shall be to recover these angles to within $\pm$ 1.5 seconds of arc (1 sigma level). The scan angle α is defined as the dihedral angle between the plane through the scan axis and the central principal point, and the plane through the scan axis and the image point in question. The along track angle β is defined as the complement of the angle between the scan axis and a line connecting the image point with momentary center of projection, i.e., the ray of projection.

3.4.1.6.1 Calibration holes in the film rails shall be located so that holes on both rails are illuminated simultaneously and shall be spaced approximately 1 cm apart.

3.4.1.6.2 The holes shall be 80 (+40 -20) microns in diameter and as circular as possible.

3.4.1.6.3 Scan traces shall be provided and shall be 50 to 75 microns in width.

3.4.1.6.4 The minimum density of the images shall be 0.3 above base fog at the primary processing level and fastest camera operating speed.

3.4.1.7 Panoramic Film

The cameras shall utilize 3404, 2.5 mil base polyester film but shall also be capable of operations using 1.5 mil base (UTB) SO 380 polyester film. Nominal thickness with emulsion for the above films are 3.0 mil and 2.0 mil respectively. A design goal shall include the capability to utilize split loads of any combination of two of the following film types: 3404, SO 180, SO 230, and SO 340.

3.4.1.8 Camera operational error limits. Table I is the cross track blur budget and Table II is the along track blur budget.

Data based upon 2.44 millisecond exposure, type 3404 Film and are 3 sigma values.

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TABLE I CROSS-TRACK BLUR BUDGET (IN MICRONS)

	Error Type	Image Blur 80 N.M.	Image Blur 100 N.M.	Accuracies Assumed
Camera Sources				
Vibration	R	2.0	1.0	
Film Lift	S	1.78	1.42	.007 in Film Lift
Lens Distortion	S	0.83	0.64	5 micron distortion @ edge of format
Nodal Point Location	F	0.44	0.36	+ or -.002 inch
Uncompensated Image Motion	S	9.8 $SIN^2 \theta$	7.9 SIN 2 θ	
Interface Sources				
Yaw Alignment	F	0.24 $COS^2 \theta$	0.19 $COS^2 \theta$	11 minutes
Pitch Alignment	F	0.11 SIN 2 θ	0.086 SIN 2 θ	11 minutes
Vehicle Sources				
Roll Attitude	R	0.17 $SIN^2 \theta$	0.13 $SIN^2 \theta$	0.54 Degree
Yaw Attitdde	R	1.11 $COS^2 \theta$	0.89 $COS^2 \theta$	0.84 Degree
Yaw Programmer	R	1.29 $COS^2 \theta$	1.06 $COS^2 \theta$	1.0 Degree
Pitch Attitude	R	0.42 SIN 2 θ	0.33 SIN 2 θ	0.70 Degree
Roll Rate	R	0.12	1.12	18 Degrees/Hour

Note: R= Random
S= Systematic
F= Fixed

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TABLE II ALONG-TRACK BLUR BUDGET (IN MICRONS)

	Error Type	Image Blur 80 N.M.	Image Blur 100 N.M.	Accuracies Assumed
Camera Sources				
Vibration	R	2.0	1.2	
IMC Servo	R	2.23 COS θ	1.78 COS θ	3%
IMC Cam Error	R	2.23 COS θ	1.78 COS θ	3%
Uncompensated Image Motion	S	1.85	1.48	@ Edge of Format
Interface Sources				
Orbital Determination	R	2.23 COS θ	1.78 COS θ	3%
V/H Command	R	2.23 COS θ	1.78 COS θ	3%
Roll Alignment	F	0.24 SIN θ	0.19 SIN θ	11.4 minutes
Pitch Alignment	F	0.12 COS θ	0.095 COS θ	11 minutes
Vehicle Sources				
Roll Attitude	R	0.68 SIN θ	0.54 SIN θ	0.54 Degree
Pitch Attitude	R	0.47 COS θ	0.37 COS θ	0.70 Degree
Pitch Rate	R	0.10 COS θ	0.10 COS θ	14.4 Degrees/Hour
Yaw Rate	R	0.10 SIN θ	0.10 SIN θ	14.4 Degrees/Hour
Terrain Height Variation	R	0.36	0.29	3000 feet

Note: R=Random
S=Systematic
F=Fixed

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3.4.1.9 Camera Data Readout

3.4.1.9.1 A Silicon light pulser data head shall be used to record data on each 70 mm panoramic format. The data head shall be mounted by the camera contractor with the appropriate film clamping device. LMSC shall supply the data head to the camera contractor and shall condition the signals to the data head as described in para. 3.4.13.

3.4.1.9.2 The numerical Camera Serial Number shall be recorded on each Panoramic format (under the rail area) by a lamp.

3.4.1.9.3 The Start of Pass Mark shall be recorded beside the format on the initial Panoramic frame of an operate sequence.

3.4.1.9.4 A 200 PPS timing track shall be recorded on each panoramic format beside the format.

3.4.1.10 Horizon Cameras

Two 55 millimeter focal length, f/6.3 horizon cameras shall be integrated with each panoramic camera. The horizon cameras shall be capable of recording the earth horizons to the port and starboard side of the vehicle from orbital altitudes. In addition, the following requirements shall be met:

1. Paired horizon cameras shall operate simultaneously on alternate panoramic cycles and expose horizon formats adjacent to panoramic formats per Itek Drawing No. 78600.

2. Artificially illuminated fiducials shall be generated adjacent to each horizon format and shall be used as a reference to assist in the determination of the angular roll and pitch of the vehicle.

3. The format dimensions and fiducial locations shall be per Itek Drawing No. 78600.

4. The lens shall have characteristics as follows:

   a. Focal length 55 millimeters

   b. Field Angle: Not less than 48° in the vehicle x-x axis.

      Not less than 23° in the vehicle z-z axis.

   c. f/6.3 aperture with iris diaphragm control from f/6.3 to f/22.

5. The focus shall be for vacuum conditions at 70° F.

6. Shutters - Alphax II heavy duty, 1/100 sec.

7. LMSC shall provide structure doors compatible with the above parameters and at angles of ± 75 degrees from the vehicle +z axis.

3.4.2 Panoramic Camera Control

The camera controls shall include the following:

1. V/H Programmer (LMSC provided)
2. Camera Servo
3. FMC (Forward Motion Compensation) device.
4. Homing Control
5. Variable Slit Width Control
6. Filter Control

Camera controls shall be an integral part of the camera subsystem except for the V/H Programmer. The V/H Programmer shall be supplied by LMSC, per design requirements described in para. 3.4.15.

3.4.2.1 Design Criteria

The following items shall be included in the V/H Programmer Design:

1. Output Impedance- less than 10 ohms.
2. V/H Programmer output shall see a minimum input impedance of 10 K ohms resistive. (Camera Servo System Requirements- see paragraph 3.4.2.2).
3. The Programmer shall be capable of generating both positive and negative cosine functions.

4. Output voltage shall be 1.4 volt DC minimum and 4.2 volts DC maximum with the start voltage adjustable in 20 equal steps and the half cycle voltage adjustable in 20 equal steps.
5. A predetermined voltage (start voltage) shall be programmed between each V/H Programmer cycle (once every orbit) and no open circuit shall occur.
6. The programmer shall be resettable to the start position during any part of the cycle by tape command and shall allow the start command to re-initiate the time delay for cycle start when the cameras are not operating.
7. The programmer design shall preclude inputs to the camera that would exceed 5 volts.
8. The V/H Programmer output voltage shall be proportional to the forward motion compensation in radians per second. The relationship is: 1 volt output from the V/H Program is equal to a scan rate of 1 rad/sec. The signal shall include the effects of V/H ratio, stereo half angle, and pitch rate of the vehicle.

3.4.2.2 Adjustments (V/H)

Period and start time interval shall be adjustable in the field to permit mission selection and subsequent V/H Programmer adjustment six (6) days prior to launch. The following requirements shall be used and shall be compatible with pre-flight and in-flight adjustment.

1. Nominal start time intervals shall be 25, 50, 200 seconds.
2. Twenty start time intervals shall be available.
3. Start and half cycle voltages shall increase in magnitude with increasing step positions to minimize the number of on-orbit adjustments.

3.4.2.2.1 Accuracy

The V/H Programmer shall provide the following accuracies.

(1) Ramp to function match within 1.0% RMS.

(2) Ramp repeatability 1.0% RMS.

3.4.2.3 Camera Servo System

The servo system shall regulate the camera cycle periods within 1% RMS of the corresponding V/H Programmer voltage over a camera temperature range of 40 to 100° F. The servo-drive system shall provide a range of cycle periods from 1.5 to 4.5 seconds per cycle. The velocity of the lens-scan arm during the photographic scan shall be controlled so as to produce no visible banding or photographic degradation in ground scenes. The input impedance shall be compatible with the V/H Programmer and shall be greater than 10 K ohms (resistive).

3.4.2.4 FMC Device

The FMC device shall provide angular motion of the appropriate camera components to eliminate image smear resulting from vehicle forward motion in flight. The design shall produce the appropriate image velocity to match the ground angular velocity and yield a minimum of 3% overlap at the center of format. The device shall be capable of providing displacement for any operational cycle period from 1.5 to 4.5 seconds.

3.4.2.5 Homing Device and Transfer Operation

The camera shall include the necessary circuitry and components to operate the cameras during the A to B transfer as described in paragraph 3.4.1.4 of T3-5-019. The circuitry shall also include lens position control to preclude film fogging during non-operational periods.

3.4.2.6 Exposure Control

A means shall be provided to vary the slit width as a function of solar altitude. A fail safe device shall be provided which can be RTC commanded to return the slit to a nominal position.

A means shall be provided to switch filter types (Detector and RTC controlled),thereby providing a means to control exposure of split film loads (Para. 3.4.1.7). LMSC shall provide an exposure control programmer)as described in para. 3.4.14.

3.4.3 DISIC Subsystem

The DISIC subsystem shall be supplied per [redacted] Exhibit [redacted] Performance Specification (DISIC) Subsystem. The subsystem shall consist of one DISIC camera with two take-up cassettes, one supply cassette, exit housing, film chutes and baffles, designed so that the total weight is less than 105 pounds, including 2000 ft. of terrain film and 2000 feet of stellar film (2.5 Mil base). DISIC photography shall be generated concurrently with 70 mm

Panoramic photography. The DISIC subsystem shall also have the capability of independent programmed operation. Exposed film shall be transported to the cassettes within the recovery systems via independent film paths. The A and B film paths shall contain back-up film cutters. Fusing shall be provided in power circuits to protect the Panoramic subsystem power, but not in the DISIC subsystem. The DISIC shall operate with 21 to 29.0 volts unregulated DC with power consumption less than 1600 watt hours for 2000 feet of terrain film for the 9.375 sec/cycle terrain cycle period.

3.4.3.1 Cycle Period

The DISIC camera shall expose film to obtain 60 to 70 per cent overlapping terrain photography at 80 nm altitude and 9.375 sec/cycle. The DISIC subsystem shall have a maximum sustained operational capability of 45 minutes per single orbit. A change of gears shall provide a terrain cycling period of 12.500, 15.625, and 18.750 seconds for higher orbital altitudes.

3.4.3.2 Angular Relationship

The Angular Relationship between the stellar and terrain optical axes shall be 100 degrees. Calibration test of the angular relationship to an accuracy of five (5) seconds of arc shall be conducted prior to delivery to LMSC. (Data shall have been obtained but not necessarily reduced at time of delivery).

3.4.3.3 Distortion

The stellar and terrain lenses shall be calibrated to an accuracy of three (3) microns for radial and tangential distortion prior to delivery to LMSC.

3.4.3.4 Terrain Unit

The terrain unit shall provide photography to be used for indexing and correlations of panoramic photography by the Government. The terrain unit shall be equipped with a calibrated reseau plate. Grid line width shall be 10 microns or less and line spacing shall be 2.5 mm. The terrain unit supply spool shall accommodate 2000 feet of 5 inch 2.5 mil. base polyester film. The time relationship between the opening of the terrain unit shutter and one of the stellar unit shutters shall be capable of being determined to within 1 millisecond.

3.4.3.5 Stellar Unit

The 35 mm camera shall provide photography to be used to determine the spatial orientation of the terrain camera. Six stellar photographs shall be generated for each terrain format in the slave mode (9.375 sec/terrain frame). Two simultaneous stellar photographs shall be generated for each terrain format in the independent mode. The necessary lens baffling shall be provided by the camera contractor and LMSC to minimize obscuration of stellar imagery due to earth albedo. An automatic sensor and an in-flight select shall be available to cap either one of the stellar units if required.

3.4.3.6 Transfer Sequence - DISIC Subsystem

During the transfer sequence from the A to B take-up cassette, the requirements shown in para. 3.4.16 shall apply.

3.4.3.7 DISIC Exposure Control

The exposure control shall consist of an electro-mechanical device to provide effective terrain exposures of 1/250 or 1/500 seconds. The camera interface shall include the necessary electrical pins for exposure control commands. LMSC shall furnish the necessary command and control to activate the exposure control in flight and adjust the timing of the command during Pad checkout. Design requirements of the LMSC design are shown in para. 3.4.14.

3.4.3.8 DISIC Control

LMSC shall provide control of the DISIC as described in para.3.4.9.2.

3.4.3.9 Cut and Splice Mechanism

LMSC shall provide a Cut and Splice mechanism to accomplish the A to B transfer for the DISIC subsystem. The mechanism shall be compatible with the requirements of paragraph 3.4.16 and shall mechanically mate with the DISIC film exit housing.

3.4.3.10 DISIC Film

The following film shall be used for the DISIC subsystem:

Terrain - 3400

Alternate SO 230

Stellar 3401

Alternate 3400

Film 2.5 mil base, 3.0 mil thick

Alternate 1.5 mil base, 2.0 mil thick

3.4.3.11 Recording

The DISIC shall utilize the same type data head and have the same characteristics as described in paragraph 3.4.13, except no index column or complement time word will be recorded.

3.4.4 System Structures

System structures shall include the payload frame and the mechanical and electrical interfaces between subsystems. In addition to carrying distributed loads, the system structures shall provide a light tight housing for the camera subsystems. Light leakage acceptability is as defined in T3-6-012. The structures shall include mounting provisions for the following major components:

1. Command Box
2. TM Boxes (Includes tape recorder subsystem components).
3. Pwr. Junction Box
4. Transfer Box
5. Pressure Make-up subsystem (PMU)
6. Switch Programmer (Exposure Control).
7. Slope Programmer (Including OSFG).
8. Panoramic Supply Cassette
9. Panoramic Camera Module
10. Digital Clock
11. DISIC and associated components including a cycle counter
12. SRV'S
13. SLP Data Block Conditioner

3.4.4.1 Instrument Barrel Assembly

The barrel structure shall provide the mechanical and electrical interface for the LMSC 39205 vehicle and the conic adapter. Three mounting brackets shall be provided for the panoramic camera assembly and the main supply. Mounting brackets shall also be provided for other components as required. The barrel shall be fabricated in one section. The assembly shall be 60 inches in diameter and shall not require additional structure for mating to the LMSC 39205 vehicle. A pressure diaphragm shall be provided between the LMSC 39205 vehicle and the barrel assembly. The diaphragm shall be structurally compatible with the differential pressure encountered during test, pad checkout, launch and orbit operations.

3.4.4.2 DISIC Conic

The DISIC Conic shall provide the mechanical and electrical interface for the Instrument Barrel Assembly and the B SRV. Structural mounts shall be provided for the required components.

3.4.4.3 SRV Mount

The system structures shall provide structural mounting compatible with the SRV's described in paragraph 3.4.5.

3.4.4.4 Fairing

The fairing shall provide the mechanical and electrical interfaces for the DISIC Conic and the "A" SRV and shall include a thermal curtain.

3.4.4.5 DISIC Film Chutes

Film chutes shall be provided by LMSC between the cut and splice mechanism and the A and B SRV's as required to protect the payload from light or mechanical damage.

3.4.4.6 Doors and Boots

The system structure shall provide detachable doors which shall be ejected on command during orbit injection. The structures shall also provide boots or other similar devices to seal the camera subsystems from external light. Boot design shall provide for pressure variations encountered during test, pad, ascent and orbit operations.

3.4.4.7 Access Panels

Access panels shall be provided as required and shall include access doors for tracking adjustment and observations of all camera subsystem major film paths.

[redacted]

3.4.5 Basic Recovery Subsystem

The minimum requirements for the Recovery Subsystem will consist of two (2) Mark 5A Satellite Recovery Vehicles described in GE-RSD Drawing No. 47R196829, "Vehicle Assemblies - Satellite Recovery Vehicle" and 6K617 "Space Vehicle Assy. Modification". The Recovery Subsystem will include those elements necessary to the sequencing and execution of events by which the SRV is ejected from orbit, the Thrust Cone is separated from the re-entry vehicle, the capsule is separated from the heat shield, and then decelerated by parachute to the required descent rate. Recovery aids and their sequencing are also required.

3.4.5.1 Powered Flight Requirements

3.4.5.1.1 Thermal Requirements

The forward SRV will form the nose of the Space Vehicle and, as such, it must withstand aerodynamic heating during ascent. Any thermal control coatings used on the exterior surface of this forward re-entry vehicle must resist this hearing environment and be able to perform their thermal control function in orbit thereafter.

3.4.5.1.2 Structural Requirements

The SRV shall be capable of sustaining the aerodynamic and inertial loading during the powered flight ascent trajectory. The ascent loads shall be based upon criteria presented in T3-6-002 Environmental Specification.

3.4.5.2 On-Orbit Requirements

The system shall be designed for orbital and launch parameters as stated in Section 3.3.2.1 and 3.3.2.2 of this document. The normal attitude of vehicle system in flight shall be "forward flying" (SRV Forward). The "A" SRV shall be capable of a minimum time in orbit of 10 days.

3.4.5.2.1 Thermal Control

When the SRV is directly exposed to the space environment during the on-orbit phase of the mission, thermal control of the film in the take-up spools shall be maintained at 70° F. $\pm$ 30° F. by passive means with the exception of the main takeup motors and recovery battery which are controlled by means of thermostats and heaters. Temperatures shall be maintained within this range for all (two coating matrices will be required) orbital parameters identified in 3.3.2.1 and for all Beta angles between $\pm$ 65 degrees, where Beta is the angle between the orbit plane and the sun vector. Minimum temperature of the recovery battery at activation shall be 60° F. Active heating is required prior to activation of the battery to insure maintaining this minimum temperature.

3.4.5.3 Recovery Requirements

The LMSC 39205 Agena vehicle will orient the space vehicle in the proper attitude for SRV separation as specified in LMSC Detail Specification 1419071 for Primary and Back up (Lifeboat) recovery. Upon receipt of the proper signal from the Agena, the SRV shall be capable of initiating and undergoing a recovery sequence with specified film loads ranging from empty to full. Following ejection from orbit and atmospheric re-entry, the SRV shall deploy a parachute deceleration system. The 3 σ dispersion limits for design operation shall be $\pm$ 10 nautical miles cross track and $\pm$ 70 nautical miles along track at a nominal impact point of 10,000 ft. altitude. Bias for wind drift should be capable of being calculated but its contribution to dispersion is not included.

3.4.5.3.1 Separation and Ejection

The Space Vehicle shall contain mechanisms for separating the SRV vehicle from its structural mounting on the Space Vehicle at a velocity between 1.5 and 2 feet per second. Total rate (pitch and yaw components) due to structural separation shall not exceed 1°/sec. Following separation the SRV shall be spun about its axis of symmetry at the rate sufficient to average out thrust misalignments. Retro velocity of not less than 800 ft/sec with a full load of film will be initiated by firing of a retro-rocket, nominally 12 sec. after transfer signal. This retro velocity in conjunction with the specified deboost envelope and R/V loading conditions will permit re-entry of the R/V within the dispersion envelope. Despin shall reduce roll rate to a level compatible with aerodynamic alignment of the vehicle in the re-entry region. Prior to re-entry the remaining retro-rocket assembly will be jettisoned.

3.4.5.3.2 Atmospheric Re-entry

The re-entry vehicle shall be capable of withstanding the aerodynamic heating and loads associated with a re-entry under all film loading conditions. The RV contractor shall prepare an operational matrix of re-entry conditions describing margins and dispersions provided under varying conditions of film loading. True anomaly values for deboost shall be derived for impact in the Hawaiian recovery area, with deboost velocities corresponding to all load configurations. The vehicle shall have sufficient aerodynamic stability in all specified load configurations so that the angle of attack envelope approaches a value near zero at the time of peak axial deceleration.

3.4.5.3.3 Parachute Descent

A subsonic deceleration system shall be incorporated in the re-entry vehicle and shall be deployed immediately after the vehicle achieves subsonic velocity. This sub-system shall be designed to provide a descent rate of less than 30 ft. per second at an altitude of 10,000 ft. in a fully loaded configuration. When the main or primary parachute is deployed, the heat shield shall have separated from the recovery vehicle. The parachute system shall be designed for air pickup by the aircraft.

3.4.5.3.4 Recovery Aids

Recovery aids shall include a beacon and flashing light. The beacon will be activated at the time of the arm signal. The flashing light will be activated at the time of parachute deployment.

3.4.5.3.5 Water Impact Flotation

In the event air snatch is not successful and the recovery capsule assembly descends at nominal descent rate to the ocean surface, it is required that the capsule maintain a watertight environment for the film both before and after water impact and that it float in an upright position for a maximum of 85 hours in a condition of sea state 3. Between 48 and 85 hours, it shall be self scuttling.

3.4.5.4 Weight Requirements

A fully loaded SRV shall have a Separation Weight of 425 lb. (max.), a Re-entry Vehicle Weight of 335 lb. (max.) and a suspended weight of 230 lb. (max.).

3.4.5.5 SRV Capabilities

Up to 16,300 feet of 3.0 mil 70 mm film and up to 1000 feet of DISIC stellar and 1000 feet of DISIC terrain film shall be stored in the number one Recovery subsystem during the first operational phase. At some time after completion of the first operational phase, the number one Recovery subsystem shall be ejected. After ejection of Recovery system number one, the LMSC 39205 Agena vehicle shall be programmed for the second operational phase. Power and attitude of the system shall be maintained throughout the transition from the A to B Mission. The LMSC 39205 Agena vehicle shall maintain attitudes between all reconnaissance operations. During the second operational phase approximately 15,500 feet of 70 mm film and 1000 feet of stellar and 1000 feet of terrain film shall be programmed, during a one (1) to ten (10) day interval. Recovery system number two shall be recovered sometime between completion of first photo reconnaissance phase and the 20th day in orbit.

[redacted]

The re-entry and recovery sequence of operations shall be initiated and recovery of number two Recovery subsystem shall be effected, thus completing the system operations. All film footage capacities are stated for 3.0 mil thick film for convenience. Use of UTB film requires adjustment of these numbers to obtain the correct film footage.

3.4.6 System Supply Cassettes

The supply cassettes for the Panoramic and DISIC subsystems shall consist of film spools, mounting brackets, enclosures, drive unit braking device, the necessary controls to assure proper tension throughout the test, ascent, and orbital phases of operation. The cassettes shall be compatible with the system structure supplied by LMSC, and shall operate from 21 to 29.5 VDC Unregulated Power measured at the cassette subsystem interface. All spools on each subsystem shall be capable of individual independent operation. The main supply shall operate at a full tension during ascent by an initial Pad command which shall be released by the receipt of the Orbit Mode Signal Command. Design shall allow for control during test.

3.4.6.1 Panoramic Supply Cassette

Each Panoramic supply cassette shall consist of two spools, each spool shall have a nominal capacity of 16,300 feet of 2.5 mil base, 3.0 mil thick 70 mm film. Main supply mounts shall be provided by LMSC and shall be located in the instrument barrel.

3.4.6.2 DISIC Supply Cassette

The DISIC supply cassette shall have a nominal capacity of 2000 feet of 2.5 mil base, 3.0 mil thick 5 inch terrain film and 2000 feet of 2.5 base, 3.0 mil thick 35 mm stellar film.

3.4.7 System Take-up Cassette

The Take-up Cassettes for the Panoramic and DISIC subsystems shall include the same basic type of components shown for the Supply Cassettes. The design shall conform to the basic configuration and space limitations of the Recovery Subsystem as described in paragraph 3.4.3. The Cassettes shall utilize a flange design and provide sufficient clearances to assure satisfactory operation at a minimum temperature of 20° F. The center to center distance of the two (2) panoramic films shall be nominal 3.12 inches. Each A take-up spool shall have a nominal capacity of 8000 feet of 3.0 mil thick, 2.5 mil base 70 mm film. Each B take-up spool shall have a nominal capacity of 7750 feet of 3.0 mil thick, 2.5 mil base 70 mm film. The cassettes shall operate from 21.0 to 29.5 (+) VDC unregulated power at the take-up interface. All spools shall be operated at a programmed current and include film radius telemetry monitors. The panoramic camera subsystem shall utilize a cut and wrap sequence for transfer from A to the B take-up cassettes. The DISIC subsystem shall utilize a cut and splice sequence for A to B transfer.

3.4.7.1 Panoramic Take-up Cassette - A

Each spool shall utilize an anti-back up device that does not interfere with the Panoramic Camera operation. During the ascent mode, the anti back-up devices shall be released and a reduced voltage applied to the spool drive systems to insure adequate film tension compensation. The anti back-up device shall be capable of being released for test and checkout purposes by applying 21 to 29.5 VDC to the appropriate take- up interface connector pins. This device shall be in effect without application of power.

3.4.7.2 Panoramic Take-up Cassette - B

Each spool shall utilize a brake device that will prevent spool rotation during ascent, "A" mode operation and "B" mode non-operate periods. The device shall be in effect without application of power. The spools will be indexed to allow optimum film tracking through the"B" cassette to the "A" cassette. The gap bwtween the hub rollers shall not interfere with the passage of a maximum splice thickness of .0075 inches.

3.4.7.3 DISIC Take-up Cassette

The DISIC take-up cassettes shall have a nominal capacity of 1000 feet of 2.5 mil base, 3.0 mil thick 5 inch terrain film and 1000 feet of 2.5 mil base, 3.0 mil thick 35 mm stellar film.

3.4.7.4 Temperature Limits

All take-up cassettes shall provide satisfactory operation over a temperature range of 40-100° F. LMSC shall provide a passive method for indicating temperatures above 140° F. Heaters and thermostats shall be provided and installed by ITEK in the panoramic cassette area to assure a minimum operational cassette temperature of 40 degrees F., and the heaters shall not be operated beyond 60 degrees F.

3.4.7.5 Start Stop Capability

All take-up cassettes shall be capable of being started and stopped a minimum of three hundred (300) times in flight.

3.4.7.6 Film Off-spooling, Panoramic Subsystem-Test Conditions

Spool RPM during film off-spooling shall not exceed 60 RPM.

3.4.8 DRCG

LMSC shall provide and checkout the Digital clock. The clock shall be capable of storing time unambiguously for a period of five days. Upon receipt of an interrogate command, the clock shall provide the signals required for auxiliary recording of binary time on the Panoramic Camera and DISIC subsystem film. The clock error shall not exceed 2.5 milliseconds in any twelve hour period after accounting for clock offset. The Clock shall operate from the LMSC Agena Vehicle 24 Volt DC Unregulated power source. The clock and its ancillary equipment shall be capable of driving the data heads to provide the proper exposure for the film as described in paragraph 3.4.1.7 and 3.4.3.10

3.4.9 Commands and Programming

The LMSC 39205 Vehicle orbital timer shall contain punched mylar tapes which control both the vehicle orbital functions and system program options. The electrical interfaces shall be compatible with T3-5-023, Electrical Interface Specification - J3.

3.4.9.1 Program Options

The program options shall include the following items, each item controlled by a tape-brush and RTC commands:

1. Reset V/H Programmer start control, Yaw Programmer start, exposure control reset and V/H oblateness function start.
2. Panoramic Geometry Control (Tape brush only)
3. Continuous TM on (Tape brush only)
4. V/H Programmer start control
5. Camera Program "On" and "Off"
6. DISIC "On"
7. DISIC "Off"
8. DISIC Exposure Control
9. Pan Exposure Control

3.4.9.2 Commands

A magnetic core storage register, as specified by A/P DCS T33-7-020, will be utilized as a command system for controlling programmed camera operations.

3.4.9.2.1 Command System - General Description

The command subsystem shall be capable of accepting up to 32 5-bit parallel words from the Agena type 22 decoder, storing the words indefinitely and generating them on command. Each of the 32 words shall be used to generate an ON or OFF execute in response to 16 tracks punched in a cascade on the H Timer tape. The cascade shall consist of a series of sequential punches on 16 tracks with a spacing of approximately 10 seconds between adjacent tracks.

Operations shall be generated in the following manner: four of the five bits in each word shall be coded to form a 16 state four bit binary code. The four bit word shall be decoded and result in one of 16 enabling lines being energized.

Each enabling line shall correspond to one of the 16 H Timer tracks. When a punch appears on the track corresponding to the energized enabling line, an execute command shall be generated. The execute shall be either ON or OFF depending on the state of the fifth parallel bit. A "one" bit shall create an ON execute and a "zero" bit shall create an OFF execute. Each execute command either ON or OFF, shall cause the memory to advance to the next stored word. The 32 stored words shall allow a maximum of 16 controlled operations for the system between acquisitions.

Mono/Stereo control shall be available through RTC select only and shall be controllable from acquisition to acquisition and not operation to operation.

In addition to the Normal Mode described above, an Emergency Mode consisting of two programs (4 H Timer Tracks), four orbit operation intermix shall be provided to allow failsafe back-up capability.

The DISIC subsystem is slaved to the panoramic instruments operate command and shall subsequently be controlled in the slave mode by the existence or absence of the panoramic subsystem operate command. Control and programming of the DISIC subsystem in the independent mode shall be controlled by a stored program and two (2) Real Time commands for enable, disable, and stellar select. A secure Real Time command shall be available for the A to B transfer.

3.4.10 Telemetry Transducers

LMSC shall coordinate instrumentation schedules and functions to be telemetered. The instrumentation functions shall provide information for analysis of system performance. TM functions shall be provided for as described in an addendum to T3-7-004.

3.4.11 Telemetry Signal Conditioner

A signal conditioner capable of accepting instrumentation signals from the system and conditioning them into suitable form for transmission by the LMSC 39205 Agena Vehicle. The signal conditioner shall be compatible with the telemeter channels. One channel, which is time shared with Agena Functions and the Vehicle tape recorder, shall be provided. The tape recorder shall record data from a .4 RPS Commutator. TM monitoring of all stepper switches shall be standardized and shall utilize a 5 x 5 code as shown below.

POSITION

VOLTS - PIN 2	1	2	3	4	5
1	1	6	11	16	21
2	2	7	12	17	22
3	3	8	13	18	23
4	4	9	14	19	24
5	5	10	15	20	25

3.4.12 Attitude Determination

Vehicle attitude determination shall be derived from stellar photography provided by the DISIC subsystem. The stellar photography shall be compatible with the following accuracy requirements for attitude when multi star solutions are utilized:

Roll:	$\pm$ 5.0 seconds
Yaw:	$\pm$ 5.0 seconds
Pitch:	$\pm$ 35.0 seconds

The panoramic horizon cameras shall provide back-up attitude information with accuracies of $\pm$ 10.0 minutes of roll and pitch.

3.4.13 SLP Signal Conditioning

LMSC shall provide the conditioning of the signals to each panoramic silicon light-pulser data head. The conditioning shall meet the following design criteria:

1. Dot Size: 8 mils at 50% density point
2. Dot Spacing: 18 mils on centers
3. Density: 0.3 minimum delta (base fog and dot)
4. Drive: Adjustable, 10 to 80 msec for each column. Each time word adjustable from 25 to 35 milliamps.
5. Adjustment: Bench type only at the component level prior to installation into the J-3 Payload system.

6. Data Recorded: An index column, 29 bit time word plus a parity bit, and a complement time word plus a parity bit.
7. The exposure time shall be automatically changed, upon receipt of the panoramic camera change signal.

3.4.14 Exposure Control Subsystem

The exposure control subsystem (Switch Programmer) shall control the CR instrument slit width mechanism and the DISIC exposure mechanism in time sequence to change exposure setting as the system goes through day to night and night to day crossings. In addition, the exposure control subsystem shall provide real time control to override the standard night to day and day to night exposure control sequence for the CR instruments only. In the event of power failure to the DISIC solenoid, the DISIC shall provide exposure control at 1/500 sec.

3.4.14.1 Timing Sequence Mode

The timing requirement and the sequence shall be as shown in Figure 1. Time delays shall be either adjustable within limits on-orbit or prior to launch. ΔT_2, ΔT_3, ΔT_4, ΔT_5 shall be individually set prior to launch to between 20 to 400 seconds in 20 seconds increments. The increment for ΔT_1

shall be either 10 second or 20 second and shall be selected prior to launch. During the mission, there shall be 20 selectable time delays for ΔT_1 between 10 to 200 seconds or 20 to 400 seconds depending upon the time increment selected. The 210- ΔT_1 or 420 ΔT_1 time delay is selected by the selection of 10 or 20 second increments for ΔT_1. 210 - ΔT_1 corresponds to the 10 second increment and 420 - ΔT_1 corresponds to the 20 second increment. All time delay settings shall be repeatable within 1%.

3.4.14.2 Real Time Control Mode

Real time control capability for CR instrument slit widths shall be provided to override the timing sequence mode. The following capability shall be provided:

a. Select any one of 4 slit width for both instruments.

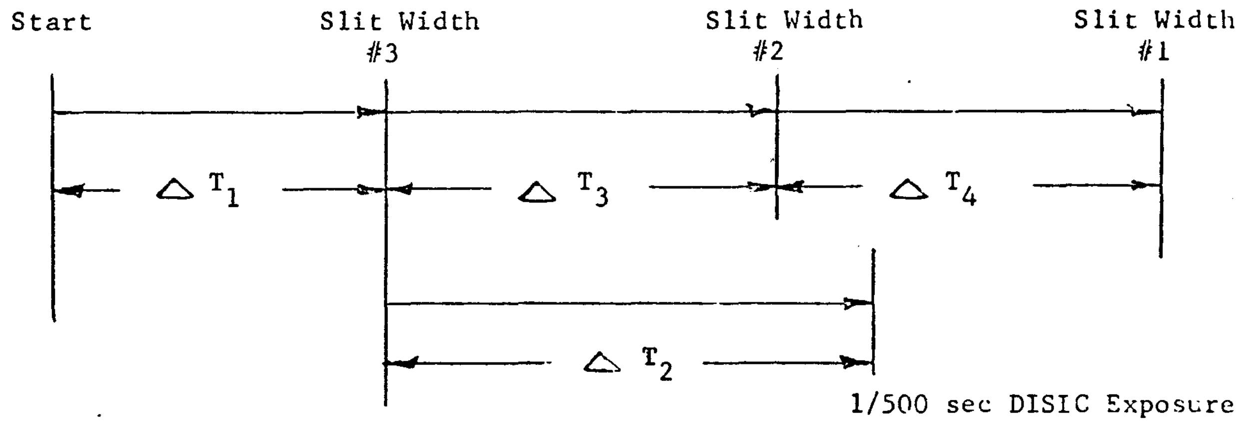
b. Place both instruments in failsafe slit width.

c. Place either instrument in failsafe slit width and the other instrument shall be operated in the timing sequence mode or in any one of 4 slit widths.

C ~~TOP SECRET~~ [redacted]

[redacted]

NIGHT TO DAY SEQUENCE



DAY TO NIGHT SEQUENCE

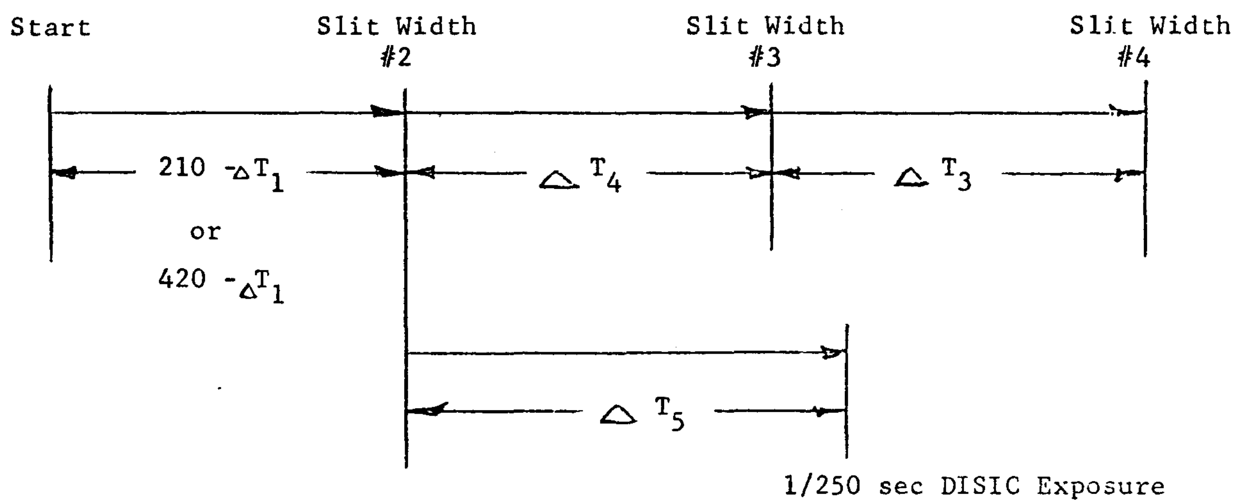


FIG. 1

C ~~TOP SECRET~~ [redacted]

3.4.15 Image Motion Compensation (IMC) Subsystem

The IMC subsystem (Slope Programmer) shall consist of the Forward Motion Compensation (FMC) Function Generator and the Yaw Function programmer.

The vector diagram of Figure 2, defines the FMC function and the yaw function of the IMC.

3.4.15.1 FMC Function Generator

The FMC function generator shall generate a function to control the CR camera system for compensation of $\bar{v}_{FMC}$ defined in Figure 2. The FMC function shall be the sum of the eccentricity function and the oblateness function. The eccentricity shall be FMC, assuming spherical earth, and the oblateness function shall compensate for the earth oblateness factor relative to the satellite altitude.

The eccentricity function shall be approximated by the following cosine function:

$$E_{ef} = \frac{E_s + E_{hc}}{2} + \frac{E_s - E_{hc}}{2} \text{Cos } 2\pi f_1 t$$

where E_s = start voltage

E_{hc} = half cycle voltage

f_1 = reciprocal of the eccentricity function period

The oblateness function shall be approximated by the following function:

$$E_{of} = \frac{KE_{ef}}{2} \left[1 - \cos 2\pi f_2 (t - \Delta t)\right]$$

K = gain control

f_2 = reciprocal of the oblateness function period $\left(\frac{1}{86.5 + 1 \text{ min.}}\right)$

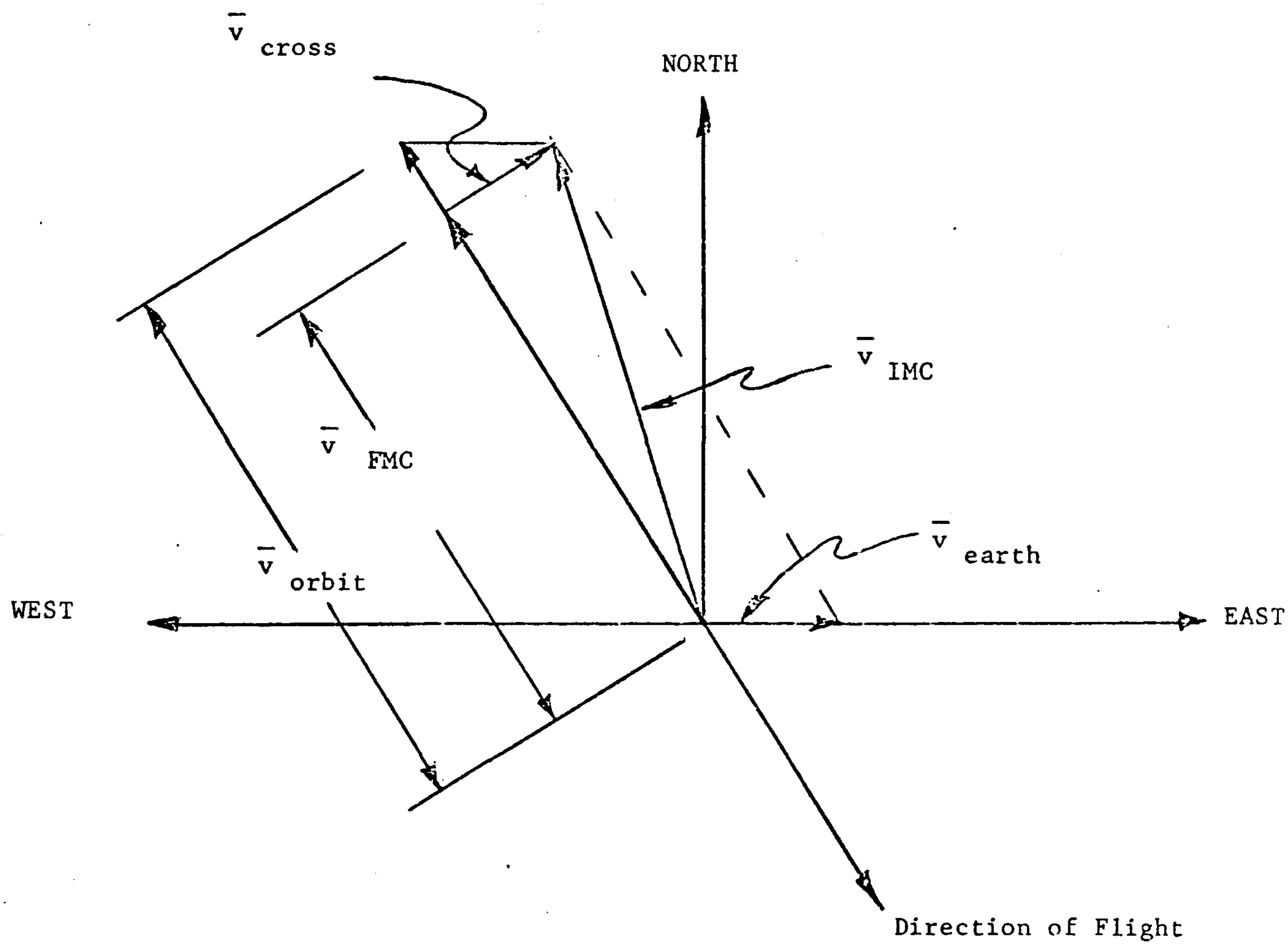
Δt = delta time between oblateness function start and eccentricity function start

The FMC function which is $E_{ef} + E_{of}$, shall be accurate to within 1% of E_s or E_{hc} whichever is larger. Pre-launch and on-orbit adjustment shall be provided to match the orbits specified in para 3.3.2.1. E_s, E_{hc}, and start time of eccentricity function shall be adjustable within limits of on-orbit. f_1 and K shall be adjustable prior to launch.

3.4.15.2 Yaw Function Generator

The yaw function generator shall generate a signal to the Agena guidance system to compensate for $\bar{v}_{cross}$ defined in Figure 2. The yaw function aligns the Agena X axis to the $\bar{v}_{IMC}$ direction defined in Figure 2. The yaw function shall be approximated by the following suppressed carrier voltage:

$$e_y = E_M \sin \omega_s t \sin \omega_c t$$
$$= 1/2\, E_M \cos \left[(\omega_c - \omega_s)t\right] - 1/2\, E_M \cos \left[(\omega_c + \omega_s)t\right]$$



$\bar{v}_{earth}$ - Earth Rotation Velocity Vector referred to satellite

$\bar{v}_{orbit}$ - Forward Ground Track Velocity referred to satellite

$\bar{v}_{IMC}$ - Image Motion Velocity referred to satellite ($\bar{v}_{earth} + \bar{v}_{orbit}$)

$\bar{v}_{cross}$ -Cross Track Velocity Component of $\bar{v}_{IMC}$ (Yaw compensation)

$\bar{v}_{FMC}$ -Forward Motion Component of $\bar{v}_{IMC}$ (Forward Motion Compensation)

FIGURE 2

where E_M = Maximum yaw function voltage

$_c$ = 400 cps sinusoidal carrier

$_s$ = Sinusoidal signal with a period of 86.5 ± 1 minute

E_M shall be adjustable prior to launch to match the orbits specified in para. 3.3.2.1.

3.4.16 Cut and Splice Mechanism

LMSC shall furnish a cut and splice mechanism to accomplish the transfer of DISIC film takeup from the A takeup cassette to the B takeup cassette. The following design criteria shall apply:

1. Up to 80 inches of the A mission payload can be stored on the B Take-up cassette.
2. The loss of some payload at the end of the B mission shall be tolerated to simplify the subsystem and/or improve the reliability of the flight article.
3. Slack between the DISIC metering roller and the cut and splice mechanism shall not be acceptable.
4. The cut and splice operation shall occur prior to the beginning of the B Panoramic mission.
5. Back-up cutter functions shall be provided for the A and B missions.
6. The transfer sequence shall be initiated by a secure RTC, independent of the normal recovery sequence. Initiation of the recovery sequence shall be used as a back-up for the transfer sequence.

7. Early A to B transfer of the prime photographic system shall be independent of the DISIC subsystem.

8. Subsequent to the cut and splice, and prior to the A recovery, the DISIC A payload (from the cut and splice mechanism to the A take-up cassette) shall be taken up.

3.5 Storage and Handling

Storage and handling shall be in accordance with LMSC T3-4-505, and/or GE S0020-01-0014 and S0020-02-0014. The camera contractors shall furnish ground handling equipment (dollies) as required for handling their equipment at the AP facility (GFE). Under conditions of controlled environment, a minimum shelf life of 24 months is required for all components (including pyros) used on payload systems and GFE equipment. NOTE: Exceptions have been granted for the SRV heat shield, retro and igniter, as well as the Atlas reefing line and bagline cutters. Also the DISIC platen rubber pad and tesafoam seals.

3.6 Thermal Design

Passive thermal control means shall be employed in the "J" system. Structural surface optical properties and associate mosaic shall be employed to maintain the camera subsystem at $70^{\circ} \pm 30^{\circ}$ F. during the operational portions of the orbit (defined by orbital parameters specified within this document). It is noted that the temperatures of system components, such as structures, mounts, and other thermal non-critical components, will exceed $70^{\circ} \pm 30^{\circ}$ F at times during the orbit. Additionally, since the J-3 system doors will be open continually (after ascent), the camera drum assembly shall be capable of providing the required thermal protection for any temperature-sensitive components in the door area. The temperature control design goal shall be to maintain the camera optical train at a temperature of 70° F $\pm$ 10° F. All temperature transducers shall be Micro Systems Type Model 3003-006 or equivalent with a low voltage excitation system. A System Thermal Math Model shall be used to predict in flight temperatures. Symmetrical and/or assymmetrical paint skin patterns will be developed, based on the analytical model predictions. Aluminum thermal shielding or equivalent shall be used as required for components mounted to the space structure. Associate Contractors shall identify temperature sensitive components in their respective subsystem and establish temperature limits. The maximum-minimum and time averaged temperature will be predicted for all system components in a space environment range as follows:

Beta: -65° to $+65^{\circ}$

Period: 88 to 91.5 minutes

Minimum Height: 80 nautical miles

Inclination Angle: 60 thru 110°

Nominal Perigee Latitude: 20° North Tangent Point Descending

Solar Constant shall include diurnal variations.

Average Albedo coefficient shall range from .25 to .55. The internal power duty cycle shall be calculated on a range from 0 minutes to 20 minutes per orbit. The attitude during active phase shall be as specified for the LMSC 39205 Agena vehicle.

3.7 Light Leaks

Light Leak Tests in accordance with the appropriate LMSC specification shall be performed on the system. All leaks located shall be corrected prior to final pre-launch assembly. Maximum density of 0.02 above base fog shall be used as the limit for light leaks. A light leak detection system shall be installed for light leak checks during the test phases. The system shall consist of four high-sensitivity photometers, installed for test only through access ports in the skin of the payload system. Provisions shall be made to guarantee light tightness of both the photometer installations and the flight access port covers to be subsequently installed.

3.8 System Altitude Test and Corona Marking

3.8.1 System Altitude Test

The system, in flight configuration, shall be tested in an altitude chamber to test system environmental performance and susceptibility to corona marking. Operate times will follow the flight profile and the static system internal pressure shall be 3 to 10 microns during a minimum of 5% of the A mode and 1 to 3 microns or less during a minimum of 20% of the B mode. The DISIC and Main Instruments shall be programmed for simultaneous operation. The DISIC subsystem shall also be programmed for independent operation to confirm independent mode operation. DISIC in-flight shutter capping capability shall be confirmed for both automatic and command control.

3.8.2 Main Instruments

Corona marking shall be limited to a density of less than 0.4 above the base plus fog level during the first five consecutive frames from the start of pass mark at each instrument start-up. Tests shall be in accordance with para. 3.8.1.

3.8.3 DISIC Subsystem

Corona marking shall be limited to 10% of the programmed formats and any such marking shall be at a density less than 0.4 above the base fog level. Tests shall be in accordance with 3.8.1.

4.0 Quality Assurance Provisions

4.1 Selection of Parts and Components

Parts and Components shall be selected from any of the following sources preferably in the order listed:

A. LMSC Space Systems Preferred Parts Handbook

B. Military Standards/Military Specification

C. Missiles and Space Industry Standards

D. LMSC and ITEK Specification Controlled Drawings.

E. Items proven satisfactory by prior flight useage

F. Parts and components which have been qualified prior to flight to level requirements by the Design Application.

4.2 Semi-Conductors

No semi-conductors shall be used that are not vendor certified. All semi-conductor devices except for non-cavity devices (micro-diodes) shall be inspected by the X-ray method in accordance with LMSC 1412815C.

4.3 Electro Magnetic Interference (EMI) Control

The provisions of specification LMSC 447969 and T3-6-002 are to be used as a guide for controlling EMI in electrical and electronic assemblies and conic components. No EMI testing of the system or subsystem shall be required.

4.4 Inspection and Certification

Prior to testing a "J-3" system, all components of the system shall be inspected by a Quality Assurance Representative and certified as complying with the applicable drawing. The system shall meet flight quality standards in regard to workmanship and cleanliness.

4.4.1 Failure During Test

In the event of failure during test, the testing shall be discontinued. Such failure shall be completely documented and reported for analysis and dispositioned. Disposition shall be in accordance with LMSC and/or Associate Contractors Standard Operating Procedures and Specifications.

4.4.2 Test Certification

A Quality Assurance Representative shall witness and verify the accuracy of all testing.

4.5 Testing

4.5.1 Operational Systems

The testing of the system shall consist of acceptance and pre-launch tests and shall be compatible with the AP Factory to Launch Program. The system shall be tested to demonstrate the photographic integrity and provide H.O. calibration data. Data for Pan Geometry shall be provided to LMSC by ITEK at time of delivery of cameras to AP. (Reference paragraphs 3.4.1.2 and 3.4.1.3.3.). Testing shall be in accordance with the basic provisions of the applicable LMSC Acceptance Test Specification. A minimum of five (5) days duration shall be required for the thermal altitude environmental chamber test.

5.0 Preparation for Delivery

Precautions shall be taken to protect the acceptance system from damage and contamination during storage and shipment. Storage of Panoramic Instruments, DISIC camera, cassettes, and etc., shall be under modified Class No. 2 Clean Room Conditions as per TO-0025-203. Transit cases for the camera subsystem components shall be furnished by the camera contractors and shall incorporate a shock recorder, humidity recorder and air pressure regulation valve. The DISIC transit case will not have a humidity recorder.

6.0 Notes

6.1 Field Support

Associate contractors shall provide field support at the AP facility. Fairchild support is specified under [redacted] contract.

6.2 Spare Parts

Spare parts requirements shall be submitted to the Customer by all Contractors. Long lead items shall be noted and spare parts shall be furnished as GFE after approval by the Customer. AP shall maintain stockrooms and inventories of all spare parts provisioned, with the exception of DISIC parts, to support the program.

6.3 Film Requirements

The film required to support test and flight operations shall be furnished to all contractors and on a schedule to adequately support all phases of the program. Film requirements and schedules will be coordinated with the Customer by each contractor for the film requirements at their respective facilities.

6.4 Test Equipment

AP shall furnish test equipment required for all phases of the AP to Pad Test Program. Test equipment for the DISIC subsystem shall be GFE per [redacted] Exhibit [redacted] for verification testing. Test equipment for ITEK subsystem shall be provided GFE and maintained by ITEK Field Engineering.