SSS-269
Copy # M of 8
Pages 2
27 June 1966
(Total page count, includ. attachments is 91 pages)

Subject: Changes to SS-MOL-1 Integrated, 29 April 1966

The attached material is the result of a review of the system specification, taking into consideration, contractor comments and baseline changes. The change material consists of:

Attachment No. 1

Suggested Changes to SS-MOL-1 Integrated

These changes were under consideration for SCN-3; however, time did not permit their inclusion. They were previously submitted to Capt. Bass, and are included in the SS-MOL-1 changes being circulated by SAFSL-5 (see SSMC-22, dated 26 May 1966).

Attachment No. 2

Applicable Documents

The 10 pages of applicable documents in SS-MOL-1 have been carefully reviewed by R. Papich, J. Dawson, J. Morgan, and A. Gillogly. The only ones considered suitable for call-out are those listed in Attachment No. 2. Many of the remaining MIL Specs are worthy of consideration for inclusion in CEI and/or subsystem specifications.

Attachment No. 3

Suggested White Page Changes

These suggested changes to the white pages are those prepared since submission of Attachment No. 1. They have resulted from an effort to call out requirements on white pages whenever security considerations permit the bulk of the material is contained in 3.3.4.

Attachment No. 4

Suggested Green Page Changes

These suggested changes to the pages complement many of the white page changes (e.g., material deleted from the green pages was in most cases moved to the white). Also, requirements against the OV or LV were removed from 3.3.4, and placed in the 3.3.1 or 3.3.2 (e.g., DRV launcher requirements against the LV were moved to 3.3.2.2.3 - see page 3-55 of Attachment No. 3). Finally, 3.3.4 was completely rewritten because of the expanded white 3.3.4, and the reorganization of the material into subsystems.

SUGGESTED CHANGES TO SS-MOL-1 INTEGRATED

Page	Paragraph	
3-1	3.0.1	General Add to the first paragraph: "The disposal of the Laboratory and Mission Payloads shall be accomplished by the ACTS. The translation thrusters will be fired by ground or stored program command after Gemini B separation in order to obtain impact into a designated broad ocean area."
3-31	3.1.3.1.2.4	Mission Payload System Segment Change to read: "The effectiveness of the Mission Payload Segment for the total mission shall be not less than 0.95 in the manned-automatic mode, and 0.80 in the automatic mode.
3-53	3.3.2	Laboratory Vehicle System Segment Change to read: "The Laboratory Vehicle System Segment The Laboratory Vehicle System Segment shall consist of a Laboratory Module (less the mission payload control equipment), plus the structural shell of the Mission Module, which shall house the mission payloads. The Mission Module shall be unpressurized, ten feet in diameter, and 36 feet, 2 inches long, and located aft of the Laboratory Module. The mission module structure shall contain a separation plane at station 355. The Laboratory Module shall consist of a pressurized section and an unpressurized section. The pressurized section will

Page	Paragraph	
3-53	3.3.2 (Cont'd)	consist of one compartment to enclose and support the operation of environmental control, life support, attitude control, power generation, communications, vehicle status monitoring, and mission equipments."
3-55	3.3.2.2.3	<u>Data Recovery Capsule</u> Change to read: "<u>Data Re-entry Vehicle (DRV)</u> The Laboratory shall be capable of incorporating and launching one Data Re-entry Vehicle with provisions for a second DRV. The capability shall permit: access for placing data into the DRV in an environmentally controlled atmosphere; means for deploying the DRV without adverse effects on the OV; and means for controlling the attitude and time of release."
3-55	3.3.2.2.4.1	<u>Allowable Pressure Differentials</u> Change to read: "Vent paths shall be sized consistent with the design pressure differentials. The allowable pressure differentials on the aft Laboratory Bulkhead are 6.0 to -0.5 psi $(P_{laboratory} - P_{mission\ module})$. The allowable pressure differentials on the Mission Module aft bulkhead are +2.0 to -0.5 psi $(P_{mission\ module} - P_{fwd\ booster\ compartment})$. No flow shall occur from the booster to the Mission Module."

Page	Paragraph	
3-59	3. 3. 2. 2. 5. 2. 1 (SCN-1)	Command (C-4) Add the following sentence: "The capability for flight computer loading at 10 kbps shall be provided."
3-61	3. 3. 2. 2. 5. 2. 2. 3 (SCN-1)	Format Selection Equipment (C-4) Delete the words: "any one of several." Add the sentence: "To simplify flight operations, the number of formats shall be minimized."
3-61	3. 3. 2. 2. 5. 2. 2. 4 (b) (SCN-1)	Recorders (C-4) Delete the second sentence: "The nominal playback rate for stored telemetry is 128 kilobit/sec.."
3-62	3. 3. 2. 2. 5. 2. 4. 4 (SCN-1)	Display and Control (U) Delete the second sentence: "The computer display panel shall consist of all indicators and lights necessary for non-textual communications between the computer and the flight crew."
3-62	3. 3. 2. 2. 5. 2. 4. 2	Computer Subsystem Control Unit Add at the end of the paragraph: "The MPSS computer shall be primary and the Laboratory computer shall be employed as back-up."

Page	Paragraph	
3-63	3.3.2.2.6.2.1	General Add the following: "Equipment located in the Laboratory must be capable of operation for periods of up to two hours in duration with the Laboratory unpressurized."
3-79	3.3.2.2.8.7.2	Under and Over-Voltage Change to read: "Laboratory equipment shall withstand, without damage, continuous voltages from 20-33 volts at its power terminals."
3-110	3.3.5.2.4.3	Crew Performance Tests Delete entire paragraph.
4-6	4.1.2.3	Orbiting Vehicle Requirements Change to read: "An electromagnetic compatibility (EMC) qualification test will be performed at VAFB on the Flight Vehicle in conditions simulating the lift-off R.F. environment. The quality assurance provisions of SSD Exhibit 64-4 shall apply to this test. The mobile service tower shall be removed for this test. In addition, electromagnetic interference (EMI) measurements shall be taken at the Gemini B to Laboratory Vehicle interface and at the Laboratory Vehicle to Launch Vehicle interface after electrical mating of the Flight Vehicle system. Additional monitoring of critical circuits in any segment may be performed as required by the factory EMI test results."

Page	Paragraph	
3-51	3.3.1.2.8	Aerospace Ground Equipment AGE

Add the following paragraphs:

"The electronic AGE for the LVSS and MPSS shall be designed and implemented to permit, but not be limited to:

a) Simultaneous and independent subsystem tests.
b) LVSS and MPSS combined system tests."

"The LVSS and MPSS AGE shall include, but not be limited to, test control consoles, digital computer subsystems, and vehicle interface equipments. The LVSS and the MPSS AGE computers shall be identical and shall permit the execution of test computer programs prepared in the MOL Test Engineer Oriented Language (MOLTOL), and compiled by the appropriate computer prior to their (test computer program's) operational use. Test computer programs utilized at the integration and launch areas shall be functionally identical to those utilized at the factory areas."

"The LVSS and MPSS AGE computer subsystems shall incorporate provisions for direct real-time communications, for both commands and data interchange between identical computer subsystems."

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4. CONTRACT	5. CONTRACTUAL AUTHORITY	FILE OPPOSITE SPEC. PAGE NO.
Program 632A	CCN	2-1

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 2.0 Applicable Documents

Delete entire section (pages 2-1 thru 2-10), and replace with the following two pages.

2.0 APPLICABLE DOCUMENTS (U)

Military specifications, standards, exhibits, manuals, regulations, publications, bulletins, pamphlets, and other documents are herein specified as appropriate to obtain first tier compliance for the MOL System.

MIL-D-70327 (Para. 3.2.1.7.4)	Drawings, Engineering and Associated Lists
MIL-E-5400H (Para. 3.2.1.5.1)	Electronic Equipment, Aircraft General Specification for
MIL-HDBK-300 (Para. 3.2.1.3)	Technical Information File of AGE for Air Weapon System
MIL-M-38310 (Para. 3.3.1.1.1.1)	Mass Properties Control Requirements for Missile and Space Vehicles
MIL-Q-9858A (Para. 3.2.1.7.1)	Quality Control System Requirements
MIL-S-8512B (Para. 3.1.3.5.1)	Support Equipment, Aeronautical, Special General Specification for the Design of
MIL-STD-143A (Para. 3.2.1.1)	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-785 (Para. 3.1.3.1.1)	Requirements for Reliability Program (for Systems and Equipments)
SSD 61-47B (Para. 3.3.9.2.2)	Computer Program Subsystem Development Milestones
SSD 64-4 (Para. 3.2.1.8)	Electromagnetic Compatibility Requirements for Manned Spacecraft, General Specification for
SSD 64-5 (Para. 3.2.2.1)	General Specification for Wiring Harness in Manned Spacecraft

FED-STD-209	Clean Room and Work Station Requirements, Controlled Environment
FED-STD-222 (Para. 3.3.2.2.5.15)	Radiation Standards for Communications and other Information Processing Equipment
AFSCM 375-1	Configuration Management During (All) Phase
SSBD 65-22	Titan IIIM System Performance/ Design Requirements, General Specification, 12 November 1965
NAVSHIPS 250-649-1 (Para. 3.3.2.2.6.2.8)	U. S. Navy Submarine Atmosphere Habitability Data Book, Rev 1, Navy Bureau of Ships
AFWTRM 127-1 (Para. 3.3.2.2.8.7.7)	WTR Range Safety Manual
SSMD-77 (Para. 3.1.1.1.10)	Government Plan for Program Management for the MOL
SAFSL-100004 (Para. 3.3.2.2.9.2)	Structural Criteria for the Manned Orbiting Laboratory (MOL) Laboratory Vehicle System
SAFSL-100002 (Para. 3.1.3.3, 3.1.3.4 & 3.2.2.8)	Environmental Criteria for the MOL System

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

SCN #1

Paragraph 3.0.1 General (S-3 SAR)

Change the fourth sentence of the second paragraph to read:

"Provisions shall be made for conversion of the Orbiting Vehicle at the Laboratory Vehicle contractor's plant, from the Manned-Automatic configuration to the Automatic configuration, within a 4-month pre-launch period utilizing appropriately packaged hardware and software elements.

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.1.1.3.4 Insertion Conditions (S-3 SAR)

Change the last paragraph to read:

It shall be possible to alter insertion parameters within the range of system capabilities as late as three days prior to a scheduled launch, provided the changes do not exceed the re-deployment capability of the down-range elements.

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Program 632A	CCN	3-9

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.1.1.4.3 Flight Crew Transfer (C-4)

Change to read:

Passage of the flight crew between the Gemini B and the Laboratory Vehicle shall normally be accomplished within a pressurized tunnel. Capability of extra-vehicular crew transfer through the Laboratory Vehicle DRV launch tube will be provided as a backup mode.

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Program 632A	CCN	3-10

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.1.1.5.8 Command and Control (Manned-Automatic Configuration) (C-4)

Add the following paragraph:

The OV command and control capability shall use a flight crew of two in a manner consistent with the requirement to reserve the flight crew for functions for which they are especially and uniquely qualified. The system shall be capable of operation by a single crewman with minimum degradation to system performance.

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Program 632A	CCN	3-29

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.3.1.1 General (C-4)

Add the following to the third paragraph (as modified by SCN #1):

Those portions of the AVE designed for on-orbit maintenance shall have features which will facilitate on-orbit fault detection, isolation, and repair; and shall, to the maximum possible extent, utilize common methods of equipment removal and replacement and common tools and checkout equipment. In accomplishing the on-orbit maintenance function, the utilization of the crew capabilities, the AVE design features, and the associated ground equipment and personnel, including the ground-vehicle communications and command links, shall be optimized.

Provisions shall be made, where feasible, for back-up manned modes of operation of equipments to compensate for malfunctions. Degraded performance shall be accepted for these back-up modes when necessary.

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Program 632A	CCN	3-32

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.3.2.1.1 Ground Maintenance Requirements (C-4)

The last sub-paragraph should be modified as follows:

The MOL System and its associated AGE shall be designed for ease of maintenance and shall have features which will facilitate fault isolation and detection in both the AGE and the flight equipment. The MOL System and associated AGE shall be designed for ease in removal and replacement of the major modules and/or components.

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Program 632A	CCN	3-34

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.3.7.2 Ground Safety

Change the first paragraph to read as follows:

The design shall be such that hazards to personnel and equipment during the pre-launch, checkout, and launch operations are minimized.

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Program 632A	CCN	3-45

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.1.1.1.3 Weight and Balance (C-4)

Add the following paragraph:

Weight and balance equipment shall not be required at the MOL launch site. Final weight and balance adjustment for the Gemini B shall be performed at the contractor's facility prior to shipment to the MOL launch site. Final weight and balance adjustment for the Laboratory Vehicle shall be performed during the Mission Module/ Laboratory Module integration and checkout at the Laboratory Vehicle contractor's facility prior to shipment to the MOL launch site.

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Program 632A	CCN	3-46

6. EFFECTIVITY
MOL Program

7. TEXT CHANGE

Paragraph 3.3.1.1.5 Explosive Devices, Squib Simulator, etc.

Add the following paragraph:

AFWTRM 127-1 shall be followed in the design, installation, and checkout of ordnance items. Generally, explosive devices shall be designed to permit installation as late as possible during the pre-launch phase.

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Program 632A	CCN	3-55

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.2.1.5 Mission Module Structure (C-4)

Add the following paragraph:

The Mission Module structure shall support the Mission Payload and protect it from deleterious shock and vibration during powered flights. It shall also, during orbital flight, maintain vibration at a level which will not degrade mission performance below specification requirements. The Mission Module structure shall contain a separation plane at Station 355.

Paragraph 3.3.2.2.3 Data Recovery Capsule (C-4)

Change paragraph title as follows:

Paragraph 3.3.2.2.3 Data Re-entry Vehicle (DRV) (C-4)

Change to read:

For the manned-automatic mode the Laboratory Module shall provide for two Data Re-entry Vehicles (DRV), DRV structural supports, launcher tube assembly, release mechanism, auxiliary electrical and mechanical equipment required to evaluate DRV status, and to control DRV release and separation.

The Laboratory Module shall provide the required space and environmental control for the DRV's. Storage and support for a single DRV shall be provided inside the Laboratory Module and if required, a second DRV shall be contained within the DRV launch tube. The DRV launch tube shall be adequate to contain and support the DRV in the launch, ascent, orbit, and deboost environments. The launch tube centerline shall be oriented 90 degrees to the Orbiting Vehicle roll axis. In the event a DRV does not eject from the DRV launcher, the capability to retrieve the DRV data and to reseal the DRV launch tube shall exist.

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.2.2.3.1 DRV Environmental Control (C-4)

Add the following paragraph:

The DRV and/or launcher tube shall have provisions for controlled venting so that DRV internal pressure does not exceed the external pressure by more than 5 psi when separated from the OV, or in the event of loss of Laboratory Module pressure. Manual pressure relief shall be provided for controlled access to the DRV launcher tube.

Paragraph 3.3.2.2.3.2 Launch Tube Alignment (S-3 SAR)

Add the following paragraph:

The launch tube for the DRV shall maintain the DRV axes of symmetry within $1/2^{o}$ of the Laboratory Vehicle yaw axis. Support and ejection equipment shall have provision for making and checking the alignment.

Paragraph 3.3.2.2.3.3 Pre-launch Testing (C-4)

Add the following paragraph:

At the launch pad, the DRV's, shall be capable of all necessary pre-launch tests as part of an overall system test.

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Program 632A	CCN	3-79

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.2.2.8.7.2 Under and Over-Voltage (C-4)

Revise as follows:

Laboratory equipment shall withstand, without damage, continuous voltages from 20-33 volts at its power terminals and power interruptions up to one second, and shall give specified performance upon return to the equipment operating voltage.

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Program 632A	CCN	3-85/6

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3. 3. 2. 2. 13. 2 Performance (C-4)

Change paragraph to read as follows:

The Laboratory Vehicle System Segment peculiar AGE shall include all of the equipment necessary to transport, handle, store, verify, calibrate, checkout, monitor, record and service the Laboratory Vehicle. This AGE shall be capable of providing a means of verifying the proper operation of the Laboratory Vehicle and identifying areas of failure or operation outside the prescribed limits. In addition, the transportation and ground handling AGE shall be capable of maintaining the Laboratory Vehicle and Mission Payload requirements for temperature, humidity, dust control, and alignment. The Laboratory Vehicle System Segment peculiar AGE shall be capable of integration with the complete MOL system AGE at VAFB. Fault isolation equipment at the launch site will be limited to that equipment necessary to isolate faults to the module or replaceable component level. Detailed fault isolation and failure analysis within modules or components will be conducted at contractor or sub-contractor plants. Portions of the Laboratory Vehicle AGE shall support the Laboratory Vehicle System Segment end-to-end systems test when integrated into the Flight Vehicle checkout system.

Paragraph 3. 3. 2. 2. 13. 3 Alignments

Add the following paragraph:

DRV installation AGE shall have provision for making and checking the alignment of the DRV axes of symmetry (3. 3. 2. 2. 3).

Provisions shall be made so that the alignment of the Mission Module reference axes to the Laboratory Module reference axes can be measured to within one minute of arc. (This is not to imply that the alignment shall be within one minute of arc).

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.4 Mission Payload System Segment

Delete entire page and replace with the following 10 pages.

3.3.4 Mission Payload System Segment

The Mission Payload System Segment shall be composed of the Mission Payload equipment contained in the unpressurized Mission Module and the Mission Payload control equipment contained in the Laboratory Module. Detailed specifications of the Mission Payload will be provided under separate cover.

3.3.4.1 Allocated Performance and Design Requirements

Effectiveness requirements for this segment are specified in paragraph 3.1.3.1.2.

3.3.4.1.2 Weight

The weight allocation for this segment is specified in paragraph 3.3.1.1.1.

3.3.4.1.3 Electrical Power

The electrical power allocation for this segment is specified in paragraph 3.3.1.1.2. The allocation per referenced paragraph shall be supplied to the Mission Payload System Segment by the Laboratory Vehicle System Segment.

3.3.4.1.4 Alignment

There shall not be a requirement for alignment equipment at the launch base. Final alignments and adjustments shall be performed during the Mission Module/Laboratory Module integration and checkout prior to shipment to the launch base.

3.3.4.2 Peculiar Performance and Design Requirements

3.3.4.2.1 Structure and Thermal Control Subsystem

3.3.4.2.1.1 Mission Module Structure Design

The Mission Section contractor shall determine the design requirements for the Mission Module structural shell based upon critical ground and orbital mission requirements. (The Laboratory Vehicle contractor will perform the final design of the Mission Module shell, based on these MPSS requirements and predicted launch flight loads).

3.3.4.2.1.2 Support Structures

Supporting structures shall be provided for mounting MPSS equipment in the Laboratory Module and in the Mission Module. Protection shall be provided for the equipment to withstand handling, transportation, launch, and orbit loads. The following major load excitation sources shall be considered in the design of MPSS Support Structures:

Transportation:	Shock and Vibration
On-Pad:	Winds and Overpressure
Launch:	Acoustic, Transient Shocks, Sustained Acceleration and Vibration
On-Orbit:	Data Re-entry Vehicle Launch, ACTS Maneuvers, and Gemini B Separation

The load levels for the above are specified in SAFSL-100002, Environmental Criteria for the MOL System.

Provision shall be made for installation, inspections, and replacement of equipment as required. Factors of safety shall be applied such that the structural elements will have sufficient strength to withstand (simultaneously) limit loads, applied temperature, and other accompanying environmental phenomena without excessive elastic or plastic deformation. The factor of safety to be employed is 1.40.

3.3.4.2.1.3 Thermal Control

MPSS temperatures for equipment shall be maintained within their specified limits of both level and gradient by a combination of selected coatings, insulation, and zoned heater control, active thermal control shall be employed only where passive control proves inadequate.

Ground conditioning during all phases of ground test (factory system test and pad operations) shall employ internal ducting, supplemented electric heating as required to maintain required thermal control of the AVE.

3.3.4.2.2 Navigation and Control Requirements

(Includes Communications, Command & Instrumentation)

The Navigation and Control Subsystem (NCS) shall provide for the Mission Payload System Segment communications, command, control and instrumentation requirements. It shall utilize the Laboratory Vehicle computer and SGLS for data processing and air to ground communication.

3.3.4.2.2.1 Navigation Requirements

The Navigation and Control Subsystem shall determine the position of the Orbiting Vehicle by computer interpolation of ephemeris data from the Satellite Control Facility (SCF). The SCF data shall be up-dated at intervals not to exceed four revolutions. Expected orbit prediction accuracies from the SCF are as follows:

Error (1σ)	Revolutions after End of Orbit Determination Span		
(n. mi.)	0	2	4
in-track	0.15	0.25	0.50
cross-track	0.04	0.06	0.12
radial	0.04	0.06	0.12

The subsystem shall provide for the on-board measurement and processing of longitudinal accelerations to improve orbit prediction accuracies. A star acquisition and tracking system (SATS) shall be integrated into the MPSS. Based on the above navigation accuracies, the SATS shall establish the attitude of its mounting axes with respect to the local vertical and the orbit plane with 2σ errors no greater than 1.5 arc min. Prior to star acquisition, navigation data from the SCF and ACTS data (Orientation and rate) shall be utilized by the computer, and through the command loop, point the axis of the star trackers to the line of sight to the star with an error no greater than 2°. The reliability of the SATS for the 30 day mission shall be 0.95.

3.3.4.2.2.2 Command

The functions performed by this element shall be achieved in the Mission Data Adapter Unit (MDAU). This unit shall provide the interface between the on-board computer and other MPSS equipment.

Future commands shall be stored in the computer identified by a time label. The time label shall be continuously compared against incoming system clock time. The least significant character of the time label shall be 0.001 second. The MDAU shall decode discrete commands from the computer. Each decoder shall be separately addressable.

The command element shall be capable of receiving real time commands from the crew or from the ground via the SGLS and the computer, and processing them to the affected subsystem.

3.3.4.2.2.3 Instrumentation and Telemetry

Instrumentation power supplies, analog to digital converters, and multiplexers shall be provided in the MPSS to prepare telemetry for the main multiplexer in the LVSS. The instrumentation points shall be assigned so that no single failure will prevent ground receipt of critical instrumentation required for control of the MPSS.

The interface between the MPSS and LVSS shall consist of a minimum number of wires required for the serial transmission of orbital telemetry information. A capability for the convenient addition of instrumentation shall be provided.

3.3.4.2.3 Electric Power and Signal Distribution Subsystem

MPSS equipment shall be designed to give specified performance when operated with 22 to 31 vdc at the equipment power terminals.

MPSS equipment shall withstand, without damage, continuous voltages from 20 to 22, and 31 to 33 vdc at their power terminals without damage.

MPSS equipment shall be capable of withstanding power interruptions up to one second and shall give specified performance within 30 seconds after return of the equipment to operating voltage of 22 to 31 vdc at their terminals, providing the timing signal is restored/retained correctly.

a. The functions to be performed by the MPSS EPSD subsystem are as follows:

   (1) Condition, distribute, monitor, measure and switch electrical power.

   (2) Distribute electrical signals.

   (3) Protect the power source from equipment malfunctions.

   (4) Provide secondary power sources to protect against power interrupts and excursions of primary bus voltage outside of specified regulation.

   (5) Incorporate EMC into the MPSS.

b. The performance requirements are as follows:

   (1) Selectively connect the user subsystems load to either the Mission Payload Power Interface (MPPI) or the AGE source of electric power.

(2) Remove the subsystem loads from the MPPI under full load conditions.

(3) Condition the power obtained from either source to provide functions of inversion, conversion and regulation.

(4) Distribute power to the loads so that the voltage at the equipment terminals is not less than 22 vdc.

(5) Program the automatic switching of power for loads that are supplied in an established sequence.

3.3.4.2.4 Consoles and Displays Subsystem

The MPSS Consoles and Displays (C&D) subsystem shall be designed:

a. To allow payload operation by a single operator, and two operators.

b. To conform with the basic console appearance design established by the Laboratory Vehicle contractor.

c. Such that sub-modules of the consoles can be installed and removed through a 32 in. clear circular hatch in the side of the Laboratory Vehicle.

d. To accommodate those elements of the Mission Section subsystems which are mounted in or on the consoles.

e. To allow for crew operation of the mission equipments and supporting peripheral equipment.

f. To allow for the display of critical diagnostic data from the peripheral equipment for monitor and alarm purposes.

g. To allow for the display of mission data for evaluation by the crew.

3.3.4.2.5 Data Re-entry Vehicle Subsystem

3.3.4.2.5.1 General Requirements

Manned-Automatic Configuration

The Data Re-entry Vehicle subsystem (DRVS) shall include one Data Re-entry Vehicle (DRV), release mechanism, and auxiliary electrical and mechanical equipment required to evaluate DRV status, and to control DRV release and separation. Provisions shall be made to incorporate a second DRV.

3.3.4.2.5.2 Retro-Rocket Ignitor-Installation

If required, because of shipping regulations, the DRV's shall be designed to allow installation of the ignitors in the rocket motors at the Launch Complex without dis-assembling the DRV, and without invalidating any previous testing. However, electro-explosive devices, i.e., initiators, shall be shipped separately and installed at VAFB at the latest practicable time compatible with safety and operational requirements.

3.3.4.2.5.3 DRV Environmental Control

The environmental control shall maintain the internal DRV temperature within $70^{\circ}\,{}^{+20^{\circ}}_{-30^{\circ}}$ F. This will be accomplished, using both passive and active thermal control as required.

The DRV and/or launcher tube shall have provisions for controlled venting so that DRV internal pressure does not exceed the external pressure by more than 3 psi when separated from the OV or in the event of loss of Laboratory Module pressure. Manual pressure relief shall be provided for controlled access to the DRV launcher tube.

3.3.4.2.5.4 Pre-Launch Testing

At the launch pad, the DRV subsystem shall be capable of all necessary pre-launch tests as part of an overall system test while fully assembled and mated with the Laboratory Module.

3.3.4.2.5.5 Data Re-entry Vehicle (DRV)

The DRV shall be the Mark V.

a. General

(1) The DRV and its components will be designed and qualified to withstand at least 60 days in a vacuum space environment without degrading its subsequent operational capability or reliability, and be capable of being deboosted from any position on the orbits defined in paragraph 3.1.1.1.4.2. The DRV shall not significantly contaminate the Laboratory Module liveable environment with toxic products. Contamination shall be avoided by the proper selection of DRV materials or prevention of outgassing of toxic materials. The DRV will provide thermal and environmental protection for its payload during launch, orbit, and re-entry operations; and will supply status data via telemetry. Its capabilities shall include: preparation for de-orbit and separation from the DRVS support structure, re-entry and recovery.

(2) After separation and spin-up, the DRV will deboost itself from orbit by firing the retro-rocket, and despinning, if required, to a rate which will allow the proper re-entry angle and proper parachute deployment. The deboost operation shall result in no damage or detrimental effects to the Orbiting Vehicle. Approximately at the time of separation, the DRV will commence transmitting an RF signal modulated to provide minimum operational decision data and which will act as a tracking and retrieval aid. A redundant tracking aid shall be required. This deboost must also be successful from the emergency mode attitude limits, including both N-S and S-N re-entry.

(3) After re-entry, the DRV will descend via a parachute designed for aerial retrieval. The descent rate at 10,000 feet will not exceed 25 ft./sec. under standard atmosphere conditions. DRV primary and secondary recovery modes shall be aerial and water, respectively.

(4) The DRV will survive water impact, and the retrieval aids will remain active for a minimum of 10 hours. The DRV will continue to float for a minimum of 50 hours, with the sink system flooding and sinking the capsule after a maximum of 90 hours in the ocean.

(5) The DRV shall contain a system for self destruction if it does not re-enter within a designated area.

b. Data Re-entry Vehicle Separation

The DRV separation and push-off subsystem are to be considered part of the DRV subsystem. The DRV shall be ejected so as to place it in the correct attitude, and then spin stabilized prior to ignition of the retro-rocket.

c. Deboost and Re-entry Dispersions

At DRV separation, with the OV under the control of the primary stabilization system, the impact point of the DRV shall be within a rectangle $\pm$ 75 nm in-track and $\pm$ 8 nm cross-track (three sigma). Impact is defined as the latitude and longitude of the DRV upon descending to 50,000 ft. In the case where the vehicle is in the emergency mode, the acceptable dispersion rectangle will be increased by a factor of 2 in each dimension.

d. DRV Electrical Subsystem

Power required in the DRV shall be supplied by the EPSD subsystem of the Mission Payload System Segment until the battery has been activated. The DRV will require no more than two electrical signals to prepare it for deboost.

The electrical design of the DRV subsystem, consisting of harnessing and components to control and monitor the DRV status and separation, shall meet the electrical design requirements of Section 3.2.

e. Telemetry

The DRV shall provide monitors for bettery voltages and temperature, heat shield temperature and loop continuity. DRV sequencing and discretes will be monitored by beacon modulation after DRV separation.

3.3.4.3 Functional Interfaces

(Functional interface documents shall be listed here, when defined and approved in accordance with IFS-MOL-100001).

3.3.4.4 Contract End Items

(The Contractors shall provide for incorporation in this paragraph, a list of the Contract End Items by CEI specification number, nomenclature, and the CEI into which it installs. This paragraph shall list all end items being provided under these system segments).

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Program 632A	CCN	3-110

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.5.2.4.3 Crew Performance Tests

Delete entire paragraph.....

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.9.1.7.3 Command (C-4)

Change first sentence to read as follows:

"Commands to the Gemini B shall up-date displays and the computer."

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.9.1.9.5 Data Flow, Computation, and Display (C-4)

Add the following at the end of the section (as modified by SCN #3):

The capability to up-date the orbit determination and ephemeris prediction every orbit revolution shall exist in the software.

The capability to transmit up-dated orbit parameters to the vehicle within one orbit revolution of receipt of the tracking data for the orbit up-date shall exist, provided a SCF tracking station is available.

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Program 632A	CCN	4-6

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 4.1.2.1 General Requirements

Change fourth sentence from:

"Limited qualification tests such as thermal-vacuum and EMI, shall be performed on the development test article at the system segment level."

-to read:

"Qualification tests shall be performed on qualification test articles at the system segment level."

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.0.4.2 Target Access

Add the following to the paragraph:

It shall be an operational requirement to photograph as many targets as possible consistent with high quality stereo photography.

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.1.4.3 Command and Control

Delete entire paragraph entitled "Manned - Automatic Configuration".

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.1.4.4 Mission Orbital Envelope

Revise first sentence to read:

The altitude range for photography shall be 70 to 230 n. mi.

Paragraph 3.3.1.4.6 Target Acquisition

Paragraph misnumbered. Should be 3.1.1.4.6.
Change the first sentence to read......

The target acquisition system (exclusive of the crewman) shall be capable, with 95 percent probability, of automatically acquiring the target and holding the aiming error to less than 0.2° exclusive of target location error throughout the range of $\pm 30^{\circ}$ in track and $\pm 40^{\circ}$ cross track.

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Program 632A	CCN	3-16.5

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.1.1.4.11 Security of Operations

Insert the following addition prior to the existing paragraph.

Provisions shall be made for the protection of materials revealing the Dorian aspects of the MOL system during launch, through recovery and subsequent disposal of the Laboratory Module and Mission Payload. Particular emphasis shall be placed on safeguarding target location information.

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.1.5.2 Malfunction Operations (Manned-Automatic Flights)

Revise entire section to read......

To permit obtaining maximum useful performance data on the Mission Payload under flight conditions, the Orbiting Vehicle shall be designed so that operations of the Mission Payload hardware shall be possible if the flight crew cannot enter the Laboratory Vehicle for safety or other reasons. It is not intended that major design pertubations be required to implement this requirement, nor that all Mission Payload hardware be operable. For example, the above shall not require that unmanned operational capability be provided for hardware for which only manual operation by the flight crew is feasible. Return of useful photographic data shall not be a requirement.

Paragraph 3.3.1.5.3 Mission Payload Ground Handling

Delete this section and replace with the following........

Paragraph 3.3.1.5.3 Support Module (Automatic Mode)

For automatic mode operations, the Gemini B shall be replaced by a Support Module (SM). The Support Module shall serve as the nose fairing of the flight vehicle and shall be designed to withstand the launch and ascent environment. Provisions shall be made to carry and launch six Data Re-entry Vehicles (DRV's).

The design of the Support Module shall be such that additional propellants for 40 day missions can be accommodated, (see 3.0.1).

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.2.5.1 Space Allocation Requirements

Delete from the 6th line......wideband transmitter and antenna

Paragraphs 3.3.2.5.2 through Paragraph 3.3.2.5.5

Delete existing paragraphs.

Add the following paragraphs:

Paragraph 3.3.2.5.2 Environmental Requirements

The Laboratory Vehicle shall provide an environment such that the camera platens can be maintained at a temperature ________F. Film temperatures shall be maintained at a temperature of $70^\circ {}^{+20^\circ}_{-30^\circ}$ F. The relative humidity within the Laboratory Vehicle shall be such that condensate will not form on the film.

Paragraph 3.3.2.5.3 Accessibility Requirements

The Laboratory Module interior shall be arranged for crew access to perform the following mission oriented tasks:

a. Film installation in the DRV's or film removal from the DRV's.
b. Exchange of film cassettes.
c. Operating and servicing of the film processor.
d. Transfer of the DRV from the storage location to the launch tube.
e. Spare parts installation or other required maintenance and servicing.

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6. EFFECTIVITY
MOL Program

7. TEXT CHANGE

3.3.2.5.4 ACTS Requirements

a. Maneuvering Capability

The ACTS shall have the capability of orienting the Orbiting Vehicle to any pitch attitude. During pitch maneuvers, the pitch attitude determination accuracy shall be allowed to degrade, over that specified in 3.3.2.2.7.4.1, to a maximum (probability .95) of 2% of the commanded angle change. The system shall be capabile of settling within 30 seconds from the end of a maneuver down to within the accuracies specified in 3.3.2.2.7.4 prior to commencement of photographic operation.

b. Photography on and off Signal

During a photographic sequence, the MPSS shall provide a signal which may be used to inhibit the ACTS. Following the last photographs of a given target (or cluster of targets), an end-of-photography signal will be provided which may be used to enable the ACTS until the start of photography on the next target. During this between target period, not more than three seconds shall be required for the attitude control system to settle to within attitude and attitude rate specifications.

c. Attitude and Rate Control during Photography

At no time during photography (with probability 0.95 or better), shall the angular deviation of the coordinate axes at Station 500, relative to the Local Vertical/Relative Velocity Vector, exceed the following:

Pitch ± 2.0 degrees
Roll ± 2.0 degrees
Yaw ± 1.0 degrees

Similarly, the three combined axes attitude rate shall not exceed 0.015 degrees per second (with a probability of 0.95).

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6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

3.3.2.5.5 Mission Module Structure

The forward section of the Mission Module structure shall contain an aperture, approximately 12 feet long by 130 degrees, through which the target will be viewed. During transport and launch, this opening shall be covered by an ejectable door.

Separation devices for items such as the ejectable door, when activated, shall not cause damage to the payload and peripheral equipment, mis-align equipment outside adjustment capability, or cause contamination of sensitive equipment to occur.

3.3.2.5.6 Decryption Requirements

Data of an encrypted nature received from the MCC (via tracking stations) shall be circulated through government furnished decryption equipment by the Laboratory Vehicle Command Subsystem prior to its dissemination to either Laboratory or Mission Payload Segments.

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Program 632A	CCN	3-104.1

6. EFFECTIVITY
MOL Program

7. TEXT CHANGE

Paragraph 3.3.4 Mission Payload System Segment

Delete entire section 3.3.4 (Pages 3-104.1 through 3-104.33) and replace with the following ____ pages.

SPECIAL HANDLING

3.3.4.5 Mission Payload System Segment

(Note the green pages under Section 3.3.4 supplement the white pages).

The forward portion of the Mission Module Structure shall house the tracking mirror and be termed the TM Bay. The aft portion of the Mission Module Structure shall support the Camera Optical Assembly and be termed the COA Bay.

The Mission Payload System Segment AVE shall be composed of two sections as follows:

a. Mission Section

This section shall consist of the following AVE subsystems:

(1) Structures and Thermal Control (TM Bay)
(2) Navigation and Control (NCS) (Includes Communication, Command and Instrumentation)
(3) Electric Power and Signal Distribution
(4) Consoles and Displays (Manned-Automatic only)
(5) Data Re-entry Vehicles
(6) Terrain Camera
(7) Acquisition
(8) Automatic Support

b. Photographic Section

This section shall consist of the following AVE subsystems:

(1) Structure and Thermal Control (COA Bay)
(2) Camera
(3) Primary Optics (Camera Optical Assembly and Tracking Mirror)

(4) Visual Optics (Manned-Automatic only)

(5) Film Handling

(6) Electrical and Instrumentation

(7) Film Processor (Manned-Automatic only)

(8) Image Motion Detector

(9) Automatic Support

3.3.4.5.1 Allocated Performance and Design Requirements

The effectiveness allocation of the Mission Payload System Segment for the total mission shall be apportioned as follows:

	Manned-Automatic	Automatic
Mission Section		
Photographic Section		
Combined Effectiveness	.95	.80

3.3.4.5.1.2 Weight

Within the Mission Payload System Segment, the maximum design allocations of weights shall be as follows:

	Manned-Automatic	Automatic
Mission Section	2800	
Photographic Section	5633	
	8433 lb.	8320

3.3.4.5.1.3 Electric Power

Mission Section		
Photographic Section		
	500 watts	

3.3.4.5.1.4 On Orbit Alignment

It shall be a requirement that precision alignment of the main optics and camera be capable of being performed automatically in orbit. A capability shall be provided in the Manned-Automatic mode for disabling the automatic feature and for either the crew to perform precision alignments of the main optics and camera, or for the alignments to be made by ground command.

3.3.4.5.1.5 Design Considerations

Mission Payload System Segment design criteria shall be such as to minimize launch base test requirements and to maximum payload security.

3.3.4.5.1.6 Flight Termination System

There are no functional flight termination system requirements for the Mission Payload. Launch abort and equipment recovery will include security provisions for Mission Payload System Segment equipments (e.g., target cues).

3.3.4.5.1.7 Torque Disturbances

The torque disturbances due to outgassing, magnetic materials, and other sources of external OV torque associated with mission equipment shall not exceed 0.25 ft. lbs. or a total of 5×10^4 ft. lbs. sec. for the 30-day mission. The torque disturbances due to internal Mission Payload moving parts shall not cause changes in OV angular momentum which exceeds the following during the period beginning one minute before and ending immediately after an active photographic pass:

Yaw angular momentum	$\pm$ 25 ft. lb. sec.
Pitch " "	$\pm$ 25 ft. lb. sec.
Roll " "	$\pm$ 25 ft. lb. sec.

The maximum moment imposed on the OV by torquers within the Mission Module shall be:

Roll	TBD ft. #
Pitch	TBD ft. #
Yaw	TBD ft. #

3.3.4.5.2 Peculiar Performance and Design Requirements (Mission Section)

The Mission Section AVE subsystem design requirements presented in this section supplement those contained in 3.3.4.2 of the white pages. The Photographic Section AVE subsystem design requirements are presented in 3.3.4.5.3.

3.3.4.5.2.1 Structure and Thermal Control Subsystem

3.3.4.5.2.1.1 Mission Module Structure Design (TM Bay)

The TM Bay shall house the tracking mirror and its supporting gimbal, the thermal door assembly with its associated bellows and environmental doors, ejectable door, star tracker door, mission section electronic equipment, heaters, AGE cooling ducts, test connectors, and access doors.

3.3.4.5.2.1.2 Support Structures

Supporting structures shall be provided for housing and/or mounting the Mission Section equipment in the TM Bay and the following MPSS equipment in the Laboratory Module:

a. Mission Section Consoles and Displays

b. ATS mounts (2)

c. Visual Optics mounts

d. Terrain Camera mounts

3.3.4.5.2.1.3 Thermal Control (TM Bay)

The Mission Section Thermal Control Subsystem shall maintain the temperature of the Tracking Mirror and other equipment installed in the TM Bay within specified limits. In fulfillment of this requirement, use shall be made of coatings, insulation, heaters and environmental doors.

3.3.4.5.2.1.3.1 Ground Conditioning

Immediately prior to launch (T-48 hours), the ground conditioning system, in conjunction with the AVE temperature control system, shall provide on orbit temperature conditions. The requirement shall be that the internal temperatures on the ground shall be within the expected orbital flight tolerances. Prior to this time, the limits may be extended provided no irreversible affects occur. (See 3.3.4.6.4 for AGE requirements)

3.3.4.5.2.1.3.2 Powered Flight

The thermal control subsystem shall be activated prior to launch to achieve and maintain optics temperatures at orbital design values.

3.3.4.5.2.1.3.3 Orbital Flight

The Thermal Control System shall maintain the photographic section equipment at a temperature that will provide specified system performance. Gradients shall be controlled so that resolution of the image will not be degraded below specification performance.

3.3.4.5.2.2 Navigation and Control Subsystem (NCS)

3.3.4.5.2.2.1 General

The Navigation and Control Subsystem shall provide for control of the camera, acquisition scopes, tracking mirror, and thermal doors using stored commands and computations provided by the computer. Requirements for communication, command, and instrumentation are included herein.

The NCS shall employ the Computer Subsystem specified in paragraph 3.3.2.2.5.2.4. The NCS shall receive an ephemeris table and the position of the targets as earth referenced coordinates for calculation of pointing angles. The NCS shall be designed to support the Mission Payload System Segment in either the manned-automatic or automatic modes. The NCS shall be capable of servicing a tracking station pass coincident with photographic operations.

3.3.4.5.2.2.2 Target Acquisition and Selection (Manned-Automatic)

The NCS shall provide closed loop control of the Acquisition and Tracking Scopes (ATS). The control interface shall be similar to that provided for the primary tracking mirror. Manual controller inputs shall be accepted from the crew to slew the ATS in the manned search mode for target centering or for minimization of tracking rate errors. It shall be possible for the crew by activation of a switch, when a target is centered and its apparent motion minimized, to up-date the position and rate information utilized by the NCS. Each crewman shall have a capability to control either of the acquisition scopes by an appropriate target transfer operational sequence. The design shall be such that it is impossible for both crewmen to simultaneously control the same acquisition telescope.

Alternate targets (or target clusters) shall be available to the crew to permit the circumvention of weather. The selection of options for the target or cluster following any given target or cluster shall be prepared at the Mission Control Center. The target options shall be transmitted to the vehicle either as earth referenced coordinates, or as designators of targets stored in the vehicle.

Controls shall be provided for the designation of targets by the crew and for their comments relating to the estimated quality of the photography.

The NCS shall provide open loop commands to the target cue system. These commands shall result in the automatic presentation of the target cueing aids required by the crew to center the targets or properly position the offset reference.

3.3.4.5.2.2.3 Main Optics Tracking

The NCS shall provide closed loop control of the tracking mirror. The tracking mirror shall be capable of pointing the line-of-sight $\pm 40^\circ$ in roll (left and right of the X-Z plane), 30° forward in pitch and 40° aft in pitch. The tracking mirror shall be gimballed in two axes and be servo driven to slew, follow computed target tracking rates, and respond to position and rate change inputs inserted by an image motion detector or by a member of the crew, utilizing the same hand controller used to train the ATS during target acquisition.

The accuracy and resolution of the digital interface with the motors and instruments shall be designed for compatibility with the mirror servo-mechanisms. During a single forward to rearward track, the NCS shall provide for mono or stereo photography of a single target or a target cluster. Target cluster requirements are specified in Section 3.3.4.5.2.2.5.

3.3.4.5.2.2.4 Minimum Time Between Targets

The time in seconds between adjacent targets achievable by the system shall be no greater than $\frac{\Delta \Sigma}{12} + 3$ or $\frac{\Delta \Omega}{6} + 3$ seconds, which ever is larger, where $\Delta \Sigma$ and $\Delta \Omega$ are the stereo and obliquity angle changes, respectively, in degrees commanded between targets.

3.3.4.5.2.2.5 Sequential Control

The NCS shall provide for the sequential control of the Mission Payload System Segment. This function shall include the execution of real time commands within one second of their receipt, and the execution of stored commands within 200 msec. of the time indicated by their associated time label. Stored commands shall be employed for housekeeping tasks not directly related to photography.

During a single forward to rearward motion of the tracking mirror, the NCS shall sequence the events required to photograph a single target, or a cluster of targets. When photographing target clusters, the available time and camera cycle constraints may limit photography to the one exposure setting calculated by the NCS using sun angle and scene content information. The cluster or target definition provided by the ground shall specify the exposure ground rule, stereo angle, and specific target for each frame. Clustered targets may be defined as offsets to the first target in the cluster to be photographed.

Manned-Automatic Version

When photographing a target cluster, manual hand controller input correcting position for the first frame shall apply to all targets in the cluster. Rate corrections shall be accepted throughout the sequence.

3.3.4.5.2.2.6 Thermal Door Control

The NCS shall control the thermal door servos. The door positions shall be controlled to limit the heat energy entering the tracking mirror bay without obstructing the light from the target by more than 2%.

3.3.4.5.2.2.7 Camera Control

The Navigation and Control System (NCS) shall provide open loop adjustments and commands, and off-axis Image Motion Compensation (IMC) control. The open loop adjustments shall include exposure slit width, focus setting for slant range, and settings for cross-format image motion compensation. Commands shall include camera choice (primary or secondary) and a start exposure signal. Calculations required for off-axis IMC shall be performed by the NCS.

In the Manned-Automatic Configuration, camera override controls shall allow inhibiting of programmed exposures, manual camera selection, and initiation of exposures during non-programmed periods.

The camera may take a sequence of up to ten photographs of each target, nominally within approximately + 15 to -15 degrees fore and aft (stereo) angeles. Normally, three different exposure settings shall be used for each target. The nominal sequence rate shall be 1 frame per second.

The focus sensor shall provide signals correlating with the apparent error in focus for the scene under observation. Open loop operations shall be provided by recording focus error signals for ground analysis and subsequent platen commands in all modes. In addition, the Manned-Automatic mode shall have open loop focus capability which can be controlled by the crew.

The NCS shall provide information to telemetry and to the camera for use by the data lamps. This information shall include a convenient rev and frame identifier; system time, accurate to one millisecond, which can be sampled by the camera for recording time of exposure; exposure setting; across-the-format IMC settings; and information allowing the determination of the angle between the LOS to the target and the local vertical with an error no greater than 2 minutes of arc (2 sigma).

Manned-Automatic Version

The NCS shall provide control signals to select the film to be positioned for each exposure.

3.3.4.5.2.2.8 Image Motion Compensation (IMC)

By further processing the orbit ephemeris information and accelerometer inputs, the image motion shall be determined to sufficient accuracy to reduce the image rate at the center of the format to that required by 3.1.1.4.7. The NCS shall provide information to the Image Motion Detector (3.3.4.5.3.5.8) equating to a V/H error no greater than one percent. The Image Motion Detector shall return error signals proportioned to the in-track image motion and the cross component resulting from yaw error. These error signals shall be fed, as correction signals to the main optics tracking mirror control loop, to reduce the image motion.

Manned-Automatic Configuration

Manual hand controller inputs shall be accepted from the crew to correct image rates. These corrections shall apply to the orbit reference, and affect following targets. The use of either the image motion detector inputs or primary optics viewing and hand control inputs for tracking mirror control shall be a crew option.

Provisions shall be made for manual hand controller inputs when computer aiding is partially or completely deleted because of malfunction.

3.3.4.5.2.2.9 Alignment Monitor Set

The NCS shall include an alignment monitor set which shall monitor relative alignments between the main optics, star tracker, and tracking mirror. Pointing errors due to vehicle thermal distortions and motions of the optical barrel in its mount shall be minimized by the computation and provision of correction signals to the ATS and tracking mirror control loops.

3.3.4.5.2.2.10 Communications and Instrumentation

Two data services shall be provided for MPSS telemetry from the NCS computer: real time diagnostic data and a stored mission reporting service.

Real time diagnostic data shall be provided at a rate between one and five kilobits per second. These data shall contribute to the analysis of control system performance. This diagnostic data shall include all control signals interfacing with the computer software.

The mission reporting service shall provide a summary of system operation during the photographic pass. This service shall be provided at a rate between 500 and 1200 bits per second to permit direct transfer to data lines between the tracking station and the Mission Control Center. Operational data on each photograph shall be included. In addition, critical instrumentation data shall be reported as a backup to the vehicle telemetry recorder/SGLS ground station/SCF data processing system.

The NCS shall accept data from the MCC (via tracking stations) as specified in Section 3.3.2.2.5.2. Data required by the NCS shall be organized into words and blocks of words. Both the words and blocks shall be tested for validity.

For all possible conditions of communications noise, the coding shall assure that distorted data is not acted upon by the NCS. As a secondary requirement, the coding shall assure efficient information transfer with any bit error rate less than 10^{-3}. Coding used for command feedback (telemetry verification) shall permit continuation of a block after experiencing a temporary loss of telemetry reception.

Although the up-link command rate is 1 kbps, NCS equipment shall be designed to accept data at a 10 kbps rate. Coincident photographic operations are not required when accepting data at 10 kbps. Efficient operation of 10 kbps is not required at bit error rates greater than 10^{-5}.

3.3.4.5.2.2.11 Data Readout Assembly (Manned-Automatic)

A readout assembly shall be provided for the transmission of photographic information to the ground at a rate of 20 mbps and compatible with the SCF S-band data link. The primary requirements for this system are quality, reliability, and security. The data readout subsystem shall interface with the Laboratory Module communication subsystem for transmission.

3.3.4.5.2.2.11.1 Resolution

As a design objective, the data readout subsystem shall scan and transmit pictures with no loss in resolution. It is required that the loss in photographic resolution due to scanning and digitizing shall be no greater than 20 percent.

3.3.4.5.2.2.11.2 Quantity

The readout subsystem shall read out the maximum area of photographic material consistent with the other requirements in Section 3.3.4.5.3.7. The subsystem shall scan and transmit 5 square inches in 4 minutes.

3.3.4.5.2.2.11.3 Operational Employment

Operation of the readout subsystem shall require a minimum of the crew's time. The scanner shall accept portions of various pictures which have been edited by the flight crew.

Crew assistance shall not be required during the readout station pass. Readout will be performed only at stations equipped with advanced SGLS. Stations equipped for readout shall be the New Hampshire Station, the Vandenberg Station, the Hawaii Station, and the __________ Station. It shall be a design objective to record data in encrypted form at the tracking station, and process the encrypted data at user facilities.

3.3.4.5.2.2.12 Reliability

The NCS shall be designed to survive failure such that after any single failure, the NCS shall be capable of supporting a productive mission. Redundancy shall be utilized and it shall be a design objective that this redundancy be achieved with a minimum of additional equipment configured so that failure may reduce capability, but not abort the mission.

The design of the NCS and the arrangement of the equipment shall be such that each of the redundant elements will be able to be tested and checked individually.

3.3.4.5.2.3 Electric Power and Signal Distribution Subsystem

The Mission Section EPSD subsystem will receive power from the Laboratory Vehicle and distribute it to the Photographic Section and to the various Mission Section subsystems.

3.3.4.5.2.4 Console and Displays Subsystem

The Mission Section Consoles and Displays shall be designed to enhance the crew contribution in obtaining the greatest number of high quality photographs on a timely basis. Appropriate controls and displays shall be provided to permit the crew to utilize these equipment design features incorporated for degraded operational modes.

The Mission Section Consoles and Displays subsystem equipment shall be located in Consoles 8, 1, 2 & 3. Consoles 2 and 8 provide the controls and displays to accomplish the acquisition, tracking and photography of targets. Console 1 contains the camera, the camera focusing and alignment controls, the film cassette, and the film status displays. Console 3 contains the film processing and readout equipment.

Various other controls and displays shall be appropriately grouped in Consoles 1, 8, 2 and 3 for accomplishing and/or displaying various other functions, including the following :

(a) Power switching for various mission equipments (star tractor, V/H sensor, voice recorder, terrain camera, etc.)
(b) DRV Control panel
(c) Thermal door position and main mirror position display
(d) Digital and/or analog displays of target prority, time to next photo exposures
(e) Master warning and master caution lights for mission equipment status information.

3.3.4.5.2.5 Data Re-entry Vehicle Subsystem

(The requirements given below supplement those contained in 3.3.4.2.5 of the white pages.)

3.3.4.5.2.5.1 General Requirements

Automatic Configuration

In the Automatic Configuration, six DRV's shall be carried in the Support Module. The requirements to convert from the Manned-Automatic to the Automatic Configuration are given under the Automatic Support Subsystem. The DRV used in the automatic mode shall be the same type used for the Manned-Automatic mode. Each shall have the capability of returning 58 lbs. of primary record and 4 lbs of terrain film.

3.3.4.5.2.5.2 DRV Environmental Control

The relative humidity shall be controlled so that no condensate will form on the film.

Automatic Configuration

The DRV and film chute shall be pressure sealed as necessary, so that the Laboratory Module pressure can be maintained at 5.0 psia.

3.3.4.5.2.6 Terrain Camera Subsystem

The 70 mm terrain camera shall be provided to the Mission Section Contractor as GFE. The camera shall be mounted internally on the underside of the Laboratory Module forward of the acquisition scopes. An optical window and camera attachments shall be incorporated into the Laboratory Module shell. Protection shall be provided as necessary to preclude degradation of the optical properties of the window during powered flight. The camera shall contain sufficient film for two exposures of every target photographed by the main camera. Exposed terrain carmera film shall be returned to earth, via the Gemini B in the Manned-Automatic mode and via the last (6th) DRV in the Automatic mode.

3.3.4.5.2.7 Acquisition Subsystem (Manned-Automatic)

The Acquisition subsystem shall perform the following functions:

a. Provide means to observe the ground and to recognize and track up to two targets simultaneously.

b. Provide cueing materials to assist crew in target location.

c. Provide displays at each reconnaissance console and means to transfer displays and control between consoles.

All Acquisition subsystem components (except buried cables) shall be designed for removal during conversion from Manned Automatic to Automatic mode.

3.3.4.5.2.7.1 Acquisition and Tracking Scopes (ATS)

Two acquisition and tracking scopes are required. The optical axes of the scopes shall be capable of being trained from + 70° to -40° in-track, and ± 45° cross-track. The NCS shall provide closed loop control of these devices. Manual hand controller inputs shall be accepted from the crew and corrected position and tracking rate data shall be fed to the computer to aid in target acquisition by the main optics.

The scope image shall provide for a minimum magnification of 5 power, with a 4° field of view, with means for adjusting the optical magnification up to at least 25 power (0.8° field of view). The entire scene obtained by the optical elements of the acquisition telescope shall be displayed. Each crew member shall have a single control which permits changing the magnification of the acquisition telescope being directed by the hand controller. The magnification controller, with an appropriate mode change, shall also be utilized to control the magnification of the primary visual optics (see paragraph 3.3.4.5.4). It shall be a design objective to also provide 1x for a wide field of view.

The slew rate capability of the ATS shall be at least 20 degrees per second in both pitch and roll.

3.3.4.5.2.7.2 Resolution

The resolution of the Acquisition subsystem, when set for minimum magnification shall be such as to be able to detect, at an altitude of 80 nautical miles, line patterns of 50 foot wide black and white lines having a contrast ratio of 2 to 1.

3.3.4.5.2.7.3 Target Cue Display

A means of displaying target cues shall be provided on each reconnaissance console. The capability shall exist to display the target cue with proper scale corresponding to the optical power of the tracking device (ATS or main optics eye-piece) being used.

3.3.4.5.2.8 Automatic Support Subsystem

3.3.4.5.2.8.1 Functional Requirements

The Automatic Support subsystem shall provide for the conversion of the Mission Section hardware for Automatic mode operations. It shall perform the following functions:

a. Provide a means for automatic de-orbiting and retrieving all exposed film from the OV.

b. Provide a means for automatically inserting main and terrain camera film into the DRV's.

c. Provide for system electrical continuity and loading when Manned-Automatic equipments removed.

The Support Module Structure and fairing shall be supplied by the Support Module Contractor. The film tunnel, film cutters, and sealers shall be provided by the Photographic Section Contractor.

3.3.4.5.2.8.2 Hardware Changes

The Automatic Support subsystem shall include:

a. The conversion requirements to remove the acquisition and tracking scopes, MPSS consoles and displays, DRV's, and other Manned-Automatic mode equipment from the Laboratory Module, together with the plugs, seals, and adapters required when this equipment is removed.

b. Six 33 inch DRV's to be installed in the Support Module.

c. An automatic programmer, electrical power and thermal control provisions for the Support Module.

d. DRV attachment and ejection provisions.

e. Support Module instrumentation.

Note: The Support Module is not part of the Mission Section.

3.3.4.5.2.8.3 DRV's (Automatic Mode)

The DRV's used in the Automatic mode will be the modified Mark V's specified for the Manned-Automatic mode, except that the last one of the six ejected shall include provisions for take-up and returning up to 4 lbs. of 70 mm terrain camera film in addition to the normal load of 9.5 inch main camera film.

3.3.4.5.3 Peculiar Performance and Design Requirements (Photographic Section)

The Photographic Section shall contain optical, mechanical, thermal, electrical, and structural components necessary to perform high quality, stereo, photographic reconnaissance.

The optical system of the Payload (see figure 3-5), shall consist of a 70 inch aperture, [redacted] focal length Ross telephoto lens having a 0.54° semi-field angle. The optical axis shall be approximately parallel to the longitudinal axis of the Mission Module. The Ross corrector assembly shall be above and approximately parallel to the optical axis of the primary mirror.

A frame camera utilizing 9-1/2 inch wide film shall be located at the end of the Ross corrector barrel on the Laboratory Module pressurized side of the bulkhead.

The total film supply for the primary and secondary cameras shall be sufficient to obtain 15,000 frames of photography for a 30-day mission. The 15,000 photographs may be apportioned by command between one and ten photographs per target. The capability shall exist to carry up to 20,000 frames (approximately 300 lbs.) of primary film for Automatic mode flights up to 40 days in duration.

The primary output shall be a latent image recorded on a black and white film having the resolving power of Type 3404, but an exposure index of 6. The on-axis static, nadir lens-film resolution as a function of apparent contrast shall be as indicated in Figure 3-6 when the film has received optimum exposure for a ground scene luminance of 890 feet-lamberts and is forced processed in D-19 developer.

3.3.4.5.3.1 Structure and Thermal Control Subsystem

This subsystem shall consist of the following:

a. The COA Structure which shall tie together the primary mirror, the folding mirrors, Ross corrector assembly, and the main camera.

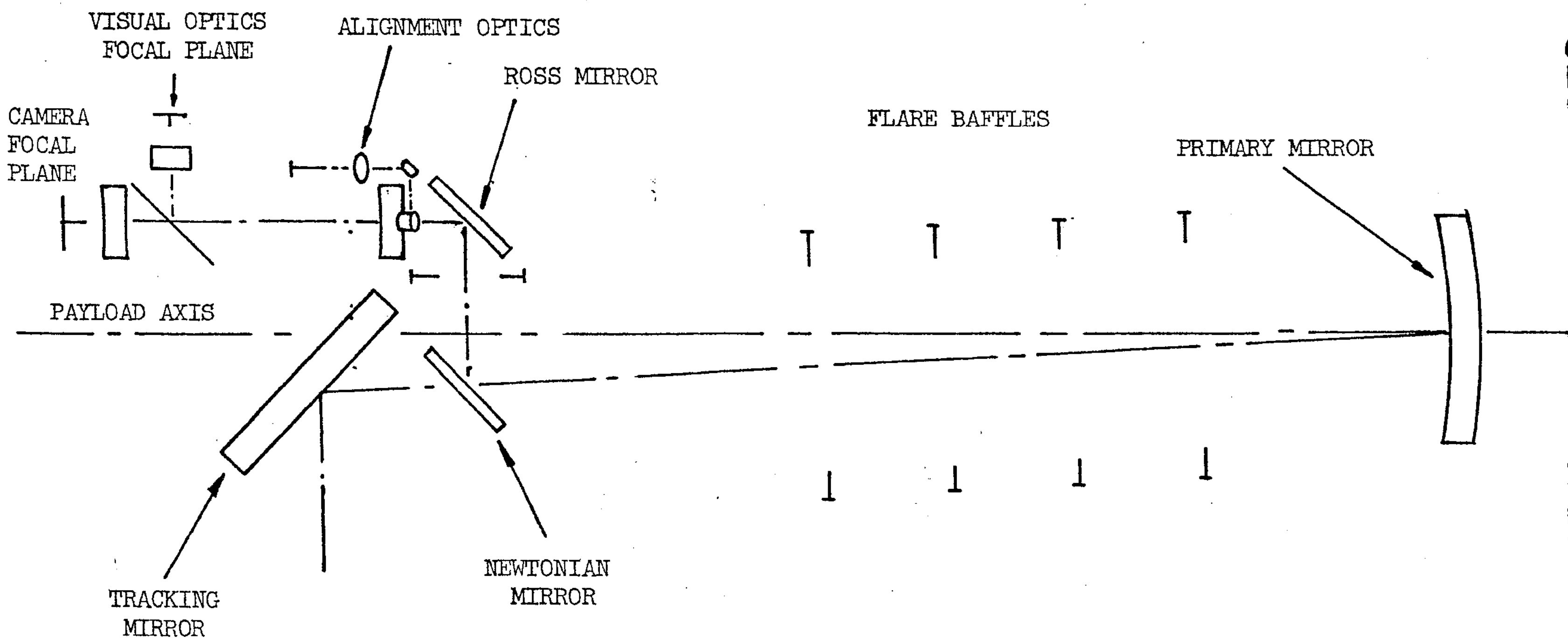

FIGURE 3-5 OPTICAL SENSOR BASIC CONFIGURATION

FIGURE 3-6

STATIC RESOLUTION VERSUS CONTRAST

[redacted]

b. The mounts to tie the COA Structure to the Mission Module COA Bay, the launch locks for the main optics.

c. The thermal control of the COA.

3.3.4.5.3.1.1 COA Structure

The COA Structure shall provide the necessary support, orientation and protection to components of the COA (less Tracking Mirror) during handling, transportation, launch and orbit. It shall accurately position the primary mirror, folding mirrors and Ross corrector barrel relative to the Mission Module attachment points.

3.3.4.5.3.1.2 Mechanical Mounting (COA to Mission Module)

a. General

Suitable mechanical mountings for the COA shall be supplied for all phases of the payload operations. The mounting shall not in any way affect or alter the performance of the Photographic Section.

b. Ground Handling

Mechanical mounting of the Photographic Section during testing shall be performed in such a way that the test results shall be independent of the mounting constraints.

c. Powered Flight

The Photographic Section shall be mounted in such a way that launch forces cannot endanger the Photographic Section or its subsequent performance.

d. Orbit

The mechanical mountings during flight must be such that no performance degradation results.

No focus shift of the image on the record and no alignment shift of any of the payload elements shall occur due to the payload mountings.

3.3.4.5.3.1.3 COA Bay Thermal Control

a. General

The Photographic Section thermal control subsystem shall provide proper temperature control for the COA Bay during all phases of vehicle operations. Passive thermal control shall be used to the greatest practical extent. Ground conditioning of the Photographic Section shall be performed by internal convective cooling and electric heating as required.

b. Ground Conditioning

The temperature and humidity limits shall be established such that no moisture condensation shall occur on any portion of the camera or optical assembly.

c. Powered Flight

The temperature and humidity limits shall be established such that no moisture condensation shall occur on any portion of the COA. In addition, the ascent heating load shall be attenuated to an extent that will allow acceptable thermal conditions for payload operation within five hours after launch.

d. Orbit

A passive system of environmental control shall be employed to the greatest practical extent. This system shall utilize thermal control coatings, insulation, and component placement. Active environmental control shall be automatic.

Temperature requirements for the Photographic Section shall be determined by the optical performance requirements.

Coating deterioration due to the space environment and those environments encountered prior to and during powered flight shall be minimized and must be compatible with the mission life and system performance requirements.

The optical performance degradation with door open time shall be minimized. The design goal is to obtain no measurable degradation for 10 minutes of active operation with the maximum sun angle ($\beta = 0$, 21 June) and nominal albedo (.38).

3.3.4.5.3.2 Camera Subsystem

3.3.4.5.3.2.1 Primary Camera

The camera system shall consist of the mechanical, electrical, and optical elements necessary to position the film and properly expose it. The system shall include a camera capable of providing a circular image on 9.5" wide aerial film. The film shall be transported across the platen between exposures and held in place during exposure. The film holding system shall be of such a design that system performance will not be degraded by film surface deformation.

Film transport from the storage reels, positioning on the camera platen, and transport to the take-up reels shall be automatically initiated after each exposure. The time between completion of one exposure to the allowable start of another shall be 1.0 second or less.

The local exposure time shall be defined as the time specified to expose a picture element. The frame exposure time shall be the time required to expose a photographic frame to all scene and data information. The nominal local exposure time will be 1/200 sec for a film having the resolution of Type 3404, but a speed of 6. An exposure range will be provided for all sun elevation angles down to 5°. The nominal frame exposure time shall be 0.2 sec in accordance with the requirements on the number of frames/target.

The position of the camera platen shall be controllable, on-orbit, to provide 0.1 inches for focus correction. The camera shall be designed to accommodate the equipment necessary for recording data on the 9-1/2 inch film.

Focus adjustments shall be made by ground command. Suitable sensor indications shall be passed via telemetry so that the required commands may be determined. A capability for the crew to make adjustments shall be provided.

3.3.4.5.3.2.2 Secondary Camera (Manned-Automatic Configuration

The system shall also be capable of providing secondary records, one type of which is suitable for on-board processing, by means of interposing a second film platen at the image plane in place of the primary film. Introduction of the second platen in place of the primary platen shall be done automatically and shall not take longer than 1 second. (replacing the secondary platen with the primary platen also shall not take longer than 1 second). The secondary platen shall use the same film format and data imprinting as the primary platen.

3.3.4.5.3.2.3 Across-the-Format IMC

Across-the-format IMC shall be provided which, when used, shall insure that the average geometric mean performance at the film plane anywhere within a 0.8° diameter circle about the center of the format will be greater than that given by Figure 3-7. Across-the-format IMC shall be used only for the primary record.

3.3.4.5.3.2.4 Photographic Format

The photographic image shall be a 9.4 inch diameter circular format centered with respect to the edges of the film. The inter-frame spacing shall be 1 inch, giving a frame length of 10.4 inches.

Areas outside the image, the four corners, are available for edge data recording on the film. Edge data to be recorded shall include the following:

a. Binary and Numeric Data

(1) Revolution Number

(2) Frame Number

(3) Vehicle Time

(4) Exposure Start and Exposure Finish Times

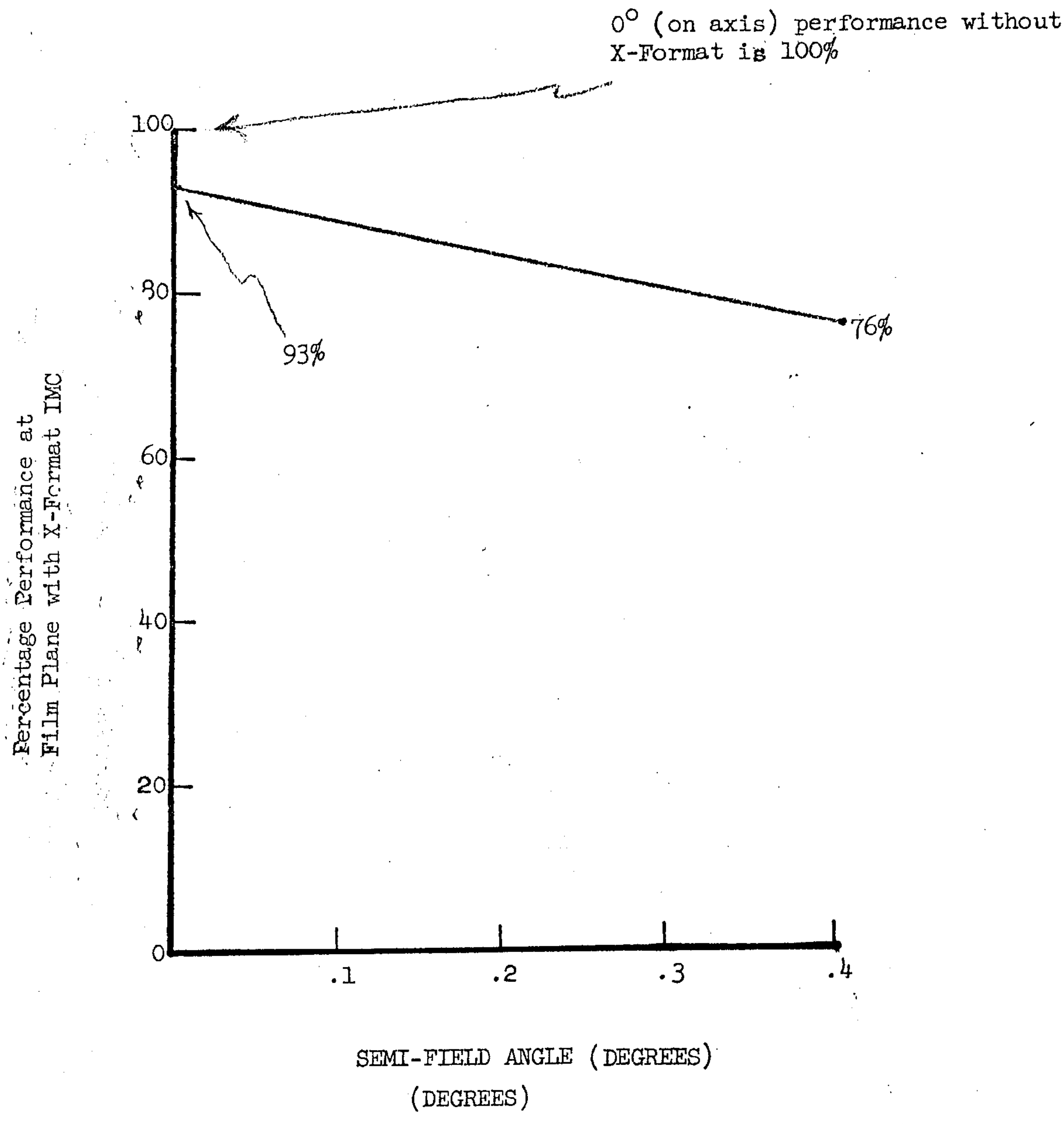

FIGURE 3-7. ACROSS-THE-FORMAT IMC REQUIREMENT

(5) Vehicle Attitude

(6) Tracking Mirror Position

(7) Exposure Slit Number

(8) Exposure Slit Orientation

(9) Vehicle Identification Number

b. Special Markings

(1) Fiducial Marks

(2) Interframe Marks

(3) Special Frame Marking (Auxiliary platen only).

3.3.4.5.3.3 Primary Optics Subsystem

3.3.4.5.3.3.1 Primary Mirror Assembly

The primary mirror assembly shall be the complete assembly of the primary mirror, primary mirror mount, launch locks, alignment servos, and end cap. The primary mirror shall have a 70 inch diameter clear aperture. Its mount shall provide a minimum strain mounting system for the primary mirror when in a gravity-free environment. The alignment servos shall provide the capability of aligning the optical axis of the primary mirror to the optical axis of the Ross corrector assembly and provide a secondary means of focus adjustment.

3.3.4.5.3.3.2 Diagonal Mirror Assembly

The diagonal mirror assembly shall be mounted in the Newtonian folding position and be supported by a structural spider within the COA barrel. The diagonal mirror shall be a plano mirror mounted in a minimum strain mounting system.

3.3.4.5.3.3.3 Tracking Mirror Assembly

The Tracking Mirror assembly shall comprise the optical tracking mirror, its mountings, and launch locks. The tracking mirror shall be the main line-of-sight pointing element of the optical system. It shall be a 70-inch diameter, circular plano mirror mounted in a minimum strain mounting system. The tracking mirror shall be mounted in the tracking mirror gimbaled drive provided by the Mission Section contractor.

3.3.4.5.3.3.4 Ross Corrector Assembly

The Ross Corrector assembly shall include four refracting lens elements housed within a structural tube, the Ross diagonal mirror, the pellicle mirror and portions of the visual optics assembly. The assembly structure shall provide mountings for the Ross diagonal mirror and the camera. It shall be attached to the Laboratory Module bulkhead by means of the LM bellows pressure seal. Ross diagonal mirror servos shall provide two degrees of freedom to adjust the alignment of the optical axis of the Ross correctors assembly with the optical center of the primary mirror.

3.3.4.5.3.3.5 Alignment Optics Assembly

An alignment optics assembly shall be provided for automatic on-orbit alignment of the primary optics. The alignment device shall be pre-aligned to the Ross corrector optical elements, sense the apparent positional errors of the primary mirror and activate the alignment servos to restore optical alignment. Apparent tilt and longitudinal shifts of the primary mirror shall be corrected by motion of the primary mirror. Centering corrective motions shall employ two rotational degrees of freedom of the Ross diagonal mirror.

3.3.4.5.3.4 Visual Optics (Manned-Automatic)

An optical system shall allow either crewman to look at the central portion of the camera field of view through the primary optics for the purposes of reducing rate error and/or making visual observations of the target. Simultaneous operation of the eye-pieces is not required. A suitable reticle shall be provided for tracking. The reticle shall be programmed to stay in focus for any ground target within the photographic range. Consideration shall be given to a reticle with servo controlled transverse motions in case reticle quickening is found to be desirable.

The part of the visual optical system which is attached to the Laboratory Module must be adjustable to compensate for any relative motion between the Laboratory Module and the Mission Module.

The magnification of the system shall be variable within limits which shall be chosen by simulation of the tracking task, but the maximum magnification need not exceed [redacted] The minimum magnification shall be compatible with acquisition scope magnification for ease of crew adaptation when transferring attention from a target on the acquisition scope display to the same target in the visual optics. The apparent field of view shall be 40°. A derotation prism shall be provided which can be driven by the computer to maintain an erect image for all tracking angles.

a. <u>Minimum Acceptable Performance of Primary Visual Optical Subsystem</u>

Magnification	[redacted] continuously variable
Apparent Field	40° full field
Light Transmission	35% for visual relay only
Revolving Power	
Central 10°	30 lines/degree
Rest of field	15 lines/degree
Eye Relief (min.)	40 mm

b. <u>Minimum Acceptable Performance of Secondary Visual Optics Subsystem</u>

Magnification	[redacted]
Apparent Field	40° Full Field
Light Transmission	30%
Central 10°	25 lines/degree
Rest of Field	15 lines/degree
Eye Relief (min.)	40 mm

3.3.4.5.3.5 Film Handling Subsystem

3.3.4.5.3.5.1 Film Requirement

The nominal film width shall be 9-1/2 inches. The primary reconnaissance film shall be black and white film having the resolution of Type 3403, but a speed of 6. Secondary reconnaissance films shall be provided. The secondary records shall also have a 9-1/2 inch nominal film width. For the Manned-Automatic mode, the vehicle shall carry a nominal film load of 13,000 ft., including both primary and secondary records. For the Automatic mode, the nominal film load shall be 17,400 ft. of primary record only. Consideration shall be given to protecting the film from excessive radiation damage.

3.3.4.5.3.5.2 Black and White

Manned-Automatic Configuration

The primary film will be loaded from one (1) supply reel. The exposed record shall be wound into take-up cassettes and manually removed from the camera under operational lighting.

Automatic Configuration

The primary film will be loaded into one supply reel, threaded through the camera and into multiple take-up cassettes.

3.3.4.5.3.5.3 Color and Special Films (Manned-Automatic Configuration)

The vehicle shall be capable of carrying additional supply cassettes of color, night, or special films for use with the secondary camera.

3.3.4.5.3.5.4 Data Return Capsules (Manned-Automatic only)

3.3.4.5.3.5.4.1 General

Three (3) Data Return Capsules (DRC's) shall be utilized as take-up cassettes for the primary record during photographic operations. Each DRC shall have a capability of returning 60 pounds of film, for a total of 180 pounds of primary record, in the Gemini.

A fourth DRC (for secondary package) shall be utilized to return 60 pounds of secondary record and cues in the Gemini. This latter data will be enclosed in sealed canisters, installed and secured in the fourth DRC. The DRC's shall have flotation capability.

3.3.4.5.3.5.4.2 Environmental Control

The DRC design shall minimize the possibility of film damage due to (a) handling, (b) contamination, (c) light leaks, and (d) excessive temperature excursions. The film records shall be maintained at a temperature of 70^{+20}_{-30} oF. However, the sealed film canisters are permitted to approach a maximum temperature of 120°F for a period not exceeding one hour.

3.3.4.5.3.5.4.3 Alignment/Adjustment

The design of the DRC's containing the primary record in association with the Laboratory Module DRC support equipment, shall incorporate provisions for take-up cassette/film alignment and adjustment during photographic operations.

3.3.4.5.3.5.4.4 DRC Film Weight Breakdown

The DRC film weight breakdown shall be as follows:

Data	DRC's	Weight (pounds)
Primary Record	3	180
Secondary Record/Cues	1	60
Total		240

Data	Canisters	Weight (pounds)
Processed	2	20
Color	1	10
Infra-Red	1	10
High Speed	1	10
Cues	1	6
Terrain	1	4

3.3.4.5.3.6 Electrical Power and Instrumentation Subsystem

3.3.4.5.3.6.1 Electrical Power

Electrical power for the Photographic Section shall be supplied by the Laboratory Vehicle via the Mission Section EPSD subsystem.

3.3.4.5.3.6.2 Instrumentation

Suitable Photographic Section environmental and performance monitoring sensors shall be provided to enable real time and post flight diagnostic analysis. Photographic Section telemetry signals shall be passed to the MCC by the Laboratory Vehicle SGLS via the Mission Section C.&C.I. subsystem.

3.3.4.5.3.7 Film Processor Subsystem (Manned-Automatic Configuration)

3.3.4.5.3.7.1 General

An on-board processor shall be provided which will process groups of selected frames of black and white primary or secondary record for the purpose of on-board photographic reconnaissance and/or quality information and readout to the ground for quick access to reconnaissance information and photographic quality information. The operation of the processor shall be automatic once the film to be processed is loaded and the controls set.

3.3.4.5.3.7.2 Acquisition

There shall be supply cassettes of secondary record available for on-board processing. One of these cassettes shall be mounted on the secondary camera prior to these photographic passes where output for flight crew photographic viewing and readout is needed. The secondary takeup cassette containing the exposed film which is to be processed shall be removed and transferred to the processor as required.

It shall be possible to process a limited amount of primary camera record for monitoring performance of the primary camera. Removal of primary camera record for processing shall be limited to a few frames taken from the standard primary camera take-up cassette prior to the photographic mission and to frames taken between the removal of a full cassette load and the start of the next regular cassette load.

3.3.4.5.3.7.3 Processor

The on-board film processor shall be capable of processing 50 photographs with no more than 5 minutes per photograph total processing time. Batch sizes of less than 50 frames shall be processible but at slightly longer processing time per photograph. The processor shall not degrade resolution by more than 15 percent of the resolution obtainable with otpimum ground processing. All chemical contaminants shall be identified and controlled in such a manner that they will not in any way endanger the health, safety, or comfort of the flight crew. The processor shall be capable of operation in nominal Laboratory Module lighting conditions (10 ft-candles) and shall produce a photograph, dried to an RH comparable to the Laboratory Module RH level, and suitable for viewing and readout.

3.3.4.5.3.7.4 Viewer

A viewer shall be provided to examine the on-board processed record. The viewer shall be large enough to accommodate two frames of photography. The viewer shall be equipped with a binocular microscope of magnification range ________________ to ______________ capable of displaying the scene to its resolution limit. The microscope shall be capable of scanning an entire image.

3.3.4.5.3.8 Image Motion Detector Subsystem

An Image Motion Detector (V/R Sensor) shall be provided as part of the Photographic Section. This Image Motion Detector shall be integrated into the Navigation and Control Subsystem (NCS) of the Mission Section. Using information from the NCS, equating to a V/R error no greater than one percent, the image motion shall be determined with sufficient accuracy to enable the image rate at the center of the format to be reduced to a value not to exceed 4×10^{-5} radians/second (2σ).

3.3.4.5.3.9 Automatic Support Subsystem

The Automatic Support subsystem shall comprise those elements required to convert the Photographic Section from manned-automatic to automatic mode operations. It shall include the following:

a. Automatic film handling and transport assembly.

b. Film chute leading from the camera to the DRV's in the Support Module.

c. DRV/film chute separation mechanism.

3.3.4.5.3.9.1 Film Chute Design Requirements

The film chute shall be designed to transport the film from the camera to each of the six DRV's in the Support Module. The chute shall be designed for up to 40 days of orbital operation without leakage while pressurized to 5 psia. Prior to ejecting a DRV, it shall be disconnected from the film chute and the chute sealed with negligible loss of pressurization gas.

3.3.4.6 Mission Payload Peculiar AGE Requirements

The MPSS AGE will conform to the general design and performance requirements given for the Orbiting Vehicle in paragraph 3.3.1.2.8, and those for the Laboratory Vehicle in paragraph 3.3.2.2.13. Requirements for MPSS alignment, special purpose and handling equipment are given below.

3.3.4.6.1 Alignment Equipment

a. Mission Section

AGE shall be provided for alignment of the optical and star acquisition and tracking equipments with reference to the Mission Module principal axes. The AGE shall also be capable of measuring these alignments to within one minute of arc.

The alignment of the tracking mirror assembly and its measurement shall also be provided for.

A structure representing the Camera Optical Assembly (COA), will be utilized with the MPSS to aid in these alignments.

b. Photographic Section

Special equipment for optical and mechanical alignment of components shall be designed and utilized to validate optical and mechanical dimensions of the optical sensor, to align the navigation and control reference with the optical sensor, and to align automatic film handling equipment as necessary.

3.3.4.6.2 Special Purpose Equipment

a. Mission Section

AGE shall be provided which will allow for testing of the MPSS consoles. This AGE will provide stimuli for exercising the displays and simulated MPSS equipment to test responses from operation of the consoles.

In addition, special power supplies stimulating the Laboratory Module CPS shall be provided for testing the MPSS. Fixtures for vibration testing also, shall be provided.

Special test equipment for thermal-vacuum testing will be provided.

b. Photographic Section

Special purpose equipment shall be designed and utilized by the Photographic Section Contractor at his facility during manufacture and sub-assembly build-up operation and through assembly and acceptance of the Mission Payload System Segment.

3.3.4.6.3 Handling and Transportation Equipment

a. Mission Section

AGE shall be provided for handling and transporting the MM and other MPSS equipments within payload contractors' plants, and between contractors' plants. It is a design requirement that this AGE protect the MPSS AVE and control the AVE environments to levels within those the AVE is expected to experience while on the pad, at launch, during powered flight, and on-orbit. Specifically, the following guidelines apply:

Shock and Vibration - isolation to levels within those expected during launch and powered flight.

Temperature Limits - within those specified for the design.

Cleanliness - within those limits specified by Federal Standard 209, class 10,000 (internal) and class 100,000 (external), plus elimination of oils and volatiles in the atmosphere.

b. Photographic Section

Suitable handling equipment for the COA interface substitute shall be provided to implement vertical and horizontal lifting, erection to a vertical attitude, and in-plant transport in a horizontal attitude. Equipment for assembly of the COA interface substitute into a Mission Module shall be limited to that equipment directly associated with handling of the optical sensor.

Necessary handling equipment for installation of the Photographic Section Laboratory Module components shall be provided.

Photographic Section items shall be packaged in suitable containers which hold the contents within the environmental limits established for the hardware.

3.3.4.6.4 PAD Environmental Control Equipment

The AGE shall provide for control of the temperature inside the Mission Module as follows:

Temperature - $70^{o}F \pm 5^{o}$ normal requirement
- $70^{o}F \pm 1^{o}$ starting 48 hours before launch

The AGE shall provide incoming air to the Mission Module as follows:

Cleanliness - Federal Standard 209 class 10,000, plus elimination of oils and volatiles in the atmosphere.

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4. CONTRACT	5. CONTRACTUAL AUTHORITY	FILE OPPOSITE SPEC. PAGE NO.
Program 632A	CCN	3-122.1

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.7.5 Mission Payload Peculiar Facility Requirements

Revise to read........

Adequate provisions shall be made in the checkout, maintenance, and launch areas for DORIAN environmental and special security requirements. The provisions of FED-STD-222 are applicable to the Mission Payload control room of the Launch Control Center.

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Program 632A	CCN	3-124.1

6. EFFECTIVITY
MOL Program

7. TEXT CHANGE

Paragraph 3.3.8.5 Mission Payload Peculiar Launch Operations Support

2nd Paragraph. Revise 1st sentence to read.......

The Mission Payload AVE, with the possible exception of the DRV's, arrives at VAFB integrated with the Laboratory Vehicle.

4th Paragraph. End of sentence to read...... "required level of cleanliness of temperature, humidity control and security."

Replace last paragraph with......

All explosive ordnance installation operations will be performed at the latest practicable time at the launch site as compatible with safety and operational requirements. Final arming of explosive ordnance systems shall be accomplished during the "T-Count" in accordance with these safety and operational requirements.

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Program 632A	CCN	3-140.1

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.9.5.1 <u>Ground Support System Requirements</u>

2nd line. Delete "MOL System" and replace with "Mission Payload".

Paragraph a. Delete last sentence. "The capability to update..... exist in the software."

Paragraph e. 1st line. Delete "MOL System" and replace with "Mission Payload". Delete last sentence. "A capability for preliminary........is taking place shall also exist."

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Program 632A	CCN	3-150.1

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 3.3.12.5.1 General Training Requirements

Revise to read......

Training required for the crew members shall include indoctrination to the Mission Payload equipment and its function through the engineering specialty assignments associated with engineering simulation, and operational design. The final integrated Mission Simulation (Mission Simulator) will include major crew functions for Mission Payload training such as:

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Program 632A	CCN	4-15

6. EFFECTIVITY

MOL Program

7. TEXT CHANGE

Paragraph 4.3 Mission Payload Peculiar Flight Certification Testing

Delete entire section 4.3 (pages 4-15 and 4-16), and replace with the following 3 pages.

4.3 Mission Payload Peculiar Flight Certification Testing

The requirements defined in 4.1.1.1 through 4.1.1.4, 4.1.1.6, 4.1.1.9, 4.1.1.10, 4.1.1.11, 4.1.2.1 through 4.1.2.4, 4.1.2.6, 4.1.2.9, 4.1.2.10, 4.1.2.11, 4.1.3, 4.1.4.1 through 4.1.4.4, 4.1.4.6, 4.1.4.9, 4.1.4.10, 4.1.4.11 and 4.2 apply here in terms of the MPSS.

4.3.1 MPSS Test Flow

The Mission and Photographic Sections of the MPSS AVE, shall each undergo qualification and acceptance testing at the respective contractor's plant. Following completion of Mission Section testing, the equipment to be installed in the Laboratory Module shall be shipped to the Laboratory Vehicle integrating contractor's plant. The TM Bay shall be shipped to the Photographic Section contractor's plant for mating with the COA Bay. Following completion of thermal optical tests at the Photographic Section contractor's plant, the integrated Mission Module shall be shipped to the LV integrating contractor's plant. The MPSS integrating contractor shall then conduct acceptance testing on the MPSS prior to the start of combined Laboratory Module/Mission Payload tests.

4.3.2 Qualification Testing

The MPSS equipment shall be qualified at the component, section (mission or photographic), complete Mission Module and complete Laboratory Vehicle levels of assembly. All equipment components shall undergo a qualification test program as individual components. The adequacy of the primary load-carrying structure of the Mission Module shall be verified in conjunction with the Laboratory Module structure. Acoustic or vibration, pyrotechnic-event shock, and thermal-vacuum (33 day) qualification tests shall be conducted on both the TM Bay and COA Bay separately as a requirement for qualification of equipment located in those bays. Dynamic performance characteristics of the Mission Module shall be verified at the Mission Module level of assembly.

The Mission and Photographic Sections of the MPSS shall each undergo EMI/EMC testing at the respective contractor's plant. EMI/EMC testing of a complete MPSS shall be conducted in conjunction with the LM at the LV integrating contractor's plant.

4.3.3 Acceptance Testing

All equipment components shall be required to operate without failure, malfunction, or out of tolerance performance degradation during or after exposure (as applicable) to both vibration and thermal-vacuum (5 days) acceptance tests. Acoustic or vibration, thermal-vacuum and EMI/EMC shall be conducted on both the TM Bay and COA Bay separately as a condition of acceptance.

Dynamic performance characteristics of each Mission Module shall be verified at the Mission Module level of assembly. Preliminary information on the dynamic characteristics shall be obtained at the TM Bay and COA level of assembly. Final orbital dynamic characteristics of each vehicle will be verified by analysis, utilizing test data (resonant frequencies, structural damping, and model patterns) obtained during the LV vibration model survey.

4.3.4 Development Testing

4.3.4.1 Thermal

Thermo-vacuum tests shall be conducted on the TM Bay and COA Bay separately for development of the thermal control system. Insulation effectiveness, equipment operating temperatures, along with thermal control system location and operation shall be determined or verified.

4.3.4.2 Dynamic (Mode Surveys)

Resonant frequencies, mode shapes and structural damping shall be determined by test of a dynamically simulated orbiting vehicle. Preliminary information on the dynamic characteristics shall be obtained at the TM Bay and COA level of assembly.

4.3.4.3 Acoustic and Pyrotechnic Shock

Acoustic and pyrotechnic-event shock tests shall be conducted on a dynamically simulated TM Bay and COA Bay (separately or as a MM) to determine equipment vibration and shock levels throughout the MM.

4.3.4.4 Operational Performance

The Mission Section and Photographic Section contractors shall conduct a development program to determine design feasibility, design adequacy, equipment performance, functional parameters, packaging and fabrication techniques, and performance testing techniques.