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1 JUL 1964



IMPROVED CARTOGRAPHIC  
CAMERA SUBSYSTEM (ICS) PROGRAM  
REQUIREMENT SPECIFICATION

Prepared:

  
R. O. Mlady

Approved:

\_\_\_\_\_  
Contractor Representative

\_\_\_\_\_  
Contractor Representative

\_\_\_\_\_  
SAFSP Representative

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## 1.0 SCOPE

### 1.1 Document Scope

This document defines the technical requirements for a Cartographic Camera subsystem on the J Program satellite reconnaissance system.

### 1.2 Improved Cartographic Camera Subsystem Program Scope

The ICS program will provide for design, development, manufacture, qualification, testing and delivery of a Cartographic Camera subsystem. The camera subsystem shall be compatible with the J system per A/P Interface Drawing No. \_\_\_\_\_ and shall be subjected to the same environments including a possible 30 day orbit life.

Changes in the existing J system as required to incorporate one Cartographic Camera subsystem are considered as an integral part of the ICS program. The ICS subsystem will be incorporated in the J system as GFE.

## 2.0 CARTOGRAPHIC CAMERA SUBSYSTEM REQUIREMENTS

The requirements outlined define the parameters for a camera subsystem to be incorporated in the J system to obtain improved reconnaissance and mapping capabilities. FSDS Spec. No. 57DB-1A will define the parameters in detail. Where conflicts arise between this specification and 57DB-1A, the conflicts will be resolved by the Contractors and SAFSP.

### 2.1 Camera Parameters

The camera body shall contain the terrain and stellar cameras positioned so that the terrain camera is oriented vertically downward in the vehicle's orbital plane and the stellar camera is at an elevation angle of  $96^{\circ}$ .

#### 2.1.1 Terrain Camera

The terrain camera shall contain a 3 inch focal length  $f/4.5$  lens with a focal

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plane corrector plate and will provide coverage over a  $4\frac{1}{2}$  inch square format.

#### 2.1.1.1 Lens Performance

The lens shall have a minimum acceptance resolution of 90 lines/mm AWAR when tested with a standard high contrast USAF test target and 65 lines/mm AWAR when tested with a standard low contrast USAF test target, as specified in MIL-STD-150A. Testing shall be in accordance with MIL-STD-150A using Eastman Kodak Type 4400 emulsion and a Wratten 12 filter.

#### 2.1.1.2 Dynamic Performance

The operation of the shutter or any other dynamic components of the camera subsystem shall not degrade the photographic resolution more than one, sixth-root-of-two, test pattern below the performance required in paragraph 2.1.1.1.

#### 2.1.1.3 Lens Distortion

The radial lens distortion shall not exceed 0.030 mm and the tangential distortion shall not exceed 0.005 mm as measured in accordance with MIL-STD-150A.

#### 2.1.3 Stellar Camera

The stellar camera shall contain a 3 inch focal length, f/2.8 lens providing a coverage over a 1.25 inch diameter format.

#### 2.1.2.1 Lens Performance

The lens shall have a minimum acceptable resolution of 80 lines/mm when tested with a standard high contrast USAF test target as specified in MIL-STD-150A using a white light illumination source and Eastman Kodak Type 4400 emulsion.

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## 2.1.2.2 Dynamic Performance

The operation of the shutter or any other dynamic components in the camera subsystem shall not degrade the photographic resolution more than one, sixth-root-of-two, test pattern below the performance required in paragraph 2.1.2.1.

## 2.1.2.3 Lens Distortion

The radial lens distortion shall not exceed 0.050 mm and the tangential distortion shall not exceed 0.005 mm.

2.2 Camera Subsystem Parameters

- |  | <u>Terrain</u>                                     | <u>Stellar</u>    |
|--|--|-------------------|
| 1. Cycling Rates (Mode 1)  | 12.2 sec/cycle                                     | 12.2 sec/cycle    |
| 2. Cycling Rates (Mode 2)  | 12.2 sec/cycle                                     | 4.1 sec/cycle     |
| 3. Data Recording  | Time & Serial No.                                  | Time & Serial No. |
| 4. Shutter Synchronization - Plus or minus one (1) millisecond measured at the center of exposure of each camera.                          |  |                   |
| 5. Fixed Exposure Time   | 1/500 sec  | 2 seconds         |
| 6. Duty Cycle - 45 minutes maximum per orbit   |  |                   |
| 7. Pressurization  | - Not Required -                                   |                   |
| 8. IMC   | - Not Required -                                   |                   |
| 9. Camera Weight<br>(Including cassettes film chutes & film)   | - Less than 90 lbs. -                              |                   |
| 10. Exit housing weight  | - 3.5 lbs. -                                       |                   |
| 11. Power (2000 feet of film)  | -Less than 1450 watt hrs. (____ Amps Max.)         |                   |
| 12. Film Requirements  | 5" x 2000 feet<br>(2.5 mil Estar base - Type 4400) | 35 mm x 1600 ft.  |
| 13. Power Supply - 28 VDC unregulated and 28 VDC regulated for TM functions supplied at camera interface by A/P.                           |  |                   |
| 14. Anti-Backup Device - Each takeup cassette shall be designed with an electro-mechanical mechanism to prevent the spools from unwinding. |  |                   |

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The device shall be capable of release for test and checkout by applying 22 to 29 volts, DC, ~~continuously~~ to appropriate terminals. The device shall be engaged when the voltage is removed.

## 2.3 Coverage (At 100 nm)

Flight Line Coverage (2000 ft. of film)	240,000 nm @67% O.L.
Area Coverage	$36 \times 10^6$ sq. nm

## 2.4 Film Corona Marking:

Over a pressure range of  $1 \times 10^{-5}$  mm Hg to 30 microns, Corona discharge phenomenon effects will produce no unacceptable photographic results.

Acceptable results are defined as shown below:

Stellar/Terrain Corona Criteria - One full roll of stellar and terrain film programmed through the camera in flight configuration shall contain less than ten (10) percent corona marked formats and the maximum density of any mark shall be less than 0.4 above the base plus fog level. 90% of the formats may have a maximum density of any mark of less than 0.1 above the base plus fog level. Processing of test film shall be consistent with the practices used for processing flight film.

## 2.5 Calibration Accuracy

Stellar/Index Optical Axis Angle	+ 5 seconds of Arc by stellar calibrated methods
Reseau	+ 1 micron
Fiducials	+ 1 micron
Principal Point	+ 3 microns
Radial Distortion	+ 3 microns
Tangential Distortion	+ 5 microns

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Distortion, resolution and principal point shall be measured by the manufacturer using a multi-collimator calibration. Calibration data will be supplied to agencies for reduction and analysis as directed by the SAFSP.

## 2.5.1 Stellar Calibration

Stellar calibration of the camera subsystem will be required in addition to the primary calibration. Provision for a stellar calibration capability shall be designed into the Camera subsystem. Stellar calibration will be conducted at the A/P facility during verification tests and on a subsystem level before and after system environmental tests. Subsystem testing will be evaluated by SAFSP to determine the requirement for continued subsystem tests. Subsystem level tests are defined as the tests conducted when the camera subsystem, excluding takeup cassettes, is installed in the J system barrel assembly.

## 2.6 Special Manufacturing Tolerances

2.6.1 The stellar and terrain reseau shall be manufactured and controlled to an accuracy of one (1) micron for the purpose of reducing the time and costs of calibration.

## 2.7 Data Recording

2.7.1 The time of the center of exposure on each stellar and terrain frame of photography shall be recorded with a resolution of one (1) millisecond using data supplied from the modified Fairchild E Prime clock.

2.7.2 A 29 bit binary time word will be recorded on the 35 mm and the 5 inch film during simultaneous terrain and stellar frames. The time word will also be recorded on each stellar frame that is taken independently. A Fairchild silicon light pulser matrix will be used to record the time word.

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2.7.3 One parallel output will be available for recording time on both the stellar and terrain formats and switching must be accomplished internal to the camera to accommodate the 29 bit word.

## 2.8 Clock Modification

Clock modification for the ICS program will be per sub-contract to the New York manufacturer and in accordance with T3-4-508.

2.8.1 The modification for the ICS program will consist of adding a third independent 29 bit parallel time word capable of driving the Fairchild silicon light pulser matrix.

## 2.9 Internal Baffling and Filters

2.9.1 Baffles will be designed and included in the Stellar Camera by the N.Y. manufacturer to minimize the effects of albedo and solar radiation such that no more than 30% of the stellar image field is obscured.

2.9.2 Terrain lens light filters shall be provided by N.Y. and shall be of the proper value to be used as a haze filter for the selected film.

## 2.10 Instrumentation - Camera Subsystem

Instrumentation to monitor and evaluate the operation of the camera subsystem during test and flight will be incorporated by the N.Y. manufacturer, with the required connector pins supplied at the camera interface. The required power and signal conditioning will be supplied by A/P external to the camera subsystem and will be compatible with the TM system. Four (4) spare pins or more will be provided for instrumentation that may be required at a later date. TM data regarding test and operational information of the ICS program will be made available to N.Y.

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## 2.10.1 Thermal Instrumentation

Micro-Systems TE-3D temp sensors with a nominal resistance of 2000 ohms at 78° will be used for all thermal instrumentation. The necessary power and circuitry will be supplied external to the camera by A/P. A four-point calibration curve for each sensor will be supplied for inclusion in the Camera log book that is made available to A/P. The Camera Contractor will use A/P T3-517; Page 1, 2 and 3 only, as a general guide for installation of the temp sensors. Two temp sensors will be located in the camera body.

## 2.10.2 Operational Data Instrumentation

Instrumentation to adequately monitor and evaluate camera operation will be defined in the camera D.C.S. The following items will be included:

1. Terrain shutter operation
2. Film transport and idler roller motion
3. Drive motor voltage
4. Operate command
5. Mode selection
6. Camera cycling
7. Film takeup footage
8. Multiplexing external to the camera for simplified TM range selection and TM signal conditioning.
9. Temperature

## 2.11 Temperature Limitations

Nominal flight operating temperatures external of the camera subsystem will be 70° ± 20°F. However the camera subsystem must be capable of operating through a range of 40 to 120°F for external ambient temperatures with a minimum of photographic degradation. Temperature sensitive components within the camera subsystem shall be identified by the manufacturer and designed to function under the maximum temperature limitations.

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## 2.12 Reseau Illumination

2.12.1 Natural illumination will be used for the terrain resseau with provision for artificial illumination during calibration.

2.12.2 Artificial illumination will be used for the stellar resseau.

## 2.13 Radiation Shielding

Radiation shielding will not be provided.

## 2.14 Transfer Sequence

During the transfer sequence required to transfer operation from the "A" to the "B" takeup cassette, a time delay is required between activation of the primary film cut and splice device and the water seal mechanism.

The delay will eliminate the requirement for film cutting by the water seal mechanism and will also prevent film loss that occurs when both mechanisms are actuated simultaneously.

The control of the takeup cassettes, camera, and film cutters will be reviewed by both Contractors to assure a system that will provide the proper transfer sequence. Provisions for control will be provided external to the camera subsystem.

## 3.0 J SYSTEM HARDWARE DESIGN/REDESIGN/MODIFICATION

The J system will be changed as required to incorporate and interface with the Camera subsystem.

### 3.1 Mechanical Requirements

The following major structures and associated components and equipment will be designed or modified as required to incorporate and interface with the camera subsystem.

1. Structure barrel
2. Fairing

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3. "B" SRV

4. "A" SRV

Test aids, tooling, and fixtures will be provided as required.

### 3.1.1 ~~Cut and~~ Splice Device

A cut and splice device will be designed by A/P and qualified for use on the ICS program. One device will be supplied to N.Y. for use in camera qualification tests. A/P will modify the device for N.Y. such that pyro actuation is not required.

### 3.2 Electrical Requirements

J system electrical design will be made compatible with the camera subsystem and associated electrical equipment will be designed and modified as required. This will include new cables (clock to camera, camera to film cassettes); modified cables and harnesses; modified transfer, forward pyro, command, and TM - power J-Boxes; and a new Control/Sequence box. Fusing will be provided by A/P external to the camera.

### 3.3 Mock-up

The mock-up of the J system will be modified by A/P to evaluate the space requirements of the ICS.

### 3.4 Instrumentation J System

In addition to the instrumentation provided on the camera subsystem, A/P will provide instrumentation to monitor and evaluate the performance of the ICS components. Instrumentation will be defined in the A/P ICS.

### 3.5 Command and Control

Command and control capabilities for the ICS program will be furnished by A/P

1. Pan System (Stereo or mono) will provide for simultaneous operation of the ICS when in mode one.

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2. A stored program independent of Pan Program will provide for ICS mode 2. The ICS program will be disabled by RTC, but not controlled by intermix control.
3. See 2.14 for Transfer Sequence.

## 3.6 Computer Program

Computer programs and computational methods required for command and control analysis of system performance will be furnished by A/P.

## 4.0 GHE REQUIREMENTS

- 4.1 Modification of universal handling fixture by A/P.
- 4.2 Patio Testing Equipment and fixtures will be designed, fabricated and furnished by N.Y. Handling and transportation fixtures for integrated vehicle structure-camera tests will be supplied by A/P.
- 4.3 One set of spare cassettes will be furnished to A/P by the N.Y manufacturer for the purpose of special tests that may be required at A/P.
- 4.4 Modify security dust covers. (A/P)
- 4.5 Modify existing P/L carrying cases (A/P).

## 5.0 GSE REQUIREMENTS

### 5.1 A/P Requirements

A/P will provide new or modified GSE equipment pertaining to the following:

1. Test Consoles
2. Payload simulator
3. ICS simulator
4. Clock (sub-contract)

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## 6.0 TEST REQUIREMENTS

The A/P Contractor shall provide for no refurbishments and/or retesting required because of failure of GFE, except when required by A/P induced failure.

### 6.1 Development Tests

Developmental testing will be conducted by the Contractors on any hardware and/or subsystem as required to provide design proof data to substantiate design details and to provide design parameters required for hardware fabrication, test, and operation.

### 6.2 Qualification Tests

Associate Contractors will be responsible for conducting qualification tests to insure that the equipment capabilities will exceed the operational and ascent requirements.

#### 6.2.1 A/P Hardware Qualification:

##### 6.2.1.1 Structures

The following structures and associated components or equipment will be subjected to qualification tests:

1. Recovery barrel
2. SRV

##### 6.2.1.2 Components

The following components will be qualified:

1. Doors
2. Cut and Splice Device
3. Hot wire cutter
4. Water Seal
5. T/M (repackaged)
6. Electrical boxes as required

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## 6.2.2 N.Y. Hardware Qualification:

All major components of the camera subsystem will be qualified. (Reference 57-DB-1A)

1. Supply cassette
2. Takeup cassette No. 1
3. Takeup cassette No. 2
4. Stellar/Terrain Camera including film exit housing and film chutes
5. Complete system of above components

6.3 Acceptance Tests

## 6.3.1 A/P Requirements

The following A/P components will be subjected to acceptance tests:

1. ~~Cut~~ and Splice Device
2. Hot wire cutter
3. Control/sequencer box
4. Water seal

## 6.3.2 N.Y. Requirements:

The following equipment will be acceptance tested:

1. Supply cassette
2. Takeup cassette No. 1
3. Takeup cassette No. 2
4. Stellar/Index Camera

6.4 Systems Tests

Systems test will be conducted by A/P, with the necessary changes incorporated in the procedures and test equipment to accommodate the ICS program.

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## 6.5 Classification of Tests

Inspection and testing shall be classified as follows:

### 6.5.1 System Qualification Tests

Qualification test objective is to prove the system reliable beyond operational requirements. Tests shall be run on a system to verify compliance with performance requirements. Tests shall be run with no adjustments or repairs during the course of the test. If any modifications are necessary after the completion of any qualification test, the test must be rerun. Explicit waiver may be granted upon demonstration that the modification will not affect the response to the particular test. The system shall be qualified to the applicable limits of IMSC 6117B, using environments specified for the "Payload Area". IMSC shall accomplish these tests.

### 6.5.2 Component and Subassembly Qualification

All components and subassemblies shall be separately qualified to the limits applicable in IMSC 6117B, dated 1 July 1960, and 57-DB-1A using environments specified for Payload Area and camera subsystem. Components, subassemblies and parts need not be given qualification tests if prior qualification under test conditions at least as severe as required in this specification are documented. Parts qualification shall be presented to the Government.

### 6.5.3 Acceptance Tests

Acceptance tests shall be run on production units to verify workmanship and operability. The individual test shall be run with no adjustments or repairs during the course of the test. If any modifications or repairs are made following the completion of any acceptance test, tests previously run on the repaired or modified component must be repeated, unless an explicit waiver is granted, based on the demonstration that the modification or repair will not affect the response to the particular test or tests. Tests may be witnessed by the Government and recommendations thereon shall be made to SAFSP.

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#### 6.5.4 Individual Tests

##### 6.5.4.1 System Qualification Tests

All tests shall be performed as required by an approved D.C.S. and defined by Qualification Test Specifications. Directing documentation and test procedures must be released prior to start of test. Certification of performance and test reports with data must be presented to the Government to verify test completion success for the following:

###### 6.5.4.1.1 Vibration Test

###### 6.5.4.1.2 Thermal Altitude

###### 6.5.4.1.3 Voltage Sensitivity

###### 6.5.4.1.4 Optical Resolution

###### 6.5.4.1.5 Acceleration Test (where applicable)

##### 6.5.4.2 System Acceptant Tests

These tests shall be performed to Acceptance Test Specifications, per Test Procedure to verify manufacturing capability to flight objectives.

###### 6.5.4.2.1 Vibration

###### 6.5.4.2.2 Altitude

###### 6.5.4.2.3 Functional

###### 6.5.4.2.4 Optical Resolution

##### 6.5.5 Test Specifications

All Qualification and Acceptance Test Specifications shall be prepared by the Associate Contractors and approved by the Government prior to the performance of the Qualification and/or Acceptance Test.

##### 6.5.6 Reports and Monitoring

###### 6.5.6.1 System Qualification Tests

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All qualification tests results shall be reported to the Government, giving in detail all failures, repairs necessary, and malfunctions not resulting in failure. The Government may witness all qualification tests.

6.5.6.2 Component and Subassembly Qualifications

Reports on components and subassembly qualification tests shall be reported to the Government. The Government may witness such tests.

6.5.6.3 Acceptance Test

The acceptance test shall be reported to the Government. All failures, repairs and malfunctions not resulting in failure shall be reported. The Government may witness or review all acceptance tests.

6.5.6.4 Flight Performance Analysis Report

The flight performance analysis report will be submitted to the required organizations.

7.0 DOCUMENT RESPONSIBILITIES

Associate Contractors shall prepare and submit to the Government all required documentation for subsystems and equipment for which they are responsible.

7.1 Design Control Specifications

7.2 Qualification Specifications and Procedures

7.3 Acceptance Test Specifications and Procedures

7.4 Failure Analysis

7.5 Drawings and Schematics as Required

7.6 FEDR/CARD Reports at the A/P Facility

7.7 Operation Manuals

7.8 Field Specs. and Procedures

8.0 HARDWARE LIST

The equipment to be supplied is not limited by this list.

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8.1 N.Y. Requirements

1. Camera Subsystem
  - a. Supply cassette
  - b. Takeup cassettes (two)
  - c. ICS Camera
  - d. Film exit housing
  - e. Film chutes
  - f. ICS mockup for incorporation in J system mockup.
2. Auxiliary Equipment
  - a. Optical test stand
  - b. Spare cassettes
  - c. One camera test stand
  - d. One C/O console for camera subsystem C/O by N.Y. at the A/P facility.
  - e. Patio. test fixtures and equipment

The auxiliary equipment will be supplied to A/P as required.

8.2 A/P Requirements

1. J System
  - a. Mounting structures for ICS and additional J system components.
  - b. Film chutes forward of the film transfer box.
  - c. Inter-connecting cables and harnesses
  - d. Cut and Splice Device
  - e. Light seal closures
  - f. Access doors
  - g. Stellar boots
  - h. Hot wire cutters
  - i. Tooling and fixtures

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- j. Test Aids
- k. Electrical system boxes
- l. Commutator
- m. J System mockup

**2. Auxiliary Equipment**

- a. ~~Cut and Splice Device (one) modified~~
- b. Handling and transportation fixtures for the integrated vehicle structure - camera as required when patio tests are conducted in the integrated configuration.
- c. Laboratory test equipment to be supplied to N.Y. at the A/P facility. Should other program schedules preclude use of such equipment, A/P will separately negotiate, with SAFSEP, the purchase of such additional equipment required to support the IOS program.

**9.0 APPLICABLE DOCUMENTS**

The following documents form a part of this specification. In case of conflict or ambiguity, this specification will take precedence over the applicable document listed. Should certain documents not be available to a Contractor for security or proprietary reasons, these documents will be screened and revised so that pertinent information required can be forwarded to the Contractor.

T3-4-508	Storage and Handling Specification
T3-4-001	J Follow-on Requirements Specification
T3-3-002	Acceptance Test Spec - J System
IMSC 6117B	General Environmental Specification for Agena Satellite Program
IMSC 1412815-8	X-ray Inspection of Semi-Conductors
IMSC 0419A (Amendment No. 1)	Elastics for Application to Electrical Components

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SP 1102	General Environmental Specification
SP62-65-0002 Rev. A	Process Specification Film 4400
SP2-478	J System Requirement Specification
SP4-188	ICS Work Statement (A/P)
57-DB-1A	ICS Program Requirement Specification (N.Y.)
57-DB-2A	ICS Program Work Statement
MIL-V-173	Varnish, Moisture and Fungus Resistant
MIL-E-ID	Electron Tubes and Crystal Rectifiers
MIL-E-5400	Electronic Equipment, Aircraft, General Spec. for
MIL-STD-150A	Photographic Lenses
MIL-F-9329	Filters, Light Photographic Lens, for Aerial & Ground Cameras
MIL-C-4150	Case, Carrying & Storage, Shock and Water proof
TO-0025-203	Standard Functional Criteria for the Design and Operation of Clean Rooms
JAN-F-675	Films, Reflection Reduction for Glass Optical Elements

## 10.0 QUALITY CONTROL

As an aid to quality control, and reviews for improving reliability, a FEDR/CARD system will be used at the A/P facility by all Contractors as outlined by the A/P procedure and as presently used on the existing systems.

## 11.0 FIELD SUPPORT

E.I. will provide personnel for technical support at A/P for 12 months, subject to negotiation and approval by SAFHP. Field support effort will be separately negotiated with SAFHP.

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Service, facilities, and equipment will be defined at the time of negotiation.

#### 12.0 ENGINEERING SUPPORT

The Contractors will provide the effort for technical evaluation to insure the integrity of the systems are maintained as the ICS subsystem is incorporated into the J system.

#### 13.0 BUY-OFF

Verification tests will be conducted by N.Y. personnel upon receipt of the camera subsystem at the A/P facility. A DD 250 signoff and approval for the camera subsystem shall be completed after verification test data have been reviewed by SAFSP.

#### 14.0 DESIGN REVIEWS

The Contractors shall provide for design reviews as required to monitor and evaluate the design and development. The reviews shall be at various stages of the program and will consist of the following:

1. Component Design Reviews to evaluate individual component design as it affects the J system. Schedule impact will be resolved for compatibility with the system schedules and for compatibility with the other Associate Contractor's design.
2. Parts Application Reviews to determine compliance with acceptable parts selection for design and evaluate effects of parts that deviate from applicable MIL specifications.
3. Subsystem Reviews - Same as (1) except at the subsystem level.
4. System Reviews - System reviews will be held, as requested, to evaluate the compatibility and design of the complete J/ICS flight system. Scheduling of the reviews will be as required to properly evaluate the system as it progresses through the design and development portion of the program.

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## 15.0 SPARE PARTS

Spare parts requirements will be determined and a list thereof furnished to the Government. Long lead items will be noted. Spares for the camera subsystem will be furnished as flightworthy GFE. A/P will maintain stockrooms and inventories of all spare parts provisioned to support the ICS program.

## 16.0 FILM REQUIREMENTS

The film required to support test and flight operations will be furnished GFE to both Contractors and on a schedule to adequately support all phases of the ICS Program. Film requirements will be coordinated by A/P with the Government.

## 17.0 DELIVERY SCHEDULES

Delivery schedules for the integrated ICS/J systems will be in accordance with the schedule outlined in the A/P document SP4-188. N.Y. will be supplied with a current schedule by A/P to assure compatibility of all schedules.

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