~~SPECIAL HANDLING~~

14 00067147D

9204-SHC64-209

Copy #

14 December 1964

Dear Jim:

Transmitted herewith are five (5) copies each of the DD-250 form covering the shipment of the Main Camera Preliminary Interface Specification (9204-SHC64-191) under Contract MB-1957 on 19 November 1964.

Copies #1, #2 and #3 of this document were hand carried to [redacted] on 19 November 1964. Copy #9 is enclosed for your records.

Please sign two (2) copies of the DD-250 form and return to W. N. Snouffer, P.O. Box 115, Bedford, Massachusetts.

Very truly yours,

Jack

J. E. Lilley,
Contract Administrator

JEL/mm

MB-1957
TP

~~SPECIAL HANDLING~~

FUL-0274
Copy #1

9204-SHC64-209/1 Copy # 1

SHIPPING CONTAINER TALLY 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

MATERIEL INSPECTION AND RECEIVING REPORT (DOMESTIC)

1.

2. FLOW CHART OR PROCEDURE NO. | 3. SHEET NO. 1 | 4. NO. OF SHEETS

5. OFFICE ADMINISTERING CONTRACT

6. INSPECTION OFFICE

7. CREDIT VOUCHER OR FILE NO.

8. AGENCY PLACING ORDER ON SUPPLIER—CITY—STATE
United States Government, Washington, D.C.

9. PRIME CONTRACT OR P. O. NO.
MB-1957

10. NAME OF PRIME CONTRACTOR—CITY—STATE
Itek Corporation, 10 Maguire Rd., Lexington, Massachusetts

11. SUPPLEMENTS AND CHANGE ORDERS

12. MANUFACTURER OR WAREHOUSE SHIPPED FROM—CITY—STATE

13. ORDER NO. ON SUPPLIER

14. SHIPPED TO—MARK FOR
[redacted]
(Accountable Office when different)

15. PROC. DIR. OR REQUISITION NO.

16. SHIPMENT ORDER NO.

17. SHIPMENT NUMBER ON CONTRACT
A. PARTIAL | B. FINAL

18. GROSS WEIGHT | 19. NET WEIGHT

20. DATE SHIPPED: 19/64 | 21. SEAL NUMBERS | 22. B/L OR REGISTRATION NO. | 23. CAR NO. | 24. ROUTING

CONTRACT ITEM NUMBER 25	STOCK AND/OR PART NUMBER AND DESCRIPTION OF ARTICLES (Indicate no. of shipping containers—Type of container—Container no.) 26	UNIT OF MEAS. 27	QUANTITY SHIPPED 28	QUANTITY RECEIVED 29	UNIT COST 30	TOTAL COST 31
4	Main Camera Preliminary Interface Specification (#9204-SHC64-191) Copy #1 Copy #2 Copy #3 Copy #9		4 Copies			

Received and Accepted: [redacted]
Authorized Signature

32. APPROPRIATION

C. ARTICLES SHOWN IN COLUMN 28 WERE RECEIVED IN APPARENT GOOD CONDITION, EXCEPT AS NOTED
DATE: INCHECKER:

33. INVOICE ROUTING

34. CLASS—CODE | 35. ACCOUNT NO.—STORES ACCOUNT | 36. DEBIT VOUCHER OR I. R. NO.

A. I CERTIFY THAT THE ITEMS LISTED HEREIN HAVE BEEN INSPECTED BY ME OR UNDER MY SUPERVISION. THEY CONFORM TO CONTRACT, AND HAVE BEEN ACCEPTED, EXCEPT AS NOTED.

DATE | SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE

(Typed name of Inspector)

B. I CERTIFY THAT I HAVE RECEIVED AND/OR ACCEPTED THE ARTICLES SHOWN HEREIN (for use on Contract No.) EXCEPT AS NOTED.

19 Feb 65 [redacted]
DATE

DD FORM 250, OCT. 55

14 00067148D

MAIN CAMERA

PRELIMINARY INTERFACE SPECIFICATION

12 November 1964

MAIN CAMERA

INTERFACE SPECIFICATION

1.0 SCOPE

This specification defines requirements for the interface of the main camera assembly with the spacecraft. Interface requirements of the Stellar/Index (S/I) camera and Recovery Takeup, which are also provided by the camera manufacturer, are defined in separate documents.

2.0 OPERATIONAL SEQUENCE

2.1 Mission Duration

Five to ten days.

2.2 Photographic Operation

Duration of photographic operation is between 1.5 and 2.5 hours total, depending on orbital altitude, and assuming simultaneous operation of both optical bars. This period will be expended in a maximum of 30 cycles of operation, with a maximum cycle length of 15 minutes.

2.3 Camera Operation

Maximum duration of camera operation is 6 hours total, including photographic operation, start/stop sequence, and rewind. This assumes simultaneous operation of both optical bars.

3.0 CAMERA CONFIGURATION

3.1 Camera Description

The main camera comprises two optical bars mounted in a truss frame. Each optical bar is a self-contained imaging system, including optics, film transport, film supply, and drives. The optical lines of sight intersect at 30° for stereo effect. The optical bars rotate continuously, but frames are exposed only through a scan angle of 120°. Film is recycled within the optical bars to complete exposure of all frames. Following exposure of the film load, a leader is spliced to the film aboard the rotating elements, and the exposed film is spooled into the recovery vehicle.

3.2 Camera Size

The main camera, as shown on drawing No. SK67665, occupies a cylindrical envelope 171-inches long by 110-inches diameter.

3.3 Structural Interface

Structural connection of the camera to the spacecraft shall be at three bolts located by coordinated tooling to be provided by the camera manufacturer. The bolt circle diameter shall be 106-inches. Brackets shall be provided on the spacecraft which accommodate the camera truss joint detail, and which support the camera during assembly without use of the interface bolts.

3.4 Electrical Interface

Main camera leads shall terminate at eleven electrical connectors at a mutually acceptable point on the vehicle wall. Function of each connector shall be as follows:

3.4.1 Prime Power, Optical Bar A

3.4.2 Prime Power, Optical Bar B

3.4.3 Programmer Commands

3.4.4 Telemetry Signals, Optical Bar A

3.4.5 Telemetry Signals, Optical Bar B

3.4.6 Ground Test Signal Input, Optical Bar A

3.4.7 Ground Test Signal Input, Optical Bar B

3.4.8 Ground Test Signal Output, Optical Bar A

3.4.9 Ground Test Signal Output, Optical Bar B

3.4.10 Recovery Takeup Control

3.4.11 Stellar/Index Camera Control

3.5 Takeup Chutes

The camera manufacturer shall furnish and install two film chutes between the main camera and the recovery vehicle, and shall install the cut/seal unit(s) to sever all films and seal the opening in the recovery vehicle.

3.6 Window Baffle

The camera manufacturer shall furnish and install a light baffle from the main camera to a mutually acceptable interface around the window opening.

4.0 CAMERA WEIGHT AND BALANCE

4.1 Weight

The main camera shall weigh 2200-pounds plus 880-pounds film load for a total of 3080-pounds (exclusive of S/I camera and recovery takeup).

4.2 Center of Gravity

During launch and simultaneous operation of the optical bars, center of gravity is as shown in drawing No. SK67665. During individual optical bar operation, the center of gravity will shift toward the takeup spool of the optical bar in use, the maximum shift being 18-inches with full film load at one end of the camera.

4.3 Static Moments of Inertia

Moments of inertia of the complete main camera with full film load in the supply spools measured about the nominal camera center of gravity are the following:

4.3.1 310 slug foot^2 About Roll Axis

4.3.2 1120 slug foot^2 About Pitch Axis

4.3.3 1380 slug foot^2 About Yaw Axis

4.4 Momentum Unbalance

4.4.1 Net angular momentum about the yaw axis during camera operation shall be less than $\pm$ 100 slug foot^2/second.

4.4.2 Net angular momentum about the roll axis during operation of one optical bar only shall be less than ± 100 slug foot²/second.

4.4.3 Short duration torque unbalance during start/stop cycles shall be less than 5-pound-feet about roll, pitch, and yaw axes.

5.0 VEHICLE CONFIGURATION REQUIREMENTS

5.1 Assembly

The spacecraft shall accept the main camera assembly as a unit with no requirement for disassembly or realignment of the camera. Access doors and work platforms shall be provided in the vehicle for assembly and prelaunch adjustment.

5.2 Spool Loading

The spacecraft shall provide space beyond the camera envelope over the film supply spools for withdrawal of loaded spools. The spools are 42-inches in diameter by 10-inches long, and weigh 460-pounds. The spacecraft shall accommodate handling equipment for removal and installation of loaded spools.

5.3 Mechanical Alignment

The three points defining the camera structural interface shall be aligned with respect to the vehicle attitude reference with sufficient accuracy to maintain the attitude tolerance of paragraph 8.1 of this specification. The camera manufacturer shall define alignment references on the interface tool, subject to approval of the spacecraft manufacturer. Total mechanical alignment shall include the effects of initial setting error and vehicle deformations occurring between initial alignment and camera operation.

5.4 Jet Locations

Attitude control jets shall be located to minimize plume interference and structural excitation at the camera.

5.5 Window Separation

The window area shown on drawing No. SK67665 shall be clear of any obstruction from completion of launch to completion of mission. Mechanisms for window separation shall not produce excessive shock loads at the camera interface.

5.6 Light Baffling

Stray light shall not enter the interior of the spacecraft. All spacecraft joints shall be light tight. Pressure relief valves shall be provided by the spacecraft to bleed pressure from the camera compartment during ascent at a rate which will preclude rupture of camera baffles.

5.7 Electrical Interface

The spacecraft contractor shall provide eleven electrical connectors as required by paragraph 3.4 of this specification, and shall furnish and install cables to the appropriate terminals. The cable to the S/I camera shall terminate at a connector adjacent to that unit. The cable to the Recovery Takeup shall terminate at the Recovery Vehicle umbilical. Final choice of all connectors shall be subject to approval of the camera manufacturer.

5.8 Takeup Chutes

The spacecraft shall incorporate brackets to mount film chutes from main camera to recovery vehicle.

6.0 CAMERA POWER SUPPLY

6.1 Power Interface

Primary power for the main camera, S/I camera, and recovery takeup shall be supplied at the main camera power interface and distributed from the main camera. Power for the recovery takeup shall be supplied from a source independent of the camera source. The same regulation requirements govern both power sources.

6.2 Voltage Regulation

6.2.1 Nominal Voltage

Primary power shall be supplied at +28v and -28v. The supplies shall be referenced to each other. A return conductor independent of the equipment frame shall be provided. Separate returns for +28v and -28v may be furnished, but shall be capable of interconnection.

6.2.2 Regulation Tolerance

The voltage at all primary power leads shall be within ± 3v of nominal, measured at the interface connector with respect to the power supply return lead. Regulation shall include all effects of noise, internal battery resistance, wiring drops in interconnecting cables, load, and change in battery voltage as a function of the state of charge. Regulation shall also include the effects of transient loads on the supply which are described in paragraph 6.3.2.

6.3 Main Camera Power Demand

6.3.1 Total Energy

The combined nominal capacity of the main power supplies shall be 6000-watt-hours.

6.3.2 Power Profile

The total load indicated below pertains to simultaneous operation of both optical bars, and shall be equally balanced between the +28v and -28v power supplies:

a. 1900-watts camera startup, duration 20 seconds each operating cycle;
b. 1000 watts steady photographic operation;
c. 1900 watts camera shutdown, duration 60 seconds each operating cycle;
d. 745 watts film rewind, duration 72 minutes each of two rewind cycles;
e. 0.5 watt standby drain.

The peak power load on either supply will be 950 watts, averaged over 60 seconds. Voltage shall be regulated within the tolerance of 6.2.2 during transient loads of 100 amperes, corresponding to peaks approximately three times the 60 second average.

6.4 Recovery Takeup Power Demand

6.4.1 Total Energy

The combined nominal capacity of the recovery takeup supplies shall be 1000 watt-hours.

6.4.2 Power Profile

The total load shall be 800 watts for a duration of 72 minutes. The +28v and -28v supplies shall be equally loaded. Voltage shall be regulated within the tolerance of 6.2.2 during transient peaks of 75 amperes.

7.0 TELEMETRY

The spacecraft shall provide a telemetry channel for transmission of camera data with a 5 Kilocycle information capacity. Camera telemetry will be provided in the following bandwidths.

7.1 Fifteen Channels, 25 cycles per second each

7.2 Twenty Channels, 10 cycles per second each

7.3 Four Channels, 100 cycles per second each

7.4 Four Channels, 1000 cycles per second each

8.0 VEHICLE ATTITUDE

8.1 Angular Tolerance

Attitude deviations of the camera structural interface measured with respect to axes defined by the orbital plane and local vertical shall be less than the following values for 99 percent of the camera operating time. The allowable deviation shall include random and systematic errors noted by paragraph 5.3 of this specification.

a. ±0.50 degrees about roll axis.
b. ±0.50 degrees about pitch axis.
c. ±0.50 degrees about yaw axis.

8.2 Residual Rate

Maximum vehicle angular rates shall be less than 0.31 milliradians per second about roll, pitch or yaw axes during camera operation.

9.0 VEHICLE PROGRAMMER REQUIREMENTS

9.1 Vehicle Programmer Outputs

The vehicle programmer shall supply to the camera system the following command signals.

9.1.1 Prime Power On

This signal shall be provided to the camera system 2 seconds prior to camera system on/off command, and shall have a minimum duration of 10 milliseconds.

9.1.2 Camera System A on/off

9.1.3 Camera System B on/off

These signals shall be provided 20 seconds prior to the photographic cycle and shall be maintained through the completion of the photographic cycle.

9.1.4 Camera System A Rewind on

9.1.5 Camera System B Rewind on

These signals shall have a minimum duration of 10 milliseconds to initiate the rewind cycle.

9.1.6 Recovery Sequence on

This signal shall be maintained during recovery sequence.

9.1.7 Initiate Recovery Sequence

This signal shall have a minimum duration of 10 milliseconds.

9.1.8 Telemetry on/off

This signal shall be maintained throughout telemetry transfer.

9.1.9 V/h Data Code

This signal shall be a 12-bit serial binary code providing real time V/h data accurate to ± 0.2% of instantaneous V/h rates.

9.1.10 Sun Angle Data Code

This signal shall be a 4-bit serial binary code providing sun angle data.

9.1.11 System Clock Reset

This signal shall have a minimum duration of 10 milliseconds.

9.2 Camera System Programmer Outputs

9.2.1 An output signal shall be generated by the camera system programmer when film takeup sequence has been completed. This signal shall have a minimum duration of 10 milliseconds.

10.0 THERMAL INTERFACE

10.1 Spacecraft Wall Temperature

The spacecraft contractor shall control the temperature of the inside surface of the camera compartment on orbit to maintain an average temperature of 70°F ± 15°F at all points visible to the camera. Average temperature is defined by:

$$T_{avg} = (\overline{T^4})^{1/4} = [\ \frac{1}{P} \int_0^P T^4\ dt\ ]^{1/4}$$

where

t = time

T = instantaneous temperature

P = orbital period

The inner surface of the spacecraft seen by the camera shall be painted black to preclude light reflection.

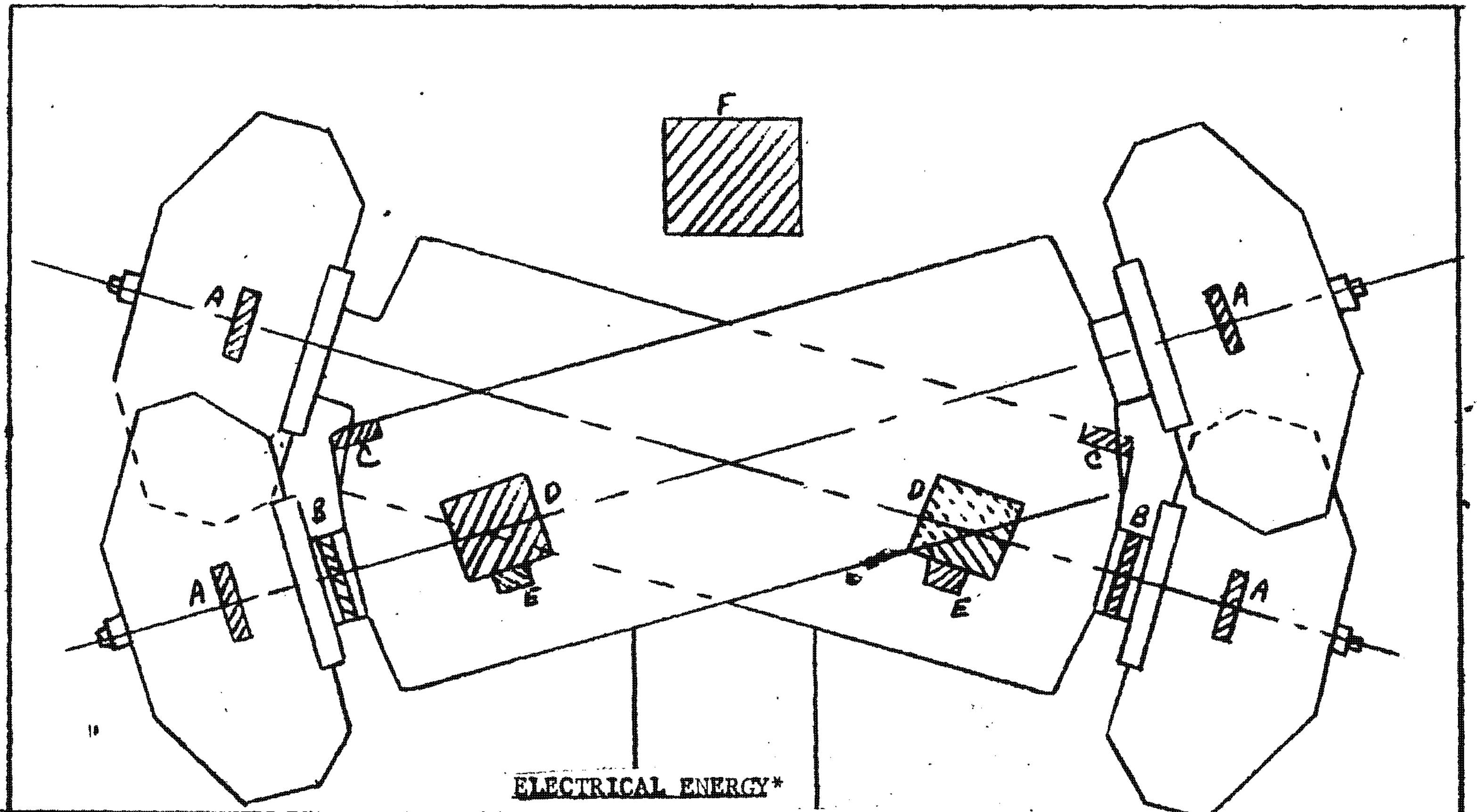
10.2 Camera Heat Load

The locations of heat dissipating components on the cameras and heat rates are shown in Figure 1. Geometry of the camera for shadowing calculations is defined by drawing No. SK67665. External surfaces of the camera, except for small heat dissipating surfaces, act as diffuse refractory surfaces. No heat shall be conducted between camera mount and vehicle wall.

10.3 Ascent Heating

During ascent, the temperature inside the spacecraft wall shall nowhere exceed 100°F.

ELECTRICAL HEAT DISSIPATION
COMPONENT LOCATIONS



ELECTRICAL ENERGY*

COMPONENT	LOCATION	Cameras Operating	Rewind
1. Reel Torquers	A	9.2 watt-hrs-each	29.2 watt-hrs-each
2. Bar Torquers	B	10.9 watt-hrs-each	——
3. Fiducial	C	9.7 watt-hrs-each	——
4. Film Drum**	D	1.7 watt-hrs-each	7.2 watt-hrs-each
5. IMC	E	2.4 watt-hrs-each	——
6. Control Circuitry Power and Control Amplifiers Control Logic Telemetry Date Block	F	55.0 watt-hrs-Sys.	174.0 watt-hrs-each

*Rewind – Approx. 4320 sec
Max. Period, Cameras Operating – Approx. 900 sec

**Continuous Drive