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TECHNICAL PUBLICATION

MODIFICATION KH-4A, KEYHOLE CAMERA SYSTEM

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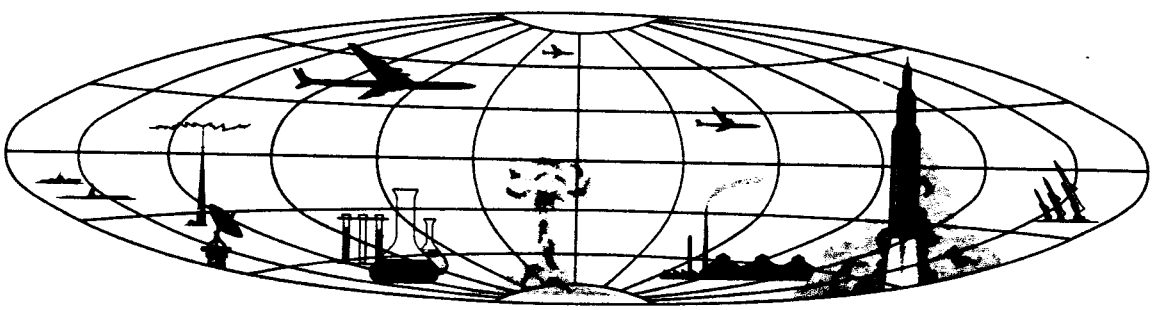

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MODIFICATION KH-4A, KEYHOLE CAMERA SYSTEM

PREFACE

This publication presents general technical information pertinent to the reduction of quantitative data obtained from photography generated by Modification KH-4A of the KEYHOLE camera system. Specific mission and camera data will be published separately for each KH-4A mission. Contents and format of published data will conform to preceding KEYHOLE publications of this nature.

The KH-4A system of photography in effect produces two separate reconnaissance missions from a single vehicle launching. It is a modification of the currently operational KH-4 system. The basic KH-4 camera configuration is retained but the film payload has been doubled and two recovery subsystems have been installed permitting independent ejection of the two payload components. After the first reconnaissance phase is completed and its payload ejected, the vehicle is programmed into an inactive state. It is subsequently reactivated for a second and final reconnaissance phase.

For operational purposes, the planned orbital life of the vehicle is thirty days, including eight days of active operation during which the two reconnaissance phases are completed. Flexibility in photographic programming is an inherent operational feature that offers obvious advantages over previous modes of satellite reconnaissance.

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KH-4A CAMERA CONFIGURATIONS

The KH-4A system of photography utilizes two KH-4 panoramic cameras (with associated horizon cameras) and two stellar-index (S/I) camera subsystems.

Panoramic Cameras

The two panoramic cameras are mounted in a 30-degree convergent stereoscopic configuration, one looking forward and the other looking aft. They may be operated together for stereoscopic coverage or individually when monoscopic coverage is desired. Their maximum sustained operating period is fifteen minutes. The cameras are nonsynchronous. In the event that one camera fails to function, the other is not affected and will continue to operate.

A detailed description of these instruments is available in [redacted] published March 1962. However, the principal features of the KH-4 panoramic camera are repeated in the tabulation below. Data applying exclusively to Modification KH-4A is so indicated.

Lens: Petzval f/3.5

Focal length: 24"

Slit widths (KH-4A): 0.06", 0.10", 0.20" and 0.30"

Angular field of view: 5 degrees

Scan angle: 70 degrees

Film type: 70 mm wide, 3.2 mils thick, polyester base

Film capacity (KH-4A): Approximately 15,600 feet, half of which is recovered in each recovery sequence.

Image motion compensation (IMC): Proportional to the velocity/height (V/H) ratio.

Horizon Cameras

Two horizon cameras are associated with each panoramic camera for determination of vehicle attitude. The paired horizon cameras will operate simultaneously on alternate panoramic cycles and the horizon formats will be exposed adjacent to the main panoramic frames.

Stellar/Index Cameras

The S/I camera subsystems are programmed to operate from the master panoramic camera during the operational cycles. The index cameras and the stellar cameras (two each) are fed by independent film transport systems.

Stellar photography (using 35 mm film) will provide a means of determining pitch, roll, and yaw conditions during operational cycles. It is anticipated that vehicle pitch and roll may be determined to the order of 0.10 degrees. Yaw may be determined to 0.50 degrees when stellar photography is employed in conjunction with index camera photography. The stellar camera accommodates 65 feet of 35 mm film and one stellar photograph is generated for each index camera exposure. A reseau is provided for elimination or minimization of image distortion.

The index camera (using 70 mm film) provides terrestrial photography for rapid correlation and indexing of panoramic photography and yaw determination. The camera is fitted with a calibrated reseau. The ratio of index camera exposures to master panoramic camera exposures is 1:7 in the KH-4 system, and no change is anticipated in the KH-4A system of index photography. The index camera presently accommodates 120 feet of 70 mm film. This capacity may be increased in the near future. Further details on the S/I cameras are available in [redacted] of March 1962.

FORMAT AND TITLING

Panoramic Cameras

The KH-4A panoramic format is identical to the KH-4 panoramic format in all respects except titling. The KH-4 titling sequence is modified for incorporation into the KH-4A system as follows:

a) The pass number requires three digits instead of the two employed in the KH-4 system. Pass numbers in the KH-4A system will conform to the actual vehicle revolutions from the launch, including the inactive period. For example, first-phase photography may terminate in pass 023 and second-phase photography may commence with pass 117.

b) The "E" designation for engineering passes will appear in the pass description block and will immediately precede the type designator. Example: the symbols EDS mean "Engineering - Descending - Stereo."

c) Since the KH-4A system involves a time separation between the first and second-phase photographic takes, parts one and two will be indicated by the digits 1 and 2, respectively. The part designators will immediately follow the mission number, separated by a dash. Example: 1001-1.

d) The time difference between the first and second reconnaissance phases renders the launch date insignificant. Consequently, the actual photographic date (Z time) including day, month, and year, in that sequence, will follow the mission number block. Example: 1001-1 13 6 63.

IMAGE MOTION COMPENSATION

Existent KEYHOLE systems possess orbital characteristics that permit employment of linear ramps for image motion compensation (IMC). However, such ramps are capable of satisfying IMC requirements only in situations that do not involve altitude changes of a decreasing - increasing nature (or vice versa) within the individual passes. It may therefore be said that linear ramps are adaptable solely to "unidirectional" IMC requirements, such as exist in operations involving decreasing or increasing altitude changes only.

The extended operational life of the KH-4A vehicle introduces a decay factor that ultimately affects the altitude profiles. Progression from decreasing to increasing altitude, and vice versa, occurs within the passes. This situation can best be met with the employment of cosine-curve ramps.

The cosine ramp serves precisely the same purpose as the linear ramp. It is simply a modification that permits application of the ramp to a combination (increasing - decreasing) altitude profile. The cosine ramp is composed of three segments, as is the linear ramp: two constant-rate (flat) segments and one change-rate (slope) segment. The constant-rate segments are located at the beginning and end of the ramp. All pertinent IMC data and velocity/height factors, etc., will be furnished for the cosine ramps employed in each mission.