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TCS-1205-63/KH
25 March 1963

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INFORMATION PERTAINING TO V/H RAMPS FOR KH-6 SYSTEM

As in the KH-4 system, the operation of the camera in the KH-6 system is controlled by a set of preprogrammed V/H ramps which in effect determines the operating rate of the camera along a range of actual V/H conditions.

The linear ramps (from now on straight line ramps will be referred to as linear ramps) presently specified for the KH-6 system are suited for decreasing altitude operation only. They will provide image motion compensation to within 4-5% of the actual V/H curve. Because of the more strict image motion compensation requirements of the KH-6 system and the fact that the altitude profile will progress from a decreasing altitude to an increasing altitude and vice versa within a pass, it has become necessary to initiate the use of a cosine-curve type ramp. The cosine-curve ramp can match 95% of the nominal orbit in the area of interest to within 1% IMC error.

Although users of KH-4 photography are familiar with linear ramps, there are enough modifications to the ramps as used by the KH-6 system to warrant a full explanation of their make-up and function. This memorandum also fully explains the cosine-curve ramp and provides information necessary for the complete utilization of ramp data as provided by NPIC.

LINEAR RAMPS. All linear ramps used in the KH-6 system are 2400 seconds in duration. The ramp consists of three segments, two of constant rate and one of increasing rate. The segments of constant rate are located one at the beginning and one at the end of the ramp. The first segment of the ramp is 360 seconds long and starts from zero. The second segment, the sloping section, is 1500 seconds long and runs from 360 seconds to 1860 seconds. The third and final segment is 540 seconds long and runs from 1860 seconds to the end or 2400 seconds. (See Fig. 1) It should be noted that rates plot as a straight line, while cycle period does not.

As shown in Figure 1 the rates are plotted as a function of time. NPIC will furnish, for each KH-6 mission, the rates for the beginning and ending of all linear ramps used in the mission. These are rates and period for the monoscopic mode which can be converted for the stereoscopic mode. (See conversion factors)

SAMPLE	Ramp Number 4	Begin	End
	Cycle Period (sec)	2.41	1.47
	Scan Velocity (″/sec)	39.6	66.0
	IMC Velocity (″/sec)	1.32	2.84

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With this information one can plot the ramp or ramps as a graph. Accompanying this information will be the "camera on time" and "camera off time" for each block where a block is defined as a strip of consecutive photographs in multiples of 16 frames. These time values are expressed in seconds and are always referenced from the beginning of the ramp (time zero). With this information one can locate the block on the ramp and determine any desired rate or cycle period corresponding to a rate.

All data provided for each mission will be published as "Operational Technical Camera Data" by the National Photographic Interpretation Center, on a timely basis, before users receive the film. If only one value is available, as is sometimes the case, the following conversion factors will allow conversion of one rate to another and from a rate to the corresponding cycle period. It should be noted here that two cycle periods are possible, one period for the monoscopic mode and one period for the stereoscopic mode. This information is also included in the following conversion factors.

Monoscopic cycle period - MCP
Stereoscopic cycle period - SCP

$$SCP = 1.0718 \times MCP$$

$$\text{Scan Velocity ("/sec)} = \frac{93.324}{MCP}$$

$$\text{IMC Velocity ("/sec) Center of Format} = \frac{4.0657}{MCP}$$

These conversion factors hold for MCP and SCP. Rates expressed in inches per second can be changed to radians per second by dividing by the focal length (66 inches).

COSINE-CURVE RAMP. The purpose of the cosine ramp is the same as the linear but enables the system to operate on both a decreasing and increasing altitude profile. The cosine ramp is 4600 seconds in duration and, as in the linear ramp, it is made up of three segments, two being of constant rate and the third segment representing that portion of the curve which has an ever-changing rate or slope (see Fig. 2). The flat portions of the curve are located at the beginning and end of the ramp. The first flat region of the ramp starts at time zero and runs for 200 seconds. The second segment of the curve, which is the sloping portion, runs from 200 seconds to 3600 seconds and is 3400 seconds in length. The last segment, which is flat or of constant rate, runs from 3600 seconds to 4600 seconds and is 1000 seconds in length.

The equation of the curve is as follows:

$$\omega = \frac{\omega_c + \omega_s}{2} - \frac{\omega_c - \omega_s}{2} \cos\left(\frac{\pi t}{1700}\right)$$

Where: ω = rate

ω_c = rate at center (1900 seconds on ramp)

ω_s = rate at beginning of ramp (200 seconds up ramp)

t = time referenced from 200 seconds

1700 = the center, in time, of the curved portion of ramp

For each mission the start and center rates, IMC velocity and scan velocity, plus the corresponding cycle period, will be furnished by NPIC for every cosine ramp used in the mission. With the equation of the curve and rates furnished the plot of the curve can be determined. The conversion factors can be applied to both the cosine and linear ramps, as the same relationships hold. Rates and period data per ramp will appear as follows:

Ramp 4	Start	Center
Cycle Period (sec)		
IMC Velocity ("/sec)		
Scan Velocity ("/sec)		

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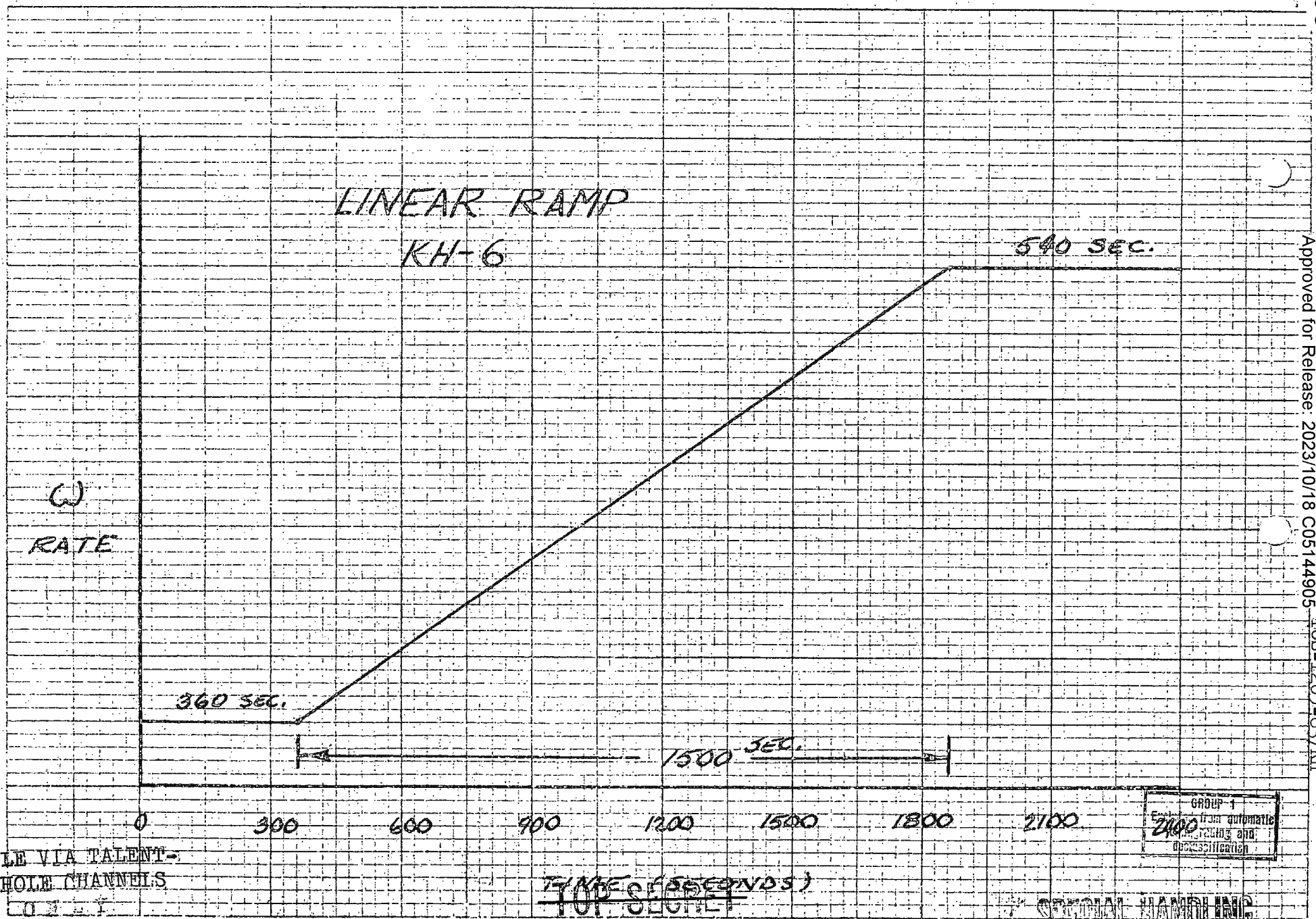

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COSINE-CURVE RAMP

KH-6

$$\omega = \frac{\omega_c + \omega_s}{2} - \frac{\omega_c - \omega_s}{2} \cos\left(\frac{t}{1700}\right)$$

ω_s = STARTING RATE

ω_c = RATE AT CENTER

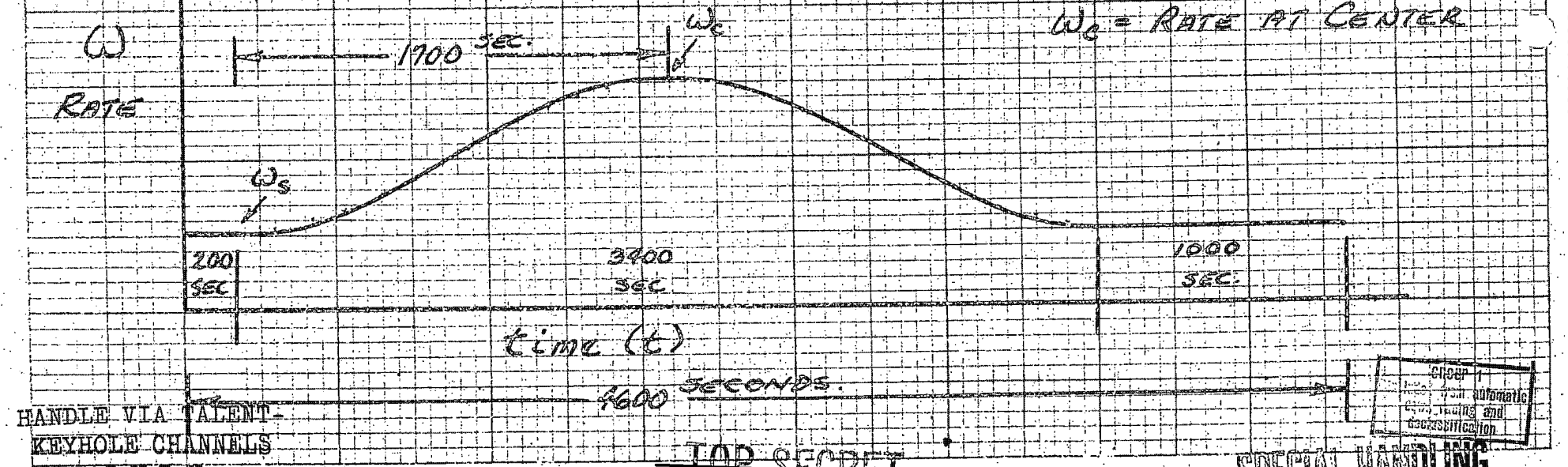

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Figure 7

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