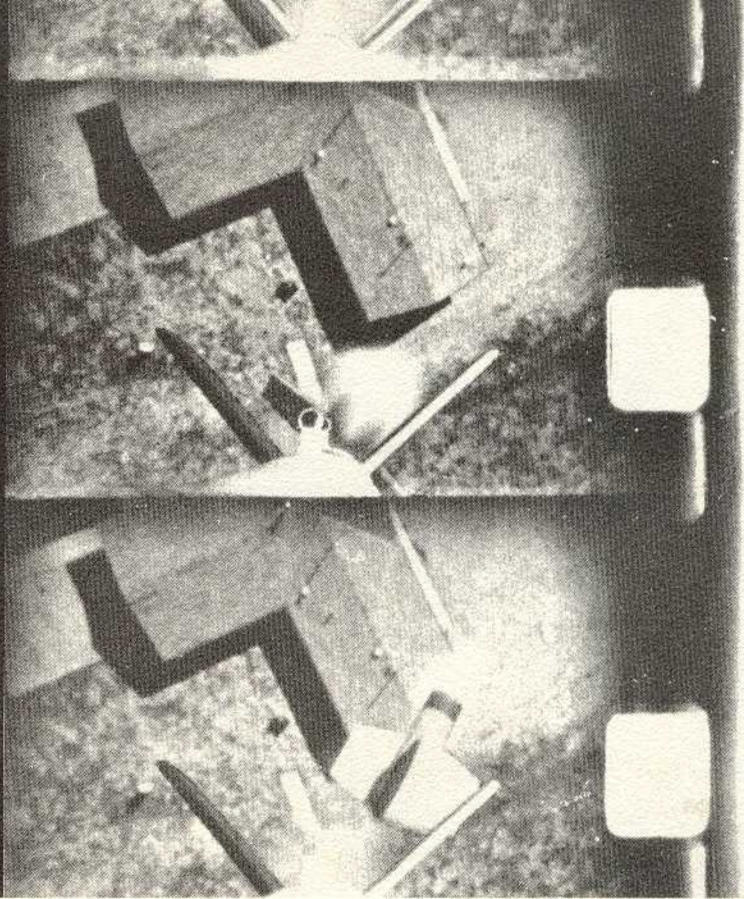
ESTES

CINEROC

OPERATING MANUAL



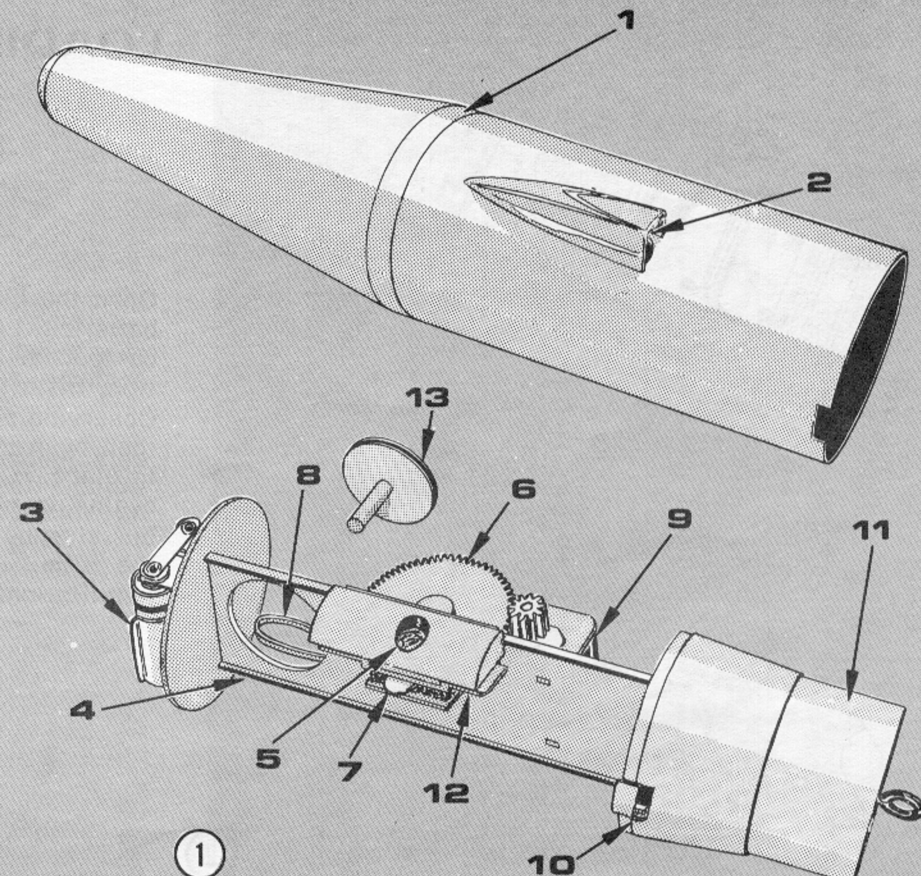
CONGRATULATIONS: You are the owner of a Cineroc . . . . the most significant development in the history of model rocketry. It was designed for YOU . . . . the model rocketeer. The Cineroc represents the first practical means for recording in-flight sequences from lift off to recovery. For the first time you will be able to actually see things you've always wondered about. What does ignition REALLY look like? What REALLY happens at staging? Does the parachute REALLY "pop" open? Chances are, you'll be able to photograph all of these events in ONE flight. As you progress, you'll learn to take aerial shots from a variety of angles and for specific experimental purposes. And at the same time, you will expand your knowledge and further your understanding of the principles involved in model rocketry.

MIKE DOERFFLER

CINEROC Design Engineer,
Research & Development
Estes Industries.

CINEROC PARTS

1. CAMERA CASING
2. MIRROR
3. BATTERY HOLDER
4. FRAME
5. LENS
6. SHUTTER GEAR
7. PRESSURE PLATE
8. DRIVE BAND
9. MOTOR
10. SWITCH
11. ADAPTER
12. GATE
13. PULLEY



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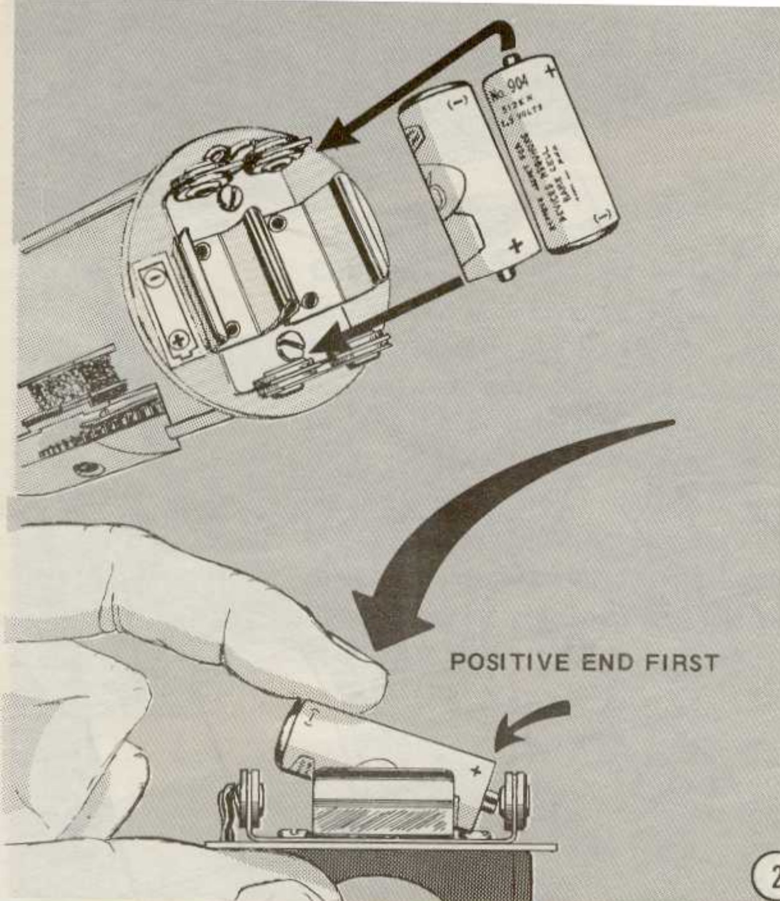
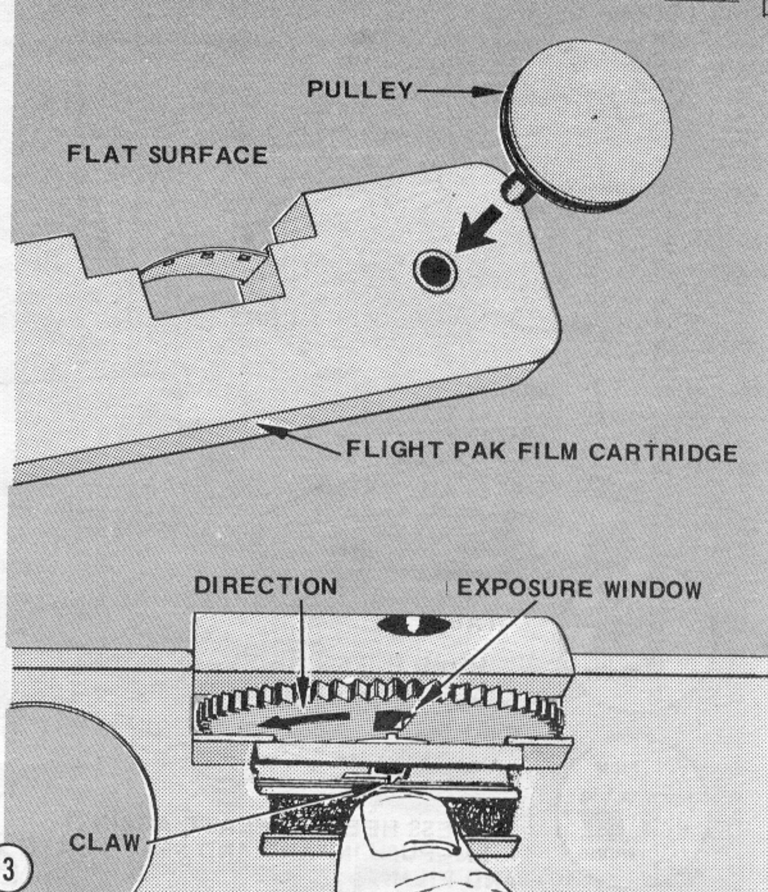


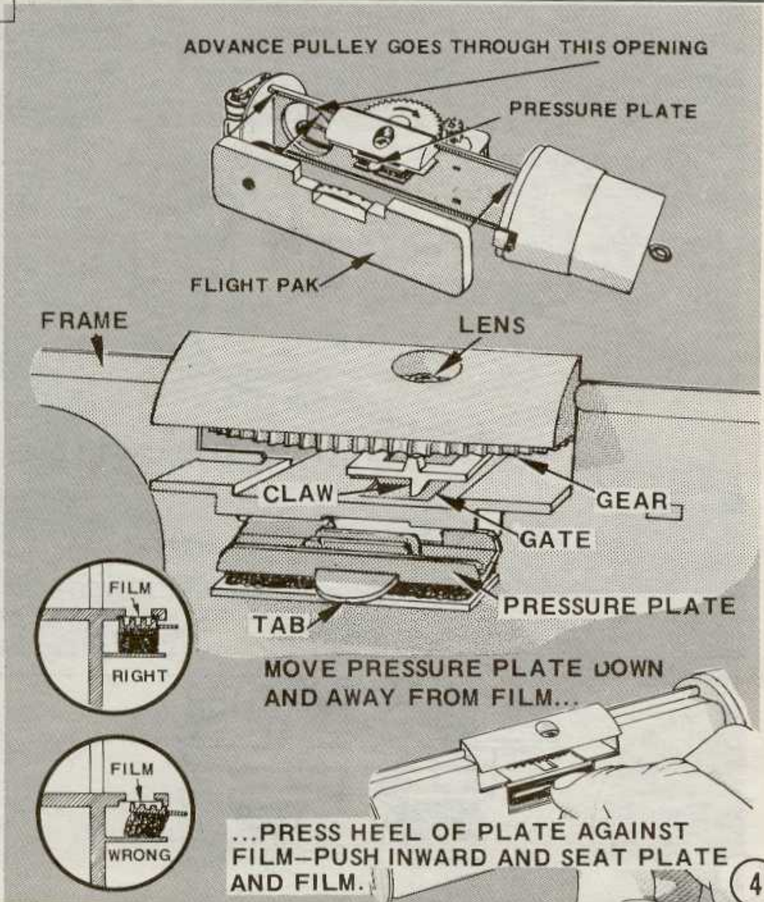
LOADING YOUR CINEROC

Open the black plastic bag and remove the two batteries. Leave the film in the bag until it is to be loaded. This insures maximum light protection. Install the batteries in the battery holder. Observing polarity, insert the positive end first, then push the negative end down until it snaps in place. If, in the process of loading, the motor begins to run, immediately turn the switch off, but also be sure the motor runs before loading the film. If it doesn't, recheck the battery installation.

In subdued light, lay the Flight-Pak, **taped side down**, on a flat surface. Push the advance pulley in until it stops.

Turn the shutter gear in the direction indicated until the opening in the gear is directly below the lens. This positions the advance claw so that the film is easier to put into the gate.

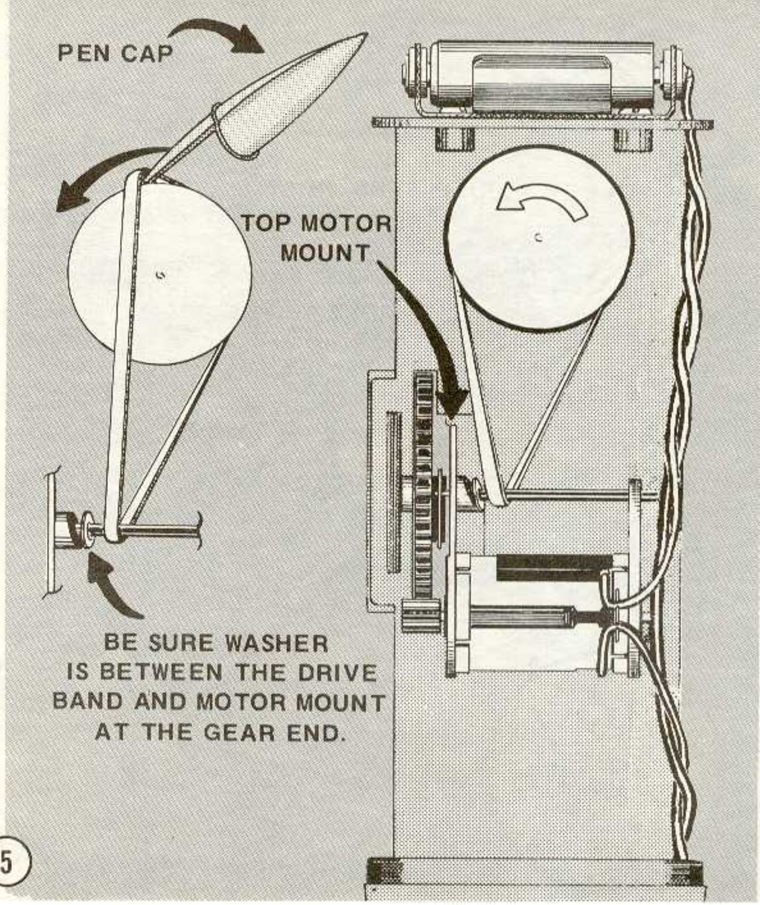


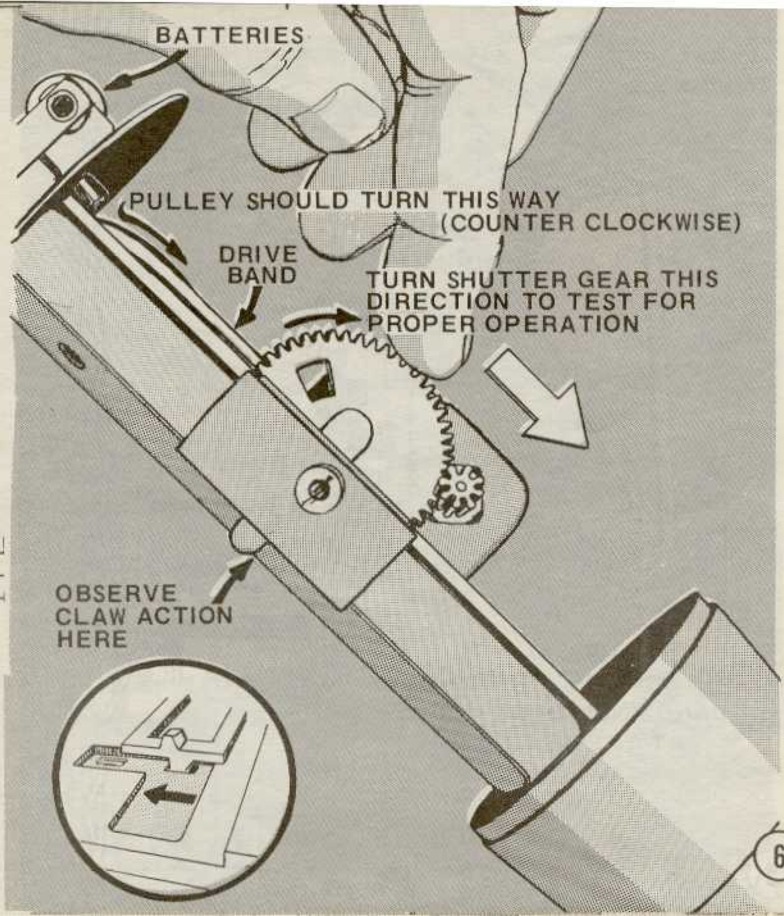


Depressing the finger tab (pressure plate), slip the Flight-Pak into place against the side of the frame, positioning the film between the pressure plate and gate. Release the finger tab making sure the pressure ribs are evenly in place against the back of the film. Check the position of the claw. It should be in one of the film notches or on top of the film between notches. If the claw is caught between the edge of the film and the exposure window, the camera will not operate properly; this should be corrected.

Use a ball pen cap, a small paint brush handle or a similar object to position the drive band onto the advance pulley as illustrated. Do not use your fingers or a pencil point. The natural oil of your fingers and the graphite contained in the pencil will lubricate the band, causing it to slip on the shaft and possibly causing the camera to fail. If twists develop during the process of routing the band, remove them. Check to be certain the small teflon washer is between the band and the top motor mount.

WARNING: The drive band must be positioned as shown. It must start from the side of the shaft furtherest from the camera frame, then over to the side of the advance pulley nearest the shutter gear. The camera will not operate if the band is installed incorrectly.



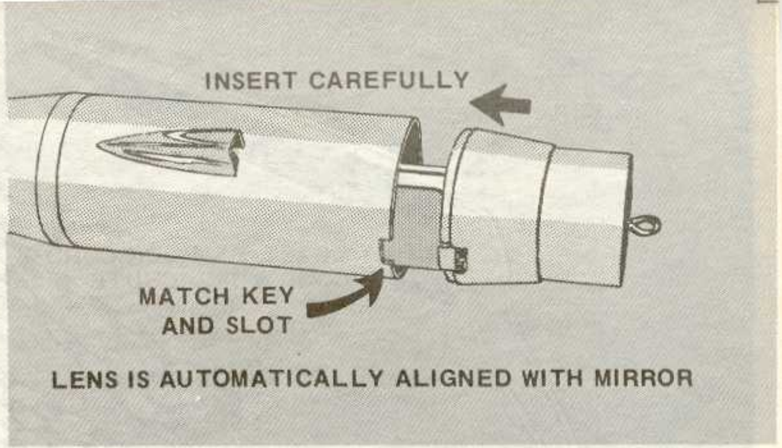


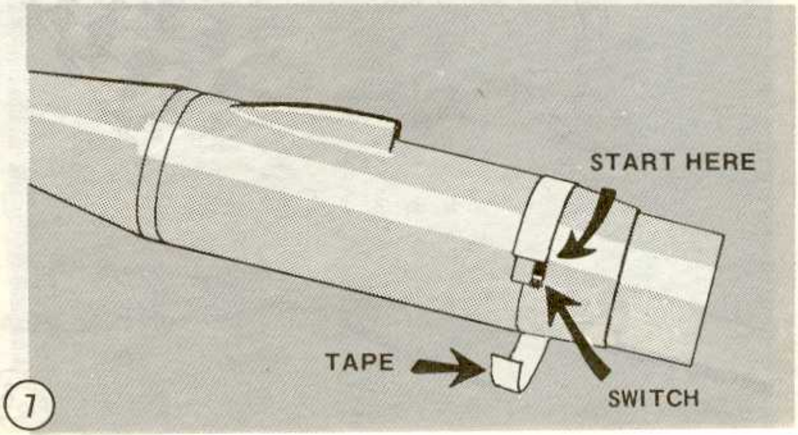
Check the camera for proper operation. Do not turn the camera on, but rather turn the shutter gear manually in the direction indicated. The advance claw should drop into one of the film notches, move the film toward the batteries, stop and return to the next notch with each revolution of the shutter gear. At the same time, the advance pulley should be turning very slowly in the direction indicated. Because of the slowness of the pulley, it may take as many as 5 frames to confirm its movement.

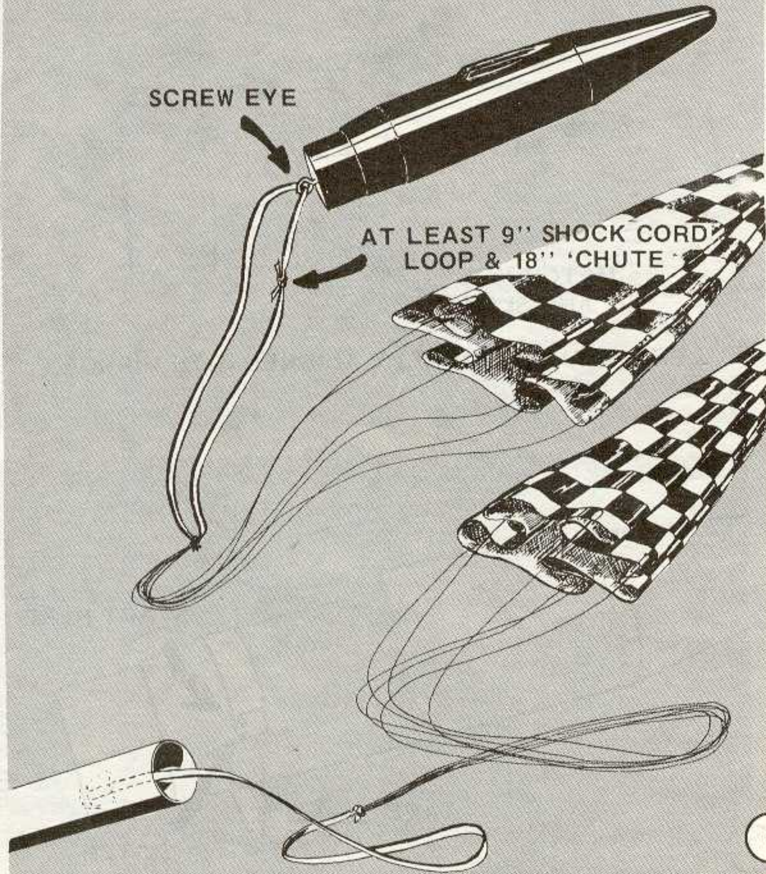
IMPORTANT: Make sure that the claw engages the film sprocket hole and that the film advances with each revolution of the shutter gear.

Slide the loaded Cineroc assembly straight into the camera casing, matching the rectangular key on the adapter with the rectangular slot in the casing. If the key and slot do not match once the assembly has been slid in the casing, do not twist the adapter to correct, rather pull the assembly straight out and straight in again until they match in one movement. If done correctly, the lens will be seen centered by sighting into the mirror.

Secure the Cineroc base adapter to the camera casing with a strip of the yellow tape supplied with your camera. Start on one side of the switch and run the tape around the case to the other side. Press down any part of the tape that appears loose and make sure the tape doesn't cover the switch.

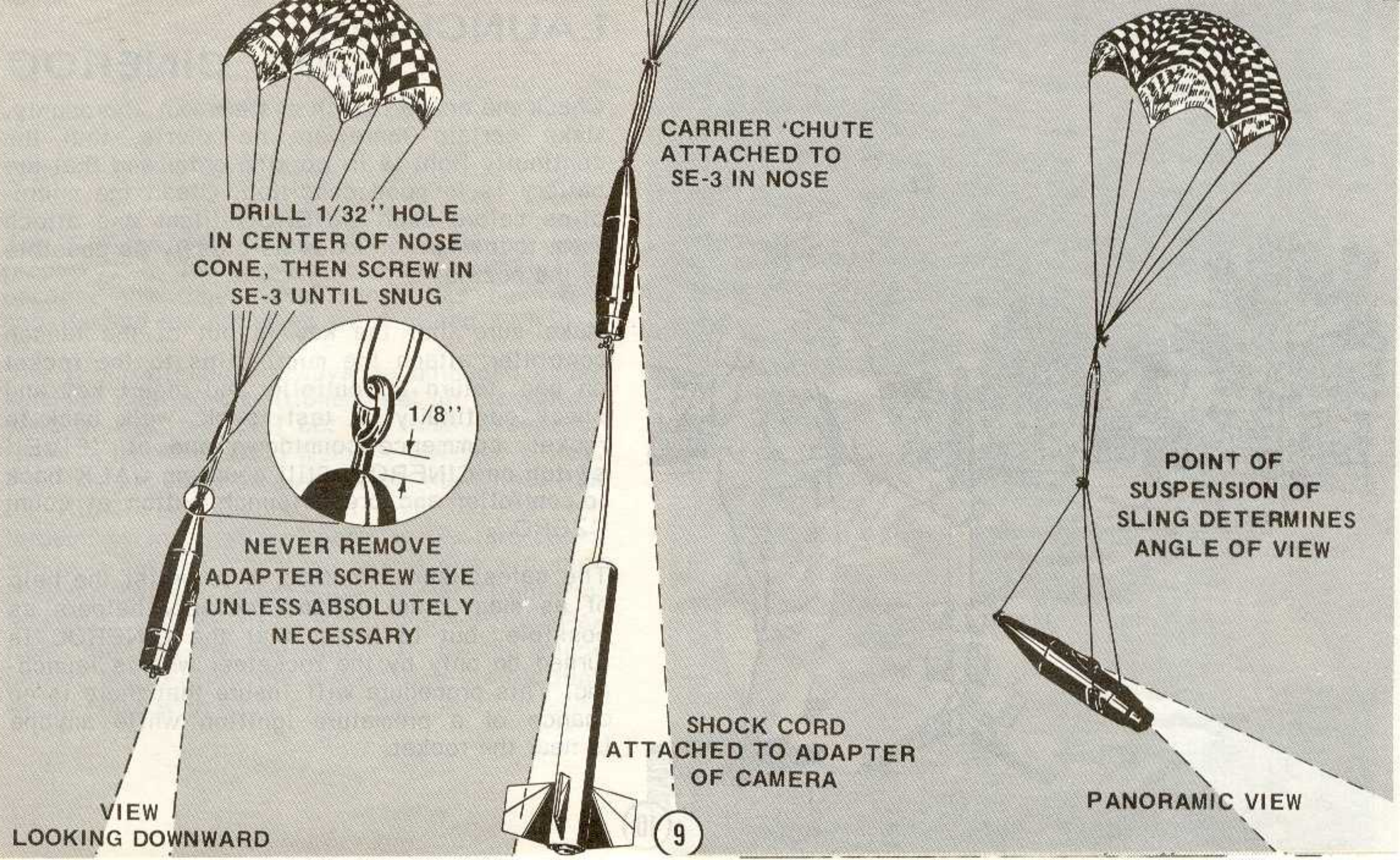






In preparing the Cineroc for flight, the parachute attachment point should be given careful consideration. The extreme versatility of the Cineroc becomes apparent when a little thought is given to the many attachment variations possible. The rear adapter attachment method illustrated at the left is standard and is recommended for the first few flights. An 18'' parachute and shock cord is supplied with your camera and should be assembled as shown.

Attachment methods which can provide nearly every desired view are illustrated on the right. They include the upward view after ejection which is very helpful in observing the opening and behavior of different parachute designs. The others provide views of terrain below after ejection. Two of these will take shots downward depending on the parachute attitude. Of these two, one will also give an interesting look at the carrier rocket during descent. The attachment method shown on the far right, if done properly, makes it possible to capture oblique views of the earth and horizon. When attaching the parachute to the nose, use a longer shock cord and/or shroud lines so that there are no snap-swivels or knots on the outside of the rocket when ready for flight. Adjust the length of the attachment lines so that the camera is suspended from the parachute at the desired angle, then secure all knots with a drop of glue.



DRILL 1/32'' HOLE
IN CENTER OF NOSE
CONE, THEN SCREW IN
SE-3 UNTIL SNUG
1/8''
NEVER REMOVE
ADAPTER SCREW EYE
UNLESS ABSOLUTELY
NECESSARY
VIEW
LOOKING DOWNWARD
CARRIER 'CHUTE
ATTACHED TO
SE-3 IN NOSE
SHOCK CORD
ATTACHED TO ADAPTER
OF CAMERA
POINT OF
SUSPENSION OF
SLING DETERMINES
ANGLE OF VIEW
PANORAMIC VIEW

LAUNCHING YOUR CINEROC

Check the entire launch system out thoroughly. Make certain there are no shorts, that the continuity light is in working order and that the battery is in good condition. Clean the micro-clips before each CINEROC flight and attach them to the igniter leads as closely as possible to the nozzle.

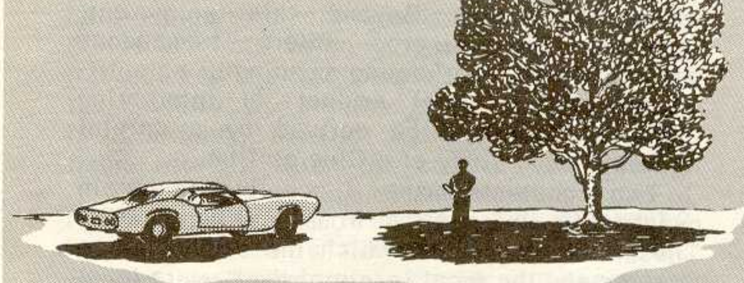
Make sure that the key is out of the launch controller: attach the micro-clips to the rocket on pad: return to controller and insert key and check continuity: if test is ok, walk back to rocket, commence countdown and at "FIVE" switch on CINEROC. Still counting WALK back to controller and press launch button at count "ZERO".

The safest launch method is to enlist the help of as many tracking and recovery helpers as possible, but to insist that the CINEROC is turned on only by the rocketeer who is launching. This procedure will insure that there is no chance of a premature ignition while anyone is near the rocket.

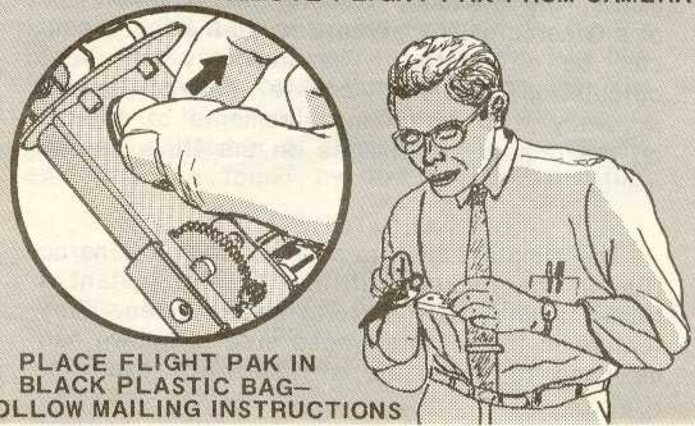
The Cineroc may or may not be running upon recovery. If it is not, it will probably be because the time since launch has been excessive and the batteries are depleted.

The Cineroc should always be unloaded under subdued lighting conditions. Peel off the yellow band of tape and pull out the inner assembly. Remove the drive band from the advance pulley. Pull out the advance pulley from the Flight-Pak as illustrated. Check that film has all run through by inspection of gate: in the rare cases where it has not, carry out next steps with care in order that film is not pulled out of Flight-Pak. REMOVE BATTERIES. Remove the Flight-Pak from the camera and place it in the black plastic bag. Follow the film mailing instructions which come with each Flight-Pak.

UNLOAD IN SUBDUED LIGHT CONDITIONS; IN SHADE OF CAR, TREE OR BUILDING – EVEN THE SHADOW OF YOUR OWN BODY



REMOVE DRIVE BAND – LIFT OUT PULLEY
REMOVE FLIGHT PAK FROM CAMERA



(11) PLACE FLIGHT PAK IN BLACK PLASTIC BAG– FOLLOW MAILING INSTRUCTIONS

PHOTO INTERPRETATION

Simply taking and showing motion pictures from a moving model rocket can be a very worthwhile experience. Beyond this enjoyment, however, the Cineroc offers tremendous possibilities for performing meaningful scientific studies. A great amount of interesting technical data can be derived by a careful frame-by-frame study of a Cineroc film.

Two constants make it possible to obtain quantitative information from a Cineroc film. These are the rate at which the camera takes pictures and the focal length of the camera lens. With these constants and a few other measurements, the altitude, velocity and acceleration of a Cineroc at any given time during the ascent can be calculated. The accuracy of these calculations will, of course, depend on the accuracy with which measurements of objects on the ground and images on the films can be made.

ALTITUDE

The simplest item to measure with a Cineroc film is the rocket's altitude at the instant a frame (individual picture) was taken. Any feature in the picture whose size is known can be used to determine altitude. For example, let's see what the altitude of a vehicle was when the picture shown was taken.

The roof on the building shown in the upper portion of the picture measures 20 feet on the indicated side. Measuring the image on the film with a precision caliper, we find that the image of the roof is 0.0985 inches long. Because we know that the ratio of altitude to camera focal length is proportional to the ratio of object size to image size, we can perform a simple calculation to find altitude:

FIRST convert the image size to feet

$$\frac{.0985}{12} = .00820 \text{ feet}$$

THEN use the equation:

$$H = \frac{(0).0328}{I}$$

Where:
H = altitude in feet
0 = object size in feet
I = image size in feet

THEN

$$H = \frac{20 \times .0328}{.00820}$$

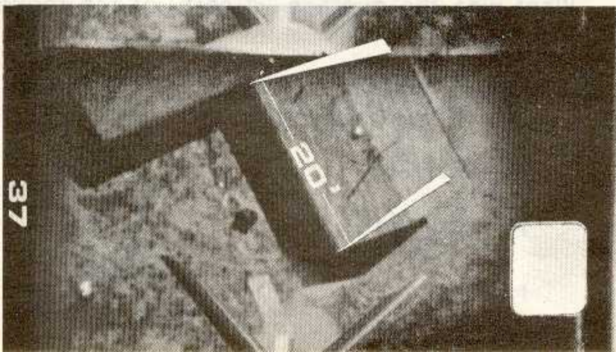
$$H = 80.0 \text{ feet}$$

If the building is 10 feet high, then the actual altitude is 90.0'. It should be remembered that any figure based on measurements taken from a Cineroc film can only be as accurate as that measurement. To increase this accuracy, frames to be studied should be enlarged photographically. The true image measurement is then found by the simple proportion equation:

$$I = \frac{A\ .02625}{B}$$

I = image size in feet.

Where: A = enlarged image size.
B = enlarged film width.



VELOCITY

Both velocity and acceleration are expressed as distance-time relationships. In order then to derive accurate velocity figures, both distance traveled and the time elapsed must be known. If the velocity at staging of a Cineroc-Omega is to be found, the first step is to determine the frame rate at which the camera was running.

The frame rate can be measured in either of two ways. The first involves a loss of about 2 feet of film but is the most accurate. Before placing the Cineroc on its carrier, aim the mirror hood at a large faced electric clock with a sweep-second hand and turn the camera on for a short 3 to 5 second burst. Proceed to fly the rocket in the normal manner. After the film has been processed, count the frames on the film covered by three or four seconds of the second hand. The number of frames taken per second can then be found by the simple equation:

$$f = \frac{N}{T}$$

f = frames per second
Where: N = the number of frames counted over the known time
T = the known time in seconds

The second method for determining the frame rate uses the same equation but is less accurate. In this method the burn time of the booster engine is the known time. This burn time must be assumed from the first sign of ignition to the first sign of staging. The frames are counted over this time and both factors are substituted into the equation. These methods of calculating the frame rate of the Cineroc are for those who want a very accurate figure for their studies. The average Cineroc runs at approximately 31 frames per second. For most calculations this is sufficiently accurate.

The next step is to find the time interval from one frame to the next by the equation:

$$I_t = \frac{1}{f}$$

Where: I_t = time interval between frames in seconds
f = frames per second

The final step in determining velocity at staging is to calculate the altitude of the rocket at each of the two frames on either side of the frame which indicates the first sign of staging. Note the difference in altitude and substitute it along with the time interval into the equation:

$$Va = \frac{Hd}{I_t\,(N-1)}$$

Where: Va = Average velocity in feet per second
Hd = the difference of altitude in feet
I_t = the time interval in seconds
N = the number of frames used

Example Problem: A Cineroc film shows the first sign of staging on the 46th frame counting from the first sign of ignition. It is assumed that the camera was running at 31 frames per second. A building which appears on the film throughout the ascent measures 20 feet on one side. This side measures .0740 inch on the frame before staging and .0670 inch on the frame after staging.

What was the average velocity of the rocket during staging?

Altitude at frame prior to staging (frame 45)
(divide I by 12 to convert to feet)

$$H = \frac{(0)\ .0328}{I}$$

0 = 20'
I = .0740

$$H = \frac{20 \times .0328}{.00616}$$

$$H = 106.4'$$

Altitude at frame after staging (frame 47)
(divide I by 12 to convert to feet)

$$H = \frac{(0)\ .0328}{I} \qquad 0 = 20' \quad I = .0670''$$

$$H = \frac{20 \times .0328}{.00558}$$

$$H = 117.7'$$

From frame 45 to frame 47 the rocket ascended the difference in altitudes or 11.3'

To find the frame to frame time interval:

$$I_t = \frac{1}{f} \qquad f = 31 \text{ (frames per second)}$$

$$I_t = .0323 \text{ second}$$

Then find the average velocity at staging:

$$Va = \frac{Hd}{I_t\ (N-1)}$$

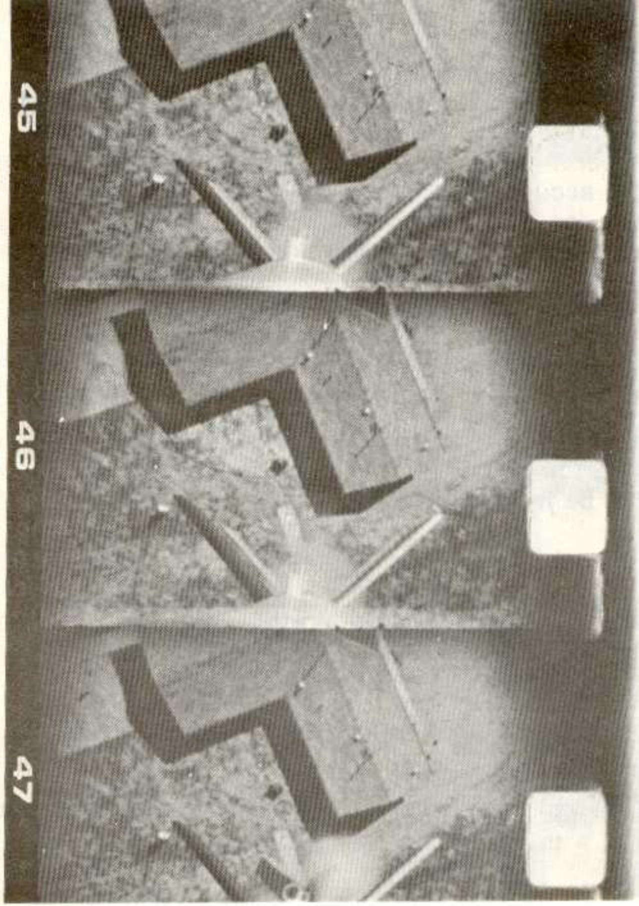
Hd = 11.3 feet
I_t = .0323 second
N = 3 (frame 45 to frame 47 = 3 frames)

$$Va = \frac{11.3}{.0323\ (3-1)}$$

$$Va = \frac{11.3}{.0323 \times 2}$$

$$Va = \frac{11.3}{.0646}$$

$$Va = 175.0 \text{ feet per second}$$



Determining velocity in this manner is not limited to just staging. It can be calculated accurately for any point on the film during the ascent. Once the rocket begins to pitch over, the accuracy of determining altitude diminishes as does the accuracy of other calculations which are dependent on the altitude.

ACCELERATION

The acceleration of the model is found simply by finding the difference in velocity at various intervals and expressing it feet per second per second. The deceleration of the model is found in the same manner, and both can be found by the equation:

$$Aa = (Va_2 - Va_1)\frac{1}{I_t\ (N-1)}$$

Aa = the average acceleration (or deceleration) in feet per second per second

Where:

Va_1

and

Va_2 = the two average velocities

I_t = the time interval between frames in seconds

N = the number of frames used.

An example problem:

The calculated velocity for a rocket at frame 37 of a Cineroc film is 101.3 feet per second. The velocity is 116.2 feet per second at frame 39. The camera was running at 31 frames per second. What was the average acceleration during this period?

From the previous velocity problem:

$I_t = .0323$

N = (frame 37 to frame 39 = 3 frames)

THEN

$$Aa = (Va_2 - Va_1)\frac{1}{I_t\ (N-1)}$$

$$Aa = (116.2 - 101.3)\ \frac{1}{.0323\ (3-1)}$$

$$Aa = 14.9\ \frac{1}{.0323\ (2)}$$

$$Aa = 14.9\ \frac{1}{.0646}$$

$$Aa = 14.9 \times 15.48$$

Aa = 230.66 feet per second per second

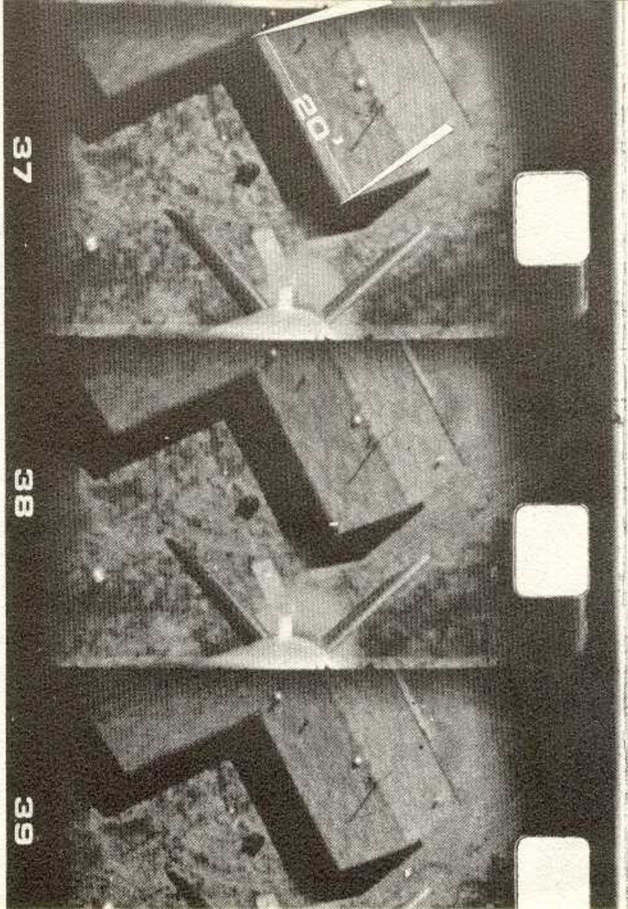
To express this value in G's of acceleration during burn, use the equation:

$$G = \frac{Aa}{32.2}$$

$$= \frac{230.66}{32.2}$$

$$= 7.16g$$

The amount of data which can be extracted from a single Cineroc film is enormous as indicated by these few equations given. It is hoped that the full extent of the value of the Cineroc in studying model rocket flight behavior be explored by the curious as well as the very serious model rocketeer. In these studies, it is highly recommended that all mathematical aspects surrounding each flight be recorded. These include weights, engine classification, launch time temperature, ground elevation, time of launch, etc. This data will prove helpful in drawing conclusions to why certain events occurred and to the possibility of re-occurrence. If you are the serious rocketeer, you now have the means to prove or disprove a theory regarding model rocket flight.



Because of the high altitude achieved by CINEROC/OMEGA combinations it is strongly advised that not only should initial flights be SINGLE STAGE but that TWO STAGE flights be limited to calm weather. If this advice is followed, chances of losing your CINEROC will be minimized.

ESTES

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