



FOR USE: Immediate

WESTINGHOUSE TV CAMERAS BRING APOLLO VIDEO FROM LIFTOFF TO LUNAR LANDSCAPE

Compact color television cameras on the launch pad and on the surface of the moon promise some never-before-seen views of liftoff and lunar exploration during the mission of Apollo-13.

For the first time a color television camera will be located on the launch pad for a space send-off. The camera selected to take a close-up look at the Saturn V launch is the same type astronauts will use in the command module and on the lunar surface during the Apollo mission.

The little TV camera will be perched on the launch umbilical tower just above and a scant 40 feet away from the nose of the 35-story-tall rocket. The superwide-angle lens on the camera will capture a top to bottom view of the rocket and its ascent past the camera lens following ignition.

Four days later an almost identical TV camera will be set up on the moon to provide the first extended live color coverage of manned exploration of the lunar surface. Another compact color TV camera of the same design will be carried in the command module to give earthlings an inside view of space travel.

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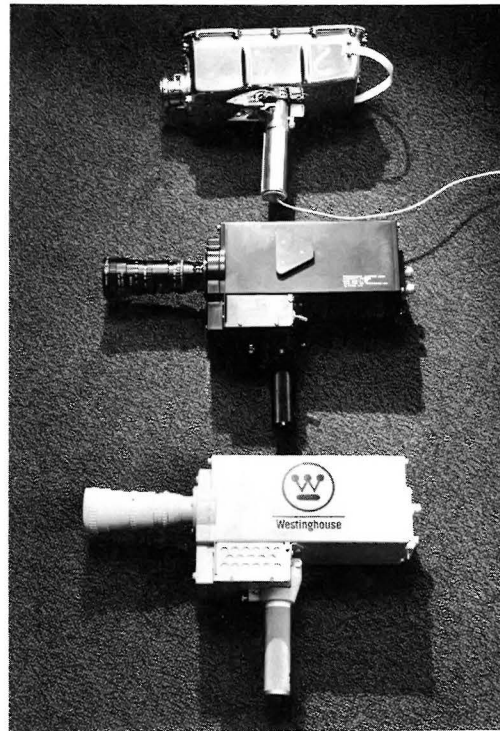
The Apollo television cameras were developed and built by Westinghouse Electric Corporation's Defense and Space Center in Baltimore under contract to the National Aeronautics and Space Administration's Manned Spacecraft Center in Houston.

Westinghouse supplied the Apollo color television camera on the launch pad under a lease arrangement with the television pool organization which provides exclusive coverage of certain aspects of the mission for the major TV networks.

TV Precautions

The compact color TV camera being assigned to this variety of video tasks is the same type that has been operated by the astronauts from inside the command modules on every lunar expedition since Apollo-10. The original and primary role of the color camera was to telecast activities of the astronauts while they were enroute to and returning from the moon.

The color camera was modified for use in the lunar environment during Apollo-12 and operated for 45-minutes from a compartment of the lunar module on the moon. It delivered a very limited view but good color rendition.



TV Cameras for A-13

PRX-29943-2

Immediately after the color camera was lifted from the modular equipment stowage assembly (MESA) compartment, it was inadvertently pointed at the sun. The imaging tube burned and television coverage of the moonwalk blacked out.

The mission plan for Apollo-13 includes planning and precautions which should assure television coverage of the moonwalk:

- A 45-degree angle has been set as the maximum permissible limit between the direction of the sun and the direction in which the camera is pointed.
- Mission control will closely monitor TV signals from the lunar surface and warn the astronauts when it appears the camera is being directed too near the direction of the sun.
- The camera will be equipped with an easy-to-handle soft rubber lens cap permanently attached to the lens neck.
- A seven-pound black and white TV camera will be carried as a backup unit for the color camera being used on the lunar surface.

TV Preview

The telecasts of astronaut activity on the lunar surface during Apollo-13 should be even better than the black and white TV pictures taken on the moon during Apollo-11. The Westinghouse-Apollo color TV camera will provide not only the added dimension of color but the advantage of a zoom lens.

The color camera takes pictures faster and should deliver better action shots of the astronauts. The unit operates at a rate of 30 frames per second and 525 lines per frame compared with the ten frame- and 320 line- rate of the little seven-pound black and white TV camera used during the first moonwalk.

The mission profile calls for two periods of astronaut activity on the lunar surface -- each lasting four to five hours. The initial EVA activity period will begin at about 6 a.m. (EST) on April 16.

Commander Lovell is scheduled to exit from the lunar module first, climb down the ladder and pull an easily reachable D-shaped ring attached to a lanyard which will open the modular equipment stowage assembly (MESA). The MESA is a hinged compartment panel on the descent stage -- the lower part -- of the LM.

Deployment of the MESA will aim the TV camera at an area near the bottom of the ladder. The camera will have been turned on from the cabin prior to Astronaut Lovell's exit from the LM.

Once both astronauts are on the lunar surface, Commander Lovell will deploy the S-band antenna, which looks like an inverted umbrella and is used to beam TV signals back to earth. While the commander is erecting the antenna, Lunar Module Pilot Fred Haise will remove the TV camera from the MESA and deploy it on a tripod about 50 feet from the LM.

Viewers will be able to distinguish between Astronauts Haise and Lovell by the red bands around the arm and leg of Commander Lovell's space suit.

After the antenna has been erected and the TV camera deployed, Astronaut Haise will reenter the LM and power up the antenna. About 20 minutes later the LM pilot will relocate the TV camera to show the unloading of the Apollo Lunar Surface Experiment Package (ALSEP).

After the ALSEP has been unloaded, Commander Lovell will take a panoramic series of TV pictures and then position the camera to show the experimental package being transported to a site some 300 feet from the LM. When the two astronauts return to the LM later, the TV camera will be set up to show their close-out activities.

The probable location of the sun during the second period of EVA may very well preclude extensive television coverage of astronaut activity. In the unlikely event of a camera failure, the black and white backup TV camera is stowed in the ascent stage of the LM and is equipped for quick installation.

The color TV camera located inside the command module should also provide some dramatic telecasts. A NASA spokesman has indicated the camera will be used at about 2 p.m. on April 15 in an attempt to take a picture of the Fra Mauro landing site as the command module travels over it at an altitude of about seven nautical miles.

Plans also call for television coverage of the docking of the LM and Command Module following the launching and after the LM blasts off from the moon. The Command Module TV camera may be used for an earth to space press conference during the return trip to earth.

Gantry Camera

Some of the most dramatic motion picture footage of the Saturn V liftoff has come from a camera located on the launch umbilical tower --

called the gantry -- next to the rocket. Apollo-13 will be the first time such wide-angle, color closeups of the launch will be seen in a live broadcast.



Lunar Surface Camera and Gantry Camera PRX-29944-12

The Westinghouse color TV camera qualified for the task because its size permits installation within the small protective space allocated for camera equipment. The camera also has the advantage of having been tested for safety and reliable operation under the most rigorous conditions.

The TV camera is installed in a protective type of box at the 360-foot level on the tower. The protective box has soundproofing, a quartz window and is covered with an ablative material which, if it comes in contact with flame, burns away during launch without damaging the housing itself.

Nitrogen is continually pumped into the housing to prevent the buildup of moisture and to provide a non-explosive environment for the camera. The color TV camera itself is of the same type used on the Apollo missions except for a new type of imaging tube which has been installed in the camera to enable it to withstand the brilliant light from rocket ignition.

New Sun-Proof Tube

The color TV camera installed on the gantry next to the Saturn V will be equipped with a new type of imaging tube that will not fail if accidentally pointed at the sun. TV cameras being carried on the Apollo-13 mission will not be equipped with the tube.

The new tube, a product of the Westinghouse electronic tube division in Elmira, New York, largely eliminates the problem of over-exposure. When a TV camera is pointed at the sun, the lens focuses the sun's energy on one part of the sensitive target of the imaging tube.

In such a case the target's temperature soars by as much as two million degrees Fahrenheit per second and burns out almost immediately. The new Westinghouse tube has a heat-resistant target much less susceptible



Burn-Resistant Camera Tube PR-29949

to burnout, even when exposed to images 100,000 times brighter than normal operating levels.

The new tube -- an advanced version of the secondary electron conduction tube -- is equipped with a fine metal screen built into the target. The mesh acts as a heat sink, or energy absorber, into which heat can be poured without a correspondingly high rise in temperature.

It is expected the new tube will be evaluated for future Apollo flights.

Camera Design Changes

Stanley Lebar, Westinghouse-Apollo TV camera program manager, said the color cameras scheduled for use on Apollo-13 are new units which incorporate several technical improvements over earlier versions. He said the cameras used on Apollo-12 were refurbished and modified units used on previous missions.

The improvements include an improved motor and drive assembly which operates the spinning color wheel system. The new assembly reduces the camera's power requirements from 20 watts to 15 watts and lessens the crippling potential of internally-generated heat.

Metal gears which can withstand the heat of the lunar environment have replaced plastic gears used in the first color cameras. Mr. Lebar said a baked-on lubricant prevents the gears and other moving metal parts from welding in the vacuum of the moon.

The Westinghouse manager said a new drive assembly suspension system eliminates the danger of vibration which might degrade the picture --

a problem not existent with the plastic gears. Mr. Lebar said the improvements grew out of experience on previous TV camera work Westinghouse provided to NASA.

The most recent change in the color cameras is the addition of a new switch which can be flipped to standby or transmit. The switch will enable astronauts to maintain "lock" -- a means of staying tuned in on a line of communication with earth -- when the camera is not transmitting a picture.

The standby switch might be used while astronauts are moving the camera about inside the Command Module during telecasts but at moments when not taking pictures. The camera also has a switch for the automatic light control system.

How The Camera Works

The only difference between the color TV cameras being used inside the Command Module and on the lunar surface is their exterior coating. The unit being used on the moon is treated with a special white thermal coating -- a paint slow to absorb heat and quick to emit it. The CM unit is black.

The Westinghouse color TV cameras for Apollo can operate in light ranging from one-tenth of a foot candle to 10,000 foot candles or from near total darkness to the glaring brightness of lunar day -- as long as the brightness is not concentrated.

The component which gives the cameras this capability is the secondary electron conduction (SEC) imaging tube developed at the Westinghouse Research Laboratories in Pittsburgh and the company's electronic tube division in Elmira, N. Y.

Like the more common vidicon imaging tube, the SEC tube converts the light on an object into electrical signals. But the SEC tube goes a step farther by amplifying the signals hundreds of times before they are converted back into visible images.

The variable focus zoom lenses on the Westinghouse color cameras have a focal length ranging from 12.5 millimeters to 75 millimeters and will provide a diagonal field of view from 54 to nine degrees.

Larkin Niemyer, director of engineering for the color camera, said the camera system used in the Command Module also includes a tiny television monitor which enables astronauts to see the exact picture being transmitted back to earth. The mini-monitor weighs only three pounds and has a black-and-white screen about the size of a credit card or two-by-two and three-quarter inches.

The compact Westinghouse color camera is far smaller than commercial broadcast cameras. Mr. Niemyer said about 70 per cent of its components and circuitry are in the form of speck-sized integrated circuits.

One unusual aspect of the color TV camera is that it employs only one imaging tube.



CM Camera with Mini Monitor
PRX-29475-13

Standard broadcast cameras are built with three tubes, each with a separate color photographic function.

In the standard camera, one tube picks up images of everything that is red or a shade of red. Another does the same thing with all the blue visual information and a third has an eye only for green. When combined on the home screen, they produce one picture with various shades, hues and pure colors.

The Westinghouse camera employs another method called the field sequential technique which requires only one imaging tube. It is based on a technique first developed by Dr. Peter C. Goldmark, president of CBS Laboratories 29 years ago. The field sequential method was used in 1940 to beam America's first successful color television broadcast and is in use today in medicine to transmit color pictures from inside the human body.

Mr. Niemyer said the chief component in the system is a color wheel designed and built especially for the Apollo color camera by Westinghouse. The wheel, only about three inches in diameter, is divided into six sections containing red, blue and green filters. Here's a layman's explanation of how it works:

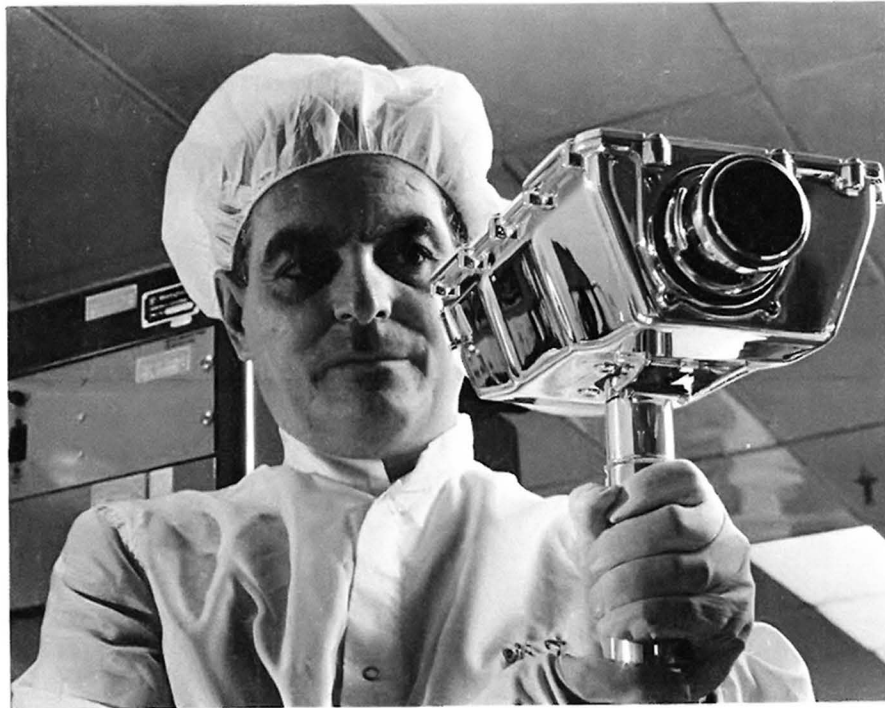
The wheel spins at 600 revolutions per minute so that the sequence of color filters passing in front of the imaging tube during one revolution is red, blue and green, red, blue and green.

As each color filter passes in front of the imaging tube, it collects all of the information on red colors and hues, then blue colors and green and then repeats the sequence again. In effect the camera is taking many one-color pictures at an extremely rapid rate.

Each picture is transmitted back to earth where special equipment combines them like a matrix, one on top of the other to produce a multi-colored image on the screen. The conversion equipment will produce images at a rate compatible with the standard rate for commercial television.

The Backup Camera

The little Westinghouse black and white camera that will serve as the video safety valve on Apollo-13 is designed to be both sensitive and rugged. Its sensitivity comes from its low-light-level SEC imaging tube.



Black and White Backup Camera

PRX-29109-36

The rugged characteristics of the camera are largely a result of the microminiature electronic components used in its construction. The

Westinghouse TV Cameras Bring Apollo Video
From Liftoff To Lunar Landscape

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camera weighs only $7\frac{1}{4}$ pounds even though it contains more than 250 components.

The camera is about the size of a cigar box. It will be stowed inside the lunar module cabin on a wall mount -- but cannot be operated from inside the LM.

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APOLLO-13 TV SCHEDULE

DAY	DATE	EST	GET	DURATION	ACTIVITY/SUBJECT	VEH	STA
SATURDAY	APRIL 11	17:28	03:15	1 HR 08 MIN	TRANSPOSITION & DOCKING	CSM	GDS
SUNDAY	APRIL 12	19:28	30:15	30 MIN	SPACECRAFT INTERIOR (MCC-2)	CSM	GDS
TUESDAY	APRIL 14	00:13	58:00	30 MIN	INTERIOR & IVT TO LM	CSM	GDS
WEDNESDAY	APRIL 15	14:03	95:50	15 MIN	FRA MAURO	CSM	MAD
THURSDAY	APRIL 16	02:23	108:10	3 HR 52 MIN	LUNAR SURFACE (EVA-1)	LM	GDS/HSK
THURSDAY	APRIL 16	22:03	127:50	6 HR 35 MIN	LUNAR SURFACE (EVA-2)	LM	GDS
FRIDAY	APRIL 17	10:36	140:23	22 MIN	DOCKING	CSM	MAD
SATURDAY	APRIL 18	14:13	168:00	25 MIN	LUNAR SURFACE (POST TEI)	CSM	MAD
MONDAY	APRIL 20	19:58	221:45	15 MIN	EARTH & SPACECRAFT INTERIOR	CSM	GDS

