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IMAX CAMERA
(12-IML-1)

IMAX Space Technology, Inc.
Houston, TX USA

The IMAX camera system is used to record on-orbit activities of interest to the public. Because of the extremely high resolution of the IMAX camera, projector, and audio systems, the audience is afforded a motion picture experience unlike any other. IMAX films have been said to be the next best thing to actually being there. For this reason, IMAX is the perfect medium to bring the space experience down to Earth.

IMAX and OMNIMAX motion picture systems were designed to create motion picture images of superior quality and audience impact. These "high-fidelity" images, accompanied by superior quality multi-channel sound, involve the viewers in the motion picture. A strong sense of reality is achieved by reducing or eliminating the various "clues" which normally remind the audience that they are watching a motion picture.

The IMAX system presents motion pictures on a screen which is flat or just slightly curved and rectangular (1.34 to 1 aspect ratio). The image occupies a 60 to 120 degree lateral field of view and a 40 to 80 degree vertical field of view.

The OMNIMAX system presents motion pictures on a dome screen, typically using about 80 percent of a hemisphere. In this type of theater, the image occupies a lateral field of view averaging 180 degrees and a vertical field of view averaging 125 degrees.

Features of the IMAX/OMNIMAX system and theater design include:

A screen-to-audience relationship that provides every viewer a virtually unobstructed, very wide field of view. The edges of the picture are not within the recognition field of view.

The bottom edge of the screen is placed so that audience can look down as well as up and to the sides. This allows the horizon to be in a natural position for most viewers.

IMAX/OMNIMAX is the largest motion picture format in the world (10 times larger than the usual 35 mm format). This large format records images with more "information" thereby producing a virtually grain-free, sharply defined image.

The specially designed IMAX/OMNIMAX rolling loop projector handles the large format film with outstanding image stability. Special attention to the illumination system and screen design results in excellent picture contrast and brightness.

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The IMAX Sound System by SONICS is a six-channel high fidelity system that has been developed specifically for use in these theaters. The system includes six specially designed loudspeakers located behind the screen and around the audience, and a central sub-bass (or sub-woofer) loudspeaker array.

In order to provide the desired frequency response, dynamic range, and acoustic output capability, the system utilizes essentially a 5-way loudspeaker/amplification scheme. That is, the audible frequency spectrum is divided into five bands of approximately two octaves each. Each of these bands is then amplified separately, with a total amplifier output capability of approximately 14,000 watts.

Each of the six main loudspeaker channels reproduces approximately eight octaves, with the bottom two octaves of all channels reproduced by a single sub-bass loudspeaker array located at the center of the screen.

In IMAX, the sound is not recorded on the film as in conventional 35 mm optical or 70 mm magnetic, but on a separate sound reproducer synchronized with the projector. This separate sound reproducer has traditionally been a six-track, 35 mm sprocketed tape reproducer called a "Dubber".

THE IMAX CAMERA SYSTEM

The IMAX camera is a 65 mm, single lens, reflex viewing design with a 15 perforation per frame horizontal pull-across. The frame size is 2.06 by 2.77 inches. Film travels through the camera at a rate of 336 feet per minute (5.6 feet per second) when the camera is running at the standard 24 frames per second. The film magazines hold 1100 feet of Estar base 65 mm color negative film. This yields between 3 min. to 3 min. 15 sec of filming time per load.

Film used is Eastman Kodak color negative. 5245 (estar base) is used for exterior filming and 5296 (Estar base) is used for interior and low light level filming. In a normal four locker configuration, seven rolls of film are flown, two loaded in the magazines and five in metal film cans.

The camera has a rotating shutter with a 155° opening which yields an exposure time of about 1/60th of a second. The camera runs on a 30 V dc motor. The frame rate is variable from 6 to 36 frames per second. The electronically controlled motor maintains speed with ±0.3 fps. Two independent thermal circuit breakers protect the camera electronics.

A specially designed power panel supplies power to the camera. The panel includes filters for EMI/EMC, power switch, and a 20 amp magnetic circuit breaker. When installed on the Aft Flight Deck the panel receives its power from Cabin Payload

bus A or B. The camera draws between 300 and 400 watts of power under normal operating conditions.

The viewing system is a through-the-lens type using a beam splitter (a partial mirror) in the light path to reflect light into the viewfinder. The beam splitter reduces the amount of light reaching the film by two-thirds of a stop. This is taken into consideration when determining the ISO rating of the film used.

The viewfinder has diopter adjustment which can be varied to compensate for differences in individual eyesight. A magnifier is provided for critical adjustment of the diopter and lens focus. A manual light trap can be closed to prevent spurious light from entering the viewfinder which could cause unwanted exposure of the film. A silicone rubber eyecup provides a light seal between the cameraperson's eye and the viewfinder.

Camera controls include a fixed and variable frame rate adjustment system, electronic and mechanical footage counters, electronic and mechanical tachometers (frame rate indicators), pilot light, and on-off switch. Exterior controls are connected to the camera via special mil-spec electrical connectors. Switches in the camera film compartment prevent the camera from running when the lid is open, if there is not film present or if there is a film jam.

Depending on configuration, the camera weights between 85 and 95 pounds with a full load of film.

IMAX uses modified Zeiss medium format lenses. The lenses have IMAX heavy duty bayonet mounts and front element support cages to improve lens mount stiffness and eliminate image shake. Levers are provided on the focus rings to facilitate focusing. Custom ultraviolet filters are used on all lenses. Lens selection varies depending on flight requirements. The following lenses are available for flight use:

30 mm f:3.5 fisheye - 148.4° horizontal by 96° vertical field of view for IMAX and 148.4° horizontal by 74.2° vertically up and 31.5° vertically down for OMNIMAX. The 30 mm is the standard OMNIMAX lens.

40 mm f:4, this lens gives the truest representation of real life on the IMAX screen. Field of view is 82° horizontal by 62.5° vertical.

50 mm f:2.8 - 70° horizontal by 52° vertical field of view

60 mm f:3.5 - 80.2° horizontal by 44° vertical field of view.

100 mm f:3.5 - 38.4° horizontal by 27.3° vertical field of view.

110 mm f:2 - 35.1° horizontal by 24.9° vertical field of view.

250 mm f:6.6 - 15.8° horizontal by 11.1° vertical field of view.

The 30 mm, 50 mm, and 110 mm will be aboard IML-1.

Accessories for the IMAX camera include a gimballed mount, overhead window bracket, camera handle, audio cassette recorder, emergency speed control and photoflood light (cage light).

The gimballed mount is used for filming out the Orbiter aft flight deck windows. The mount is attached to the camera and then held in place in the windows via a Velcro interface. A small shroud (black cloth) is used with this mount to reduce the chance of reflections from the glass ruining the image. To maintain the proper lens to window clearances the gimballed bracket has two operating configurations. The short configuration is for use with the 30 mm lens. The long configuration is used for all other lenses. Inhibit rings on the lenses prevent lens mounting if the bracket is in the wrong configuration.

The gimballed mount is also used with the overhead window bracket for filming out the overhead windows. The gimballed mount is attached to the overhead bracket via a Velcro interface like that of the aft window.

There are two configurations for the overhead window bracket as well. The stowed position, the configuration in which the bracket is launched, and the extended position. The overhead window bracket is held in place by the window shade latches. There is also a shroud for use with the overhead window bracket. The shrouds are held in place by Velcro.

During in cabin filming the camera handle may be attached to facilitate movement of the camera. The handle consists of two hand grips (one on each side of the camera) and an electrical interface with a thumb switch on each hand grip. Electrical connection is made through the cameras remote interlock plug on the right side of the camera. Once the electrical connection has been made the camera switch must be turned on to arm the thumb switches.

An audio cassette stereo recorder is flown to record dialogue during in cabin filming, crew comments and camera technical information. Twelve, 60-minute cassettes are provided along with an extra set of batteries for the recorder. The recorder has two microphones for stereo recording.

An emergency speed control (ESC) is provided for use should the internal speed control electronics fail. The ESC is connected to the camera via the remote interlock plug. Use of the ESC precludes use of the handle as they attach to the same connector. The camera will not run as steadily as when the normal internal circuitry is functioning. Camera speed (frames per second) should be monitored during filming. Speed adjustments should be made while the camera is running if the camera speed varies more than ±2 frames per second.

Three, 150-watt photoflood lights are flown for in-cabin filming. The light level on the mid-deck or in the module is not sufficient for IMAX photography; therefore, supplemental light must be supplied. The photoflood runs off the Orbiter 400 hz 110 volt power system.

Other support items include a film changing bag, cleaning tool, lens tissue, spare film core, "Exposed Film" tape roll and spare black film sacks.

The film changing bag is used to load and unload the film magazines, as total darkness is required for this operation.

Certain areas in the camera movement require cleaning after each roll of film is shot. The cleaning tool is used to scrape away the film residue which builds up due to the high speed at which the film moves through the camera.

Lens tissue is used to clean the lenses and other optical elements of the camera should the need arise.

The spare film core is used if a roll of film breaks in the middle and cannot be recovered using normal malfunction procedures.

The "Exposed Film" tape is used to secure the film cans. This is to make it easier for the crew to differentiate between exposed and unexposed film.

The spare black film sacks are used with the spare film core if a film break cannot be recovered using normal malfunction procedures.

The following is a list of the IMAX-IML-1 flight package:

IMAX Camera
Three Lenses, 30 mm, 50 mm, 110 mm
(two lenses flight dependent)
Gimballed Mount
Overhead Window Bracket
Two Power Cables (20′ ea.)
Power Cable Connector
Audio Recorder and Microphone
Film Changing Bag
Cleaning Tool
"EXPOSED FILM" Tape
Twelve Audio Cassettes
Spare Black Film Sacks
Three Film Magazines
Twelve Rolls of Film
Emergency Speed Control
Gimballed Shroud
Overhead Window Shroud
Three Photoflood Lights
Multi-Photo Flood Adapter Cable
Camera Handle
Spare Film Can
Lens Tissue
Spare Film Core
Spare Recorder Batteries
Camera Belt Guard