

LUNAR TELEVISION CAMERA
PRE-INSTALLATION ACCEPTANCE (PIA)
TEST PLAN

MSC/SESD Document 28-105

12 March 1968

*National Aeronautics
and Space Administration*

H O U S T O N , T E X A S

Manned Spacecraft Center



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LEC Document 641D.28.492

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Page ii of ii
Document: 28-105

TABLE OF CONTENTS

	<u>PAGE</u>
1. GENERAL	1
1.1 Security Classification	1
1.2 Responsibilities	2
1.3 Safety Precautions and Special Handling	2
2. APPLICABLE DOCUMENTS	3
3. TECHNICAL REQUIREMENTS AND TEST PLAN	3
3.1 General	3
3.2 Test Equipment and Facility Requirements	4
3.3 Required Television Camera Testing Parameters	5
4. QUALITY ASSURANCE PROVISIONS	10
5. REPORTS	10

LUNAR TELEVISION CAMERA
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1. GENERAL

According to MSC quality assurance requirements, all flight and mission related equipment shipped from MSC or direct from contractor to other activities require a pre-installation acceptance (PIA) test. This test must be performed at the activity receiving the equipment prior to installation into the spacecraft. Periodic operation of the camera (one hour every ninety days) is also required to ensure the quality and electrical integrity of the television camera image sensor (c.f. MSC/IESD Document 28-106.) When the periodic operation requirement is violated, this PIA test shall be performed to assure that the television camera performance is not degraded.

This document describes the minimum testing required to verify proper operation of the Apollo Lunar Television Cameras (Westinghouse Part Number 607R962). These tests also ensure that the cameras have not been degraded or damaged due to mishandling or excessive storage life. Requirements stated herein constitute the basis for the test procedures.

1.1 Security Classification

The fiber optics portion of the camera is classified CONFIDENTIAL; however, it is incorporated within the camera case and is not visible from the outside. Personnel without security clearance are permitted to handle and operate the camera only under the surveillance of a person with a clearance. Performance data recorded during camera tests will not be classified. The camera must be kept in a secured area when not in use.

1.2 Responsibilities

Organizations receiving the television equipment are responsible for reviewing and updating the equipment data package including the historical record card (MSC Form 772). The organization having possession of the television camera is responsible for generation of required procedural documents, for performance of the periodic operation and test, and for the PIA Test. Test procedures must be submitted to NASA/MSC Quality Engineering NC 3 for approval prior to the start of testing. The organization conducting the tests is responsible for ensuring that tests and entries into the data package are witnessed and verified by NASA quality control personnel (or their designated representative).

1.3 Safety Precautions and Special Handling

a. Camera Thermal Finish

The shape and finish of the camera constitute a passive thermal control system which is required to maintain the camera within temperature operating limits. The camera, therefore, must be handled with protective (nylon) gloves. Particular care must be given to the white, heat-radiating surface on top of the camera; marring or scratching this surface or contaminating the silver finish can disrupt thermal balance. This must be prevented.

b. Precision Lens Surfaces

The television lenses are precision optical instruments and must not be touched or contaminated in any manner. In the event cleaning becomes necessary, the technician will use protective (nylon) gloves during handling. The optical surfaces will not be wiped or cleaned with unauthorized materials or methods. Lens cleaning and handling will be accomplished only in accordance with Equipment Cleaning Procedure MSC/IESD Document 28-104.

c. Scene Light Intensity

The television camera is sensitive to low light intensity levels; therefore, sources of light producing an illuminance greater than 90 foot-candles at the surface of the lens must not be allowed in the field-of-view when operating with the wide angle lens.

Note

The lunar night lens shall be used only for special testing or Lunar Night Apollo Missions. (When using this lens the light level shall not exceed 5 foot lamberts maximum.)

Light intensities greater than those specified may cause a permanent burn spot on the image sensor and consequently a substantial degradation of picture quality.

2. APPLICABLE DOCUMENTS

- | | | |
|-------------------|--|------------|
| • NPC 200-2 | Quality Program Provisions
For Space System Contractors | April 1962 |
| • NPC 250-1 | Reliability Program Provisions
For Space System Contractors | July 1963 |
| • MSC/IESD 28-104 | Equipment Cleaning Procedure For
Apollo Lunar Television System | March 1968 |

3. TECHNICAL REQUIREMENTS AND TEST PLAN

3.1 General

a. Television Camera Check-out

The PIA test will be performed at the facility receiving the equipment prior to installation into the spacecraft in accordance with paragraph 3.3.

b. Television Lenses Checkout

The television lenses shall be inspected for obvious damage such as broken or scratched optical surfaces. A visual

inspection should also be made to determine if any moisture or other contamination is inside the lens assembly. Each lens except the lunar night lens shall also be functionally tested by connecting it to the camera and viewing an appropriate test scene or object. A subjective evaluation shall be made to determine if the lens is functioning properly. The camera shall be operated in the 10 frame/second scanning mode with the following scene parameters:

<u>Lens</u>	<u>Object Distance</u>	<u>Scene Brightness (Min/Max)</u>
Wide Angle	40 inches	50 to 90 ft-lamberts
100-mm	150 feet	1000 to 12000 ft-lamberts
Lunar Day	23 feet	1000 to 12000 ft-lamberts

3.2 Test Equipment and Facility Requirements

This test must be conducted using one of the Communication Test Set (CTS), 410-32280, located at GAEC and KSC. The CTS consists of the following items:

- 5-inch Primary Television Monitor (410-32282A)
- 12-inch Secondary Television Monitor (410-32282B)
- Video Simulator (410-32281A)
- Polaroid Film Camera
- Test Projector and Power Supply (410-32283A)
- Test Control Panel
- 28-Volt Power Supply

3.3 Required Television Camera Testing Parameters

To verify that the television camera operating condition and the video output signal format and amplitude are within specification tolerances,

the following television system operational parameters must be tested:

- Sync Format (synchronization frequency and pulse interval)
- Output signal level (voltage amplitude across 100-ohm load)
- Resolution (horizontal and vertical resolution)
- Contrast Ratio (subjective perception of grey shades)
- Signal-to-noise ratio
- Linearity
- Picture Quality (subjective evaluation)

These tests shall be conducted with the wide angle lens attached to the camera.

a. Input Power

Install the television camera onto the image projector 410-32283A and adjust the light intensity level to 0.01 foot-candle (+5%). Apply power to the camera and measure the input current. The input current should be such that a maximum power dissipation of 6.5 watts will occur with a steady input voltage between 24 and 31.5 volts dc.

b. Synchronization Format

Install the television camera onto the image projector 410-32283A and adjust the light level to 0.01 foot-candle (+5%). The spot photometer will be used to check the projector light level. View the camera video waveform on an oscilloscope and on the 410-32282 television monitor. Verify the compatibility of the camera waveform to that shown in Figure 1.

(1) Horizontal Line Time Interval

These outputs are available from the monitor sync separator and can be measured on an oscilloscope or

the camera output can be displayed on the slow scan monitor. The period for Mode I must be $312.5 \mu \text{ sec}$ ($+5\%$). Mode II is $1250 \mu \text{ sec}$ ($+5\%$).

(2) Vertical Frame Time Interval

These outputs are available from the monitor sync separator and can be measured on an oscilloscope or the camera output can be displayed directly on the slow scan monitor. The period for Mode I must be 100 ms ($+5\%$) and for Mode II 1.6 seconds ($+5\%$).

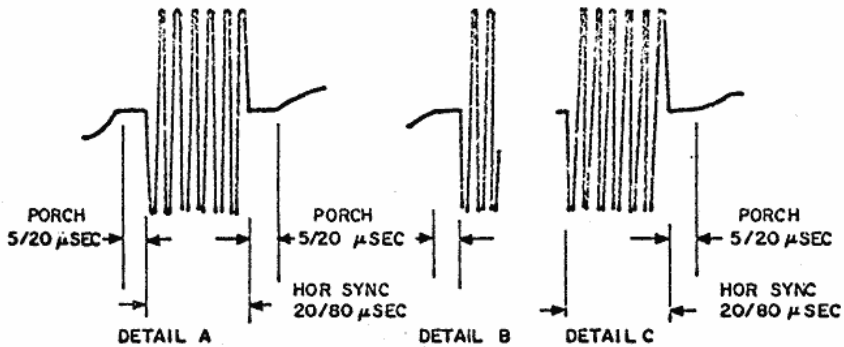
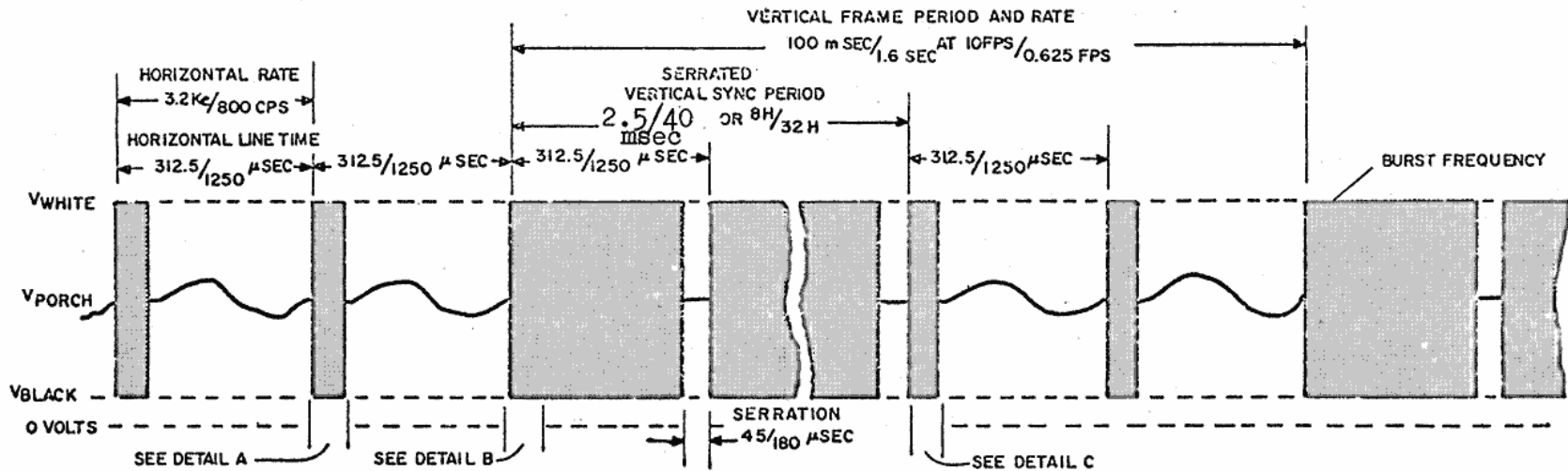
(3) Horizontal Sync Period

These measurements must be made on an oscilloscope. The burst frequency interval for Mode I should be $20 \mu \text{ sec}$ ($+5\%$) and the front and back porch interval shall be $5 \mu \text{ sec}$ ($+5\%$), respectively (8 cycles of burst). The porch intervals can be measured from points of complementary tangent angles 45 degrees from horizontal.

The burst frequency interval for Mode II should be $80 \mu \text{ sec}$ ($+5\%$) and the front and back porch shall be $20 \mu \text{ sec}$ ($+5\%$), respectively (32 cycles of burst).

(4) Vertical Sync Period

These measurements are to be made on an oscilloscope. The burst frequency interval for Mode I should be 2.5 ms ($+5\%$) and the front and back porch shall be $5 \mu \text{ sec}$ ($+5\%$). The burst frequency interval for Mode II should be 40 ms ($+5\%$) and the front and back porch shall be $20 \mu \text{ sec}$ ($+5\%$), respectively.



Mode I = Mode A
 Mode II = Mode B

NOTES

- BURST FREQUENCY = $409.6 \text{ KC} \pm 0.02\%$
- TWO MODES ARE IDENTIFIED BY A/B WHERE A IS 10 FPS AND B THE 0.625 MODES
- PERIOD BETWEEN CONSECUTIVE LEADING EDGES OF BURST FREQUENCY IS $312.5 / 1250 \mu\text{SEC}$
- FRONT AND BACK PORCH PERIODS IS A/B WHERE $A = 5 \pm 1 \mu\text{SEC}$ AND $B = 20 \pm 4 \mu\text{SEC}$
- BLACK TO WHITE = $2 \pm 0.1 \text{ VOLTS P-P}$ INTO 100 OHMS AND $1 \pm 0.05 \text{ VOLTS}$ INTO 50 OHMS
- WHITE IS POSITIVE, BLACK IS $+3 \pm 1$ INTO 100 OHMS LOAD
- BANDPASS FILTER DOWN 3 DB MAX AT 500 KC AND 20 DB MIN AT 1 MEGACYCLE
- PEAK VIDEO WITH RESPECT TO GROUND SHALL BE 2.4 VOLTS MAXIMUM. EXAMPLE WHEN BLACK LEVEL EQUALS 0.4 VOLTS THE P-P VIDEO SHALL BE $2 \text{ VOLTS} \pm 0.1 \text{ VOLTS}$
- POSITIVE SYNC TIP SHALL BE $2 \pm 0.1 \text{ VOLTS}$ ABOVE BLACK LEVEL BUT SHALL NOT EXCEED PEAK WHITE VIDEO
- PORCH LEVEL SHALL BE $1/2$ BLACK TO WHITE VOLTAGE EXCURSION $\pm 0.1 \text{ VOLTS}$
- CAMERA OUTPUT STAGE IS A CURRENT SOURCE PRODUCING 2 VOLTS P-P INTO 100 OHM EXTERNAL LOAD OR 1 VOLT INTO 50 OHM EXTERNAL LOAD
- Negative Burst level = video black ± 0.1
 Black level is the minimum signal (video or sync) excursion.

Figure 1. TV Camera Composite Video and Sync Format

c. Output Signal Levels

Using the standard EIA reticle (which is a part of the Test Projector), adjust the light level to 0.1 foot-candle (+5%). Using an oscilloscope, select a horizontal line near the center of the vertical frame. The video white level should be positive 2.2 (+0.2, -0.4) volts and the back level should be 0.3 (+0.1) volt. These voltage levels are for a 100-ohm load; the levels are to be reduced 50 percent if a 50-ohm load is used.

d. Resolution

Using the standard EIA test pattern reticle in the projector, adjust the light level to 0.1 foot-candle (+5%). Operate the camera with this test pattern and verify that the horizontal and vertical resolutions are 210 lines for Mode I. For Mode II, repeat the above tests and verify horizontal and vertical resolution of 400 TV lines, or greater.

e. Contrast Ratio

Using the grey scale reticle, adjust the light level to 0.1 foot-candle (+5%). Operate the camera with this test pattern and verify that a minimum of seven grey shades are visible on the monitor.

f. Signal-To-Noise Ratio

Using a black white reticle, adjust the light level to 0.1 foot-candle (+5%). Operate the camera with this test chart and measure the signal-to-noise ratio with an oscilloscope. Set up the oscilloscope to view a single line near the center of the frame. Measure the peak-to-peak noise in the black or negative portion of the displayed line. Measure the peak video signal level (black-to-white). The signal-to-noise ratio is peak noise.

This ratio should be 35 dB for Mode I and 24 dB or greater for Mode II.

g. Picture Quality

Using the wide angle lens, televise a typical room scene with the television camera and view the video output on the slow scan monitor. Subjectively evaluate the picture quality noting detail of resolution and contrast ratios. Care must be taken during these tests to avoid excessive light intensity levels in the field-of-view of the camera. To record the evaluation of the video picture quality, photograph the video displayed on the slow scan monitor using the polaroid camera. The photographs shall be made at the beginning and end of a 15-minute period of operation during which time no changes, including light intensity level, shall be made to the televised scene. The test operator shall also include a brief written appraisal of the picture quality.

4. QUALITY ASSURANCE PROVISIONS

The tests specified herein are to be performed under normal ambient conditions. Prior to testing, a quality inspector must examine the test equipment for verification of current calibration. Appropriate notations on the test data sheet must be made by the inspector. The quality control inspector must witness and verify all testing, recording of test data, and entries into the equipment data package. The quality provisions established by NPC 200-2 and NPS 250-1 are applicable to generation of test procedures and to performance of testing and recording of data.

5. REPORTS

A copy of the test report, including video display pictures, date and time of testing, equipment operated (including GSE), and testing organization shall be forwarded immediately after test/operation completion to the following:

- Equipment Data Pack
- NASA/MSC, Attn: Television Systems Section, EE2 Houston, Texas 77058
- NASA/MSC, Attn: Quality Engineering, NC3, Houston, Texas 77058
- NASA/MSC, Attn: GFE Office, PF3, Houston, Texas 77058