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# SYSTEM REQUIREMENTS

# FOR THE

# RETRIEVAL AND REFLIGHT OF HEXAGON

Being rewritten

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## 1.0 SCOPE

This document establishes the system level performance requirements for (1) The Retrieval Refurbishment and Reflight of the Hexagon Block IV spacecraft and (2) specific metric and quality improvments in the Hexagon payload. This specification shall be used in addition to the current Hexagon Block IV specifications. Modifications to the Block IV vehicle and operational procedure shall be minimized.

## 2.0 APPLICABLE DOCUMENTS

The following documents, of the issue in effect on the date of contract award, unless otherwise stated, form a part of this document to the extent specified herein. In the event of conflict between documents referenced here and other detail content of Section 3 to follow, the detail content of Section 3 shall take precedence.

### 2.1 Other Documents

| | |
|---|---|
| JSC 07700, Vol. XIV and attachment 1 Rev G | Space Shuttle System Payload Accommodations |
| ICD 2-1900 | Shuttle Orbiter/Cargo Standard Interface |
| NHB 1700.7 Rev. A | Safety Policy and Requirements |
| SAMTO/KHB S-100 | NASA/DOD STS Payload Ground Safety Handbook |
| AS68-00105 | Performance and Design Requirements for the Program 467 General Systems Specification DS0001 |

## 3.0 REQUIREMENTS

### 3.1 System Definition

The Hexagon Block IV spacecraft shall be modified for STS retrieval and reflight. The Block IV payload and associate spacecraft elements will also be modified to improve the metric and quality capabilities of the panoramic scan camera as documented in Appendix I. The mission scenario for both the retrieval and reflight of Hexagon are shown in Figure 3.1-1.

Figure 3.1-1. Mission Scenario



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3.1.1 Interface Definition

The existing Hexagon Block IV interfaces remain in effect. New interfaces with JSC NASA and WTR are added for the STS related development test, integration and operation efforts.

3.1.2 System Elements

The existing Hexagon elements that are modified and the new elements added to meet the performance requirements are listed below.

| | | |
|---|---|---|
| a. | Spacecraft | (Modified) |
| b. | Airborne Support Equipment | (New) |
| c. | Ground Support Equipment | (Modified/New) |

3.2 Performance Characteristics

The modified SV's shall be capable of being launched on either STS or T34D boosters from WTR into the standard Hexagon mission orbits. the initial flight of the Block IV vehicles will be on T34D's. The reflight may be either on the STS or T34D booster. Each vehicle shall be retrieved by the STS refurbished and reflown once. At the end of the second mission the vehicle shall be deorbited into a broad ocean area. The SV shall have an orbital life of 15 months minimum (launch to retrieval) for the first mission and 12 months minimum (launch to deorbit) for the reflight mission. Mission reliability will be the same for both initial and reflight of the SV. The modifications shall not introduce a single point failure in the primary mission of the SV. The payload performance enhancements are identified separately in Appendix I. The remaining performance requirements for retrieval and refubishment and reflight are identified below.

3.2.1 Spacecraft Changes

The minimum essential change required to make Block IV Hexagon SV's retrievable and refurbishable for reflight shall be made. All modifications shall be made with no significant impact on the primary mission and also protecting the SV deboost capability.

### 3.2.1 Spacecraft Changes

#### 3.2.1.1 Structural/Mechanical

A grapple fixture shall be provided on the SV, appropriately located, and consistent with RMS control capability. The grapple design must allow for emergency separation of the RMS from the spacecraft. Structural modifications required to accommodate the grappling fixture, and berthing loads shall be made to the SV.. Interface hardware shall be provided to mount spacecraft to ASE. Standard NASA catch mechanisms interfaces shall be used as appropriate. These modifications shall support the environmental requirements as defined in paragraph 3.4. Structural modifications to support EVA shall be included as required.

#### 3.2.1.2 Electrical System

SV electrical modifications shall be limited to those required for vehicle safeing such as, implementation of separation mechanisms, verification of both and interfacing with Aft Flight Deck Panel (AFDP). Power control shall be provided by both ground command and control from the AFDP for all SV electrical busses. Provision for functional verifiction shall be provided.

#### 3.2.1.3 Propulsion

Propulsion system shall reserve sufficient propellant to afford a safe deboost and a minimum of 90 days of orbit maintenance and control in the parking or retrieval orbit. Safing capability must be reversible and verifiable. Thruster life shall be capable of supporting the one year mission and three months park and orbit followed by retrieval.

#### 3.2.1.4 Appendage Management

Appendages shall be stowed or jettisoned prior to berthing. EVA shall be considered as a primary or backup for appendage management, with proper consideration for crew safety and failure modes.



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3.2.1.5 SV Testing

The SV shall be tested at the base utilizing the identical software as demonstrated in the factory. The test program at the base should be as similar as is possible to the existing test program for T34D launches.

3.2.1.6 Recovery Vehicle Changes

The RV's shall be modified for water recovery, not aerial retrieval.

Each RV shall include recovery aids consisting of a radio beacon and a flashing light which are activated upon surface impact and shall operate for a minimum of 48 hours with normal RV battery power until the RV sinks unless turned off by recovery personnel.

a. Radio Beacon - The radio beacon shall provide sufficient radiated power in such a manner that the signal can be detected and localized by the recovery aircraft at a minimum rage of 50 NM.

b. Flashing light - The flashing light shall be white in color with an intensity of 6 candles power seconds. The flash rate shall be 45 + 10 flashes per minute with duration of 60 ± 40 microseconds, the same requirements as Block I.

3.2.1.7 Command System

TBD

3.2.1.8 Payload Modifications

Payload modifications may be required to ensure capability to withstand nominal landing loads (6.0 fps) and to preclude excessive contamination. Consideration for caging, sealing mechanisms, and repressurization shall be accommodated to insure that the payload can be reflown with minimal refurbishment.

3.2.2 Airborne Support Equipment (ASE)

The ASE shall be designed for multiple use and shall accommodate STS launch and retrieval loads. Standard NASA interface hardware shall be used when possible between the STS, ASE and SV. Proof of ASE compatibility with the STS for berthing shall be validated prior to SV launch. STS environments for the shuttle cargo bay are defined in paragraph 3.4. AFD equipment for command, control and verification shall be part of the ASE.

3.2.3 Ground Support Equipment (GSE)

Existing Block IV GSE shall be modified to support both T34D launches and STS launch and post retrieval activities. Design of new GSE should be minimized. All GSE required to support post retrieval deservicing of the SV shall be transportable. Provisions shall be made to have handling equpment at landing site to perform the following functions (at a minimum):

Remove satellite vehicle
Transport the satellite vehicle
Hoist and position the SV in vertical or horizontal
Drain propellant and residual pressurants
Safe the propellant tanks via $GN_2$ purge and evacuate through scrubbers
Install shroud for transport back to factory

All GSE shall be compatible with WTR STS and/or T34D launch facilities.

3.2.4 Instrumentation

The SV and ASE shall be instrumented and provided sufficient flight data to verify actual flight environments. The loads, thermal, vibration acoustic and contamination data shall be used to substantiate refurbishment requirements.

3.2.5 Launch and Retrieval Operations

For the T34D launches the standard Block IV prelaunch and launch requirements hold. The basic on-orbit operation of the Hexagon vehicles also remains unchanged. The new operations requirements added are for STS launch of the SV and the SV retrieval.

3.2.5.1 STS Performance and Integration (Hexagon)

STS performance shall be as specified in JSC 07700, Volume XIV and the approved STS flight plan. The STS/SV interface shall be in accordance with the STS/payload interface specification (JSC 07700/Volume XIV and Attachment 1 ICD 2-19001 and the approved Payload Integration Plan (PIP).

3.2.5.2 Operations Interfaces SCF/JSC

The data transmission commanding telemetry and voice communiations requirements for both the SCF and JSC will be identified in specific annexes to the PIP.

3.2.5.3 Prelaunch

SV performance testing and system checkout will be required prior to SV installation into the STS cargo bay. SV checkout and maintenance time while on the launch pad will be minimized and physical access to the SV will be limited. The SV and shroud shall be transported to SLC-6 in the transporter and unloaded at the VPF (or equivalent) for processing prior to incorporation into the STS.

3.2.5.4 SV Deployment

The principle means of deploying the SV shall be the single remote manipulator of the STS. ASE indicators and/or other data as required shall be provided to the STS or ground control to support deployment activities. Following deployment, the STS shall maneuver away from the SV, allowing solar array deployment. Following normal practice of subsystems checkout and orbit determination, the SV shall be adjusted to the operational orbit and initiate mission requirements. The STS shall remain in close proximity to effect a contingency retrieval in the event of a major SV malfunction determined during on orbit SV checkout phase.

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3.2.5.5 Retrieval

Following completion of the active mission (post RV 4 separation), any jettisonable apendages except solar arrays shall be separated. The SV shall adjust the orbit to await launch/arrival of STS. The SV shall be capable of maintaining itself in this orbit for no more than 120 days, prior to either an SV deboost or SV orbit adjust to the rendezvous orbit. The retrievsal orbit shall be such that a one day sync pattern in phase with the STS launch can be achieved. The STS launch window shall be constrained to aid rendezvous. The SV attitude control system shall be deactivated and verified just prior to grapple. The deactivation of the attitude control system via RCS or AFD command shutdown shall be reversible by ground command to allow contingency control, should an abort situation develop.

The SV shall be capable of deboost as an entity from any point in the retrieval timeline, including STS bay door closure attempt. The SV shall also be capable of a safe deboost from operational to parking orbits into a broad ocean area.

Command authority shall be maintained by the SCF/RTS during proximity operations just prior to grapple. [redacted] link shall be the primary command and telemetry modes, following completion of proximity operations; however, the system must be capable of achieving retrieval operations solely by SCF/RTS operations.

(b)(1)
(b)(3) 10 USC 424

3.2.5.6 Post Retrieval

Minimum teardown of the SV at the landing facility should be planned. The SV shall be deserviced at the landing site. Following return of STS and SV to the servicing area. The SV shall be removed, propellant drained, and system secured to meet safety requirements for return to factory. Verification of SV health shall be performed prior to SV release from STS. Health verification shall be performed either by direct contact between the SV and the ground or via on-board shuttle capabilities while attached to the STS. The SV shall be removed from the STS, safed for transport and shipped to the West Coast contractor facility for refurbishment.



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3.2.6 Refurbishment

SV teardown shall be minimized and, as a goal, all SV refurbihment for reflight shall be done at West Coast SV facilities. The maximum refurbishment time shall not exceed fifteen (15) months from receipt of retrieved SV at the factory to ship to WTR for relaunch. Refurbishment of the SV shall include, as a minimum, post retrieval testing, replacement of expandables, replacement of worn/malfunction hardware and the addition of payload enhancements.

Following hardware refurbishment. The sections shall be remated if required and functionally tested both in the horizontal and vertical. As a minimum, a payload performance test shall be completed in the A-2 chamber. Software validation testing to assure pad compatibility shall be required as well as a final functional test prior to ship to SLC 4 or SLC 6.

3.3 Safety

The SV and its support equipment shall be designed such that malfunctions will not damage the SV, STS or T34D, or cause injury. The design shall conform to the requirements of MIL-STD-1574A, System Safety Program for Space and Missile Systems; NHB 2700.7 Rev. A, Safety Policy and Requreirements for Payloads Using the Space Transporation System; and SAMTO/KHB S-100, Range/Launch Base Requirements for STS Payloads.

3.4 Environmental Compatibility

The SV and ASE shall be designed to achieve their specified performance during and subsequent to exposure to the following environments.

3.4.1 Shipping, Handling and Storage Environments

The SV and ASE shall be capable of operating within specification limits after exposure to both controlled and natural environments while in a nonoperating condition during fabrication, storage and transportation.

3.4.2 SV and ASE Environments

The SV and ASE shall be designed to withstand the prelaunch, launch/ascent, and space environments specified for STS payloads in JSC 07700, Volume XIV, as applicable to the SV operational orbits, and the T34D launch/ascent.

3.4.2.1 Prelaunch Environment

The SV shall be capable of operating within specification limits during and after exposure to the launch site environment. The SV shall be capable of operating within specification limits during and after exposure to environments within the STS for TBD hours prior to launch.

3.4.2.2 Launch and Ascent Environment

The SV and ASE shall be capable of operating within specification limits after exposure to the environments of the STS and Titan 34D.

3.4.2.3 Abort, Descent and Landing Environment

The SV and ASE shall be capable of being refurbished to operating within specification limits after exposure to the STS abort, descent and landing environments including transportsation from the landing site.

3.4.2.4 Orbital Environment

The SV shall be capable of operating within specification limits during and after exposure to the orbital environments including the cumulative effect of natural radiation.

3.5 Training

Joint NASA and USAF training efforts shall be supported by the SV contractors as necessary. Training aids and simulations shall be provided as required.

3.6 Security

Security guidance provided and Hexagon Block IV applies. Additional guidance with respect to STS operations retrieval and reflight will be provided.

4.0 ACRONYMS (HEXAGON

The following acronyms are defined to their usage in this document.

| | |
|---|---|
| AFGWC | AF Global Weather Central |
| AGE | Aerospace Ground Equipment |
| ASE | Airborne Support Equipment |
| CE | Circular Error |
| DMA | Defense Mapping Agency |
| DBS | Doppler Beacon System |
| GFE | Government Furnished Equipment |
| GPS | Global Positioning System |
| GRD | Ground Resolved Distance |
| ICD | Interface Control Document |
| FOHx | Follow-on HEXAGON |
| JSC | Johnson Space Center |
| LE | Linear Error |
| LOS | Line-of-Sight |
| MCC | Mission Control Complex |
| MC&G | Mapping, Charting and Geodesy |
| MMD | Mean Mission Duration |
| MTF/TM | Modulation Transfer Function/Threshold Modulation |
| NRD | Navigation Requirements Document |
| PCM | Pulse Code Modulation |
| RRD | Recovery Vehicle |
| S/C | Spacecraft |
| SCF | Satellite Control Facility |

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| | |
|---|---|
| SGLS | Space Ground Link System |
| SPO | System Program Office |
| STC | Satellite Test Center |
| SV | Satellite Vehicle |
| TT&C | Tracking, Telemetry and Command |
| TBD | To be determined |
| T34D | Titan 34D Launch Vehicle |
| VAFB | Vandenberg Air Force Base |
| WTR | Western Test Range |

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APPENDIX I

TO THE SYSTEMS REQUIREMENTS FOR THE

RETRIEVAL AND REFLIGHT OF HEXAGON

PAYLOAD IMPROVEMENTS

24 November 1982

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## 1.0 INTRODUCTION

This document establishes general requirements for the payload improvements area. It should be treated as part of the basic document, System Requirements for the Retrieval and Reflight of Hexagon. All basic Hexagon Block IV performance requirements shall be met unless more stringent requirements are indicated in this document. Existing contractor and government interfaces shall be modified based on these requirements.

## 2.0 PERFORMANCE REQUIREMENTS

### 2.1 Metric Panoramic Camera System (MPCS) Performance Requirements

The MPCS shall be capable of achieving the performance requirements specified in Table 2.1-1 subject to the conditions specified in this document.

Table 2.1-1. MPCS Performance Requirements

| | |
|---|---|
| Image Quality (Worldwide) | .53 M (21 inches) ground resolved distance |
| Metric Accuracy (90% Levels) | |
| Absolute (World wide) | 23 M Horizontal/17M Vertical |
| Relative (over 300 NMi) | 15 M Horizontal/16M Vertical |
| (over 10 NMi) | 9 M Horizontal/13 M Vertical |
| Height Determination | 2 M Vertical |

#### 2.1.1 Image Quality

The MPCS shall be capable of producing imagery with a ground resolved distance (GRD) of less than 0.53 M (21 in.) over 100 percent of an image frame (see 4.0 Glossary). This quality shall be subject to the conditions described in paragraph 3.2.2.

 

2.1.2 Metric Accuracy

The MPCS shall be capable of achieving all metric accuracy requirements at any location within an image frame world wide. The definitions in 4.0 Glossary shall be used when referring to metric accuracy. The MPCS shall supply all data and materials necessary to meet all metric accuracy requirements in a stand-alone mode (after calibration). The general use of ground control points in collected imagery to achieve any metric accuracy requirements shall not be necessary. Errors due to the Defense Mapping Agency (DMA) data exploitation are not included in the accuracy requirements.

2.1.2.1 Absolute (Single Point) Accuracy

The MPCS shall provide all data and materials necessary for determinining the absolute position of any ground point within 23 meters (90 percentile circular errors - CE) in the horizontal direction and 17 meters (90 percentile linear error -LE) in the vertical direction with respect to the World Geodetic System.

2.1.2.2 Relative (Point-to-Point) Accuracy

The MPCS shall provide all data and materials necessary for determining the position of any ground point relative to another ground point within an area 300 nm x 300 nm to within 15 meters (90 percentile CE) and 16 meters (90 percentile LE) in the horizontal and vertical directions, respectively. This requirement shall apply to a multi-rev, multi-imaging pass collection of any 300 nm x 300 nm area. Within a single stereo pair, the MPCS shall provide all data and materals necessary for determining the position of any ground point relative to another ground point within the model area (10 nm in-track by 100 nm cross-track) to within 9 m (90 percentile CE) and 13 m (90 percentile LE) in the horizontal and vertical directions, respectively.

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2.1.2.3 Object Height Determination Accuracy

The MPCS shall provide all data and materials necessary for determining the height of objects to within 2 meters (90 percentile LE) relative to local ground level.

## 2.2 Metric Performance Allocation

Accuracy errors to meet the metric performance shall be allocated to timing, ephemeris and line-of-sight recovery. Specifically, the system shall provide the means of establishing: time of exposure of a ground image point; ephemeris of the MPCS at the instant of exposure; and orientation of the line-of-sight from the MPCS to the imaged ground point at the time of exposure. This data shall be provided to the accuracy shown in Table 2.2-1.

Table 2.2-1. Metric Performance Allocation

| Error Component | | Requirement (1 Sigma) |
|---|---|---|
| Timing: | Relative* | .03 MSEC |
| | Absolute | .10 MSEC |
| Ephemeris (GFE) | | 5M/AXIS |
| LOS Recovery | | |
| | Absolute | 2.7 ARCSEC |
| | Relative* | 1.2 ARCSEC |
| Residual Calibration | | 4.2 Micro Meter |

*Relative uncertainty between fore and aft images of a stereo pair.

### 2.2.1 Ephemeris Accuracy

The MPCS shall provide the data required to allow post-mission reconstruction (GFE) of the satellite vehicle (SV) orbital ephemeris to an accuracy of 5 meters (1 sigma) in each of the three axes defined by the SV along-track direction, cross-track direction, and radial direction.

2.2.2 Line-of-Sight (LOS) Recovery

The MPCS shall provide the data required for post mission recovery of the camera lines-of-sight corresponding to the forward and aft images of a stereo pair to an accuracy specified in Table 2.2-1. Data from the following LOS recovery sensors, as applicable, shall be provided: stellar sensors, SV attitude sensors, stereo angle monitors, thermal sensors, and/or other sensors called for in the system design. Ground Data Handling System (GDHS) impacts shall be minimized. Relative pointing accuracy refers to the LOS uncertainty between corresponding forward and aft images of a stereo pair.

2.2.3 Residual calibration Errors

Inherent in metric exploitation are residual errors that are not removable by system calibration. The residual error (rss) from all calibrations per 3.2.3 and 3.2.4 shall not be taken to be better than the value provided in Table 2.2-1.

2.3 Operational Orbits

Mission shall be conducted in sun-synchronous orbits. The SV shall be capable of an orbital life of 15 months minimum from launch including at least 12 months in the operational orbit with the remaining time in a standby orbit awaiting STS retrieval. The operational orbit shall afford the SV a tumbling life of 16 orbit revolutions minimum.

2.3.1 Orbital Design Constraints

The operational orbit for the SV shall be defined such that photographic operations can be conducted at any location between 82$^{o}$ North latitude and 55$^{o}$ South latitude. The defined orbit shall provide a swath repetition pattern (as projected above 30$^{o}$ N or below 30$^{o}$ S altitude) such that the ground swath for a $\pm 30^{o}$ panoramic scan provides closure on itself every 9 days or sooner. The SV orbit shall also be constrainted by the following bounds:

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| | | |
|---|---|---|
| a. | Perigee altitude: | 80 NM minimum |
| b. | Apogee altitude: | 300 NM maximum |
| c. | Latitude of perigee: | TBD |
| c. | Inclination: | Sun-synchronous |
| e. | Orbit Plane: | 9:30 a.m. to 12:00 Noon (hour angle at South bound equatorial crossing). |

3.0 PAYLOAD

The MPCS shall consist of two panoramic cameras for stereoscopic imagery and an integral line-of-sight (LOS) recovery package. The MPCS also includes support structure, film, film supply and take-up(s), film handling and steering elements, camera, support electronics, electrical power conditioning and environmental control elements. The integral LOS recovery package includes stellar sensors, SV attitude sensors, stereo angle monitors, and thermal sensors as appropriate.

3.1 Weight Allocation

The payload weight shall not exceed TBD pounds at lift-off.

3.2 Metric Panoramic Camera System

The MPCS shall be capable of continuous monoscopic collection with frame-to-frame overlap of approximately 5 percent at zero scan angle; and continuous stereo collection with a stereo overlap of 100 percent at zero scan angle. The "nominal" stereo convergence angle shall be 29 degrees subject to achieving the stereo overlap requirement.

3.2.1 Resolution

The MPCS shall be capable of producing imagery of the quality required in 2.1.1 with at least a 50 percent probability of achieving the required resolution for any access meeting the following limiting conditions: maximum imaging altitude of 125 nautical miles, a 29° stereo angle, a 40 degree solar elevation angle, a 2.0 to 1.0 entrance pupil contrast ratio and type SO-412 film. The GRD shall be expressed as



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the geometric mean of the in-track and cross-track resolution as determined by an MTF/TM intersecton computation method, inluding all degradations, both fixed and random, which affect the image quality for each camera. Acquisition conditions shall include meeting the requirement on both forward and aft frames of a stereo pair with 100 percent overlap on the target.

3.2.2 Film Load

The MPCS shall carry a minimum of 150,000 feet of type SO-412 film for each camera. The MPCS shall also be capable of operating with other film types including but not limited to SO-130, SO-255, and SO-315.

3.2.3 Photographic Format

Reference markings recorded on the film shall include a reseau grid. The recording accuracy, configuration, frequency, and placement of the reseau shall be commensurate with achieving all metric accuracy requirements.

3.2.3.1 Reseau

A reseau grid shall be exposed across the entire format during film exposure. The reseau grid spacing shall be such that film distortions between markings may be considered linear.

3.2.4 MPCS Calibration

The pan cameras shall be designed for maximum structural and thermal stability. The orientation of all interior elements of the pan camera shall be precisely determinable and shall be calibrated preflight. The orientation of all interior elements shall remain effectively unchanged subsequent to preflight calibration or shall be capable of being measured (or monitored) at prescribed intervals, both preflight and during orbital operations. At a minimum, this preflight calibration shall include: determination of the focal length; mathematical determination of the principal point; calibration of the reseaus and fiducials with respect to the principal point; and calibration of the stellar sensor focal plane. The residual plate error attributable to sensor system calibration (including associated mensuration) shall be per Table 2.2-1.

### 3.2.5 Line-of-Sight (LOS) Recovery

The MPCS shall contain the additional sensors, computational capability, and associated equipment necessary to provide the data via the SV required for post-mission recovery of the payload sensor line-of-sight. The line of sight shall be recoverable to an accuracy such that the requirements in table 2.2-1 are achieved in the GDHS.

## 4.0 GLOSSARY

**Absolute accuracy** — The difference between the measured coordinates and the error free coordinates of a given point as defined in the World Geodetic System.

**Fiducial marks** — Index marks which are rigidly connected with the camera lens through the camera body used to define the principal point of the photograph. Marks which define the principal point (line) of a photograph and fulfills the requirements of interior orientation.

**Heighting accuracy** — The difference between the measured and actual height of an object relative to the local surrounding terrain.

**Image frame** — Defined to be the length of film (or equivalent ground area) collection in a given scan of the camera. For metric and image quality purposes a standard frame is defined by the bounds of a $\pm 30$ degree scan and a $\pm$ 2.5 degree field of view.

**Imaging operating** — Defined to be the time span from camera turn-on to shut-down during which imaging takes place. An imagery operation is made up of one or more imagery frames.

**Relative accuracy** — The difference between measured and actual coordinates of two points imaged during a single operation in an arbitrary coordinate system.

**Reseau** — An accurate set of grid points to provide a means of calibrating film distrortion. Reseau marks are also used as measuring points and may act as fiducial points.

**Aerospace Ground Equipment** — Equipment used to support transporation, handling, and test of the satellite vehicle that is not launched.

**Airborne Support Equipment** — Equipment used to support handling and test of the satellite vehicle that is launched with it.

**World Wide** — A band around the earth between 55° South Latitude and 82° North Latitude.

**Standby Orbit** — A parking orbit os suitably low aerodynamic drag.



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