

**MODIFICATIONS**

**Draft dated 6/11/01 to AO Release dated 11/29/01**

**NASA Provided Hardware – S/W**

- **Added Mass and Thermal Simulator Kinematic Mounts**
- **Deleted FPA Simulator**
- **Grouped some electrical items into an “Integrated Test Set”**

**NASA Provided Support Personnel** - new section added

**PI-Provided Hardware and S/W**

- **Added Mass and Thermal Simulator for the Optics Assembly**
- **Deleted ETU Control Cards**
- **Added Instrument Control Electronics Simulator**
- **Added EGSE**
- **Added ETU and Flight MLI/Thermal Blankets**
- **Added Descriptions/Requirements for Mass and Thermal Simulator, Instrument Control Electronics Simulator, Structural Thermal Model, and Engineering Test Unit**

## NASA PROVIDED HARDWARE – S/W

- **Mechanical**
  - Mass and Thermal Simulator (MTS) Kinematic Mounts
  - Engineering Test Unit (ETU) Kinematic Mounts
  - Flight Kinematic Mounts
  - Science Instrument Metrology Reference Fixture (SMRF)
  - SMRF Base Fixture
- **Electrical**
  - ETU Focal Plane Assembly (FPA) and Focal Plane Electronics (FPE)
  - Flight Focal Plane Assembly (FPA) and Focal Plane Electronics (FPE) for each module
  - Harness – ETU
    - IC&DH to NIRSpec Optical Assembly
    - FPE to FPA
  - Integrated Test Set
    - IC&DH Box
      - ISIM Processor
      - Focal Plane Electronics Data Processor
      - Comm Card – 1355
      - Power Card
    - Ground System Simulator
      - Real Time Command and Control
      - Data Base
    - S/C Simulator
      - Solid State Recorder (SSR) Simulator
      - Primary Power Distribution Unit Simulator
- **Software**
  - Real Time Operating System
  - CC&DH S/W
  - ISIM flight s/w – includes OPE and detector operation/data handling
  - Customized tools for flight s/w development
  - Ground test data base and procedures
- **Thermal**
  - FPA Thermal Straps
  - Module/ISIM interface close-out blankets
  - Harness Parasitic Heat Removal System
- **Optical**
  - OTE Simulator

## **NASA PROVIDED SUPPORT PERSONNEL**

The NGST Science and Operations Center (Space Telescope Science Institute, STScI), under contract to the NGST Project (NGSTP), will, upon request of/approval by the NGSTP, provide two support personnel to be co-located at the Science Instrument contractor facility. The roles of these personnel are described below, as extracted from the Science and Operations Statement of Work (NGST-SOW-000725), Section A.5 NGST Project and Team Interactions

- 1) "...STScI will provide support and products (e.g., operations support for I&T, science impact studies for design trades, etc.) to the...SI developers...This support includes the co-location of an individual at each developer's site...who shall become the lead STScI technical expert for that...instrument...That person shall support that development team by producing designs, performing analysis, testing, and performing other team functions as assigned by that development team lead(s). That person shall also use this participation to gain insight into the operation of the hardware, influence its design and implementation for low cost operations and science optimization, and help assure the quality of its interfaces to the ground system..."
- 2) "...a test conductor shall reside at each developer's site (to assist the developer with operating the ground system, integrating electronic I&T procedures, etc.) and use this position to become intimately knowledgeable of the hardware. This person shall be the contractor's technical lead for that hardware for all flight operations related activities. That test conductor shall eventually fill a controller position on the Flight Operations Team..."

**PI-PROVIDED HARDWARE AND S/W**

- **INSTRUMENT SIMULATORS** [Delivered NLT 21 months prior to ETU]

- **MASS AND THERMAL SIMULATOR for the Optics Assembly**

The ISIM Project will use the Optics Assembly Mass and Thermal Simulator(s) (MTS) for the Optical Assembly (MTSOA) in the ISIM Structure qualification/acceptance testing (modal survey, static loads, vibration, gravity release (sag), and thermal/vacuum). The Observatory Prime Contractor will subsequently use the ISIM ETU Structure, with the MTSOA installed, for Optical Telescope qualification testing.

The MTSOA shall replicate the instrument mass, center of gravity, and ISIM mechanical and conducted thermal interfaces within the following tolerances:

Parameter	Requirement	Measurement Knowledge
Mass	Predicted value +/- 1kg	Comply with instrument IRD
Center of Gravity	Predicted Value +/- 10mm	
First Frequency	Predicted Value +10/-0 Hz	
Conducted Heat Transfer thru mounting hardware	Predicted Value +/-10%	
“Base Plate” CTE	Same as Flight Unit	n/a

The MTSOA shall comply with the instrument/ISIM interface mounting geometry and methodology as delineated in the instrument ICD.

A Master Reference Cube (MRC) shall be installed on the MTSOA to provide an optical reference surface. Opto-mechanical fiducial(s) and optical cubes shall also be installed on the MTSOA. The NIRCam Instrument Team and the ISIM Project will mutually determine the location, placement, and viewability of the MRC, fiducial (s), and cube(s). The MRC, fiducial(s), and cube(s) will be used for initial placement/alignment determination and to determine shifts in location during the ISIM structure testing. As such, they shall be capable of surviving the test environments to which the ISIM/MTSOA will be exposed.

- **INSTRUMENT CONTROL ELECTRONICS SIMULATOR**

The Instrument Control Electronics Simulator (ICES) will be used by the GSFC Flight Software Integrated Product Team to develop and test the ISIM Command and Data Handling software.

The ICES shall be comprised of Mechanisms Control Card and a Calibration Control and Housekeeping Card.

The ICES shall replicate the instrument command receipt and telemetry response operations as applicable to mechanisms and calibration source control and engineering telemetry/housekeeping data. The ICES shall comply with the bus interface(s) as delineated in the instrument ICD.

- **STRUCTURE THERMAL MODEL** [Delivered with the ETU]

If the NIRCam instrument development team implements the NIRCam as a multiple optics assembly instrument, the team shall provide the ISIM Project with a Structural Thermal Model (STM) for each optics assembly module subsequent to module #1 (module #1 shall be the Engineering Test Unit described below).

The ISIM Project will use the STM in the ISIM Engineering Test Unit testing (modal survey, vibration, acoustics, emi/emc, thermal/vacuum).

The STM shall replicate the instrument mass, center of gravity, ISIM mechanical interfaces, and conducted and radiated thermal interfaces within the following tolerances:

Parameter	Requirement	Measurement Knowledge
Mass	Predicted value +/- 1kg	Comply with instrument IRD
Center of Gravity	Predicted Value +/- 10mm	
First Frequency	Predicted Value +10/-0 Hz	
Conducted Heat Transfer (thru mounting hardware and from FPA)	Predicted Value +/-5%	
Radiated Heat Transfer (from/to instrument enclosure)	Predicted Value(s) +/-20%	
“Base Plate” CTE	Same as Flight Unit	n/a

The STM shall comply with the instrument/ISIM interface mounting geometry and methodology as delineated in the instrument ICD.

A Master Reference Cube (MRC) shall be installed on the STM to provide an optical reference surface. Opto-mechanical fiducial(s) and optical cubes shall also be installed on the STM. The NIRCam Instrument Team and the ISIM Project will mutually determine the location, placement, and viewability of the MRC, fiducial (s), and cube(s). The MRC, fiducial(s), and cube(s) will be used for initial placement/alignment determination and to determine shifts in location during the ISIM ETU Integration and Test. As such, they shall be capable of surviving the test environments to which the ISIM/STM will be exposed.

- **ENGINEERING TEST UNIT** - *Optics Assembly and Instrument Control Electronics* [delivered NLT 10 months prior to 1<sup>st</sup> Flight Unit]

The ISIM Project will use the ETU in the ISIM Engineering Test Unit Integration and Test program (mechanical integration, electrical integration, modal survey, vibration, acoustics, emi/emc, thermal/vacuum) to validate all ISIM I&T procedures prior to use/application to the Flight ISIM I&T program. The Observatory Prime Contractor will subsequently use the ISIM ETU, with NIRCam ETU/STM(s) installed, for Optical Telescope Performance Testing.

THE NIRCam ETU shall be a flight-like operational module of the NIRCam instrument. The ETU shall incorporate flight like optical components, mechanisms, detectors, and wavefront sensing and control optical elements/components. The performance characteristics of the flight-like components will be jointly determined during Phase-A by the NIRCam developer, the Observatory (OTE) Prime Contractor, and the ISIM Project.

The NIRCam ETU shall replicate the instrument electrical functionality, ie, it shall incorporate flight circuit designs using flight or equivalent performance non-flight parts. The ETU shall comply with the power and serial bus interface(s) as delineated in the instrument ICD.

THE NIRCam shall replicate the instrument mass, center of gravity, moments of inertia, ISIM mechanical interfaces, conducted and radiated thermal interfaces within the following tolerances:

Parameter	Requirement	Measurement Knowledge
Mass	Predicted Flight Unit Value +/- 0.5kg	Comply with instrument IRD
Center of Gravity	Predicted Flight Unit Value +/- 5mm	
First Frequency	Predicted Flight Unit Value +5/-0 Hz	
Conducted Heat Transfer (thru mounting hardware and from FPA)	Predicted Flight Unit Value +5/-0%	
Radiated Heat Transfer (from/to instrument enclosure)	Predicted Flight Unit Value(s) +10/-0%	
“Base Plate” CTE	Same as Flight Unit	n/a

A Master Reference Cube (MRC) shall be installed on the ETU Optics Assembly (ETUOA) to provide an optical reference surface. Opto-mechanical fiducial(s) and optical cubes shall also be installed on the ETUOA. The NIRCam Instrument Team and the ISIM Project will mutually determine the location, placement, and viewability of the MRC, fiducial (s), and cube(s). The MRC, fiducial(s), and cube(s) will be used for initial placement/alignment determination and to determine shifts in location during the ISIM structure testing. As such, they shall be capable of surviving the test environments to which the ISIM/ETUOA will be exposed.

- **Flight Modules** - *Optics Assembly and Instrument Control Electronics* (delivered per AO schedule)
  - A Master Reference Cube (MRC) shall be installed on the Flight Unit Optics Assembly(s) (FUOA) to provide an optical reference surface. Opto-mechanical fiducial(s) and optical cubes shall also be installed on the FUOA(s). The NIRCam Instrument Team and the ISIM Project will mutually determine the location, placement, and viewability of the MRC, fiducial (s), and cube(s). The MRC, fiducial(s), and cube(s) will be used for initial placement/alignment determination and to determine shifts in location during the ISIM Integration and Test. As such, they shall be capable of surviving the test environments to which the ISIM/FUOA(s) will be exposed.
- **Mechanical**
  - Mechanical Ground Support Equipment (MGSE) – handling fixtures, slings, installation fixtures, etc
  - Shipping container(s)
- **Electrical**
  - Electrical Ground Support Equipment (EGSE)
  - PWB Coupons (Flight Cards)

- **Software**
  - Flight S/W Objects for control/operation of Mechanisms Control Card(s) and Calibration Control and Housekeeping Cards
  - Data Base Inputs
  
- **Thermal**
  - ETU MLI/Thermal Blanket(s)
  - Flight MLI/Thermal Blankets
  
- **Optical**
  - Optical Elements Witness Samples