Observatory Integration and Test at NRL

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OBSERVATORY

AIT

- Instrument Delivery to NRL
- Instrument Receiving and Inspection
- Post Delivery Acceptance Test (NRL Buy off)
- Star Tracker/Omni Antenna Installation
- Instrument Integration to the S/C Bus
- First Full Functional (Ambient Condition)
- Test Readiness Review
- Magnetic Balance
- EMI/EMC
- Spin Balance & Mass Properties
- Modal Testing & Jitter Testing (If Required)
- Random Vibration, Acoustic
- Pyro Shock/ Mechanism Deployment
- TVAC (Instrument doors deployment, and FPA Excitation)
- End to End Compatibility Test (With Ground Station)
- Post Environmental Test Full Functional
- Post Environmental Test Alignment Verification
- Pre-Ship Readiness Review
- Test Complete | Ship to KSC

24-25 April
Instrument Delivery to NRL

- Deliver to NRL
  - Instrument Configuration
    - In Shipping Container with
    - GN2 purge for Humidity.
    - Shock Monitors
    - Doors Closed
    - Triple Bagged
    - Grounded to Container
  - GSE
    - Mechanical
      - Lifting Frame
      - Rotation Frame
      - Instrument Drill Template
    - Electrical
      - S/C Power Rack
      - Data Collection Computers
        - Command & Control S/W
        - Telemetry Data
      - Temperature Control
    - Thermal
      - Instrument for 10°C Ops (TBD)
    - Contamination Control
      - GN2 Purge Suitcase
Transportation Requirements

- Shipping container
  - Modify Shipping Container to Accept ECD
  - Instrument Handling Dolly (FLOTRON)
  - GN2 Purge Connections, Environment Monitors/Recorders
  - External Ground lug
  - Fork Lift at NRL to move shipping container
  - Shipping Container Road Covers (Vendor (Scott))
  - Transport Environments (3Gs all axes) requires an Air Ride Trailer (Double Drop)

- Complimentary Equipment
  - EGSE and Power Rack
  - TGSE
  - Lifting Slings and Associated Lift Hardware
  - Lifting Sling and Spreader Bar (Long Throw into Shipping Container)
  - Wire Ropes for Lift Fixture for Container Integration
Instrument Receiving and Inspection

**Shipments from California**
- Truck
- Environ Controls (Temp + RH)
- Instrument Purge On
- All GSE Shipped
- Escorted by 1NRL + 1LMMS (Chase Vehicle)

**Recv at NRL**
- Remove from Truck (Fork Lift)
- High Bay A59
- Facility Ground Conn.
- Container Inspection
- Environ Equip Read
- Replace Purge Equip
- Inspect Lift Equipment (Proof Load Certs)

**NRL Flight**
- Cables Installed at LMMS
- Star Tracker
- Omni Antenna
- Aperture Door

**Perform Instrument Receiving Inspection**
Post Delivery Acceptance Test (NRL Buy off)

Instrument GSE
  Instr EGSE
  Perform EGSE Verf
  Instr TGSE
  GN2 Purge

Procedures
  Instr Acceptance Test Plan
  Test /Operations Proc Released
  Training(?)

NRL Facility
  GN2
  Facility Power
  Class 1000 Clean Room
  Clean Room Supplies
  Clean Room Facility Ground

Post Delivery
  FAME Instrument Acceptance Test
    Connections
    Instrument TGSE
    Instrument EGSE

  Establish Operating Environment
  Establish EGSE Comm to Instr
  Telemetry Data
  Instrument Thermal Control
    FPA at 10°C
  Purge System Off
    (During Data Collection)

  Instrument Test
    Charge Injection
    FPA LED Flat Field
    FPA Focus LD
  Active Focus Adjustment and Return to have
  Door ‘OPEN’ Command
    (Door Bag)
  Manually closed Door TGSE off, Heat
  °FPA to 22°C GN2 Purge on

NRL Buy OFF
  Buy Off Criteria
  Defined in Acceptance Test Plan
Star Tracker/Omni Antenna Installation

LMMS GSE Required
Instrument Rotation Fixture
Aperture Door ‘Expansion’ Bag

LMMS Prerequisites
NRL Buy-off of Instrument
Instrument Flight Captive Blanket

NRL Prerequisites
Star Tracker Assy Buy-off
(Star Tracker Assy Certified
to level 500A (TBR))
(Sub-Assy TVAC Complete)

NRL GSE
Installation Tooling
Teflon Sheet
Hardware for Star Tracker Installation

Instrument Prep
Clean and Remove Mass Sim Bag
Remove Instr Star Tracker
(Tear-Away Blanket)
Disconnect Star Tracker
Mass Sim Ground + Cable
Remove the Tracker
Mass Simulator

Star Tracker Install
Install Star Tracker
(Thermal and Mechanical I/F)
Electrical Ground
Electrical Cable(s)
Install Antenna Hat
(2lbs)
Verify Surface Cleanliness
(Level 500A (TBR))
Star Tracker Dust
Cover Installed
Star Tracker Bag Installed

Install Flight Blanket
Rotate & Add Captive flight Blanket

24-25 April 2001
FAME Technical Int
Instrument Integration to the S/C Bus

Prerequisites
LMMS
Doors Closed
GN2 Purge On
EGSE Disconnect
Instrument Grounded
NRL
Forward Ring Drilled /Insp
Bus Leveled
Star Tracker Assy Installed
S/C Grounded
Install Tank MLI
Instrument Integration Procedure Released

NRL GSE
1000 LB cap Hydroset
Inclinometer
Optical Inspection Equipment

Instrument Preps
Verify S/C Level
Inspect and Clean Instr Mount on Bus
Attach lift fixture and Hydroset (to Instrument)
Offload weight and remove Screws
Lift the Instrument (Level instrument in Lift Fixture)
Inspect and Clean Flexures
Translate over Bus
Verify Instr to Bus Orientation
Lower Instr to Bus (Crane/Hydroset)
Instrument Contact
Install Bolts
Off load Instr Weight to Bus
Torque Mounting Bolts
Verify IAC-STC-BAC
Shim as required for Instrument to Bus Align
Final Mounting Torque Verf

Electrical Connections
Connect Instr to Bus Grnd
Perform Ground Audits
Remove Instr Facility Grnd
Verf Elec Power Polarity
Clean and Inspect Connectors
Flight mate Connectors and Coax
Torque and Stake Connectors

Instrument to Bus Complete

24-25 April
FAME Technical Int
First Full Functional (FPA @10°C)

LMMS GSE
Instr TGSE
GN2 Purge

NRL Prerequisites
Antenna Hats Installed
BUS EGSE Verf
(Power, Software, Cmd)
NRL Test Procedure Released

NRL GSE
Test Racks and Cables
Antenna Hats

Electrical Connect
Coax to Antenna Hat
Connect Instr TGSE to Radiator
Instr GN2 Purge
Apply Instrument Power
Apply Electrical Power
(Verf power Start-up Sequence)
Perf Bus Elec Fuctional Test
Verfiy Instr Passive Telemetry
Perform Instr Elec Verf Test
Establish Instr Temp Control
Instr FPA to 10°C
GN2 Purge Off
(During data Collection)
CI, Flat Field, Instr Focus FPA LD
Active Focus Drive
Centroid Testing (TBD)
Doors Open Command

Terminate Functional Test
Manual Door Close
GN2 Purge On
Remove Instrument TGSE
FPA to 22°C

Observatory Power Off

Observatory Full Functional Test Complete
Prerequisites

• Instrument Buy-Off Complete
• Bus Buy Off Complete
• Environmental Test Procedures Released
• Open Item Audit and Evaluation (DRs, NMRS)
• Configuration Audits (As Built Configuration List)
• Complete Full Functional Analysis Complete
• Pre-Environmental Test Alignments Complete (Test Baseline)

Test Readiness Review
NASA, USNO, NRL, LMMS
Magnetic Balance (@NRL, or GSFC)

Prerequisites
- Install Solar Shields (with Trim Tabs and Areas)
- Flight Balance Magnets
- Test Procedure Released
- ABCL
- LMMS GSE Instrument Purge (TBD)
- NRL GSE Observatory Translation and Rotation Fixture
- NASA GFSC Portable Magnetometer Equipment
- Observatory Lift Fixture
- Observatory Shipping Container (if at GSFC)
- Bus Test Adapter & Marmon Clamp
- Test Racks, Cables

Static Measurement Balance
- Install on Fixture
- Set-up Test Configuration
- Establish Background
- Magnetic Dipole Measurement
- Balance To Fraction of Requirement

Dynamic (Power Up) Balance
- Connect Test Cables
- Deploy Solar Shields
- Remove Observatory Covers
- Power Up Sequence

Set Up Power Supplies to Back Drive Arrays (TBD)
- Perform Dipole Measurement (TBD)
- Balance To Requirement
- Power Down Sequence
- Install Observatory Covers

Magnetic Dipole Balance to ≤ 200 Pole-cm
EMI/EMC
@NRL or GSFC

Prerequisites
- Solar Shield Installed
- ABCL
- Harness installed for Flight
- Test Procedure Released
- Pre-Test Functional

LMMS GSE
Instrument TGSE
100 Foot Hoses

NRL GSE
- Observatory Lift Fixture
- Test, Racks, Cables
- Observatory Shipping Box (if at GSFC)
- Observatory Dolly
- BUS Test Adapter
- Marmon Ring

EMI/EMC
- Transport Observatory to EMI Chamber
- Install on Fixture
- Set up Test Equipment
- Connect Test Cables
- Connect Instrument TGSE to Radiator
- Remove S/A covers & other Non Flight Covers
- Power up Sequence
- Perform Test
- Power Down Sequence
- Install S/A & other Protective Covers
Spin Balance & Mass Properties

Prerequisites

- Solar Shield Installed
- Set up & Balance Bus Test Adapter & Marmon Ring
- ABCL
- Test Procedure released

LMMS GSE
- PURGE Disconnected

NRL GSE
- BUS Test Adapter
- Marmon Ring

- Fixture Balanced & Indexed
- Install Observatory on Fixture
- Deploy Arrays & Remove covers and Other Non-Flight Covers
- Spin Balance Arrays Down
- Arrays up verification?
- Doors open Spin Balance? (STC & INST)
- Install S/A & Other Protective Covers
Modal Testing

LMMS GSE
- Instrument TGSE?
- Instrument Purge

Prerequisites
- Drill FV Test Adapter to modal plate
- Build up Interstage with Mass Simulator
- Sun Shield Installed
- ABCL
- Test Procedure released

NRL GSE
- SRM Mass Simulator
- Large Modal Plate
- Modal Test Rack
- Accelerometers & Cables
- Test Racks, Cables

NRL FLT HW
- Flight Interstage
- Flight like Marmon Clamp

JITTER TESTING Option
- Hook up Observatory Test cables
- Attach Instrument TGSE
- Remove Purge
- Ensure proper sensors are installed
- Attach Observatory Lift Fixture
- Separate Observatory from Interstage & Lift up small amount (still cabled up)
- Power up Observatory
- Measure Jitter
- Power Down Sequence
- Reconnect Purge
Lateral Random Vibration

LMMS  GSE
• Instrument Purge
• Internal Accelerometers

Prerequisites
• Modal Test Done
• ABCL
• Build Up Interstage with SRM Mass Simulator
• Sun Shield Installed
• Test Procedure Released
• Pre Test Functional
• Vibe Table adapter plate drilled for FV test adapter

FIRST LATERAL AXIS
• FV Test Adapter installed on Vibe table
• Install Accelerometers on Observatory & Interstage
• Connect Instrument internal Accelerometers
• Install FV on Test Adapter
• Hook Up EGSE Cables
• Remove S/A Covers & other covers
• Power Up functions active at Launch
• Perform test, notch as req’d
• Perform Post Test Functional
• Power Down
• Install S/A Covers & other covers

SECOND LATERAL AXIS
• Rotate Test Article 90°
• Verify Instrumentation
• Remove S/A Covers & other covers
• Power Up functions active at Launch
• Perform Test, Notch as Req’s
• Perform Post Test Functional
• Power Down
• Install S/A Covers & other covers
• Disconnect Accelerometers & Test Cables for move
• Install FV on Transport Dolly

NRL  GSE
• Test Racks, Cables
• Observatory Transport Dolly
• Observatory Lift Fixture
• FV Test Adapter

NRL  FLT  HW
• Flight Inter-stage
• Flight Marmon Clamps
• SRM Mass Simulator

24-25 April
Axial Random Vibration & Acoustic

LMMS  GSE
• Instrument Purge
• Instrument Internal Accelerometers

Prerequisites
• ABCL
• Modal Test Done
• Build Up Interstage with Mass Simulator SRM
• SUN Shield Installed
• Test Procedure Released
• Pre-Test Functional
• Vibe Table Adapter plate drilled for FV Test Adapter

AXIAL RANDOM VIBRATION
• FV Test Adapter Installed in Acoustic Chamber
• Hook Up Bus & Instrument Accelerometers cables
• Hook up EGSE Cables
• Remove S/A & other Covers
• Power Up Functions active at Launch
• Perform Test, notch as Required
• Perform Post Test Functional
• Power Down
• Reinstall S/A & other Covers

ACOUSTIC
• Set up acoustic chamber for Acoustic Test
• Disconnect Purge
• Remove S/A & other Covers
• Power up Functions active at Launch
• Perform Lower Level Test, check responses
• Perform Full Level Test
• Perform Post Test Functional
• Power Down
• Install S/A Covers & other covers
• Reconnect Purge

NRL  FLT  HW
• Test Racks, Cables
• Observatory Transport Dolly
• Observatory Lift Fixture
• FV Test Adapter

NRL  FLT
• Flight Interstage
• Flight Marmon Clamps
Pyro Shock Mechanism Deployment

**Prerequisites**
- Instrument Purge
- Instrument Internal Accelerometers
- Vibe & Acoustic Done
- ABCL
- Test Procedure released
- SUN Shield Installed
- Pre-Test Functional
- MLI on S/A & BUS to look for snags

**LMMS GSE**
- Test Racks, Cables
- Firing Rack
- Observatory Lift Fixture
- FV Test Adapter
- SRM Mass Simulator
- Observatory Test Adapter

**OBSERVATORY INTERSTAGE**
- FV Still in Acoustic Chamber
- Purge still on
- Hook Up Observatory Lift Fixture, Remove Slack (offload?)
- Accelerometer & Test Cables Still Hooked up
- Install any new shock accels or hookup ones previously installed
- Remove S/A & other Covers
- Power up Functions active at Separation
- Perform Test
- Separate Observatory from Interstage enough to activate SEP Switch
- Post Test Functional
- Power Down
- Set Observatory down on Dolly
- Install S/A Covers & other covers
- Disconnect Accelerometer & Test Cables for move

**SOLAR ARRAY**
- Move Observatory to location for S/A Deployment
- Install Observatory on special test fixture if required
- Connect up shock accelerometers
- Connect up EGSE Cables
- Remove S/A & other covers
- Power up functions active at deploy
- Perform test
- Post Test Functional
- Power Down
- Install S/A covers & other covers
- Restow or remove Arrays
- Disconnect Cables, remove accelerometers
- Put Observatory on Transport Dolly
**Thermal Vacuum (TVAC)**

**Prerequisites**
- Instrument Purge
- Vibe & Acoustic Completed
- Chamber Trolley drilled to accept observatory Test Adapter
- Remove MLI if installed for S/A Deployment testing
- Test Procedure Released
- ABCL

**Test Set up**
- Chamber Plate on Trolley, under crane footprint
- Mount Observatory test adapter on plate
- With Observatory on Ground install thermocouples & Verify
- Mount Observatory on Adapter Plate
- Remove Antenna Protective covers
- Roll trolley to chamber & install Plate in chamber
- Hook Up test cables & verify
- Ensure That INST door bagging material is clear of INST door
- Set up Video camera to view Doors

**TVAC Test**
- Perform open door functional Test
- Close door, perform functional test
- Pull vacuum perform ambient temperature functional test
- Go Hot with FPA heaters on (drive off H20 & Volatiles)
- Perform 3 Thermal Cycles with Functional test at each extreme
- At appropriate time, deploy Instrument covers
- Warm up test article
- Open Door
- Close Instrument doors
- Attach purge
- Remove Observatory from chamber
- Install protective covers
- Place Observatory on transport Dollies

**Test Set up**
- Chamber Test Cables
- Observatory Lift Fixture
- Observatory Test Adapter
- Chamber Trolley & Plate
- Marmon clamp
- Video Camera & Monitor

**LMMS GSE**
- Instrument Purge

**NRL GSE**
- Chamber Test Cables
- Observatory Lift Fixture
- Observatory Test Adapter
- Chamber Trolley & Plate
- Marmon clamp
- Video Camera & Monitor
End to End Compatibility
Post Environmental Test
Full Functional

LMMS GSE
Instrument TGSE
GN2 Purge

LMMS Prereq
Instr to S/C Procedure Release
NRL Prereq
Antenna Hats Installed
BUS EGSE Verf
(Power,Software, Cmd)
NRL Test Procedure Released

NRL GSE
Space craft EGSE
Test Cables
Antenna Hats
Test Racks

Electrical Connect
Coax to Antenna Hat
Connect Instr TGSE to Radiator
Instr GN2 Purge
Apply Instrument Power
Apply Electrical Power
(Verf power Start-up Sequence)
Perf Bus Elec Fuctional Test
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Active Focus Drive Verf
Centroid Testing(TBD)
Doors Open Command

Terminate Functional Test
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Remove Instrument TGSE
FPA to 22°C
Observatory Power Off

Observatory
Full Functional
Test Complete

24-25 April
FAME Technical Int
Post Environmental Test Alignment Verification

Prerequisites

- Instrument Purge
- Environmental testing Complete
- Observatory Test Adapter
- Observatory Lift Fixture
- SIP Table
- Theodolites
- Marmon Clamp
- Move Observatory from Trolley to SIP Table
- Perform Optical Inspection
  - IMU’s
  - STAR TRACKERS
  - BAC
  - IAC
- Compare Results to Pre-test Inspections
Testing Complete

Pre-Ship Readiness Review

**Prerequisites**

- Instrument Buy-Off Complete
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- Environmental Testing Complete
- Open Item Audit and Evaluation (DRs, NMRS)
- Configuration Audits (As Built Configuration List)
- Complete Full Functional Analysis Complete
- Post-Environmental Test Alignments Complete

Pre-Ship Review

NASA, USNO, NRL, LMMS