National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

AFTA

AFTA-WFIRST Telescope Cold Test

September 9, 2013

ITT EXELIS

AFTA-WFIRST Cold Test
Problem Statement and Objective

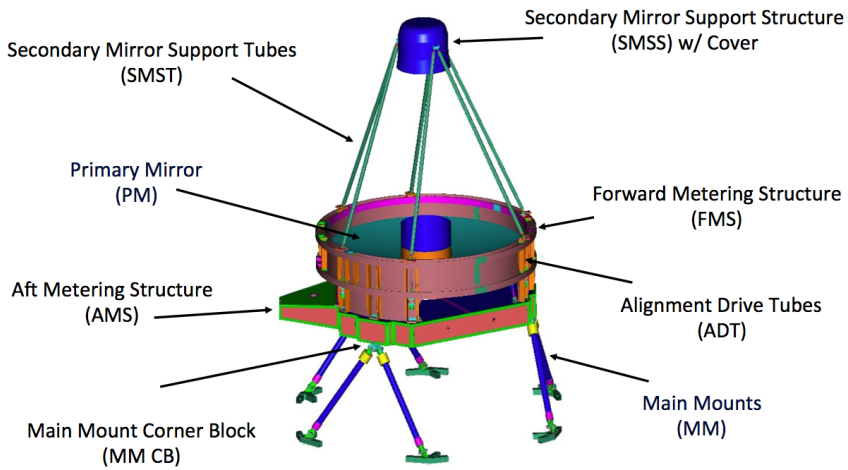
- **Problem Statement:** The telescope system was designed to operate at room temperature (293K). For AFTA-WFIRST running the operating temperature closer to 250K would greatly improve the science collection. Mounted mirror assemblies have been tested in this temperature range (glass, RTV, metal), and while similar composite structures have been utilized for missions in this temperature range, these specific designs have not been analyzed and/or tested for performance and/or survivability.

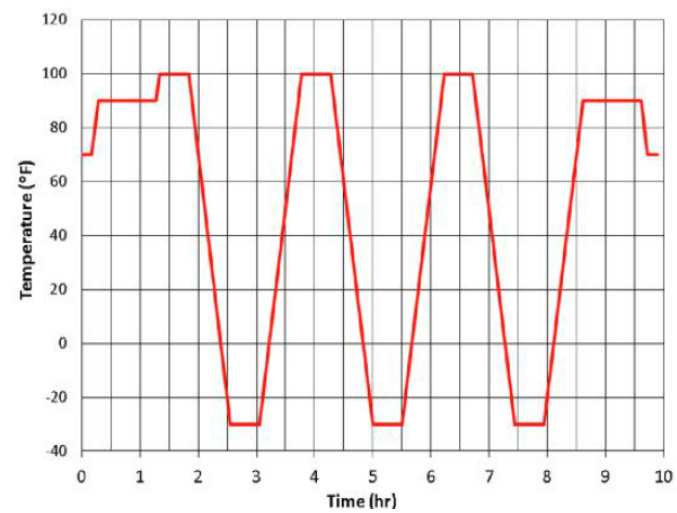
- **Objective:** Perform a 'cold box' test that would thermally cycle development hardware of all representative joints and bonds appropriately instrumented to collect thermal data and perceive bond or layup disruption. This test is for feasibility only. Additional testing and analysis is required to retire risk of lower temperature operation.

- **Scope:** This test will be limited to testing composite performance – glass, RTV, and invar have been tested to 100K with no survival issues – optical performance predictions will be verified by incorporating a cold airbag test in the PM test flow.

AFTA-WFIRST Cold Test Status

- Test Plan and Test Readiness reviewed and approved
- Hardware consists of 4 development articles that were manufactured using all flight hardware processes and procedures
- The hardware was located, cleaned and prepped by removing some previously used GSE.
- Pre-test non-destructive hardware evaluation (NDE) complete
- Warm/cold thermal cycling completed
  - Hardware and cold box were instrumented for monitoring during the test
  - On-site JPL oversight
- Post-test NDE and Test Report in work





- Preliminary results: One of the articles has completed post-cycling NDE and was found to agree well with pre-test NDE

AFTA-WFIRST Cold Test
Other Considerations on Operating Colder

Telescope system was designed to operate around 293K (Room Temperature)

- Does not require requalification for warm launch

Various material considerations influence using the system at colder temperatures

- Mirror Materials
  - Corning ULE™ is optimized for room temperature applications
  - ULE™ has been tested at 20K with degraded CTE characteristics
- Structures
  - Laminate also optimized for room temperature use
  - CTE characteristics degrade slowly so some level of off-nominal conditions would be acceptable
- Bonding Materials
  - GE RTV-566 used to attach mirrors to mounts would need qualification at off-nominal temperatures
- Mechanisms
  - Precision mechanisms would be a concern
- Transfer adhesive (966) 'gets loose' around 216K
- Survival set point for hybrid heater controllers would need to be lowered, which may be accomplished by replacing the sensors or adding a resistor

Current AFTA-WFIRST study plan includes CTE testing of 4 composite coupon samples in FY14