

**LBT PROJECT**  
**2x8,4m TELESCOPE**

Doc.No. : 640s002  
Issue : Issue B  
Date : 8-Sep-05

**LBT PROJECT**  
**2 X 8,4m OPTICAL TELESCOPE**

**LBT Adaptive Optics System**  
**AIT Management Plan**

	<b>Signature</b>	<b>Date</b>
Prepared	Joar Brynnel	2-May-05
Reviewed	Simone Esposito (OAA) Armando Riccardo (OAA) Daniele Gallieni (ADS) Roberto Biasi (Microgate)	8-Sept-2005
Approved		

## 1. Revision History

<b>Issue</b>	<b>Date</b>	<b>Changes</b>	<b>Responsible</b>
Draft 1	2-May-05	First draft	Joar Brynnel
Draft 2	2-Sept-05	Second draft Added Section 4	Joar Brynnel
Issue A	7-Sept-05	Update after input from ADS, OAA and Microgate	Daniele Gallieni Armando Riccardo Roberto Biasi Joar Brynnel
Issue B	8-Sept-05	More comments from OAA - Document title changed to reflect contents - Section 3.1: Changed wording for clarification - Section 4: Added clarification - Adding [RD1]	Simone Esposito

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### **3. About this document**

#### **3.1. Purpose**

This document is a summary of the assembly, integration and test (AIT) of the first LBT Adaptive Optics system in Italy. Work packages and Milestones are defined, and acceptance test criteria are determined.

#### **3.2. Reference Documents**

[RD1] LBT672\_plan\_05sept05\_MG.mpp; Microsoft project schedule for ADS and MG activities; D. Gallieni and R. Biasi

## 4. Executive Summary

The Assembly, Integration and Test (AIT) of the LBT Adaptive Optics system #1 (SX) and #2 (DX) is a complex process involving several groups on various locations in Arizona and Italy. In February 2005 an LBT Adaptive Optics meeting was held in Arcetri between all involved parties. This document is a summary of the management session from this meeting. Parties present during discussion were Arcetri, LBTPO, ADS and Microgate. There was a consensus that this schedule is realistic, assuming that no significant technical problems or other force majeure event would occur. Any such problem shall be dealt with on a case by case basis.

The LBT Adaptive Optics systems (SX and DX) are developed under three contracts:

- AO103, WLBT On-Axis Wavefront Sensing Units
- AO104, Adaptive Secondary Development, Testing and Commissioning
- AO017, LBT672 Adaptive Secondary Units

This document defines the AIT process for LBT Adaptive Optics system #1. Milestones are defined, with associated test criteria. The Adaptive Optics system AIT process starts at T0 when the mirror shell #1 arrives in Italy. A relative development schedule, based on shell delivery date, is presented.

Figure 1 shows a Gantt chart for the complete process, assuming a delivery of the first science grade shell at ADS in Lecco on October 17 2005. The planning also assumes delivery of the engineering grade shell shortly before the arrival of the first science grade shell.

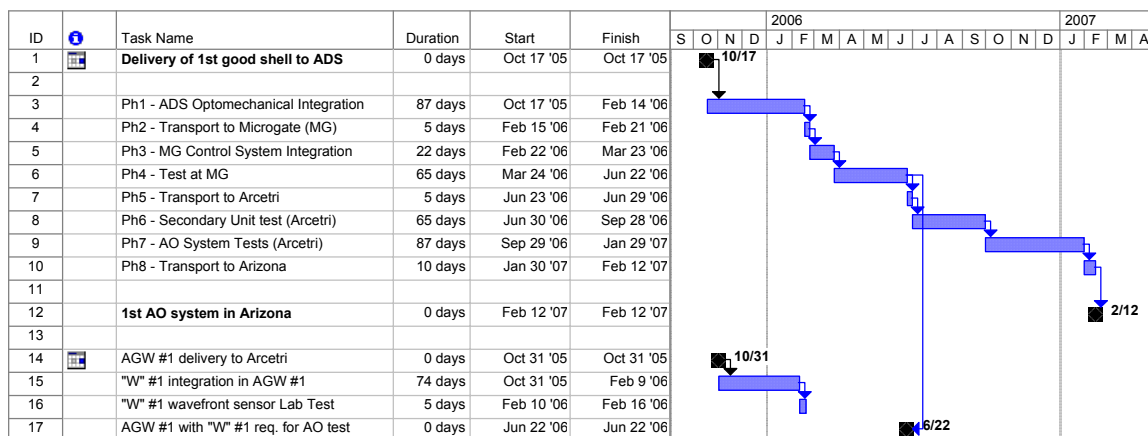


Figure 1: Schedule assuming first good shell to ADS on 17 October 2005

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## **5. Phase 1 – Opto-mechanical Integration**

After shell arrival in Lecco, opto-mechanical system integration can start.

### **5.1. Work package definition**

- Mechanical integration of the adaptive secondary unit
- Integration of reference body and shell into adaptive secondary unit
- Magnets gluing on the thin shells (engineering shell and final shell)
- Integration of the adaptive secondary unit and hexapod into the M2 hub
- Milestone tests (ref. sect.5.4)
- Adaptive secondary unit and hexapod dismounted from M2 hub

### **5.2. Milestone definition**

After finishing of Opto-Mechanical integration in Lecco, the unit will be inspected in Lecco. This constitutes the milestone “*Ready for shipping to Microgate*”

### **5.3. Schedule**

The milestone “*Ready for shipping to Microgate*” is expected to be reached at T0 + 4 Months.

### **5.4. Test plan**

- Interface to hub
- Hexapod movement range in hub
- Interface to swing arm
- Inspection of dust protection
- Weight
- Flexure testing

### **5.5. Requirements before testing**

- Hexapod accepted and functional

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### **5.6. Test Responsible**

- ADS

### **5.7. Test Participants**

- ADS
- Arcetri
- LBT PO



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## **6. Phase 2 – Transport to Microgate**

### **6.1. Work package definition**

- Packing of secondary unit and shells (engineering and science #1)
- Transport from Lecco to Bolzano

### **6.2. Milestone definition**

Equipment as defined in section 6.1 inspected at Microgate's premises in Bolzano.

### **6.3. Responsible parties**

- ADS
- Microgate

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## **7. Phase 3 – Control System Integration**

This phase is defined as integration and test of the Adaptive secondary Control electronics and Software.

### **7.1. Work package definition**

- Integration of AdSec control electronics to Adaptive Secondary Unit #1
- Installation of Actuators

### **7.2. Milestone definition**

After Control System integration into AdSec unit, the unit will be tested in Bolzano. This constitutes the milestone “*Ready for Electro-Mechanical test*”

### **7.3. Schedule**

The milestone “*Ready for Electro-Mechanical test*” is expected to be reached at T0 + 5 Months.

### **7.4. Test plan**

- Remote power switching
- Power consumption

### **7.5. Requirements before testing**

- Control system integrated into hub
- Arcetri to deliver configuration and characterization software
- M2 unit assembled to final telescope configuration, and aligned
- Engineering shell installed
- Final electronics ready
- Safety features verified
- Actuator calibration done
- Swing arm rack parts available
- Temperature tests already performed
- Communication working
- Cooling system supply available
- US standard power supply available

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## **7.6. Test Responsible**

- Microgate
- ADS

## **7.7. Test Participants**

- Microgate
- ADS
- Arcetri
- LBT PO

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## **8. Phase 4 – AIT at Microgate**

### **8.1. Work package definition**

This phase is defined as performing electro-mechanical testing of the M2 unit at Microgate in Bolzano.

- Membrane gluing (engineering shell)
- Closed loop tests with engineering shell
- Membrane gluing (final shell)
- Closed loop tests and calibration with final shell

### **8.2. Milestone definition**

After finishing the electro-mechanical tests, the unit will be tested in Bolzano. This constitutes the milestone “*AdSec unit #1Ready for Optical test*”

### **8.3. Schedule**

The milestone “*AdSec unit #1Ready for Optical test*” is expected to be reached at T0 + 8 Months.

### **8.4. Test plan**

- Electro-mechanical tests at room temperature at different elevation angles
- Chopping at different elevation angles
- Crosstalk
- Noise
- Dynamical performance at different gaps at different elevation angles
- Communication

### **8.5. Test Responsible**

- Microgate
- ADS

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## **8.6. Test Participants**

- Microgate
- ADS
- Arcetri
- LBT PO

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## **9. Phase 5 – Transport to Arcetri**

### **9.1. Work package definition**

- Packing of secondary unit #1, shells and control system
- Transport from Bolzano to Arcetri

### **9.2. Milestone definition**

Equipment as defined in section 9.1 received and inspected at Arcetri.

### **9.3. Responsible parties**

- ADS
- Microgate

### **9.4. Test Participants**

- ADS
- Microgate
- Arcetri

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## **10. “W” wavefront sensor lab acceptance test**

In parallel with the AdSec unit testing in Bolzano as described in section 8, the W wavefront sensor shall be tested in Arcetri. The goal is that the W sensor shall be ready for system tests before the AdSec unit arrives in Arcetri.

### **10.1. Work package definition**

Full performance testing of “W” sensor #1 (LBTO contract AO103).

### **10.2. Milestone definition**

After finishing the W sensor integration, the unit will be tested in Arcetri. This constitutes the milestone “*W sensor ready for System test*”

### **10.3. Schedule**

The milestone “*W sensor ready for System test*” is expected to be reached at T0 + 8 Months, but no later than milestone “*AdSec unit #1 Ready for Optical test*” as defined in section 8.

### **10.4. Test plan**

- Artificial source operation
- Flexure tests
- Sensitivity
- Stage performance
- Automatic source acquisition
- Operation with different binning modes
- Operation with different tilt modulation
- Use of different reconstructors
- User interface AO supervisor
- Engineering interface
- Diagnostics
- Thermal testing of electronic boxes
- Input disturbance
- Fault trapping, exception handling

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### **10.5. Requirements before testing**

- TCS simulator available in Arcetri
- W unit integrated in AGW #1
- Cooling, electrical power connected through AGW
- Interferometer available
- Polychromatic fiber source
- Lucifer 1 micron dummy window and Lucifer simulator

### **10.6. Test Responsible**

- Arcetri

### **10.7. Participants**

- Arcetri
- Potsdam
- LBTPO



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## **11. Phase 6 – Secondary Unit tests**

During this phase the Secondary Unit #1 is tested for acceptance by Arcetri. It also means acceptance testing for LBTO Contract AO104.

### **11.1. Work package definition**

Testing of Secondary Unit #1 for compliance with technical requirements.

### **11.2. Milestone definition**

After delivery of Secondary Unit #1 to Arcetri, the unit will be tested for acceptance. Successful completion of tests constitutes the milestone “*Flattened secondary shell, ready for AO tests*”.

### **11.3. Schedule**

The milestone “*Flattened secondary shell, ready for AO tests*” is expected to be reached at T0 + 10 Months.

### **11.4. Test plan**

- Alignment procedure (interferometer with retro-reflector)
- Functionality at different ambient temperatures
- Mirror flattening at different gaps
- Flattening in chopping mode
- Local capacitive sensor calibration
- Flattening at different ambient temperatures
- M2 unit thermal performance (surface temperature)

### **11.5. Requirements before testing**

- Test tower thermal and pressure control working
- Secondary unit connected to cooling system
- US power supply 3-phase
- TCS interface (required by T0 + 7 months)
- Hexapod control system (required by T0 + 7 months)
- Interferometer installed in AGW frame (planned for September 2005)

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### **11.6. Test Responsible**

- Arcetri

### **11.7. Participants**

- Arcetri
- ADS
- LBT PO

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## **12. Phase 7 – AO System tests**

In this phase the complete LBT AO system #1 is tested. It means closing the AO loop using all the final hardware and software.

### **12.1. Work package definition**

- Testing W sensor in AGw structure under test tower
- Testing Secondary unit mounted in test tower
- Closing AO loop

### **12.2. Milestone definition**

After successful completion of all tests outlined in this section, the milestone “*AO System Acceptance Test*” will be declared completed.

### **12.3. Schedule**

The milestone “*AO System Acceptance Test*” is expected to be reached at T0 + 14 Months.

### **12.4. Test plan**

- Interaction matrix
- WFS calibration
- Closed loop time delay measurements
- Temporal filtering
- Closed loop performance signal error RMS and WF error RMS
- Strehl ratio measurements with and without turbulence
- Chopping
- Re-centering and refocusing
- Offloading to TCS
- Documentation review
- Spare parts inspection
- Telescope interface check

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### **12.5. Requirements before testing**

- IR camera in test tower (ARNICA)
- TCS interface
- Hexapod control system including software

### **12.6. Test Responsible**

- Arcetri
- LBT PO

### **12.7. Participants**

- Arcetri
- LBT PO

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## **13. Phase 8 – Transport to Mt Graham**

### **13.1. Work package definition**

- Receive M2hub from ADS
- Install adaptive secondary unit and hexapod into M2 hub
- Packing of hub, hexapod, secondary unit, shell, control system
- Transport from Arcetri to Arizona

### **13.2. Milestone definition**

Equipment as defined in section 13.1 received and inspected in Arizona.

### **13.3. Responsible parties**

- Arcetri
- LBT PO
- ADS

### **13.4. Test Participants**

- Arcetri
- LBT PO

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