LBT-ADOPT
TECHNICAL REPORT

Doc.No : 640f002
Version : A
Date : 03 Nov 2005

LBT672 Unit Electro-Mechanical Acceptance Test Plan and Specifications

Armando Riccardi(1)

(1) INAF-Osservatorio Astrofisico di Arcetri

ABSTRACT

This document reports the lab testing activity for the acceptance of the LBT672a/b units in terms of electro-mechanical performances. The document covers the electromechanical tests (performed in Microgate by MG+ADS+OAA) that are mentioned in Phase 4 of the AIT Management Plan (640s002). The acceptance of the results of tests represents the *"Adsec unit Ready for Optical test"* milestone.

Modification Record

Version	Date	Author	Section/Paragraph affected	Reason/Remarks
A	03/11/2005	A. Riccardi	All	

Abbreviations, acronyms and symbols

Symbol	Description
ADS	ADS International srl
AIT	Assembly, Integration and Test
AO	Adaptive Optics
ASM	Adaptive Secondary Mirror
ATT	Arcetri Test Tower
INAF	Istituto Nazionale di AstroFisica
LBT	Large Binocular Telesecope
LBT672	LBT 672-actuator Adaptive Secondary Mirror Unit
LBTO	LBT Observatory
MG	Microgate srl
MMT336	MMT 336-actuator Adaptive Secondary Mirror Unit
OAA	Osservatorio Astrofisico di Arcetri
P45	LBT 45-actuator Adaptive Secondary Mirror Prototype
PtV	Peak-to-valley
resp.	Responsible parties
rms	root mean square
SL	Seeing Limited
TS1	Thin Shell 1 (telescope shell)
TS2	Thin Shell 2 (reduced size shell for electro-mechanical tests)
W	Wave-front sensing unit for First Light LBT AO System
WFE	Wave-Front Error

Contents

1 Introduction

The present document reports the technical specifications to be test at the end of the Phase 4 for the electro-mechanical acceptance of the LBT672 unit. The compliance of the test results with specifications constitutes the *"AdSec unit Ready for Optical test"* milestone related to the LBTO Contracts AO104 and AO017. See Ref. [1] for a general description of phases and milestones.

2 Requirements for starting electro-mechanical tests

The following items are required in order to start the electromechanical test of Phase 4:

- LBT672 unit successfully achieved the "Ready for electro-mechanical test" milestone at the end of Phase 3 (resp. MG+ADS)
- OAA has to provide AO supervisor software with the following functionalities (resp. OAA):
  - unit initialization and configuration
  - status (position, command, forces and temperature) displayer
  - capacitive sensor noise characterization
  - coil-to-capsens crosstalk characterization
  - mirror setting procedure for shell-to-refplate gap from 50μm to 100μm
  - feed-forward matrix calibration
  - step response characterization
  - internal control loop transfer function characterization
  - chopping characterization
- Cooling system (50% water, 50% glycole) (resp. MG) able to provide 11 l/min with 1bar delta-pressure
- Test stand supporting LBT672 unit and allowing to perform tests with elevation angles from 10° to 90°

3 Electromechanical test plan an specifications

1. Set Adaptive Secondary Mirror inlet cooling temperature to T_{ASM} = ambient-3°C, cooling flux 11 l/min (see Ref. [3])
2. Set the LBT672 unit at 90° elevation angle
3. Set the mirror at the nominal AO gap (~70μm) with suitable configuration for this environment. and wait for thermalization
4. Check the following electro-mechanical specifications (see Ref [4], Sec. 3.2):
   - Actuator position sensor noise < 10nm RMS (goal 3nm RMS)
   - settling time (single actuator and modal, for each controllable mode) < 1.5ms (goal 0.7ms), 0.1N max delta-force
   - tracking of a turbulent actuator command history generated with median seeing r_0(500nm) = 16 cm and wind speed 20 m/s (Taylor frozen turbulence hypothesis). The command history is compared with the corresponding capacitive sensor readings (actual position when command is sent). The specification on the turbulence tracking error is: 50 nm rms WFE (goal: 28 nm rms), with full-speed and full-mode correction. Data are collected using diagnostic records stored in SDRAM memory of DSP boards
   - Actuator position sensor long term stability < 20nm RMS over 8 hours with constant temperature
5. Set the mirror at nominal chopping gap (~100μm) with suitable configuration for this environment.
6. Check the following electro-mechanical specifications:
   - minimal chopping requirements (scaled from MMT336, Ref. [5]): ±4 arcsec (on-sky equivalent from capacitive sensor reading, i.e. 80μm PtV stroke at the edge) at 5 Hz with 90% duty cycle. Goal (scaling from P45, Ref. [6]): ±7 arcsec (140μm PtV stroke at the edge), 5 Hz, 90% duty cycle
   - on-source tilt reproducibility: 10 mas rms (λ/10 at 5 μm) on-sky equivalent from capacitive sensor reading. Goal: 3 mas rms (<λ/10 at K=2.2 μm)
7. Repeat the above test at 70°, 45° and 20° elevation angles

4 Conclusion of Phase 4

In case the LBT672 unit will pass successfully the electro-mechanical acceptance tests, the milestone *"AdSec unit Ready for Optical test"* is reached.

5 References

[1] Brynnel, J., "LBT Adaptive Optics System AIT Management Plan," 640s002, Issue B, 08 Sep 2005
[2] Biasi, R. "Adaptive secondary control system," 640a006, Issue B, 18 Dec 2003
[3] Gallieni, D. "LBT adaptive secondary, mechanics construction status report" LBT AO progress meeting 21-24 Feb 2005 (http://lbtwww.arcetri.astro.it/adopt/lbtao/review-feb-2005/daniele_gallieni-lbt_adaptive_secondary_mechanics.ppt)
[4] Gallieni, D. "F/15 Adaptive Secondary Mechanical Design," 640a005, Issue D, 17 Dec 2003
[5] G. Brusa, A. Riccardi, P. Salinari, F. P. Wildi, M. Lloyd-Hart, H. M. Martin, R. Allen, D. Fisher, D. L. Miller, R. Biasi, D. Gallieni, and F. Zocchi, ``***MMT adaptive secondary: performance evaluation and field testing***," in *Adaptive Optical System Technologies II. Edited by Wizinowich, Peter L.; Bonaccini, Domenico*, vol. 4839 of *Proc. SPIE*, pp. 691-702, Feb. 2003
[6] M.Xompero, D. Zanotti, and A. Riccardi, "P45 test results and beyond," LBT AO progress meeting 21-24 Feb 2005 (http://lbtwww.arcetri.astro.it/adopt/lbtao/review-feb-2005/marco_xompero-p45_test_results.ppt)
[7] Carbillet, M., Riccardi, A., and Esposito, S., "***Numerical simulation studies for the first-light adaptive optics system of the Large Binocular Telescope***", in *Advancements in Adaptive Optics. Edited by Domenico Bonaccini Calia, Brent L. Ellerbroek, Roberto Ragazzoni*, vol. 5490 of *Proc. SPIE*, pp. 721-732, 2004
[8] A. Riccardi, G. Brusa, P. Salinari, S. Busoni, O. Lardiere, P. Ranfagni, D. Gallieni, R. Biasi, M. Andrighettoni, S. Miller, and P. Mantegazza, ``***Adaptive secondary mirrors for the Large binocular telescope***," in *Astronomical Adaptive Optics Systems and Applications. Edited by Tyson, Robert K.; Lloyd-Hart, Michael*, vol. 5169 of *Proc. SPIE*, pp. 159-168, Dec. 2003.

Doc_info_start
Title: LBT672 Unit Electro-Mechanical Acceptance Test Plan and Specifications
Document Type: Test Plan and Specifications
Source: INAF-Osservatorio Astrofisico di Arcetri
Issued by: A. Riccardi
Date_of_Issue: 03 Nov 2005
Revised by:
Date_of_Revision:
Checked by: A. Riccardi
Date_of_Check: 03 Nov 2005
Accepted by: A. Riccardi
Date_of_Acceptance: 03 Nov 2005
Released by: A. Riccardi
Date_of_Release: 03 Nov 2005
File Type:PDF
Local Name:
Category: Telescope Auxiliaries
Sub-Category: M2 Adaptive F/15
Assembly: M2 Adaptive F/15 General
Sub-Assembly:
Part Name:
CAN designation: 640f002
Revision: A
Doc_info_end