VERY LARGE TELESCOPE

COMMISSIONING TEST PROCEDURE

2.12.D

The VLT-Astronomical Site Monitor

Verification of ASM

INTERNAL USE ONLY

Document No.:	VLT-PRO-ESO-10200-1453
Issue No.:	1.0 (prep 1)
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Issue/Rev.	Date	Section/Page affected	Reason/Initiation/Document/Remarks
1.0 prep 1	May 28, 1998		

Change Record

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1 Scope

The version V1.0 of VLT Astronomical Monitor is composed of subsystems which have been tested and commissioned individually. The purpose of the ASM verification is to check again their performances when connected to each other and to the VLT backbone, with the latest VLT Software release and in automated operation. It is reminded that the specification of the DIMM call for an accuracy better than +/- 10% over the whole range of operating conditions.

2 Applicable Documents

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of the specification shall be considered a superseding requirement.

-VLT-VPO-97/0184	Individual Integration/Commissioning Planning Activities 20 Aug.97, Updated Nov.97
-VLT-SPE-ESO-17410-1174	VLT-ASM Seeing and Coherence Monitor, Dimm Upgrade Plan -2.0, Dec.96
-VLT-SPE-ESO-17441-1175	Astronomical Site Monitor Control SW Specification - 1.0/prep.2, Nov.96
-VLT-SPE-ESO-17410-1253	VLT-ASM Dimm Retractable Enclosure, Functional Specification -2.0, Dec.96
-VLT-TRE-ESO-17430-1270	VLT-ASM Control Hardware, Functional Description - Draft 2, Jan.97
-VLT-SPE-ESO-17441-1213	Astronomical Site Monitor Control SW Design Description - 1.0/prep.1, Nov.96
-VLT-MAN-ESO-17441-1404	VLT-ASM Control Software, Installation and Operation Manual - 1.0/prep.1, 1 Aug.97
-VLT-MAN-ESO-17441-1405	Astronomical Site Monitor DIMM Upgrade Mission - Test Report, 21 Aug.97
-VLT-DCR-DJO-11710-0000	Small CCD Head Interface -f, Jan.96
-VLT-MAN-DJO-11700-0001	Technical CCD Systems, User Manual -1, May96
-VLT-MAN-ESO-11240-0672	CCD Detectors Control Software, User Manual -1.5, 19 Nov.97
-VLT-TRE-ESO-17430-1271	VLT-ASM Control Hardware, Design Description - Draft 2, Jan.97
-VLT-TRE-ESO-17431-1272	VLT-ASM LCU, Signal Description - Draft 2, Jan.97
-VLT-TRE-ESO-17431-1273	VLT-ASM LCU, Hardware Signal Assignment - Draft 2, Jan.97
-VLT-TRE-ESO-17431-1274	VLT-ASM LCU, Software Signal Assignment - Draft 2, Jan.97
-VLT-PRO-ESO-17434-1274	VLT-ASM Seeing Monitor, Modifications to the Motor Assembly - Draft 2, Jan.97
-Vaisala Technical Notice	MILOS 500 Automatic Weather Station for the ESO VLT Project Nov. 1997

3 Test Requirements

3.1 Test Item Definition

The version V1.0 of VLT Astronomical Monitor is composed of a meteorological station and a seeing monitor on a tower protected in daytime by an enclosure.

Status: it is assumed that the ASM is fully connected to VLT observatory (with the possible exception of cooling fluid). Basic functionality of each item has been proven in local mode. A pointing model is resident at the telescope.

3.2 Test Methods

3.2.1 Test Conditions

Sky clear of partially clear. High wind conditions (15 to 18 m/s) when they occur should be used to estimate actual operating limits.

3.2.2 Test Sequence

1-Verification of the Vaisala Meteorological Station
2-Measurement of presetting accuracy (with pointing model)
3-Measurement of tracking accuracy (with pointing model, no autoguiding)
4-Measurement of wind load effects on telescope structure 5-Optimization of the DIMM validation limits (TCCD centroiding)
6-DIMM instrumental noise measurement (double star simulator)
7-DIMM absolute pixel scale verification
8-Verification of automated functions

3.3 Precautions/Safety Aspects

Refer to safety aspects regarding automated operation of the telescope enclosure: it should be switched to *manual* mode when personnel has to climb up the tower.

3.4 Data Processing/Reduction Method

Standard graphic/statistics software: MIDAS should be installed on -or accessible from- the ASM workstation.

4 Definition of Tests

4.1 Verification of the Vaisala Meteorological Station

4.1.1 Test Principle

The old MILOS 200 Vaisala operating since 1984 at Paranal has been replaced by a more modern MILOS 500 model. The two stations are running in parallel to establish consistency of the long term database.

4.1.2 Test Setup

4.1.3 Test Equipment List

4.1.4 Data Acquisition and Archiving

Regression plots

4.1.5 Step-by-Step Test Procedure

-Record several weeks of Temperature and Humidity data on both stations
-Verify correlation of MILOS 200 and MILOS 500 and measure possible offsets
-Verify correlation of levels 30m, 20m, 10m and 2m of MILOS 500 when relevant

4.2 Measurement of telescope presetting accuracy

4.2.1 Test Principle

The DIMM telescope cannot work without pointing model. Even then, the presetting reaches the required accuracy in a limited part of the sky only: the pointing model has been adjusted for the South Eastern side up to a distance of 45 degree from zenith. This corresponds to the area of target selections by the star catalogue.

4.2.2 Test Setup

4.2.3 Test Equipment List

4.2.4 Data Acquisition and Archiving

Distance of object from center of field.

4.2.5 Step-by-Step Test Procedure

-remove image duplicator (prism) from telescope
-preset to object in the preset area, take an exposure, measure distance
-repeat on other targets
-plot diagram of presetting accuracy as a function of sky position
-update limits in star catalogue configuration file if necessary

4.3 Measurement of telescope tracking accuracy

4.3.1 Test Principle

The time between two autoguiding commands is limited by the length of the individual frame measurement, it may vary as a function of the type of processing (single readout or multiple partial wipe). This test is to establish the limits of the autoguiding refreshment rate as set by the drift due to tracking unaccuracy.

4.3.2 Test Setup

Autoguiding Disabled

4.3.3 Test Equipment List

4.3.4 Data Acquisition and Archiving

Average drift in arcsec/sec

4.3.5 Step-by-Step Test Procedure

-remove image duplicator (prism) from telescope
-preset to an object in the working area (ie: including south-western sky)
-center the object in the field
-take an exposure every 5, measure distance from center
-repeat on other targets
-plot diagram of tracking drift velocity as a function of sky position
-update autoguider setup table if necessary

4.4 Measurement of wind load effects on telescope structure

4.4.1 Test Principle

The wind operating limit of the DIMM depends on the reaction of the structure to wind load and induced image distorsions during the short (5 to 10 ms) exposure time.

4.4.2 Test Setup

4.4.3 Test Equipment List

4.4.4 Data Acquisition and Archiving

Image elongation as a function of wind velocity

4.4.5 Step-by-Step Test Procedure

-relax all validation limits so that each measurement sequence delivers image statistics
-disable autoguiding
-start measurements in DIMM mode
-repeat for various wind conditions

-test the effect of partially closed enclosure on wind load

4.5 Optimization of the DIMM validation limits

4.5.1 Test Principle

A number of tests are performed on the individual short exposures of the DIMM before accepting centroid measurements in the seeing calculation process. The purpose of this test is to set the highest quality standards for the actual configuration nevertheless permitting operation in the same range of conditions as the VLT unit telescopes.

4.5.2 Test Setup

4.5.3 Test Equipment List

4.5.4 Data Acquisition and Archiving

number of rejected exposures as a function of parameter value

4.5.5 Step-by-Step Test Procedure

-Verification of saturation limit
-Verification of Valid pixel limit
-Verification of S/N ratio limit
-Verification of Spot elongation limit
-Verification of Spot decentering limit
-Verification of Gaussian Clipping limit
-Verification of Rejected exposures limit
-Verification of Clipped Exposures limit
-Verification of Statistical Error limit

4.6 DIMM instrumental noise measurement

4.6.1 Test Principle

When the system has reached its operational status, the instrumental noise has to be measured. This noise corresponds to the artificial differential motion generated in the computation chain. As it is decorrelated from atmospheric effects, it can then be subtracted from real measurements. The unstability of this noise term constitutes the major part of the final measurement accuracy.

4.6.2 Test Setup

A transportable double star simulator was prepared in Garching to permit regular calibration of the DIMM. It is composed of a simple optical setup with a variable intensity light source inside a wooden box.

4.6.3 Test Equipment List

4.6.4 Data Acquisition and Archiving

Plot noise and rms of noise versus average flux level

4.6.5 Step-by-Step Test Procedure

-Remove TCCD from telescope and insert into the double star simulator prepared for this purpose.
-Let the system measure as if it were on the sky.
-Repeat the measurement for various levels of illumination representative of the magnitudes present in the DIMM star catalogue.
-Update the DIMM hardware constants table with the average values of differential motion obtained in both longitudinal and transverse axes.

4.7 DIMM absolute pixel scale verification

4.7.1 Test Principle

The absolute accuracy of seeing measurements is entirely dependent on the knowledge of the size of the TCCD pixel on the sky. Images of double stars of known separation will be taken The measurements will be repeated in various conditions of external temperature to verify that the effect of focus variations is negligible.

4.7.2 Test Setup

4.7.3 Test Equipment List

Access to star catalogue is compulsory. In appendix follows an example of object coordinates obtained from WDS Catalog (Selection criteria: magnitude of both components lower than 6, separation greater than 1 arsec. As ST at beginning of night 0hUT=13h on June 18, interesting objects in the eastern part of the southern half sky have 10h to 20h RA, and -24 to -64 degres Dec). Binaries of stable separation are those for which a second measurement was obtained (date2 not empty) and no difference in separation was found (sep2 empty).

4.7.4 Data Acquisition and Archiving

The separation in pixel between two objects in the field versus the separation in arcsec as listed from the catalogue. Compute average angular size and rms error from a dispersion diagram.

4.7.5 Step-by-Step Test Procedure

-Imaging Mode (no autoguiding): isolated short exposures of duration compatible with tracking drift measured in Test 3. Measure separation in pixel using TCCD graphic interface.
-DIMM mode (autoguiding): use same exposure time but a reasonable number of images in a sequence. Read the average spot separation as delivered in the DIMM log at the end of the image sequence (do not use differential motion information).
-Update the DIMM hardware constants table.

4.8 Verification of automated functions

4.8.1 Test Principle

THE ASM is a fully automated device, it has to be able to run unattended in all conditions. For that purpose, a number of functions have been defined for protecting the telescope in daytime and in case of bad atmospheric conditions, and for selecting stars during operation.

4.8.2 Test Setup

4.8.3 Test Equipment List

4.8.4 Data Acquisition and Archiving

4.8.5 Step-by-Step Test Procedure

-Test wind limits (generate false meteo file and modify wind value)
-Test humidity/dew point limits (as above)
-Test sunset/sunrise limits
-Test star catalogue target selection process
-Update Operation Configuration File if necessary (max wind, max humidity and min dew point difference, max sun elevation)
Update target star catalogue if necessary (max magnitude)