SST On-site AIT Plan

SST-AIT-PLA-012

Version 2b

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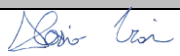
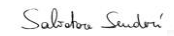
Alessio Trois (INAF)		SST-STR PRM
Salvatore Scuderi (INAF)		SST-STR PM
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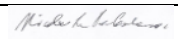
Nicola La Palombara (INAF)		SST-PRO PRQM
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Ver.	Created	Comment	Distribution	Editor(s)
1.aD	09/11/2022	First draft issue	SST-PO	
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2a	01/12/2022	Product Review issue	SST Team, CTAO, PR Board	

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Scope & Purpose

This document describes the SST AIT plan and procedures that shall be executed on site.

The current version of the document includes the AIT plan and procedure related to the Mechanical Structure and the Optical Assembly. The next version of the document will include the full on-site AIT plan.

In section 2 of the document, the verification plan of the site interfaces is explained.

In section 3, the on-site assembly plan and procedures of the SST Telescope are illustrated.

In section 4, the site test plan is laid out.

Finally, in section 5 safety warnings and rules to be observed during the AIV activities are reported.

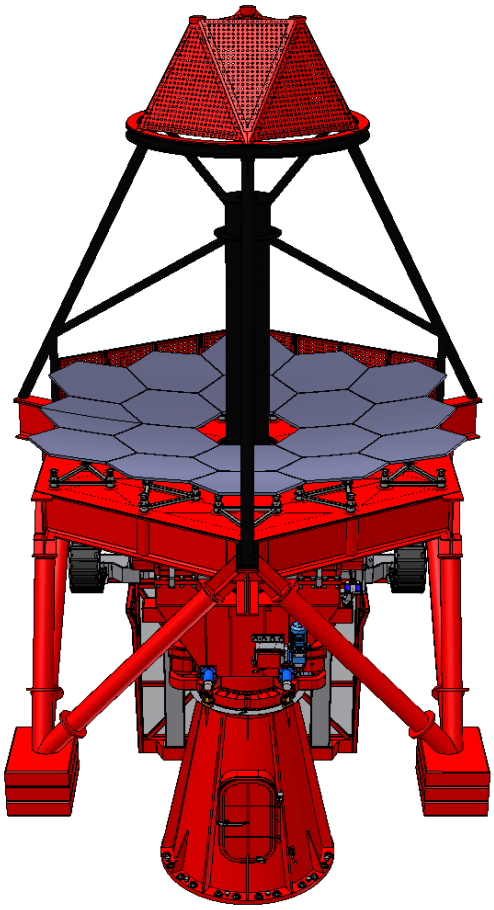


Figure 1-1: SST Telescope

1.2 Applicable Documents

[AD1] SST-MEC-SPE-002 2b SST Mechanical Structure Subsystem Specification

1.3 Reference Documents

[RD1] SST-MEC-DSR-001 2b SST Mechanical Structure Design Report

1.4 Definition of Terms and Abbreviations

1.4.1 Abbreviations and Acronyms

ACADA	Array Control and Data Acquisition System
AIT	Assembly Integration and Testing
AIV	Assembly Integration and Verification
BKO	Bridging phase Kick-Off
CDR	Critical Design Review
CTA	Cherenkov Telescope Array
CTAO	Cherenkov Telescope Array Observatory
FAR	Final Acceptance Review
FRC	France Contribution
DR	Delivery Review
DVER	Design Verification Engineering Review
ERIC	European Research Infrastructure Consortium
ESC	Executive Steering Committee
IKC	In Kind Contribution
INAF	Istituto Nazionale di Astrofisica
INSU	Institut National des Science de l'Univers
KO	Kick-Off
MPIK	Max-Planck-Institut für Kernphysik
OP	Observatoire de Paris – PSL, CNRS
PA	Product Assurance
PBS	Product Breakdown Structure
PM	Project Manager
PR	Product Review
PRM	Programme Manager
PRR	Production Readiness Review
PSE	Programme System Engineer
QA	Quality Assurance
RAMS	Reliability, Availability, Maintainability & Safety
SE	System Engineer
SST	Small-Sized Telescope
TRR	Test Readiness Review
WBS	Work Breakdown Structure

1.4.2 Glossary

TERM	DEFINITION
"As Built" Configuration	The as-built configuration or applied configuration is defining the as-built status per each serial number of Configuration Item (CI) subject to formal acceptance.
"As Designed" Configuration	The as-designed configuration or Applicable configuration is defining the current design status of a Configuration Item (CI)
AIV	AIV is the Assembly Integration and Verification, which is referred to the integration activities related with the verification of the system or sub-system. In the framework of SST for briefness this term includes also the Assembly Integration and Testing which is related with the integration activities and testing to be performed during the integration at system and subsystem levels
Baseline	Set of information which describes exhaustively a situation at a given instant of time or over a given time interval.
Change	Vehicle for proposing modifications to an approved baselined data or the business agreement.
Configuration	Functional or physical Characteristics of a product defined in configuration definition documents subject to configuration baseline.
Configuration Item	Aggregation of hardware, software, processed materials, services or any of its discrete portions, that is designated for configuration management and treated as a single entity in the configuration management process. **NOTE:** A configuration item can contain other lower-level configuration item(s).
Deviation	Written authorization to depart from the originally specified requirements for a product prior to its production.
Firmware	Firmware is software programmed onto an electronic device which is treated like a pure hardware.
Executive Steering Committee	The SST Executive Steering Committee (ESC) is the high-level decision-making body which will manage the strategic direction of the Programme and will be in charge of overseeing progress and facilitating global collaboration among the participating groups.
Institutes	Research Institutes involved in the SST Programme.
Contractor	Industry involved in the SST Programme which has a contract with an institute
SST-PRO	It is the team composed by Institutes and Contractors responsible, involved in the production of SST telescopes elements, which coordinate the project level activities.
Hardware	Hardware is a single or an assembly of physical electronic devices which cannot be changed in its user environment.
Item	Any part, component device, sub-unit, unit, equipment or device that can be individually considered.
Model	Physical or abstract representation of relevant aspects of an item or process that is put forward as a basis for calculations, predictions or further assessment useful for the preparation of SST production
Partners	are those entities taking responsibility for IKC delivery by signing IKC agreements with CTAO, plus any organisation identified by these signing entities as playing an essential role in SST delivery. The institutes are the partners of the CTA-SST consortium.
Product	A product (hardware, software, service) required in the frame of the program and included as element of the product tree having a unique identifier. A product may be deliverable or not.
Product Breakdown Structure	Hierarchical structure depicting the product orientated breakdown of the project into successive levels of detail down to the configuration items necessary to deliver the required functions. The Product Breakdown Structure (PBS) in general is influenced by Institutes/partners decisions to group certain products or by program history. It identifies products and their interfaces; it serves as the basis for the WBS
Service	Service is the result of at least one activity necessarily performed at the interface between the SST consortium and CTA and is generally intangible.
Software	Set of computer programs, procedures, documentation and their associated data.
SST-E2E	The SST end-to-end telescope, or simply SST, will consist of the SST Structure and the SST Camera (including all mechanics, mirrors, auxiliary devices and required software), integrated and commissioned on-site including all required documents. It ends at (and integrates into CTA via) the system interfaces specified by the CTA PBS.
SST Consortium	The SST Consortium then consists of the Partners and their associated Teams, where a Team is a set of individuals within a single organisation at a single location (such as a University group).
System	An entity of products assembled or working together for a well-defined specified purpose. In SST the term system can be utilised in alternative to Telescope End-to-End.
Sub-System	Like a system but a lower level. In SST the SST system is composed by the subsystem SST-MECH, SST-OPT, SST-TCS and SST-CAM.
Waiver	Written authorization to use or release a product which does not conform to the specified requirements
Work Breakdown Structure	Hierarchical representation of the activities necessary to complete a project.

2 Site interfaces verification

2.1 Mechanical interfaces

2.1.1 Visual inspection

Verifications and visual tests – Mechanical				
DESCRIPTION	OK	NOT OK	NA	NOTE
Presence of proper tubes for signal and power cables routing (exit at the foundation centre) without obstructions	☐	☐	☐	
(TBD) Presence of proper tubes for cooling lines (exit at the foundation centre) without obstructions	☐	☐	☐	
Integrity and cleanness of the anchor bolts threads	☐	☐	☐	
Proper cleanness of the plate for telescope base adjusting screws	☐	☐	☐	

RESULT

DATE	OPERATOR	SIGNATURE

2.1.2 Dimensional check

Measurement tests - Mechanical			
DESCRIPTION	RESULTS	UNIT	NOTE
Dimensional correspondence with drawing 7150-000-02-00	OK ☐ NOT OK ☐		

RESULT

DATE	OPERATOR	SIGNATURE

2.2 Electrical interfaces

2.2.1 Earth termination system

DESCRIPTION	OK	NOT OK	NA	NOTE
Verifications and visual tests – Electrical				
Earth-termination system realization according to drawing 3150-000-03-00	☐	☐	☐	
Presence of executive design and drawings for telescope foundation	☐	☐	☐	
Diameter of the reinforcing rods ≥ 12mm	☐	☐	☐	
Presence of proper connections among reinforcing rods of the foundation (by means of wire-lashing or other methods)	☐	☐	☐	
Presence of the earth ring electrode	☐	☐	☐	
Diameter of the earth ring electrode ≥ 10mm	☐	☐	☐	
Presence of proper connections of the earth ring electrode with the reinforcing rods mesh	☐	☐	☐	
Presence of additional horizontal earth electrodes with the proper length according to soil characteristics (refer to resistivity measurement)	☐	☐	☐	
No loose connections and no accidental breaks in the conductors and joints	☐	☐	☐	
No part of the system with corrosion presence	☐	☐	☐	
No presence of materials at the joints which may create galvanic coupling	☐	☐	☐	
Presence of earth test box	☐	☐	☐	
Presence of galvanic connection between the earth electrode and the anchor bolts (in particular at the interface with the heat shrinkable tubes, if installed)	☐	☐	☐	
Continuous connection between earth-termination system of the telescope and of the site one	☐	☐	☐	
Proper earth resistance value at MT/BT cabin able to guarantee $R_E \times I_E = U_E \leq U_{Tp}(t_f)$ or adequate touch voltages (according to CEI EN 50522) (refer to R_E measurement)	☐	☐	☐	
Neutral and PE conductors earthed at MT/BT cabin transformer (TN-S system)	☐	☐	☐	

RESULT

DATE	OPERATOR	SIGNATURE

2.2.2 Earth resistance check

Measurement tests - Electrical			
DESCRIPTION	**RESULTS**	**UNIT**	**NOTE**
Earth resistance value R_E at MT/BT cabin		Ω	Mean value
Measurement tool		Type	
Calibrated on		Date	
Earth resistance value R_E at telescope area		Ω	Mean value. Recommended value < 10 Ω
Measurement tool		Type	
Calibrated on		Date	
Earth resistivity value ρ at telescope area		Ωm	Mean value
Measurement tool		Type	
Calibrated on		Date	
Electrical continuity of the telescope earth termination system		Ω	Test current recommended ≥ 0.2A Recommended value < 1 Ω (mean value)
Measurement tool		Type	
Calibrated on		Date	

RESULT

DATE	OPERATOR	SIGNATURE

2.2.3 Incoming Power lines

Measurement tests - Electrical				
DESCRIPTION	RESULTS		UNIT	NOTE
Cables insulation Measurement tool Calibrated on	L1 – PE		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L2 – PE		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L3 – PE		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L1 – L2		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L2 – L3		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L3 – L1		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L1 - N		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L2 - N		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ
	L3 - N		MΩ	Test voltage = 500V (I_{dc} = 1mA) Insulation voltage ≥ 0.5MΩ

Measurement tests - Electrical				
DESCRIPTION	RESULTS		UNIT	NOTE
			Type	
			Date	
Voltage levels	L1 – L2		V	Allowed range 400V±10%
	L2 – L3		V	Allowed range 400V±10%
	L3 – L1		V	Allowed range 400V±10%
	L1 – N		V	Allowed range 230V±10%
	L2 – N		V	Allowed range 230V±10%
	L3 – N		V	Allowed range 230V±10%
Measurement tool Calibrated on	N – PE		V	~0V
			Type	
			Date	
Right hand rotary field (L1, L2, L3)	OK ☐ NOT OK ☐			
Measurement tool Calibrated on			Type	
			Date	
Frequency level			Hz	Allowed range 50Hz±1%
Measurement tool Calibrated on			Type	
			Date	
Earth fault loop impedance			Ω	$Z_s \times I_a \leq U_o$
Measurement tool Calibrated on			Type	
			Date	

RESULT

DATE	OPERATOR	SIGNATURE

3 On-Site Assembly plan and procedures

3.1 Required conditions

Table 1: Assembly required conditions

REQUIRED CONDITIONS	REFERENCE
Foundation and its interfaces checked and accepted.	-
Telescope items inspected and accepted.	-
Electricity from the site distribution (if possible)	-

3.2 Support equipment

Table 2: Assembly support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
Formwork	Special	7150-000-04-00	1	For Base grouting
Linear level	Standard	N/A	1	
Mobile crane	Standard	N/A	1	8 t capacity at a distance of 10-12 m
Manlift	Z-30/20N / Genie	N/A	2	Articulating boom type (maximum platform dimensions 120x80 cm) or similar.
Transpallet	Standard	N/A	1	
Wire rope	Standard	N/A	AR	
Hydraulic tensioning cylinder	Standard	N/A	1	Equipped with pump
Lifting point for bolting	Vario-Starpoint VRS-F-M20 with star key / RUD	7101315	2	Or similar M20 eyebolts
Hoist	standard	N/A	2	
Lifting point for bolting	Load ring VLBG 4t M24 with bolt / RUD	8500827	3	Or similar M24 eyebolts
Lifting point for bolting	Load ring VLBG 5t M30 with bolt / RUD	8500828	2	Or similar M30 eyebolts
Lifting point for bolting	Load ring VLBG 2,5t M20 with bolt / RUD	8500826	2	Or similar
Eye bolt for lifting	M12 / Standard	N/A	2	
Measuring system	Standard	N/A	1	Precision spirit gauge level
Mechanics tool set	Standard	N/A	2	

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
Electrical torque wrench	Standard	N/A	1	Capacity 500 Nm
Electrical tool set	Standard	N/A	2	
Electrical drill	Standard	N/A	1	
Adaptor ∅ 14mm	Special	7113-710-03-00	1	To connect the drill to the secondary shaft of the EL Actuator motor
Dynamometer	Standard	N/A	2	
Sandpaper	Standard	N/A	AR	
Portable Power Generator	Standard	N/A	1	10 kVA

3.2.1 Bolts torque table

Structural bolting is to be torqued with a dynamometric wrench according to the following tightening torque table.

For bolt sizes larger than M10, all bolts in a connection shall be tightened with two steps: a first step to 50% of the nominal torque, then a second step to 100% nominal torque.

All structural bolting is class 8.8 galvanized steel. The table applies both to bolts in tapped holes and bolts with nut.

Table 3: Bolt torque table

Class 8.8 bolt	Nominal preload (70% yield strength) [kN]	Nominal tightening torque, K1 class (k=0.125) [Nm]
M5	8	5.0
M6	12	8.6
M7	16	13.7
M8	20	20
M10	32	40
M12	46	69
M14	63	110
M16	82	164
M18	103	233
M20	128	320
M22	155	426
M24	184	552
M27	233	788
M30	288	1080
M33	348	1436
M36	415	1869

3.3 Consumables

Table 4: On-site assembly Consumables

NOMENCLATURE	TYPE / MANUFACTURER	QTY	REMARKS
Grease	SKF LGEP 2	AR	
Anti-shrinkage grout	BASF MasterFlow 928	About 200 kg	
Water	Standard	About 100 L	
Diesel fuel	Standard	About 100 L	

3.4 Items

NOMENCLATURE	PT NO.	QTY	REMARKS
Mount Assembly	7110-000-00-00	1	Fully equipped
M1 dish	7121-000-00-00	1	
Central tube	7123-000-01-00	1	
Mast	7123-000-00-00	1	
M2 Subsystem	N/A	1	With M2 mirror
Counterweights	7122-000-00-00	1	
M1 shields	7121-000-00-00	1	
LPS & Grounding	7134-000-00-00	1	
M1 Dish cabling	7133-300-00-00	1	
M2 cabling	7133-500-00-00	1	
Mast cabling	7133-400-00-00	1	
Camera		1	
M1 segment	COR1	6	
M1 segment	COR2	6	
M1 segment	COR3	6	

3.5 Procedure Steps

CAUTION

BE CAREFUL TO REMOVE THE TEMPORARY ANTI-RUST PROTECTIVE PAINT FROM ALL NOT PAINTED MACHINED SURFACES BEFORE INSTALLATION.

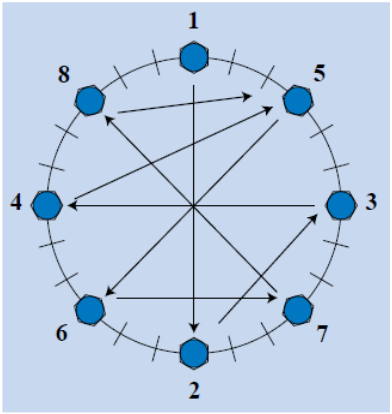
1. Clean from dirt with water and soap all foundation anchor bolts.
2. Check any presence of rust on the anchor bolts. In case rust is detected, use sandpaper to remove it.

3. Install three lifting points for bolting VRS-F-M20 on the Mount subassembly. Use the wire ropes and a hoist to connect them to the crane.
4. Lower and center the Mount Subassembly on the Foundation. Be careful that the Base Door must be North oriented.

5. Install the adjusting M30 screws on the Base. Adjust all the screws so that to have an equal protrusion.
6. Put some grease on the adjusting screws in order to allow their removal after the cast.
7. Use the linear level, placed on the EL Axis Bearing Interfaces, to check and adjust the horizontal tilt of the Mount Subassembly with the adjusting screws installed on the Base. Check that all adjusting screws are in contact with the ground.
8. Install the framework for Base grouting inside the Base.
9. Carry out the grouting of the Base interface.

Figure 2: grouting of the telescope Base

10. Install the M30 washers and the nuts on the anchor bolts. Tighten the fastenings manually.
11. Verify again with the linear level the horizontal tilt of the Mount Assembly.
12. Grout the Base with anti-shrinkage grout and wait for the settling and hardening process (at least 3 days).
13. Remove the framework.
14. Loosen the adjusting screws of about 15mm.
15. Use the hydraulic tensioning cylinder to tighten and torque the nuts of the Base with a proper procedure (tightening in at least two stages, starting from half preload, in the crossed rows order shown in the diagram below). Tightening the bolts to 230 kN.



16. Clean the EL Bearings interface surfaces.

CAUTION
BE CAREFUL THAT THE GROUND MUST BE FLAT.

17. Remove with the crane one of the two halves of the M1 Dish (does not matter which) from the transport support and lay it on the ground.

18. Install two load rings VLBG 5t M30 on the M1 Dish R Structure. Use the wire ropes to connect them to the mobile crane.
19. Lift the M1 Dish R Structure with the mobile crane and rotate it around its vertical axis.
20. Remove the wooden protections from the M1 Dish halves interface of M1 Dish R Structure.
21. Engage the M1 Dish R Structure with the M1 Dish L Structure. Install all fastenings that attach the M1 Dish halves without releasing the lifting sling.
22. Connect the Conduits of the M1 Dish Front Structure with the Conduits of the M1 Dish Back Structure.
23. Lay the M1 Dish horizontally on the ground using wooden supports/protections to avoid damages.
24. Lift the M1 Dish from the M1 Dish top corner (the one located on top when the telescope is pointing towards horizon) and move it in vertical position above the AZ Fork.

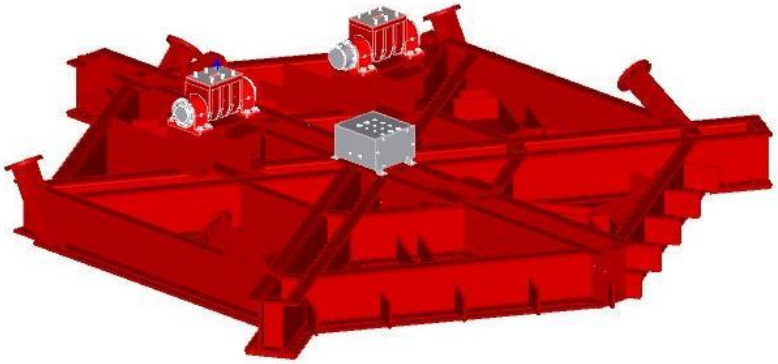


Figure 3-3 EL bearings and EL cable wrap box installation on M1 dish

25. Engage the EL Axis Bearings with the AZ Fork main structure. Install all M24 fastenings that attach the EL Axis Bearings to the AZ Fork main structure, with special care in order to match aligning keys located on the AZ Fork interfaces.
26. Extract manually (with battery drill) the EL Actuator, in order to engage it with its interface on M1 Dish, without releasing the crane from the M1 Dish.

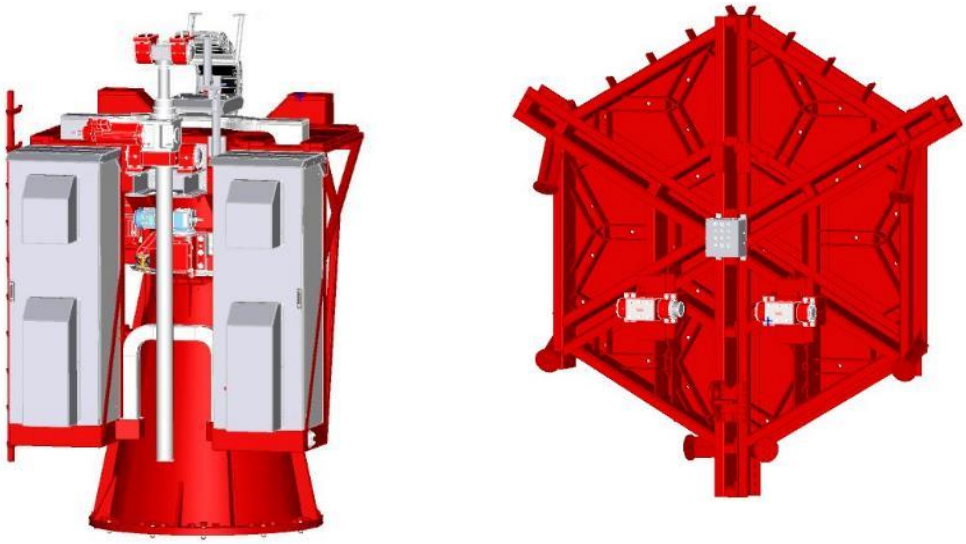


Figure 3-4 M1 Dish installation on Mount assembly

27. Fix the upper hinge with M20 screws without tighten them.
28. Remove the wire ropes and the lifting points from the M1 Dish.
29. Install the M1 Dish Cable Wrap box and the EL Cable Wrap consequently.
30. Provide a 20 to 30° EL manual motion in order to guarantee self-alignment of the ELA Upper hinge.
31. Tighten screws that attach the ELA Upper Hinge to the M1 Dish with torque wrench to 240 Nm.
32. Complete EL axis motion until 90° with EL actuator manually driven.
33. Clamp the elevation screw jack motor axis, so that unbalance of the elevation does not induce reverse motion of the screw.

CAUTION
BE CAREFUL TO MANUALLY BRAKE THE ELEVATION SCREW JACK MOTOR AXIS BECAUSE THE STRUCTURE IS NOT BALANCED YET.

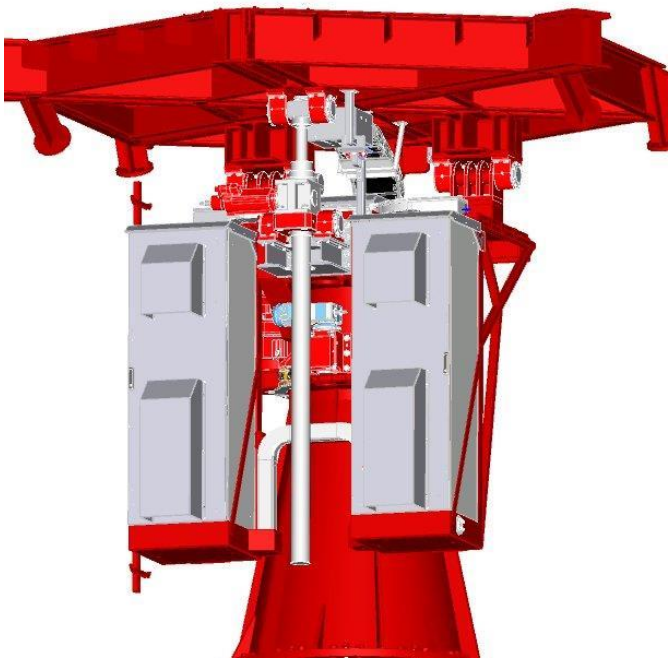


Figure 3-5 M1 dish installed on Mount assembly

34. Install the witness of the EL Limit Switches.
35. Install the entire OSS Upper structure (central tube, mast and top ring).
36. Install three load rings VLBG 4t M24 on the assembled M2 Subsystem. Use the wire ropes and a hoist to connect them to the mobile crane.
37. Lift the assembled M2 Subsystem and remove the four Support Legs used to support the M2 Back Up Structure during the pre-assembly from the M2 Back Up Structure.
38. Lower the assembled M2 Subsystem on the Mast with the correct orientation. Install all M16 fastenings that attach the M2 Back Up Structure to the Mast.
39. Re-install the LPS bars on the M1 Dish and along the Mast.
40. Install the Support Tubes for the counterweights on the M1 Dish.
41. Install the load ring VLBG 4t M24 on the Counterweight. Use a lifting means to lower the counterweights to their correct position. Install the Counterweights.
42. The Elevation balance does not need to be measured, as the exact amount of counterweights is determined in factory for SST-1, and shall be just replicated for all SSTs.

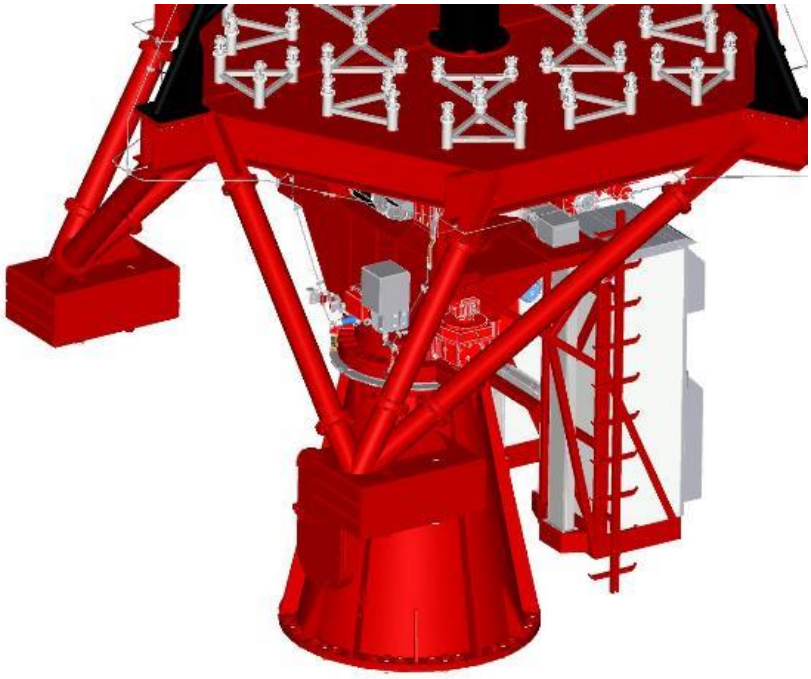


Figure 3-6 Counterweights installed

43. From now on the Elevation axis of the telescope is sufficiently balanced not to induce unwanted movements. Rotate the EL axis from 90° to 0° with manual move of the EL Actuator.
44. Install the Cable Wrap Chain between the M1 Dish Cable Wrap box and the AZ Fork Cable Wrap box.
45. Install all Conduits along the Mast from the M1 Dish to the M2 Junction Box and to the Camera SPD Junction Boxes.
46. Connect the LPS & Grounding System between the M1 Dish and the AZ Fork.
47. Use the Telescope Control System (TCS) to rotate the telescope until the two EL extreme positions and adjust the EL Switches position.
48. Install all M1 Segments with telescope at 0° in EL axis.
49. Use the lifting means to lift the camera and to move it to its correct position.
50. Install the camera on the Central tube.
51. Connect the electrical and signal cables of the Camera to the junction box.
52. Install the M1 shields on the M1 dish.
53. Thread all cables inside the Cable Trays and the Conduits from the Electrical Cabinets, through the EL Cable Wrap, to the Camera SPD Junction Box, to the M2 Junction Box.
54. Connect the cables of the M2 subsystems to the M2 Junction Box, to the Camera SPD Junction Box.

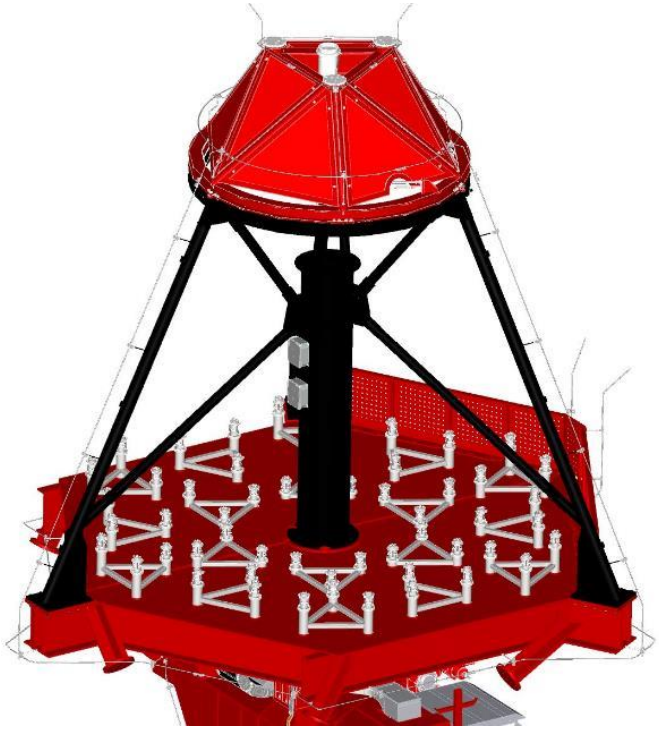


Figure 3-7 Lightning Protection System rods installation

4 On-site Test Plan

4.1.1 System Inspection & Tests

4.1.1.1 Rain, Snow, Ice and Hail

Task code

SST-7100-000-00-710A-A

Requirement to be met

Protection from environmental damages or contamination.

Required conditions

Telescope entirely assembled and balanced.

A check list needs to be prepared for the purpose.

Support equipment

None.

Procedure

1. The check list needs to be verified point by point successfully with a photo for each verification.
2. The check list will include:

    - Door seal.
    - AZ bearing cover.
    - Electrical cabinet door sealing.
    - Electrical cabinet roof.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.2 Dust and sand

Task code

SST-7100-000-00-710B-A

Requirement to be met

Protection from dust and sand contamination.

Required conditions

Telescope entirely assembled and balanced.

A check list needs to be prepared for the purpose.

Support equipment

None.

Procedure

1. Checklist needs to be verified point by point successfully with a photo for each verification.
2. The checklist will include:
    - Door seal.
    - AZ bearing cover.
    - Electrical cabinet door sealing.
    - Electrical cabinet air inlet filters.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.3 Braking

Task code

SST-7113-300-00-340A-A

Requirement to be met

AZ braking angle shall be less than 2deg.

EL braking angle shall be less than 1deg.

M2 shall be subjected, during braking, to a deceleration equal or less than 1.5g.

Required conditions

Telescope completely assembled and balanced.

Elevation angle 0deg (horizon pointing).

Support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
Software procedure	Special	N/A	1	

Procedure

1. Move the EL axis to horizon, if not already positioned at 0deg.
2. Move the AZ axis at the maximum velocity using the mount control software in ABSOLUTE Mode
3. Push an emergency button.
4. Save the data and verify the braking time and the braking angular displacement.
5. Repeat the test both in CW and in CCW directions.

6. Move the EL axis at the maximum velocity using the mount control software in ABSOLUTE Mode
7. Push an emergency button.
8. Save the data and verify the braking time and the braking angular displacement.
9. Repeat the test both in Up and in Down directions.
10. Calculate the acceleration at M2 considering its distance from the EL axis of about 4m.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.4 Main axes Eingenfrequencies

Task code

SST-7113-300-00-342A-A

Requirement to be met

Telescope AZ and EL axes shall have an eigenfrequency higher than 2.5Hz.

Required conditions

Telescope completely assembled and balanced.

Support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
SW procedure	Special	N/A	1	

Procedure

1. Record telescope response (position) to a white noise stimulus generated at Azimuth drive level as a sequence of torque commands.
2. The stimulus has adequate amplitude to avoid servo saturation (which generates non-linear behavior).
3. The closed loop transfer functions is calculated offline from the recorded data (input and output position).
4. Record telescope response (position) to a white noise stimulus generated at Elevation drive level as a sequence of torque commands.
5. The test has to be repeated with the EL axis in three different position: 0°, 30°, 60°, 90°.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.5 Maintenance/access points

Task code

SST-7100-000-00-710D-A

Requirement to be met

Presence of access points and handling equipment.

Required conditions

Telescope entirely assembled and balanced.

A check list need to be prepared for the purpose related to the built-in access means of the telescope and handling equipment.

Support equipment

None.

Procedure

1. Checklist needs to be verified point by point successfully with a photo for each verification.
2. The check list will include:
    - Base door.
    - Cabinet doors.
    - Ladder to reach AZ fork upper surface.
    - Camera handling device.
    - AZ Motors handling device.
    - Battery drill and adapters.
    - M1 handling devices.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.6 Telescope maintenance

SST-7100-000-00-320B-A

Requirement to be met

Presence of the interfaces necessary to connect the handling equipment.

Required conditions

Telescope entirely assembled and balanced.

Support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS

AZ Motors handling device	Special	7113-710-03-00	1	
M1 Segments handling devices	Special	7125-300-00-00	1	
M2 handling cart	Special	7124-200-00-00	1	
Camera handling device	Specia	7128-000-00-00	1	

Procedure

1. Check the time required for the execution of the following maintenance activity:
    - AZ motor removal and installation.
    - AZ stow pin removal and installation.
    - EL stow pin removal and installation.
    - M1 segment removal and installation.
    - Camera removal and installation.
    - Secondary mirror removal and installation.
2. Confirm elapsed time with the one foreseen in the maintenance manual.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.7 Flood protection

Task code

SST-7100-000-00-710E-A

Requirement to be met

Protection of the product from flood.

Required conditions

Telescope entirely assembled and balanced.

A check list needs to be prepared for the purpose.

Support equipment

None.

Procedure

1. The check list needs to be verified point by point successfully with a photo for each verification.
2. The check list will include:
    - Door seal.
    - Electrical cabinet door sealing.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.8 Entrance control

Task code

SST-7111-000-00-710A-A

Requirement to be met

Entrance control device must not impede the exit.

Required conditions

Base completely assembled.

Support equipment

None.

Procedure

1. Verify the aperture of the base door from outside and inside of the base. Photo of the system is required.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.9 Safety signaling

Task code

SST-7100-000-00-710F-A

Requirement to be met

Presence of safety signals on the telescope where necessary.

Required conditions

Telescope entirely assembled and balanced.

A checklist needs to be prepared for the purpose.

Support equipment

None.

Procedure

1. The check list needs to be verified point by point successfully with a photo for each verification.
2. The check list will include:
    - Safety signals in proximity with remote control socket.
    - Verify presence of siren.

- Presence of signs in proximity of motion system that can be possibly moved manually.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.10 Drive control safety

Task code

SST-7100-000-00-320A-A

Requirement to be met

Required conditions

Telescope completely assembled and balanced.

Support equipment

None.

Procedure

1. Verify on the Mount Control System (changes in Boolean status of THCU variables) the input and output signals (with telescope not operative) of:
    a. AZ clockwise operation limit (AZLCW1)
    b. AZ clockwise emergency limit (AZLCW2)
    c. AZ counterclockwise operation limit (AZLCCW1)
    d. AZ counterclockwise emergency limit (AZLCCW2)
    e. EL low operation limit (ELOLOW)
    f. EL low emergency limit (ELELOW)
    g. EL high operation limit (ELOHIGH)
    h. EL high emergency limit (ELEHIGH)
    i. Cabinet door switch (DOORCAB)
    j. Remote emergency stop button (EMERG)
    k. Cabinet door emergency stop button (EMERGENCYSTOP)
    l. Base door switch (DOOR)
    m. Emergency stop button of mobile push buttons panel (EMSTOP)
    n. AZ stow pin inserted switch (AZSTOIN)
    o. AZ stow pin extracted switch (AZSTOEX)
    p. EL stow pin inserted switch (ELSTOIN)
    q. EL stow pin extracted switch (ELSTOEX)
2. Verify the correct functionality of the switches with the telescope operative:
    a. AZ clockwise operation limit (AZLCW1) → *movement stopped, motors still active*
    b. AZ clockwise emergency limit (AZLCW2) → *the axis is stopped and STO function is activated*
    c. AZ counterclockwise operation limit (AZLCCW1) → *movement stopped, motors still active*

d. AZ counterclockwise emergency limit (AZLCCW2) → *the axis is stopped and STO function is activated*

e. EL low operation limit (ELOLOW) → *movement stopped, motors still active*

f. EL low emergency limit (ELELOW) → *the axis is stopped and STO function is activated*

g. EL high operation limit (ELOHIGH) → *movement stopped, motors still active*

h. EL high emergency limit (ELEHIGH)→ *the axis is stopped and STO function is activated*

i. Cabinet door switch (DOORCAB) → *no movements, STO functions activated*

j. Remote emergency stop button (EMERG) →*the axis is stopped and SS1 function is activated*

k. Emergency stop on cabinet door (EMERGENCYSTOP) → *the axis is stopped and STO function is activated*

l. Base door switch (DOOR) → *no movements, STO functions activated*

m. Emergency stop of mobile push buttons panel (EMSTOP) → *the axis is stopped and STO function is activated*

n. AZ stow pin inserted switch (AZSTOIN) → *AZ motor power off and brake engaged*

o. AZ stow pin extracted switch (AZSTOEX) → *AZ motor power on possible*

p. EL stow pin inserted switch (ELSTOIN) → *EL motor power off and brake engaged*

q. EL stow pin extracted switch (ELSTOEX) → *EL motor power on possible*

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.11 Main axes range limits

Task code

SST-7113-500-00-340A-A

Requirement to be met

Telescope main axes set of switches functionality during motion

Required conditions

Telescope completely assembled and balanced.

Support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
Electrical drill	Special	N/A	1	
Adaptor ∅ 14mm	Special	7113-710-03-00	1	To connect the drill to the secondary shaft of

				the AZ motor L and EL Actuator motor

Procedure

NOTES
• AZ 0° refers to East direction. • The actual hardware configuration of the limit switches does not allow to test the emergency limit using a control SW command because torque is not available. So, it has to be used the drill connected to the secondary shaft of the motor to move the axis until the emergency limit is engaged. The drives in this case must be powered off.

1. Move the azimuth axis in the negative direction up to the intervention of the negative limit switches (JOG Mode):
   - pre-limit (AZLCCW0)
   - operation limit (AZLCCW1)
   - override procedure (switching off the drives and moving by drill)
   - emergency limit (AZLCCW2).
2. Verify the correct angular position of the limit switches engagement reading the position on the control software:
   - pre-limit (AZLCCW0): -260°
   - operation limit (AZLCCW1): -270°
   - emergency limit (AZLCCW2): -272,5°
3. Move the azimuth axis in the positive direction up to the intervention of the positive limit switches (JOG Mode):
   - pre-limit (AZLCW0)
   - operation limit (AZLCW1)
   - override procedure (switching off the drives and moving by drill)
   - emergency limit (AZLCW2).
4. Verify the correct angular position of the limit switches engagement reading the position on the control software:
   - pre-limit (AZLCW0): +260°
   - operation limit (AZLCW1): +270°
   - emergency limit (AZLCW2): +272,5°
5. Verify that the angular range of the azimuth axis is ± 270°
6. Move the elevation axis in the low direction up to the intervention of the negative limit switches (JOG Mode):
   - pre-limit (ELPLOW)
   - operation limit (ELOLOW)
   - override procedure (switching off the drives and moving by drill)

- emergency limit (ELELOW).

7. Verify the correct angular position of the limit switches engagement:
   - pre-limit (ELPLOW): +5°
   - operation limit (ELOLOW): +0°
   - emergency limit (ELELOW): -1°
8. Move the azimuth axis in the high direction up to the intervention of the positive limit switches (JOG Mode):
   - pre-limit (ELPHIGH)
   - operation limit (ELOHIGH)
   - override procedure (switching off the drives and moving by drill)
   - emergency limit (ELEHIGH).
9. Verify the correct angular position of the limit switches engagement:
   - pre-limit (ELPHIGH): +86°
   - operation limit (ELOHIGH): +91°
   - emergency limit (ELEHIGH): +92°
10. Verify that the EL angular range is at least 91°.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.1.12 Emergency stop test

Please refer to section 4.1.1.3.

4.1.1.13 Observation pointing safety

Task code

SST-7113-700-00-341A-A

Requirement to be met

Telescope main axes set of switches functionality during motion.

Required conditions

Telescope completely assembled and balanced.

Support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
Shell script	Special	N/A	1	
Electrical drill	Standard	N/A	1	
Adaptor ∅ 19mm	Special	7113-710-03-00	1	To connect the drill to the secondary shaft of the Stow Pin motor

Right-angle attachment for electrical drill	Standard	N/A	1	

Procedure

NOTE

AZ 0° refers to East direction.

1. Move the AZ axis in its mean position
2. Move the AZ axis toward the stow pin position and verify all steps until the completion of the AZ Stow Pin insertion:
    - AZ stow pin pre-limit switch (AZSTOWPRE) engaged at ±12° (only in case the stow function is active) and speed slowed down with a ramp.
    - AZ stow pin enabling encoder position (-90 ±0.088°)
    - AZ stow pin inserted switch (AZSTOIN) triggered.
3. Extract the stow pin and verify the AZ stow pin extracted switch (AZSTOEX) is triggered.

CAUTION

BE CAREFUL NOT TO EXCEED THE ALLOWED STROKE WHEN INSERTING/EXTRACTING MANUALLY THE STOW PIN.

NOTE

Do next step to verify the emergency operation of the AZ Stow Pin.

4. Operate the AZ Stow Pin motor secondary shaft with a drill to insert and retract manually the pin.
5. Move the EL axis in its mean position
6. Move the EL axis toward the lower stow pin position and verify all steps until the completion of the EL Stow Pin insertion:
    - EL stow pin pre-limit switch (ELSTOWPRE) engaged at +5° (only in case the stow function is active) and speed slowed down with a ramp.
    - EL stow pin enabling encoder position (0±0.127°)
    - EL stow pin inserted switch (ELSTOIN) triggered.
7. Extract the stow pin and verify the EL stow pin extracted switch (ELSTOEX) is triggered.
8. Move the EL axis toward the upper stow pin position and verify all steps until the completion of the EL Stow Pin insertion:

- EL stow pin pre-limit switch (ELSTOWPRE) engaged at +85° (only in case the stow function is active) and speed slowed down with a ramp.
- EL stow pin enable switch (ELSTOWEN) triggered at +90.4±0.127°
- EL stow pin inserted switch (ELSTOIN) triggered.

9. Extract the stow pin and verify the EL stow pin extracted (ELSTOEX) switch is triggered.

CAUTION
BE CAREFUL NOT TO EXCEED THE ALLOWED STROKE WHEN INSERTING/EXTRACTING MANUALLY THE STOW PIN.

NOTE
Do next step to verify the emergency operation of the EL Stow Pin.

10. Remove the EL Stow pin cover to gain access to the EL Stow Pin motor secondary shaft.
11. Operate the EL Stow Pin motor secondary shaft with a drill equipped with the right-angle attachment to insert and retract manually the pin.

NOTE: Stow position at 90° can be implemented later via software (bullet 8). This does not jeopardize the verification of the system functionality.

RESULT

DATE	OPERATOR	SIGNATURE

4.1.2 Tracking precision

Task code

SST-7100-000-00-340A-A

Requirement to be met

Telescope tracking accuracy of the main axes shall be lower than 6 arcmin RMS

Required conditions

Telescope completely assembled and balanced.

Wind speed lower than 36km/h.

Support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
Software procedure	Special	N/A	1	

Procedure

1. Record the wind speed from the weather station.
2. Move the azimuth axis and the elevation axis in their mean position (ABSOLUTE Mode)
3. Track a source in the sky with the telescope axes for 15 minutes (TRACKING Mode).
4. Acquire and store the trajectory received, the position commands generated by the control system SW and the encoder reading during all the tracking for both the axes.
5. Calculate the RMS of the tracking differences between the commanded position and the encoder position of the two axes.
6. Repeat steps from 3 to 5 for other five to ten sources (one of them must be at EL angle > 75°).

RESULT

DATE	OPERATOR	SIGNATURE

4.1.3 Post-calibrating pointing accuracy

Task code

SST-7100-000-00-340B-A

Requirement to be met

Positioning accuracy of the main axes on all angular displacement lower than 7arcsec RMS in favorable conditions (with pointing model). In operation conditions it shall be lower than 20arcsec RMS.

Required conditions

Telescope completely assembled and balanced.

Wind speed lower than 11km/h (favorable conditions) and 36km/h (operation conditions).

The PMC must be installed and operative.

Support equipment

NOMENCLATURE	TYPE / MANUFACTURER	PT NO.	QTY	REMARKS
Software procedure	Special	N/A	1	
PMC	Special	N/A	1	Provided with its software

Procedure

NOTE
AZ 0° refers to East direction.

1. Record the wind speed from the weather station.

2. Move the AZ axis (ABSOLUTE Mode) in its mean position.
3. Move the AZ axis (ABSOLUTE Mode) at the following positions: 1°, 5°, 10°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270° each with the following speed: 4.5°/s, 0.5°/s, 0.01°/s.
4. Repeat step 3 for the negative AZ positions (till -270°).
5. Acquire and store AZ encoder positions for each slew.
6. Move the EL axis (ABSOLUTE Mode) in its mean position.
7. Move the EL axis (ABSOLUTE Mode) at the following positions: 1°, 5°, 10°, 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°, each with the following speed: 2°/s, 0.2°/s, 0.01°/s.
8. Acquire and store EL encoder positions for each slew.
9. Point on the sky a known source. Store its coordinate position on the PMC field of view. That will be used as reference to verify other known sources.
10. Point on the sky a known source, different from the reference one. Store its coordinate position on the PMC field of view. Record the pointing error.
11. Repeat the test outlined at 8 with a certain number (minimum 30 sources) of known sources.
12. Compute the RMS pointing error from the acquired data.

NOTES: Without pointing model it is not possible to verify the total compensated accuracy (12 arcsec). The not compensated accuracy can be affected by long term stability due to the foundation concrete settling after 1 year.

RESULT

DATE	OPERATOR	SIGNATURE

5 Safety

5.1 Safety for Assembly & Integration

WARNINGS

- YOU MUST READ AND UNDERSTAND THE INSTALLATION AND TEST PROCEDURES BEFORE PERFORMING THE WORK.
- ALL WORKERS INVOLVED ON INSTALLATION AND TEST ACTIVITIES MUST HAVE IN-DEPTH KNOWLEDGE OF THE SAFETY MANUAL. NON COMPLIANCE WITH THESE SAFETY RULES MAY RESULT IN POTENTIALLY GRIEVOUS INJURIES OF THE WORKERS AND/OR DAMAGE TO THE TELESCOPE COMPONENTS.
- THE SAFETY PRECAUTIONS DESCRIBED IN THE FOLLOWING SECTIONS MUST BE ALWAYS FOLLOWED DURING ALL INSTALLATION AND TEST ACTIVITIES. NON COMPLIANCE WITH THESE SAFETY RULES MAY RESULT IN POTENTIALLY GRIEVOUS INJURIES OF THE OPERATORS AND/OR DAMAGE TO THE SYSTEM.

BE CAREFUL THAT THE WORKING AREA IS ADEQUATELY SIGNALLED (SAFETY CONES, SAFETY TAPE, SAFETY FENCES) TO AVOID ACCESS TO UNAUTHORIZED PERSONNEL.

DO NOT WORK WITHOUT PROPER PERSONAL PROTECTIVE EQUIPMENT. WEAR HARD HAT, PROTECTIVE CLOTHING, FOOT PROTECTION, SAFETY GLOVES AND EYE PROTECTIONS.

BE CAREFUL THAT AT LEAST TWO WORKERS MUST BE PRESENT DURING ALL INSTALLATION AND TEST OPERATIONS ON THE ITEM OR SUBSYSTEM: ONE PERFORMING THE OPERATIONS, THE OTHER ONE MONITORING AND KEEPING READY FOR HELP/RESCUE AND FOR RAISE AN EMERGENCY CALL IN CASE OF NEED.

BE CAREFUL THAT THE RISK OF MECHANICAL SCHOCKS BETWEEN MOBILE MASSIVE SUBSYSTEMS THAT CAN ROTATE AT IMPORTANT SPEEDS AND NEARBY OPERATORS AND / OR ITS TOOLING AND ACCESS MEANS EXISTS. THEREFORE, IT MUST BE THE OPERATORS CARE TO POWER THE DRIVE SYSTEM OFF BEFORE TRYING TO ACCESS THE ITEM.

- WHEN THE USE OF SPECIFIC LIFTING AND HANDLING MEANS (FORKLIFTS, CRANES) IS REQUIRED, THEY MUST BE OPERATED ONLY BY TRAINED AND QUALIFIED PERSONNEL. ALL OTHER OPERATORS MUST TAKE CARE TO REMAIN WELL OUT OF THE PATH OF THESE MEANS WHEN THEY ARE USED.

3.

- BE CAREFUL THAT DURING INSTALLATION OPERATIONS VERY HEAVY ITEMS WILL NEED TO BE LIFTED AND MOVED AROUND. THE OPERATORS MUST PAY ATTENTION NOT TO BE CRUSHED BETWEEN MOVABLE PARTS DURING THE VARIOUS LIFTING, HANDLING AND TRANSPORTING OPERATIONS.

4.

- BE CAREFUL THAT WHEN HEAVY PARTS ARE LIFTED, IT IS STRICTLY FORBIDDEN TO STAY BELOW A LOAD. OPERATORS NEAR THE LIFTING OPERATION MUST TAKE CARE NOT TO BE IN DANGEROUS SITUATIONS.

5.

- THE WIND SPEED DURING LIFTING ACTIVITIES MUST BE IN ACCORDANCE WITH THE LOCAL RULES.

- WHEN THE USE OF A MANLIFT IS REQUIRED, IT MUST BE OPERATED ONLY BY TRAINED AND QUALIFIED PERSONNEL. ALL OTHER OPERATORS MUST TAKE CARE TO REMAIN WELL OUT OF THE PATH OF THIS MEAN WHEN IT IS USED.

6.

- WHEN USING A MANLIFT, THE WIND SPEED MUST BE IN ACCORDANCE WITH THE LOCAL RULES.

BE CAREFUL THAT TOOLS AND EQUIPMENT ARE IN CORRECT AND SAFE CONDITION. IF YOU FIND DEFECTS OR ANY SUSPECT CONDITION THAT YOU CANNOT REMOVE IMMEDIATELY, REPORT TO YOUR SUPERIOR. NEVER USE FAULTY AND UNSAFE EQUIPMENT.

HEAVY OBJECT. TO AVOID BACK INJURY, TWO OPERATORS AND/OR THE USE OF LIFTING AIDS AND PROPER LIFTING TECHNIQUES ARE REQUIRED WHEN MOVING IT.

	BE CAREFUL TO RESPECT THE SAFETY DATA SHEET OF CHEMICAL PRODUCTS.
	THE WORKING AREA IS LOCATED AT A CERTAIN HEIGHT FROM THE GROUND. HENCE, THE RISK OF WORKERS FALL EXISTS. THEREFORE, THE WORKERS MUST USE FALL-PREVENTION EQUIPMENT (SAFETY HARNESS) LINKED TO SAFE AND STABLE PIECES OF EQUIPMENT WITHSTANDING THEIR WEIGHT (SECURITY ANCHOR POINTS OF A MANLIFT FOR INSTANCE) BEFORE ACCESSING THE WORKING AREA.
	BE CAREFUL THAT WALKING AND/OR WORKING CLOSE TO EDGES MUST BE DONE WITH EXTREME CARE AND LIMITED TO A MINIMUM. A SAFETY HARNESS MUST BE USED TO AVOID FALLING DOWN.
	BE CAREFUL THAT DUE TO THE ENVIRONMENTAL CONDITIONS THE SURFACE CAN BE DUSTY, GRITTY, ICY. WALKING ON THE SLIPPERY SURFACES MUST BE DONE WITH CARE TO AVOID ANY SLIDE AND POTENTIAL FALL OF THE OPERATORS. RUNNING IS STRICTLY FORBIDDEN.
	BE CAREFUL NOT TO TRIP ON THE VARIOUS OBSTACLES WHEN WALKING.
7. 	• BE CAREFUL TO RESPECT ALL GENERAL WARNING NOTES OF HEIDENHAIN - MOUNTING INSTRUCTIONS FOR SCANNING HEAD. • BEFORE TO PLUG OR UNPLUG EVERY CONNECTORS, THE POWER SUPPLY AND ALL THE DEVICES CONNECTED TO THE ENCODER COMPONENTS (HEADS, BOARDS, SIGNAL ANALYZER) MUST BE TURNED OFF AND THE POWER SOURCE MUST BE CUT.
	BE CAREFUL THAT SOME ITEM ARE ELECTRICALLY POWERED. HENCE, RISK OF ELECTRICAL SHOCKS BY CONTACT BETWEEN AN OPERATOR AND ELECTRICAL PARTS EXISTS. THEREFORE, IT MUST BE THE OPERATOR'S CARE TO POWER THE ITEM OFF BEFORE WORKING ON IT.

BE CAREFUL THAT THE UPS VOLTAGE CAN BE PRESENT IN SOME ITEMS WHEN NORMAL POWER IS OFF. CONTACT COULD CAUSE ELECTRICAL SHOCK OR BURN. BEFORE SERVICING, VERIFY THAT ALSO THE CIRCUIT BREAKER PROTECTING THE UPS SUPPLY OF THE ITEM IS DISCONNECTED, OR THAT NO VOLTAGE IS PRESENT.

CAUTION

BE CAREFUL NOT TO PINCH OR TEAR OUT THE CABLES DURING INSTALLATION OPERATIONS.

5.2 Safety for Testing

WARNINGS

- YOU MUST READ AND UNDERSTAND THE INSTALLATION AND TEST PROCEDURES BEFORE PERFORMING THE WORK.
- ALL WORKERS INVOLVED ON INSTALLATION AND TEST ACTIVITIES MUST HAVE IN-DEPTH KNOWLEDGE OF THE SAFETY MANUAL. NON COMPLIANCE WITH THESE SAFETY RULES MAY RESULT IN POTENTIALLY GRIEVOUS INJURIES OF THE WORKERS AND/OR DAMAGE TO THE TELESCOPE COMPONENTS.
- THE SAFETY PRECAUTIONS DESCRIBED IN THE FOLLOWING SECTIONS MUST BE ALWAYS FOLLOWED DURING ALL INSTALLATION AND TEST ACTIVITIES. NON COMPLIANCE WITH THESE SAFETY RULES MAY RESULT IN POTENTIALLY GRIEVOUS INJURIES OF THE OPERATORS AND/OR DAMAGE TO THE SYSTEM.

BE CAREFAUL THAT THE WORKING AREA IS ADEQUATELY SIGNALLED (SAFETY CONES, SAFETY TAPE, SAFETY FENCES) TO AVOID ACCESS TO UNAUTHORIZED PERSONNEL.

NOT WORK WITHOUT PROPER PERSONAL PROTECTIVE EQUIPMENT. WEAR HARD HAT, PROTECTIVE CLOTHING, FOOT PROTECTION, SAFETY GLOVES AND EYE PROTECTIONS.

BE CAREFUL THAT AT LEAST TWO WORKERS MUST BE PRESENT DURING ALL INSTALLATION AND TEST OPERATIONS ON THE ITEM OR SUBSYSTEM: ONE PERFORMING THE OPERATIONS, THE OTHER ONE MONITORING AND KEEPING READY FOR HELP/RESCUE AND FOR RAISE AN EMERGENCY CALL IN CASE OF NEED.

BE CAREFUL THAT THE RISK OF MECHANICAL SCHOCKS BETWEEN MOBILE MASSIVE SUBSYSTEMS THAT CAN ROTATE AT IMPORTANT SPEEDS AND NEARBY OPERATORS AND / OR ITS TOOLING AND ACCESS MEANS EXISTS. THEREFORE, IT MUST BE THE OPERATORS CARE TO POWER THE DRIVE SYSTEM OFF BEFORE TRYING TO ACCESS THE ITEM.

- WHEN THE USE OF SPECIFIC LIFTING AND HANDLING MEANS (FORKLIFTS, CRANES) IS REQUIRED, THEY MUST BE OPERATED ONLY BY TRAINED AND QUALIFIED PERSONNEL. ALL OTHER OPERATORS MUST TAKE CARE TO REMAIN WELL OUT OF THE PATH OF THESE MEANS WHEN THEY ARE USED.

10.

- BE CAREFUL THAT DURING INSTALLATION OPERATIONS VERY HEAVY ITEMS WILL NEED TO BE LIFTED AND MOVED AROUND. THE OPERATORS MUST PAY ATTENTION NOT TO BE CRUSHED BETWEEN MOVABLE PARTS DURING THE VARIOUS LIFTING, HANDLING AND TRANSPORTING OPERATIONS.

11.

- BE CAREFUL THAT WHEN HEAVY PARTS ARE LIFTED, IT IS STRICTLY FORBIDDEN TO STAY BELOW A LOAD. OPERATORS NEAR THE LIFTING OPERATION MUST TAKE CARE NOT TO BE IN DANGEROUS SITUATIONS.

12.

- THE WIND SPEED DURING LIFTING ACTIVITIES MUST BE IN ACCORDANCE WITH THE LOCAL RULES.

- WHEN THE USE OF A MANLIFT IS REQUIRED, IT MUST BE OPERATED ONLY BY TRAINED AND QUALIFIED PERSONNEL. ALL OTHER OPERATORS MUST TAKE CARE TO REMAIN WELL OUT OF THE PATH OF THIS MEAN WHEN IT IS USED.

13.

- WHEN USING A MANLIFT, THE WIND SPEED MUST BE IN ACCORDANCE WITH THE LOCAL RULES.

BE CAREFUL THAT TOOLS AND EQUIPMENT ARE IN CORRECT AND SAFE CONDITION. IF YOU FIND DEFECTS OR ANY SUSPECT CONDITION THAT YOU CANNOT REMOVE IMMEDIATELY, REPORT TO YOUR SUPERIOR. NEVER USE FAULTY AND UNSAFE EQUIPMENT.

HEAVY OBJECT. TO AVOID BACK INJURY, TWO OPERATORS AND/OR THE USE OF LIFTING AIDS AND PROPER LIFTING TECHNIQUES ARE REQUIRED WHEN MOVING IT.

BE CAREFUL TO RESPECT THE SAFETY DATA SHEET OF CHEMICAL PRODUCTS.

THE WORKING AREA IS LOCATED AT A CERTAIN HEIGHT FROM THE GROUND. HENCE, THE RISK OF WORKERS FALL EXISTS. THEREFORE, THE WORKERS MUST USE FALL-PREVENTION EQUIPMENT (SAFETY HARNESS) LINKED TO SAFE AND STABLE PIECES OF EQUIPMENT WITHSTANDING THEIR WEIGHT (SECURITY ANCHOR POINTS OF A MANLIFT FOR INSTANCE) BEFORE ACCESSING THE WORKING AREA.

BE CAREFUL THAT WALKING AND/OR WORKING CLOSE TO EDGES MUST BE DONE WITH EXTREME CARE AND LIMITED TO A MINIMUM. A SAFETY HARNESS MUST BE USED TO AVOID FALLING DOWN.

BE CAREFUL THAT DUE TO THE ENVIRONMENTAL CONDITIONS THE SURFACE CAN BE DUSTY, GRITTY, ICY. WALKING ON THE SLIPPERY SURFACES MUST BE DONE WITH CARE TO AVOID ANY SLIDE AND POTENTIAL FALL OF THE OPERATORS. RUNNING IS STRICTLY FORBIDDEN.

	BE CAREFUL NOT TO TRIP ON THE VARIOUS OBSTACLES WHEN WALKING.
14. 	• BE CAREFUL TO RESPECT ALL GENERAL WARNING NOTES OF HEIDENHAIN - MOUNTING INSTRUCTIONS FOR SCANNING HEAD. • BEFORE TO PLUG OR UNPLUG EVERY CONNECTORS, THE POWER SUPPLY AND ALL THE DEVICES CONNECTED TO THE ENCODER COMPONENTS (HEADS, BOARDS, SIGNAL ANALYZER) MUST BE TURNED OFF AND THE POWER SOURCE MUST BE CUT.
	BE CAREFUL THAT SOME ITEM ARE ELECTRICALLY POWERED. HENCE, RISK OF ELECTRICAL SHOCKS BY CONTACT BETWEEN AN OPERATOR AND ELECTRICAL PARTS EXISTS. THEREFORE, IT MUST BE THE OPERATOR'S CARE TO POWER THE ITEM OFF BEFORE WORKING ON IT.
	BE CAREFUL THAT THE UPS VOLTAGE CAN BE PRESENT IN SOME ITEMS WHEN NORMAL POWER IS OFF. CONTACT COULD CAUSE ELECTRICAL SHOCK OR BURN. BEFORE SERVICING, VERIFY THAT ALSO THE CIRCUIT BREAKER PROTECTING THE UPS SUPPLY OF THE ITEM IS DISCONNECTED, OR THAT NO VOLTAGE IS PRESENT.

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