



Telescope

Half Moon Platform Specifications

Código : ESP/TELE/0202-R

Edición : 1.B

Fecha: 2013-10-31

Gran Telescopio de Canarias, S.A.

*Instituto de Astrofísica de Canarias
Vía Láctea s/n
38200 - LA LAGUNA, TENERIFE, Islas Canarias
Tfno +34 922 315 031 Fax +34 922 315 032*

*Centro Común de Astrofísica de La Palma
Cuesta de San José s/n
38712 BREÑA BAJA, LA PALMA, Islas Canarias
Tfno +34 922 425 720 Fax +34 922 425 701*

<http://www.gtc.iac.es> E-Mail: gtc@iac.es

Control de aprobación

Autor/es:	Benjamin Siegel Ingeniero de Desarrollos
Revisado por:	Javier Castro López-Tarruella Responsable Grupo de Desarrollos Ramón Ascanio López de Ayala Responsable Grupo de Administración
Aprobado por:	Benjamin Siegel Grupo de Desarrollos Luis A. Rodríguez Garcia Responsable Grupo de Mantenimiento
Autorizado por:	Pedro Álvarez Martín Director Fecha: 2013-11-26

Changes record

Issue	Date	Section	Page	Change description
1.A	10/10/2013	All	All	First Issue.
1.B	31/10/2013	Applicable Documents	5	Elimination of applicable drawing DR/TL-MN-HM/000
		5.2.1.2.1	13	Inclusion of requirement defining the general telescope structure envelope

Configuration Items

Code	Description
TL-MN-HM	Half Moon Platform

Applicable documents

N°	Document title	Code	Issue
A1	Cassegrain Focal Station Envelope	DR/GTC/002	1.G
A2	Folded Cassegrain Focal Station Envelope	DR/GTC/004	1.G
A3	Telescope Lower Tube Revolution Envelope	DR/GTC/009	1.A
A4	Interface Half-Moon Platform – Telescope Structure	DR/I-TL-TL-003/000	1.B
A5	Half Moon Platform – Complementary Platform Cassegrain	DR/TL-MN-HM-300/000	1.A
A6	Half Moon Platform – Complementary Platform Folded Cassegrain	DR/TL-MN-HM-400/000	1.A
A7	Envelopes in the Telescope Chamber	DR/CW/003	1.F

Reference documents

N°	Document title	Code	Issue
R 1	Telescope Mechanics – Half Moon Platform Preliminary Design	RPT/TELE/0394-R	1.A
R 2			
R 3			
R 4			

List of acronyms and abbreviations

CS	Control System
EMI	Electromagnetic Interference
GTC	Gran Telescopio Canarias
I/F	Interface
ISS	Interlock and Safety System
MPMNT	Mean preventive Maintenance Night-Time
MTBF	Mean Time between Failures
MTTR	Mean Time to repair
SRCF	Safety Related Control Function
TBC	To be confirmed
TBD	To be defined

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1. SUMMARY

This document contains the specifications for the Half Moon Platform which will be mount on the telescope structure for operation and maintenance of the Cassegrain and Folded Cassegrain foci.

2. INTRODUCTION

2.1 Use of shall/should

“Shall” is used for requirements no matter how stable they are, whereas “should” is reserved for guidelines. Requirements are mandatory and guidelines are not mandatory, although their fulfillment should be strongly pursued.

2.2 Stable and unstable requirements

Unstable or undefined requirements are identified by “TBC” or “TBD” respectively.

3. DEFINITIONS

3.1 Azimuth Axis

Rotation axis of the telescope mount.

3.2 Elevation Axis

Rotation axis of the telescope tube.

3.3 Mean Preventive Maintenance Day-Time (MPMDT)

The MPMDT is the day-time per year that the system is not available for operation due to planned (preventive) maintenance tasks.

3.4 Mean Time between Failures (MTBF)

The MTBF for a system is the mean time between two consecutive failures of the system.

3.5 Mean Time to Repair (MTTR)

The MTTR for a system is the mean time spent in unplanned (corrective) maintenance to repair the system.

3.6 Reference Coordinate System

The origin of the reference coordinate system is the intersection of the elevation axis with the azimuth axis. The positive X-axis runs in direction of the elevation axis towards Nasmyth focus A and the positive Z-axis points to the zenith completing the Y-axis the right handed coordinate system.

4. SCOPE

These specifications affect the Half Moon platform as a whole including all configuration items shown in Figure 4-1.

More details about the mechanics of the platform can be found in reference document R 1, Telescope Mechanics - *Half Moon Platform Preliminary Design*. However, the presented design in R 1 is a preliminary design being not mandatory.

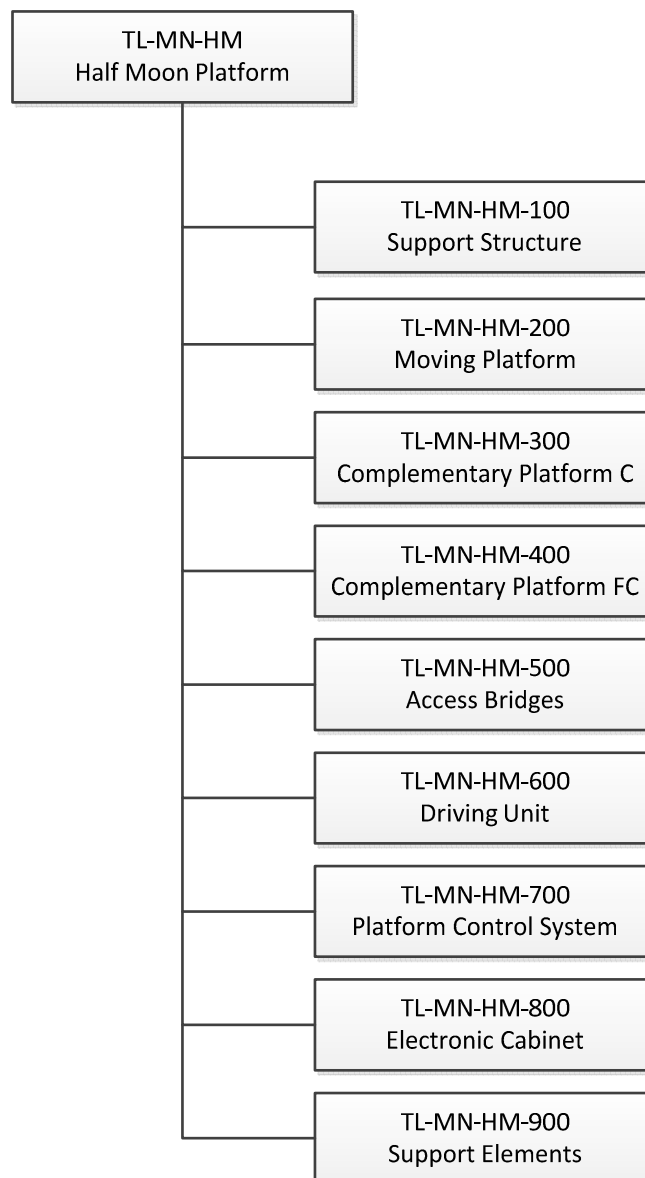


Figure 4-1 GTC subsystem composing the Half Moon Platform.

5. REQUIREMENTS

All requirements in this chapter shall have the following codes:

SP/TL-MN-HM/NNN,

where NNN is the index that appears immediately before the requirement title.

5.1 Functional Requirements

5.1.1 Concept

Source: Maintenance Group, Developments Group

The Half-Moon Platform shall provide direct and safe access for maintenance of the Folded Cassegrain and Cassegrain focal stations (see drawings A1 and A2), without the need for the workers to use special safety equipment like ropes or harnesses.

Access shall be possible from both Nasmyth platforms, independently of the position of the moving part of the Half-Moon platform. This action shall not require any further action on the part of the worker, such as put in position access stairs or ramps.

During telescope operation the platform shall be positioned outside of the tube revolution envelope.

The platform shall change, being moved by electromechanical actuators, between the following positions:

- Folded Cassegrain
- Cassegrain
- Resting

Complementary platforms in Cassegrain and Folded Cassegrain positions shall form, together with the moving part of the platform, a closed floor surface for safe transit and maintenance.

At the same time these complementary platforms shall contain conduct trays for cables and hoses.

5.1.2 Operation Functions

Source: Developments Group

The Half Moon Platform shall have the following operation functions:

- Remove Platform: The platform is removed from the telescope tube stopping automatically in the resting position.
- Approach Platform: The platform moves towards the telescope tube stopping automatically in Cassegrain or Folded Cassegrain Position, depending on the position of the tube.
- Stop Platform: The actual movement can be stopped reselecting the remove or the approach function.

5.2 Design Requirements

5.2.1 General Design Requirements

5.2.1.1 Safety Requirements

5.2.1.1.1 Safety Policy

Source: Safety Coordination

The contractor shall design, fabricate and test according to the applicable normative for safety in general and particularly according to UNE-EN ISO 12100:2012.

5.2.1.1.2 Emergency Stop Rope

Source: Development Group

An emergency stop rope shall be integrated over the full length of the railing (curved part) of the moving platform, being well marked and protected against unintentional activation.

5.2.1.2 Structure and Mechanics

5.2.1.2.1 Platform Dimensions

Source: Development Group

To avoid interference with other elements in the telescope chamber, the Half-Moon Platform shall always stay inside the Telescope Structure Envelope defined in applicable drawing A7.

In the opposite direction, the platform railing shall maintain a minimum distance of 550 mm to the Folded Cassegrain Instrument Envelope (see drawing A2) allowing the transit of persons.

5.2.1.2.2 Total mass

Source: Development Group

The overall installed mass of the Half Moon Platform shall be less than 4.000 kg.

5.2.1.2.3 Mass Watching Guideline

Source: Development Group

The mass of moved parts shall be kept low. This refers on one side to the moving platform reducing energy consumption and on the other side to the complementary platforms installed on the telescope tube reducing the counterweights to install.

5.2.1.2.4 Hygroscopic Materials

Source: Development Group

Hygroscopic materials, such as cable ties made out of polyamide, shall be avoided if possible since they become fragile due to the low humidity on site.

5.2.1.2.5 Thermal Expansion Coefficient Guideline

Source: Development Group

In case of use of non-ferrous metal for the platform components, the effects of the differential thermal expansions shall be analyzed avoiding their impact on the functionality of the platform itself and on the telescope mechanics on the other side.

5.2.1.2.6 Loose Parts Guideline

Source: Development Group

The design of components and support elements of the Half Moon Platform shall reduce the need for tools as well as the risk of parts falling down, due to the proximity to the telescope optics.

5.2.1.2.7 Attachment guideline

Source: Development Group

All components of the platform shall be designed in such a way as to avoid or minimize modifications on the telescope structure or other installed subsystems.

5.2.1.2.8 Fixing Type Guideline

Source: Development Group

Bolted connections should be preferred to welded connections fixing components to the telescope structure, due to the closeness to delicate optical equipment.

5.2.1.3 Coating, Painting and Surface Protection

5.2.1.3.1 Coating and Painting

Source: RPT/STMA/0168-R

All parts of the Platform, grating excepted, shall be painted in semi matte red, RAL 3003 (Gloss: 10%-20%, angle of 60°), applying previously an adequate primer.

5.2.1.3.2 Surface Protection

Parent requirements: 5.5.1.1

All functional surfaces normally not painted such as attachment flanges shall be accordingly and permanently protected against the climatologic conditions.

Commercial components like the platform grating, rails or spherical bearings shall be selected taking into account the climatologic conditions.

5.2.1.4 Electro Technology and Cabling

5.2.1.4.1 EMC Standards

Parent Requirement: SP/GTC/5.7.1

The components of the Half Moon Platform shall meet the electromagnetic emission generic standard UNE-EN 50081-2 and the electromagnetic immunity generic standard UNE-EN 50082-2.

5.2.1.4.2 Earthing

Parent requirement: SP/GTC/11.5.6.10

Metallic structures shall be electrically connected to the Telescope structure. Electrical apparatus shall be connected to the GTC electrical supply earthing.

5.2.1.4.3 Fire Prevention

Source: Development Group

Cabling shall be selected which prevents fire from spreading through it.

5.2.1.5 Thermal Requirements

5.2.1.5.1 Reference Temperature

Source: Development Group

The reference temperature for all the dimensions and tolerances, unless otherwise specified, shall be 8.5°C.

This affects all drawings and metrological reports requiring possible extrapolations.

5.2.1.5.2 Low thermal Inertia Guideline

Parent Requirement: SP/GTC/8.2.6.3

The design and the applied materials of the Platform should aim to minimize thermal inertia.

5.2.1.6 Reliability and Support Requirements

5.2.1.6.1 Service Life Time

Parent Requirement: SP/GTC/5.4.1

The service life time of the Half Moon Platform shall be at least 50 years at 3 full cycles (remove and approach) per day.

5.2.1.6.2 MTBF

Source: Development Group

The Half Moon Platform shall have an MTBF of at least 3000 full moving cycles (remove and approach).

5.2.1.6.3 MTTR

Source: Development Group

The Half Moon Platform shall have an MTTR of less than 3 hours.

5.2.1.6.4 MPMDT

Source: Development Group

The Half Moon Platform shall have a MPMDT of less than 3 person-hours per year.

5.2.1.6.5 Accessibility

Source: Development Group

It shall be possible to dismount and access the components of the Half Moon Platform in a straight forward manner in order to facilitate maintenance.

5.2.1.6.6 Resting Position in Emergencies

Source: Development Group

It shall be possible to carry the platform to the resting position under any circumstances in less than 1 hour. This time refers to the complete operation time including the integration of special components or application of special tools foreseen for emergencies.

5.2.1.7 Standardization Guideline

Parent Requirement: SP/GTC/5.4.8

Components should be standard, commercial and well proven and should be selected in such a way as to minimize maintenance.

5.2.1.8 Scattered Light control

Parent Requirement: SP/GTC/5.2.7.1

The Half Moon Platform shall not have any part emitting light, for example control lamps of the operation panels or similar, when parked and switched off.

5.2.2 Support Structure

5.2.2.1 Spherical bearings

Source: Development Group

The spherical bearings shall be maintenance free over the whole service life time (5.2.1.6.1).

5.2.2.2 Alignment features

Source: Development Group

Alignment features shall be incorporated that permit to align and fix the support structure on the telescope compensating manufacturing and mounting errors of the platform support structure itself and the telescope structure.

Final aim is to avoid structural warping and consequential high forces on components, as well as the possibility to position in range of tolerance the moving part of the platform and the complementary platforms (see drawings A4 to A6).

5.2.2.3 Mechanical Interfaces with Telescope Structure

Joining locations for the platform support structure are shown in drawing A4 and shall be completely defined, in close collaboration with GRANTECAN, during the detailed design phase.

5.2.3 Moving Platform

5.2.3.1 Platform Floor

Source: Development Group

The floor of the platform shall be a grating or similar influencing as less as possible the free air circulation in the telescope chamber.

5.2.3.2 Auxiliary Railing

Source: Development Group

Auxiliary railing shall provide personnel safety in areas between the moving platform and the complementary platforms.

Auxiliary railing that must take different positions in Cassegrain and Folded Cassegrain position, shall do this position change automatically. This shall be realized or actively (motorized) or passively (i.e. by levers and the proper platform movement).

5.2.3.3 Cassegrain and Folded Cassegrain Position

Source: Development Group

The interface between the moving part of the platform and the complementary platforms shall have the form defined in drawings A5 and A6.

The level difference between moving platform, being located in Cassegrain or Folded Cassegrain position, and complementary platforms shall be less than 3 mm in average and less than 5mm at the most.

5.2.3.4 Resting Position

Source: Development Group

Being the platform in Resting Position, the distance between platform and tube rotation envelope shall be at least 100 mm (see drawing A3).

5.2.4 Complementary Platforms

5.2.4.1 Air Circulation

Source: Development Group

The complementary platforms shall allow free air circulation, as far as possible.

5.2.4.2 Cable Trays

Source: Development Group

The complementary platforms shall have the function of cable trays in the areas defined in drawings A5 and A6. The cable trays shall have a depth of 150 mm.

5.2.4.3 Access

Source: Development Group

Access to the conducts shall be provided lifting segmented floor covers, without the need of tools. With open floor covers the cable tray shall stay free of bridges, i.e. it shall be possible to introduce conducts from above.

5.2.4.4 Floor Covers

Source: Development Group

Floor covers shall be pivotally mounted by means of spherical bearings. The covers shall be provided with air springs holding them or in closed or in opened position pushed against defined mechanical stops. The covers shall stay surely, without movement, or in closed or in opened position independently of the tube position.

5.2.4.5 Dimensions and Floor Cover Divisions

Source: Development Group

Dimensions and floor cover divisions shall be as defined in drawings A5 and A6.

5.2.4.6 Conduct Apertures

Source: Development Group

Conduct Apertures shall be foreseen as defined in drawings A5 and A6.

5.2.4.7 Mechanical Interfaces with Telescope Structure

Source: Development Group

The mechanical interface between complementary platforms and telescope structure, including position, adjustment capability and fixing type, shall be as defined in drawings A5 and A6.

5.2.5 Access Bridges

5.2.5.1 Access Doors

Source: Development Group

The access ways to the moving part of the platform shall be provided with access doors. It shall be possible to fix them in opened position falling back automatically to closed position if released.

5.2.5.2 Mechanical Interfaces with Telescope Structure

Source: Development Group

Joining locations for the access bridges are shown in drawing A4 and shall be completely defined, in close collaboration with GRANTECAN, during the detailed design phase.

5.2.6 Driving Unit

5.2.6.1 Drive

Source: Development Group

The platform shall be moved by electromechanical actuators with automatic lubrication. The screw-type shall be defined during the detailed design phase.

5.2.6.2 Drive Load Reduction

Source: Development Group

The load on the electromechanical actuators shall be reduced installing a hydraulic or mechanical energy accumulator. At the same time, this device should be able to act as a safety system (see requirement 5.2.6.3).

5.2.6.3 Safety Drive System

Source: Development Group

A safety system shall be installed leading the platform to take a safe position in case of total collapse of one or both of the electromechanical actuators. At the same time, this security system should be able to reduce the drive load (see requirement 5.2.6.2).

5.2.6.4 Halt-on-Power-off

Source: Development Group

The moving platform shall maintain the position being powered-off the system.

5.2.6.5 Encoder

Source: Development Group

The system shall comprise an absolute encoder determining the position of the platform directly after start-up without the need of a homing procedure.

5.2.6.6 Position Switches

Source: Development Group

The platform shall have position switches on both sides indicating the three main positions, Cassegrain, Folded Cassegrain and Resting Position.

5.2.6.7 Brakes

Source: Development Group

Each actuator shall have a brake independently of the screw-type of the electromechanical actuator. It shall be engaged if the platform is in one of the three main positions or in any intermediate position.

The brakes shall be a fail-safe-type, i.e. spring applied and pneumatically or electrically released.

In case of a custom solution the complete installation, including hoses and electrovalves, shall be provided ready for connection to the telescope clean air circuit (5bar).

5.2.6.8 End Stops and Dampers

Source: Development Group

The movement of the platform shall be limited by mechanical end stops and dampers.

5.2.6.9 Mechanical Interfaces with Telescope Structure

Source: Development Group

Joining locations for the driving unit are shown in drawing A4 and shall be completely defined, in close collaboration with GRANTECAN, during the detailed design phase.

5.2.7 Electronic Cabinet

5.2.7.1 Location

Source: Development Group

The electronic cabinet shall be located as defined in drawing A4. The position can be changed after prior consultation with GRANTECAN.

5.2.7.2 Cabling

Source: Development Group

The cabling between electronic cabinet and devices shall have certain over-length providing margin during the integration of the Half-Moon Platform on the telescope.

5.2.7.3 Dimensions

Source: Development Group

The electronic cabinet shall have sufficient space for storing the cabling over-lengths. See also requirement 5.4.4.2.

5.3 Performance Requirements

5.3.1 Static Load Capacity

Source: Development Group

The minimum required load capacity being the platform in Cassegrain or Folded Cassegrain Position shall comply with normative TBD.

5.3.2 Dynamic Load Capacity

Source: Development Group

The minimum dynamic load capacity changing the platform its position shall be 500 kg on the storage areas (see drawing A2).

5.3.3 Positioning Time

Parent Requirement: 5.3.2

Source: Development Group

The maximum positioning time between Resting Position and Cassegrain or Folded Cassegrain Position shall be 1 minute with a goal of 45 seconds, carrying the platform the full storage load stated in 5.3.2.

5.3.4 Positioning Behavior

Source: Development Group

The platform shall reach the positions defined in 5.1.1 smoothly and without perceptible shocks.

5.3.5 Braking Time

Source: Development Group

The braking time in case of an emergency stop shall be less than 1 second at any specified environmental or load conditions.

5.3.6 Structural behavior

Source: Development Group

The minimum first eigen-frequency of the platform shall be minimum 12 Hz neglecting the flexibility of the telescope mount and considering the following load case:

Static load of 500 kg on the storage area (see drawing A2) and 1000 kg distributed over the whole platform or concentrated on an area of 8 m².

The load of 1000 kg corresponds to persons standing on the platform whereas these could be a group of visitors or a group of workers with tools and other equipment. For this reason the load is considered to be distributed or concentrated on a reduced area.

This load case refers to the platform in standstill, powered-off and brakes engaged.

5.4 Control System

5.4.1 Operation Panels

Source: Development Group

The Half-Moon Platform shall have three operation panels, one right next to each of the access bridges and one integrated in the electronic cabinet door.

Each operation panel shall have at least:

- Key Interlock
- Emergency Button
- Buttons for operation Functions
- Status and errors indicators (see also requirement 5.2.1.8)

Only that operation panel on which the key interlock has been turned on shall be active.

5.4.2 Safety Related Control Functions (SRCFs) on local level

Safety Related Control Functions shall be revised and completed during the detailed design phase.

5.4.2.1 Emergency Stop

Source: Developments group

The system shall execute an emergency stop under the following conditions:

- Activation of emergency buttons or ropes
- Order from the ISS for emergency stop or emergency shut-off (see requirements 5.4.3.1 and 5.4.3.2).

The activation of emergency buttons or ropes shall be communicated to the ISS (see also requirement 5.4.4.1).

5.4.2.2 Emergency Situations

Source: Developments group

The system shall handle autonomously at least the following emergency situations, maintaining the safety and integrity of persons and equipment:

- Electrical power failure
- Failure of critical sensors or their cabling
- Cable wrap stuck (if applicable)
- Cooling system failure (if applicable)
- Over-Speed
- Over-Load of the drives
- Disappearance of the operation permission of the ISS (see requirement 0).

Any emergency situation shall be communicated to the ISS (see also requirement 5.4.4.1).

5.4.2.3 Access Door locked / unlocked

Source: Developments group

The access doors shall be locked automatically previous to any movement of the platform staying locked during the whole motion. Only a correctly closed door (detected by the proper locking device) can be locked.

The doors shall be unlocked only after the platform has reached the Cassegrain or the Folded Cassegrain position, confirmed by the corresponding position switches, and after the drives has been disabled.

5.4.2.4 Drives enable / disable

Source: Developments group

The drives of the platform can only be enabled turning to “on” the interlock-key of any of the operation panels (see requirement 5.4.1), both access doors are closed and locked and operation permission from the ISS is present (see requirement 0).

5.4.3 SRCFs induced by the Interlock and Safety System (ISS)

Safety Related Control Functions shall be revised and completed during the detailed design phase.

5.4.3.1 Emergency Stop

Source: Developments group

The platform shall execute an emergency stop receiving the corresponding order from the ISS, which shall have priority over local functions. The 24 VDC power supply shall be maintained (TBD).

5.4.3.2 Emergency Shut-off

Source: Developments group

The platform shall execute an emergency shut-off receiving the corresponding order from the ISS, which shall have priority over local functions. The 24 VDC power supply shall also be cut (TBD).

5.4.3.3 Operation Permission

Source: Developments group

The Half-Moon platform shall be able to enable the drives only and exclusively if the permission for operation is given by the ISS.

5.4.3.4 Safety Integrity Level (SIL) / Performance Level (PL)

Source: Developments group

The safety integrity level (SIL) or performance level (PL) required for the safety related control functions shall be determined during the risk assessment.

5.4.4 Communications from the Half-Moon Platform CS to the ISS

5.4.4.1 Communication Content

Source: Developments group

The control system of the platform shall provide to the ISS, by means of the I/F-module, the following information:

- State of all position switches
- Position and state of the access doors
- State of the drives
- Emergency button pushed or emergency rope pulled (should be identifiable)
- Emergency situation detected by the local safety control system of the platform (see also requirement 5.4.2.2).

5.4.4.2 I/F-Module

Source: Maintenance group

The I/F-module shall be an IM151-1 from Siemens being installed inside the electronic cabinet.

5.5 General Requirements

5.5.1 Environmental Conditions

5.5.1.1 Climatologic Conditions

Parent Requirements: SP/GTC/5.3.6

The Half Moon Platform shall be designed to operate and survive under the conditions stated in Table 1.

	Nominal conditions	Limit of operation	Survival limit
Temperature	-2°C to +19°C	N/A	-15°C to +35°C
Thermal variation (at night) in 15 minutes	0°C to 0.9°C	N/A	N/A
Thermal variation (at night) in 1 hour	0°C to 1.8°C	N/A	N/A
Thermal variation (at night) in 2 hours	0°C to 2.4°C	N/A	N/A
Relative humidity	2% to 87%	90% (or condensation)	0% to 100% with condensation
Atmospheric pressure	770 to 790 mbar	N/A	N/A
Wind	13m/s	22m/s with gusts up to 27m/s	55m/s with gusts up to 67m/s

Table 1 Climatologic conditions.

Nominal conditions are those in which the specified performances shall be matched without any degradation. Exceeding the nominal conditions and until the limit of operation it shall be possible to operate the system accepting performance degradation. The survival limit shall be reached not necessarily in operative status.

Comment: Normally, on the telescope site the relative humidity reaches very low values what can lead to problems with the electronics.

5.5.1.2 Telescope motion

Parent requirements: SP/GTC/7.1.8.7, SP/GTC/7.1.8.12

The Half Moon Platform shall operate at nominal performances with the telescope azimuth axes moving within the following limits:

- Azimuth speed $\leq 2.2^\circ/\text{s}$
- Azimuth acceleration $\leq 0.31^\circ/\text{s}^2$

5.5.1.3 Earthquake overload

Parent Requirement: SP/GTC/5.3.6.5

The Half Moon Platform shall withstand seismic acceleration loads of 1g in any direction and under any nominal load condition, without structural damage.

5.5.1.4 Dust guideline

Parent Requirement: SP/GTC/5.3.6.9

All components shall operate without degradation of the required performance during and after episodes of Saharian dust complying with protection rating IP65. Components which not comply with this rating shall be protected adequately.

5.5.2 Packaging, Handling, Storage and Transportation Requirements

5.5.2.1 Package Dimensions and Transportation Guideline

Parent requirements: SP/GTC/5.8

The pieces to be transported and integrated at the GTC site, ORM, La Palma, without the need of extraordinary means or actions should comply with the dimensions indicated in Table 2.

The final location of a particular piece or its handling within the GTC as well as its sequence of integration could eventually restrict the indicated limits.

	Recommended limit	Maximum limit
Elevation (including package)	2.7 (trailer height 1.3 m)	3.1 m (trailer height 0.9 m)
Total elevation	4 m	4 m
Plant: width x length (including package) ¹	From 4.5m x 6m to 2.5m x 8m	From 5.5m x 5.5m to 2.5m x 12m
Mass (excluding package)	12t	19t

Table 2 Limits for packing dimensions.

¹ These dimensions are limited by the radii of curvature of the access road to the ORM. Therefore, the wider the piece, the shorter is the trailer, and vice versa. Standard trailer width is 2.5m.

5.5.2.2 Storage

Source: System Engineering Group

The design of the items and packages shall prevent them from damage under the conditions shown in Table 3, when stored at the GTC facilities.

Condition	Requirement
Altitude	2250 to 2300 m
Temperature	-15°C to +35°C
Ambient air temperature day variation ²	11°C
Relative humidity	0% to 100% with condensation
Cleanliness	Occasional dust, sand and insects
Atmospheric pressure	770 to 790 mbar

Table 3 Environmental conditions for packages.

² Maximum day temperature variation expected at the ORM.