



Magellan AO Project


Clio2 Instrument Acceptance & Verification Matrix for PSR

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Clio2 Instrument

Acceptance & Verification Matrix For PSR

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Revision History

Issue	Date	Changes	Responsible
A	2012-Jun-17	Initial Release	P. Hinz



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1. Applicable Documents


- [RD1] MAOP-001 “Requirements and Specifications for the Magellan Adaptive Optics System”
- [RD2] MAOP-012 “CDR for the Magellan Adaptive Optics System, CDR Documents for the CDR Committee Released May 19, 2009, For Comment by noon May 26, 2009”

2. Acronyms and Abbreviations

AOS	Adaptive Optics System
ASM	Adaptive Secondary Mirror
CG	Center of Gravity
CRO	Calibration Return Optic
NIR	Nasmyth Instrument Rotator
OD	Outside Diameter
TBC	To Be Confirmed
TBD	To Be Determined
TBR	To Be Reviewed
W-Unit	Wavefront Sensing Unit

3. Scope of Document

This document provides the Acceptance and Verification Matrix for the Clio2 1-5 μm wavelength imaging camera, planned for use with the Magellan AO system. The system describes the requirements and specifications for the system and states whether the system meets those requirements and specifications. It indicates whether the system meets the requirements and specification by either design, through analysis, inspection or test.

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4. Verification Matrix

Table 1 below contains the verification matrix. The column headings definitions are the following:

Item No.	Each requirement/specification is assigned and item number starting at 1.
Section No.	Where applicable, this corresponds to the MagAO requirements definition. The number corresponds to the section number the requirement/specification is contained in [AD1].
Title	The title of the section.
Req./Specs.	The basic requirement or specification called for.
Design	An “X” in this column indicates whether the specification is inherent in the design of the system.
Analysis	An “X” in this column indicates whether the specification is verified by analysis.
Inspection	An “X” in this column indicates whether the specification is verified by inspection. The inspection procedures are contained in this document
Test	An “X” in this column indicates whether the specification is verified by test. The test procedures are contained in this document.
Comply	A “C” in this column indicates compliance an “NC” indicates non-compliance.
Comments	Explanatory comments are contained in this column.



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Requirements for the Clio2 Instrument

Item No.	Title	Specs.	Design	Analysis	Inspection	Test	Comply	Comments
	Science Requirements							
	Clio2 IR AO MODE (1-5 μm)							
1	High Strehl (on-axis)	$\geq 60\%$ Strehls @ $\lambda = 1.65 \mu\text{m}$; $R \leq 8$, $0.8''$ seeing ($< 190 \text{ nm rms wavefront error}$)	X	X		X	C	Internal pinhole tests demonstrate $> 80\%$ Strehl at H band with Clio2 optics
2	Diffraction-limited Resolutions 1-5.4 μm	$< 0.018''$ sampling	X			X	C	Proved on sky with Clio2 at MMT (Hinz et al. 2010)
3	Wavelengths bands of interest	1-5 μm	X			X	C	Tested at MMT
4	5σ detection of L=15 mag point source	$< 60 \text{ sec}$	X			X	C	Tested at MMT
5	Dark Current well below the sky brightness.	$< 1 \text{ e-/s}$	X			X		TBD at UA in late June
6	Low read noise	$< 20 \text{ e-}$	X			X		TBD at UA in late June



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Engineering Requirements							
Operational Orientation Range							
8	Clio2 shall work at any rotation angle of the instrument rotator.		X			X	C Lab tested inverted in June 2012.
Clio2 Optical Requirements							
9	Clio2 shall reflect the visible light to the W unit.		X			X	C Dichroic modified for MagAO
9	Clio2 shall deliver two magnification scales for imaging: 28 mas/pixel and 16 mas/pixel		X			X	C Demonstrated at the MMT.
Mass							
10	The mounted portion of the Clio2 instrument shall be less than 80 kg.	Mass <80 kg CG within 200 +/- 20 mm from the instrument rotator axis.	X		X		C Measured and calculated mass is 77kgs CG is calculated to be 152mm from rotator axis.
Clio2 Mounting Mechanical Requirements							
11	The Clio mounting structure shall provide sufficient stiffness to provide < 2 arcminute tilt of the instrument for any rotator angle.	Optical Tilt < 2 arcmin		X		X	C Per FEA, worse case gravity vector rotation results in 0.49 arcmin of tilt. The worse case tip is a magnitude less at 0.05 arcmin.
15	The mount shall allow for safe removal of Clio2 in less than three hours by three people (TBD).		X				TBD on Magellan telescope, Simulated Tests successful at UA
Cryogenic Requirements							
	The Clio2 Cryostat shall be able to be brought to operating temperature (80 K for optics, and 60 K for the detector) in 24 hours from the beginning of the cooldown period.	<24 hours to reach temperature	X			X	C Tested in June 2012



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	The cryostat shall maintain operating temperature for > 1 day for the optics (outer vessel) and >2 days for the detector (inner vessel)	>1 day hold time for outer vessel. >2 days for inner vessel.	X			X	C	Achieved 42 hours for outer vessel, 52 hours for inner vessel. 20 hours when inverted.
	Thermal Requirements							
16	The cooling system shall be sufficient to remove 1 kW of heat from the Clio electronics rack.		X			X		TBD – Early July at UA
17	A minimum mixture ratio of 25/75 ethylene glycol-water mixture (Dowtherm® or equivalent) shall be the cooling medium.		X				C	The cooler only has to be able to handle the lowest operational temperature without freezing which is -10°C. Freezing point of 25/75 mix is -12°C.
18	The coolant flow into the electronics rack shall be a minimum of 5 liters/min at a pressure of 3 bars at -10° C.		X			X		TBD at Magellan
19	The maximum inlet pressure at the electronics shall be 7 bar.		X			X		TBD at Magellan
20	There shall be an inlet and outlet line both ½” in diameter. The inlet end to the electronics rack shall be a male swagelock quick disconnect connector and the return end from the electronics rack shall be a female. When the electronics rack is removed the lines shall be capable of plugging into one another to complete the loop, contain any leaks and prevent contamination. All plumbing in the loop shall minimize connections as much as practicable to reduce the chance of leakage.		X		X		C	at fitcheck
	Electrical Requirements							
23	The electrical requirements for the electronics rack are Main Supply: 120 VAC/ 15 A, 1 Ph (NEMA Connector)		X				C	By design



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23	The electrical requirements between the electronics rack and the Clio2 mounted instrument are 1 120 Vac cord 1 fiber 6 custom motor control cables 1 custom housekeeping cable		X				C	By design.
26	The Clio2 camera shall be electrically isolated from the telescope structure.		X				C	Mechanically isolated by design
Communications Requirements								
27	The communications requirements for the electronics rack on the platform to the observatory network are Cat5 gigabit Ethernet		X				C	By design
Clio2 Instrument Safety								
30	A dichroic cover and instrument cover will be provided for storage when off the telescope.		X				C	Provided with instrument
Clio2 Interface								
63	A new custom flange (made of a Clio2 “box” and a 17.7mm thick shim plate) will mount Clio2 to the NAS. The flange thickness places the center of the 15o tilted front surface of the dichoric Clio2 window 130 mm ahead of the f16.16 focus (138 mm behind the NAS flange). Permanent fixed shim to align the pupil of Clio2 the window is set by 3 micrometers. The shortened snout will place the first focus of the F/16 beam in the exact center of the W-unit cube (in reflected optical $\lambda < 1.0\mu\text{m}$ light). The Clio2 “box” plus the 17.7mm shim plate when combined will place the f/16 focus in transmitted light ($\lambda > 1.0\mu\text{m}$) exactly on the input focal plane of Clio2 when mounted on the NAS.		X				C	See MAOP-003 for design.
Environmental Conditions								
67	Storage Temperature	-10° to +35° C				X	C	General Requirement



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68	Operating Temperature	-10° to +25° C (14° to 77° F)				X	C	Demonstrated at MMT
69	Storage Pressure	560 to 760 Torr (10.8 to 14.7 psi)				X	C	Demonstrated at MMT & UA
70	Operating Pressure	560 to 750 Torr (10.8 to 14.5 psi)				X	C	Demonstrated at MMT & UA
71	Storage Humidity	5 to 80%				X	C	Demonstrated at MMT & UA
72	Operating Humidity	5 to 95% Non-Condensing				X	C	Demonstrated at MMT & UA
73	Max Operating Wind	21 m/s (49. mph)	X				C	By design
74	Survival Windspeed	33 m/s (73.8 mph)	X				C	By Design
75	Altitude	0 to 2524 m (0 to 8281 ft)				X	C	Tested at MMT
76	Seismic	0.5 g Lateral -0.5 to 1.5g Vertical	X				C	By FEA

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