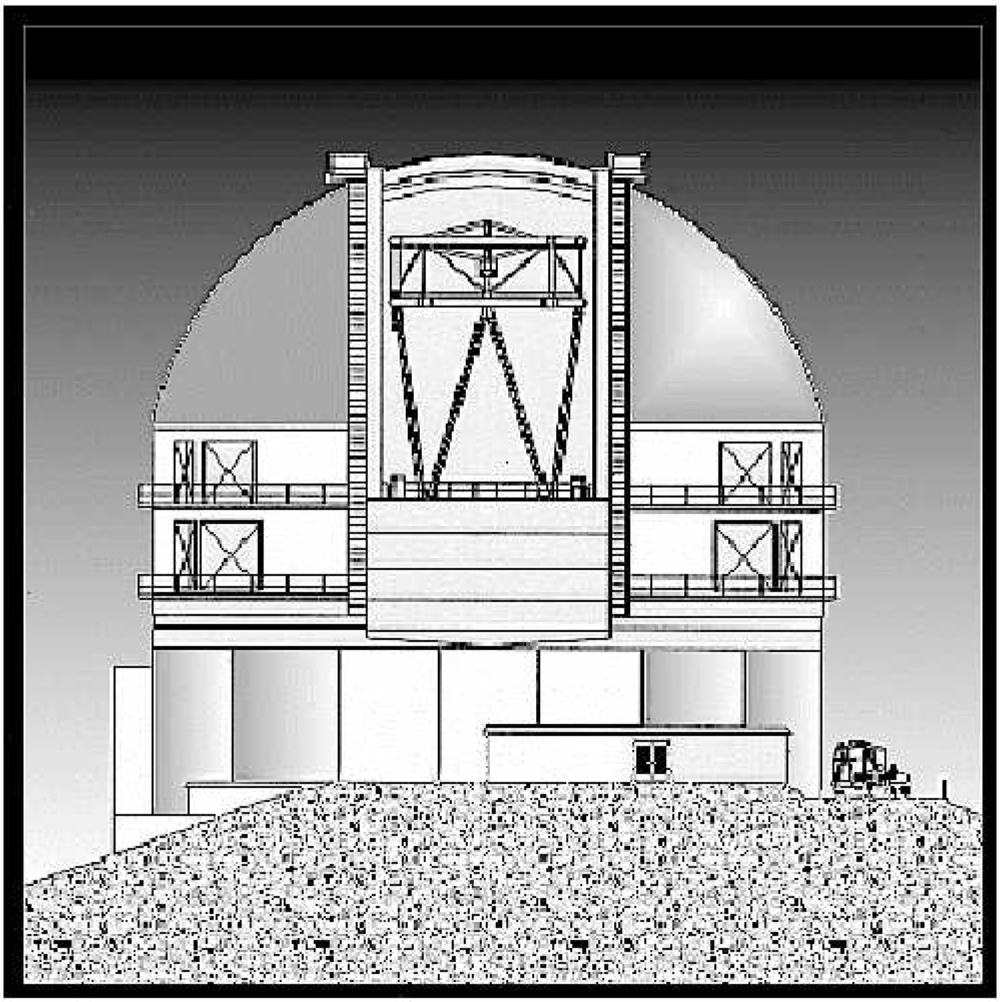
GEMINI
8-M Telescopes
Project

SPE-O-G0060
Revision A

Design Requirements Document
M2 Positioning Mechanism
Eccentric Bearings



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A	Initial Release	4/18/96	

1.0 SCOPE. This document details the requirements for the eccentrically mounted bearings of the M2 Positioning Mechanism for the f/16 infrared (IR) secondary for the Gemini 8-meter telescopes. Three of these bearings form a major portion of the structure of the M2 Positioning Mechanism. The M2 Positioning Mechanism must support the f/16 Secondary Mirror and the M2 Tilt Mechanism, and translate them in directions normal to the Telescope optical axis. Each M2 Positioning Mechanism will use three bearings.

1.1 PARAGRAPH REFERENCES. When a paragraph within this Design Requirements Document is referenced, each applicable sub-indentured paragraph shall be considered as referenced also.

1.2 DEFINITIONS. The following capitalized terms are defined and their use throughout this Design Requirements Document will be consistent with these definitions.

(a) Bearing - The "Bearing" is shown on drawing 85-GP-3400-0002. The "Bearing" must meet the requirements of this Design Requirements Document.

(b) Inner Ring - The "Inner Ring" is the ring of the Bearing that is free to rotate if the outside diameter of the Bearing is fixed.

(c) M2 Positioning Mechanism - The "M2 Positioning Mechanism" mounts to the Telescope and supports the M2 Tilt Mechanism and the f/16 Secondary Mirror. It is used to translate the M2 Tilt Mechanism and the f/16 Secondary Mirror in directions normal to the Telescope optical axis. It is shown on drawing 85-GP-3400-0001. Each M2 Positioning Mechanism contains three Bearings.

(d) Non-Repeatable Runout - "Non-Repeatable Runout" is any runout of the Bearing that does not repeat when the appropriate ring, Inner Ring or Outer Ring, is rotated one complete revolution.

(e) Outer Ring - The "Outer Ring" is the ring of the Bearing that is free to rotate if the inside diameter of the Bearing is fixed.

(f) Overall Runout - "Overall Runout" is the total runout for all causes. Non-Repeatable Runout and Rate of Runout may not be subtracted from the total runout to arrive at Overall Runout.

(g) Telescope - The "Telescope" is the Gemini 8-meter telescope.

1.3 Coordinate axes and directions will be referenced in this Design Requirements Document. The coordinate system used is a right-handed Cartesian coordinate system. The Z-axis is the optical axis of the Telescope positive from the primary mirror towards the V16 Secondary Mirror. The X-axis is parallel to the Telescope elevation axis. The Y-axis forms the third axis of the right-handed Cartesian coordinate system and is pointed vertically up with the Telescope in the horizon pointing orientation. The Z-axis is parallel to the Bearing rotation axis.

2.0 APPLICABLE DOCUMENTS. The following documents form a part of this design Requirements Document to the extent referenced herein.

2.1 U.S. Government Documents

2.1.1 Military Standards

- MIL-STD-810E, July'89

2.2 AURA Project Documents

2.2.1 Drawings

- 85-GP-3400-0001, Assembly, M2 Positioning System
- 85-GP-3400-0002, Bearing, Eccentric, M2 Positioning Mechanism

2.2.2 Requirements Documents

None.

3.0 REQUIREMENTS Unless otherwise specified, the Bearing shall meet all of the requirements contained in this Design Requirements Document with the Bearing fully preloaded and lubricated, when mounted on the appropriate surface of the Bearing, and subjected to the environments of section 3.3.1, below. The Bearing may meet these requirements after an initial run in period. The Bearing shall meet all requirements in this Design Requirements Document in any gravity orientation.

3.1 Physical Requirements

3.1.1 The Bearing shall conform to the envelope shown on drawing 85-GP-3400-0002.

3.1.2 The Bearing shall have a mass no greater than 40 kg.

3.1.3 The Bearing shall be preloaded and have no axial, radial or tilt play.

3.1.4 The Bearing shall have an aluminum body. The rollers and races of the Bearing shall be hardened stainless steel.

3.2 Mechanical Requirements

3.2.1 Stiffness Bearing stiffness shall be with the Bearing rigidly mounted on the Outer Ring and the load applied to the Inner Ring, and with the Bearing mounted on the Inner Ring and the load applied to the Outer Ring. The Bearing shall meet these requirements with a reversing load through zero (0) load.

3.2.1.1 The Bearing shall have axial stiffness no less than 50×10^6 N/m.

3.2.1.2 The Bearing shall have radial stiffness no less than 200×10^6 N/m.

3.2.1.3 The Bearing shall have moment stiffness no less than 12×10^6 N-m/rad.

3.2.2 Friction Torque Bearing friction torque shall be with the Bearing mounted on the Outer Ring and the Inner Ring rotated relative to the Outer Ring. The Bearing shall also meet these requirements with the Bearing mounted on the Inner Ring and the Outer Ring rotated relative to the Inner Ring. The Bearing shall meet these requirements in both rotation directions when the relative rotation is reversed.

3.2.2.1 The Bearing shall have running friction torque no greater than 25 N-m. Running fiiction torque shall be with a Bearing rotation speed of up to I rpm.

3.2.2.2 The Bearing shall have friction torque no greater than 25 N-m for rotations of 100 arcseconds.

3.2.2.3 The Bearing shall have static friction torque (breakaway torque) no greater than 25 N-m.

3.2.3 Runouts

3.2.3.1 The Bearing Overall Runout in the axial direction shall be no greater than 0.05 mm, and no greater than 0.005 mm in any 3° rotation. Non-repeatable axial runout shall not exceed 0.005 mm.

3.2.3.2 The Bearing Overall Runout in the radial direction shall be no greater than 0.05 mm, and no greater than 0.005 mm in any 3° rotation. Non-repeatable radial runout shall not exceed 0.005 mm.

3.2.3.3 The Bearing Overall Runout in tilt shall be no greater than 0.005°, and no greater than 0.0005° in any 3° rotation. Non-repeatable runout in tilt shall not exceed 0.0005°.

3.3 Environmental Requirements

3.3.1 Operating Environment. The Bearing shall meet all of the requirements of this Design Requirements Document when mounted on either ring and when subjected to any combination of the following conditions:

Condition	Requirement
altitude	sea level to 4300 m
air temperature	-15° to +25° C
relative humidity	0% to 95%
axial load	2625 N
radial load	5975 N
moment load	1150 N-m
gravity orientation	Z axis vertical up to vertical down

3.3.2 Survival Environment. The Bearing shall survive any combination of the following conditions when mounted on either ring. The Bearing shall be capable of meeting all of the requirements of this Design Requirements Document after these conditions are removed:

Condition	Requirement
altitude	sea level to 15,500 m
air temperature	-20° to +40° C
relative humidity	0% to 100% with condensation
axial load	31,500 N
radial load	34,400 N
moment load	14,000 N-m
seismic	12 g, .5 Hz to I 00 Hz, all axes

3.3.3 Transportation Environment. The M2 Tilt System shall meet the requirements stated in section 3.4.1, above, without damage or requirement for repair, after being subjected to any combination of the environmental conditions specified below for any duration of time during any number of occurrences (collectively, the "Transportation Conditions"), while packaged in accordance with 5.0, below:

Condition	Requirement
altitude	sea level to 15,500 m
air temperature	-20° to +40° C
relative humidity	0% to 100% with condensation
wind speed	0 to 67 m/sec
vibration	IAW MIL-STD-810E, July '89 section 514.4
shock	IAW MIL-STD-810E, July '89 section 516.4

3.4 Reliability/Maintainability

3.4.1 Reliability. The Bearing shall have a shelf life of 1 year, minimum. The Bearing shall be capable of meeting all requirements in this Design Requirements Document up to a total of 25,000 revolutions in both directions.

3.4.2 Maintainability. Bearing shall require no periodic maintenance.

4.0 QUALITY ASSURANCE PROVISIONS Supplier shall be responsible for performance of all quality assurance functions. Supplier shall originate and maintain a quality assurance program to assure compliance of the Bearing to all requirements of this Design Requirements Document.

5.0 PREPARATION FOR DELIVERY The Bearing shall be packaged suitably for transport by commercial carrier. The shipping container shall be reusable and be suitable for long term storage of the Bearing.