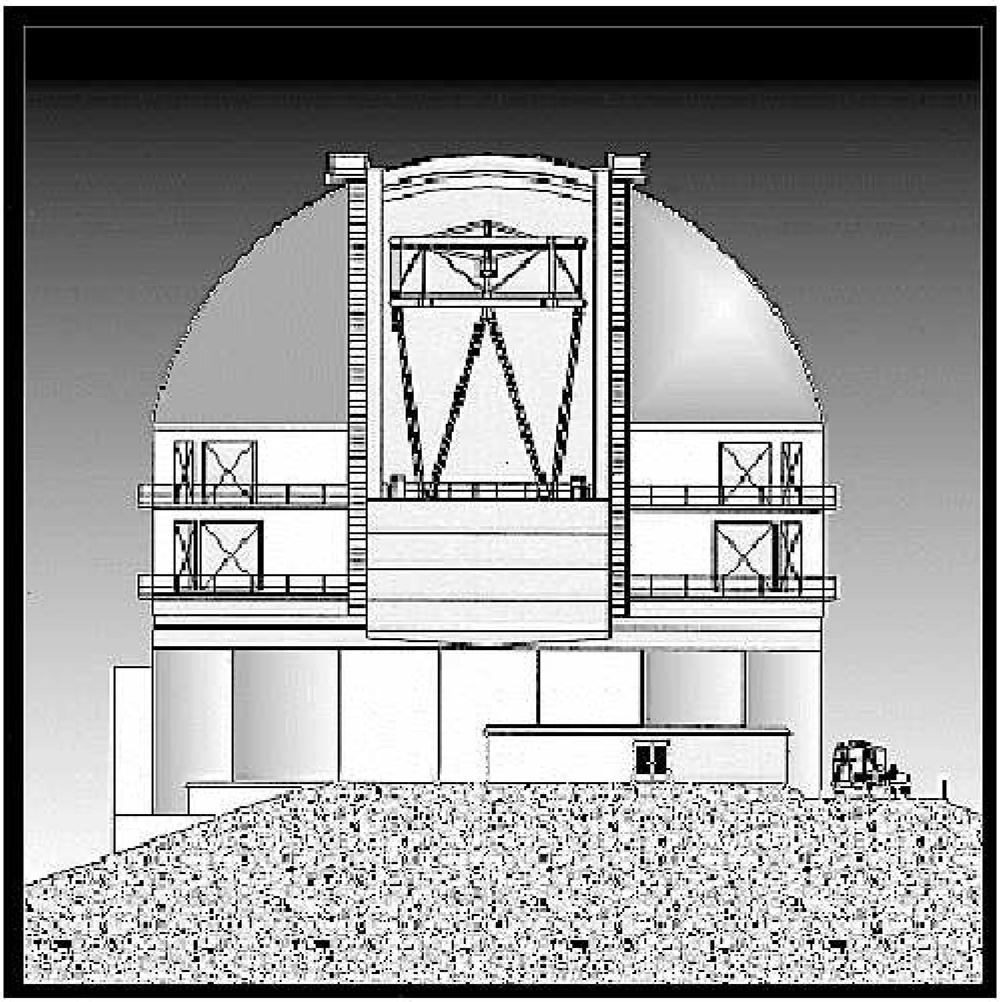
GEMINI
8-M Telescopes
Project

SPE-TE-G0043

Functional Specification for the Gemini Coating Plants



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1. General.

1.1 This section describes the functional specification of the Coating Plant(s). Engineering specifications will be developed by Royal Observatories during the design phase.

1.2 The Coating Plant(s) will be used primarily for coating the primary and secondary mirrors.

2. Primary Mirror Considerations.

2.1 The mirror(s) will be coated with the primary optical surfaces facing vertically.

2.2 The primary mirror(s) will be between 8.1m and 8.4m diameter. The Coating Plant(s) must be capable of coating a Corning ULE meniscus mirror.

2.3 Mirror handling arrangements will be specified and designed by the Gemini Project.

3. Interfaces.

3.1 The interfaces between the coating plant and the enclosure are detailed in the RGO Gemini Coating Plant Building Interface Document (RGO-N-?).

4. Coatings.

4.1 The Coating Plant(s) will be designed to deposit aluminum at the time of build and commissioning of the Coating Plant at the Sites. The reflectivity of the aluminum is specified in Table 1.1. The coating plant must be designed to readily allow an upgrade (at some unspecified time in the future) to deposit the protected silver coatings being developed under contract to ODA.

4.2 Initial coating uniformity requirements are $\pm$5%, with a coating thickness of approximately 1000 angstroms.

4.3 Scattering. The coating thickness shall be approximately 100 nm with a maximum $\pm$5% (peak-to-valley) low frequency variation across the entire surface of the primary. The micro-roughness, which determines the coating's scattering properties, shall not exceed 2 nm rms, so that it does not exceed the micro-roughness of the primary mirror's surface finish.

5. Future Upgrades.

5.1 The Coating Plant(s) must be capable of being upgraded to a high vacuum plant (10^{-7} torr) with minimal modifications. This will probably require, but may not be limited to, the use of stainless steel for the initial fabrication of the vacuum chamber(s) and the inclusion of additional ports that would initially be blanked off but would allow additional pumps to be connected to the chamber to provide higher pumping capacity at a later date.

5.2 As the Coating Plant(s) may be used for depositing interference films (at some later date) the uniformity requirements may become more strict. To accommodate this possibility the plant equipment for depositing the coating, such as the sputtering head support and rotation system, should be as modular as possible and be designed to allow upgrades, at minimal cost, to allow better uniformity to be achieved at a later date.

6. Operation.

6.1 The Coating Plant(s) must be fully automatic in operation, with manual overrides where appropriate. Mimic displays will be required on the control console showing the plant status.

7. Safety and Standards.

7.1 Requirements for safety interlocks will be determined during the design specification phase.

7.2 The Coating Plant(s) must conform to ASME and BS standards.

7.3 Operation of the Coating Plant(s) must conform to OSHA and UK Factory Act safety standards. Gemini will provide a list of solutions used to strip coatings (TBD).

7.4 The Coating Plant(s) must be designed to operate safely under the site seismic loading building requirements.

8. Maintenance.

8.1 The Coating Plant(s) must be designed to allow all necessary maintenance procedures to be performed efficiently with minimum manpower requirements.

9. Environmental.

9.1 The Coating Plant(s) will operate at the summit of Mauna Kea (13,800 ft) in Hawaii and Cerro Pachon (9000 ft) in Chile. Environmental conditions are listed below.

General:

Mauna Kea:	
Seismic ground acceleration:	Zone 3 Requirements given in the Uniform Building Code
Min and Max Air Temperature Range	-15^{o}C to +25^{o}C (+5^{o}F to +77^{o}F)
Min and Max Air Humidity Range:	5% to 100%
Min and Max Air Pressure Range:	600 mb to 700 mb
Cerro Pachon:	
Seismic ground acceleration:	Zone 4 requirements given in the Unifrom Building Code
Min and Max Air Temperature Range	-15^{o}C to +30^{o}C (+5^{o}F to +86^{o}F)

Min and Max Air Humidity Range:	5% to 100%
Min and Max Air Pressure Range:	700 mb to 800 mb

Operating Conditions:

Mauna Kea	
Operating temperature range:	-15ºC to +20ºC (+5ºF to +68ºF)
Operating humidity range:	5% to 90%
Air Pressure range:	600 mb to 700 mb
Cerro Pachon	
Operating temperature range:	-15 ºC to +25ºC (+5ºF to +77ºF)
Operating humidity range:	5% to 95%
Air Pressure range:	700 mb to 800 mb

Table 1.1
REFLECTANCE VALUES FOR ALUMINUM

λ (μ)	***R*, Al***	λ (μ)	***R*, Al***
0.3000	0.9208	2.0000	0.9779
0.3500	0.9205	3.0000	0.9805
0.4000	0.9194	4.0000	0.9826
0.4500	0.9175	5.0000	0.9843
0.5000	0.9162	6.0000	0.9856
0.5500	0.9157	7.0000	0.9866
0.6000	0.9117	8.0000	0.9872
0.6500	0.9057	9.0000	0.9874
0.7000	0.8977	10.0000	0.9876
0.7500	0.8862	11.0000	0.9879
0.7750	0.8773	12.0000	0.9882
0.8000	0.8676	13.0000	0.9884
0.8250	0.8657	14.0000	0.9886
0.8500	0.8677	16.0000	0.9892
0.8750	0.8744	18.0000	0.9896
0.9000	0.8908	20.0000	0.9902
0.9250	0.9075	22.0000	0.9907
0.9500	0.9243	24.0000	0.9912
1.0000	0.9402	26.0000	0.9918
1.2000	0.9637	28.0000	0.9923
1.5000	0.9742	30.0000	0.9928

The Gemini Aluminum Coating Goal is to allow a maximum reflectance decrease of the values in the above table as follows:

For λ between 0.30 and 0.38 μm, the goal is to decrease by no more than *0.05* (5%).
For λ between 0.38 and 0.8 μm, a decrease of *0.03* (3%) is allowed.
For λ between 0.8 and 2.0 μm, an decrease of *0.01* (1%) is allowed.
For λ between 2.0 to 2.5μm, 3.4 to 4.4 μm, and 8.0 to 13.0 μm, a decrease of *0.002* (0.2%) is allowed.
For other λ between 2.0 and 25 μm, a decrease of *0.01* (1%) is allowed.

*UHV Evaporated Aluminum information from "IR Reflectance of Aluminum Evaporated in Ultra-High Vacuum", Bennett et. al., Journal of the Optical Society of America, **53**: 1089-1100, 1963.

Table 1.2
EMITTANCE VALUES FOR SILVER

λ (m)	E, Ag* (fresh UHV evaporated silver)	λ (m)	E, Ag* (fresh UHV evaporated silver)
0.3000	0.8240	2.0000	0.0060
0.3500	0.1945	3.0000	0.0058
0.4000	0.0436	4.0000	0.0056
0.4500	0.0294	5.0000	0.0054
0.5000	0.0214	6.0000	0.0052
0.5500	0.0169	7.0000	0.0050
0.6000	0.0140	8.0000	0.0049
0.6500	0.0120	9.0000	0.0048
0.7000	0.0106	10.0000	0.0047
0.7500	0.0090	11.0000	0.0046
0.7750	0.0087	12.0000	0.0046
0.8000	0.0084	13.0000	0.0045
0.8250	0.0082	14.0000	0.0045
0.8500	0.0080	16.0000	0.0044
0.8750	0.0075	18.0000	0.0044
0.9000	0.0071	20.0000	0.0044
0.9250	0.0070	22.0000	0.0044
0.9500	0.0070	24.0000	0.0043
1.0000	0.0064	26.0000	0.0043
1.2000	0.0062	28.0000	0.0042
1.5000	0.0061	30.0000	0.0042

The Gemini Protected Silver Coating Goal is to allow a maximum emissivity change of the values in the above table as follows:

For λ between 0.30 and 0.38 μm, the goal is to decrease by no more than *0.30* (30%).
For λ between 0.38 and 0.8 μm, an increase of *0.05* (5%) is allowed.
For λ between 0.8 and 2.0 μm, an increase of *0.01* (1%) is allowed.
For λ between 2.0 to 2.5μm, and 3.4 to 4.4 μm, an increase of *0.001* (0.1%) is allowed.
For λ between 8.0 and 13.0 μm an increase of *0.002* (0.2%) is allowed.
For other λ between 2.0 and 25 μm, an increase of *0.01* (1%) is allowed.

*UHV Evaporated Silver Information from "IR Reflectance and Emittance of Gold and Silver in Ultra-High Vacuum", Bennett et. al., Applied Optics, **4**:221-4, 1965.