James Webb Space Telescope Optical Telescope Element (OTE) Mirror Coatings

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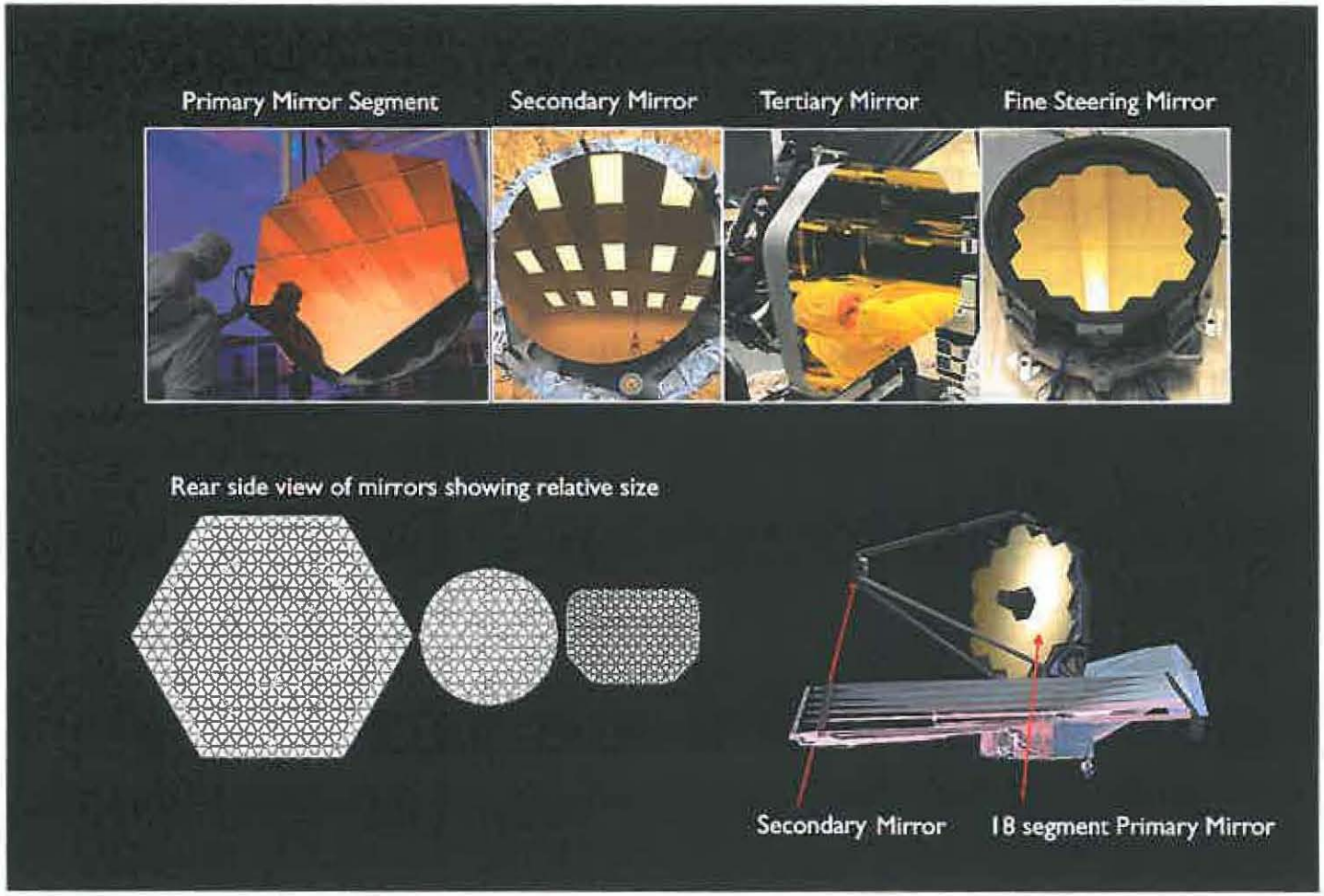
Ball ITT EXELIS ATK

Outline

- Introduction
- Coating Qualification Program
- Flight Mirrors

JWST Optical Telescope Element (OTE) Mirrors



JWST OTE Mirror Sizes

Mirror	Size	Figure
Primary Mirror	6.5 m aperture f/1.2	Elliptical
PM Segments	1.52 m point to point	
Secondary Mirror	0.738 m diameter	Hyperbolic
Tertiary Mirror	0. 513 m x 0.709 m	Elliptical
Fine Steering Mirror	0.17 m diameter	Flat

Reflectance Requirements

Wavelength (μm)	Reflectance Requirements (%)
0.8	≥ 94.1
1.0	≥ 96.3
1.5	≥ 97.4
2.0 -20.0	≥ 97.9
20.1 – 27.0	≥ 97.9
27.1 – 29.0 (Goal)	≥ 97.9

Coating Qualification Program

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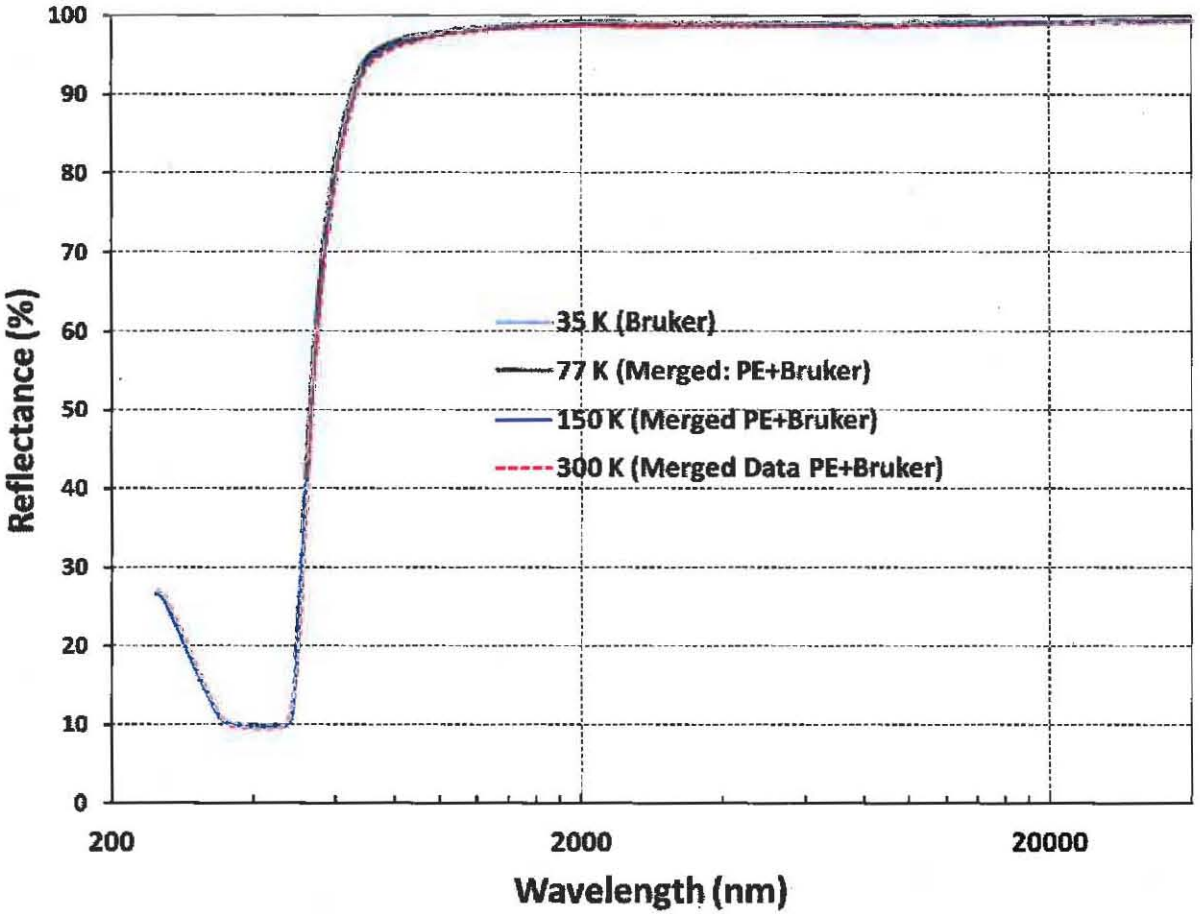
- Reflectance
- Uniformity
- Run to run thickness variation
- Micro roughness
- Durability
- Maintainability
- Coating stress
- Scratch/dig
- Pinholes.

Coating Reflectance at Temperatures from 300K to 35K



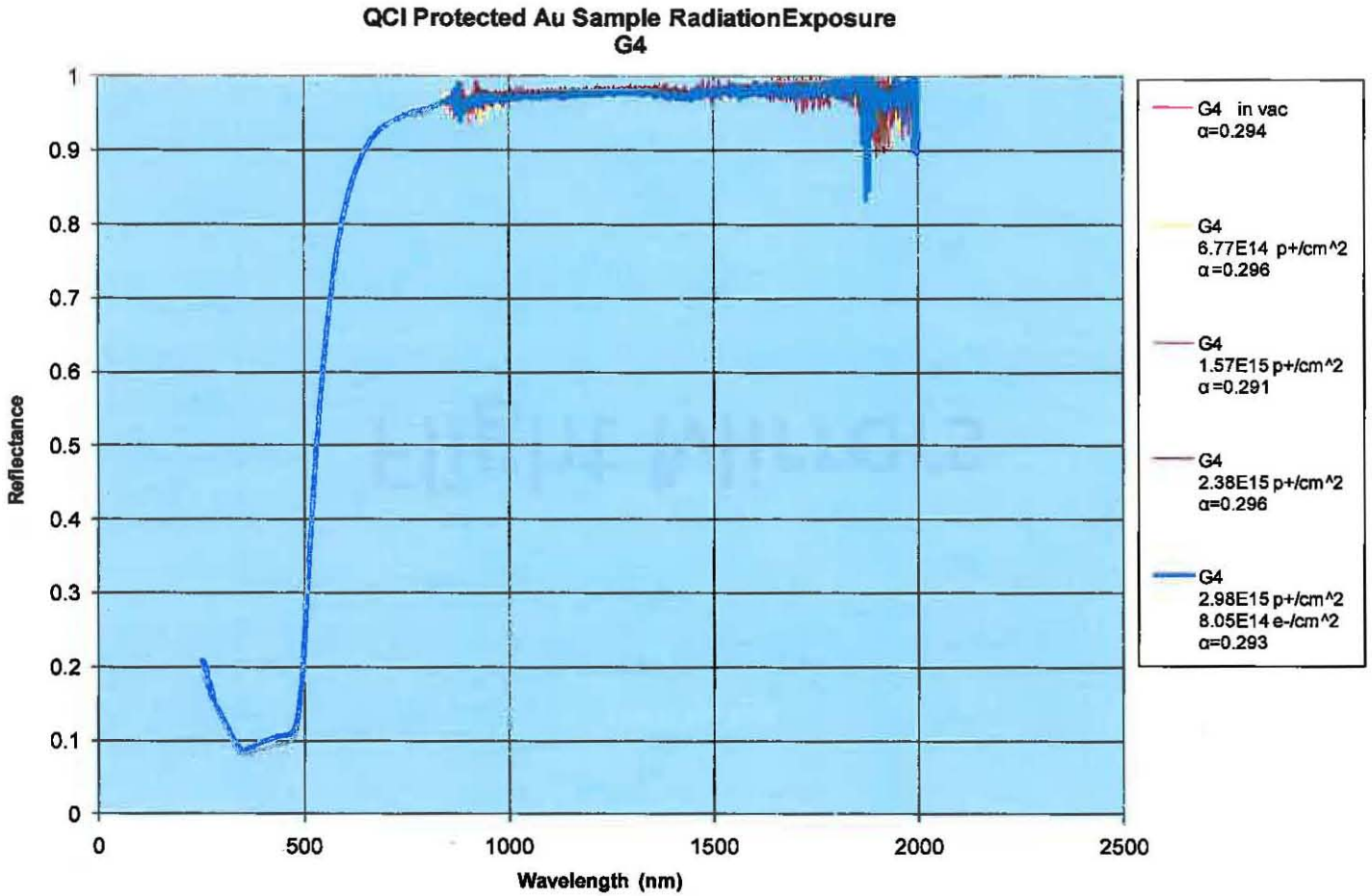
Radiation Exposure

Proton Beam Energy:	**3.0KeV**
Electron Beam Energy:	**10KeV**

Exposure Rates for JWST OTE Gold-Coated Test Samples

	First Exposure time length (sec) 2.38E+05	2nd Exposure time length (sec) 2.56E+05	3rd Exposure time length (sec) 2.55E+05	4th Exposure time length (sec) 2.62E+05	
sample	**p/cm^2 s**	**p/cm^2 s**	**p/cm^2 s**	**p/cm^2 s**	**e/cm^2 s**
G3	2.97E+09	3.60E+09	3.33E+09	2.21E+09	2.30E+09
G4	2.84E+09	3.50E+09	3.17E+09	2.29E+09	3.07E+09
G6	2.98E+09	3.55E+09	3.29E+09	2.29E+09	2.55E+09
G7	3.11E+09	3.67E+09	3.45E+09	2.18E+09	1.81E+09

Reflectance of QCI sample G4

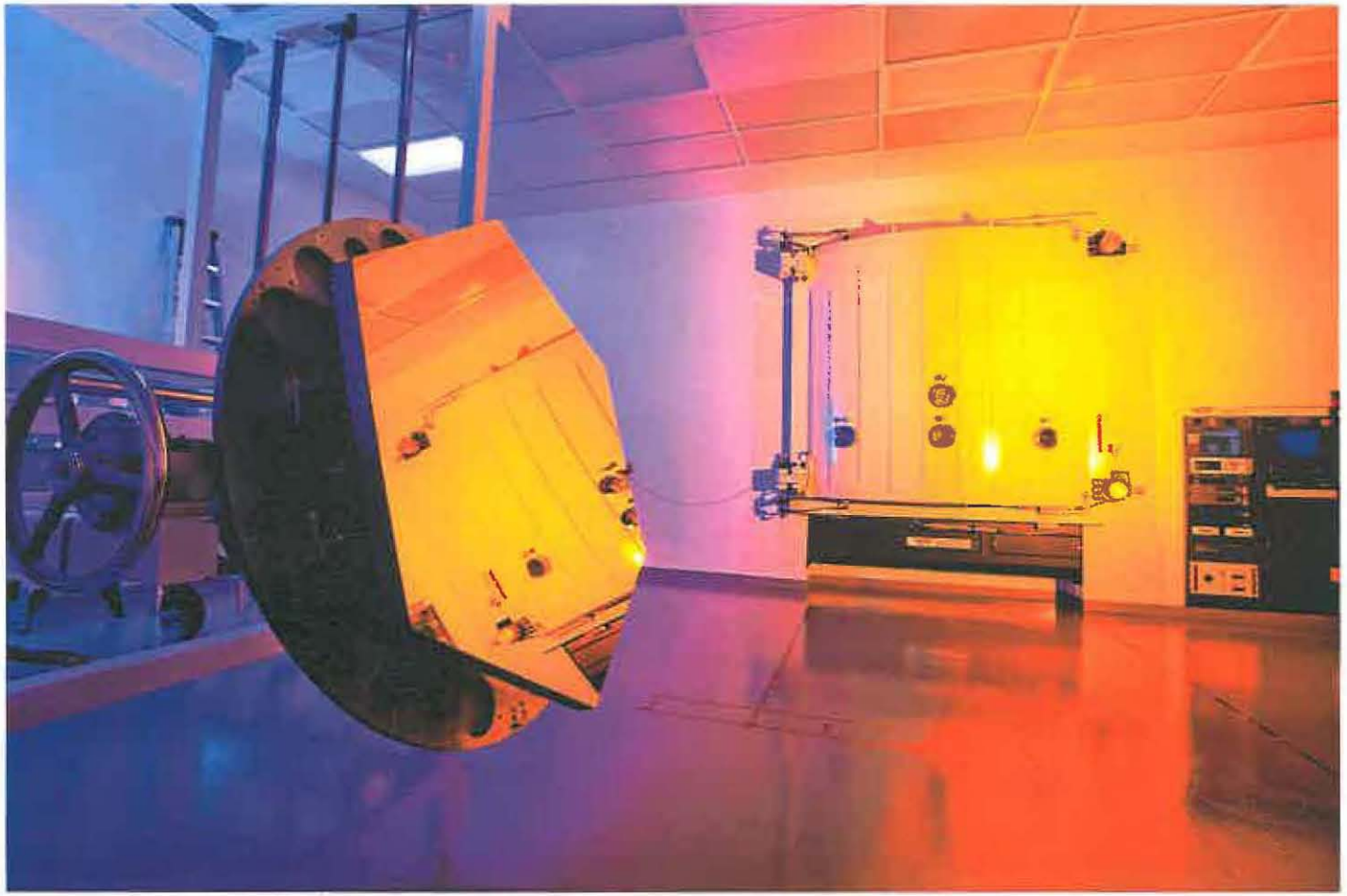


Exposed to 2.98E15 protons/cm^2 at 3keV plus 8.05E14 electrons/cm^2 at 10keV

Flight Mirrors

Tertiary Mirror

The Engineering Development Unit (EDU) primary mirror segment



Coated in gold by Quantum Coating Incorporated

Primary Mirror Segment Assembly B6

PMSA B6 in the coating fixture and being readied for shipment to BATC.

Primary Mirror Segment Assembly C3



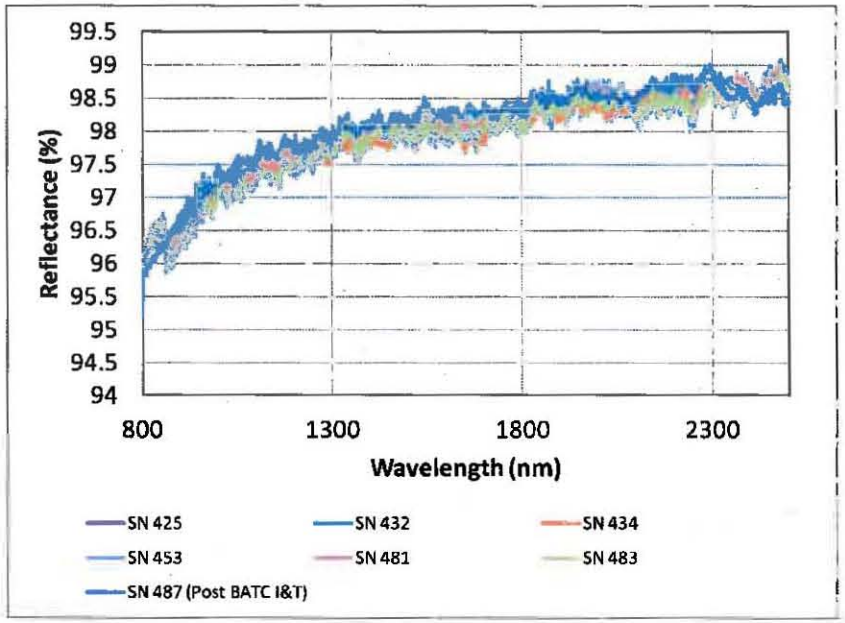

PMSA C3 in the coating fixture with the mask on, the mask removed (top pictures) and being readied for shipment to BATC.

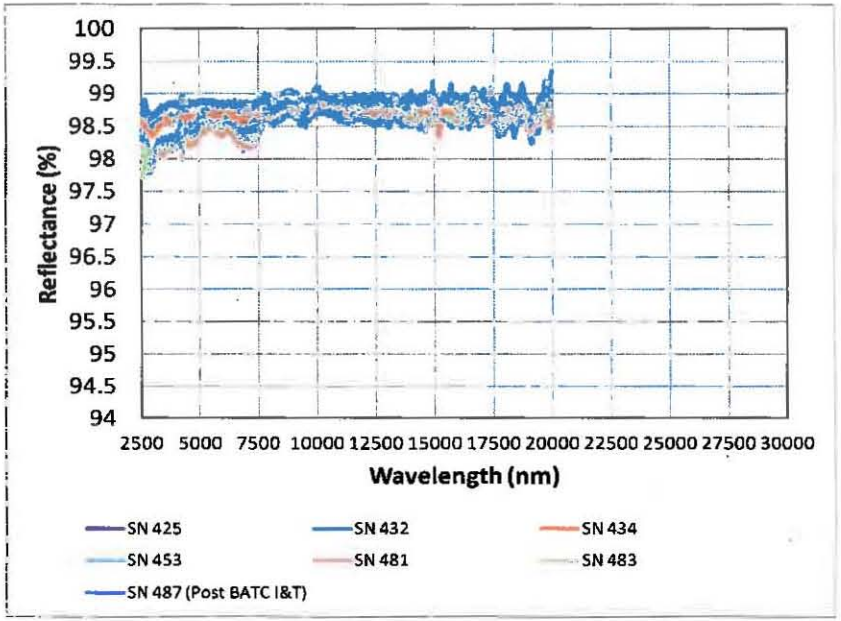
PMSA A1 Reflectance Results

Wavelength (μm)	Reflectance Requirement(%)	Measured Reflectance (%)
0.8	≥ 94.1	96.0
1.0	≥ 96.3	97.3
1.5	≥ 97.4	98.0
2.0 -20.0	≥ 97.9	98.5 – 98.8
20.1 – 27.0	≥ 97.9	99.08 – 99.42
27.1 – 29.0 (Goal)	≥ 97.9	99.16 – 99.35

Secondary Mirror

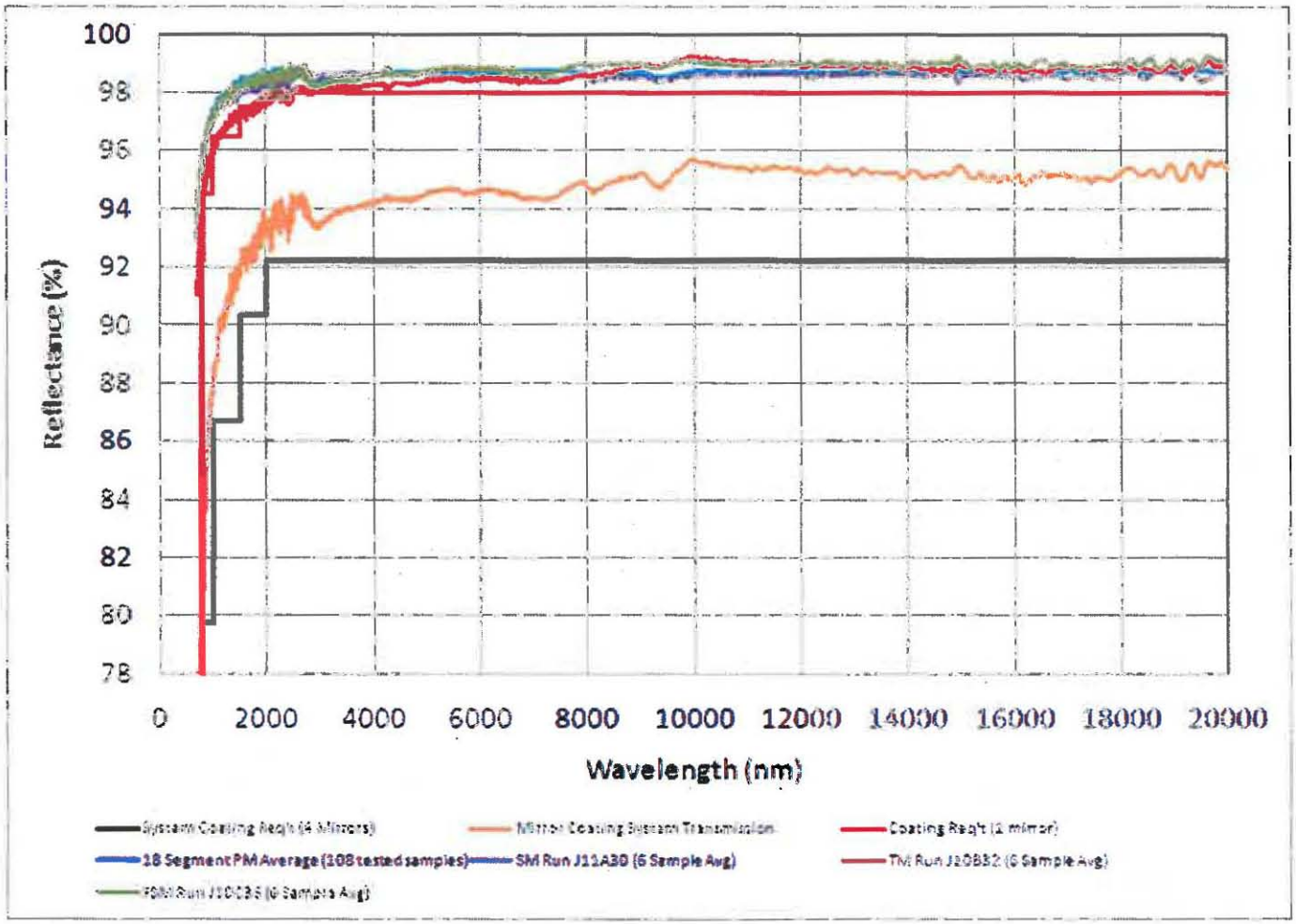
PMSA A1 Run Reflectance



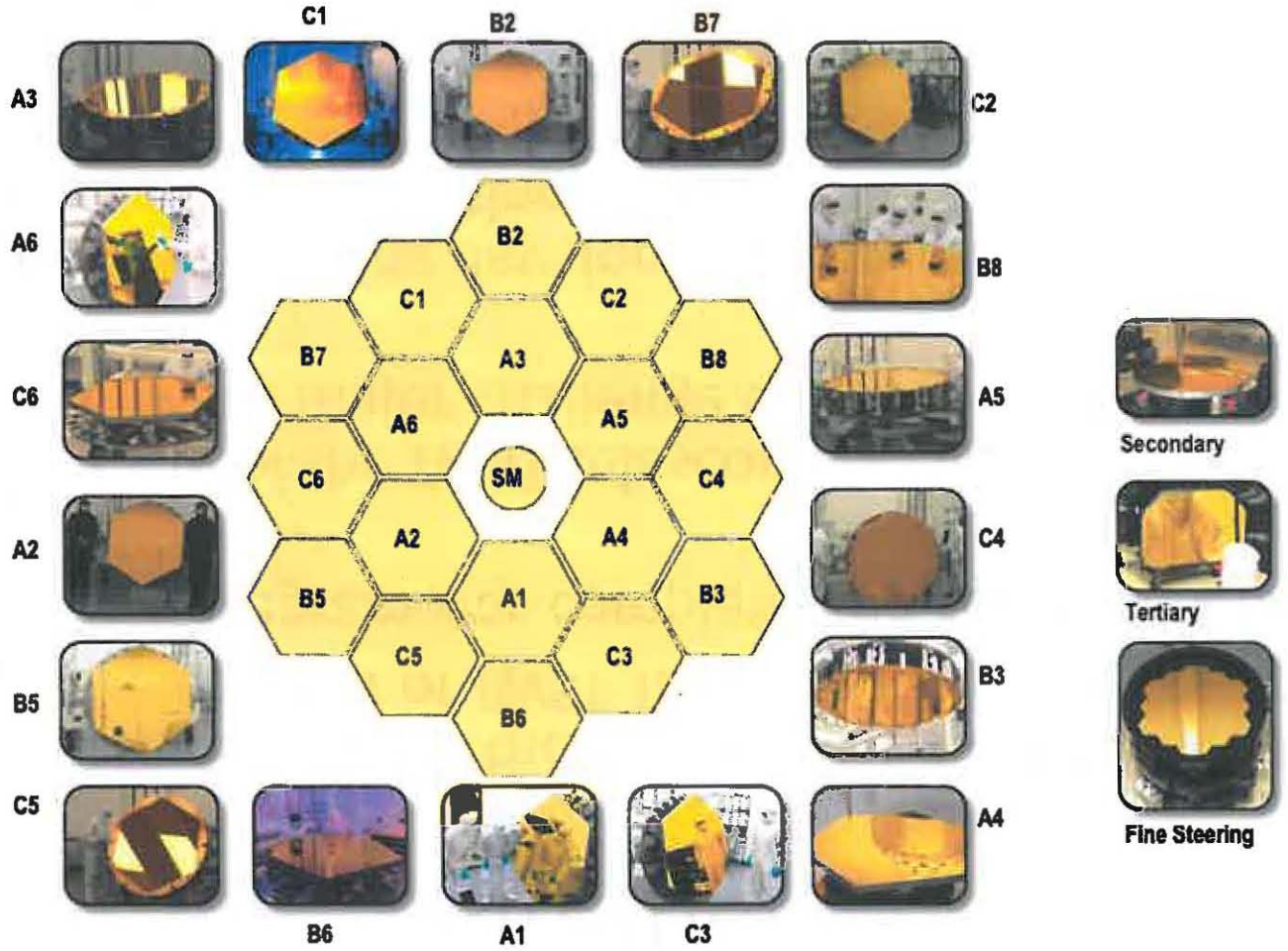


Post BATC I&T Sample compared to 6 QCI Acceptance Samples.

Reflectivity of the JWST Mirrors and the Throughput of the Telescope.



JWST Telescope Mirrors



Summary

- Completion of coating the mirrors was a major milestone in the development of JWST Telescope.
- The coating program was completed on schedule with excellent results.
- The large size of the JWST telescope primary mirror segments was a major challenge that was overcome successfully.
- The extensive coating development program over a two year period before coating was key to the successful program.
- Success ensures the scientific discovery potential of James Webb Space Telescope.