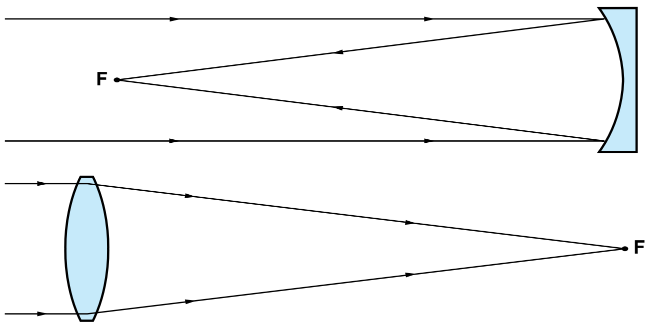
Meade® Ultra-High Transmission Coatings (UHTC™) Group

An important optional feature to optimize the performance of your Meade telescope.

Image brightness and resolution in a telescope are crucially dependent on the reflectivity of the telescope's mirrors and on the transmission of its lenses. Neither of these processes, mirror-reflectivity or lens-transmission, is, however, perfect; light loss occurs in each instance where light is reflected or transmitted. Uncoated glass, for example, reflects about 4% of the light impacting it; in the case of an uncoated lens 4% of the light is lost at entrance to *and* at exit from the lens, for a total light loss of about 8%.

Early reflecting telescopes of the 1700's and 1800's suffered greatly from mirrors of poor reflectivity — reflection losses of 50% or more were not uncommon. Later, silvered mirrors improved reflectivity, but at high cost and with poor durability. Modern optical coatings have succeeded in reducing mirror-reflection and lens-transmission losses to acceptable levels at reasonable cost.



Each time light encounters a mirror *(above)* or lens *(below)* surface, some light is lost. In the case of a lens, light is lost both at entrance to and at exit from the lens.

Meade Standard Coatings: The optical surfaces of all Meade telescopes include high-grade optical coatings fully consistent in quality with the precision of the optical surfaces themselves. These standard-equipment coatings include mirror surfaces of highly purified aluminum, vacuum-deposited at high temperature and overcoated with silicon monoxide (SiO), and correcting lenses coated on both sides for high light transmission with magnesium fluoride (MgF_2). Meade standard mirror and lens coatings equal or exceed the reflectivity and transmission, respectively, of virtually any optical coatings currently offered in the commercial telescope industry.

The Meade UHTC Group: Technologies recently developed at the Meade Irvine coatings facility, however, including installation of some of the largest and most advanced vacuum coating instrumentation currently available, have permitted the vacuum-deposition of a series of exotic optical coatings precisely tuned to optimize the visual, photographic, and CCD imaging performance of Meade telescopes. These specialized, and extremely advantageous, coatings are offered here as the Meade Ultra-High Transmission Coatings (UHTC) group, a coatings group available optionally on many Meade telescope models.

In Meade catadioptric, or mirror-lens, telescopes (including the ETX-90EC, ETX-105EC, and ETX-125EC; LX10, LX90, and LX200GPS Schmidt-Cassegrains; and LXD55-Series Schmidt-Newtonians) before incoming light is brought to a focus, it passes through, or is reflected by, four optical surfaces: the front surface of the correcting lens, the rear surface of the correcting lens, the primary mirror, and the secondary mirror. Each of these four surfaces results in some loss of light, with the level of loss being dependent on the chemistry of each surface's optical coatings and on the wavelength of light. (Standard aluminum mirror coatings, for example, typically have their highest reflectivity in the yellow region of the visual spectrum, at a wavelength of about 580nm.)

Mirror Coatings: Meade ETX, Schmidt-Cassegrain, and Schmidt-Newtonian telescopes equipped with the Ultra-High Transmission Coatings group include primary and secondary mirrors coated with aluminum enhanced with a complex stack of multi-layer coatings of titanium dioxide (TiO_2) and silicon dioxide (SiO_2). The thickness of each coating layer precisely controlled to within ±1% of optimal thickness. The result is a dramatic increase in mirror reflectivity across the entire visible spectrum; at the important hydrogen-alpha wavelength of 656nm. — the predominant wavelength of emission nebulae — reflectivity is increased from 89% to over 97%.

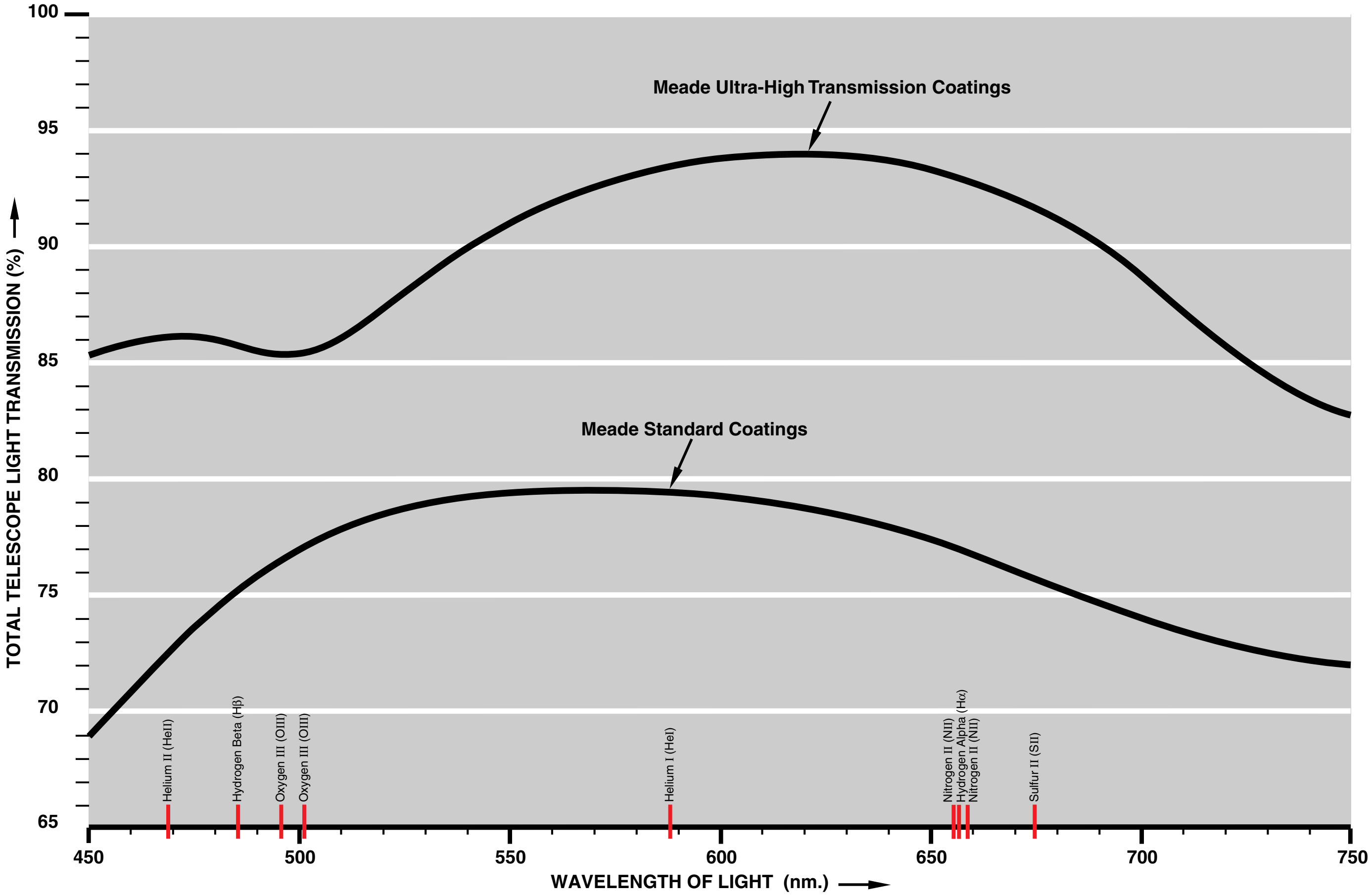
Correcting Lens Coatings: Meade telescopes ordered with the UHTC group include, in addition, an exotic and tightly-controlled series of coatings on both sides of the correcting lens or correcting plate, coatings which include multiple layers of aluminum oxide (Al_2O_3), titanium dioxide (TiO_2), and magnesium fluoride (MgF_2). Per-surface light transmission of the correcting lens is thereby increased at the yellow wavelength of 580nm., for example, to 99.8%, versus a per-surface transmission of 98.7% for the standard coating.

UHTC
ULTRA HIGH TRANSMISSION COATINGS

A special UHTC label is affixed to the optical tube of each Meade telescope equipped with these advanced coatings.

The importance of the UHTC group becomes apparent when comparing *total* telescope light transmission, or throughput, caused by the multiplier, or compounding, effect of the four optical surfaces. With each optical surface contributing significantly to telescope light throughput, the effect of all four surfaces *combined* is indeed dramatic, as demonstrated by the graphs on the facing page, as well as by the table of the brightest nebular emission lines. At the H-α wavelength of 656nm., total transmission increases from 76.9% to 93.1%, an increase of 21%; at the helium wavelengths of 588nm. and 469nm. — strong emission lines in hot planetary nebulae — total telescope transmission increases by 18% and 19%, respectively; at the

Control panel of a Meade UHTC electron-beam vacuum coater.



Total telescope light transmission by wavelength of light. These graphs show the total amount of light transmitted to the telescope focus by the four optical surfaces (primary mirror, secondary mirror, and two lens surfaces) of Meade ETX, Schmidt-Cassegrain, and Schmidt-Newtonian telescopes. The wavelengths of the brightest nebular emission lines are indicated in red. Meade standard coatings equal or exceed the total light transmission of virtually all other optical coatings currently offered in the commercial telescope industry; notwithstanding this fact, Meade UHTC coatings enable a dramatic increase in lunar, planetary, and deep-space image brightness and resolution. Note that the graphs presented here are spectrophotometric results of actual Meade mirrors and correcting lenses, not theoretical abstractions.

two nitrogen II lines of 655nm. and 658nm. and at the sulfur II line of 673nm., transmission is increased by 21%. ***Averaged over the entire visible spectrum (450nm. to 700nm.), total light transmission to the telescope focus increases by about 20%.***

Observing with the UHTC: Meade ETX, Schmidt-Cassegrain, and Schmidt-Newtonian telescopes equipped with the UHTC present dramatically enhanced detail on the full range of celestial objects — from emission and planetary nebulae such as M8, M20,

Emission Line	Wave-length (nm.)	Transmission: Standard Coatings (%)	Transmission: UHTC Group (%)	Increase*
Hydrogen-alpha ($H\alpha$)	656	76.9	93.1	21%
Hydrogen-beta ($H\beta$)	486	75.3	85.8	14%
Oxygen III	496	76.5	85.4	12%
Oxygen III	501	77.0	85.4	11%
Helium II	469	72.5	86.1	19%
Helium I	588	79.5	93.5	18%
Nitrogen II	655	77.0	93.2	21%
Nitrogen II	658	76.7	92.8	21%
Sulfur II	673	75.7	91.8	21%

* The % increase is obtained by dividing the UHTC-transmission (column 4) by the standard coatings transmission (column 3).

and M57 to star clusters and galaxies such as M3, M13, and M101. Observations of the Moon and planets, since they are observed in reflected (white) sunlight, benefit in resolution and image brightness from the full spectrum of increased transmission. The overall effect of the UHTC is, as it relates to image brightness and resolution, to increase the telescope's effective aperture. **Image brightness and resolution (*i.e.,* the ability to see fine detail) of the Meade 10" LX200GPS are, for example, effectively increased by about one full inch of aperture.**

Effects on CCD Imaging: While the human eye loses sensitivity to light beyond wavelengths of about 700nm., CCD imaging chips remain sensitive to about 750nm. and longer, wavelengths at which the reflectivity of an aluminum coating is near its lowpoint. Importantly, however, the UHTC's total light transmission at 750nm. is 83%, *vs.* 72% for standard coatings, an increase of 83/72, or 15%.

Ordering the UHTC: *The Meade Ultra-High Transmission Coatings group, if desired, must be specified at the time of telescope purchase; the UHTC can not be retrofitted.* The UHTC is available for any of these Meade telescopes:

ETX telescopes *(pp. 6 - 11)*: ETX-90EC, ETX-105EC, ETX-125EC

Schmidt-Cassegrains *(pp. 28 - 49)*: 8" LX10, 8" LX90, 7" LX200GPS, 8" LX200GPS, 10" LX200GPS, 12" LX200GPS, 16" LX200GPS

LXD55 Schmidt-Newtonians *(pp. 68 - 71)*: 6" Model SN-6, 8" Model SN-8, 10" Model SN-10