

Smithsonian Astrophysical Observatory
Specification Bin-020

Antireflection Coating for Binospec Calcium Fluoride Lenses

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Antireflection Coating Specifications

Introduction

There are six CaF₂ lenses in each of Binospec's two identical channels, or 12 in total. Eight of these lenses, four in each identical channel, require multilayer antireflection coatings on the glass-air surfaces to maximize the light transmitted through the optics and to minimize the effect of ghost images and scattered light. Since the Binospec lenses are coupled with Cargille Laboratories's Laser Liquid 5610 (LL5610), the coated surfaces may come into contact with this siloxane liquid. SAO therefore specifies an antireflection coating that can be cleaned of LL5610 spills. SAO's other specifications are to ensure that the antireflection coatings are stable under normal operating conditions.

Surfaces to be Coated

Lens	Drawing	Radius of Curvature of Coated Surface (mm)
Collimator 6	BINS-1006	uncoated
Collimator 9	BINS-1009	211.855
Camera 2	BINS-1012	3203.160
Camera 3	BINS-1013	416.251
Camera 5	BINS-1015	uncoated
Camera 9	BINS-1019	4249.818

1. Antireflection Performance

1.1 Reflectivity at 5° Incidence Angle

Wavelength Range	Maximum Reflectivity
375 to 450 nm	1.8%
450 to 1000 nm	1.5%

1.2 Reflectivity at 45° Incidence Angle

Less than 2.0% between 390 and 1000 nm.

1.3 Coating Absorption at 5° Incidence Angle

Wavelength Range	Maximum Absorption
375 to 400 nm	0.5%
400 to 450 nm	0.4%
450 to 1200 nm	0.25%

The coating performance shall be verified with witness samples arranged so as to approximate the curvature of the lenses, and measured at 5° and 45° incidence angles.

2. Coating Durability

Cleaning: the coatings shall survive without damage 25 gentle cleanings with a cotton swab wetted with ethyl alcohol, isopropyl alcohol, acetone, or a mild detergent solution (to be specified by Optron). Loose grit will be removed first with a gentle flushing of dry nitrogen gas.

Adhesion: a piece of 1 cm wide cellophane tape is pressed firmly onto the coated surface. If the tape is quickly removed at an angle normal to the surface, the coatings shall show no signs of removal.

Resistance to Chemicals: the coatings shall survive without damage 25 brief (10 minutes or less) wettings with water, ethyl alcohol, isopropyl alcohol, or acetone. The coating shall survive without damage for one month in contact with Cargille Laboratories's LL5610 (formulation with $n_D=1.5000$ at 25 °C), a siloxane liquid. This liquid is used as a coupling fluid between Binospec's lenses.

Operating Conditions: the coatings shall survive without damage lens temperatures between -20 °C and +20 °C at relative humidities of 95% or less. The mountain-top environment of the MMT is typically high in ozone, and this shall not damage the coatings.