

# ANTI-REFLECTIVE COATINGS FOR IR APPLICATIONS

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**AccuCoat**inc.  
COATINGS FOR OPTICS



AccuCoat produces the highest quality anti-reflective (AR) coatings on infra-red (IR) substrates. From high-efficiency broadband, to narrowband and dual-band, AccuCoat can create prototypes through high-volume custom coatings that provide the performance and durability required of demanding optics applications for military, industrial, medical and commercial use. AR coatings are applied to a variety of substrates for use in applications including bar-code scanners, autonomous vehicles, displays, cameras, fiber optics, lasers, illumination systems, range finders, instrumentation, microscopes, temperature sensors and more.

AccuCoat ensures consistency by using a state-of-the-art robotic cleaning system and then employing a proprietary physical vapor deposition (PVD) process with ion-assisted deposition (IAD). AccuCoat offers AR coatings for IR applications in wavelengths ranging from 3.5 to 5 microns or 8 to 12 microns, with custom-designed solutions up to the 15-micron range.

Testing is done with state-of-the-art testing chambers to meet military and ISO specifications for adhesion, abrasion, temperature and humidity.

## IR SUBSTRATES

AccuCoat offers coatings on a wide variety of standard and sensitive material types from Ohara and Schott, and it also has advanced expertise in coating single point diamond turned (SPDT) optics including:

- Germanium (Ge)
- Chalcogenide
- Silicon (Si)
- Cleartran™ (ZnS)
- Zinc Selenide (ZnSe)

SELECTING THE  
RIGHT MATERIAL FOR  
THE APPLICATION



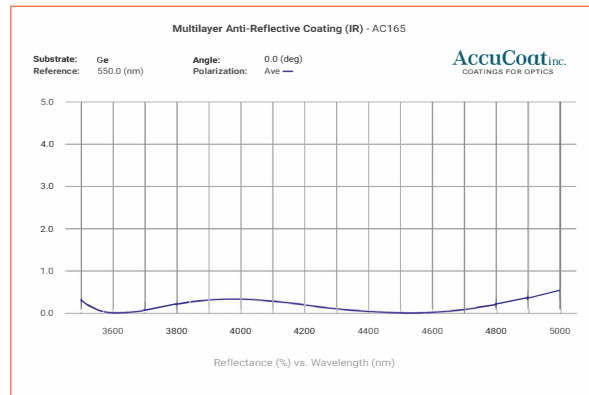
## Ensuring uniformity: cleaning and deposition

Proper cleaning of optics is a necessary step in ensuring that all optics are free of any contaminants, dust or debris. AccuCoat employs different cleaning systems, depending on the substrate, to achieve the highest quality coating. A fully robotic ultrasonic cleaning system is used for some germanium and silicon. Hand washing methods are used for more sensitive materials.

AccuCoat uses a Physical Vapor Deposition (PVD) method combined with Ion Assisted Deposition (IAD). The deposition process begins by using IAD to clean the substrate in situ prior to coating. This removes any organic residue and offers extra assurance that the coating will achieve the highest adherence. Then, once the substrate is clean, the deposition process begins with an ion beam directed at the substrate in the vacuum chamber, adding density to the evaporated film, which gives the coating better durability. AccuCoat uses an IAD process with a cold cathode plasma source, which increases the index and durability, reducing stress in the films and limiting severe wavefront deformation.

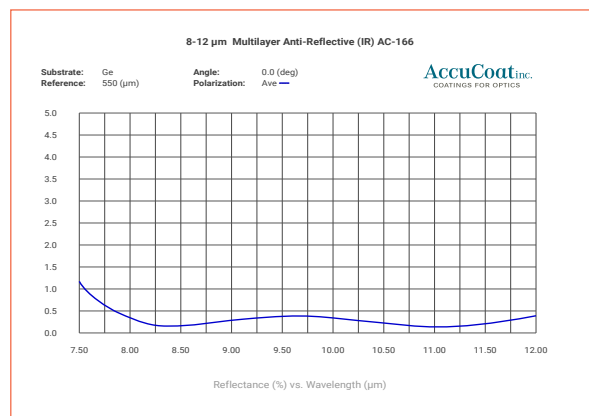
### Multilayer Broadband AR Coating (IR) AC165

Less than 0.5% reflection average in the region (3.5-5.0 microns)



### Multilayer AR Coating (IR) AC166

Less than 0.5% reflection average in the region (8.0-12.0 microns)





## Testing

AccuCoat's in-house test center is reflective of the quality found throughout the entire organization. While some coating vendors perform tests on an initial coating run and not on subsequent batches, AccuCoat's high standards for quality control and monitoring require that a battery of tests be performed on a lot basis for all coating runs. Sample pieces are tested from every coating run, from adhesion and abrasion to spectral measurement of each coated surface. Parts are reviewed while cleaning and unloading tools.

Equipped with state-of-the-art spectrophotometers and environmental chambers, the in-house lab is capable of performing testing as required by the customer, whether it is basic adhesion or abrasion testing for commercial applications up to rigorous testing that ensures that the coatings meet military specifications. Further capabilities include ISO international environmental test standards for optical coatings. See the lists below for specific tests available from the AccuCoat test lab.

## Spectrophotometers



Perkin Elmer Lambda 950 UV-Vis-NIR  
(2 machines measuring 185nm – 3300nm)

Perkin Elmer Lambda 900 UV-Vis-NIR  
(185nm – 3300nm)

Perkin Elmer 983 IR (LWIR) (2.5 – 50  $\mu$ m)

## Environmental Chambers



Associated Environmental LHE 1.5 Chamber:  
20% – 98% RH, -18°C – +65°C

Tenney JR Temperature Environmental Test  
Chamber: -70°C – 200°C



**AccuCoat's typical in-house optic testing includes:**

- Moderate and severe abrasion
- Adhesion
- Humidity cycling
- Temperature cycling
- Water solubility
- Salt solubility
- Solubility and cleanability

*Additional optic durability tests are available from certified lab partners:*

- Salt spray fog
- Laser damage testing

**AccuCoat's Mil-Spec and ISO Standard tests:**

- MIL-M-13508C
- MIL-PRF-13830B
- MIL-F-48616
- MIL-C-14806A
- MIL-C-48497A
- MIL-STD-810
- MIL-C-675C
- ISO 9211-4
- ISO 9022-1

**Durability tests**

**Operating environment tests:**

- 24-hour humidity exposure
- 10-day humidity exposure
- Temperature cycling: -62°C to +85°C
- Temperature shock: +23°C/-57°C/+71°C/+23°C
- Moderate abrasion/severe abrasion
- Adhesion
- Salt solubility (not appropriate for metals)
- Salt Fog (not appropriate for metals)

*Other tests are available upon customer request.*



## Traceability

While coatings for the military may require documentation of materials, design, cleaning, processes, AccuCoat offers complete lot traceability for all of its coated parts from the moment they arrive to shipment of the coated product. All testing documents, coating curves, part serializations and certifications are provided to the customer. The company maintains records for all of its coatings for 5 years as a standard process, and that can be extended up to 7 years or beyond, as required.

## ITAR Compliance

International Traffic in Arms Regulations (ITAR) compliance is required by the U.S. government of all manufacturers, exporters and brokers of defense articles, services or related technical data on the U.S. Munitions List (USML). AccuCoat has been ITAR-certified and registered with the State Department's Directorate of Defense Trade Controls (DDTC) since 2008. As required, the staff is educated on ITAR requirements and follows best practices for maintaining information security. All records pertinent to controlled projects are retained for 5 to 7 years, depending on program requirements. All of AccuCoat's coatings are wholly U.S. manufactured.

## Real-world Applications

AccuCoat Inc. is a world-class optical coating facility that, for over 20 years, has produced a wide range of thin-film optical coatings such as anti-reflective, beamsplitters, dichroic and metal mirrors, filters, and IR coatings. AccuCoat works with each customer to ensure that the coatings are designed to meet their specific application needs. The following are examples of challenges that customers faced and the solution that AccuCoat was able to provide using its extensive in-house expertise:

*AR coating on germanium substrate:* A manufacturer was struggling with part performance due to coatings that had been applied by a different provider. The AR coating was not holding up consistently in the environment it was intended for. AccuCoat designed a new coating to alleviate a transmission problem and created a plasma cleaning step that allows the parts to meet the demanding eraser durability test parameters. The result was that the parts exceeded the transmission performance required for the application, and AccuCoat was also able to increase the volume of the parts delivered.

## About AccuCoat

AccuCoat has over 20 years of experience in optical coatings, serving the commercial, consumer, defense, medical and research communities throughout the world. With state-of-the-art equipment, AccuCoat engineers are capable of process designs for prototype to high-volume thin-film coatings on glass, metal and polymer optical components. Its coatings include multilayer anti-reflective (AR), beam splitter, metal reflector, IR and wavelength specific coatings for UV, visible and infrared light regions.

Customers have come to appreciate direct access to the company owners for fast answers and a professional approach to every project. That attention to detail shows in the quality of the final product.