# BRISTOL INSTRUMENTS

Accuracy. Reliability. Confidence.

# **OPTICAL THICKNESS GAUGE**



Determine the EXACT THICKNESS of your transparent and semi-transparent materials.

Bristol Instruments offers a family of instruments that employ proven optical technology to provide the most precise and reliable thickness measurement available. These systems measure:

- Hard and soft materials without damage or deformation
- Materials as thin as 12 µm and as thick as 80 mm
- Up to 31 layers simultaneously, including air gaps

Thickness measurements are made with an unprecedented level of accuracy, versatility, and convenience. What's more, these systems measure thickness in real time, making them ideal for integration into a production process to improve quality, increase yields, and reduce costs.

## FEATURES AND BENEFITS

- Reliable accuracy for greater confidence in your test results
- Straightforward, user-friendly operation for greater productivity
- Easily integrated into your manufacturing process
- Rugged design for production environments
- Standard 3-year warranty minimizes the cost of ownership

# **Popular Applications**

The evolution of a variety of materials and devices has driven the development of more precise manufacturing processes. These new processes require that very tight tolerances of critical dimensions such as material thickeness are maintained. Therefore, the Optical Thickness Gauge systems from Bristol Instruments are ideal for R&D and production engineers who need a reliably accurate method of measuring material thickness in real time.



### LENS ASSEMBLIES AND OPTICAL COMPONENTS

Measure individual lenses and multi-element lens systems, including air gaps.



CONTACT AND INTRAOCULAR LENSES

In situ measurement of center thickness, sagittal height, and group index in wet cell and transparent packaging.



#### **MEDICAL TUBING AND CATHETERS**

Simultaneously measures wall thickness, inner and outer diameter of tubing, as well as wall thickness of catheter body, neck and cone.



## **ELECTONIC DISPLAYS AND COMPONENTS**

Measures total and individual layer thickness, including air gaps and optically clear adhesives.



#### **VR/AR/MR OPTICAL COMPONENTS**

Measures total and individual layer thickness of lens and screen assemblies, including air gaps.



#### **GLASS SLIMMING AND POLISHING**

Measures thickness before and after chemical etching and polishing processes.

# **Non-Contact Thickness Measurement Using Light**

The Thickness Gauge systems from Bristol Instruments take advantage of the unique properties of light to accurately measure the thickness of transparent and semi-transparent materials. To make a measurement, light is directed onto the material under test through an optical probe that is connected to the instrument by a flexible fiber-optic patch cord. This results in reflections from each surface and layer interface. These reflections are collected and returned to the Thickness Gauge for analysis by an optical interferometer. The optical interferometer is basically a very precise "ruler" that can be used to determine the distances traveled by each reflection. The differences in these distances provide the information about the exact thickness of all the material layers.



# **Reliable Accuracy and Exceptional Repeatability**

The Thickness Gauge systems from Bristol Instruments offer the highest performance available to ensure the most meaningful test results. Thickness is measured to an **accuracy as high as**  $\pm$  0.1 µm to meet the most demanding testing requirements. What's more, with a measurement **repeatability of**  $\pm$  0.02 µm, the system can detect thickness changes as small as 0.04 µm.

The performance of the Thickness Gauge system is guaranteed by comparing every measurement to a built-in intrinsic standard of length that is recognized by the US National Institutes of Standards and Technology (NIST). The result is the reliable accuracy needed to provide the utmost confidence in the measurement results. For added confidence, each system is rigorously tested with a set of three different NIST-certified gauge blocks to verify its performance.





#### **REFLECTIONS FROM A SINGLE-LAYER MATERIAL**

# **Convenient Operation with Opti-Cal™ Software**

The primary user interface for the Thickness Gauge products is the user-friendly Opti-Cal software included with every system. This Windows-based software provides control of instrument measurement parameters, displays the interferometer signal, and reports thickness data. Multi-user licensing and future software updates are provided at no additional cost.

The **Reflection Peaks Graph** displays the interferogram signal peaks that result from the reflected light at each surface and interface of the material under test. The graph below is for a hollow glass tube. The distances between the positions of the peaks provide information about the top and bottom wall thicknesses and the inner and outer diameters.

The **Data Table** reports the thickness information for up to 31 different layers. This includes individual layer thickness, total thickness by layer, and measurement standard deviation. Data can be reported in units of millimeters (mm), micrometers ( $\mu$ m), and millionths of an inch (mils).





Layer	Layer	Material Name-	Standard	Total
	Thickness (mm)	Group Index	Deviation (mm)	Thickness (mm)
1	1.47944	Manual-Glass: 1.5	0.000095	1.47944
2	2.61881	Manual-Air: 1.000275	0.000147	4.09825
3	1.49582	Manual-Glass: 1.5	0.000108	5.59407

Measurement data for a glass tube. The top graph shows the interferogram with reflection peaks identified. The measurement results are given in the table on the lower left.

# **Measurement Modes of Operation**

Opti-Cal™ software offers two modes of operation.

**Automatic Peak Mode** automatically identifies reflection peaks for analysis using a minimum intensity level threshold. The Opti-Cal software then uses the relative positions of the selected peaks to calculate and report the thickness of as many as 31 layers.



**Quality Control Mode** benefits parts testing during the production process. A material design file can be created to define the expected thickness and tolerances of up to 31 layers. The Opti-Cal software then compares the measured thickness results of a part to the part's design criteria. The tolerances are used to determine whether a part passes or fails inspection. Color coding in the Data Table easily identifies the PASS/FAIL results. **GREEN** indicates that a layer is within tolerance and **RED** indicates that the layer is out of tolerance.

Lay	Layer Thickness (mm)	Design Thickness (mm)	Tolerance (mm)	Material Name- Group Index	Delta Thickness (mm)	Standard Deviation (mm)	Total Thickness (mm)
1	1.47933	1.50000	0.25000/-0.25000	Glass-1.500000	-0.02067	0.000143	1.47933
2	2.62058	2.25000	0.25000/-0.25000	Air-1.000275	0.37058	0.000195	4.09991
3	1.49274	1.50000	0.25000/-0.25000	Glass-1.500000	-0.00726	0.000145	5.59264

Quality Control Mode results for a two-element lens assembly shows that the air gap (layer 2) is too thin and out of tolerance.

# **Designed for Easy Workflow Integration**

The Optical Thickness Gauge products from Bristol Instruments provide the most precise and reliable non-contact thickness measurement available. These systems also offer the versatility and convenience necessary so that they can be easily integrated into virtually any production process.

#### **FLEXIBLE INTEGRATION**

All data collection, analysis, and measurement calculations are performed by the instrument itself. Therefore, test data can be reported to almost any computer in a variety of ways using either the included USB or Ethernet interface. For example:

- Measurement data can be displayed and saved to a Windows-based PC using the included Opti-Cal software and USB interface.
- The Ethernet interface can be used to connect the instrument to a local area network and allow remote, multi-user read-only access to an instrument's real-time measurement data.
- The included library of SCPI commands allows the instrument to be integrated into a custom application for automatic data reporting. This can be done using LabVIEW or user-provided custom programming.

#### **VERSATILE OPERATION**

The Thickness Gauge chassis can be located remotely from the system's optical probe by a distance that is limited only by the length of the fiber-optic patch cord used. Bristol Instruments has tested and approved a fiber-optic patch cord with a length up to 30.5 m (100 feet). This capability benefits a variety of applications, but especially those in clean room and controlled environments.

#### **MULTI-PROBE SUPPORT**

The Thickness Gauge system can be configured with up to eight optical probes to efficiently provide thickness measurements at multiple locations. For example, an array of measurements can be collected across a part without additional positioning or alignment steps, (e.g., points across a sheet of glass, or the circumference of a tube).



SPECIFICA	TIONS					157/1	<b>37</b> Series				
MODEL		157	157LS	157XLS	137	137LS	137XLS				
THICKNESS MEASUREMENT											
Method	Method		Non-contact optical interferometry								
Maximum Physi (Layer of air with inde	Maximum Physical Thickness (Layer of air with index of refraction of 1.0)		40 mm	80 mm	12 mm	40 mm	80 mm				
Maximum Physi (Material with index of	Maximum Physical Thickness (Material with index of refraction of 1.5)		26 mm	53 mm	8 mm	26 mm	53 mm				
Minimum Physic	Minimum Physical Thickness <sup>1</sup> (Material with index of refraction of 1.5) Accuracy <sup>2</sup> Repeatability <sup>3,4</sup>		20 µm	24 µm	35 µm						
(Material with index o			12 μm (± 1.0 μm accuracy)	16 μm (± 1.0 μm accuracy)							
Accuracy <sup>2</sup>			± 0.1 μm		± 1.0 µm						
Repeatability <sup>3, 4</sup>			± 0.02 μm		± 0.05 μm						
Traceability		Verified with NIST certified gauge blocks									
Units		mm, µm, mils									
MEASUREMENT RATE		10 Hz	7 Hz	4 Hz	10 Hz	7 Hz	4 Hz				
INSTRUMENT INTERFACE OPTIONS		USB and Ethernet with Windows-based display program Ethernet can be used for network connection allowing instrument access for up to 8 clients Library of commands for LabVIEW and custom programming									
MINIMUM COMPUTER REQUIREMENTS <sup>5</sup>		PC running Windows 10, 1 GB available RAM, USB 2.0 (or later) port, monitor, pointing device									
DIMENSIONS AND	WEIGHT										
Dimensions (H >	«WxD)		3.5" x 17.0" x 15.0" (89 mm x 432 mm x 381 mm)								
Weight		17 lbs ( 7.65 kg)									
POWER REQUIREMENTS		90 - 264 VAC, 47 - 63 Hz, 80 VA max									
WARRANTY		3 years (parts and labor)									

(1) Models 157 and 157LS are capable of measuring down to 12  $\mu m,$  but with lower accuracy.

(2) Defined as measurement uncertainty, or maximum thickness error, with a confidence level of ≥ 99.7%. Accuracy is verified with NIST Traceable gauge blocks up to 50mm.

(3) Standard deviation for a 60 minute measurement period.

(4) Specification is given for 1 mm sample with an index of refraction of 1.5. Dependent on the reflectivity of the material under test at the probe wavelength of 1.3 µm. Specification is given at 4% reflectivity. When reflectivity is lower, repeatability is reduced to a worst case of ~0.15 µm.

(5) Required for initial optical probe alignment and use with the Windows-based display program. Not required for measurement.

Bristol Instruments reserves the right to change the specifications as may be required to permit improvements in the design of its products. Specifications are subject to change without notice.



# CONTACT US TO SCHEDULE A

FREE ANALYSIS OF YOUR PART.

Send us your part and we will provide a live video demonstration of our measurement capabilities.

