

157/137 Series

OPTICAL THICKNESS GAUGE

Get the **reliable accuracy** you need for the most demanding non-contact thickness measurement applications. Conveniently measure the thickness of **up to 31 layers** of transparent and semi-transparent materials.

Bristol Instruments offers the **157/137 Series Optical Thickness Gauge** that conveniently and non-destructively measures the thickness of transparent/semi-transparent materials with reliable accuracy and exceptional repeatability. What's more, these systems have the ability to measure the thickness of up to 31 layers, including air gaps, simultaneously.

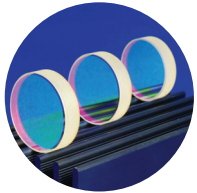


Key Features:

- Measures hard and soft transparent/semi-transparent materials without damage or deformation.
- Up to 31 layers, including air gaps, can be measured simultaneously.
- High performance gauge offering accuracy up to $\pm 0.1 \mu\text{m}$ and repeatability as good as $0.02 \mu\text{m}$.
- Quantifies materials from $12 \mu\text{m}$ to 80mm in total thickness.

Popular Applications

Our Optical Thickness Gauges are well suited for a wide range of applications. Examples of some popular applications include the following:



LENS ASSEMBLIES AND OPTICAL COMPONENTS

Easily and simultaneously measures compound lenses, displays, and bonded optics including air gaps.



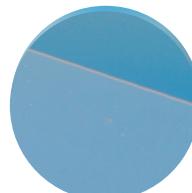
DISPLAY COMPONENTS AND ASSEMBLIES

Easily and simultaneously measure total and individual material thicknesses including air gaps and optically clear adhesives.



CONTACT AND INTRAOCULAR LENSES

Compatible with wet cell and transparent packaging in situ lens measurements including center thickness, sagittal height and group index.



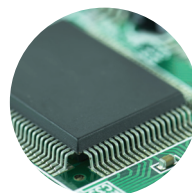
GLASS SLIMMING

Measures thickness before and after the chemical etching and/or polishing process.



MEDICAL TUBING AND CATHETERS

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

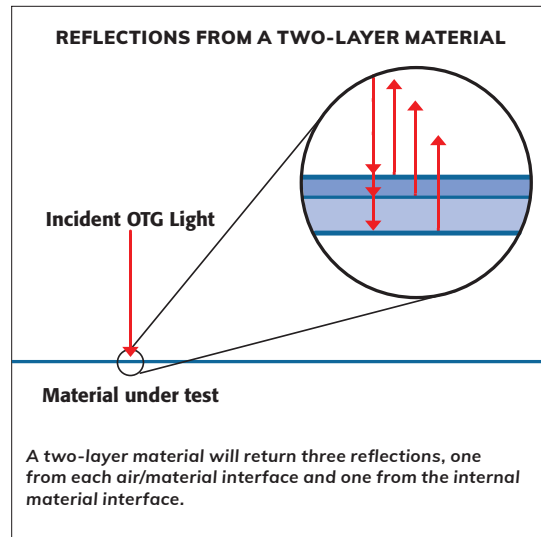
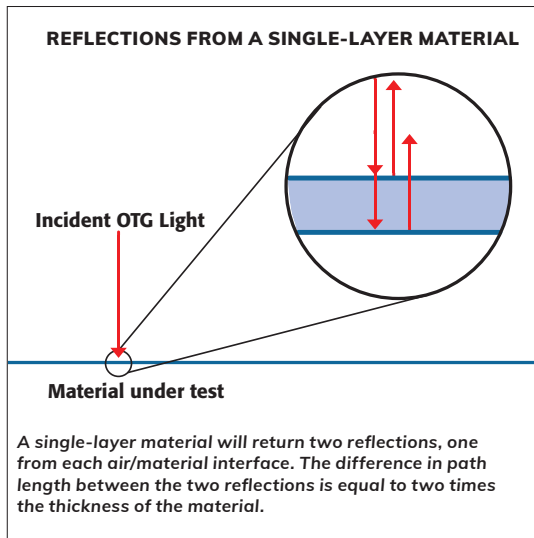


SEMICONDUCTORS

Infrared measurement light allows non-destructive layer characterization of Silicon/GaAs materials.

Thickness Measurement Using Light - The Bristol Advantage

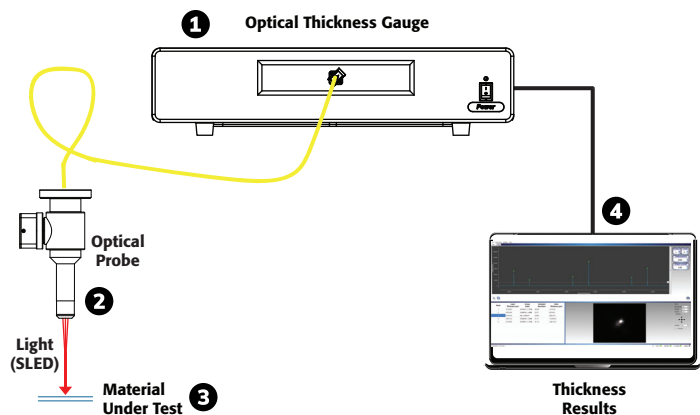
The Optical Thickness Gauge (OTG) from Bristol Instruments utilizes our proven optical interferometer technology to collect incident light reflections to accurately and repeatably measure all layers of your material under test.



How It Works

Operation of the Optical Thickness Gauge (OTG) is straightforward, making it easy to get reliable measurement data every time.

- (1)** Optical Thickness Gauge chassis contains a superluminescent LED (SLED), an interferometer assembly, and a digital signal processor (DSP). Conveniently sized to be rack mountable (2U height).
- (2)** Emitted light from the SLED is sent via a fiber optic patch cord to an optical probe that is focused on to the material under test.
- (3)** The resulting reflected light from all the material's layer interfaces is simultaneously collected by the optical probe and sent back to the OTG's interferometer for analysis.
- (4)** From this analysis, thickness data is calculated using onboard processing and the results can be easily transferred to a PC using a USB or Ethernet interface. The included Opti-Cal™ software provides control of measurement parameters and can also report thickness data in a variety of formats.



Accurate, Repeatable, and Reliable Thickness Measurement

Our Optical Thickness Gauges are designed to provide you with the highest performance to ensure the most meaningful test results.

HIGHEST MEASUREMENT ACCURACY

- Exceptional accuracy of $\pm 0.1 \mu\text{m}$ for the 157 model and $\pm 1.0 \mu\text{m}$ for the 137 model. Bristol defines accuracy as measurement uncertainty, or maximum thickness error.
- Our accuracy uncertainty specification is set to three times the measurement standard deviation (3σ) resulting in a confidence level of 99.7%. Essentially all your measurements are expected to fall within our specified accuracy limits (See measurement accuracy range defined by dashed horizontal lines in the figure below).

STABLE LONG-TERM REPEATABILITY

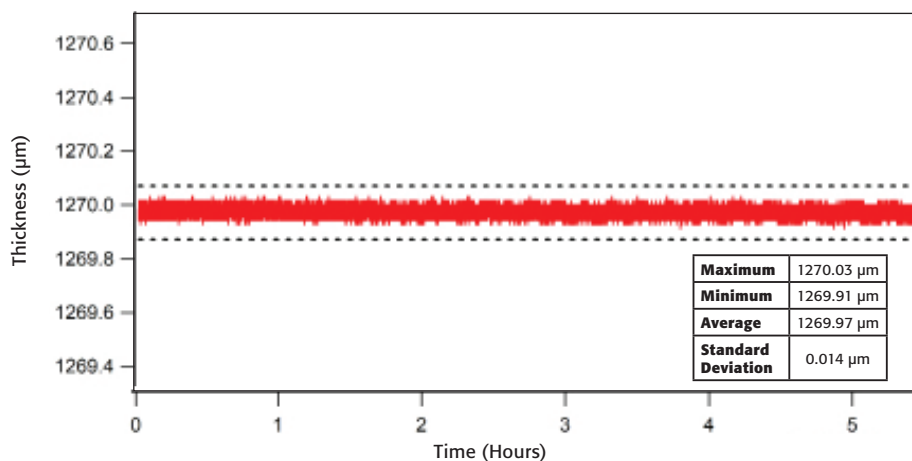
- Our 157 model's repeatability of $0.02 \mu\text{m}$ and $0.05 \mu\text{m}$ for the 137 model is defined as the standard deviation of repeated single measurements taken over a 60-minute period (without averaging).
- Excellent Repeatability equates to an exceptional ability to detect thickness differences as small as $0.04 \mu\text{m}$ (0.0016 mils).

CONTINUOUS CALIBRATION

- Every Bristol Thickness Gauge includes a built-in, intrinsic and invariant standard of length: a HeNe (Helium Neon) laser that is used continuously to compare every thickness measurement. Our unique, continuous calibration system guarantees you will achieve our specified accuracy for every measurement today and in the future.

TRACEABLE PERFORMANCE TO NIST STANDARDS

- Every Optical Thickness Gauge system is rigorously tested against a set of NIST-certified gauge blocks and includes a certificate of calibration for your peace of mind and quality assurance.

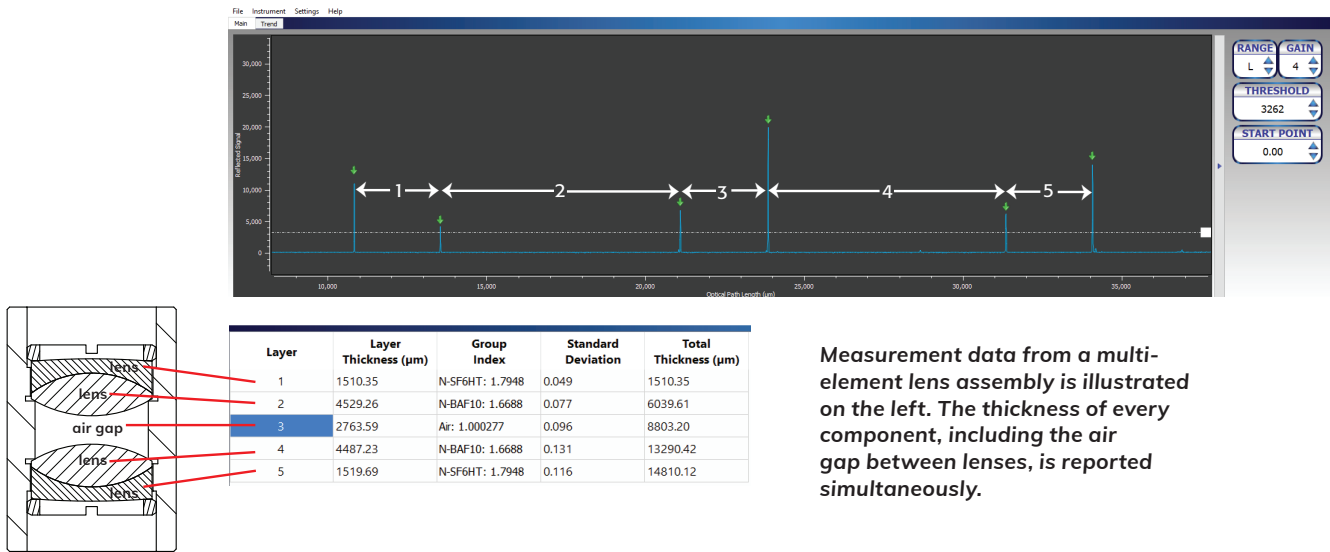


Representative long-term repeatability data from a 157 Series Thickness Gauge. Measurements taken of a NIST-certified gauge block with a thickness of $1269.9695 \mu\text{m}$. The instrument's specified accuracy range of $\pm 0.1 \mu\text{m}$ is displayed by the dashed lines.

Convenient Operation with Opti-Cal™ Software

The primary user interface for our Optical Thickness Gauge products is the Windows-based Opti-Cal™ software included with every system. Opti-Cal™ intuitively provides control of instrument measurement parameters, displays the interferometer signal, and reports thickness data which can easily be exported.

The **Reflection Peaks Graph** displays the interferogram signal peaks that result from the reflected light at each of the sample's layer interfaces.



Measurement data from a multi-element lens assembly is illustrated on the left. The thickness of every component, including the air gap between lenses, is reported simultaneously.

**WANT TO KNOW IF THIS METROLOGY METHOD CAN WORK FOR YOU?
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.

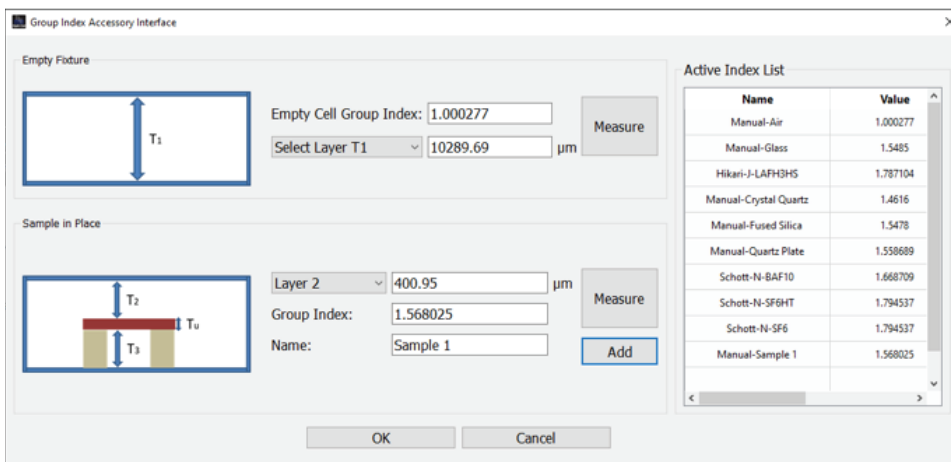
Measurement Modes with Opti-Cal™ Software

- 1) **Automatic Peak Mode:** This mode automatically finds reflection peaks and calculate layer thicknesses. User defined threshold and start point set the sensitivity and search range for this mode. Opti-Cal™ can report up to 31 layers simultaneously at a refresh rate from 4 to 20 Hz (depending on the optical probe).
- 2) **QC Mode:** Our Quality Control mode allows the input of your part's thickness design and tolerance criteria from which Opti-Cal™ can then compare measured thickness data. Thickness tolerance PASS/FAIL results are easily identified by color coding.

Layer	Layer Thickness (µm)	Design Thickness (µm)	Tolerance (µm)	Material Name-Group Index	Delta Thickness (µm)	Standard Deviation	Total Thickness (µm)
1	1510.60	1500.00	30.00/-30.00	N-SF6HT-1.794537	10.60	0.018	1510.60
2	4529.32	4500.00	30.00/-30.00	N-BAF10-1.668709	29.32	0.028	6039.91
3	2763.27	3000.00	200.00/-200.00	Air-1.000277	-236.73	0.054	8803.18
4	4488.81	4500.00	30.00/-30.00	N-BAF10-1.668709	-11.19	0.045	13291.99
5	1518.60	1500.00	30.00/-30.00	N-SF6HT-1.794537	18.60	0.036	14810.59

QC results for a lens assembly, identifying an air gap 'layer 3' being too thin and out of tolerance.

- 3) **Group Index Utility:** Our Thickness Gauge measurement process converts optical path differences into thicknesses. This conversion requires the Group Index of the material(s) under test to be known. Opti-Cal™ includes a Group Index database of common materials. For unique or unknown materials, Opti-Cal™ includes a utility that can measure your sample's Group Index (requires the Group Index Measurement accessory, sold separately).



Integrated Group Index Utility

A System Designed for Easy Workflow Integration

INTERFACE OPTIONS

All of our data collection, analysis and measurement calculations are performed on-board the instrument and thus no requirement for a dedicated computer or specific operating system. Measurement data can be reported to almost any computer in a variety of ways using either the included USB or Ethernet interface. For example:

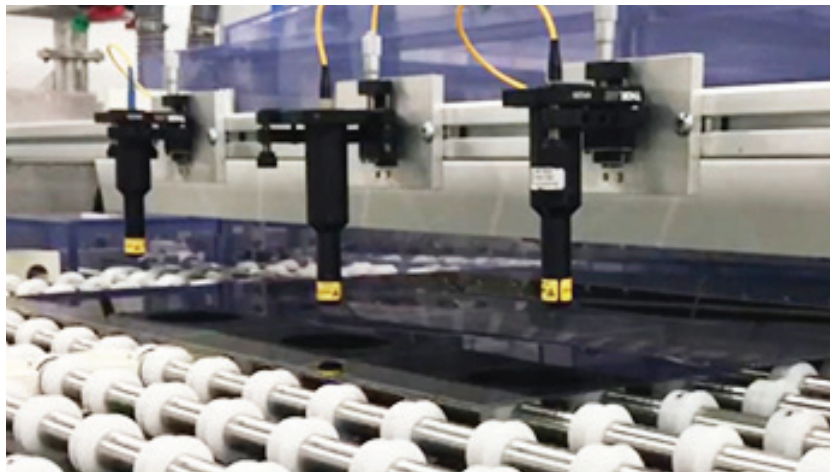
- Measurement data can be displayed and saved to a Windows-based PC using the included Opti-Cal™ software and USB interface.
- The Ethernet interface can be used to connect the instrument to a local area network and allow remote, multi-user read-only access to an instrument's real-time measurement data.
- 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.

FLEXIBLE INSTALLATION

The Optical Thickness Gauge chassis can be located up to 30.5 meters (100 feet) from the optical probe and material under test. It is limited only by the length of the fiber-optic patch cord used. Bristol 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/or controlled environments.

MULTI-PROBE SUPPORT

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

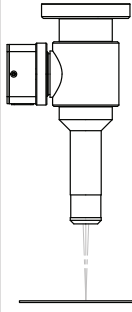
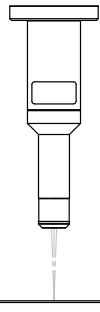
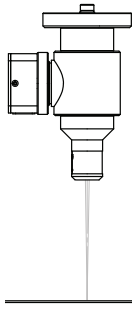
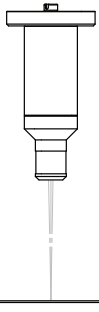

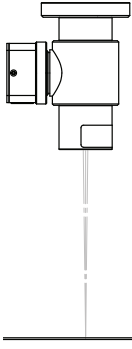
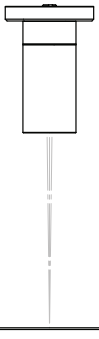


Optical Probe Options

We offer an array of Optical Probes to meet a wide range of material thicknesses, overall part sizes and ease-of-use requirements.

The comparison chart below summarizes the specification differences in the probes available.

A probe's **working distance** will dictate the maximum overall height for a part being measured. The optional **alignment camera** provides real-time visual feedback for the operator to easily align the probe to the part. Consider a part's minimum and maximum **layer thickness** characteristics, compared to the minimum and maximum **layer thickness** range of the probe.

OPTICAL PROBES							
PROBE MODEL	QAP-025/50	P-025/50	QAP-011/75	P-011/75	LP-025/75	QAP-007/125	P-007/125
							
WORKING DISTANCE	44 mm	41 mm	63 mm	63 mm	69 mm	120 mm	115 mm
OTG SYSTEM COMPATIBILITY	STANDARD	STANDARD	STANDARD, LS	STANDARD, LS	STANDARD, LS	XLS	XLS
ALIGNMENT CAMERA	Yes	—	Yes	—	—	Yes	—
LAYER THICKNESS	12 µm to 12 mm	12 µm to 12 mm	12 µm to 40 mm	12 µm to 40 mm	12 µm to 40 mm	16 µm to 80 mm	16 µm to 80 mm

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SPECIFICATIONS

157/137 Series

MODEL	157	157LS	157XLS	137	137LS	137XLS
THICKNESS MEASUREMENT						
Method	Non-contact optical interferometry					
Maximum Physical Thickness (Layer of air with index of refraction of 1.0)	12 mm	40 mm	80 mm	12 mm	40 mm	80 mm
Maximum Physical Thickness (Material with index of refraction of 1.5)	8 mm	26 mm	53 mm	8 mm	26 mm	53 mm
Minimum Physical Thickness ¹ (Material with index of refraction of 1.5)	16 µm	20 µm	24 µm	35 µm		
	12 µm (± 1.0 µm accuracy)	12 µm (± 1.0 µm accuracy)	16 µm (± 1.0 µm accuracy)			
Accuracy ²	± 0.1 µm			± 1.0 µm		
Repeatability ^{3,4}	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 to up to 8 clients Library of commands for LabVIEW and custom programming					
MINIMUM COMPUTER REQUIREMENTS ⁵	PC running Windows 10, 1 GB available RAM, USB 2.0 (or later) port, monitor, pointing device					
DIMENSIONS AND WEIGHT						
Dimensions (H x W x D)	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 µm, 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 about 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.

