

STRAIN TESTING WITH THE BAUSCH & LOMB POLARISCOPE

Glass—a by-word for breakable, fragile, delicate—and yet glassware of all kinds is handled daily, with a minimum breakage—*why?* Because of proper annealing, knowledge of materials and processes. Today, we know that strain is relieved by annealing; we can actually see strain, and thus correct conditions in the lehr which are causing it.

Strain in the finished product may have been caused by standing too long between the molding machine and the lehr. The temperature, time, etc., through the lehr may have been wrong, or “spotty” conditions in the lehr might have caused the strain. Where another batch of glass is run in, the two batches may not have mixed properly and caused strain. These strains may be viewed with the proper instruments, (polariscopes), their location marked, and their degree estimated. With this information at hand, the experienced superintendent will have no difficulty in running down the trouble. As a matter of routine, many plants inspect bottles from every lot. Others check every bottle on critical orders or when glass and shapes are changed, but for any plant, a polariscope is an indispensable aid in maintaining trouble-free production, and in preventing annoying complaints from customers. For you can actually *see* that you are right. You can request

the customer to check his temperature of filling, pasteurizing and cooling. Without the assurance of the polariscope, there is always the annoying doubt that *you* may be wrong.

how strains are viewed

A well annealed piece of glass has no effect on polarized light, so that light passes directly through without change. A strained piece of glass, however, is no longer optically homogeneous, and a beam of polarized light passing through is broken up into two rays. When these emerge, one has been held back more than the other, and is “out of step.” This causes interference which is made visible to the eye as alternate light and dark bands (sometimes weakly colored). These weak contrasts are built up purposely to brilliant colors by another optical device, known as a retardation plate, which permits us to make estimates of the amount of strain, as well as determine the area in which it occurs.

A strain is always acting in a plane perpendicular to the line of vision, or it cannot be seen. Obviously, in a bottle there may be strains which can be viewed by looking through the bottle, and also strains which can only

be detected by cutting a ring section of the bottle, and looking down through the wall. There are exponents of both methods, and, with good reason, many plants are using both methods. For the plant which has no testing equipment at all, we would recommend the purchase of the regular strain testing polariscope, as it will solve many difficulties, and many glass men feel that, if the strains visible with this instrument are relieved, the invisible ones are also probably removed. For plants with special problems, continuous melting, etc., we recommend that the ring strain detecting microscope be added to the present equipment.

description of the Polariscope

The new Bausch & Lomb Polariscope is easy to use. By holding any transparent or semi-transparent object between the light source and eyepiece, with curtains down to eliminate much of the outside light, most strains can be detected. No skill is required.

This new illuminating unit and improved optics will bring your polariscope up to date, will make you independent of daylight illumination and fit your instrument for the most exacting work.

It pays for itself by its dependable help in eliminating defective articles and controlling production.

The instrument consists of a polarizing and analyzing unit suitably mounted so that a large sample may be placed between them and viewed as a whole. An illuminating unit furnishes a powerful and uniform light.

The visible sample area is four inches square. The space permits the introduction of samples up to fifteen inches across. The concave polarizing plate is of black Carrara glass, evenly illuminated through a ground glass window. To prevent accumulation of



dust, the plate is mounted within a housing, one side of which is closed by the ground glass window and the other by a clear glass window. The analyzer is a calcite prism combined with a retardation plate. The sample space is protected by curtains to eliminate, in so far as possible, the effects of stray light which tends to lower the contrast in the strain colors being observed.

This instrument is provided with a high intensity illuminating unit, to satisfy a demand which has become evident in recent years. Many workers have found that strong illumination is absolutely essential in

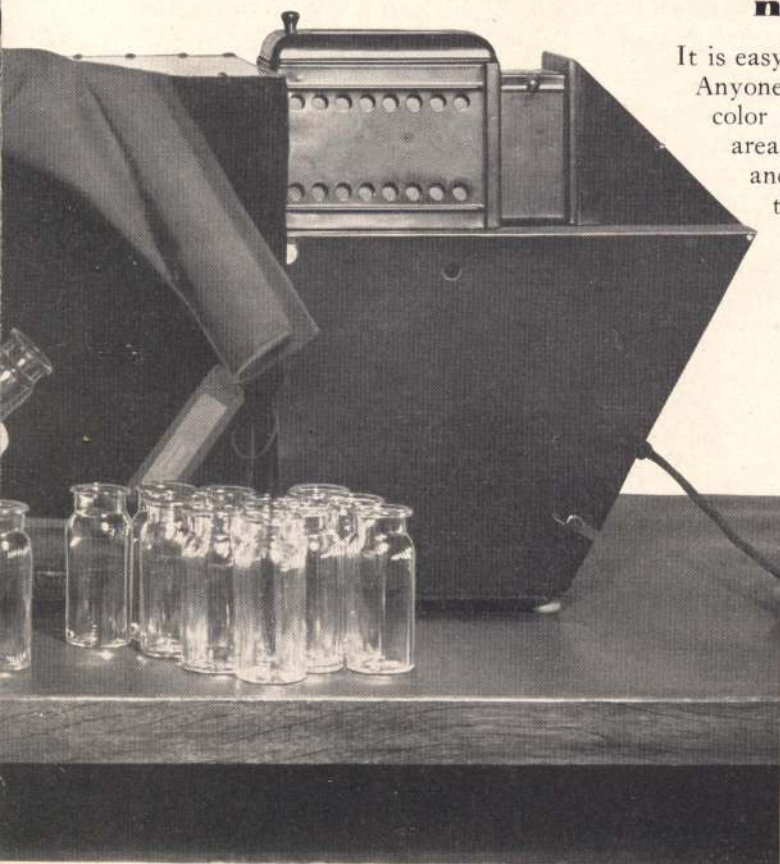
examining frosted articles and colored glass. The unit consists of a 500 watt monoplane filament lamp with a concave reflector and a condensing lens to produce an even, parallel beam of light. This beam is then re-directed by two reflectors, so that it fills the polarizer with light.

NOTE: The illuminating unit may be purchased separately for use on old models of Bausch & Lomb Polariscope. The illumination is more even and intense from this source and, if the optical parts (see price list) are also replaced, the performance will equal the new instrument; in fact, it will check with results obtained on a new instrument.

experience is not necessary

It is easy to use a polariscope. Anyone able to distinguish color differences can locate areas where strain exists and, after the principle of the instrument has been explained, can make estimates of the degree of strain.

The new B & L Polariscope—complete with high intensity illuminator and improved optics. Note compactness of complete instrument. It is semi-portable and in trouble shooting can be taken to the work.



The field of the polariscope is a purple color half-way between blue and red in the color scale, and a slight amount of strain shows in either red or blue. A greater amount of strain shows up in green or orange and yellow.

Since Bausch & Lomb holds its retardation plates to a high degree of uniformity, these colors may be taken as standard. Operators or instruments may then be interchanged without confusion. Opinions as to degree of strain need not differ when B & L polariscopes are used.

the superior features

The complete instrument is superior to previous models in the following respects:

The additional illuminating unit gives brilliant and uniform illumination, revealing details heretofore unnoticed.

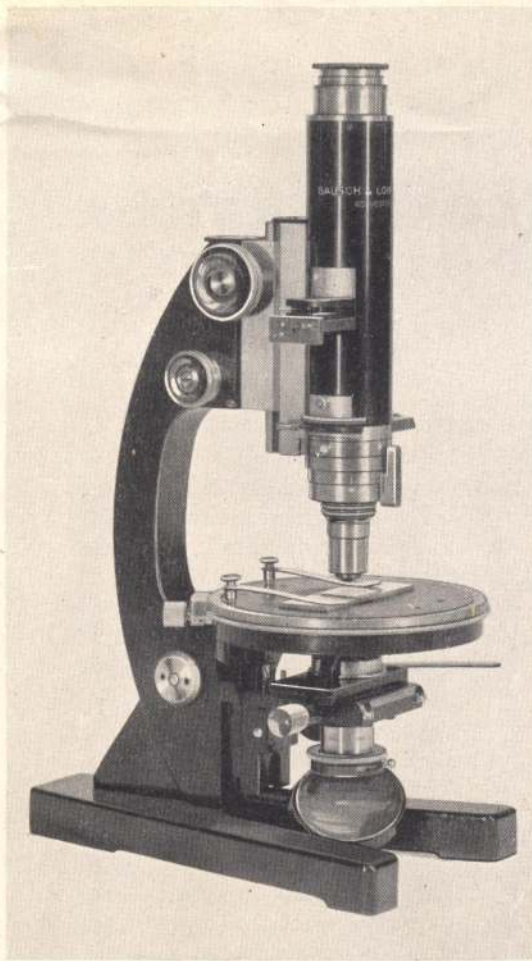
The new polarizing plate has a concave surface, instead of plane, concentrating light into the eyepiece, and improving the completeness of polarization over the entire field.

A new retardation plate of 565 $\mu\mu$ retardation is accurate to plus or minus 3 millimicrons which makes it possible to estimate the amount of strain. This makes it possible for different plants, departments, or manufacturer and consumer to check results.

The new ground glass gives greater uniformity to the field with less graininess.

CONSIDER THESE FACTS

1. No dark room is needed.
2. New type instruments will check with each other, due to constant illumination and the accurate retardation plate.
3. Continuous operation speeds production. Operator passes the glass object into the Polariscope with one hand and removes it with the other, at the same time bringing in the next piece. No lost motion—no time wasted.
4. Large operating and optical field permits inspection of large bodies up to 15" diameter, at a glance.
5. It detects strains in colored glass. (Amber, green, bottle glass).
6. It detects strains in semi-transparent glass, such as electric light bulbs that have been frosted.
7. Normal viewing distance for the sample, 10 to 15 inches.
8. Uses a special retardation plate to produce contrast in strain colors from which the amount of strain can be estimated.



The LC Petrographic Microscope

THE POLARIZING MICROSCOPE

for research and control

Every ceramist knows the important part that the petrographic microscope plays in his work. From refractories to glass making, there are problems which can only be solved by petrographic methods.

For the plant which utilizes these methods or which is about to install equipment of this type, we offer our latest model—the LC Petrographic Microscope. This instrument is the last word in instrument building, combining the features of sharp extinction, strain free optics and mechanical conveniences which have customarily distinguished our petrographic microscopes. Of particular interest to the microscopist are the following features:

1. New style objective adapters.
2. Interchangeable condensers with different N.A.
3. Focusing Bertrand lens.
4. Large field eyepieces.
5. The new type stand, which makes the instrument more stable and attractive.
6. The extra clearance of arm and body tube which allows the use of the new Universal stage or high ring sections.
7. Provision for accessories for measurement of optical characteristics.

A SIMPLIFIED MICROSCOPE

for bottle makers

The ring section method has been sponsored by a great many experts and is coming into wide usage. The sample must be destroyed, a section being cut out of the bottle. The broken surfaces of the section must either be ground and polished, or if left rough, sealed between cover glasses—or immersed in a glass dish with a suitable liquid.

This section is placed on the stage of a polarizing microscope, and the strains studied. Their location and

direction can be interpreted as "case" striae and other defects.

Bausch & Lomb supply a simplified polarizing microscope for examining ring sections for strain. The instrument provides a field of large area for such work. It is equipped with circular revolving stage, polarizer and analyzer set for total extinction, and a retardation plate providing a rich purple field set at the position for maximum sensitivity (same as in Strain Testing Polariscope). Ample room is provided for thick sections. Analyzer and polarizer parts can be removed, permitting use of the microscope for other purposes.

Write for prices and specifications on equipment suitable for your work.

GLASS THICKNESS MEASUREMENT

It is often necessary or desirable to measure the thickness of glass or transparent material, without destroying the sample, such as centrifuge sedimentation tubes, electric light bulbs, internally frosted bulbs, radio tubes, sheet glass, glass tubes and other products of the glass and transparent celluloid industry. Thickness is often of very great importance, especially where high pressure or high vacuum must be withstood, and with the B & L Glass Thickness Gage measurements can be made without breaking the sample.

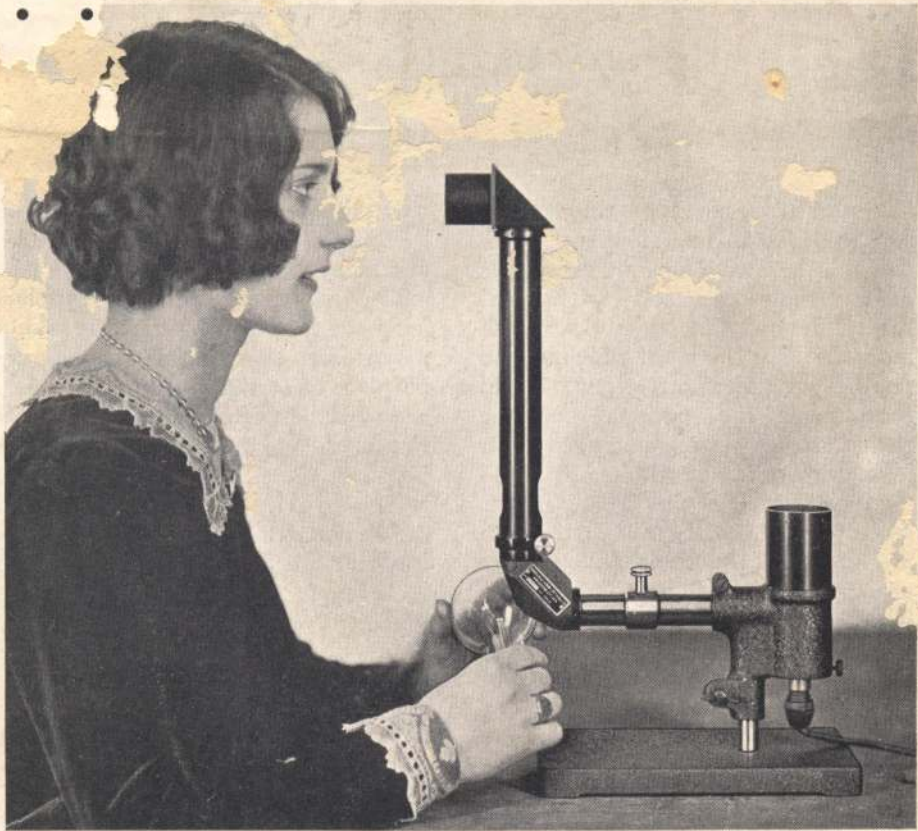
This Bausch & Lomb bench type instrument will measure thickness up to one-eighth of an inch and is adjusted to $N = 1.522$. A test glass of that index of refraction is furnished with the instrument. It can, however,

be furnished adjusted to the refractive index of any transparent material one may wish to measure, but 1.522 is the most common glass used.

The portable (pocket size) optical thickness gage is built on the same principle as the bench type, but depends upon an outside light source for illumination of the scale. It measures the thickness of common glass (of a refractive index $N = 1.522$).

This instrument cannot be adjusted to measure glass of unusual refractive index, but the difference can readily be computed mathematically if the index of refraction is known.

Instruments can be furnished for other glass thicknesses or other indices of refraction on special order at additional cost.



The Bench Type Glass Thickness Gage

PRICES AND SPECIFICATIONS

Code Word	Catalog No.	Specifications	Price
<i>Klive</i>	33-65-96-01	<i>New Bausch & Lomb Strain Finding Polariscopes with illuminating unit attached</i>	\$170.00
<i>Klix</i>	33-65-97-01	<i>Illuminating Unit</i> as used on the new Polariscopes—for attaching to old units	50.00
		<i>New Optical Parts</i> for modernizing old B & L Polariscopes including concave black glass Polarizer, new type ground glass, and standardized retardation plate. (Send in your eyepiece for fitting)	21.25
<i>Dipot</i>	41-41-08	<i>Bulb</i> , 115 V, 500 W, prefocused for illuminating unit	MCP* 3.00
<i>Agmad</i>	31-28-61	<i>L C P larizing Microscope</i> with 40 mm., 16 mm, 4 mm objectives an \times , 7.5 \times and 10 \times eyepieces. With divisible and centering nosepiece and 3 objective holders and a 1.1 N.A. condenser—in case	470.25
<i>Dwajn</i>	33-19-70-01	<i>Optical Glass Thickness Gage</i> , Bench Type, for 110 V, A. C.	100.00
<i>Acuf</i>	31-31-32	<i>Bulb</i> , 6V, 15 C.P. for 33-19-70-01	MCP* .22
<i>Dwawn</i>	33-19-75	<i>Optical Glass Thickness Gage</i> , Portable Type, with leather case, to measure up to .150"	30.00

*Manufacturer's Current Price.

Without further notice the prices herein are subject to increase for taxes and charges now or hereafter imposed by federal, state or other authorities applicable to the sale of articles covered by this price list.

BAUSCH & LOMB OPTICAL CO.

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New York

Chicago

San Francisco

London

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