



Bellingham + Stanley

Technical Bulletin

Bulletin No: R017

Title: *Calibrating a refractometer with a solid test plate*

Applying a solid test plate to the prism of a refractometer requires considerable care in order to achieve a repeatable and reliable reading. This Technical Bulletin provides some explanation of the cause of poor repeatability along with advice for improvement.

About solid test plates

A test plate is a plate of solid material such as glass, silica etc which has been carefully machined to have an optically flat face, suitable for contact with the prism of a refractometer.

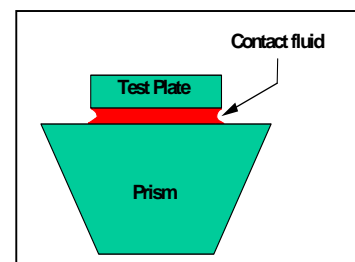
The advantages of using a solid test plate as a reference standard are as follows:

- A test plate has an unlimited shelf-life compared to typical liquid RI standards
- Solid materials have relatively low temperature coefficients compared to liquids, which means the RI will vary by a very small amount as the temperature changes. Temperature control is important but not near as much as with a liquid sample.
- A test plate can be a traceable standard.

Application principle

To obtain a reading with a test plate, it is necessary to make an effective parallel contact with the prism. Because of microscopic imperfections, it is necessary to use a very thin film of contact fluid between the plate and the prism. The contact liquid must have a refractive index higher than that of the test plate to allow the light to refract through to the test plate surface. The refractometer will seek the lowest refracting surface and so the plate will be measured rather than the contact liquid. Typical contact fluids are mono-bromonaphthalene (RI ~1.66) and methylene iodide (RI ~1.74).

To apply the plate a tiny drop (the minimal amount) of contact fluid should be positioned at the centre of the prism surface and the plate carefully applied allowing the contact liquid to form a coherent film across the plate-prism interface.



Achieving a good contact, evidenced by a sharp borderline and good repeatability in reading, is often not that easy. Care is certainly needed in applying the right amount of contact fluid and forming a reliable film layer. There follows some comments from our laboratory staff to a B+S customer that help to explain the problems in using a test plate effectively.

Problems in applying a test plate? – Tips from the B+S Lab

The variation in refractive index between applications of the test piece is due to the degree of parallelism between the prism and the test piece. As both the prism and the test piece are manufactured to a high degree of optical flatness, the introduction of contact fluid between the two can cause a slight deviation from parallelism to be formed. As you have noticed, this very small angle can cause a shift in the position of the visible borderline when measured

on the Abbe refractometer.

Although the thickness of the layer of contact fluid will not in itself affect the reading, it is much easier to obtain a uniform thickness layer by using a small amount. The method we use is to apply a small dot of contact fluid to the middle of the prism surface then apply the test piece. By looking at the top of the test piece you can see the contact fluid spread over the bottom surface. Ensure that all of the bottom surface is in full contact with the prism. Light pressure applied evenly to the top surface can help here.

If there are areas where the contact fluid has not reached on the test piece then too little fluid has been used. Remove the test piece and apply more contact fluid. If the test piece can be easily moved around on the prism surface then it is likely that too much contact fluid has been used. Be careful here, as sliding the test piece on the prism when a very good contact has occurred can cause scratching to the prism surface. Lift off the test piece, dry the bottom and replace using only the contact fluid left on the prism. Again, look at the top of the test piece and ensure that the contact fluid spreads to cover the whole surface, applying light and even pressure if required. With a very good application, surface tension effects can make it difficult to remove the test piece from the instrument prism. Rather than risk scratching the prism by sliding the test piece off, an application of Industrial Methylated Spirits can help to release the test piece from the prism.

Applying the "correct" amount of contact fluid should become easier after you have made a few applications and get a feel for the technique. Assess your method by repeat applications and you should be able to achieve an acceptable repeatability.