

GUIDE

THE USE OF REFRACTOMETERS FOR ANTIFREEZES

Your fire sprinkler system antifreeze is subjected to all kinds of fire and lab tests. One test that can really identify small changes in antifreeze from dilution or mixing is a refractive index (RI) check with a refractometer. But while these devices can provide useful, accurate information, they can also be misinterpreted. Here is some background and why this happens.

WHAT EXACTLY IS A REFRACTOMETER?

A refractometer is an optics instrument that provides a refractive index value, “n” or “nD” for a material. The refractometer operates on the principle of light refraction, or the bending of light as it travels through an object. It’s basically a geometry problem. As light penetrates

an object and bumps into its molecules, it changes directions, and it is these angle changes (θ) that calculate the index of refraction. Examples of this could include looking at fish in a pond or a diamond ring.

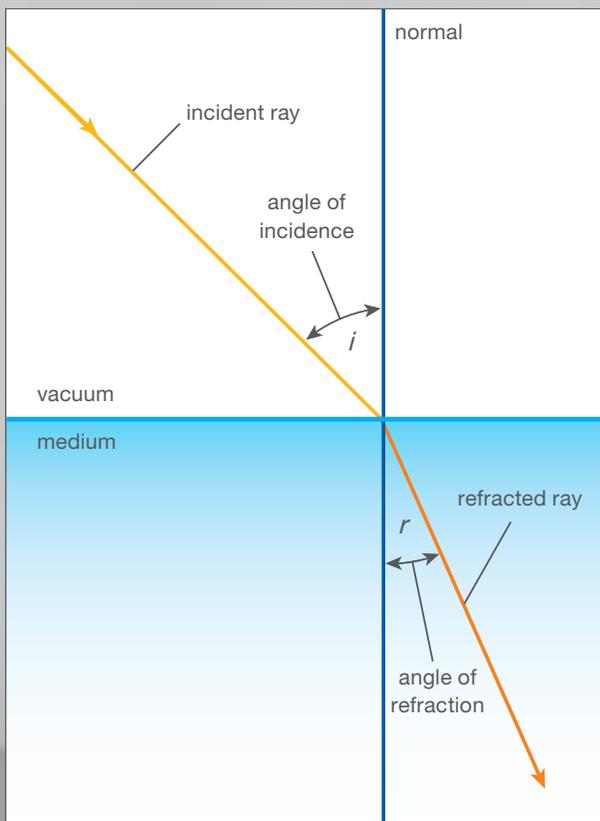


FIGURE 1. Refractive Index



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TYPES OF REFRACTOMETERS

Refractometers are unique in that they use accurate, straightforward science packed into a simple instrument. They are commonly used in the chemicals industry, but their use extends to gemologists, homebrewers and more. The instrument in general contains a light source, reference prism, and detector. There are 2 notable types of refractive index meters: Abbe and handheld.



FIGURE 2. Abbe Refractometer (left), Digital Handheld Refractometers (right)

The Abbe refractometer, named after the inventor, has a microscope to visually look at areas of contrast when measuring the sample. The handheld manual or digital refractometer is most appropriately used in the field. They are portable, more reasonable in price and accurate to +/- 0.0003. In fact, handheld refractometers might be better known for providing the BRIX level, reported as °Bx or % sugar content of various food and beverages. The BRIX scale is correlated to the refractive index.

USING YOUR REFRACTOMETER

It is important that you have a refractometer that has an RI scale, covering a range of roughly 1.3 to 1.5.

DO NOT USE BRIX, GLYCOL OR GLYCERIN SCALES.

Follow the manufacturer's instructions. These are all very similar for the handheld refractometers, but defer to your specific brand's guidelines. Here are some best practices:

- The device should be clean and dry before use. Residual antifreeze or water will change the results.
- The device should be calibrated in the environment it is being used with deionized water.
- The device and fluid being tested should be close to the same temperature.
- Use enough drops of the antifreeze to make sure the well (sight glass) are covered. Several drops are often needed. Always use a new, clean dropper.

The RI will be reported as a unitless number at a particular temperature, or autocorrected to 20°C which is often shown as "nD20". The refractive index is always reported at a particular temperature because it changes with temperature. The colder your antifreeze when measured, the higher the RI. Conversely, the hotter your antifreeze when measured, the lower the RI.

In the field, there are many variables such as storage conditions, temperature changes and contamination that affect RI. freezemaster™ antifreeze is never to be purposely diluted with water. See Figure 3 below for reference, where freezemaster™ antifreeze was diluted with water and measured with a laboratory grade Abbe refractometer at 20°C. The corresponding freezing points (ASTM D6660 method) are also shown.

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SCATTERPLOT OF FREEZE POINT VS RI

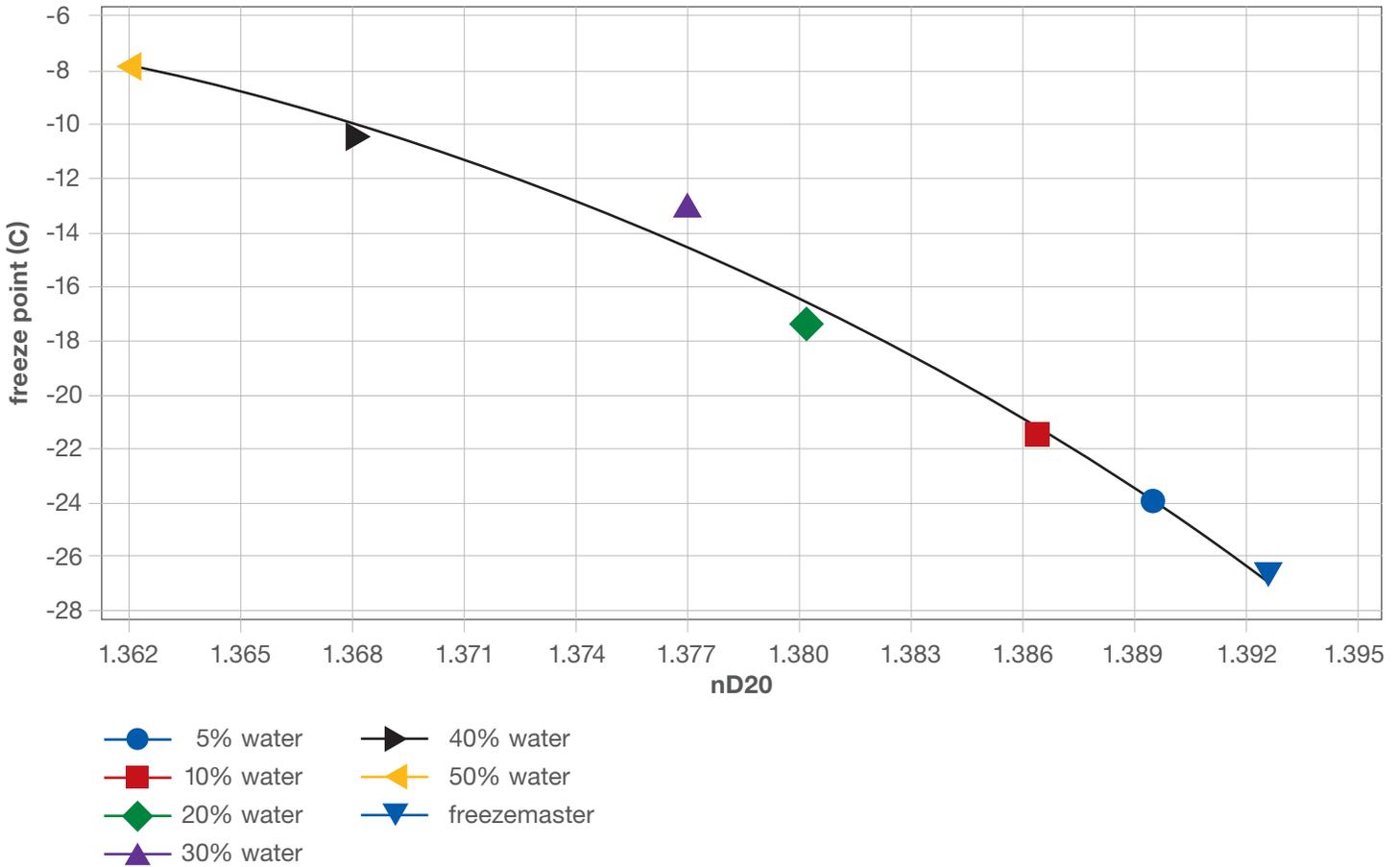


FIGURE 3. freeze point (ASTM D6660) vs. refractive index (nD20) for freezemaster™ antifreeze diluted with water

Lubrizol's Research & Development and Quality Assurance teams have expertise on the science of refractometry and have established a validated, corporate test method. When used correctly, the refractometer is quite the detective in finding where your antifreeze's composition is.

FOR MORE INFORMATION PLEASE CONTACT YOUR LOCAL SALES REPRESENTATIVE OR VISIT FREEZEMASTER.COM