

# McCRONE MICROSCOPES AND ACCESSORIES

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## INDEX OF REFRACTION LIQUIDS

Cargille Index of Refraction Liquids are standard in many laboratories because of their stability and ease of use. Carefully prepared certified liquids are available in a range of 1.300 to 2.31. Dispersion and temperature coefficient data are available for each liquid. Of course, refractive index is a function of temperature so if one is working at temperatures other than room temperature, some adjustment has to be made for the refractive index change.

*Applications of Index of Refraction Liquids include:*

1. Identification of minerals, ores, chemicals, plastics and other translucent or transparent solids by immersion techniques under the microscope.
2. Inspection of transparent materials with or without "frosted" surfaces for internal defects, contaminants, i.e., optical glass, plastics, synthetic and natural crystals, etc.
3. Strain examination of transparent or translucent, molded or formed parts, curved or intricately shaped, by immersion in conjunction with polariscopes.
4. Index determination of synthetic fibers, and other materials, for identification or quality control by means of the spectrophotometer wherein dispersion curves are utilized to determine the index of refraction after finding the wavelength for the index of refraction match between the specimen and liquid.
5. Protection and examination of a cathode coating by use of a protective index of refraction formulation that matches the index of refraction of the crystals permitting optical inspection without stripping and reimmersion.
6. Flow pattern studies in aerodynamics using an Index of Refraction Liquid in place of air and beads to show flow patterns, with high-speed motion picture cameras. The system was constructed of clear plastic pipe and a matching Index of Refraction Liquid.
7. Temporary mounting media for examination of tooth sections where low liquids were used to provide a large difference between the mounting media and the specimen.
8. Identification of salts precipitated by body fluids. By using two specific liquids, the relative amounts of sodium chloride and potassium chloride give an indication of toxemia during the early stages of pregnancy.
9. A viscous low Index of Refraction Liquid is being used for mounting microfossils. The stability and high viscosity of this special formulation permit rotation of the specimen by shifting the Cover Slip.
10. Hollow lenses filled with Index of Refraction Liquids provide large, inexpensive lenses or lenses with unique optical properties.
11. Index of Refraction Liquids formulated for index and viscosity for use as coupling agents between interfaces of optical elements.
12. Temporary mounting of specimens in various index media for matching or contrasting index combinations.
13. Calibration for refractometer and other optical measuring instruments.
14. Optical analysis and study utilizing techniques of dispersion staining, focal masking and double variation refractometry. (High Dispersion Liquids)
15. Particle identification work in air and water pollution investigations.
16. Fragment identification in criminal accident investigations by forensic laboratories.

### *Characteristics of the Cargille Index of Refraction Liquids*

Cargille Refractive Index Liquids are divided into several different principal groups depending on indices, applications and formulation. All refractive index values were taken at 5893Å at 25° C. The Refractive Index values at other wavelengths are calculated using the Cauchy equation, which is specific for each liquid. The tolerances of variation in the UV and infrared regions become greater (than in the visible).

**Cauchy Equation:** refractive index as a function of wavelength at 25° C where W = wavelength in Angstroms (Å)

$$n(W) = 1.496871 + (623826.1/W^2 + (2.286787E + 12)/W^4)$$

### Standard Liquids

The Standard Group consists of products used for certification and calibration of equipment and other purposes such as high precision scientific research. There are 172 standard liquids classified into five Series:

Liquids 1.300 to 1.395 are a fluorocarbon Series AAA. They are slightly volatile, colorless, and should be kept tightly stoppered.

Liquids 1.400 to 1.458, Series AA, are very stable and colorless.

Liquids 1.460 to 1.640, Series A, are the most stable. They are colorless at the low end, and increase to faint yellow at the high end.

Liquids 1.81 to 2.00, Series H, are quite stable. Their color varies from yellow to brown. (Super-saturated solutions that may crystallize in time, especially if kept too cold.)

Liquids 2.01 to 2.11, Series EH are similar to the 1.81-2.00, but contain selenium and are darker. **WARNING: Toxic and corrosive!**

### High Dispersion Liquids

Dispersion staining and double variation refractometry may require Index of Refraction Liquids having much higher dispersion than the solids they are to match.

Liquids 1.500-1.640, Series E, are formulated from high dispersion compounds. This series is supplemented by two other series sets above 1.640, which have the required high dispersion.

Liquids 1.642 to 1.700, Series B, have very good stability, but the stability decreases slightly as the index increases. The color increases to yellow or yellow-brown at the high end.

Liquids 1.705 to 1.800, Series M, are based on Methylene Iodide. 1.74-1.78 contain sulfur, and are yellow. 1.79 and 1.800 have iodides added producing a dark red. (Keep well stoppered as methylene iodide evaporates.) 1.705 to 1.735 will drop in index if this happens, and 1.74 to 1.800 will increase and may form crystals.

### Refractive Index Melts

Series FH and GH are low melting point solids based on arsenic tribromide, arsenic disulfide and selenium. Toxic and corrosive! (Sheets with more specific information on precautions to be taken are included with each set.)

## REFRACTIVE INDEX LIQUIDS (Mounting Media)

### *Differences between immersion oils vs. refractive index fluids:*

While in some respects there are similarities, at the same time, the way in which the two groups of fluids are used is substantially different.

- Immersion oils, as originally designed, are for immersing objectives for microscopy and are formulated for specific properties chiefly related to viscosity (and to some degree their freedom from fluorescence). Oils are used to ensure optical continuity between the slide and the microscope optics. This synthetic product is produced in order to meet international standards. It is completely more reliable than cedar wood oil. Cedar wood oil is a natural product that has very non-desirable drying properties and specifications that could vary quite a bit.

- Refractive index liquids are formulated for a specific refractive index at a specific wavelength and generally have a lower viscosity than the immersion oils. They are used by the microscopist as mounting media for the preparation itself and for the measurement of refractive index by the immersion method.

### Standard Liquids

RANGE: 1.300-2.11

INCLUDES SERIES: AAA, AA, A, H, EH

Consists of 172 liquids divided into five different series extending in range from 1.300 to 2.11

#### HOW TO ORDER:

To order any individual bottle of R.I. liquid, please indicate the numbers 168 followed by:

- Series (AAA, AA, A, H, EH)
- Size (1/4 oz.= X, 1 oz.= XX, 4 oz. = 4, 16 oz. = 16)
- Refractive index (4 digits)

Example: 168AAX1300

#### Series AAA

Range 1.300 to 1.395. Adjusted to  $\pm 0.0002$ . Slightly volatile, colorless fluorocarbon formulation. Keep tightly stoppered to preserve the integrity of the liquid. Available in the following sets and sizes.

#### Series AA

Range 1.400-1.458. Adjusted to  $\pm 0.0002$ . Very stable, colorless.

#### Series A

Range 1.460 to 1.640. Adjusted to  $\pm 0.0002$ . Very stable, colorless at the low end and increasing to faint yellow at the high end.

Composition: Aliphatic hydrocarbons as well as other organic compounds. They are not aqueous based.

Compatibilities: They do appear to be compatible with Plexiglas (acrylic) 25° C.

#### Series H

Range 1.81 to 2.00. Adjusted to  $\pm 0.0015$ . Quite stable. Color varies from yellow to brown. Toxic and corrosive. A super-saturated solution. May crystallize with time and low temperature. Formulation: arsenic tribromide, arsenic disulfide and sulfur.

#### Series EH

Range 2.01 to 2.11. Adjusted to  $\pm 0.0015$ . Quite stable. Similar to series H but contains selenium. Toxic and corrosive. Darker color, more viscous.

#### RF Combined Series Set

Range: 1.400 - 1.700

The range of many minerals, most chemicals and virtually all biological materials are covered by the three Series AA, A, and B. These three series consist of 151 liquids and are available as set 168RF1.



### Cargille Shelf Life:

The products are very stable however they are in general organic compounds and therefore, any prediction of shelf life would clearly be less than "infinite." The dating does reference shelf life as opposed to some absolute expiration date. Once opened, shelf life is approximately half of that of an unopened bottle; and the shelf life is a function of the particular refractive index product:

Series AAA, AA, A, B, H, EH:        5 years unopened, when stored at room temperature, shielded from light;  
2.5 years if opened

Series M:                                18 months maximum

Series E:                                2.5 to 5 years depending on RI (the higher it is, the longer it will last)

### Letter of Certification (Catalog # 168CERT):

McCrone Microscopes & Accessories can provide a letter of certification when you purchase Cargille liquids. Such letters are available for additional cost at the time of the original purchase. If certification statements are ordered at a later time, then a different and more expensive cost structure applies.

### Rack for R.I. liquids (Catalog # 168RK):

Solid mahogany wood, with transparent rigid plastic cover. Contains four stepped rows for easily identifying numbers on labels. Each row holds thirteen 1/4 oz. bottles.

### Summary:

#### CARGILLE LIQUIDS

#### *Index of Refraction*

#### Areas of Interest and Typical Applications

##### - Identification

Identify minerals, ores, chemicals, specimen fragments, plastics, gems, translucent or transparent solids by microscopic immersion techniques

##### - Mounting Media

Temporarily mount specimens in various index media for matching or contrasting index combinations. Mount specimens and thin sections in a stable, viscous, non-drying index of refraction liquid to permit sample rotation by shifting cover glass for more comprehensive examination (crystal rolling)

##### - Optical Analysis

Microscopically study solids by dispersion staining, focal masking and double variation refractometry techniques with high dispersion liquids

##### - Refractometry

Calibrate refractometers and other optical instruments