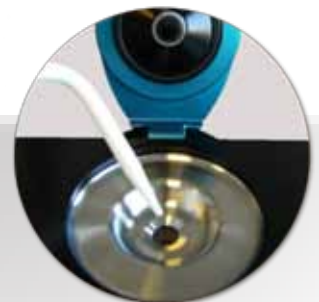


ARAGO

Refractometer Series

Measures when others fail

INNOVATIVE DIGITAL REFRACTOMETERS



IDEAL FOR

Petrochemicals & Oils
Pharmaceuticals
Food industry
Nanoparticles
Cosmetics
Chemicals
Polymers
Gel... and more

www.cordouan-tech.com





MEASUREMENT PRINCIPLE

ABBE VS FRESNEL

The refractive index (RI) of a medium is a fundamental physical property which depends on several characteristics of the medium : its temperature and surrounding pressure, the medium composition, the light wavelength. That is why the RI is often used to identify a particular substance, confirm its purity, or measure its concentration. The RI of liquids (or solids) is commonly measured with Abbe optical refractometers, relying on the measurements of the critical angle for total internal reflection. For Abbe refractometers, the RI is limited by the choice of the prism material (Fig.1). In order to get the maximum measurement range, 1.30 nD to 1.70 nD, one needs to use expensive synthetic Sapphire prism.

The **ARAGO** works on a different principle based on a light reflection measurement. This confers some keys benefits to **ARAGO** compared to Abbe refractometers : an unequaled **extended measurement range; from 1.2 nD to 3.1nD** (Fig.1) and the outstanding ability to measure in **dark/opaque samples**.

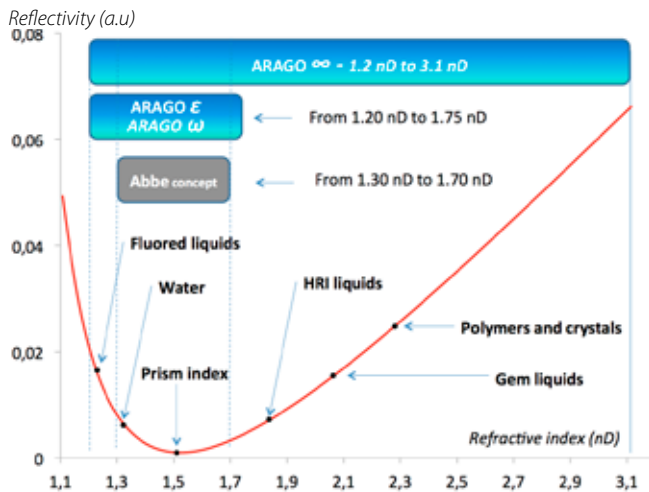


Fig. 1: Abbe Vs ARAGO - Measurement range comparison

WHERE DOES THIS INNOVATION COME FROM?

The **ARAGO** refractometer is based on an innovative concept developed and patented by the French Institute of Petroleum (IFPEN) in the course of its work on advanced petroleum applications.

Indeed, because conventional techniques failed to fulfill their needs, new characterization techniques were required in particular for high RI and particle size analysis in dark and/or concentrated medium. Thus for RI measurement they came up with an original concept based on the measurement of the reflection of light intensity at the interface between a transparent glass medium (prism) and a liquid medium (sample).

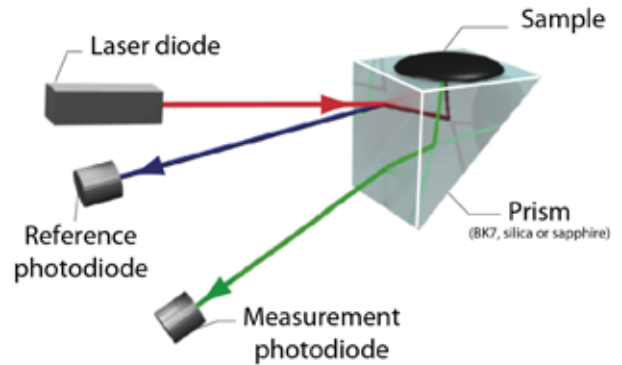


Fig. 2: ARAGO - Measurement configuration (patented)

With its unique optical design based on Fresnel reflection coefficient measurement (Fig. 2), **ARAGO** provides the broadest RI measurement range and unprecedented capability to measure concentrated and opaque liquids, compared to all other digital refractometers on the market. This makes **ARAGO** a very versatile and easy to use instrument, perfectly suitable for both conventional and the most demanding applications in research and industry.

FRIENDLY MEASUREMENTS

The **ARAGO** sample cell geometry (Fig. 3) is designed for easy cleaning, preventing from cross contamination problems between samples.

Its innovative hermetic cell cover guarantees optimum measurement accuracy, preventing sample evaporation and enhancing the temperature stability.

Simple, clever & efficient

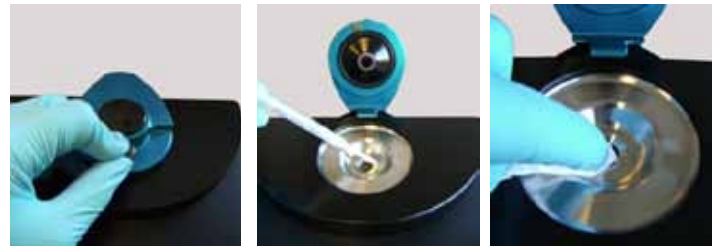


Fig. 3: ARAGO - Easy to use technology

A TECHNOLOGY BREAKTHROUGH - UNPRECEDENTED REFRACTIVE INDEX RANGE

HISTORICAL ABBE REFRACTOMETERS

- Measurement range **limited by the prism material** (1.3 nD to 1.5 nD usually and up to 1.7 nD with a sapphire prism)
- **Degraded accuracy** and repeatability with opaque media
- All commercial optical refractometers work on ABBE principle. Therefore they all have the same limitations.



ARAGO - MEASURES WHEN OTHER FAILS

- Extended measurement range : **1.2 nD to 3.1 nD !**
- Adapted for concentrated / **opaque samples**
- **Innovative** patented technology
- **High RI liquids** measurements



ARAGO REFRACTOMETERS

FEATURES & BENEFITS

- World's largest RI measurement range : from 1.2 nD to 3.1 nD
- RI Measurement accuracy : 4 th and 5 th decimal depending on model
- Sample cell :
 - Small sample volume: typ 50 μ l
 - High durability materials: 316 L stainless steel + SiO₂, BK7 or Sapphire glass prism
 - Built in TEC temperature control for efficient sample temperature stabilization
- Touch screen with user friendly interface:
 - Zeroing in one click
 - Measurement results real time plot
 - Easy and accurate temperature setting with steps down to 0.1 $^{\circ}$ C
 - Results automatic saving
- Brix scale with automatic temperature compensation; other scale on demand
- Narrow band Light source: high reliability temperature stabilized laser diode

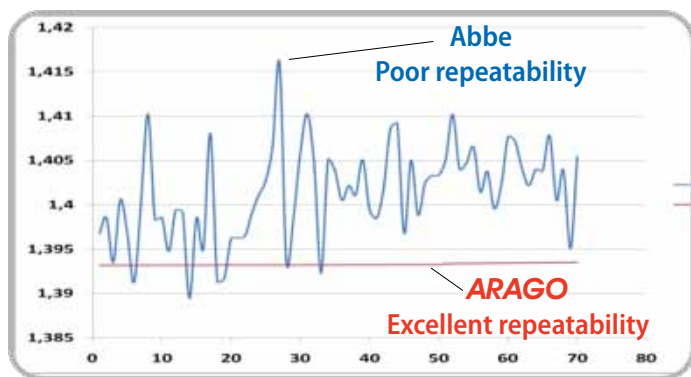


Fig. 4: **Abbe Vs ARAGO** - Measurement on a commercial black ink

Illustration, at constant T $^{\circ}$ C (25 $^{\circ}$ C), of the impact of sample absorption on the measurement repeatability performances. From this graph, one can clearly see the obvious advantage of ARAGO over Abbe refractometers...

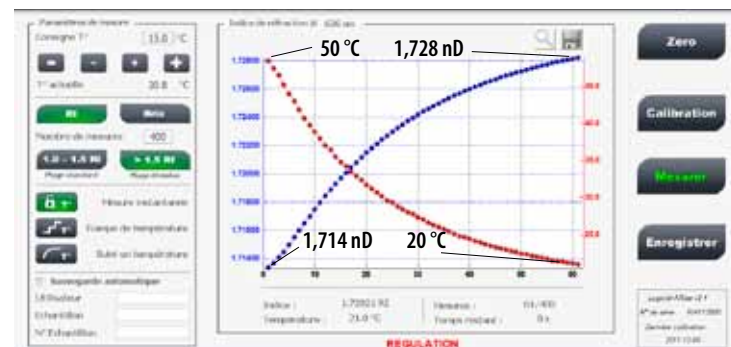


Fig.5 : **Arise**[®], intuitive software interface combined with a touchscreen computer.

Easy to use and powerful software for accurate and quick measurement. The possibility to also measure the RI as a function of temperature in real time allows new applications like polymerization process tracking or n(T) studies more generally.

APPLICATIONS

Petrochemicals & Oil

The ARAGO product line allows high precision measurement with an excellent stability and accuracy of temperature control (with steps of 0,1 $^{\circ}$ C) up to 100 $^{\circ}$ C. Compliant with norms ASTM D1747, D1218, D5006.

Examples : Study of aggregates and crystallization in oil solutions, study of viscous materials, paraffin, pollutants...

Chemical, Cosmetics and pharmaceutical

Chemical industries develop high purity products for a wide range of applications. Thanks to its 5 digit accuracy, and its ability to measure concentrated samples, the ARAGO product line provides flexible solutions for each need, from advanced research to production quality control in industry.

Examples : Fluoride and acid liquid, oxidizing agent, medical analysis (protein...), agriculture agent (fertilizer, pesticide...), antifreeze, disinfection (detergents...)...

Polymer - High refractive index

The refractometer ARAGO provides the broadest RI measurement range among all the digital refractometer market. This innovative feature open up new measurement capabilities in the most demanding applications.

Examples : high index coating, crystallisation kinetics, sol-gel, photosensitive polymer...

Colloidal and complex fluids

Study of colloidal solutions or complex fluids effective refractive index, involves high accuracy and high repeatability measurement. The ARAGO products line offers large possibility to fit with these applications.

Examples : Nanoparticles fluids for immersion lithography, polymer optimization, RI measurement of metal based liquids (Aluminum/Oxide/Gold/Titan...)...

Photonic

New photonics industries require measurement of high RI liquid. The ARAGO refractometer is able to meet these needs, especially when the material is in a liquid form.

Examples : Immersion lithography, high RI encapsulant to enhance light extraction from semi-conductor, photonic crystals, microlens array, matching index fluids for high power laser, lightpipe and waveguide applications...

Contact us!

For specific applications, we provide customized solutions, please contact us!

Examples : solids measurement (thin films, crystals...), birefringent material, on-line measurement...

ARAGO


Refractometer Series

Technical	ARAGO ϵ	ARAGO ω	ARAGO ∞
Range (nD)	1.25 to 1.51 or 1.51 to 1.75	1.20 to 1.75	1.20 to 3.10
Resolution (nD)	$\pm 0,00001$	$\pm 0,00001$	$\pm 0,000001$
Accuracy (nD) ⁽¹⁾	$\pm 0,0001$	$\pm 0,00005$	$\pm 0,00001$
Temperature control range (°C) ⁽²⁾	Ambient T°	15 to 65	15 to 80
Brix Scale (e.g. Arago ω)	0-95% / Resolution ± 0.002 % / Accuracy & Reproducibility ± 0.01 %		

Component	ARAGO ϵ	ARAGO ω	ARAGO ∞
Prism (Standard)	BK7 ⁽³⁾	Silica ⁽³⁾	Sapphire ⁽³⁾
Operating wavelength (Standard)	635 nm ⁽⁴⁾	658 nm ^{(4) (6)}	658 nm ^{(4) (6)}
Cell material	Stainless steel ⁽⁴⁾		
Operator consol	Touchscreen PC ⁽⁶⁾ or user personal computer		
Arise® Software	Setup and operation in English or French		

Common characteristics	ARAGO ϵ	ARAGO ω	ARAGO ∞
Light source ⁽⁶⁾	Laser Diode temperature stabilized with built-in Peltier system ⁽⁶⁾		
Size (cm)	10 x 24 x 27		
Weight (kg)	8		
Interfaces	USB Port		
Power requirements	100-240 VAC - 50/60 Hz - min: 10 W, max: 50 W depending on sample and ambient T°C		

Options	ARAGO ϵ	ARAGO ω	ARAGO ∞
Temperature control (15-65°C)	✓	Included	Included
High Temperature control (10-100°C)	N.A.	✓	✓
High precision ($\pm 0,00001$ nD)	N.A.	✓	Included
Software FDA 21 Part 11 Compliance	N.A.	✓	✓
NIST traceable calibration liquids	2 points	3 points	3 to 5 points
Touchscreen PC ⁽⁷⁾	✓	✓	✓

Features & benefits	<i>Fits with basics needs</i>	<i>Ready for any job</i>	<i>Measures when others fail</i>
<p>The innovative ARAGO product line was created to cover the broadest range of application from the most basic to the most advanced. This patented technology based on Fresnel principle comes from the collaboration of the French Institut of Petroleum, IFP, with Cordouan Technologies and is especially dedicated to measurement of high refractive index samples of dark solutions.</p> 	<ul style="list-style-type: none"> Fast screening Routine applications Standard accuracy Ambient temperature measurement 	<ul style="list-style-type: none"> Scientific - Research - Laboratories Industrial quality control High accuracy Temperature control Most popular model 	<ul style="list-style-type: none"> Advanced applications High resolution High RI measurement for research & industrial research Beyond Abbe measurement range Extremes conditions and complex samples

(1): Valid at refractometric standard conditions T= 20°C, $\lambda = 658$ nm, ambient temperature = 20-25°C

(2): Controlled by TEC/Peltier for ARAGO ω and ARAGO ∞

(3): Others special prisms are available for specifics applications (silica, BK7, sapphire...)

(4): optional wavelengths : 405 nm - 406 nm - 473 nm - 488 nm Ar/Ion - 589 nm Na-D - 635 nm - 643 nm Cd-C - 656 nm H - 670 nm - 685 nm - 705 nm - 785 nm - 808 nm - 830 nm... and others on request

(5): Stainless steel as standard. Hastelloy™ available as option for specific applications

(6): Available as standard for ARAGO ω and ARAGO ∞

(7): The Arago software ("Arise®") can be installed on the user PC. However Cordouan Tech. strongly recommends using the touchscreen PC, available in option, which has been chosen for its convenience.

Minimal configuration requires: Windows XP or Seven, processor 32 or 64 bits, 1 USB port, RAM 1 GB, Screen resolution 15" - 1366*768 pixels

Calibration Kit available

For the best accuracy & reliability



Touch me!

Experience the improved functionality with intuitive touchscreen



Contact sales :

sales@cordouan-tech.com



11, avenue de Canteranne
33600 Pessac - France
Tel + 33 (0)556 158 045
Fax +33(0) 547 747 491
www.cordouan-tech.com