**STANDARD ACCESSORIES**

<table>
<thead>
<tr>
<th>DR-A1</th>
<th>Test piece</th>
<th>1 pc</th>
<th>Contact liquid (monochromaphthalene)</th>
<th>1 pc</th>
<th>Allen wrench for attaching/detaching piece</th>
<th>1 pc</th>
<th>LED lamp</th>
<th>3 pcs</th>
<th>Tube band</th>
<th>10 pcs</th>
<th>AC adapter (AD-1)</th>
<th>1 pc</th>
<th>AC cable</th>
<th>1 pc</th>
<th>Instruction manual</th>
<th>1 pc</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAR-1T</td>
<td>Digital thermometer</td>
<td>1 pc</td>
<td>AC power cable</td>
<td>1 pc</td>
<td>Lamp cable</td>
<td>1 pc</td>
<td>LED lamp</td>
<td>3 pcs</td>
<td>Tube piece</td>
<td>1 pc</td>
<td>Contact liquid (monochromaphthalene)</td>
<td>1 pc</td>
<td>Allen wrench for calibration</td>
<td>1 pc</td>
<td>LED lamp</td>
<td>3 pcs</td>
</tr>
<tr>
<td>NAR-2T</td>
<td>Digital thermometer</td>
<td>1 pc</td>
<td>AC power cable</td>
<td>1 pc</td>
<td>Lamp cable</td>
<td>1 pc</td>
<td>LED lamp</td>
<td>3 pcs</td>
<td>Tube piece</td>
<td>1 pc</td>
<td>Contact liquid (monochromaphthalene)</td>
<td>1 pc</td>
<td>Allen wrench for calibration</td>
<td>1 pc</td>
<td>Test piece</td>
<td>1 pc</td>
</tr>
<tr>
<td>NAR-4T</td>
<td>Digital thermometer</td>
<td>1 pc</td>
<td>AC power cable</td>
<td>1 pc</td>
<td>Lamp cable</td>
<td>1 pc</td>
<td>LED lamp</td>
<td>3 pcs</td>
<td>Tube piece</td>
<td>1 pc</td>
<td>Contact liquid (monochromaphthalene)</td>
<td>1 pc</td>
<td>Contact liquid</td>
<td>1 pc</td>
<td>Contact liquid containing sulfur solution</td>
<td>1 pc</td>
</tr>
</tbody>
</table>

**OPTIONAL PARTS**

- For measuring solid samples (excluding the NAR-1T LIQUID)
  - Test Piece D For Measurement of Film (Part No. RE-124)
  - Test Piece E For Measurement of Film (Part No. RE-132)
  - Adapter For Film Sample (for DR-A1)
  - Contact Liquid
  - Contact Liquid containing monochromaphthalene
  - Contact Liquid containing sulfur solution
  - Contact Liquid containing Naphthalene
  - Contact Liquid containing Naphthalene containing sulfur solution
  - Test Piece C For Measurement of Film (Part No. RE-1581)
  - Test Piece D For Measurement of Film (Part No. RE-1582)
  - Test Piece E For Measurement of Film (Part No. RE-1583)
  - Contact Liquid containing monochromaphthalene
  - Contact Liquid containing monochromaphthalene containing sulfur solution
  - Contact Liquid containing monochromaphthalene containing sulfur solution
  - Contact Liquid containing Naphthalene
  - Contact Liquid containing Naphthalene containing sulfur solution

- For connecting to a computer (for DR-A1/DR-A1 Plus only)
  - RS-232C Cable For Personal Computer (D-Sub 9 Pin) Parts No. RE-15005

- For DR-A1/DR-A1 Plus

- Test Piece For Measurement of Film (Part No. RE-1498)
- Test Piece E For Measurement of Film (Part No. RE-1499)
- Contact Liquid For Film Sample (for DR-A1)
- Contact Liquid containing monochromaphthalene
- Contact Liquid containing sulfur solution
- Contact Liquid containing Naphthalene
- Contact Liquid containing Naphthalene containing sulfur solution
- Test Piece C For Measurement of Film (Part No. RE-1581)
- Test Piece D For Measurement of Film (Part No. RE-1582)
- Test Piece E For Measurement of Film (Part No. RE-1583)
- Contact Liquid containing monochromaphthalene
- Contact Liquid containing monochromaphthalene containing sulfur solution
- Contact Liquid containing monochromaphthalene containing sulfur solution
- Contact Liquid containing Naphthalene
- Contact Liquid containing Naphthalene containing sulfur solution

- For connecting to a computer (for DR-A1/DR-A1 Plus only)

- RS-232C Cable For Personal Computer (D-Sub 9 Pin) Parts No. RE-15005

**Interference Filters for MULTI-WAVELENGTH ABBE REFRACTOMETERS**

(Standard accessory only 598nm)

<table>
<thead>
<tr>
<th>Filter</th>
<th>波長</th>
<th>Parts No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>598nm</td>
<td>Parts No. RE-3520</td>
<td>598nm</td>
</tr>
<tr>
<td>497nm</td>
<td>Parts No. RE-3525</td>
<td>497nm</td>
</tr>
<tr>
<td>486nm</td>
<td>Parts No. RE-3530</td>
<td>486nm</td>
</tr>
<tr>
<td>589nm</td>
<td>Parts No. RE-3535</td>
<td>589nm</td>
</tr>
<tr>
<td>546nm</td>
<td>Parts No. RE-3540</td>
<td>546nm</td>
</tr>
</tbody>
</table>

**For DR-A1/DR-A1 Plus**

- Test Piece For Measurement of Film (Part No. RE-1498)
- Test Piece E For Measurement of Film (Part No. RE-1499)
- Contact Liquid For Film Sample (for DR-A1)
- Contact Liquid containing monochromaphthalene
- Contact Liquid containing sulfur solution
- Contact Liquid containing Naphthalene
- Contact Liquid containing Naphthalene containing sulfur solution
- Test Piece C For Measurement of Film (Part No. RE-1581)
- Test Piece D For Measurement of Film (Part No. RE-1582)
- Test Piece E For Measurement of Film (Part No. RE-1583)
- Contact Liquid containing monochromaphthalene
- Contact Liquid containing monochromaphthalene containing sulfur solution
- Contact Liquid containing monochromaphthalene containing sulfur solution
- Contact Liquid containing Naphthalene
- Contact Liquid containing Naphthalene containing sulfur solution

**For connecting to a computer (for DR-A1/DR-A1 Plus only)**

- RS-232C Cable For Personal Computer (D-Sub 9 Pin) Parts No. RE-15005

**Measurement of Birefringent Samples**

Measurement of birefringent (double refraction) materials requires an optional Polarizing Eyepiece (Part No. RE-1146). Double refraction measurements are available at wavelengths between 450 and 680nm. Contact us for more details.

**Special Order Option**

The sample stage height can be customized.

All ATAGO refractometers are designed and manufactured in Japan.

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**Page 2**

**DR-A1**<br>**DIGITAL**

**Page 3**

**NAR-1T LIQUID**

**NAR-1T SOLID**

**NAR-2T**<br>**HIGH TEMPERATURE MODEL**

**Page 4**

**NAR-3T**<br>**PRECISION MODEL**

**NAR-4T**<br>**HIGH REFRACTIVE INDEX MODEL**

**Multi-Wavelength Abbe Refractometers**

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**DR-M2**

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**DR-M2/1550**

**DR-M4**

**Page 7**

**DR-M4/1550**

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**Abbe Refractometers**

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- TEL: 91-11-277-60-66 customerservice@atago-india.com

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**Headquarters:** The Front Tower Shiba Koen, 23rd Floor 3-3-4 Shiba-kouen, Minato-ku, Tokyo 105-0011, Japan
**TEL:** 81-3-3431-1943 **FAX:** 81-3-3431-1940
**web site:** atago-net
**HACCP GMP GLP**

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*Specifications and appearance are subject to change without notice.*
**Uses and Applications of the Abbe Refractometers**

ATAGO’s Abbe Refractometers are widely used in a variety of fields; from basic research to product management.

**Uses and Applications**

- For measuring the refractive index (nD) of liquid samples between 5 to 50°C: DR-A1, DR-A1-Plus, and NAR-1T LIQUID. We recommend the NAR-3T for high-accuracy measurements.
- For measuring the refractive index (nD) of liquid samples up to 120°C: NAR-2T
- For measuring the refractive index (nD) of solid samples (glass, plastics, films, etc.): NAR-1T SOLID, DR-A1, and DR-A1-Plus. The NAR-3T is also capable of measuring clear, translucent glass or plastics.
- For measuring liquid or solid samples with a high refractive index (1.47 to 1.87): NAR-4T
- For measuring and determining the refractive index or Abbe number of liquid or solid samples at different wavelengths: DR-M Series: DR-M2, DR-M2/1550, DR-M4, and DR-M4/1550 (For high refractive index measurements.)
- For determining average dispersion values or abbe numbers: NAR-1T SOLID, NAR-2T, NAR-3T
- For measuring Brix (%): DR-A1, DR-A1-Plus, and NAR-1T LIQUID. We recommend the NAR-3T for high-accuracy measurements.
- For connecting to a printer: DR-A1, DR-A1-Plus, and DR-M Series
- For measuring birefringent (double refraction) samples (plastics, films) that have different refractive indices depending on their orientation, or for measuring the ordinary ray (n subscript null) or extraordinary ray (n subscript exponential) of liquid crystals (LCs): DR-A1, DR-A1-Plus, NAR-1T SOLID, NAR-2T, NAR-4T, and DR-M Series

**ATAGO Products Conform to ASTM Standards**

Please contact ATAGO for further details.

- D942 STM for Index of Refraction of Transparent Organic Plastics
- D1045 STM for Sampling and Testing Plasticizers Used in Plastics
- D1218 STM for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids
- D1416 STM for Rubber from Synthetic Sources—Chemical Analysis
- D1747 STM for Refractive Index of Viscous Materials
- D3321 STM for Use of the Refractometer for Field Test Determination of the Freezing Point of Aqueous Engine Coolants
- D4065 STM for Use of the Refractometer for Determining Nonvolatile Matter (Total Solids) in Floor Polishes
- D5006 STM for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
- D5775 STM for Use of the Refractometer for Field Test Determination of the Freezing Point of Aqueous Engine Coolants

**Sucrose Solution (for Brix confirmation)**

Sucrose solutions for Brix confirmation are now available by ATAGO. Please choose the most suitable sucrose solution for your application.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Part Name</th>
<th>Brix Concentration</th>
<th>Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE-110010</td>
<td>10% Sucrose</td>
<td>10.00 ± 0.03%</td>
<td>Approx. 5mL</td>
</tr>
<tr>
<td>RE-110020</td>
<td>20% Sucrose</td>
<td>20.00 ± 0.03%</td>
<td>Approx. 5mL</td>
</tr>
<tr>
<td>RE-110030</td>
<td>30% Sucrose</td>
<td>30.00 ± 0.03%</td>
<td>Approx. 5mL</td>
</tr>
<tr>
<td>RE-110040</td>
<td>40% Sucrose</td>
<td>40.00 ± 0.04%</td>
<td>Approx. 5mL</td>
</tr>
<tr>
<td>RE-110050</td>
<td>50% Sucrose</td>
<td>50.00 ± 0.05%</td>
<td>Approx. 5mL</td>
</tr>
<tr>
<td>RE-110060</td>
<td>60% Sucrose</td>
<td>60.00 ± 0.05%</td>
<td>Approx. 5mL</td>
</tr>
</tbody>
</table>

Custom concentration sucrose solutions are now available. Accuracy and price will depend on the concentration; please contact ATAGO for more details.

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**Common Specifications (DR-A1/DR-A1-Plus)**

- Measurement Range: Refractive Index (nD) 1.3000 to 1.7100, Brix 0.0 to 100.0%
- Resolution: Refractive Index (nD) 0.0001, Brix 0.1%
- Measurement accuracy: Refractive Index (nD) ±0.0002, Brix ±0.1%
- Measurement temperature: 5 to 50°C (Circulating constant temperature bath range, as well as Brix temperature compensation range.)
- Thermometer accuracy: ±0.2°C
- Ambient temperature: 5 to 40°C
- Indications: Refractive Index (nD), Brix (%), Temp (°C)
- Display: LCD
- Light source: LED Lamp (Approximating to wavelength of D-line)
- Power supply: AC adapter (100 to 240V [50/60Hz]) AC input
- Power consumption: 16VA
- Output: Printer DR-5002 (Optional)
- PC (via RS-232C)
- Dimensions and weight: 13.5×29×31cm, 6.0kg (Main unit), 10.5×17.5×4cm, 0.7kg (AC adapter)

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**Choosing the Right Model for Your Sample Type**

### DR-A1

- **Stews**
- **Ketchup**
- **Curry**
- **Salts**
- **Vinaigrettes**
- **Milk**
- **Yogurt**
- **Puree**
- **Grape juice**
- **Soy sauce**

### DR-A1-Plus

- **Clear samples with undissolved solids**
- **Opaque samples with undissolved solids**

*Samples containing undissolved solids may not produce measurement results.

---

**For Measuring Emulsions or Dark Samples**

The DR-A1-Plus features a brighter field of view, making it easier to measure emulsions or dark samples.

*Samples containing undissolved solids may not produce measurement results.*
**NAR-1T LIQUID**
Cat.No.1211

For Measuring Liquid Samples Only

**NAR-1T SOLID**
Cat.No.1212

For Measuring Solid Samples

The NAR-1T LIQUID is for liquid sample measurement only. This model has the Refractive Index scale and Brix scale, and operates with D line (589nm) light source. Calibration is performed using distilled water.

The NAR-1T SOLID Abbe Refractometer was designed for solid sample measurement (this model can also measure liquid samples). This model has the Refractive Index scale and Brix scale, and operates with D line (589nm) light source.

**Specifications**

- **Measurement Range**:
  - Refractive Index (nD): 1.0000 to 1.7000,
  - Brix: 0.00 to 95.00%
- **Minimum scale**:
  - Refractive Index (nD): 0.0001, Brix: 0.5%
- **Measurement accuracy**:
  - Refractive Index (nD): ±0.0002, Brix: ±0.1%
- **Ambient temperature**: 5 to 50°C
- **Thermometer accuracy**: ±0.2°C
- **Light source**: LED Lamp (Approximating to wavelength of D-line)
  - AC100 to 240V, 50/60Hz
- **Power supply**: 5VA
- **Power consumption**: 5VA
- **Dimensions and weight**: 13×18x23cm, 2.5kg (Main unit)
  - 10×11x7cm, 0.5kg (Thermometer)

**Note:** The refractive index scale and Brix scale are calculated according to a conversion table.

**Specifications**

- **Measurement Range**:
  - Refractive Index (nD): 1.3000 to 1.71000,
  - Brix: 0.00 to 95.0%
  - ±0.0002, Brix ±0.1%
  - ±0.0001, Brix ±0.05%
- **Minimum scale**:
  - Refractive Index (nD): 0.001, Brix 0.5%
- **Measurement accuracy**:
  - Refractive Index (nD): ±0.0001, Brix ±0.05%
  - ±0.0002, Brix ±0.1%
- **Ambient temperature**: 5 to 50°C
- **Thermometer accuracy**: ±0.2°C
- **Light source**: LED Lamp (Approximating to wavelength of D-line)
  - AC100 to 240V, 50/60Hz
- **Power supply**: 5VA
- **Power consumption**: 5VA
- **Dimensions and weight**: 13×18x23cm, 2.5kg (Main unit)
  - 10×11x7cm, 0.5kg (Thermometer)

**Note:** To obtain the refractive index value, simply refer to the conversion table that is provided with this unit. Dispersion values cannot be measured with this unit.

**NAR-2T**
Cat.No.1220

High Temperature Model

**NAR-3T**
Cat.No.1220

Precision Model

**NAR-4T**
Cat.No.1240

High Refractive Index Model

The NAR-2T is the unit with the highest degree of precision and accuracy among the Abbe Refractometers. It was developed to give improved measurement accuracy and ease of use. This was achieved by making fundamental improvements to the optical system and utilizing a larger scale, which allows for a refractive index scale measurements of up to 0.00005. Incorporating a high intensity lamp and using a double control knob gives quick and more accurate control.

Research and Development on new materials for modern technologies is being actively conducted in every industry. Many of these materials (especially polymer films and related materials) are of high refractive index - often too high for the existing Abbe refractometers. These can now be measured with the NAR-1T LIQUID range of the NAR-4T.

**Specifications**

- **Measurement Range**:
  - Refractive Index (nD): 1.4700 to 1.8700
  - Brix: 0.00 to 95.0%
- **Minimum scale**:
  - Refractive Index (nD): 0.0001, Brix 0.5%
- **Measurement accuracy**:
  - ±0.0001, Brix ±0.05%
- **Ambient temperature**: 5 to 50°C
- **Thermometer accuracy**: ±0.2°C
- **Light source**: LED Lamp (Approximating to wavelength of D-line)
  - AC100 to 240V, 50/60Hz
- **Power supply**: 5VA
- **Power consumption**: 5VA
- **Dimensions and weight**: 13×18x23cm, 2.5kg (Main unit)
  - 10×11x7cm, 0.5kg (Thermometer)

**Note:** The NAR-1T is for liquid sample measurement only. This model is for solid sample measurement (this model can also measure liquid samples). This model has the Refractive Index scale and Brix scale, and operates with D line (589nm) light source.

The NAR-3T is the unit with the highest degree of precision and accuracy among the Abbe Refractometers. It was developed to give improved measurement accuracy and ease of use. This was achieved by making fundamental improvements to the optical system and utilizing a larger scale, which allows for a refractive index scale measurements of up to 0.00005. Incorporating a high intensity lamp and using a double control knob gives quick and more accurate control.

**Specifications**

- **Measurement Range**:
  - Refractive Index (nD): 1.3000 to 1.71000,
  - Brix: 0.00 to 95.0%
- **Minimum scale**:
  - Refractive Index (nD): 0.0001, Brix 0.5%
- **Measurement accuracy**:
  - Refractive Index (nD): ±0.0002, Brix ±0.1%
- **Ambient temperature**: 5 to 120°C
- **Thermometer accuracy**: ±0.2°C
- **Light source**: LED Lamp (Approximating to wavelength of D-line)
  - AC100 to 240V, 50/60Hz
- **Power supply**: 5VA
- **Power consumption**: 5VA
- **Dimensions and weight**: 13×18x23cm, 2.5kg (Main unit)
  - 10×11x7cm, 0.5kg (Thermometer)

**Specifications**

- **Measurement Range**:
  - Refractive Index (nD): 1.1500 to 1.4800
  - Measurement temperature: 5 to 50°C
- **Minimum scale**:
  - Refractive Index (nD): 0.001, Brix 0.1%
- **Measurement accuracy**:
  - Refractive Index (nD): ±0.0001, Brix ±0.05%
- **Ambient temperature**: 10 to 120°C
- **Thermometer accuracy**: ±0.2°C
- **Light source**: LED Lamp (Approximating to wavelength of D-line)
  - AC100 to 240V, 50/60Hz
- **Power supply**: 5VA
- **Power consumption**: 5VA
- **Dimensions and weight**: 13×18x23cm, 2.5kg (Main unit)
  - 10×11x7cm, 0.5kg (Thermometer)
**MULTI-WAVELENGTH ABBE REFRACTOMETERS**

**DR-M2**

**High Refractive Index Model**

**Cat.No.1410**

Refractive Index or Abbe number (νd or νe) can be measured at different wavelengths ranging from 450 to 1,100 nm. For measurement at wavelengths ranging from 681 to 1,100 nm, the optional near infrared ray viewer (Part No.RE-9119) is required. The DR-M2/DR-M4 digitally displays the measurement results of refractive index or Abbe number on the LCD. Measurement can be achieved by matching the boundary line at the intersection point of the cross hairs. These refractometers can be connected to the digital printer. The DR-M4 is a high refractive index version of the DR-M2, with a refractive index measurement range of 1.700 to 1.8700 (at a wavelength of 589nm). The DR-M4 shares common appearance and features with the DR-M2.

**Specifications**

- **Resolution**
  - Refractive Index (νd): 0.0001, Abbe number 0.1
  - Wavelength range: From 450 to 1,100 nm
- **Measurement accuracy**
  - Refractive Index (νd): ±0.0002 (With the attached test piece at 500 to 650 nm)
- **Thermometer accuracy** ±0.2°C
- **Ambient temperature** 5 to 40°C
- **Power consumption** 13VA
- **Output** For digital printer, DP-63B (optional), Conforming to Centronics standard
- **Power supply** AC 110 to 240V, 50/60Hz
- **Dimensions and weight** 15×33×11 cm, 3.2 kg (Power supply unit)

**Optional Accessories**

**Circulating Constant Temperature Bath 60-C5** Cat.No.1923

A circulating water bath for precise temperature control of refractometers without Peltier. The temperature range can be set from 10 to 60°C and its compact, easy to use design makes it optimal for connecting to a refractometer.

**Digital Printer DP-63(C)** for DR-M2, DR-M4, DR-M2/1550, DR-M4/1550

**Cat.No.3136**

- **Printing methods** Thermal dot
- **Power consumption** 13W
- **Power supply** AC adapter
- **Input voltage** AC 100 to 240V
- **Dimensions and weight** 17x17x7 cm, 580 g (main unit only)

**ULTIMATE WAVELENGTH ABBE REFRACTOMETERS**

**DR-M2/1550**

**High Refractive Index Model**

**Cat.No.1412**

Refractive Index or Abbe number (νd or νe) can be measured at different wavelengths ranging from 450 to 1,550 nm. Measurement at wavelengths of 1550 nm has become more in demand with the recent development of materials for IT communications fields. The DR-M2/1550 and the DR-M4/1550 are suitable for measuring samples that require a refractive index in the near infrared range, such as fiber optics materials, optical glass, and plastics. These models are equipped with a power supply unit and a monochromatic light source. They can be used with a near infrared ray viewer or interference filters. These refractometers digitally display the measurement result on the LCD. Measurement can be achieved by matching the boundary line at the intersection point of the cross hairs. These units can be connected to the digital printer.

The DR-M2/1550 is a high refractive index version of the DR-M2/1550, with a refractive index measurement range of 1.700 to 1.8700 (at a wavelength of 589nm). The DR-M4/1550 shares common appearance and features with the DR-M2/1550.

**Specifications**

- **Resolution**
  - Refractive Index (νd): 0.0001, Abbe number 0.1
- **Wavelength range**: From 450 to 1,550 nm
- **Measurement accuracy**
  - Refractive Index (νd): ±0.0002 (With the attached test piece at 500 to 650 nm)
- **Thermometer accuracy** ±0.2°C
- **Ambient temperature** 5 to 40°C
- **Power consumption** 160W
- **Output** For digital printer, DP-63B (optional), Conforming to Centronics standard
- **Power supply** AC 110 to 240V, 50/60Hz
- **Dimensions and weight** 15×33×11 cm, 3.2 kg (Power supply unit)

**Abbe number can be measured simply!**

(1) Set the sample on the prism surface.
(2) Insert the 589nm interference filter (attached to the DR-M2 as a standard accessory).
(3) While looking through the eyepiece, match the boundary line with the intersection point of the cross hairs. Then, press the SET key.
(4) Replace the interference filter with the 665nm interference filter (of an optional part). While looking through the eyepiece, match the boundary line with the intersection point of the cross hairs.
(5) Press the SET key. The indication on the display at that time represents the Abbe number “νe”.

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*For optimum convenience, use an optional digital printer to print out the refractive index at each wavelength and Abbe number.*