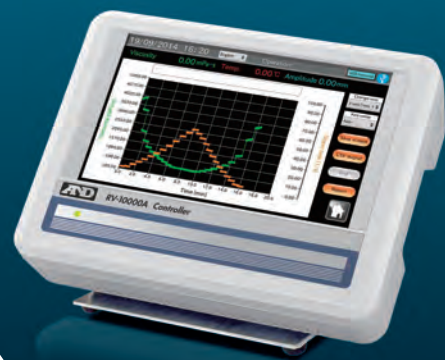
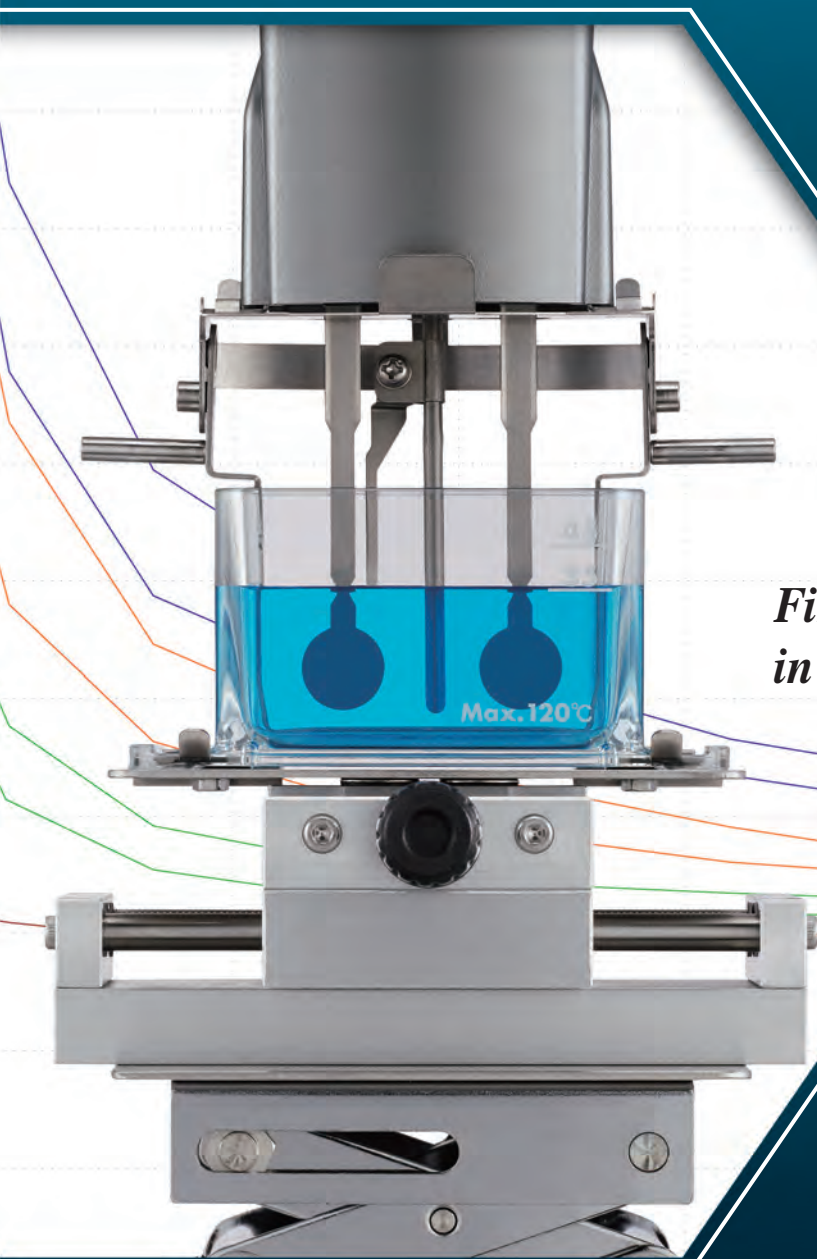


Tuning Fork Vibro Rheometer

RV-10000A



*Finally, a cure for poor repeatability
in low viscosity measurements*



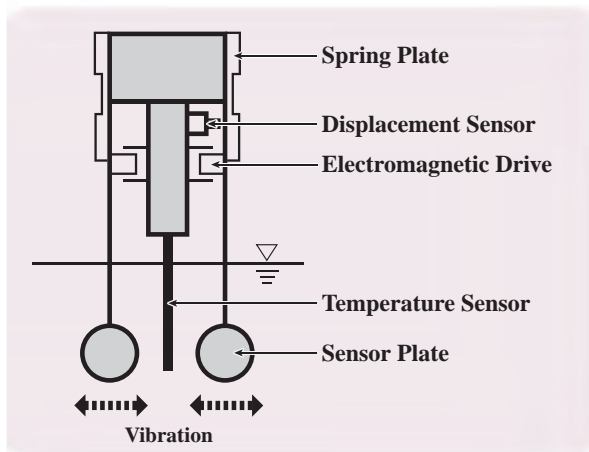
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Stop Measuring Viscosities the Hard Way

Are you struggling with an expensive rheometer that only produces unstable results when testing low viscosity (e.g. below 100 mPa·s) samples? Drawing on A&D's proven sensor technology for high-resolution analytical balances, the RV-10000A Tuning Fork Vibro Rheometer is a breakthrough alternative to conventional methods in the research of non-Newtonian fluid properties, especially for ease and precision in low viscosity measurements.

Tuning Fork Vibro Rheometer

Principle of Operation



Two thin sensor plates in a tuning fork arrangement are driven with electromagnetic force to vibrate at their natural (resonant) frequency of 30 Hz within the sample fluid. Viscosity is then calculated based on the proportional relationship between the viscous resistance of the sample fluid and the amount of electric current required to drive and maintain the sensor plates at a constant vibration amplitude.*¹ *¹ Patented

This is an application of the electromagnetic equilibrium mechanism employed by A&D's high-end weighing devices, including microbalances whose scale interval is as small as 1 µg (1/1,000,000 of 1 g).

How the shear rate is changed

The sensor plate amplitude of the RV-10000A can be altered between the minimum of 0.07 mm and the maximum of 1.2 mm (peak to peak) while the frequency is kept at 30 Hz, which will cause variation in shear rate. By this means, you can easily quantify the viscous behaviors of non-Newtonian fluids in response to different shear rates.

The tuning fork vibro method is recognized as a Japanese industrial standard for viscosity measurement of liquids (JIS Z8803). The viscometer that uses this method is also accredited as a standard device for the Japan Calibration Service System (JCSS) along with capillary and rotational viscometers.

Advantages

Wide Continuous Measurement Range—From 0.3 mPa·s

The RV-10000A has a single viscosity detection system that can measure from very low to high viscosity without interruption (max. 0.3 to 25,000 mPa·s), which realizes high versatility and allows measurement of various types of fluids with just one instrument. It also allows continuous monitoring of viscosity variation with time, temperature as well as shear rate.

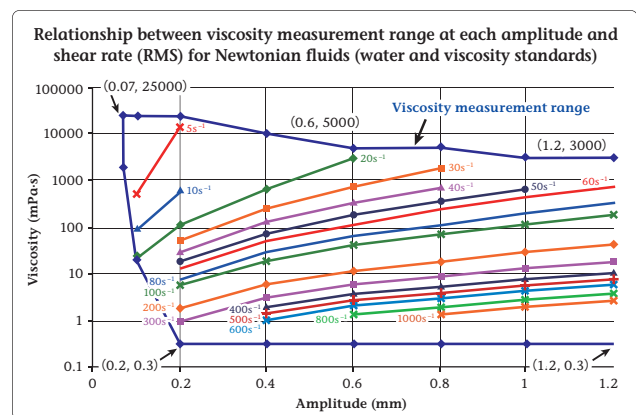
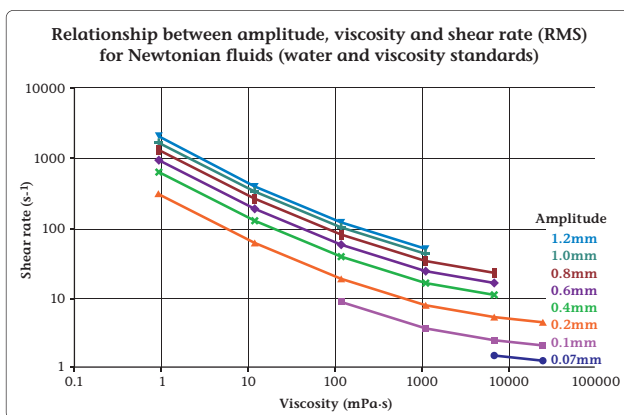
Extremely High Sensitivity

The sensor sensitivity heightened through sharp resonance phenomena even detects viscosities around the level of water with unparalleled precision. Such sensitivity even realizes measurements, for example, for finding the cloud point of surfactants and controlling the drinking sensation of beverages.

Excellent Repeatability

The RV-10000A achieves repeatability as high as 1% of the measured value (by standard deviation) for the entire measurement range, providing you with consistent results and enabling reliable comparisons of those results.

Relationship Between Vibration Amplitude, Shear Rate and Viscosity



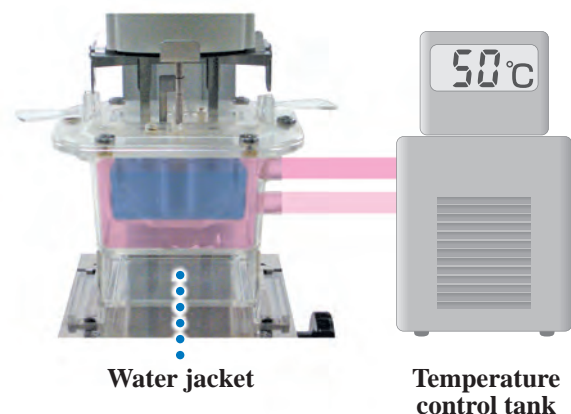
- 1) While the value measured by the tuning fork vibro rheometer is the product of viscosity and density, it is displayed in the [mPa·s] unit of measurement, assuming that the density of the sample fluid is 1 g/cm³.
- 2) With the tuning fork vibro method, there is no clear opposite surface to define the shear rate, which can be calculated however from a known viscosity such as a viscosity standard and the force (i.e. shear stress) required to drive the sensor plates at the set amplitude. The shear caused by the vibration transmits further the higher the viscosity of the sample fluid, making the shear rate lower as a result.

Simultaneous Measurements of Temperature and Viscosity

The temperature sensor (0 to 160 °C range) located between the two viscosity sensor plates allows measurement of viscosity's dependence on temperature as accurately as possible.

Sample Fluid Temperature Control

By using the provided water jacket with a commercially available temperature control tank, you can control the sample fluid temperature (between 0 and 100 °C) in order to measure the viscosity at a constant temperature or see how the viscosity varies with temperature.

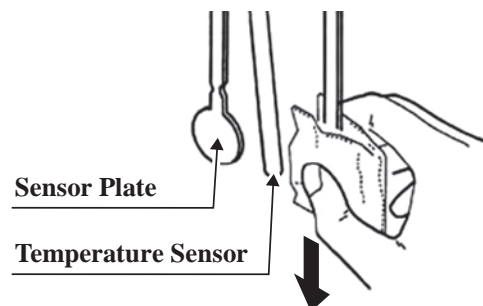


Easy Setup and Very Quick Measurement

Compared with conventional methods, it takes much less time for you to set the sample fluid, start measurement, and obtain the viscosity value (the RV-10000A requires only 20 seconds to stabilize). Moreover, since the sensor plates have a very small thermal capacity, they cause minimal temperature change to the sample fluid upon immersion, also contributing to fast and stable viscosity measurement.

It is very easy to clean the sensor after measurement as well – all you need to do is wipe off the sample residue with alcohol.*2

*2 In the case of sample fluid sticking to the sensor, an off-the-shelf ultrasonic cleaner will be effective to remove it.



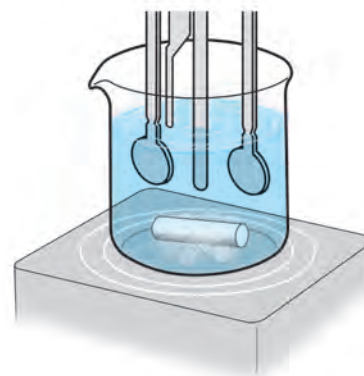
Little Interference to the Sample Fluid

The low-frequency, low-amplitude vibration causes only minute displacement in the sample fluid and keeps changes to its temperature and physical structure to a minimum. This enables highly stable measurements of viscosity variations over a long period of time. It also enables the measurement of fluids such as foams (e.g. whipped cream) without breaking their tiny air bubbles or dispersion systems (e.g. colloids) while they are settling.*3

*3 Dispersion can alternatively be maintained using a microstirrer.

Measurements of Fluids in Motion

The two sensor plates vibrate in opposite directions, meaning that even if the sample fluid is flowing or being stirred during measurements, the errors of each sensor plate are cancelled out by those of the other. It is therefore possible, for example, to measure the viscosity of a flowing fluid in a production line and maintain data compatibility between the laboratory and the field.



Measuring the sample fluid being stirred

Easy Calibration by Yourself

Both one-point and two-point calibrations are possible using either viscosity standards (available as accessories) or fluids of known viscosities. With the RV-10000A, there is no need to spend time and money having the instrument calibrated by an outside specialist.

■ Simplified Calibration Function

For a viscosity range around 1 mPa·s, a highly useful, simplified calibration function is available. You only have to prepare purified water and perform a simple one-key operation, and the RV-10000A will automatically calibrate itself using stored information on the viscosity of purified water at each temperature.

RV-10000A – Main Section

Water Jacket

A water jacket is provided as standard to be used in conjunction with a commercially available temperature control tank to control the sample fluid temperature.

X-Y-Z Stage

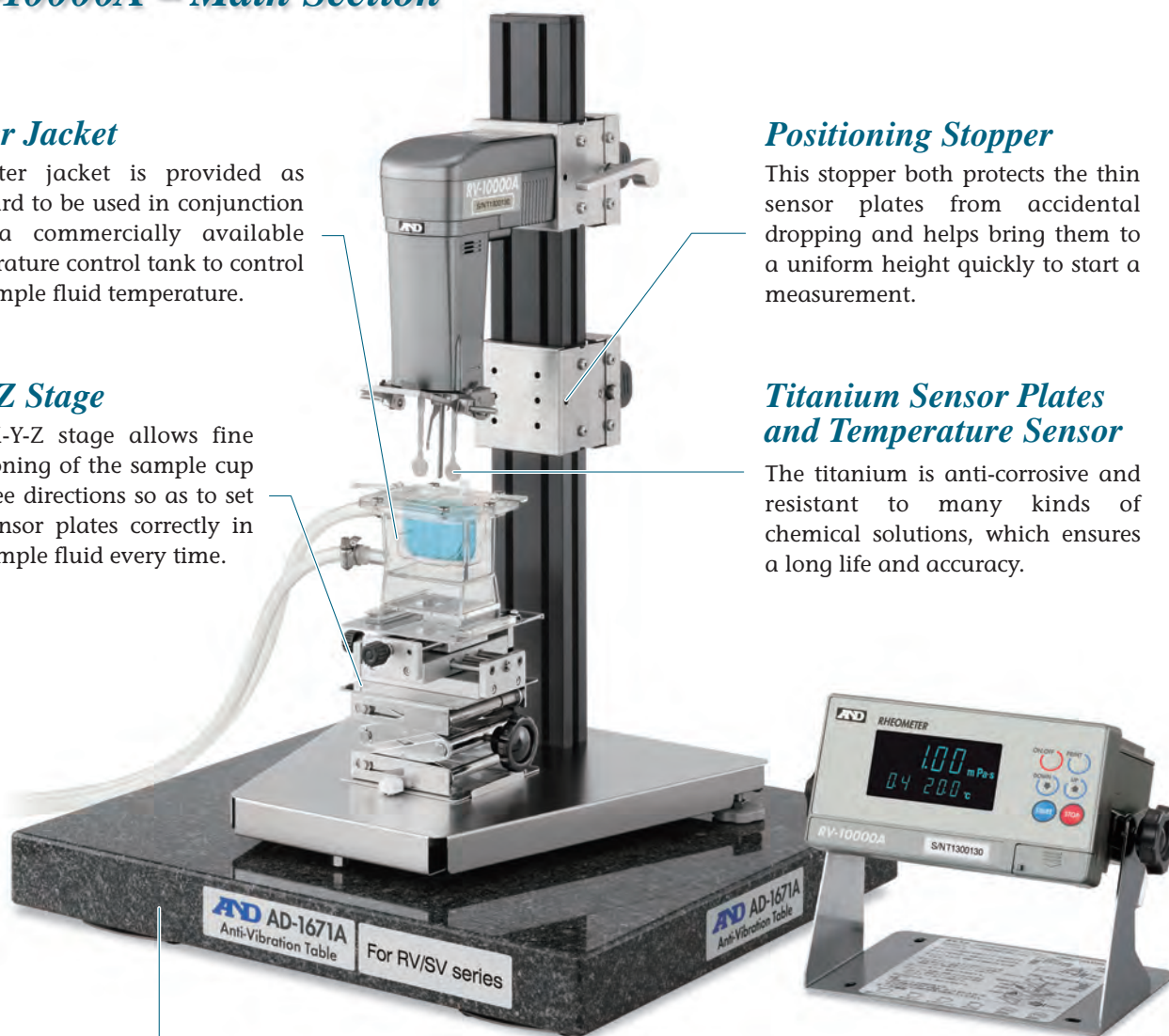
The X-Y-Z stage allows fine positioning of the sample cup in three directions so as to set the sensor plates correctly in the sample fluid every time.

Positioning Stopper

This stopper both protects the thin sensor plates from accidental dropping and helps bring them to a uniform height quickly to start a measurement.

Titanium Sensor Plates and Temperature Sensor

The titanium is anti-corrosive and resistant to many kinds of chemical solutions, which ensures a long life and accuracy.



Anti-Vibration Table (AD-1671A)

The use of this table reduces measurement errors by isolating the RV-10000A from minute external vibrations, which is especially effective when performing low viscosity (10 mPa·s or below) measurements.

RV-10000A – Controller Section

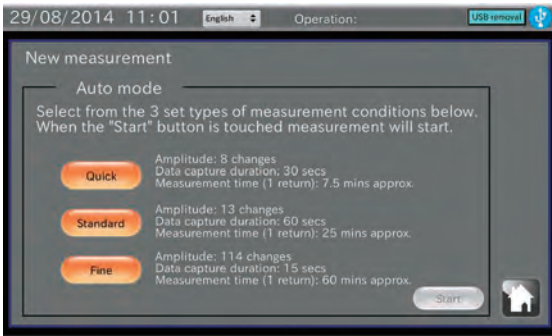


The dedicated controller can automatically change the sensor plate amplitude and take data in the manner you programmed. It also shows and graphs measured values in real time so that viscosity changes as a function of time, temperature, and/or shear rate*⁴ become plainly visible.

The results can be saved in CSV format and graph screens as JPEG images in a USB flash drive.

*⁴ The shear rate shown by the controller is a root-mean-square value and is calculated assuming that the sample is a Newtonian fluid.

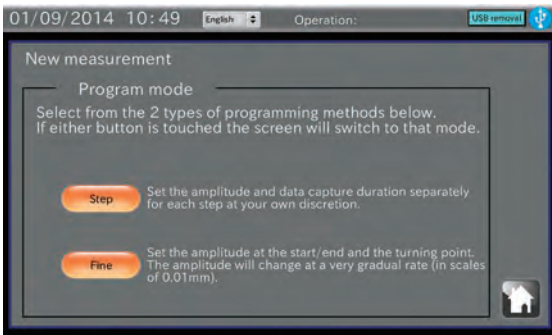
Auto Mode



In Auto mode, the sensor plate amplitude automatically goes from 0.07 mm to 1.2 mm and back to 0.07 mm again according to one of three preset types of measurement conditions: Quick, Standard and Fine modes, from which you can make a choice of how finely to change the amplitude (8, 13 or 114 levels) and how long to take for the measurement (7.5, 25 or 60 minutes in total).

Auto mode helps when you want to take a quick scan of the physical properties of the sample fluid.

Program Mode

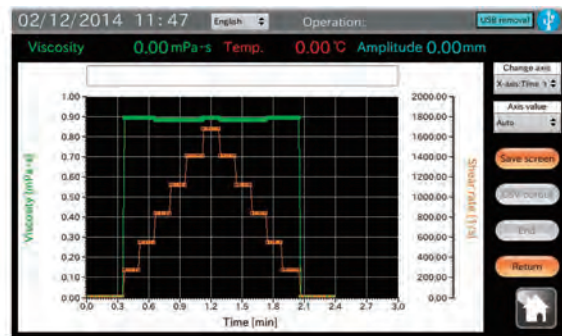
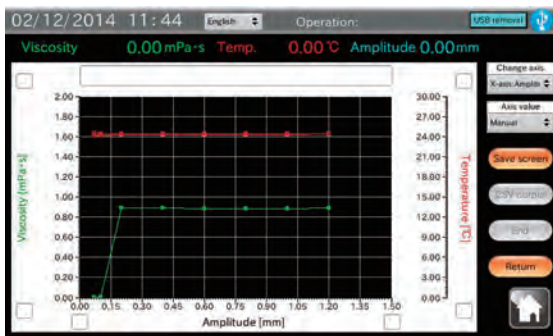


Program mode allows you to more freely design the measurement conditions, by setting either amplitude changes in steps (Step mode) or two amplitude points so that it linearly (in scales of 0.01 mm) increases and then decreases between them (Fine mode). This mode is especially useful for testing the sample fluid within a specific amplitude (shear rate) or viscosity range.

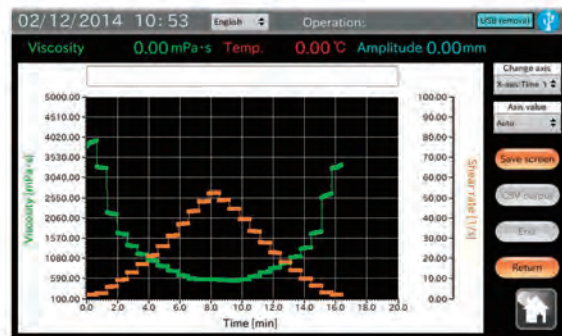
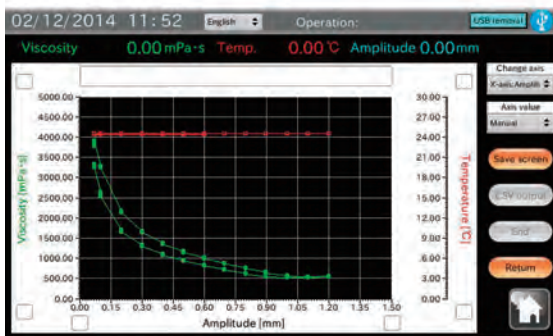
The measurement conditions set in Step mode can be saved for later measurements with the same conditions (up to 10 programs).

Measurement Examples

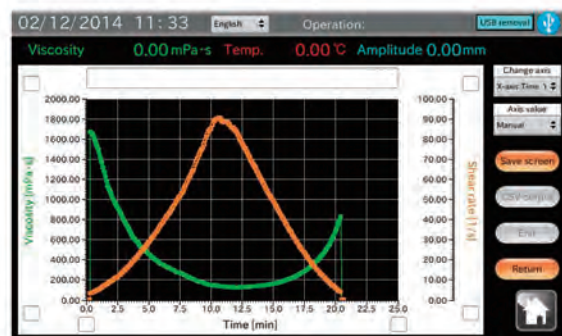
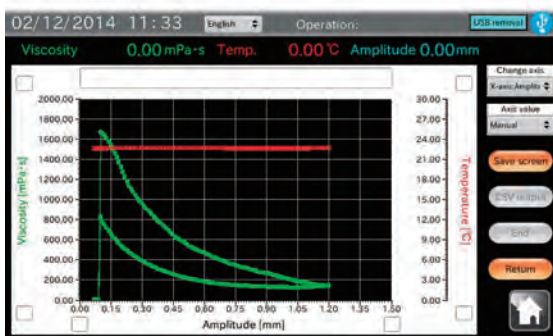
Purified water (Auto mode – Quick)



Skin moisturizing cream (Auto mode – Standard)



Yogurt (Auto mode – Fine)



Also available...

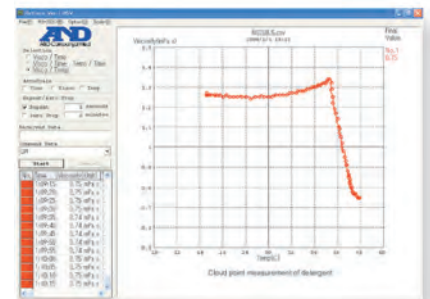
Tuning Fork Vibro Rheometer - Basic Model

RV-10000



- The sensor plate amplitude is alterable to eight levels (0.07 / 0.1 / 0.2 / 0.4 / 0.6 / 0.8 / 1.0 / 1.2 mm) by manually pressing a key on the display unit.
- The viscosity and temperature data can be sent to a PC for real-time graphing*⁵ using the provided "WinCT-Viscosity" software (as the basic model comes with no special controller).

*⁵ The amplitude/shear rate cannot be used as an axis variable.



Cloud point detection using WinCT-Viscosity

RV-10000A / RV-10000

Options & Accessories

Item	Description	
AX-SV-31-2.5	Viscosity standard for calibration JS2.5	500 ml, with certificate in accordance with JIS Z8809
AX-SV-31-5	Viscosity standard for calibration JS5	
AX-SV-31-10	Viscosity standard for calibration JS10	
AX-SV-31-20	Viscosity standard for calibration JS20	
AX-SV-31-50	Viscosity standard for calibration JS50	
AX-SV-31-100	Viscosity standard for calibration JS100	
AX-SV-31-200	Viscosity standard for calibration JS200	
AX-SV-31-500	Viscosity standard for calibration JS500	
AX-SV-31-1000	Viscosity standard for calibration JS1000	
AX-SV-31-2000	Viscosity standard for calibration JS2000	
AX-SV-31-14000	Viscosity standard for calibration JS14000	
AX-SV-33	Sample cup, 45 ml, polycarbonate × 10	
AX-SV-34	Small sample cup, 10 ml, with cover, polycarbonate × 10	
AX-SV-35	Glass sample cup, 13 ml × 1	
AX-SV-37	Water jacket × 1, small sample cup with cover × 4	
AX-SV-38	Storage container, 60 ml, glass × 10	
AX-SV-39	Storage container, 120 ml, plastic × 20	
AX-SV-54	Cup set Sample cup, 45 ml, polycarbonate × 5 Small sample cup, 10 ml, with cover, polycarbonate × 5 Glass sample cup, 13 ml × 2 Glass sample cup holder, stainless steel × 1 Water jacket × 1	

Item	Description
AD-8121B	Compact printer
AD-1682	Rechargeable battery
AD-1671A	Anti-vibration table for viscometers/rheometers
AD-1687	Environment logger



AX-SV-54 cup set (comes as standard)

Specifications

Main section

Measurement method	Tuning fork vibro method (natural frequency at 30Hz)		
Variable amplitude range	0.07 to 1.2 mm (peak-to-peak at the tip of the sensor plate)		
Measurable viscosity range*6	0.07 mm ≤ amplitude < 0.1 mm	2,000 to 25,000 mPa·s	
	0.1 mm ≤ amplitude < 0.2 mm	20 to 25,000 mPa·s	
	Amplitude = 0.2 mm	0.3 to 25,000 mPa·s	
	0.2 mm < amplitude ≤ 0.4 mm	0.3 to 12,000 mPa·s	
	0.4 mm < amplitude ≤ 0.8 mm	0.3 to 5,000 mPa·s	
	0.8 mm < amplitude ≤ 1.2 mm	0.3 to 3,000 mPa·s	
Repeatability*7*8	1% of the measured value (standard deviation)		
Accuracy*7*9	±3% (1 to 1000 mPa·s) when the amplitude is set to 0.4 mm		
Minimum display	Range (mPa·s)	Minimum display (mPa·s)	Minimum display (Pa·s)
	0.3 to 10	0.01	0.0001
	10 to 100	0.1	0.0001
	100 to 1000	1	0.001
	1000 to 25000	10*10	0.01
Viscosity measurement unit	mPa·s, Pa·s, cP, P		
Operating temperature	10 to 40°C (50 to 104°F)		
Minimum sample amount	10 ml		
Temperature display	0 to 99°C/0.1°C (32 to 210.2°F/0.1°F); 100 to 160°C/1°C (212 to 320°F/1°F)		
Temperature measurement accuracy	0 to 20°C: ±1°C (32 to 68°F: ±1.8°F)		
	20 to 30°C: ±0.5°C (68 to 86°F: ±0.9°F)		
	30 to 100°C: ±2°C (86 to 212°F: ±3.6°F)		
	100 to 160°C: ±4°C (212 to 320°F: ±7.2°F)		
Display	Vacuum Fluorescent Display (VFD)		
Connection cable length	1.5 m (between the sensor unit and the display unit)		
Communication	RS-232C as standard		
Power supply	AC Adapter		
Power consumption	Approx. 14 VA (including the AC adapter)		
External dimensions / weight	Sensor unit: 112 (W) × 132 (D) × 291(H) mm / approx. 0.8 kg		
	Display unit: 238 (W) × 132 (D) × 170 (H) mm / approx. 1.3 kg		
	Stand unit: 296 (W) × 314 (D) × 536 (H) mm / approx. 4.6 kg		
Standard accessories	AC adapter × 1, connection cable × 1, sample cup (capacity: 45 ml) × 5, small sample cup (capacity: 10 ml) × 5, small sample cup cover × 5, glass sample cup (capacity: 13 ml) × 2, glass sample cup holder × 1, water jacket × 1, WinCT-Viscosity × 1, RS-232C cable × 1, serial/USB converter × 1, stand for securing the sensor unit × 1, X-Y-Z stage × 1, positioning stopper × 1, anti-vibration table × 1		

*6 The basic model (RV-10000) has no controller section and the sensor plate amplitude can only be altered to eight levels (0.07 / 0.1 / 0.2 / 0.4 / 0.6 / 0.8 / 1.0 / 1.2 mm) by manually pressing a key on the display unit.

*7 When the sample cup (45 ml) is used

*8 Repetitive measurement with the sensor plates remaining in the sample fluid

*9 The value after calibration using a viscosity standard at a temperature range between 20°C and 30°C with no condensation

*10 The unit switches to Pa·s.

Controller section

Display	TFT color LCD with backlight (7 inches, 800 × 480 dots)
Data transmission	RS-232C, USB (1.1) × 2*11
Operating environment	5 to 40 °C (41 to 104 °F), 85% RH or less (no condensation)
Power supply	AC adapter
Power consumption	Approx. 30 VA
External dimensions	203 (W) × 153 (D) × 58 (H) mm, excluding protrusions
Net weight	Approx. 1.1 kg
Standard accessories	AC adapter × 1, touch pen with holder × 1, stand attachment × 1

*11 For inserting USB flash drives only (the two slots cannot be used at the same time)



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A&D Company, Limited

3-23-14 Higashi-Ikebukuro, Toshima-ku, Tokyo 170-0013 JAPAN
Telephone:[81](3) 5391-6132 Fax:[81](3) 5391-6148
http://www.aandd.jp

A&D ENGINEERING, INC.

1756 Automation Parkway, San Jose, CA 95131 U.S.A.
Telephone:[1](408) 263-5333 Fax:[1](408) 263-0119

A&D Australasia Pty Ltd.

32 Dew Street, Thebarton, South Australia 5031 AUSTRALIA
Telephone:[61](8) 8301-8100 Fax:[61](8) 8352-7409

A&D INSTRUMENTS LTD.

Unit 24/26 Blacklands Way Abingdon Business Park,
Abingdon, Oxon OX14 1DY UNITED KINGDOM
Telephone:[44](1235) 550420 Fax:[44](1235) 550485

<German Sales Office>

Hamburger Straße 30 D-22926 Ahrensburg GERMANY
Telephone:[49](0) 4102 459230 Fax:[49](0) 4102 459231

A&D KOREA Limited

817, Manhattan Bldg., 33, Gukjegeumyung-ro 6-gil,
Yeongdeungpo-gu, Seoul, 150-749, KOREA
Telephone:[82](2) 780-4101 Fax:[82](2) 782-4280

A&D RUS CO., LTD.

Vereyskaya str.17, Moscow, 121357 RUSSIA
Telephone: [7] (495) 937-33-44 Fax: [7] (495) 937-55-66

A&D Instruments India Private Limited

509 Udyog Vihar Phase V
Gurgaon-122 016, Haryana, INDIA
Telephone: [91](124) 471-5555 Fax: [91](124) 471-5599