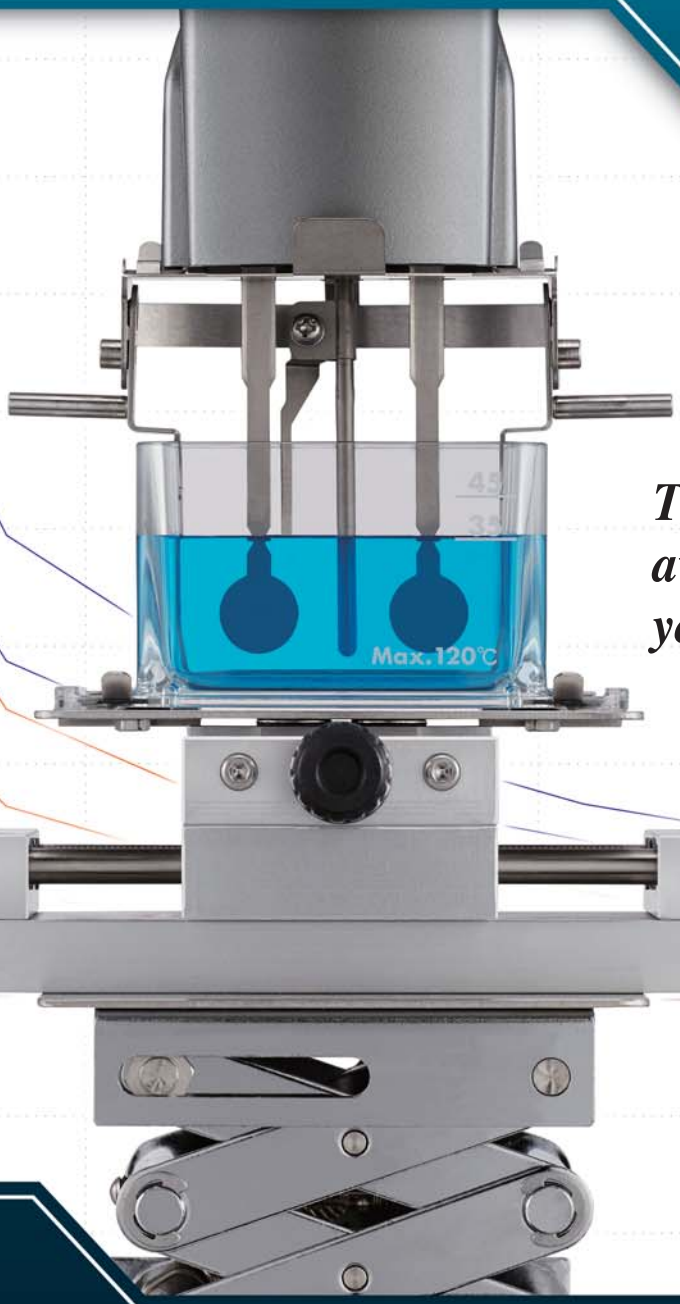
Tuning Fork Vibro Rheometer

RV-10000



The method you never knew was available may be the solution you've always wanted…

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A&D Company, Limited

…Clearly a Better Value

A Significant Breakthrough in Viscosity Measurement of Non-Newtonian Fluids

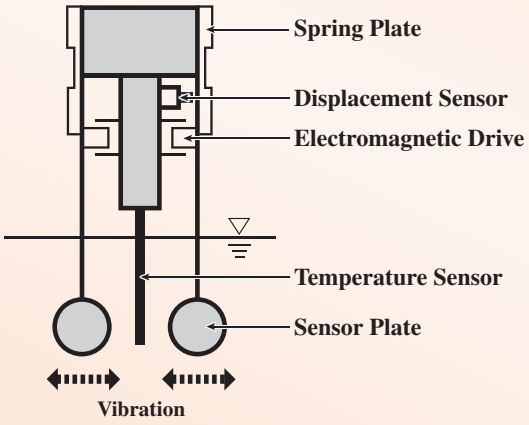
*What if you could evaluate the continuous behaviors of paints, creams, greases, polymers and many other kinds of non-Newtonian fluids more quickly, easily and precisely than you ever thought possible? With A&D's tuning fork vibro method**1 *now capable of varying the shear rate, a whole new vista of materials research is wide open ahead of you—.*

*1 *Patented*

Vibration Amplitude Made Adjustable to Change the Shear Rate

By simple key operation, the sensor plate amplitude of the RV-10000 can be altered to eight levels (between 0.07 and 1.2 mm peak-to-peak), which create different shear rates. With this function, you can easily measure viscosity changes in response to varying shear rates.

How the Tuning Fork Vibro Rheometer Works



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.

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.

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-10000 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, realizing fast and stable viscosity measurement.

It is also very easy to clean the sensor after measurement – 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.*

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.

Wide Dynamic Range of Measurements

The RV-10000 has a viscosity detection system that singly measures from very low to high viscosity in quick succession (max. 0.3 to 25,000 mPa·s), which makes the instrument highly versatile and able to cover measurement of various types of fluids by itself. It also allows continuous measurements of viscosity variation over time and/or temperature changes at differing shear rates.

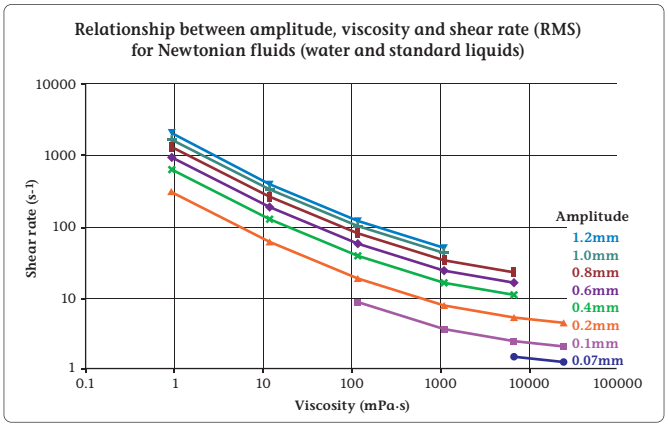
Extremely High Sensitivity

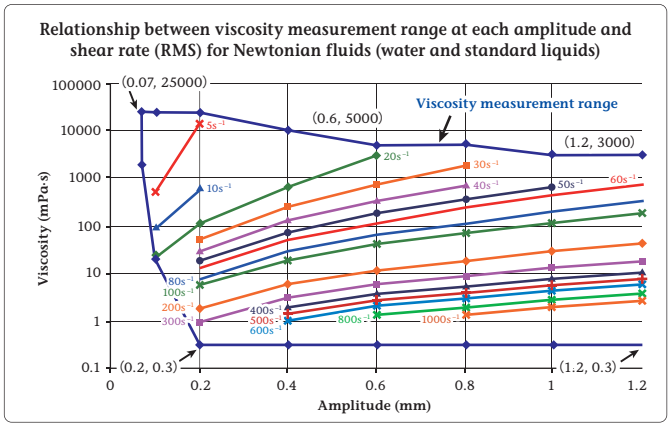
The sensor sensitivity heightened through sharp resonance phenomena even detects viscosities around the level of water with unparalleled precision. Such sensitivity realizes measurements, for example, for finding the cloud point of surfactants and controlling the drinking sensation of beverages.

Excellent Repeatability

The RV-10000 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

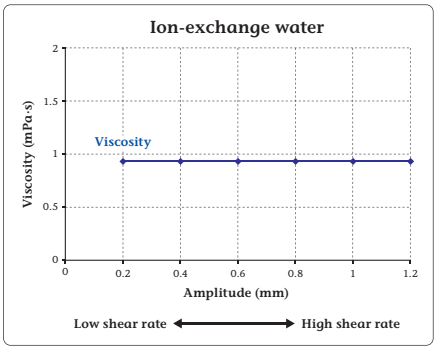


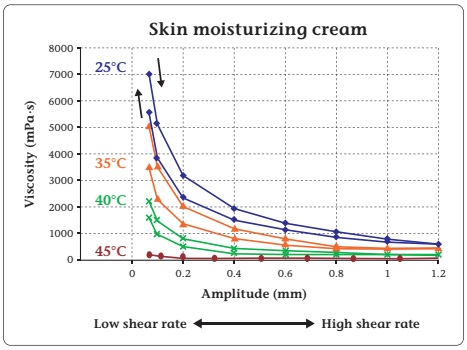


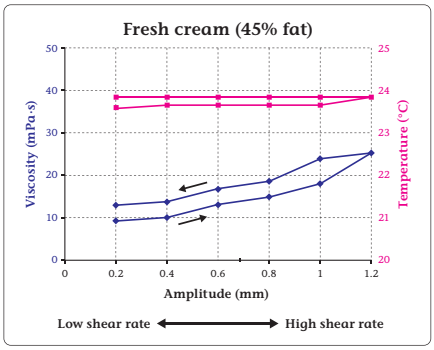
1) While the value measured by the tuning-fork vibro rheometer is the product of viscosity and density, it is displayed in the [mPa·s] unit of measurement, assuming that the density of the sample fluid is 1 g/cm³.

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 standard liquid 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.

Measurement Examples







Water Jacket

By using the water jacket with a commercially-available constant heat water 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.

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-10000 from minute external vibrations, which is especially effective when performing low viscosity (10 mPa·s or below) measurements.

VFD Display

The vacuum fluorescent display provides clear and wide-angle visibility for viscosity and temperature readings.

Standard Cup Set

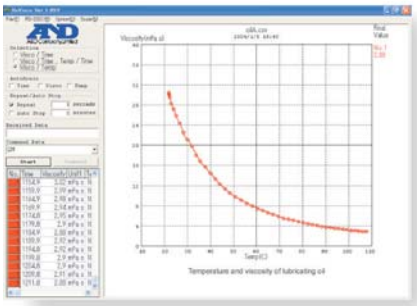
Sample cup:
- 45 ml, Polycarbonate × 5
- 10 ml, with cover, Polycarbonate × 5
- 13 ml, Glass × 2

Glass sample cup holder, Stainless steel × 1
Water jacket × 1

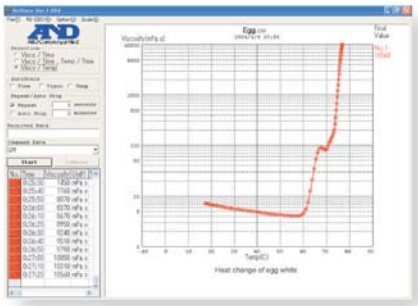
Windows Communication Tools Software "WinCT-Viscosity"

The software includes the graphing program RsVisco, which receives the viscosity and temperature data from the RV-10000 and creates a graph on a PC in real time. It visualizes viscosity that varies with time and/or temperature at different shear rates*3, and thereby makes it easy to detect the cloud points of surfactants, monitor changes from sol to gel (and vice versa), etc.

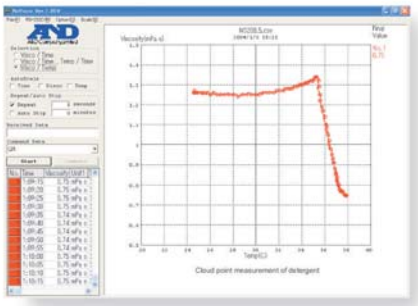
The measurement data can be saved as a CSV file and opened and graphed again later. The RV-10000 also includes a serial/USB converter for connection to a PC that has USB ports only.



Temperature and viscosity of lubricating oil



Heat change of egg white



Cloud point measurement of detergent

∗3 The shear rate cannot be used as an axis variable.

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.*4

∗4 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.

Easy Calibration by Yourself

Both one-point and two-point calibrations are possible using either viscosity standard liquids (optional) or fluids of known viscosities. With the RV-10000, 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-10000 will automatically calibrate itself using stored information on the viscosity of purified water at each temperature.

Specifications

Measurement method	Tuning fork vibro method (natural frequency at 30Hz)		
Amplitude range	0.07 to 1.2 mm (peak-to-peak at the tip of the sensor plate)		
Viscosity measurement range	Amplitude	Viscosity range	
	0.07 mm	2,000 to 25,000 mPa·s	
	0.1 mm	20 to 25,000 mPa·s	
	0.2 mm	0.3 to 25,000 mPa·s	
	0.4 mm	0.3 to 12,000 mPa·s	
	0.6 mm	0.3 to 5,000 mPa·s	
	0.8 mm		
	1.0 mm	0.3 to 3,000 mPa·s	
	1.2 mm		
Repeatability *5*6	1% of the measured value (standard deviation)		
Accuracy *5*7	±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*8	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		

*5 When the sample cup (45 ml) is used.
*6 Repetitive measurement with the sensor plates remaining in the sample fluid.
*7 The value after calibration using a viscosity standard liquid at a temperature range between 20°C and 30°C with no condensation.
*8 The unit switches to Pa·s

Options & Accessories

Item	Description	
AX-SV-31-2.5	Standard liquid for calibration JS2.5	500 ml, with certificate in accordance with JIS Z8809
AX-SV-31-5	Standard liquid for calibration JS5	
AX-SV-31-10	Standard liquid for calibration JS10	
AX-SV-31-20	Standard liquid for calibration JS20	
AX-SV-31-50	Standard liquid for calibration JS50	
AX-SV-31-100	Standard liquid for calibration JS100	
AX-SV-31-200	Standard liquid for calibration JS200	
AX-SV-31-500	Standard liquid for calibration JS500	
AX-SV-31-1000	Standard liquid for calibration JS1000	
AX-SV-31-2000	Standard liquid for calibration JS2000	
AX-SV-31-14000	Standard liquid 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	

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

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