VISCOMETER

Model TV-22/33

TOKI SANGYO

Model TV-22 VISCOMETER

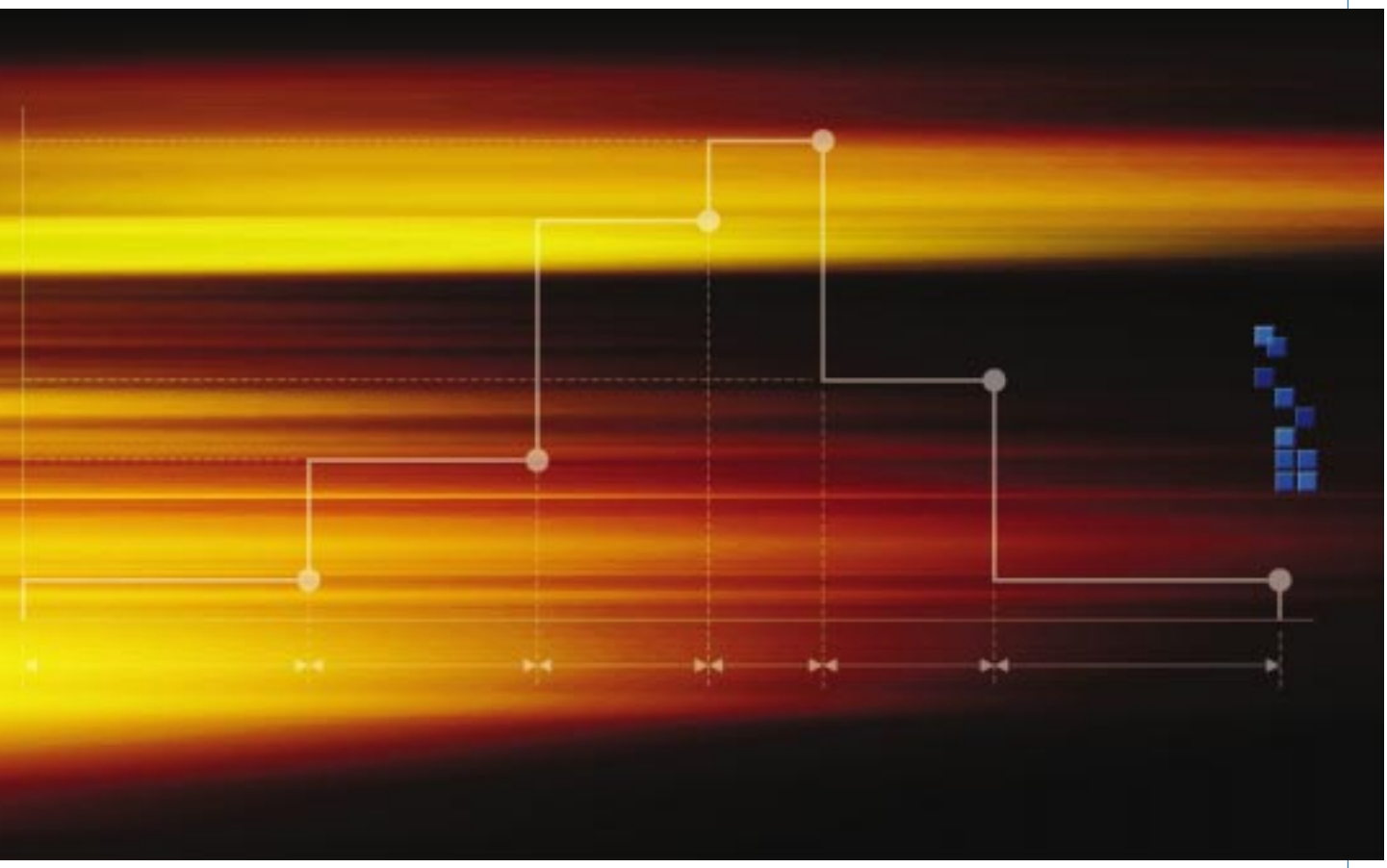
A broad range of measurement is now available in a single instrument - the multi-range Model TV-22 digital viscometer!
Superior repeatability and linearity is insured by a design which incorporates a unique combination of a proprietary pivotless mechanism with a torque balance servo system.

The power of the Model TV-22 lies in its multi-range capability which enables a five-fold increase in measurement range over conventional models* providing unparalleled cost performance and convenience. Users will also be impressed with the Model's ability to maintain its high initial repeatability and linearity over time owing to the instrument's innovative pivotless bearing design and torque balance servo system.

* based on in-house comparison

Model TV-33 VISCOMETER

Offering unmatched measurement efficiency, the Model TV-33 viscometer boasts a wealth of functions including thixotropic coefficients measurement and an 40 step speed change programmable capability.



Improvement of measurement efficiency was a chief aim in the development of this digital viscometer. The result is an instrument which can handle with ease even the most sophisticated and demanding of measurement tasks requiring functions such as "multi-range", "programmable measurement", and "thixotropic coefficients measurement".
With its high accuracy, superior durability, and outstanding efficiency, the Model TV-33 represents the ultimate in a digital viscometer.

Features

Torque balance servo system

The TV-22/33 employs the "zero method" of measurement structured on a torque balance servo system. Normally found in upper-end rheometers, this system provides for a wide dynamic range, superior linearity, and multi-range capability.

Multi-range function

The TV-22/33's multi-range function permits a single model to cover a wide range of measurement compared to conventional type viscometers. One Model TV-22L/33L, for example, provides measurement ranges from "M" to "5M" while the Model TV-22H/33H covers measurements over the "H" through "U" ranges.

Zero・span setting function

Calibration allows the viscometer to be used at accuracies higher than catalog values and compensates for unit-to-unit variances.

Programmable measurement function (TV-33)

The instrument provides programmable measurement capability involving a maximum of 40 speed step changes (up to 5 pattern settings).

Thixotropic coefficients measurement function (TV-33)

This function calculates and displays the ratio of two viscosity values as measured in the programmed measurement mode. (rotation speed can be freely set)

Pivotless mechanism

A pivotless arrangement which employs a flexible hinge (flat spring coupling) replaces the traditional pivot and jewel bearing mechanism. This eliminates parts wear and insures that the instrument's high initial repeatability is maintained over time.

Omni-directional external force limiter

Excessive external forces acting on the rotor connection are isolated with the aid of an omni-directional external force limiter which protects the inner mechanism for greatly enhanced durability.

Autostop function

Measurement is automatically terminated at a prescribed time or when the liquid measured attains a preset viscosity. (manual measurement mode only)

Remote control function

To start and stop the main unit can be operated by outer signal (dry contact). And Using out put signal (open collector), the situation of viscometer can be confirmed by buzzer and lamp.

Preheat function

Viscosity measurement can be automatically started at a preselected time to allow for a preheat "waiting" period.

One touch rotor mounting

A rod insertion system is employed which simplifies rotor mounting and removal compared to conventional threaded methods (Model TVB-22/33).

Data interchangeability

Data is cross compatible with that of Model B (spindle type) and Model E(cone-plate type) viscometers, DV-100/DV-200 digital viscometers and Model R viscometers.

Related standards: ISO2555, JIS7117-1 (Model TVB); ISO3219, JIS7117-2 (Model TVE); etc.

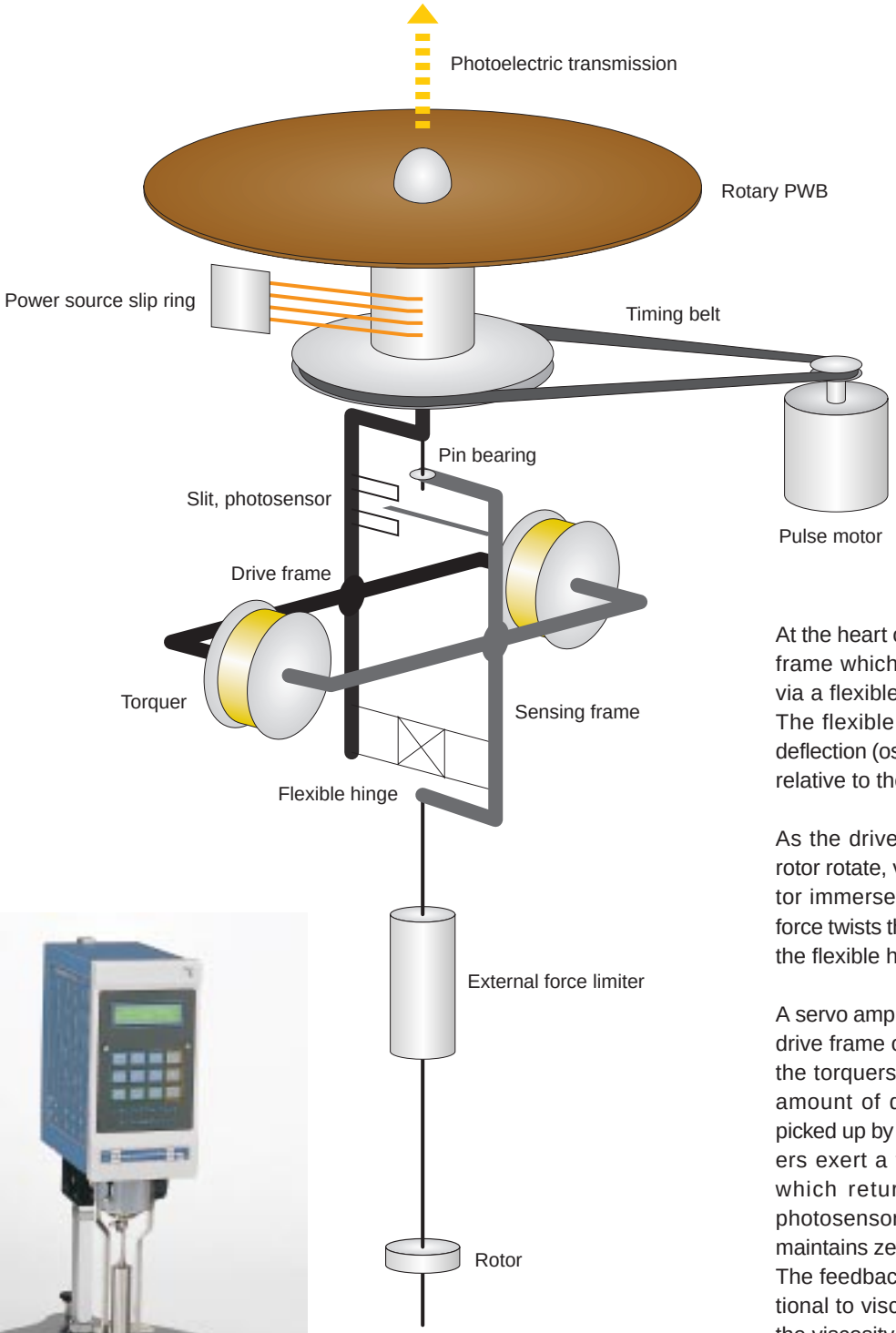
Temperature measurement function

Temperature probe-equipped models are available. The cone plate type can measure the temperature of circulating water in a sample cup.

Data recording

A calendar is mounted in the main unit. Data, measuring date and starting time can be documented using a printer (option) with digital output cable (option) connection or pen recorder, etc., with an analog output cable (option).

Principle of Operation



At the heart of the TV-22/33 is the sensing frame which is linked to the drive frame via a flexible hinge (flat spring coupling). The flexible hinge allows small angular deflection (oscillation) of the sensing frame relative to the drive frame.

As the drive frame, sensing frame, and rotor rotate, viscous torque acts on the rotor immersed in the sample liquid. This force twists the sensing frame and deflects the flexible hinge from its zero position.

A servo amplifier mounted to the top of the drive frame outputs a feedback current to the torquers which is proportional to the amount of deflection (voltage change) picked up by the photosensors. The torquers exert a force on the sensing frame which returns it to a position where photosensor voltage becomes zero and maintains zero deflection ("zero method"). The feedback current is precisely proportional to viscous torque and functions as the viscosity output signal.

Configurations

Item	Model /Spindle Type		Model / Cone Plate Type	
	TVB-22L TVB-33L **TVB-22LT TVB-33LT**	**TVB-22H TVB-33H** **TVB-22HT TVB-33HT**	**TVE-22L TVE-33L** **TVE-22LT TVE-33LT**	**TVE-22H TVE-33H** **TVE-22HT TVE-33HT**
Measurement range	Low range	High range	Low range	High range
Instrument configuration				
Viscometer main unit	○	○	○	○
Rotor set	M rotor, 4 pc. set (M1 ~ M4)	H rotor, 7 pc. set (H1 ~ H7)	Standard cone rotor set	Standard cone rotor set
Guard	M guard	H guard	---	---
Stand	○	○	○	○
Storage case	○	○	○	○
Rotor storage case	○	○	○	○
Standard accessories	○	○	○	○
Temperature probe	○	○	○	○
Conventional models replaced:	with TVB-22LT, TVB-33LT DVL-B, DVM-B BL, B8L BM, B8M RB80L - provides five (5) times the range of the above units	with TVB-22HT, TVB-33HT BH, B8H DVH-B, DVH-B-4 DVR-B, DVU-B BH, B8H B8R, B8U, BS RB80H, RB80R, RB80U	with TVE-22LT, TVE-33LT DVM-E ELD RE80L - provides five (5) times the range of the above units	with TVE-22HT, TVE-33HT DVH-E, DVR-E DVU-E EMD, EHD RE80H, RE80R, RE80U

Specifications

Main unit

TV-22 Rotation speed (rpm)	**0.5↔1↔2.5↔5↔10↔20↔50↔100↔2↔4↔10** **↳60↔30↔12↔6↔3↔1.5↔0.6↔0.3↔0↔20↵** **19 steps**
TV-33 Rotation speed(rpm)	**0.5↔1↔2.5↔5↔10↔20↔50↔100↔2↔4↔10↔20** **↳0.2↔0.1↔60↔30↔12↔6↔3↔1.5↔0.6↔0.3↔0↵** **21 steps**
TV-33 Program steps	max. 40 steps
TV-33 Program patterns	max. 5 patterns
Accuracy	less than ±1% of full scale * Note 1
Repeatability	less than ±0.2% of full scale
Using temperature range	10~60°C
Temperature probe (option)	thermoresistance (Pt100), 3 wire, Class A
External output	digital output RS232C analog output viscosity : 0~1.0V (load resistance above 10kΩ) temperature : 0~4.0V (load resistance above 10kΩ)
Input signal	Measuring start signal (dry contact)
Output signal	On measuring, Buzzer, Measuring stop (Auto stop mode) Open collector
Ambient temperature range	0~40°C
Ambient humidity range	less than 90% RH (non-condensation)
Power input	AC100~230V±10% 50/60Hz (however, rated voltage of standard accessory power cable is AC125V) * Note 2
Power consumption	less than 30VA
Wetted parts	SUS304/303 stainless steel
Dimensions	W290 x D300 x H430mm
Mass	spindle type : Model TVB approx. 8 kg (incl. stand) cone plate type : Model TVE approx. 9 kg (incl. stand)

*** Note 1: when uses M1-M4 rotor, H2-H4 rotor, 1 '34 'otor.**
*** Note 2: when power supply exceeds rated voltage of AC125V, please use separate special cable.**

TV-22 Viscosity Measurement Range

Model		Measurement range (full-scale torque)	Viscosity measurement range			
TVB-22L	**TVB-22LT**	M (67.37 µN•m)	15	~	2,000,000	mPa•s
			(1	~	2,000,000	mPa•s)* Note 3
		2.5M (168.4 µN•m)	25	~	5,000,000	mPa•s
		5M (336.9 µN•m)	50	~	10,000,000	mPa•s
TVB-22H	**TVB-22HT**	H (718.7 µN•m)	100	~	8,000,000	mPa•s
		R (1437.4 µN•m)	100	~	16,000,000	mPa•s
		U (5749.6 µN•m)	200	~	64,000,000	mPa•s
		S (2156.1 µN•m)	150	~	24,000,000	mPa•s
TVE-22L	**TVE-22LT**	M (67.37 µN•m)	0.6	~	1,200	mPa•s* Note 4
		2.5M (168.4 µN•m)	1.5	~	3,000	mPa•s* Note 4
		5M (336.9 µN•m)	3	~	6,000	mPa•s* Note 4
TVE-22H	**TVE-22HT**	H (718.7 µN•m)	6.4	~	12,800	mPa•s* Note 4
		R (1437.4 µN•m)	12.8	~	25,600	mPa•s* Note 4
		U (5749.6 µN•m)	51.2	~	102,400	mPa•s* Note 4

TV-33 Viscosity Measurement Range

Model		Measurement range (full-scale torque)	Viscosity measurement range			
TVB-33L	**TVB-33LT**	M (67.37 µN•m)	15	~	6,000,000	mPa•s
			(1	~	6,000,000	mPa•s)* Note 3
		2.5M (168.4 µN•m)	25	~	15,000,000	mPa•s
		5M (336.9 µN•m)	50	~	30,000,000	mPa•s
TVB-33H	**TVB-33HT**	H (718.7 µN•m)	100	~	40,000,000	mPa•s
		R (1437.4 µN•m)	100	~	80,000,000	mPa•s
		U (5749.6 µN•m)	200	~	320,000,000	mPa•s
		S (2156.1 µN•m)	150	~	120,000,000	mPa•s
TVE-33L	**TVE-33LT**	M (67.37 µN•m)	0.6	~	6,000	mPa•s* Note 4
		2.5M (168.4 µN•m)	1.5	~	15,000	mPa•s* Note 4
		5M (336.9 µN•m)	3	~	30,000	mPa•s* Note 4
TVE-33H	**TVE-33HT**	H (718.7 µN•m)	6.4	~	64,000	mPa•s* Note 4
		R (1437.4 µN•m)	12.8	~	128,000	mPa•s* Note 4
		U (5749.6 µN•m)	51.2	~	512,000	mPa•s* Note 4

* Note 3: measurement range with L adaptor(option) mounted.
* Note 4: measurement range with standard cone rotor. Measurement range for optional cone rotors are shown in the table below.

Cone Rotor

Cone Rotor	Sample Volume	Shear Rate	Viscosity Measurement Range
1°34' x R24 (standard)	1.1 ml	3.83N* Note 5	see above table
1°34' x R12 (option)	0.2 ml	3.83N* Note 5	8 times standard rotor
0.8° x R24 (option)	0.6 ml	7.5N* Note 5	1/2 of standard rotor
0.8° x R12 (option)	0.1 ml	7.5N* Note 5	4 times standard rotor
3° x R24 (option)	2 ml	2.0N* Note 5	2 times standard rotor
3° x R17.65 (option)	0.8 ml	2.0N* Note 5	5 times standard rotor
3° x R14 (option)	0.4 ml	2.0N* Note 5	10 times standard rotor
3° x R12 (option)	0.3 ml	2.0N* Note 5	15 times standard rotor
3° x R9.7 (option)	0.2 ml	2.0N* Note 5	30 times standard rotor
SPP (option)	0.5 ml	2.0N* Note 5	30 times standard rotor

* Note 5: N denotes rotor rotation speed (rpm)

Standard Configurations

M rotor set (TVB 22/33 L)

Standard cone rotor (TVE 22/33)

Cup with temperature sensor (Applied to E-∗T type)

H rotor set (TVB 22/33 H)

Storage case

Roller stand

Options

Cone rotor

L adaptor

T-bar stage

Useful to measure the viscosity of thixotropic and yield value sample. The sample on the stage can be measured by moving up to vertical. The stage can be moved sequent connection with an output signal.

- ○ Largest up and down stroke : Maximum 100 mm
- ○ Table speed : measuring time 20 mm/min
  fasten time 140 mm/min
- ○ Power : AC100 V～120 V
- ○ Power consumption : 10 VA
- ○ Dimensions : 136 (W)×236 (D)×245 (H)
- ○ Weight : Approx. 2.5 kg

Small sample adaptor

Mounting this adaptor to the viscometer allows viscosity measurement of small sample volumes.

(1) Sample volumes of 8~13 ㎖
(2) High accuracy with fast temperature regulation
(3) Calculation of shear rate, shear stress - ideal for rheological analysis

Printer

Printing method	thermal serial dot
Print digits	40 digits
Print width	approx. 90mm
Print speed	52.5 cps(max)
Dimensions	W160 x D170 x H66.5mm
Weight	approx. 700g (incl. battery)
Thermal paper	
Paper width	112mm
Roll diameter	ø48mm
Roll length	approx. 28m

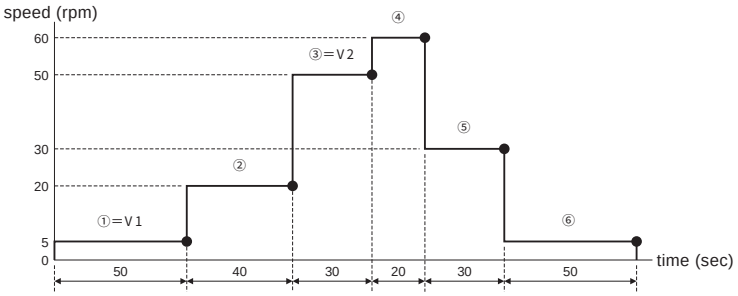
Model TV-33 Example of Measurement Pattern Program

Speed change schedule (speed change steps = 6)

Step 1: rotation speed = 5 rpm, measurement time = 50 seconds
Step 2: rotation speed = 20 rpm, measurement time = 40 seconds
Step 3: rotation speed = 50 rpm, measurement time = 30 seconds
Step 4: rotation speed = 60 rpm, measurement time = 20 seconds
Step 5: rotation speed = 30 rpm, measurement time = 30 seconds
Step 6: rotation speed = 6 rpm, measurement time = 50 seconds

Thixotropic coefficients steps

* Thixotropic coefficients = V1 (step 1 viscosity value) ÷ V2 (step 3 viscosity value)



* Thixotropic coefficients: thixotropic index (thixotropic coefficients indicating degree of structural viscosity as determined by the viscosity measured at a low rotation speed divided by the viscosity measured at ten times that speed) as stipulated in ISO 7387-1, ASTM D 2196, JIS K 6901, etc.

Example of Printer Output Format

Printout example

```
DATE:2004.03.06  TIME:15:44
TV-33  VISCOMETER  SN6269  TIMES001

PROGRAM =  2
ROTOR  =  01:  1°  34' × R24

Step:01  Range:H  Speed:  5rpm

00010  VIu    125 mPas     9.8%   +25.0℃
00020  VI     198 mPas    15.5%   +24.9℃
00030  VI     199 mPas    15.6%   +24.9℃

Step:02  Range:H  Speed:  20rpm

00010  VI     166 mPas    52.2%   +24.8℃
00020  VI     167 mPas    52.3%   +24.8℃
00030  VI     167 mPas    52.3%   +24.8℃

Step:03  Range:R  Speed:  50rpm

00010  VI     143 mPas    55.8%   +24.8℃
00020  VI     143 mPas    56.0%   +24.8℃
00030  VI     143 mPas    55.9%   +24.8℃

TI  =  1.3916
VI:STEP  01  =  199 mPas
VI:STEP  03  =  143 mPas
```

Printout Description

← Year Month Day Time
← viscometer model, serial number, No. of measurements

← program No.
← rotor code, rotor nomenclature

← step No., measurement range, rotation speed

← elapsed time (* Note 6)
viscosity

display content code (* Note 7)
% torque (* Note 9)

warning display (* Note 8)
temperature (* Note 10)

← Shear Thinning Index
← Step 1 viscosity value
← Step 2 viscosity value

* Note 6: Elapsed time is the cumulative time beginning with the start of measurement (units: seconds).
* Note 7: Display content code.
* Note 8: "Warning mark" referenced to viscosity measurement values. → [o] = overscale [u] = underscale [blank] = normal measurement
* Note 9: Normal printout, "viscosity measurements in % units".
* Note 10: Temperature measurement printout only available for models equipped with temperature measurement function. No temperature printouts for non-temperature measurement function models.

Upper Measurement Limit Tables (mPa・s)

TVB-22L/33L

Speed (rpm)

Rotor	60	30	12	6	3	1.5	0.6	0.3
L/Adp ※	10	20	50	100	200	400	1,000	2,000
No.1	100	200	500	1000	2,000	4,000	10,000	20,000
No.2	500	1,000	2,500	5,000	10,000	20,000	50,000	100,000
No.3	2,000	4,000	10,000	20,000	40,000	80,000	200,000	400,000
No.4	10,000	20,000	50,000	100,000	200,000	400,000	1,000,000	2,000,000

TVB-22L/33Lx2.5

Speed (rpm)

Rotor	60	30	12	6	3	1.5	0.6	0.3
L/Adp ※	25	50	125	250	00	1,000	2,500	5,000
No.1	250	500	1,250	2,500	5,000	10,000	25,000	50,000
No.2	1,250	2,500	6,250	12,500	25,000	50,000	125,000	250,000
No.3	5,000	10,000	25,000	50,000	100,000	200,000	500,000	1,000,000
No.4	25,000	50,000	125,000	250,000	500,000	1,000,000	2,500,000	5,000,000

TVB-22L/33Lx5

Speed (rpm)

Rotor	60	30	12	6	3	1.5	0.6	0.3
L/Adp ※	50	100	250	500	1,000	2,000	5,000	10,000
No.1	500	1,000	2,500	5,000	10,000	20,000	50,000	100,000
No.2	2,500	5,000	12,500	25,000	50,000	100,000	250,000	500,000
No.3	10,000	20,000	50,000	100,000	200,000	400,000	1,000,000	2,000,000
No.4	50,000	100,000	250,000	500,000	1,000,000	2,000,000	5,000,000	10,000,000

TVE-22L/33L

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
1°34'xR24	6	12	30	60	120	240	600	1,200
48'xR24 ※	3.07	6.14	15.35	30.7	61.4	122.8	307	614
3°xR17.65 ※	29.3	58.6	146.5	293	586	1,172	2,930	5,860
3°xR14 ※	58.6	117.2	293	586	1,172	2,344	5,860	11,720
3°xR12 ※	92.16	184.3	460.8	921.6	1,843	3,686	9,216	18,430
3°xR9.7 ※	176	352	880	1,760	3,520	7,040	17,600	35,200

TVE-22L/33Lx2.5

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
1°34'xR24	15	30	75	150	300	600	1,500	3,000
48'xR24 ※	7.675	15.35	38.38	76.75	153.5	307	767.5	1,535
3°xR17.65 ※	73.3	146.5	366.3	732.5	1,465	2,930	7,325	14,650
3°xR14 ※	146.5	239	732.5	1,465	2,930	5,860	14,650	29,300
3°xR12 ※	230.4	460.8	1,152	2,304	4,608	9,216	23,040	46,080
3°xR9.7 ※	440	880	2,200	4,400	8,800	17,600	44,000	88,000

TVE-22L/33Lx5

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
1°34'xR24	30	62	150	300	600	1,200	3,000	6,000
48'xR24 ※	15.35	30.70	76.75	153.5	307	614	1,535	3,070
3°xR17.65 ※	146.5	293	732.5	1,465	2,930	5,860	14,650	29,300
3°xR14 ※	293	586	1,465	2,930	5,860	11,720	29,300	58,600
3°xR12 ※	460.8	921.6	2,304	4,608	9,216	18,430	46,080	92,160
3°xR9.7 ※	880	1,760	4,400	8,800	17,600	35,200	88,000	176,000

TVB-22H/33H

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
No.1	100	200	500	1,000	2,000	4,000	10,000	20,000
No.2	400	800	2,000	4,000	8,000	16,000	40,000	80,000
No.3	1,000	2,000	5,000	10,000	20,000	40,000	100,000	200,000
No.4	2,000	4,000	10,000	20,000	40,000	80,000	200,000	400,000
No.5	4,000	8,000	20,000	40,000	80,000	160,000	400,000	800,000
No.6	10,000	20,000	50,000	100,000	200,000	400,000	1,000,000	2,000,000
No.7	40,000	80,000	200,000	400,000	800,000	1,600,000	4,000,000	8,000,000

TVB-22H/33H-(R)

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
No.1	200	400	1,000	2,000	4,000	8,000	20,000	40,000
No.2	800	1,600	4,000	8,000	16,000	32,000	80,000	160,000
No.3	2,000	4,000	10,000	20,000	40,000	80,000	200,000	400,000
No.4	4,000	8,000	20,000	40,000	80,000	160,000	400,000	800,000
No.5	8,000	16,000	40,000	80,000	160,000	320,000	800,000	1,600,000
No.6	20,000	40,000	100,000	200,000	400,000	800,000	2,000,000	4,000,000
No.7	80,000	160,000	400,000	800,000	1,600,000	3,200,000	8,000,000	16,000,000

TVB-22H/33H-(U)

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
No.1	800	1,600	4,000	8,000	16,000	32,000	80,000	160,000
No.2	3,200	6,400	16,000	32,000	64,000	128,000	320,000	640,000
No.3	8,000	16,000	40,000	800,000	160,000	320,000	800,000	1,600,000
No.4	16,000	32,000	80,000	160,000	320,000	640,000	1,600,000	3,200,000
No.5	32,000	64,000	160,000	320,000	640,000	1,280,000	3,200,000	6,400,000
No.6	80,000	160,000	400,000	800,000	1,600,000	3,200,000	8,000,000	16,000,000
No.7	320,000	640,000	1,600,000	3,200,000	6,400,000	12,800,000	32,000,000	64,000,000

TVE-22H/33H

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
1°34'xR24	64	128	320	640	1,280	2,560	6,400	12,800
48'xR24 ※	33	66	164	328	656	1,312	3,280	6,560
3°xR17.65 ※	312.5	625	1,563	3,125	6,250	12,500	31,250	62,500
3°xR14 ※	625	1,250	3,125	6,250	12,500	25,000	62,500	125,000
3°xR12 ※	983	1,966	4,915	9,830	19,660	39,320	98,300	196,600
3°xR9.7 ※	1,875	3,750	9,375	18,750	37,500	75,000	187,500	375,000

TVE-22H/33H-(R)

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
1°34'xR24	128	256	640	1,280	2,560	5,120	12,800	25,600
48'xR24 ※	66	131	328	655	1,310	2,620	6,550	13,100
3°xR17.65 ※	625	1,250	3,125	6,250	12,500	25,000	62,500	125,000
3°xR14 ※	1,250	2,500	6,250	12,500	25,000	50,000	125,000	250,000
3°xR12 ※	1,966	3,932	9,830	19,660	39,320	78,640	196,600	393,200
3°xR9.7 ※	3,750	7,500	18,750	37,500	75,000	150,000	375,000	750,000

TVE-22H/33H-(U)

Speed (rpm)

Rotor	100	50	20	10	5	2.5	1	0.5
1°34'xR24	512	1,024	2,560	5,120	10,240	20,480	51,200	102,400
48'xR24 ※	262	524	1,310	2,620	5,240	10,480	26,200	52,400
3°xR17.65 ※	2,500	5,000	12,500	25,000	50,000	100,000	250,000	500,000
3°xR14 ※	5,000	10,000	25,000	50,000	100,000	200,000	500,000	1,000,000
3°xR12 ※	7,864	15,728	39,320	78,640	157,280	314,560	786,400	1,572,400
3°xR9.7 ※	15,000	30,000	75,000	150,000	300,000	600,000	1,500,000	3,000,000

※ denotes option

Accurate measurement values might not be obtained in the entire area indicated by dark shading
or portions of the area indicated by light shading as these areas are subject to turbulent flow.

VISCOMETER

Reflecting our motto, “providing our customers what they want in the format they desire”, our development effort is focused on the diverse needs of customers and underscores our ceaseless drive in improving the reliability of viscosity measurement as well as the level of our measurement expertise. As a dedicated manufacturer of rheological equipment, our viscometers are endowed with TOKI SANGYO’s wealth of knowhow and depth of experience - products which our customers can use with the highest degree of confidence.

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※ Product specifications and design are subject to change or modification without notice.

⚠**Warning:** do not operate equipment in flame or explosion-hazardous location

⚠**Caution relating to safety:** manual should be thoroughly read before use and equipment should be operated and handled in the prescribed correct manner.

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