

Technical Specifications of **S-flow** Automated Houillon Viscometry Systems



OMNITEK

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Product Description - Omnitek S-flow series

Maximum throughput and ease of use with very low sample and solvent consumption

The S-flow range of instruments consists of compact, bench-top automated viscometry systems for the analysis of used and new lubricants. It conforms to the requirements in ASTM D7279, D2270 and correlates to ASTM D445. It is also the ideal system for used oil analysis laboratories that need to test a wide range of lubricant viscosities.

Additionally, S-flow systems are used for analysis of fuels like diesel, bunker fuel and bio-fuel (feedstock), hydraulic and metal working fluids and even gelatins and inks.

The S-flow system is a self-contained viscometer system that consists of a thermostatic bath with circular heater and a control touchscreen. The bath contains 4 viscometer tubes together with optical sensors to detect the flow of oil through the tubes. All measuring tubes function independently of each other.



S-flow 3500 (dual bath)

The system contains a touchscreen with storage up to 10,000 measurement results. The touchscreen allows the user to control and operate the system. Although a PC is not required to operate the instrument, additional software is available for LIMS connection and full data storage and reporting. The user has the option to operate in two modes, standard viscosity determination or tube calibration. In both modes, the operator chooses how many determinations must be made for an average result. Additional parameters such as tube constants and cleaning cycle are also controlled by the operator.

Because the sample volume is very low (0.3-1 ml), the entire measurement cycle is very short. After the user injects the sample into the tube, the sample travels down towards the optical sensors and heats up to the test temperature very quickly. Upon reaching the first sensor, the time measurement is started. When the second sensor is reached, the measurement is stopped and the result displayed on the touchscreen or through the PC software. Then, a predefined cleaning cycle automatically commences, cleaning and drying the viscometer completely.



S-flow 1250 (single bath)

The entire cycle time ranges between 3-10 minutes per tube, allowing a throughput of up to 80 tests per hour per bath under ideal operation conditions. After the injection of the sample, operator presence is no longer required. The operator only needs to return after the system has completed the measurement and cleaned the tube.

For difficult and heavily contaminated samples, an optional dual solvent injection system is available. Additionally, a duplo measurement upgrade is available which adds another optical sensor to each tube, effectively providing 2 measuring trajectories. This allows the user to perform 2 viscosity determinations on one sample.

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Versions

Omnitek S-flow is available in four different models

	S-flow 870	S-flow 1250	S-flow 3500
			
Number of baths	1	1	2
Viscometers per system	4	4	8
Time measurement	Automatic	Automatic	Automatic
Integrated cleaning pump	Yes	Yes	Yes
Chemically resistant	Yes	Yes	Yes
Solvent injection	Manual	Automatic	Automatic
Software (optional)	Yes	Yes	Yes
Integrated Viscosity Index	No	No	Yes
Dual solvent option	No	Yes	Yes
Duplo measurement option	Yes	Yes	Yes
Samples per hour *	25 - 40	40 - 80	80 - 160
Temperature range (°C) **	20 - 120	20 - 120	20 - 120
Integrated backflush	Yes	Yes	Yes
Warmup prior to measuring	Yes	Yes	Yes
Touchscreen	7"	7"	10"
Optional robotic operation	No	Yes	Yes

* Samples per / hour; depends on viscosity, tube, temperature and solvents chosen

** For temperatures around ambient, an external chiller is required

S-flow series features

- Applicable for fuels, base oils, formulated oils, and petroleum products as well as water-based fluids.
- Compliant with requirements for ASTM D7279, ASTM 2270 and correlation to ASTM D445.
- High throughput: up to 80 samples per hour per bath under ideal operation conditions.
- Very easy to use and maintain.
- Small sample volume: 0.3-1.0 ml.
- Low solvent consumption: 2-3 ml per sample.
- Extremely accurate temperature control and flow-time measurement independent of fluid type.
- Automatic flow time measurement with ultraprecise meniscus detection.
- Fully automatic cleaning and drying (model dependent).
- Fast & easy tube replacement (tubes **are not** connected to optical sensors).
- No need to drain bath during tube replacement.
- Single or dual solvent injection (model dependent).
- Integrated VI calculations (on 3500 model only).



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- Stand-alone unit. No PC required. Software operation is available as an option.
- Chemically resistant to allow for all common solvents.
- Optional duplo measurement capability.
- Integrated back flushing.

Temperature control

Temperature control, which is crucial to enable reliable viscosity measurement, is extremely tight. Omnitek S-flow surpasses ASTM standards with temperature stability better than $\pm 0.02^\circ\text{C}$.

Safety

Safety was a primary concern throughout the design of the S-flow series. Many precautions have been taken. Omnitek S-flow is constructed with only components of the highest quality. It has excellent chemical resistance towards most commonly used fluids and solvents like petroleum ether, kerosene, toluene, acetone, MEK, etc.

S-flow series specifications

Feature	S-flow 870 / 1250 / 3500
Standard methods	Complies to ASTM D7279, D2270 and Correlates to ASTM D445
Measuring range	0.3 - 3,000 mm ² /s (cSt) @ 40°C
Temperature range	20 - 120°C *
Temperature stability	Better than $\pm 0.02^\circ\text{C}$
Timer resolution	0.001 s
Sample volume	0.3 - 1.0 ml
Solvent consumption	2 - 3 ml per cycle
Sample throughput	Up to 80 samples per hour per bath (S-flow 1250 and 3500 models) **
Viscometer type	Houillon
Sensor type	Optical
PC Control	Multiple instruments controlled with 1 PC
Dimensions	44 x 48 x 62 cm. Single bath models
	70 x 48 x 62 cm. Double bath models
Weight	32 kg. Single bath models
	62 kg. Double bath models
Communication	RS-232C
Data export	USB

* For temperatures around ambient, an external chiller is required

** In optimum conditions



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Measuring Tubes

The S-flow viscometer type was designed as a high-speed, low-volume alternative for commonly used viscometer types such as the Ubbelohde and Cannon Fenske. Although reliable, these viscometer types present the user with several disadvantages:

1. Large quantities of both sample and cleaning & drying solvents are required
2. Because of their large volume it's difficult to clean or dry the viscometer completely
3. Measuring cycles are generally long

The above can cause problems where quick results are necessary in a continuous feedback process to the production line and where a large number of viscosity tests is performed on a daily basis. The S-flow eliminates all these disadvantages. Because of the small volume of the viscometer much smaller quantities of both sample and solvents are required, which saves considerably on measurement costs, guarantees complete cleaning and drying and allows for quick sample warm-up. Up to 90% savings on solvents are feasible compared to conventional viscometers. The shape and dimensions of the S-flow viscometers have been designed in such a way that disturbance of the laminar flow area by turbulence is virtually non-existent. Measuring kinematic viscosity of both transparent and opaque fluids (Newtonian) with this type of viscometer meets or exceeds the requirements in relevant international standards, such as ASTM, IP, ISO, NEN, DIN etc. The S-flow viscometer was designed for flow times of 50 seconds and higher and viscosities of 0.3-3000 mm²/s.

S-flow tube



Table below shows the standard available tubes. Any viscometer constant can be supplied on request.

Nominal constant mm ² /s ²	Measuring range mm ² /s (cSt)	Nominal constant mm ² /s ²	Measuring range mm ² /s (cSt)
0.01	0.3 - 2.0	0.50	15 - 100
0.02	0.6 - 4.0	0.70	21 - 140
0.03	0.9 - 6.0	1.00	30 - 200
0.05	1.5 - 10	2.00	60 - 400
0.07	2.1 - 14	3.00	90 - 600
0.10	3.0 - 20.0	5.00	150 - 1000
0.20	6.0 - 40.0	10.00	300 - 2,000
0.30	9.0 - 60.0	15.00	450 - 3,000

Above chart is based on flow times of 30-200 seconds, which can be regarded as normal flow times for the S-flow viscometer tubes. Supplied viscometers are guaranteed to be delivered with a margin of ± 15% from the ordered constant.

See appendix for practical guidelines to select viscometers for different viscosity ranges.



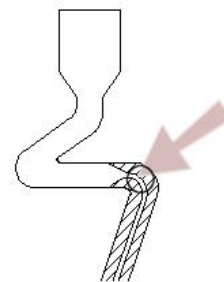
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Integrated back flushing

The backflush kit enables the user to clean tubes which have become clogged with particles, such as metal, dirt, etc.

When such a clogging occurs, this happens in the “neck” of the viscometer (see figure), at the beginning of the capillary. This particle cannot be removed using regular cleaning, which only pulls the particle further into the capillary. Instead, the tube needs to be cleaned in reverse direction. Normally, to do this, the tube needs to be taken out of the bath and connected to a vacuum line. Solvent is then reversely sucked through the tube, pushing out the particle.



Omnitek standard supplies a backflush kit which enables the user to clean the tube while staying inside the bath.

An extra connection is made at the back of the instrument, which is sealed off during normal operation. If the need arises for backflushing a tube, a silicon tube (included) is connected to this port, with a washing bottle (included) in between. This tube can be put on top of the viscometer that needs to be cleaned. Secondly, a bottle (included) of solvent is placed beneath the viscometer. Using the touchscreen on the instrument, the integrated pump of the S-flow unit can be started and the solvent will be sucked up from the vessel underneath, into the tube. From the tube it will be collected in the washing bottle. This eliminates the need to take out the tube of the bath and will be sufficient to clear the majority of particles in the tube.

Optional accessories & upgrades

Following items are optional accessories and upgrades to the instrument.

Dual solvent cleaning

A suitable solvent used for cleaning should have the following two main characteristics:

- It should be able to dissolve the sample that was tested, i.e. clean the tube
- It should evaporate quickly enough at the test temperature so that the tube is dry after cleaning

If the solvent used does have the ability to dissolve the sample, but does not evaporate quickly enough, a second solvent can be used to clean out the first solvent, as well as dry the tube. Usually, low boiling solvents are used for this purpose, such as Acetone or MEK. All fittings and valves on the system are fully chemically resistant and allow for the use of Acetone and MEK.

Cooling spiral & cooling circulator

For measurements close to ambient ($\pm 8^\circ\text{C}$), an additional cooling circulator is required to create sufficient offset for the temperature control unit. Each bath needs to be fitted with a cooling spiral, to which an external cooling circulator can be easily connected. Complete with tubing and fittings. Cooling spiral and cooling circulator will be supplied separately on request.

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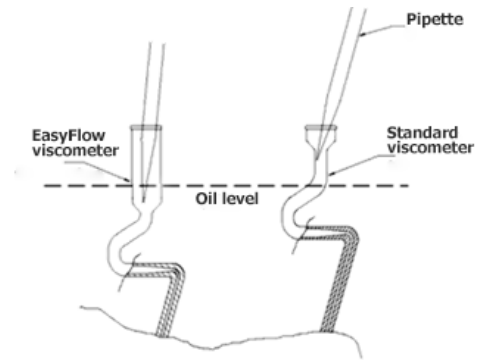
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EasyFlow viscometers tubes



For high viscosity, EasyFlow can be great use. EasyFlow viscometers can be provided starting from tube constant 1.0.



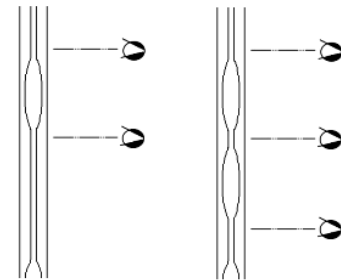
Duplo measurement tubes



The optional duplo measurement upgrade adds another array of optical fibers to the instrument, bringing the total number of detection points to three per tube instead of two. Together with adapted S-flow tubes, which are fitted with two measuring trajectories, this enables the S-flow 870, S-flow 1250 and the S-flow 3500 to perform two-time measurements with a single sample injection, increasing productivity, saving even more on solvent consumption.

Single

Duplo

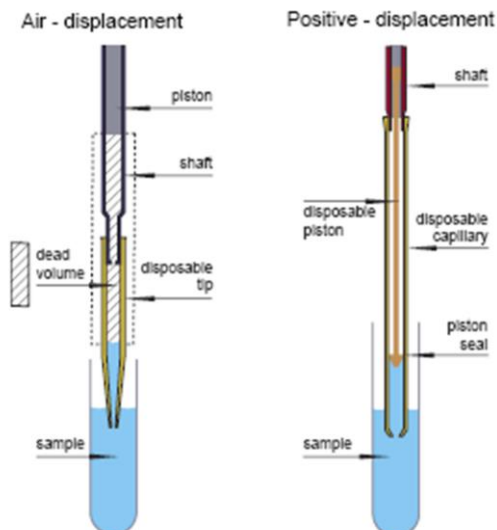


Compressor

Omnitek S-flow systems operate on clean 5 bar @ 5 l/min of compressed air. Suitable compressor can be supplied from Omnitek if no compressed air is available.

Positive - displacement pipette

Air-displacement pipette is supplied with S-flow series as a standard. It is recommended to use positive displacement pipette especially at higher viscosities (300 mm²/s and above) to avoid operator errors and for more accurate and repeatable injections.



Two pipetting concepts Positive and Air-displacement *

* Refer to: http://www.labautopedia.org/mw/index.php?title=User:S.d.hamilton/Gilson_1



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Software

All Omnitek S-flow systems utilizes advanced and easy to use **multi-lingual** software, it can be operated directly from the touchscreen, and both calibration and viscosity measurements can be performed without PC or software. However, to have more control, dedicated software is available, which can be used to control multiple systems.

Several system settings can be monitored per system, such as:

- Tube ID / Tube constant
- Minimum / maximum flow time per tube
- Reference viscosity in case of calibrations
- Required filling volume
- Allowed spread between consecutive samples
- Yes / No real-time Viscosity Index calculation (only on S-flow 3500)
- Cleaning and drying settings
 - Draining time of solvent
 - Number of individual solvent injections
 - Duration of 1 solvent injection
 - Time between solvent injections
 - Drying time

For every tube / measurement information is given, such as:

- Unit number
- Measurement stage (e.g. Measuring, Calibrating, Cleaning, Drying, etc)
- Registered flow-time per measurement
- Maximum / minimum flow-time per sample
- Average flow-time and result (viscosity or calibration constant)
- Depending on pre-set spread measurements can be excluded from calculations and automatically a new measurement can be started instead

	Unit 1	Unit 2	Unit 3	Unit 4
Status	OK 1/1	OK 1/1	OK 1/1	OK 1/1
Sample ID				
time (sec)	100.057 max	167.824 max	105.347 max	113.183 max
Average	100.057	167.824	105.347	113.183
Diff.%	0	0	0	0
Result C =	0.009994	1.09	0.009492	0.008835
VI				



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PC

A PC system can be sourced locally or through Omnitek. Omnitek supplies the latest model entry level laptop or, if required, desktop. When sourcing locally, make sure the operating system is Windows 7 or later and that the PC/Laptop has 1 USB port per instrument.

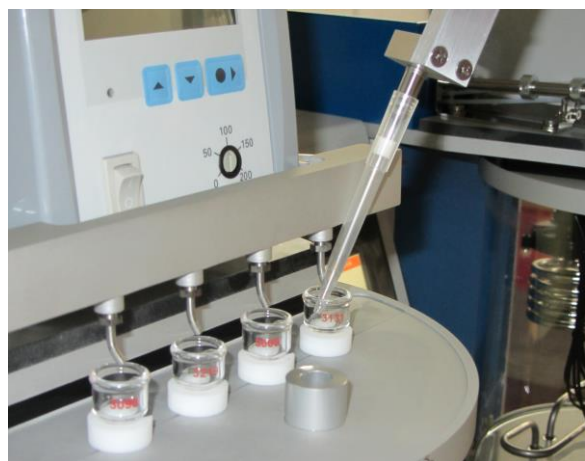
Printer

Any kind of printer can be used if instrument is connected to a PC by software. A printer can be sourced locally or through Omnitek. Omnitek supplies the latest model entry level laser printer.

Robotic Operation



Robot feeding S-flow 3000 VI



Sample injection in viscometer

Omnitek offers “Robotic Operation” for models S-flow 1250 and 3500 for customers that run large numbers of samples (>500 samples per day) and want to automate their sampling process. As each laboratory will have its own requirements, automation is a highly customized product which requires elaborate preparation. Please contact us for specific solutions to your sampling needs.

ASTM thermometers

All S-flow units can be equipped with ASTM thermometers. The recommended thermometers that can be supplied are the modern digital contact thermometers (DCT), used at multiple temperatures.

Part No.	Description
90.361.80	Digital thermometer, 3 decimals, -40 +150°C, 1 channel, with factory calibration certificate
90.361.81	Digital thermometer, 3 decimals, -40 +150°C, 2 channels, with factory calibration certificate

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S-flow site requirements

Omnitek S-flow series consists of bench-top instruments which require little counter space for operation. There are several things that need to be taken into consideration to facilitate its operation and maintenance. Instrument should be placed on a level surface which is free from vibration and located close to the utilities required for operation such as power, compressed air, solvent supply, fluid waste disposal and venting. S-flow instruments fit on standard laboratory work bench, however, 5 cm clearance is required to enable connection to utilities at the back of the instrument. An air-conditioned room is recommended for optimal temperature stability of the thermostatic bath. It is also good practice not to place the instrument in front of a window or door where the sun or drafts may cause temperature changes.

Bench space

- Dimensions of S-flow 870/1250: 44 x 48 x 62 cm (W x D x H)
- Dimensions of S-flow 3500: 70 x 48 x 62 cm (W x D x H)

Power requirement

- 2.5 kW for S-flow 870/1250, 5 kW for S-flow 3500

Compressed air (free of particles, water, oil and dust)

- Compressed air is needed at 5 Bar @ 5 l/min preferably fitted with a moisture/oil mist filter. Compressed air supply should be fitted with a connector that accepts 6 mm OD pressure tubing.

Cleaning/drying solvent

- A solvent suitable for cleaning the samples to be tested should be available. If a dual solvent configuration is ordered, a suitable drying solvent should also be available.

Ventilation

- The exhaust of the S-flow system should be connected to a ventilation duct, to ensure that solvent vapours are safely emitted. The system is provided with a hose barb having 12 mm OD, accepting flexible tubing of 13 mm ID. Alternatively, the ventilation can be directly connected to the system's exhaust, which has a ¼" female thread.

S-flow series applications

Industries	Petroleum Based Samples	Other Sample Types
Refineries Terminals (Fuel Distribution) Lubricant Manufacturers Additive Manufacturers Condition Monitoring Labs Third Party Testing Labs Research & Development Labs Quality Control Labs Military Labs Power Plants Mines Customs Universities Automotive Chemical Plants Iron & Steel Textile Aviation Railways Highways	Lubricating Oils Additives Base Stocks Industrial Oils Transmission Oils Hydraulic Fluids Used Oils Waste Oils Crude Oils Fuel Oils Gasoline Diesel Bio Fuels Marine Fuels	Printer ink



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S-flow series scope of supply list

Item	Qty per S-flow model						Part No.	Description
	870	1250	1250 DS	3500	3500 DS LB	3500 DS BB		
1	1	1	1	1	1	1	90.10x.xx	S-flow kinematic viscometry system (no cooling coil)
	4	4	4	8	8	8	90.200.00	Measuring tube, constant to be specified
	4	4	4	8	8	8	90.105.02	PTFE distancer for measuring tubes
	4	4	4	8	8	8	90.500.xx	Calibration standards (tube constant dependent)
2	1	1	1	1	1	1	90.105.00	Exhaust muffler for vacuum pump
3	1	1	1	1	1	1	90.364.00	Hose barb, blue, ¼"x 12 mm
4	1	1	1	--	--	--	90.105.20	Waste bottle cap assembly, complete with tubing, single bath
5	--	--	--	1	1	1	90.105.21	Waste bottle cap assembly, complete with tubing, dual bath
6	1	1	1	--	--	--	90.105.24	Waste collection flask, 1 liter, coated
7	--	--	--	1	1	1	90.105.25	Waste collection flask, 2 liter, coated
8	--	1	2	2	3	4	90.105.07	Coated solvent supply bottle (1 liter)
9	--	1	--	--	--	--	90.105.13	Screw cap assy for solvent supply bottle 4 mm, single bath, single solvent
10	--	--	1	--	--	--	90.105.16	Screw cap assy for solvent supply bottle 4 mm, single bath, 2 solvents
11	--	--	--	1	--	--	90.105.19	Screw cap assy for solvent supply bottle 4 mm, dual bath, single solvent
12	--	--	--	--	1	--	90.105.17	Screw cap assy for solvent supply bottle 4 mm, 1 bath 1 solvent, 1 bath 2 solvents
13	--	--	--	--	--	1	90.105.18	Screw cap assy for solvent supply bottle 4 mm, both baths, 2 solvents
14	5	5	5	5	5	5	90.105.29	Leveling supports for S-flow
15	4	4	4	8	8	8	90.105.01	PTFE tool for replacing viscometer tubes (set of 4 pcs)
16	1	1	1	1	1	1	90.105.27	Set of Allen Keys for S-flow
17	1	1	1	1	1	1	90.330.28	3 m air pressure tubing Ø 6 mm
18	2	2	2	3	3	3	92.330.48	Thermostatic bath oil (5 liters)
19	1	1	1	1	1	1	90.361.00	Micro pipette, air piston
20	1	1	1	1	1	1	90.361.01	Pipette tips, 1000 pcs
21	1	1	1	1	1	1	90.330.27	Operation manual as pdf file, English
22	1	1	1	1	1	1	90.330.36	Power supply cable, 230 V
							90.330.29	Power supply cable, 115 V

DS Dual solvent
DS LB Dual solvent, left bath
DS BB Dual solvent, both baths

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S-flow spare part kits scope of supply list

Spare part kits, for a period of 2 years normal operation (not included unless specified).

Item	Qty per S-flow models			Description	
	870	1250	3500	Model No.	
	90.328.50	90.330.002	90.331.002	Part No.	
1	-	1	2	90.330.04	Chemically resistant tubing Ø 3mm, 3 meter
2	1	1	2	90.330.14	Chemically resistant tubing Ø 4mm, 3 meter
3	1	1	2	90.330.01	Inner O-ring for bottom feedthrough viscometers, set of 10 pcs
4	1	1	2	90.330.15	Outer O-ring for bottom feedthrough viscometers, set of 10 pcs
5	1	1	2	90.330.02	O-ring for mixing chamber, set of 10 pcs
6	1	1	2	90.330.05	Insert for 3 mm PTFE tubing, set of 10 pcs
7	1	1	2	90.330.03	Seal for thermostatic bath, set of 2 pcs
8	1	1	2	90.330.50	Flat ring for thermostatic bath
9	1	1	-	90.330.26	Output driver IC for S-flow 870/1250, 2 pcs
10	-	2	4	90.110.11	Solvent injection valve

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Appendix: Guideline for tube and injection volume

Appendix:

Guideline for selecting viscometers and injection volumes

Sample volume (µl)	Tube constant (mm ² /s ²)	Viscosity (mm ² /s)																							
		Min	Max	1	2	3	5	10	15	20	30	50	75	100	150	200	300	500	750	1,000	1,500	2,000	3,000		
100 - 200	0.01	0.3	2.0																						
	0.02	0.6	4.0																						
	0.03	0.9	6.0																						
	0.05	1.5	10																						
	0.07	2.1	14																						
150 - 350	0.10	3.0	20																						
	0.2	6	40																						
	0.3	9	60																						
	0.5	15	100																						
	0.7	21	140																						
300 - 550	1.0	30	200																						
	1.2	36	240																						
	1.5	45	300																						
	2.0	60	400																						
	2.5	75	500																						
500 - 1,000	3	90	600																						
	5	150	1,000																						
	7	210	1,400																						
	10	300	2,000																						
15	450	3,000																							

Most practical viscosity range

Note:

Sample volume is indicative; it depends on tube constant and temperature. Use same volume for calibration and measurements.
Flow time range is practically set between 30 and 200 seconds
For tubes having constants of 0.03 mm²/s² or less, kinetic energy correction may be applicable

This guideline suggests tube constants and sample injection volumes for most practical viscosity ranges, sample volume is not limited to these data.



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