Technical Specifications of
BitUVisc
Automatic Viscometry Systems for Highly Viscous Samples

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V4.0

Product description – Omnitek BitUVisc series

Omnitek 'BitUVisc' is a programmable, fully automatic kinematic viscometer specially designed to handle highly viscous samples at high temperatures. The system can process samples with viscosities ranging up to 120,000 mm^2/s, up to 150ºC. It fully complies with ASTM D445, D446, D2170 and AASHTO T201.

There are 2 different models available: 110 and 120. BitUVisc 110 features a single thermostatic bath with 1 viscometer tube whereas BitUVisc 120 model holds 2 viscometer tubes in a single bath. All BitUVisc instruments are equipped with auto-sampling, preheating, fully automatic dual solvent cleaning and drying.

Viscometer tubes are based on the well-known and proven Ubbelohde design. Using specially designed thermal sensors, these tubes allow the detection of fully opaque fluids without any problems or limitations and eliminate the need to use the reverse flow tubes. The standard configuration offers viscosity measurement up to 150ºC and sample preheating up to 200ºC.

Sophisticated temperature control ensures that measurements are carried out well within the required temperature stability. The system features an innovative single position auto-sampling which provides integrated heating of the sample up to 200ºC and uses preheated solvent to effectively clean the viscometer tube. The BitUVisc is fitted with special designed duplo viscometer tubes for unstable samples such as vacuum residues, additives, crude oils, waxes, heavy fuel oils, polymers, asphalts, etc., which typically show poor determinability when sampled repeatedly. These tubes have 2 measuring sections with an approximately similar tube constant. This allows for an actual duplo determination while only sampling once.

Omnitek BitUVisc requires a PC (not included) for full operation and can be controlled through an advanced PC software application but it can also be controlled as a stand-alone unit through the responsive color touchscreen interface with a storage up to 10.000 measurement results. PC software allows the operator to specify optimized and fully customizable test methods for each individual sample. For data collection, storage, calculations and reporting, an advanced PC application is provided with the instrument, which can gather data from up to 4 instruments simultaneously.

Safety

Safety was a primary concern throughout the design of the BitUVisc series. Many precautions have been taken. The sample holders vertical and horizontal movements are controlled by calibrated stepper motors and are verified by accurate sensors. Additionally, bath over-temperature cut-offs, bath level detection and emergency stop safeties have been implemented.

BitUVisc is built from highest standards of mechanical parts. It has excellent chemical resistance against most commonly used fluids and solvents such as petroleum ether, kerosene, toluene, xylene, decalin, acetone, IPA and MEK.

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Versions

Omnitek BitUVisc is available in two different models.

Version		Independent baths	Viscometer tubes per bath	Sample Holder
	BitUVisc 110	1	1	1 position per tube
	BitUVisc 120	1	2	1 position per tube
	Dimensions Weight	38 x 62 x 78 cm (width x depth x height) 54 kg (empty)		

BitUVisc series features

- Applicable for fuels, base oils, formulated oils, highly viscous samples like vacuum residues, additives, crude oils, waxes, heavy fuel oils, polymers, asphalts, etc.
- Meets all ASTM, EN, ISO, DIN, AASHTO T201 and standards related to kinematic viscosity standards
- Extremely accurate temperature control
- Extremely accurate flow-time measurement independent of fluid type
- Viscometer filling by vacuum method
- Innovative and efficient viscometer tube cleaning allowing cross contamination free operation
- Easy viscometer tube exchange
- Chemically resistant to an extended range of fluids and solvents
- Compact design

BitUVisc series measurement steps and working principle

Measurement Steps

- Go to the status overview in the PC software and press the button "Go to sample loading position".
- Fill PE or glass sample cups with 12 ml test sample.
- Load the sample in sample holder.
- Introduce the sample information in the empty fields from software.
- Press the "START" button and the measuring process will begin.

BitUVisc working principle

1. The sample holder moves to the home position.
2. Sample cup is lifted to its position where the lower part of viscometer is immersed into the sample. The sample cup is preheated before rising to its position.
3. The sample is raised into the viscometer by vacuum to the appropriate level. This is controlled automatically by the instrument.
4. After a programmable warming up time, the sample can flow down back into the sample cup under gravity.
5. Each bulb contains thermal sensors that detect the passing of the sample. As the sample passes these sensors, flow time is measured.
6. Tubes have 2 measuring sections with an approximately identical tube constant. This allows for an actual duplo determination with only 1 sampling. When used in Duplo mode, the tube produces 2 results within one sample efflux, but can also be utilized in single mode (upper or lower section).
7. The instrument calculates the average flow time and calculates kinematic viscosity automatically.
8. After the analysis has taken place, the sample holder is moved automatically into the cleaning position.
9. A user programmable cleaning method is carried out, consisting of several injections of solvent from the top of the viscometer, as well as the bottom for high viscous samples ("solvent soak option"), in this way, the possible sample remaining in the viscometer tube is cleaned easily; followed by a drying period where air is blown through the viscometer tube. All cleaning parameters are completely customizable by the user.
10. After cleaning procedure, the system will be ready for the next sample.

Overflow bulb

Upper bulb

Lower bulb

Capillary

Filling / exit
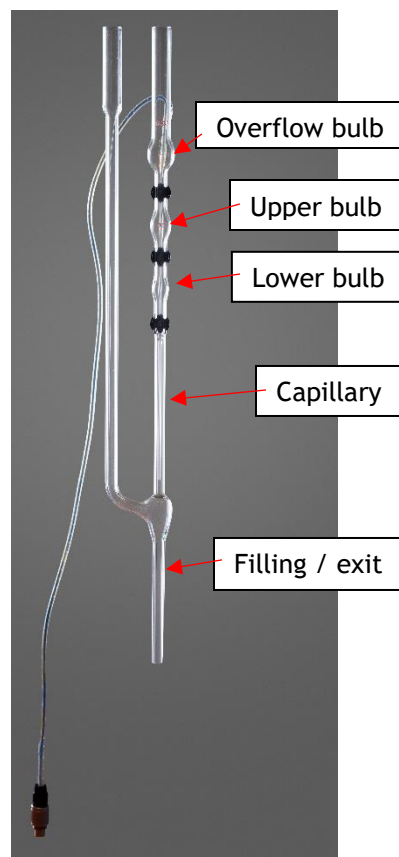
BitUVisc test procedure for highly viscous samples

Sample processing

Each sample is preheated by built-in preheater for a required time and temperature, followed by duplo measurement. During the test, sample is constantly heated in the sample holder.

Tube cleaning

After emptying the sample contained in viscometer tube (into the sample cup), viscometer is cleaned and dried with suitable solvent and air. Glass capillary tube is cleaned with preheated solvent and waste block is heated to prevent blockage. For rigorous cleaning, "solvent soak" can be applied in the cleaning method, the solvent is flushed in the container up to a certain quantity, controlled by the liquid level sensor. After the solvent is set in the container, reduced vacuum is used to suck up the solvent and clean the sample remaining in the capillary tube.

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BitUVisc series temperature control

Temperature control, which is crucial to enable reliable viscosity measurement, is extremely tight. Omnitek BitUVisc surpasses ASTM and ISO standards with temperature stability of ± 0.01ºC from 15ºC to 100ºC, and ± 0.03ºC up to 150ºC. The temperature can be easily changed through PC software or touchscreen.

BitUVisc series technical specifications

Feature	BitUVisc 110 / 120
Measuring range	Up to 120,000 mm^2/s, up to 150ºC
Temperature range	15 – 150˚C *
Temperature stability	15ºC to 100ºC ± 0.01ºC *, Up to 150ºC, ± 0.03ºC
Preheater temperature	Up to 200˚C
Timer accuracy	0.001 s
Sample volume	12 ml
Sample introduction	Vacuum
Solvent consumption	20 - 30 ml per cycle, sample dependent
Sample throughput	BitUVisc 110: up to 2 measurements per hour ** BitUVisc 120: up to 4 measurements per hour **
Applicable standards	ASTM D445, D446, D2170 and AASHTO T201
Dimensions / Weight	BitUVisc 110 / 120: 38 x 62 x 78 cm (w x d x h) / 54 kg (empty)
Viscometer type	Ubbelohde based
Sensor type	Thermal
Communication	RS-232C
PC Control	Multiple instruments controlled with 1 PC
Power requirement	BitUVisc 100: 10A @ 230 V
Data Export	USB

* For temperatures around ambient, an external cooling circulator is required
** Measurements per/hour; depends on viscosity, tube constant, temperature and solvents chosen. Measurement cycles are given for a sample with a viscosity around 50.000 mm^2/s @ 40˚C.

BitUVisc series site requirements

BitUVisc 110/120 are a bench-top instrument. There are several things that need to be taken into account to facilitate its operation and maintenance. Instrument should be placed on a flat surface which is free from vibration and located close to the utilities required for operation such as;

- Power
- Compressed air (5 bar - 5 l/min - free of particles, oil and dust - compressed air tubing has 6 mm OD, its need to be sure for connections to air source)
- Solvent supply flask
- Waste collection flask
- Venting (hose barb has 12 mm OD)

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BitUVisc 110/120 often fit on standard laboratory work benches, however 5 cm clearance is required to enable connection to utilities at the back of the instrument. If required, a specially designed pedestal base is available.

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.

Viscometer tubes

The instrument utilizes up to 2 Ubbelohde based viscometer-tubes, 1 or 2 in the bath. Using duplo measuring tubes with thermal sensors, tubes are suitable for both opaque and transparent, non-conductive samples. Prior to measurement, the sample is drawn up into the viscometer tube and then allowed to warm up to the test temperature. Then, the sample flows down under gravity and the time between the sensors is measured.

Duplo viscometer tubes are especially developed for unstable samples such as vacuum residues, additives, crude oils, waxes, heavy fuel oils, polymers, asphalts, etc., which typically show unstable viscosities when sampled repeatedly, these tubes have 2 measuring sections with an approximately identical tube constant. This allows for an actual duplo determination with only 1 sampling. The sample needs to exhibit Newtonian flow behaviour for this to work, but this applies to most petrochemical samples.

When tubes are used in Duplo mode, the tube produces 2 results within one sample efflux providing measuring range of 20-fold.

The viscometer tube is calibrated at 1 temperature of the customer's choice as standard. Special request must be made for an extra temperature on fee.

3 sensor duplo tubes measuring ranges (cSt) (thermal sensors)		
Article nr.	Duplo mode (20-fold)	
92.220.0-015	0.75 -	15
92.220.0-025	1.25 -	25
92.220.0-05	2.5 -	50
92.220.0-1	5 -	100
92.220.0-15	7.5 -	150
92.220.0-25	12.5 -	250
92.220.0-5	25 -	500
92.220.1-00	50 -	1,000
92.220.1-50	75 -	1,500
92.220.2-50	125 -	2,500
92.220.5-00	250 -	5,000
92.220.10-00	500 -	10,000
92.220.15-00	750 -	15,000
92.220.25-00	1,250 -	25,000
92.220.50-00	2,500 -	50,000
92.220.100-00	5,000 -	100,000

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BitUVisc software

BitUVisc utilizes advanced and easy to use *multi-lingual* software. One PC can control multiple systems (1 COM-port required for each instrument). Data can be exchanged with a LIMS via RS-232 or optionally via wireless. The instrument can be operated in its entirety through the PC interface. Sample ID's can be loaded and sample queues can be started, halted or temporarily suspended. Results are automatically stored in the internal database and optionally also on any external drive or network folder.

During a run several kinds of information is shown like measured flow times (average and corrected), % difference, viscosity result, bath temperature, set temperature, preheater temperature, sample ID, test method, measuring section and last results. Also, actual status like filling, cleaning, etc is shown for every unit involved. Measured flow times are presented in left or right column, depending whether upper or lower measuring bulb is used for testing.

Methods

A unique feature of BitUVisc software is its ability to define and store different operating methods, including different ways for cleaning and drying tubes. Methods can be set up for viscosity measurement or calibration and involve several configurable steps.

Operating mode	Viscosity & Calibration & QC Sample & Dilute Viscosity
Termination	Maximum determinations & Successive determinations & Any two determinations
Warm-up time	Fixed time for having sample thermally stabilized in viscometer tube
Pre-heating time	Time to allow sample being pre-heated
Reduced vacuum	Filling viscometer with reduced may prevent premature evaporating of low volatile components and/or may reduce formation of gas bubbles
Cleaning method	Different pre-defined viscometer cleaning methods can be chosen

Omnitek BitUVisc allows for defining several methods for cleaning of viscometer, such as "solvent soak". This offers great advantages in operations as for any kind of fluid optimized cleaning parameters can be set.

Method name	Defined name will show up in operating method
Injections solvent 1	Number of injections of primary solvent, e.g. toluene
Injections solvent 2	Number of injections of secondary solvent, e.g. acetone
Solvent quantity	Amount of solvent per injection
Drying time	Pre-set time
Thorough cleaning	When set it will allow for intensive solvent spraying
Soak	Use solvent to soak (feature in the BitUVisc only)
Nr. of soaks	Amount of soaks applied

Viscosity method

Cleaning method

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Measurement data

All measurement and calibration data are stored and can be retrieved or exported to tab or csv format. Stored data may include:

- Timestamp
- System ID, tube ID, tube constant
- Temperature
- Flow times, Capillary constants
- Kinematic viscosity
- Viscosity index
- Solvent viscosity
- Relative, Specific, Intrinsic, Inherent viscosity
- Viscosity number / Staudinger function
- Hagenbach-Couette correction
- Statistical calculations
- Bath temperature during analysis
- Method parameters

Measurement data resulting from viscosity and calibration

All data are collected and stored. Retrieval can be done through several screens, data can be reported to a printer or exported as TAB or CSV file for further storage or evaluation in LIMS or Excel.

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Page 9 of 13

Multi-Lingual

New multi-lingual software allows for controlling all analysis procedure in different languages.
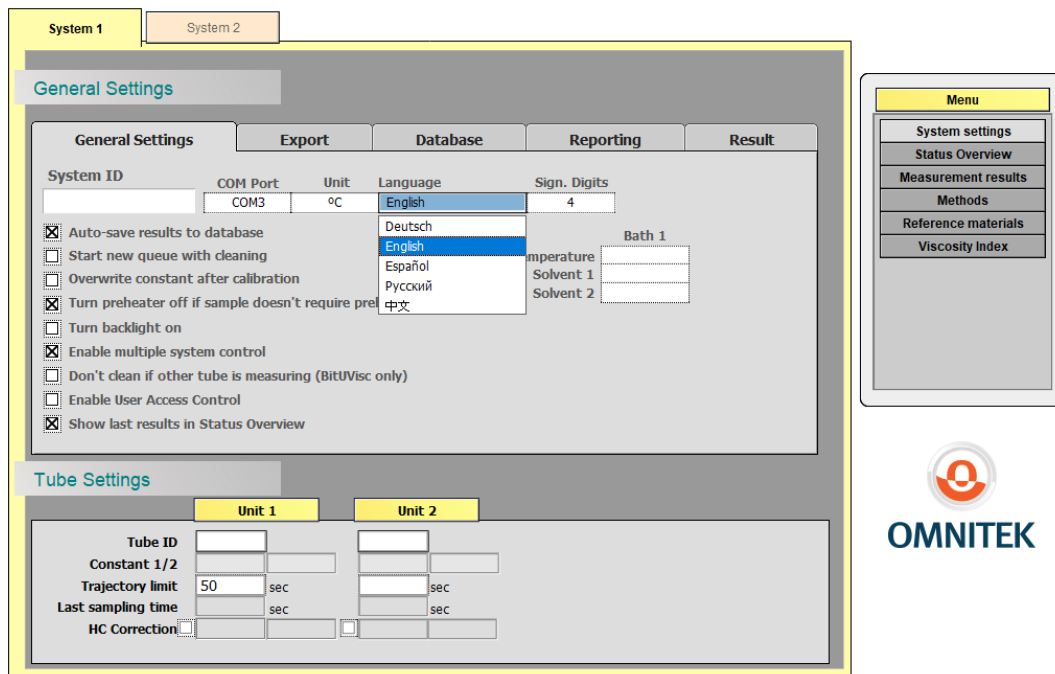
BitUVisc series standard accessories

Dual Solvent Cleaning
A suitable solvent used for cleaning should have the following 2 main characteristics:
1. It should be able to dissolve the sample that was tested, i.e. clean the tube
2. 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 solvents like Petroleum ether, Heptane, Toluene, Acetone or MEK.

Sample pre-heater
All BitUVisc versions are equipped with a sample pre-heater unit suitable to heat up fluids and solids from ambient up to 200°C (controllable). Sample pre-heating is applicable to every tube, so BitUVisc 120 is equipped with 2 sample pre-heaters.
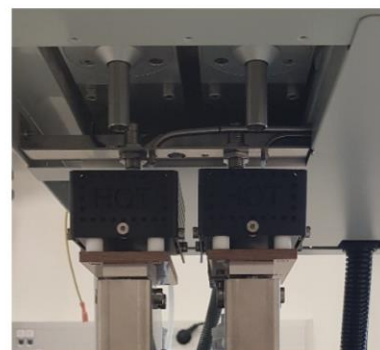
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Page 10 of 13

High temperature bath

All BitUVisc variants are built with special components capable running up to 150°C. Suitable HT oil will be provided.

BitUVisc series optional accessories

Following items are optional accessories and upgrades to the instrument.

Cooling circulator

For measurements, close to ambient (± 8°C), an additional cooling circulator is required to create sufficient offset for the temperature control unit. The 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 circulator will be supplied separately on request.

Compressor

Omnitek BitUVisc systems operate on clean 5 bar compressed air. If not available on-site a stand-alone version with @ approx. 5 l/min.

Pedestal base

Pedestal base can be supplied from Omnitek for floor-standing installation.

PC & Printer

PC can be supplied locally or from Omnitek. Omnitek supplies a new generation laptop. Minimum operation software should be Windows 7.

Any kind of printer can be used if instrument is connected to a PC by software. Printer can be supplied locally or from Omnitek. Omnitek supplies the latest model laser printer.

ASTM Thermometers

All BitUVisc 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

Glass sample cups

For temperature above 105°C, glass sample cups are required for the sample measurement.

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BitUVisc series applications

Industries	Samples
Refineries	Heavy Fuel Oils (HFO)
Bitumen (Asphalt Plants)	Residual Fuel Oils (RFO)
Road Construction & Paving	Vacuum Residues
Additive Manufacturers	Bitumens (Asphalts)
Lubricant Manufacturers	Waxy samples
Third Party Labs	Crude Oils
Research & Development	Lubricating oils
Labs	Additives
Quality Control Labs	

For other fluids / solutions please inquire

BitUVisc 100 series scope of supply list

Item	Qty 110	Qty 120	Part No.	Description
1	1	1	94.Y00.0X.04 *	BitUVisc 110 / 120 single bath kinematic viscosity system
2	1	2	92.220.00	Modified Ubbelohde viscometer tube, duplo
3	3	3	92.330.48	Bath oil, 5 liters
4	1	2	90.500.00	Viscosity calibration standard **
5	1	1	92.330.79	USB-stick with user manual, PC software and calibration certificates
6	1	1	92.330.01	Disposable sample cups, 750 pcs.
7	1	1	94.330.50	User Operation manual
8	1	1	90.350.09	Serial communication cable
9	1	1	92.330.03	USB-Serial converter
10	1	1	92.330.15/13	Power cable (230V/115V)
11	1	1	92.330.25	Programming cable
12	2	2	92.330.101	Solvent supply flask, 5 lt, complete with tubing and connectors
13	1	1	92.330.106	Waste bottle, 5 lt, complete with tubing and connectors
14	1	1	92.330.06	Bath drain accessory
15	1	2	92.330.26	Teflon stopper for U-Visc tube removal
16	1	2	92.330.24	Rubber stopper for U-Visc viscometer tube, set of 2
17	1	1	90.105.00	Exhaust muffler for vacuum pump
18	1	1	90.364.00	Hose barb, blue, ¼"x12mm
19	1	1	92.330.27	Levelling supports, set of 4
20	1	1	92.330.84	Stainless steel hose barbs to connect ext. circulator, set of 2
21	1	1	92.330.28	Allen key 3mm
22	1	1	90.330.28	3m air pressure tubing Ø 6mm
23	1	1	92.330.114	Sample grip tongs for BitUVisc

X = 0 for 1 tube, X = 1 for 2 tubes; Y = 0 for 230V / 50 Hz, 1 for 115V / 60 Hz.
*** Calibration standards will be matched to the viscometer tubes selected.*

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Page 12 of 13

BitUVisc spare part kits scope of supply list

To enable best BitUVisc performance in time it is recommended to have a set of spare-parts available. For BitUVisc 100 series spare-part kits consist of same parts but differ in numbers.

Composition of spare-parts sets

BitUVisc 100			Description
Item	92.330.00	Part No.	
1	1	90.330.28	3m air pressure tubing Ø 6 mm
2	1	90.330.38	Chemically resistant tubing 6 mm, 3 m
3	1	90.330.04	Chemically resistant tubing 3 mm, 3 m
4	1	90.330.14	Chemically resistant tubing 4 mm, 3 m
5	1	92.330.18	Pressure tubing 4 mm, yellow 3 m
6	1	92.330.19	Pressure tubing 4 mm, red 3 m
7	1	92.330.20	Pressure tubing 6 mm, red 3 m
8	1	92.330.16	O-ring kit for upper injector block, set of 5 each, includes below items
9	5	92.330.37	O-ring, 3x1 for tubing seal injector block U-Visc/BitUVisc
10	5	92.330.38	Silicon seal for injector block U-Visc/BitUVisc
11	5	92.330.39	O-ring, 11.91 x 2.62 for injector block U-Visc/BitUVisc
12	1	92.330.17	O-ring kit for bottom injector block, set of 5 each, includes below items
13	5	92.330.40	O-ring 5.28 x 1.78 for bottom feedthrough block U-Visc/BitUVisc
14	5	92.330.41	O-ring 20 x 1.5 for bottom feedthrough block U-Visc/BitUVisc
15	5	92.330.42	O-ring 7.6 x 2.62 for bottom feedthrough block U-Visc/BitUVisc
16	5	92.330.43	O-ring 32 x 3 for bottom feedthrough block U-Visc/BitUVisc
17	2	92.330.47	Viton O-ring for pressurized sampling, set of 4
18	1	92.330.09	Solvent resistant valve U-Visc/BitUVisc (A,B,E,F,G,H,I,K)
19	1	92.330.10	Air valve U-Visc (C,D)
20	1	92.330.11	Ferrule for 3 mm tubing, set of 5
21	1	92.330.12	Nut for 3 mm tubing, set of 5
22	1	92.330.34	Slow-blow fuse 8A, for U-Visc/BitUVisc, pack of 2
23	1	92.330.35	Slow-blow fuse 15A, for U-Visc/BitUVisc, pack of 2

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