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OPERATING MANUAL

Ubbelohde-Viscometer

with TC sensors and cleaning tube

SI Analytics

a xylem brand

Wichtige Hinweise:

Die Gebrauchsanleitung ist Bestandteil des Produktes. Vor der ersten Inbetriebnahme bitte sorgfältig lesen, beachten und anschließend aufbewahren. Aus Sicherheitsgründen darf das Produkt ausschließlich für die beschriebenen Zwecke eingesetzt werden. Bitte beachten Sie auch die Gebrauchsanleitungen für eventuell anzuschließende Geräte.

Alle in dieser Gebrauchsanleitung enthaltenen Angaben sind zum Zeitpunkt der Drucklegung gültige Daten. Es können jedoch vom Hersteller sowohl aus technischen und kaufmännischen Gründen, als auch aus der Notwendigkeit heraus, gesetzliche Bestimmungen verschiedener Länder zu berücksichtigen, Ergänzungen am Produkt vorgenommen werden, ohne dass die beschriebenen Eigenschaften beeinflusst werden. Eine möglicherweise aktuellere Version dieser Gebrauchsanleitung finden Sie auf unserer Webseite. Die deutsche Fassung ist die Originalversion und in allen technischen Daten bindend!

Important notes:

The operating manual is part of the product. Before initial operation, please carefully read and observe the operating manual and keep it. For safety reasons the product may only be used for the purposes described in these present operating manual. Please also consider the operating manuals for the devices to be connected.

All specifications in this operating manual are guidance values which are valid at the time of printing. However, for technical or commercial reasons or in the necessity to comply with the statuary stipulations of various countries, the manufacturer may perform additions to the product without changing the described properties. A potentially more recent version of this manual is available on our internet website. The German version is the original version and binding in all specifications!

Instructions importantes:

Le mode d'emploi fait partie du produit. Lire attentivement le mode d'emploi avant la première mise en marche de produit, et de le conserver. Pour des raisons de sécurité, le produit ne pourra être utilisé que pour les usages décrits dans ce présent mode d'emploi. Nous vous prions de respecter également les modes d'emploi pour les appareils à connecter.

Toutes les indications comprises dans ce mode d’emploi sont données à titre indicatif au moment de l'impression. Pour des raisons techniques et/ou commerciales ainsi qu'en raison des dispositions légales existantes dans les différents pays, le fabricant se réserve le droit d'effectuer des suppléments concernant le produit pour séries de dilution qui n’influencent pas les caractéristiques décrits. Une version éventuellement plus récente de ce mode d'emploi est disponible sur notre site Internet. La version allemande est la version originale et obligatoire quelles que soient les spécifications!

Instrucciones importantes:

El manual de instrucciones forma parte del producto. Antes de la operación inicial de producto, lea atentamente y observe la manual de instrucciones y guárdelas. Por razones de seguridad, el producto sólo debe ser empleado para los objetivos descritos en este manual de instrucciones. Por favor, observe el manual de instrucciones para los dispositivos a conectar.

Todas las especificaciones en este manual de instrucciones son datos orientativos que son válidos en el momento de la impresión. No obstante, por motivos técnicos o comerciales, o por la necesidad de respetar las normas legales existentes en los diferentes países, el fabricante puede efectuar modificaciones del producto sin cambiar las características descritas. Una versión más reciente de este manual se encuentra disponible en nuestra página de Internet. ¡La versión en alemán es la versión original y se establece en todas las especificaciones!

TABLE OF CONTENT

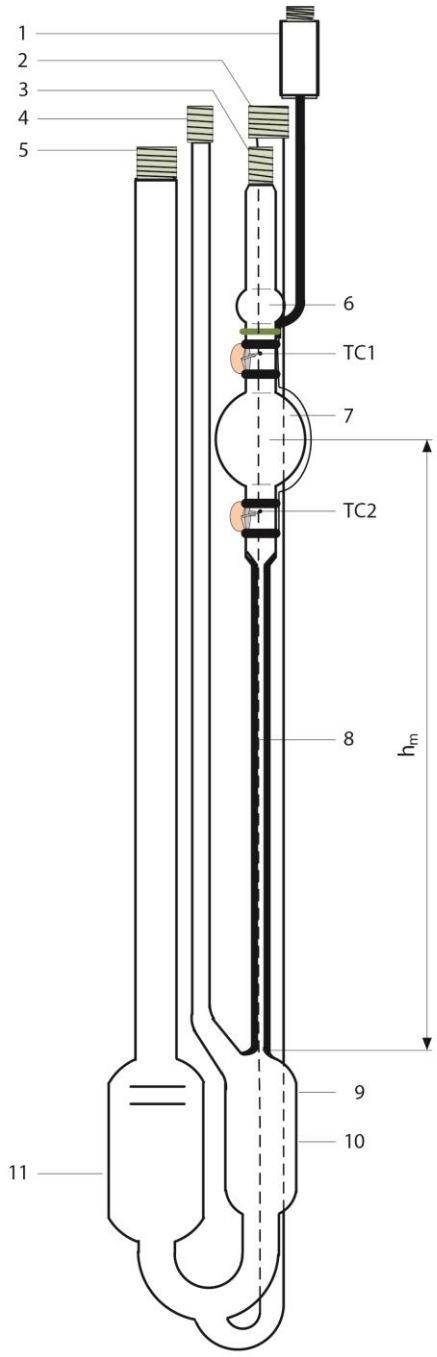
1 Specifications

1.1 Notes to the operating manual

The provided operating manual will allow you the proper and safe handling of the product. For maximum security, observe the safety and warning instructions in the operating manual!

⚠ Warning of a general danger:
Non-compliance results (can result) in injury or material damage.
ℹ Important information for device use.
🕮 Refers to another part of the operating manual.

1.2 Construction



1) Connector plug
2) Cleaning tube
3) Capillary tube
4) Venting tube
5) Filling tube
6) Pre-run bulb
7) Measuring bulb
8) Capillary
9) Spherical cap
10) Level bulb
11) Reservoir

TC_1 Upper TC sensor

TC_2 Lower TC sensor

h_m Mean hydrostatic head

Fig. 1

1.3 Intended Use

The Ubbelohde viscometers with TC sensors and suction tube are based on DIN 51562-1 or correspond to the following standard DIN 53000-1. In contrast to the standard version, the flow time is not measured by visual or optoelectronic detection, but by means of thermoelectric sensors as signal generators. With TC detection, even opaque liquids can be measured. The main field of application is therefore in the viscosity measurement of samples such as used motor oils containing soot. Such samples cannot be measured with standard Ubbelohde viscometers.

TC viscometers can only be used with AVS® measuring instruments from SI Analytics®, which are designed for TC detection. These are in particular all instruments of type AVS® 370, AVS® 470 and AVS® Pro (type I, II and III), which are equipped with the following control units of type ViscoPump:

ViscoPump II TC, VZ 8512 (art.no. 1054304) and
ViscoPump III TC, VZ 8562 (art.no. 285424070).

When selecting a suitable TC viscometer, the measuring temperature range must be considered in addition to the capillary size: Depending on the measuring temperature different types are to be used:

+10°C to +80°C: type-series 582
- 40°C to +30°C: type-series 583
+70°C to +150°C: type-series 584

ℹ Compatibility note: The respective capillary sizes of the current viscometer types of the 582 series (or 583, 584) correspond in their measuring characteristics to the respective types of previous versions according to the following table:

	Ubbelohde viscometer, (type series and production period)		
Temperature range	from 2021	2007-2020	until 2007
+10°C to +80°C	582	562	542
- 40°C to +30°C	583	563	543
+70°C to +150°C	584	564	544

Table 1

⚠ **The TC viscometers of the current series 582, 583 and 584 have a reduced chemical resistance in the vicinity of the TC sensors compared to the previous type series.** Please regard the notes in 🕮 section 4.

The viscometers basically consist of the capillary tube (3), the venting tube (4), the filling tube (5), the level bulb (10), the reservoir (11), the capillary (8) with the measuring bulb (7), the pre-run bulb (6) and the cleaning tube (2). On top of the capillary, above and below the measuring bulb (7) are located the TC sensors TC_1 and TC_2. These sensors not only define the flow-through volume of the sample, but also the mean hydrostatic head h_m. The capillary (8) ends in the upper, spherical cap (9) of the level bulb (10). The sample runs down from the capillary (8) as a thin film over this spherical cap (9) (suspended level).

The cleaning tube (2) is for connection to a waste or rinsing system. The cable for connecting the TC sensors to the ViscoPump of the AVS® measuring instruments from SI Analytics® is screwed into the connector plug (1).

2 Preparation of sample

If particles are contained in the sample liquids, they must be filtered before measurement. Depending on the sample viscosity and capillary size of the viscometer, different filters must be used: For low-viscosity samples, syringe attachment filters (5 µm) or sintered glass filter (10 ... 100 µm) can be used. For viscous samples, a strainer with suitable mesh sizes (30 ... 300 µm) must be used. When selecting the filter materials, their chemical resistance to the samples must be taken into account. With highly viscous samples, it is recommended to heat them before filling to reduce the viscosity and thus facilitate filling - provided that the sample does not change irreversibly by heating.

3 Selection of capillary

The diameter of the capillary should be selected so that the uncertainty inherent in the kinetic energy correction (HC = Hagenbach-Couette correction) does not exceed the error allowed for time measurement (see 🕮 Table 3 in section 11). Therefore, for precision measurements, efflux times whose correction seconds are stated in parentheses should not be applied. A selection of a viscometer with a smaller capillary diameter is suggested.

4 Cleaning of viscometer

After calibration at the factory, the viscometers are cleaned, but there may still be residues of the calibration liquid. Before the first use it is therefore recommended to clean the viscometers with petroleum spirit and, if necessary, acetone if aqueous samples are to be measured afterwards.

4.1 Drying of viscometer

If a solvent with a low boiling point, such as acetone, is used in the last rinsing step, drying can be carried out at room temperature by means of an air stream, preferably generated with a vacuum pump (e.g. water jet pump) and sucked through the viscometer. The use of overpressure to generate the air flow is not recommended because of the risk of contamination and damage! As a result, the viscometer must be completely dry and dust-free and can therefore be used for measurements.

4.2 Suitable cleaning agents

The following cleaning agents are recommended:

4.2.1 Water with standard laboratory detergents, e.g Mucasol®.

ℹ Please note: Laboratory cleaners are typically alkaline and can therefore attack glass. Therefore, use only diluted solutions, as recommended by the manufacturer

4.2.2 The following organic solvents are recommended: Petroleum spirit, toluene, alcohols, acetone.

ℹ The TC-sensors should no longer be brought into contact with the solvent. In particular it is not allowed to leave the TC-sensors with solvent overnight. Prolonged exposure to solvent for cleaning is only possible if the filling level does not reach any TC sensor.

4.3 Unsuitable cleaning agents

The following liquids must not be used for cleaning:

4.3.1 Sulfuric acid, chromic acid, and comparable other highly aggressive substances, especially those with an oxidizing effect, such as Nochromix®, or piranha solution (mixtures of sulfuric acid with persulfate or hydrogen peroxide)

4.3.2 The substances referred to in 4.3.1 may, in exceptional cases, only be used if the liquids do not come into contact with the TC sensors.

4.3.3 Strong alkaline cleaners which also attack glass.

5 Filling of viscometer

Approximately 20 ml of the filtered sample is filled either through the filling tube or through the cleaning tube. It is advantageous to fill the tube with the waste bottle via a hose line that also contains the Luer-Lock coupling VZ 8605. In this case the sample can be introduced into the part of the Luer-Lock coupling facing the viscometer with the aid of a disposable syringe.

6 Temperature conditioning of sample

The filled viscometer is hooked in with the bracket, type no. 053 93 (for Ubbelohde viscometers with TC sensors) in a SI Analytics® transparent thermostat. For fully using the measuring accuracy of the viscometer, the thermostatic bath should maintain the set temperature at a constant ± 0.02 °C which is possible with the SI Analytics® transparent thermostat. Temperature differences of 0.1 °C may cause an error of as much as 0.6 % in mineral oils. Measuring should take place only after an equilibration time of approx. 10 minutes (depending on Δ T between room and measuring temperatures). This equilibration time can be pre-programmed for the AVS® Pro measuring systems (see specific operating manual).

7 Automated measuring operation

TC viscometers measure the flow time of the samples automatically. For this purpose, they must be used together with measuring instruments of type AVS® 470, AVS® 370 or AVS® Pro, which are equipped with a ViscoPump (TC). To perform the measurement, please refer to the instruction manual of the respective measuring device.

8 Calculation of viscosity

The number of seconds stated for the various capillaries in the table for the kinetic energy correction (HC), are subtracted from the determined efflux time (see 🕮 Table 3 in section 11). Intermediate values may be interpolated. If desired, the AVS® measuring instruments can automatically calculate the kinetic energy correction (HC) according to the formula underlying the tables (see operating manual).

ℹ Note on kinetic energy correction (HC):

The values given in the kinetic energy correction (HC) (see 🕮 Table 3 in section 11) were determined according to a general calculation formula[1]. Due to an unavoidable specimen scattering of the viscometers, these calculated HC values have a high uncertainty of approx. 50% (see DIN 53000-2). For exact measuring results, therefore, viscometers should be used for which the values of the kinetic energy correction (HC) are sufficiently small due to sufficiently long flow times. Corresponding notes are given in the table.

If short flow times are unavoidable, an individual determination of the kinetic energy correction (HC) according to DIN 53000-3 is possible directly.

For absolute measurements, the corrected flow time directly yields the kinematic viscosity in mm^2/s by multiplication with the viscometer constant K:

$$\nu = K\,(t - t_{HC})$$

The viscometer constant *K* is mentioned in the enclosed production certificate.

[1] Cannon, Manning, Bell, *Anal. Chem.* **32** (1960) S. 355

9 Example of calculation

Ubbelohde Viscometers Type no. 582 .., 583 .., 584 …

Capillary I

Constant (corresponds to calibration certificate)	=	0.01013	mm^2/s^2
Flow time (averaged)	=	180.00	s
Kinetic energy correction (HC) for 180.00 s	=	0.31	s

Kinematic viscosity $\nu = K\,(t - t_{HC})$

$= 0.01013\ mm^2/s^2 \cdot (180.00 - 0.31)\ s$

$= 1.820\ mm^2/s$

10 Measurements and device constants

Ubbelohde-Viscometers ISO 3105, DIN 53000,
Type no. 582 .., 583 .., 584 ..

Type no.	Capillary no.	Capillary $\varnothing_i$ (mm)	Constant K (approx.)	Measuring mm^2/s (cSt) (approx.)		
… 00	0	0.36	0.001	0.2	to	1.2
… 03	0c	0.46	0.003	0.5	to	3
… 01	0a	0.53	0.005	0.8	to	5
… 10	I	0.63	0.01	1.2	to	10
… 13	Ic	0.84	0.03	3	to	30
… 11	Ia	0.95	0.05	5	to	50
… 20	II	1.13	0.1	10	to	100
… 23	IIc	1.50	0.3	30	to	300
… 21	IIa	1.69	0.5	50	to	500
… 30	III	2.01	1	100	to	1000
… 33	IIIc	2.65	3	300	to	3000
… 31	IIIa	3.00	5	500	to	5000
… 40	IV	3.60	10	1000	to	10000
… 43	IVc	4.70	30	3000	to	30000
… 41	IVa	5.34	50	6000	to	30000
… 50	V	6.40	100		above	10000

Table 2

11 Table of the kinetic energy correction (HC)

Ubbelohde-Viscometers ISO 3105, DIN 53000
Type-no. 582 .., 583 .., 584 ..

Correction seconds[1]:

Flow time [s]	Capillary no. 0	0c	0a	I	Ic	Ia	II
40	– [2]	– [2]	– [2]	– [2]	(1.04) [2]	0.46	0.15
50	– [2]	– [2]	– [2]	(4.00) [2]	0.67	0.29	0.09
60	– [2]	– [2]	– [2]	(2.78) [2]	0.46	0.20	0.07
70	– [2]	– [2]	– [2]	(2.04) [2]	0.34	0.15	0.05
80	– [2]	– [2]	(4,82) [2]	(1.56) [2]	0.26	0.11	0.04
90	– [2]	– [2]	(3,81) [2]	1.23	0.21	0.09	
100	– [2]	(7.05) [2]	(3,08) [2]	1.00	0.17	0.07	
110	– [2]	(5.82) [2]	(2.55) [2]	0.83	0.14	0.06	
120	– [2]	(4.89) [2]	2.14	0.69	0.12	0.05	
130	– [2]	(4.17) [2]	1.82	0.59	0.10	0.04	
140	– [2]	(3.59) [2]	1.57	0.51	0.09	0.04	
150	– [2]	(3.13) [2]	1.37	0.44	0.07		
160	– [2]	2.75	1.20	0.39	0.07		
170	– [2]	2.44	1.07	0.35	0.06		
180	– [2]	2.17	0.95	0.31	0.05		
190	– [2]	1.95	0.85	0.28	0.05		
200	(10.46) [2]	1.76	0.77	0.25	0.04		
225	(8.26) [2]	1.39	0.61	0.20			
250	(6.69) [2]	1.13	0.49	0.16			
275	(5.53) [2]	0.93	0.41	0.13			
300	4.65	0.78	0.34	0.11			
325	3.96	0.67	0.29	0.09			
350	3.41	0.58	0.25	0.08			
375	2.97	0.50	0.22	0.07			
400	2.61	0.44	0.19	0.06			
425	2.32	0.39	0.17	0.06			
450	2.07	0.35	0.15	0.05			
475	1.85	0.31	0.14	0.04			
500	1.67	0.28	0.12	0.04			
550	1.38	0.23	0.10				
500	1.16	0.20	0.09				
650	0.99	0.17	0.07				
700	0.85	0.14	0.06				
750	0.74	0.13	0.05				
800	0.65	0.11	0.05				
850	0.58	0.10	0.04				
900	0.52	0.09	0.04				
950	0.46	0.08	0.03				
1000	0.42	0.07	0.03				

[1] The correction seconds stated are related to the respective nominal constant.
[2] For precision measurements, these flow times should not be applied.
A selection of a viscometer with a smaller capillary diameter is suggested.

Table 3

SI Analytics

a xylem brand

Hersteller

(Manufacturer)

Xylem Analytics Germany GmbH
Am Achalaich 11
82362 Weilheim
Germany

SI Analytics
Tel. +49(0)6131.66.5111
Fax. +49(0)6131.66.5001
E-Mail: si-analytics@xylem.com
www.XylemAnalytics.com

Service und Rücksendungen

(Service and Returns)

Xylem Analytics Germany Sales GmbH & Co.KG
SI Analytics

Gebäude G12, Tor Rheinallee 145
55122 Mainz
Deutschland, Germany

Tel. +49(0)6131.66.5042
Fax. +49(0)6131.66.5105
E-Mail: Service-Instruments.si-analytics@xylem.com

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