

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

Working Group 3.32 "Properties of Liquids"

Newtonian reference liquids for viscosity

are liquids traceable to the National Standard of Viscosity¹. They are used to calibrate or to verify viscosity measuring equipment according to device-specific methods. Viscosity measuring devices² calibrated or verified by means of these reference liquids are accepted as traceable to the National Standard of Viscosity according to DIN EN ISO/IEC 17 025.

Liquids used as reference liquids meet special requirements, concerning e. g. longterm stability and flow behaviour. With respect to dissolved gases the liquids are in equilibrium with the atmosphere.

The relative uncertainty of the viscosity for reference liquids provided by the Physikalisch-Technische Bundesanstalt is from 0.2% up to 1.0% of their value. These reference liquids are mainly used to calibrate or verify high-accuracy viscometers, e. g. capillary or falling-ball viscometers, used as the internal standard of an enterprise to calibrate or verify its own viscosity measuring devices or to carry out high precision measurements.

Since 1994, Newtonian reference liquids for viscosity have been mainly supplied by calibration laboratories of the German calibration service DKD (at the moment exclusively by the calibration laboratory DKD-K-06901, Zentrum für Messen und Kalibrieren GmbH³).

Meanwhile, the measurement uncertainty stated in the calibration certificates of the DKD differs only insignificantly from that of the PTB. In addition, the supply program of the DKD with respect to viscosity and temperature ranges is identical to that of the PTB. Therefore, PTB restricts the provision of Newtonian reference liquids for viscosity for industrial demands to special cases. PTB remains responsible for highest level calibrations.

¹ The National Standard of Viscosity is kept at the Physikalisch-Technische Bundesanstalt in accordance with the „Gesetz über Einheiten im Messwesen

² For measurements of non-Newtonian liquids additional calibrations are necessary, in the case of rotational viscometers e. g. the calibration of angular velocity and torque measurement systems.

³ Zentrum für Messen und Kalibrieren GmbH, P-D ChemiePark Bitterfeld-Wolfen, Areal A Filmstraße 7, 06766 Wolfen, Tel.: 03494 6973-0, Fax: 03494 6973-34, E-Mail: info@zmk-wolfen.de, Internet: <http://www.zmk-wolfen.de>

DKD calibration certificates document the traceability of the national standards (realised by PTB) for the realisation of the units in accordance with the International System of Units (SI).

Corresponding to the measurement ranges of commonly used viscometers, a great assortment of Newtonian reference liquids for viscosity is provided by PTB in the viscosity range of 1.2 mm²/s to 775 000 mm²/s. Their kinematic viscosity is determined using viscometers of the national standard of viscosity, which is based on the kinematic viscosity of water at 20°C of $\nu = 1.0034$ mm²/s (internationally agreed value in accordance with ISO/TR 3666-1998, and subject to ITS 90). The dynamic viscosity is calculated by means of the density determined with reference standards of the liquid density which are traceable to the National Standard of the density unit.

For each Newtonian viscosity standard specimen a calibration certificate of the Physikalisch-Technische Bundesanstalt is provided. It states the value of the kinematic and dynamic viscosity and the viscosity temperature coefficient at the measuring temperature which is usually 20°C. On request, these values can be determined at other temperatures in the range of 20°C to 100°C, mainly at 23, 25, 40, and 100°C. The viscosity values stated in the certificate are valid for a period of 6 month provided that the bottle containing the reference liquid is kept unopened in the dark at room temperature.

In addition to the reference liquids listed in tables 1a,b, the secondary basic liquid SN 01 is available. Its viscosity is determined by direct comparison to the viscosity of water at 20°C and is stated with an uncertainty of 0.05% in the certificate. The reference value of the kinematic viscosity at 20°C is 0.989 mm²/s and the ratio of the surface tension to density is 31.9 cm³/s². SN 01 can be advantageously be used instead of water to calibrate standard viscometers of the highest degree of precision and to determine correction factors of the surface tension effect. More detailed information can be taken from the page "Secondary basic liquid SN 01".

The reference liquids are delivered in quantities of 100 ml, 250 ml and 500 ml, and can be obtained from:

Physikalisch-Technische Bundesanstalt
Working Group 3.32 "Properties of Liquids"
Postfach 33 45
38023 Braunschweig
Germany

Phone: +49 531 592-3320 (Dr. Henning Wolf)

Fax: +49 531 592-693320 +49 531 592-3305

E-Mail: Henning.Wolf@PTB.DE

The fee is calculated according to the average working time necessary for the determination of the viscosity and density of the standard specimen, its preparation and delivery, all of which depends on the viscosity and the quantity ordered. The fee is charged in accordance with the » Regulations Governing the Charges for Services Supplied by the Physikalisch-Technische Bundesanstalt« and is subject to change. For the first liquid we charge a delivery fee of 10 € when shipped inside Germany, 25 € when shipped inside EU, elsewhere 40 €. For each additional liquid this amount increases by 5 €.

If requested by the customer, the delivery can be effected carriage forward with the parcel service suggested by the customer. n-Nonan will only be shipped carriage forward with the parcel service suggested by the customer.

Reference liquid	Charge in € for			Charge in € for each additional temperature
	100 ml	250 ml	500 ml	
up to 20000A	738,-	861,-	984,-	123,-
up tp 50000A	984,-	1107,-	1230,-	246,-

Table 1a: Reference values for the dynamic viscosity of the liquids provided by PTB

Reference liquid	Dynamic viscosity in mPa s at					Uncertainty (%)
	20 °C	23 °C	25 °C	40 °C	100 °C	
2A	1.5	1.4	1.3	1.0	-	0.2
4A	2.9	2.7	2.6	1.9	-	0.2
10A	9.6	8.7	8.1	5.2	-	0.2
20A	20	17	16	9.1	2.2	0.2
50B	57	48	43	22	3.8	0.25
100A	87	75	68	35	6.3	0.25
500A	380	320	280	130	15	0.28
1000A	1100	890	780	330	32	0.28
2000A	1700	1400	1200	490	44	0.28
5000A	3800	3100	2700	1000	78	0.35
10000A	7900	6000	5000	1500	59	0.38
20000A	19000	14000	12000	3800	150	0.45
50000A	45000	37000	32000	13000	1100	0.5
100000A	95000	68000	57000	15000	390	0.7
200000A	230000	170000	140000	38000	950	0.8
500000B	700000	520000	430000	120000	2700	1.0

Table 1b: Reference values for the kinematic viscosity of the liquids provided by PTB

Reference liquid	Kinematic viscosity in mm ² /s at					Uncertainty (%)
	20 °C	23 °C	25 °C	40 °C	100 °C	
2A	1.9	1.8	1.7	1.4	-	0.2
4A	3.7	3.5	3.3	2.5	-	0.2
10A	12	11	10	6.5	-	0.2
20A	23	20	19	11	2.7	0.2
50B	66	56	50	25	4.7	0.25
100A	106	91	83	44	8.1	0.25
500A	450	380	340	150	19	0.28
1000A	1300	1100	930	390	40	0.28
2000A	2000	1600	1400	590	55	0.28
5000A	4500	3600	3200	1200	97	0.35
10000A	9000	6900	5700	1700	71	0.38
20000A	21000	16000	14000	4300	180	0.45
50000A	53000	44000	38000	15000	1300	0.5
100000A	106000	76000	64000	17000	460	0.7
200000A	250000	190000	160000	42000	1100	0.8
500000B	780000	580000	480000	130000	3200	1.0