

# ID N° 21893 - Contact Angle Measurement - M4<sup>a+</sup>

Executed on Mai 08, 2023, by M. Breitwieser

**Au-Stab \*\*\* TEST \*\*\* temperiert**

• **Gold / Isooktan 99.5+%** : (20,0°C, 1,3', 21mm, 0,703mm/s - accelerated;  $\theta$ -asymm.)

$\theta_{M,a} = 24_{\pm 0,70}^{\circ}$  CAH  $-49^{\circ}$ ,  ${}^a\bar{E}_a = 23,35_{\pm 0,22}$  mN/m  ${}^aH_a$  22,05mN/m,  $\bar{B}_{\%,a} = 124,5\%$

**Report**

## 1. ===== Introduction =====

**Principle:** The M4 contact angle measurement using the *modified Wilhelmy method* is based on force measurements on a cuboid or cylindrical solid body brought into contact with a liquid surface. The contact line between the solid, the liquid surface, and the gas phase is called the three-phase boundary line (triple line), and the angle at which the liquid surface meets the three-phase boundary line is the contact angle  $\theta$  (theta). The relative position of the three-phase boundary line-above, on, or below the surrounding liquid level-reflects the surface energy characteristics and is indicated by the resulting curvature of the meniscus. The weight of this meniscus curvature is determined gravimetrically, taking buoyancy and kinetic forces into account, and is related to the length of the three-phase boundary line. With perfect wetting ( $\theta=0^{\circ}$ ), this specific force reaches a maximum value, which corresponds to the surface tension of the liquid; with poor wettability ( $\theta>90^{\circ}$ ), however, this wetting force becomes negative. Energetic interactions between the solid and liquid phases are thus made visible through the contact angle (normally). When the solid body is immersed, the *triple line scans the solid surface*, yielding the advancing contact angle ( $\theta_A$ ), and when it is withdrawn, the receding contact angle ( $\theta_R$ ) is obtained - measured by force of wetting. The difference ' $\theta_A-\theta_R$ ' is called the contact angle hysteresis (CAH).

**Physically:** The Wilhelmy equation  $\cos\theta_{(A|R)} = {}^aF / (p \cdot \gamma)$  describes the relationship between the contact angle  $\theta$ , the perimeter of the solid  $p$ , the wetting force  ${}^aF$ , and the surface tension of the liquid  $\gamma$ . Adhesion tension  ${}^aE$  is defined according  ${}^aE_{A,R} = m_{meniscus}g/p = {}^aF/p = \gamma \cdot \cos\theta = \gamma_s - \gamma_{sl}$

**Practically:** In this measurement, after the position of contact of liquid and solid has been determined, the 'Gold' test specimen is moved into and out of the *Isooktan 99.5+%* liquid with a linear acceleration attended by '*CLT*' (Constant-Level-Technic). This allows the determination of *most accurate accelerated contact angles or rather of adhesion energy  ${}^aE_a$* . While for each of the selected 78 accel. measurements, the respective contact angle  $\theta_{A,a}$  or  $\theta_{R,a}$  is calculated independently. As relative wettability ( $B_{\%,a}$ ) exceeds the mark +100% this measurement may indicate occurrence of super-wetting, where *adhesion energy  ${}^aE_a$*  enables further analysis. Moreover the situation of an *inverted contact-angle hysteresis* must be mentioned.

**Information:** The IMETER M4 method description, available at '<https://imeter.de/?view=article&id=46>', provides information on procedures and calculations.

## 2. ===== partly Accelerated Contact Angle =====

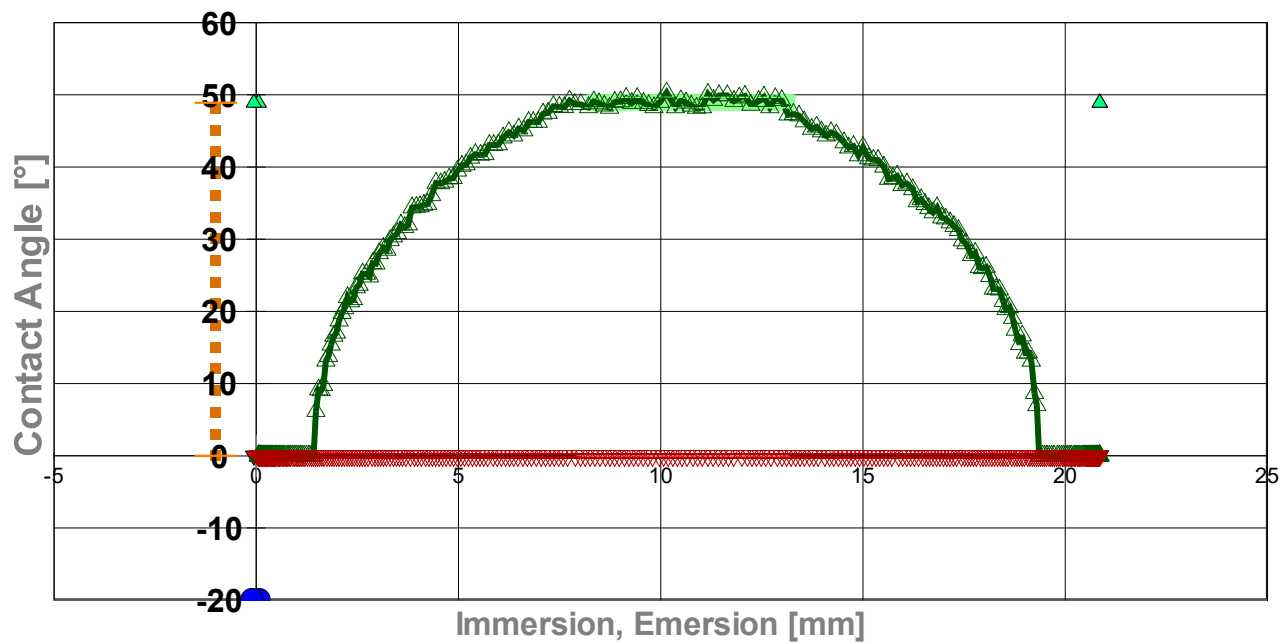
Gold, cylindric Ø8,0mm

20mm Gold \ Isooktan 99.5+%,  $\gamma = 18,75$  mN/m  $\vartheta = 20,0^{\circ}$ C

	Advancing $\theta_{A,a}$	Receding $\theta_{R,a}$	Transition - mm
<b>Contact Angle, CA <math>\theta_{M,a}</math></b>	<b>&lt;24 ±0,70°&gt;</b>	asymmetric	
<b>Contact Angle Hysteresis, CAH<sub>a</sub></b>	<b>&lt;-49°&gt;</b>	inverted	
<b>Contact Angles, <math>\theta_a</math></b>	<b>0°</b>	<b>48,9°</b>	0° <sub>adv.</sub> ⇒ 0° <sub>rec.</sub>
<b>Rated measurements <math>n_{mm-range}</math></b>	42 8,018 - 13,113mm	36 12,993 - 7,876mm	39 20,851 - 19,806mm
<b>Platform speed <math>\bar{v}_z</math> [mm/s]</b>	<b>0,703 ±1,09</b>	<b>-0,698 ±1,17</b>	
<b>Capillary number <math>Ca</math></b>	<b>1,86E-05</b>	<b>-1,85E-05</b>	
<b>Linear accelerated <math>a_z</math> [mm/s<sup>2</sup>]</b>	0,0650 15,3 sec ...	--0,0578 16,7 seconds applied	
<b>acceleration path <math>s_a</math> [mm]</b>	6,53	--7,66	
<b>Speed at Position <math>v_{@}</math> [mm/s]</b>	<b>0,997 10,566mm</b>	<b>--0,966 10,749mm</b>	
<b>Capillary number <math>Ca_{@}</math></b>	<b>2,64E-05</b>	<b>--2,55E-05</b>	
<b>max. Speed <math>v_{zmax}</math> [mm/s]</b>	<b>0,997</b>	<b>0,966</b>	

*Dynamic Contact Angle Measurement: Asymmetric advancing - receding - consider adhesion parameters for analysis. Accountable deposit layer according to Derjaguin's Law solves for  $v_{@}$  with  $e \sim 0,0084$ mm. A capillary number  $Ca$  below  $\sim 10^{-5}$  is an indication for the predominance of capillary forces over viscous drag in porous media! The change of the direction from advancing to receding - where the triple line may be pinned and only the angle is changing from advancing to receding - is analyzed within the column 'Transition'. Diagramm(s) below presenting these results and further details in a graphical way.*

-> **Diagramm 1.2: 'Contact Angle'<sup>21</sup> -- Data, Calculation and Results**



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- Adv. Angles
- Rec. Angles
- Std.Dev - Adv.
- Std.Dev - Rec.
- CA Adv. =  $0 \pm 0^\circ$
- CA Rec. =  $48,9 \pm 0,7^\circ$
- Hysteresis  $48,9^\circ$
- Contact Angle\*  $-20^\circ$
- Transition adv/rec

Diagram 'Contact Angle<sup>2</sup>' gives a summary on this contact angle measurement: The small triangular marks show the individual contact angle values depending on the immersion depth of the sample. At '0' on the x-axis, the flatface front of the sample touches the surface of the liquid, to the right the depth of immersion increases. So 'immersion' indicates the nominal position of the three-phase boundary ('Triple Line') on the sample surface. Red triangles show the contact angles when the fluid advances over the sample surface, Green triangles when retracting (receding). The contact angle peak at 0,054 mm refers a sharp edge - the 'triple line' is fixed there while the immersion goes on until this hypertensive  $\theta_A$  max.  $0,0^\circ$  is reached. - The direction reversal shows normally (why not here?) a step, that is the 'contact angle hysteresis' (CAH). The two contact angles and the extent of hysteresis are determined from the graph by plotting linear regressions over the ranges. The advancing angle  $\theta_A$  is determined by the regression equation for the immersion depth '0'; the receding angle  $\theta_R$  is determined by extrapolation to the maximum immersion depth (thus any errors due to adherence of remaining liquid are eliminated). The standard deviation of the regression curves is indicated by the width of the hatching, which also graphically indicates the data range of the regression. Further marks indicate the determined angles (red, green) and the hysteresis range (yellow) above the Y-axis, the main result, the mean dynamic contact angle  $\theta_{M,a}$  is shown in blue.

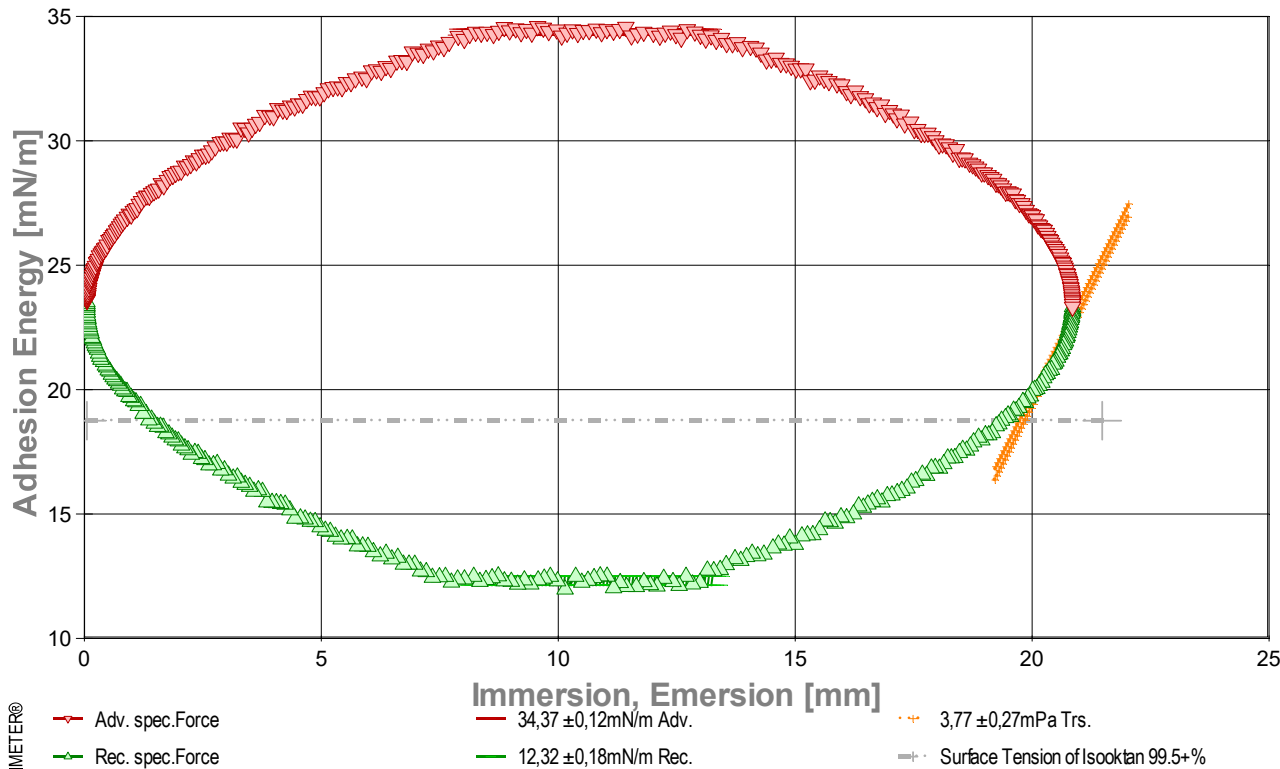
### Adhesion Force of the accelerated Triple Line

Energy of Adhesion,  ${}^a\bar{E}_a = ({}^aE_a + {}^aE_R) / 2$   **$23,35 \pm 0,22$  mN/m**

Hysteresis,  ${}^aH_a = {}^aE_a - {}^aE_R$  22,05 mN/m  
 Parameter of spreading,  $\bar{S}_a = {}^a\bar{E} - \gamma$  4,59 mJ/m<sup>2</sup>  
 relative wettability,  $B_{\%,a} = 100 \cdot {}^a\bar{E} / \gamma$  124,5% with Isooktan 99.5+%

	Advancing ${}^aE_{A,a}$	Receding ${}^aE_{R,a}$	Transition - mm
Energy of Adhesion, ${}^aE_a$ [mN/m]	<b>34,37</b>	<b>12,32</b>	23,21 <sub>&lt;adv.&gt;</sub> $\Rightarrow$ 19,66 <sub>rec.</sub>
Standard deviation ${}^a\sigma$ [mN/m]	$\pm 0,12$	$\pm 0,18$	$\pm 0,27$
Linear regression, slope [mPa]	0	0	3,77
correlation coefficient $r^2$	-	-	0,944
Relative wettability, $B_{\%,a}$	183,3%	65,71%	

- Diagramm 2.2: 'Triple-line Force<sup>2</sup>' dynamic forces at the triple line,  $\bar{v}_z = 0,70$  mm/s



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- Adv. spec.Force
- Rec. spec.Force
- 34,37  $\pm 0,12$  mN/m Adv.
- 12,32  $\pm 0,18$  mN/m Rec.
- 3,77  $\pm 0,27$  mPa Trs.
- Surface Tension of Isooktan 99.5+%

- Das Diagramm zeigt den Verlauf der Adhäsionsenergie  ${}^3E$  entlang der Probenoberfläche. Die Messstrecke ist konstant beschleunigt mit 6,6 ppm des normalen Ortsfaktors ( $9.81\text{m/s}^2$ ). Die roten  $\nabla$ -Markierungen stehen für adv.-Messwerte (Eintauchen; von links nach rechts aufgezeichnet), grüne  $\Delta$ -Markierungen gehören zu rec.-Werten (Rückzugsbewegung; von rechts nach links laufend). Die Oberflächenspannung von Isooktan 99.5+% ist als grau gestrichelte Horizontale bei 18,75 mN/m eingezeichnet; sie gibt die *maximale Zugfestigkeit* an, die eine flüssige Isooktan 99.5+%-Oberfläche aushalten kann. Aber, die Adhäsionsenergie zwischen Isooktan 99.5+% und Gold übersteigt teilweise die Oberflächenspannung. Diese *Überbenetzung* (*Superwetting*) ist gekennzeichnet durch die hier einseitige *Kontaktwinkelproblematik*, weil offenbar  $\cos(\theta) > 1$  auftritt. Falls andere Störeinflüsse (ggf. elektrostatische, rheologische) auszuschließen sind, kommen Grenzschicht- und/oder tribologische Effekte in Frage, die den lokalen Wert der Oberflächenspannung raumgreifend - oder den Wert einer ungeklärten Zusatzkraft an der *Triple Line* - erhöhen und das Geschehen verändern könnten.

### 3. ===== Details on the Measurement and Setup =====

**Sample:** 'Gold', **Form:** cylindric, diameter 8,0 mm.

**Test Liquid:** 'Isooktan 99.5+%' at 20,002°C: density 0,691906 g/mL, surface tension 18,75 mN/m, viscosity 0,4959 mPa·s; Capillary length 1,66 mm.

**Suspension/Fixation:** by operator.

**Vessel:** tempered double wall measuring cell, height 140 mm, inclosing sample and liquid at coherent temperature and atmosphere; Surface area  $\infty$  by CLT. - The 'CLT' Constant-Level-Technic prevents rising/falling of the Isooktan 99.5+% level in the vessel (surface 1452mm<sup>2</sup>) through immersion/emersion of the sample volume in the vessel by appropriate pumping of Isooktan 99.5+%.

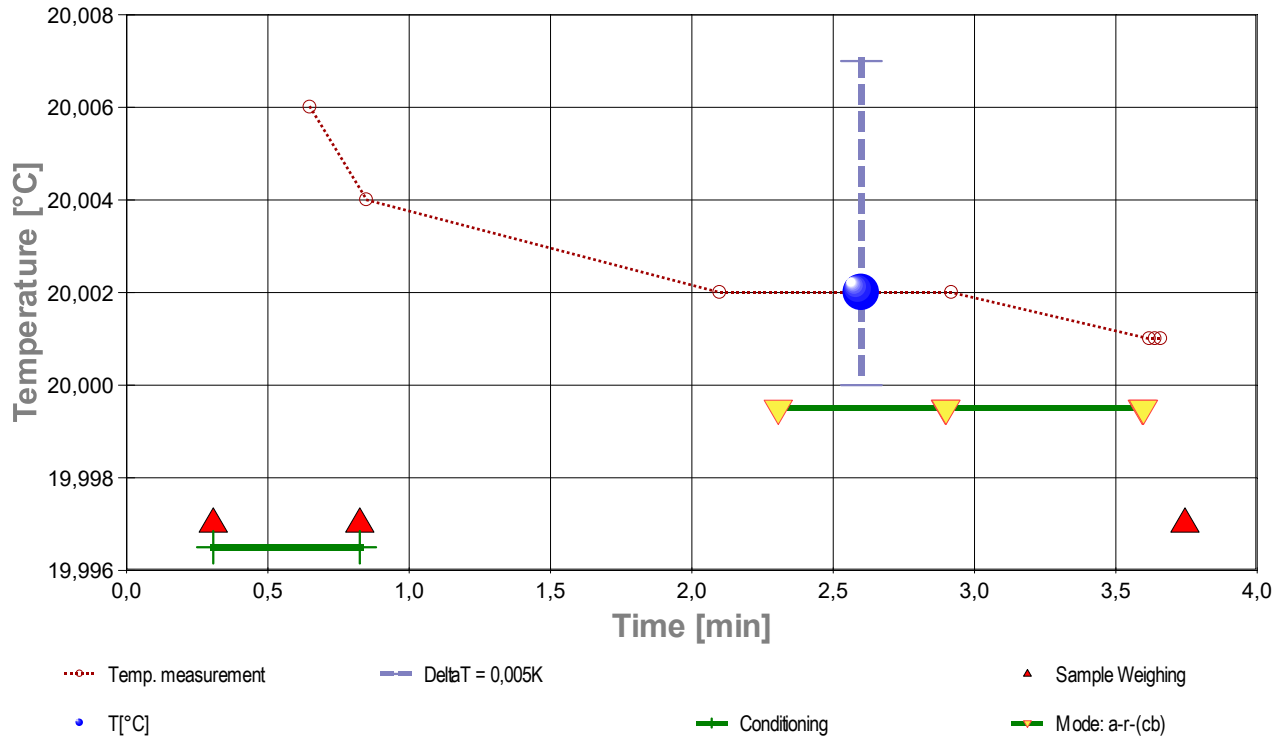
**Conditioning:** during 0,2 min in the measuring cell above the surface of the liquid.

**Sample Weight:** at start 22,7105 g, after conditioning 22,7105 g, after the measurement 22,7108 g.

**Measurement algorithm:** dynamic CA-measurement, acquisition during partial accelerated movement, reaching constant speed. Maximum immersion of 20,078 mm and force equilibration at the inflection point for 0,1 s. Duration for immersion 36 s, for emersion 42 s.

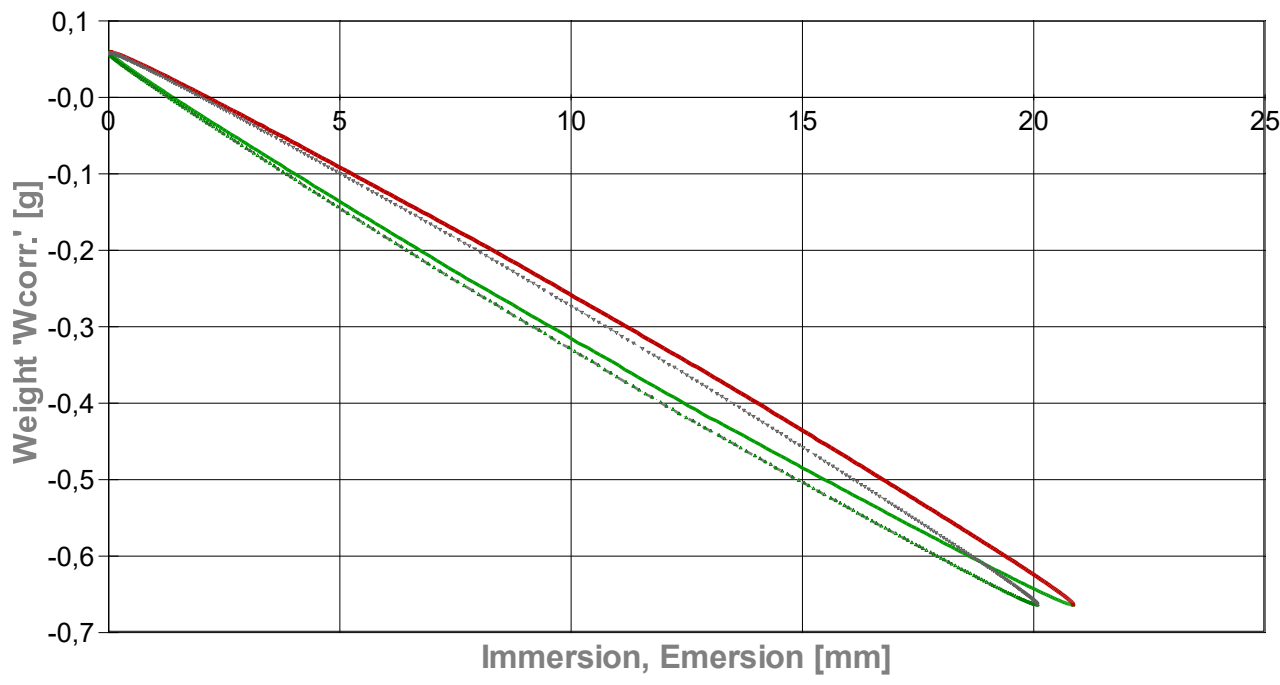
**Time & Temperature:** vier Minuten; Temperaturverlauf blieb im gesamten Zeitraum in etwa isotherm bei 20,002°C. - *Diagramm 3.3:*

'Temperature & Events<sup>2</sup>' -- Survey on Temperature and Time



- Das Diagramm "Temperature & Events<sup>2</sup>" dokumentiert neben der Flüssigkeitstemperatur der Messfluids (Isooktan 99.5+%) die zeitliche Abfolge der Verfahrensschritte. Die Temperaturmesswerte sind als kleine Kreise abgebildet; die kugelförmige Marke gibt die der Messung insgesamt zugeordnete Temperatur an (20,002°C). Markierungen auf der horizontalen grünen Linie bilden das Zeitintervall der Konditionierung ab, das auf das Einsetzen der Probe folgt. Weitere gelbe Dreiecke auf der grünen Horizontalen bezeichnen die Schaltung jeweiliger Messmodi ('a-r' bedeutet *Advancing*- und *Receding*-Bewegung). Die roten Dreiecke, unten im Diagramm, markieren die Zeitpunkte der Probenwägung von Gold (ohne Kontakt zur Fluidoberfläche).

- *Diagramm 4.3: 'RawData<sup>2</sup>' -- Acquired weights during immersion and emersion (raw data and immersion corrected lengths)*



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--- Nominal Immersion  $h^\circ$     - - - Nominal Emersion  $h^\circ$     — Immersion  $h(corr.)$     — Emersion  $h(corr.)$

- Im Diagramm "RawData<sup>2n</sup>" werden die Wägewerte zur dynamischen Kontaktwinkelmessung gegen die Eintauchtiefe der Probe abgebildet. Von den Roh-Wägewerten  $W_{RAW}$  wurden Proben- und Aufhängungsgewichte subtrahiert, so dass hier die Gewichte der Benetzungs- und Auftriebskräfte abgebildet werden ( $W_{corr.}$ ). Die Kurvenverläufe fallen mit der Eintauchtiefe  $h$  (*immersion depth*) ab, indes der Volumenauftrieb des eintauchenden Probekörpers zunimmt. Im Diagramm sind Wägewerte für die advancing- und receding-Bewegung eingetragen, sowohl für nominelle ( $h_0$ ) und für korrigierte Eintauchtiefen ( $h_{corr.}$ ). Die roten Dreiecke bezeichnen die Messwerte bei  $h_{corr.}$  bei der Vorwärtsbewegung (*adv.*), die grünen Dreiecke gehören zu Auszugsbewegungen (*rec.*). Durch 'CLT' (die *Constant-Level-Technic*) wird die Pegelveränderung besonders durch das ein- und austauchendes Probenvolumen simultan kompensiert, sodass die nominelle Eintauchtief mit der tatsächlichen identisch ist; die Kurven sind deshalb praktisch deckungsgleich.

#### 4. ===== Table of raw data and results =====

The table below provides the data for each contact angle measuring position in this run ( $n=556$ ). - Within a row the column  $t$  lists the time of the CA-measurement.  $v(t)$  is the actual speed of immersion/emersion. The nominal distance between the sample bottom flatface and the liquid surface is given by  $h_0$ , whilst  $h_{corr.}$  shows the corrected immersion depth- *due to CLT the values are the same*. The sum of calculated dynamic forces are taken into account by  $F_{dyn.}$ . The  $W_{corr.}$ -values\* are the original raw weighing values when the weight of the sample and its holder ( $W_0=22,7105g$ ) is subtracted. After buoyancy- correction,  ${}^aF$  is the force exerted on the triple line. The Energy of Adhesion  ${}^aE_{A,R} = {}^aF/p$  is the force of adhesion per meter of the circumference ( $p$ ) of the sample.  $\theta$  is the Contact Angle. The last column indicates by **chr** the **advancing** resp. **receding** state.

(Resolving dynamic force of wetting)  ${}^aF = (W_{raw}-W_0-W_{Buoy.})\cdot g + F_{Buoy.air} - F_{visc.} - F_{kinet.} - F_{work} = (W_{corr.}-W_{Buoy.})\cdot g - F_{dyn.}$

Tabelle 1.4: Data table

N°	t [sec]	v(t) [mm/s]	h <sub>0</sub> [mm]	h <sub>corr.</sub> [mm]	F <sub>dyn.</sub> [mN]	W <sub>corr.</sub> [g]	{} <sup>a</sup> F [mN]	{} <sup>a</sup> E <sub>A,R</sub> [mN/m]	θ [°deg]	chr
1.	0,00	0	0,000	0,054	0	0,0586	0,5932	23,60	0	a
2.	0,11	0,00695	0,001	0,055	1,83E-05	0,0586	0,5935	23,61	0	a
3.	0,22	0,0142	0,003	0,057	1,83E-05	0,0586	0,5941	23,64	0	a
4.	0,33	0,0214	0,005	0,059	1,83E-05	0,0586	0,5949	23,67	0	a
5.	0,44	0,0285	0,008	0,063	1,84E-05	0,0586	0,5961	23,72	0	a
6.	0,56	0,0365	0,013	0,067	1,84E-05	0,0586	0,5976	23,78	0	a
7.	0,67	0,0435	0,017	0,072	1,84E-05	0,0585	0,5983	23,81	0	a
8.	0,78	0,0508	0,023	0,078	1,85E-05	0,0585	0,6002	23,88	0	a
9.	0,90	0,0588	0,030	0,085	1,85E-05	0,0585	0,6028	23,98	0	a
10.	1,02	0,0661	0,037	0,093	1,86E-05	0,0585	0,6053	24,09	0	a
11.	1,12	0,0731	0,046	0,102	1,86E-05	0,0585	0,6085	24,21	0	a
12.	1,25	0,0812	0,056	0,113	1,87E-05	0,0583	0,6101	24,27	0	a
13.	1,37	0,0892	0,067	0,123	1,87E-05	0,0581	0,6117	24,34	0	a
14.	1,50	0,0975	0,079	0,136	1,88E-05	0,0579	0,6140	24,43	0	a
15.	1,61	0,105	0,091	0,149	1,89E-05	0,0576	0,6155	24,49	0	a
16.	1,76	0,115	0,108	0,166	1,90E-05	0,0573	0,6184	24,60	0	a
17.	1,89	0,123	0,123	0,182	1,91E-05	0,0570	0,6208	24,70	0	a
18.	2,00	0,130	0,139	0,198	1,92E-05	0,0567	0,6234	24,80	0	a
19.	2,13	0,138	0,155	0,214	1,93E-05	0,0563	0,6250	24,87	0	a
20.	2,24	0,145	0,173	0,233	1,95E-05	0,0559	0,6275	24,97	0	a
21.	2,38	0,155	0,195	0,256	1,96E-05	0,0555	0,6313	25,12	0	a
22.	2,50	0,163	0,215	0,277	1,97E-05	0,0549	0,6325	25,17	0	a
23.	2,63	0,171	0,235	0,297	1,99E-05	0,0544	0,6345	25,25	0	a
24.	2,74	0,178	0,256	0,319	2,00E-05	0,0540	0,6380	25,39	0	a
25.	2,95	0,191	0,292	0,357	2,02E-05	0,0529	0,6401	25,47	0	a
26.	3,05	0,198	0,315	0,380	2,04E-05	0,0523	0,6420	25,54	0	a
27.	3,16	0,206	0,337	0,403	2,05E-05	0,0516	0,6429	25,58	0	a
28.	3,27	0,212	0,360	0,427	2,07E-05	0,0510	0,6452	25,67	0	a
29.	3,40	0,221	0,388	0,455	2,09E-05	0,0501	0,6461	25,71	0	a
30.	3,50	0,228	0,412	0,481	2,10E-05	0,0495	0,6490	25,82	0	a
31.	3,65	0,237	0,448	0,518	2,13E-05	0,0487	0,6536	26,01	0	a
32.	3,79	0,246	0,481	0,552	2,15E-05	0,0476	0,6545	26,04	0	a
33.	3,90	0,253	0,509	0,581	2,17E-05	0,0468	0,6565	26,12	0	a
34.	4,01	0,261	0,537	0,610	2,19E-05	0,0460	0,6586	26,21	0	a
35.	4,12	0,268	0,567	0,641	2,21E-05	0,0451	0,6601	26,27	0	a

36.	4.24	0,276	0,604	0,679	2,23E-05	0,0441	0,6633	26,39	0	a
37.	4.37	0,284	0,637	0,713	2,25E-05	0,0431	0,6651	26,46	0	a
38.	4.48	0,291	0,668	0,746	2,27E-05	0,0422	0,6675	26,56	0	a
39.	4.59	0,298	0,701	0,780	2,30E-05	0,0413	0,6701	26,66	0	a
40.	4.70	0,305	0,734	0,814	2,32E-05	0,0403	0,6721	26,74	0	a
41.	4.81	0,312	0,769	0,850	2,34E-05	0,0393	0,6743	26,83	0	a
42.	4.98	0,324	0,824	0,907	2,38E-05	0,0376	0,6771	26,94	0	a
43.	5.09	0,331	0,863	0,948	2,40E-05	0,0365	0,6801	27,06	0	a
44.	5.21	0,339	0,902	0,988	2,43E-05	0,0350	0,6792	27,03	0	a
45.	5.32	0,346	0,944	1,031	2,46E-05	0,0339	0,6829	27,17	0	a
46.	5.45	0,354	0,985	1,073	2,48E-05	0,0326	0,6846	27,24	0	a
47.	5.56	0,361	1,024	1,114	2,51E-05	0,0313	0,6858	27,29	0	a
48.	5.67	0,368	1,064	1,156	2,54E-05	0,0303	0,6901	27,46	0	a
49.	5.79	0,376	1,111	1,205	2,57E-05	0,0289	0,6929	27,57	0	a
50.	5.93	0,385	1,167	1,262	2,60E-05	0,0273	0,6967	27,72	0	a
51.	6.08	0,395	1,222	1,319	2,64E-05	0,0255	0,6985	27,79	0	a
52.	6.20	0,403	1,271	1,370	2,67E-05	0,0237	0,6982	27,78	0	a
53.	6.31	0,410	1,316	1,416	2,70E-05	0,0224	0,7012	27,90	0	a
54.	6.42	0,417	1,365	1,467	2,74E-05	0,0208	0,7028	27,96	0	a
55.	6.54	0,425	1,415	1,518	2,77E-05	0,0192	0,7045	28,03	0	a
56.	6.65	0,432	1,462	1,568	2,80E-05	0,0176	0,7055	28,07	0	a
57.	6.76	0,439	1,516	1,624	2,84E-05	0,0162	0,7110	28,29	0	a
58.	6.89	0,448	1,566	1,675	2,87E-05	0,0142	0,7088	28,20	0	a
59.	7.04	0,458	1,637	1,749	2,92E-05	0,0122	0,7143	28,42	0	a
60.	7.15	0,465	1,696	1,810	2,96E-05	0,0105	0,7182	28,58	0	a
61.	7.28	0,473	1,752	1,868	2,99E-05	0,0086	0,7193	28,62	0	a
62.	7.40	0,481	1,808	1,926	3,03E-05	0,0068	0,7214	28,70	0	a
63.	7.53	0,489	1,868	1,988	3,07E-05	0,0048	0,7230	28,77	0	a
64.	7.64	0,496	1,923	2,045	3,11E-05	0,0029	0,7236	28,79	0	a
65.	7.76	0,504	1,990	2,115	3,15E-05	0,0010	0,7288	29,00	0	a
66.	7.88	0,512	2,050	2,176	3,19E-05	-0,0012	0,7281	28,97	0	a
67.	8.01	0,520	2,115	2,243	3,23E-05	-0,0033	0,7303	29,06	0	a
68.	8.12	0,528	2,172	2,303	3,27E-05	-0,0050	0,7340	29,20	0	a
69.	8.23	0,535	2,231	2,364	3,31E-05	-0,0072	0,7330	29,17	0	a
70.	8.34	0,542	2,290	2,425	3,35E-05	-0,0090	0,7362	29,29	0	a
71.	8.46	0,550	2,359	2,496	3,40E-05	-0,0111	0,7398	29,44	0	a
72.	8.57	0,557	2,420	2,559	3,44E-05	-0,0133	0,7397	29,43	0	a
73.	8.68	0,564	2,482	2,624	3,48E-05	-0,0154	0,7409	29,48	0	a
74.	8.79	0,571	2,544	2,688	3,52E-05	-0,0173	0,7442	29,61	0	a
75.	8.92	0,580	2,617	2,763	3,57E-05	-0,0195	0,7482	29,77	0	a
76.	9.07	0,590	2,715	2,866	3,63E-05	-0,0226	0,7526	29,94	0	a
77.	9.20	0,598	2,784	2,937	3,68E-05	-0,0250	0,7532	29,97	0	a
78.	9.31	0,605	2,850	3,005	3,72E-05	-0,0274	0,7529	29,96	0	a
79.	9.42	0,612	2,917	3,075	3,77E-05	-0,0294	0,7570	30,12	0	a
80.	9.53	0,619	2,985	3,145	3,81E-05	-0,0319	0,7563	30,09	0	a
81.	9.64	0,626	3,054	3,216	3,86E-05	-0,0344	0,7560	30,08	0	a
82.	9.76	0,635	3,141	3,307	3,92E-05	-0,0364	0,7672	30,53	0	a
83.	9.90	0,643	3,223	3,392	3,97E-05	-0,0394	0,7666	30,50	0	a
84.	10,01	0,651	3,294	3,465	4,02E-05	-0,0424	0,7622	30,33	0	a
85.	10,12	0,658	3,366	3,540	4,06E-05	-0,0445	0,7670	30,52	0	a
86.	10,23	0,665	3,439	3,615	4,11E-05	-0,0467	0,7710	30,68	0	a
87.	10,34	0,672	3,520	3,698	4,17E-05	-0,0494	0,7729	30,75	0	a
88.	10,50	0,682	3,626	3,808	4,24E-05	-0,0525	0,7799	31,03	0	a
89.	10,65	0,692	3,727	3,913	4,30E-05	-0,0562	0,7793	31,01	0	a
90.	10,76	0,699	3,803	3,992	4,35E-05	-0,0590	0,7786	30,98	0	a
91.	10,87	0,707	3,891	4,083	4,41E-05	-0,0613	0,7868	31,30	0	a
92.	11,03	0,717	3,992	4,188	4,48E-05	-0,0651	0,7853	31,25	0	a
93.	11,14	0,724	4,072	4,271	4,53E-05	-0,0680	0,7850	31,23	0	a
94.	11,25	0,731	4,152	4,353	4,59E-05	-0,0704	0,7894	31,41	0	a
95.	11,36	0,738	4,232	4,437	4,64E-05	-0,0734	0,7885	31,37	0	a
96.	11,47	0,745	4,314	4,521	4,69E-05	-0,0760	0,7916	31,50	0	a
97.	11,57	0,752	4,396	4,606	4,75E-05	-0,0790	0,7912	31,48	0	a
98.	11,69	0,760	4,480	4,693	4,80E-05	-0,0815	0,7960	31,67	0	a
99.	11,80	0,767	4,575	4,792	4,87E-05	-0,0846	0,7994	31,81	0	a
100.	11,92	0,775	4,660	4,879	4,92E-05	-0,0877	0,7988	31,78	0	a
101.	12,03	0,782	4,746	4,969	4,98E-05	-0,0908	0,7987	31,78	0	a
102.	12,14	0,789	4,833	5,059	5,04E-05	-0,0935	0,8028	31,94	0	a
103.	12,25	0,796	4,920	5,148	5,10E-05	-0,0962	0,8068	32,10	0	a
104.	12,36	0,803	5,015	5,247	5,16E-05	-0,0995	0,8081	32,15	0	a
105.	12,48	0,811	5,109	5,344	5,22E-05	-0,1028	0,8087	32,18	0	a
106.	12,59	0,818	5,199	5,437	5,28E-05	-0,1061	0,8079	32,15	0	a
107.	12,70	0,826	5,289	5,530	5,34E-05	-0,1088	0,8132	32,35	0	a
108.	12,81	0,833	5,380	5,625	5,40E-05	-0,1121	0,8130	32,35	0	a
109.	12,92	0,840	5,472	5,720	5,46E-05	-0,1150	0,8169	32,50	0	a
110.	13,08	0,850	5,605	5,858	5,55E-05	-0,1196	0,8186	32,57	0	a
111.	13,19	0,857	5,698	5,954	5,61E-05	-0,1231	0,8170	32,51	0	a
112.	13,29	0,864	5,801	6,061	5,68E-05	-0,1260	0,8250	32,82	0	a
113.	13,42	0,872	5,902	6,165	5,75E-05	-0,1295	0,8260	32,87	0	a
114.	13,53	0,879	5,998	6,265	5,81E-05	-0,1331	0,8244	32,80	0	a
115.	13,64	0,886	6,095	6,365	5,88E-05	-0,1361	0,8292	32,99	0	a
116.	13,75	0,894	6,192	6,466	5,94E-05	-0,1398	0,8274	32,92	0	a
117.	13,88	0,902	6,317	6,595	6,02E-05	-0,1435	0,8348	33,22	0	a
118.	14,00	0,910	6,419	6,701	6,09E-05	-0,1471	0,8354	33,24	0	a
119.	14,11	0,917	6,519	6,805	6,16E-05	-0,1508	0,8345	33,20	0	a
120.	14,21	0,924	6,633	6,922	6,23E-05	-0,1539	0,8441	33,58	0	a
121.	14,36	0,933	6,751	7,045	6,31E-05	-0,1583	0,8427	33,53	0	a
122.	14,47	0,940	6,854	7,152	6,38E-05	-0,1621	0,8416	33,49	0	a
123.	14,57	0,947	6,958	7,259	6,45E-05	-0,1653	0,8468	33,69	0	a
124.	14,69	0,955	7,062	7,367	6,52E-05	-0,1692	0,8452	33,63	0	a
125.	14,79	0,962	7,168	7,476	6,59E-05	-0,1725	0,8501	33,82	0	a
126.	14,90	0,969	7,275	7,587	6,66E-05	-0,1765	0,8485	33,76	0	a
127.	15,01	0,976	7,381	7,698	6,73E-05	-0,1798	0,8537	33,97	0	a
128.	15,20	0,988	7,566	7,889	6,85E-05	-0,1858	0,8598	34,21	0	a
129.	15,33	0,997	7,691	8,018	5,12E-05	-0,1906	0,8566	34,08	0	a
130.	15,43	0,997	7,800	8,131	5,17E-05	-0,1940	0,8617	34,29	0	a
131.	15,55	0,997	7,920	8,256	5,22E-05	-0,1981	0,8639	34,37	0	a
132.	15,67	0,997	8,034	8,374	5,27E-05	-0,2023	0,8630	34,34	0	a
133.	15,78	0,997	8,154	8,498	5,32E-05	-0,2065	0,8639	34,37	0	a
134.	15,92	0,997	8,284	8,633	5,38E-05	-0,2114	0,8616	34,28	0	a
135.	16,03	0,997	8,394	8,746	5,42E-05	-0,2150	0,8649	34,41	0	a
136.	16,14	0,997	8,505	8,861	5,47E-05	-0,2186	0,8687	34,56	0	a
137.	16,25	0,997	8,612	8,972	5,52E-05	-0,2228	0,8653	34,43	0	a
138.	16,37	0,997	8,737	9,102	5,57E-05	-0,2271	0,8673	34,51	0	a

139.	16,48	0,997	8,846	9,215	5,62E-05	-0,2314	0,8635	34,36	0	a
140.	16,59	0,997	8,956	9,329	5,67E-05	-0,2350	0,8668	34,49	0	a
141.	16,70	0,997	9,065	9,441	5,71E-05	-0,2393	0,8630	34,34	0	a
142.	16,81	0,997	9,184	9,565	5,76E-05	-0,2429	0,8697	34,60	0	a
143.	16,94	0,997	9,299	9,684	5,81E-05	-0,2472	0,8681	34,54	0	a
144.	17,05	0,997	9,409	9,798	5,86E-05	-0,2515	0,8646	34,40	0	a
145.	17,20	0,997	9,573	9,967	5,93E-05	-0,2572	0,8662	34,47	0	a
146.	17,31	0,997	9,675	10,073	5,98E-05	-0,2615	0,8601	34,22	0	a
147.	17,42	0,997	9,783	10,186	6,02E-05	-0,2651	0,8630	34,34	0	a
148.	17,53	0,997	9,893	10,299	6,07E-05	-0,2687	0,8663	34,47	0	a
149.	17,64	0,997	10,002	10,413	6,12E-05	-0,2730	0,8626	34,32	0	a
150.	17,75	0,997	10,111	10,526	6,16E-05	-0,2766	0,8657	34,45	0	a
151.	17,86	0,997	10,233	10,652	6,22E-05	-0,2810	0,8655	34,44	0	a
152.	18,01	0,997	10,377	10,801	6,28E-05	-0,2860	0,8671	34,50	0	a
153.	18,12	0,997	10,486	10,914	6,32E-05	-0,2903	0,8635	34,36	0	a
154.	18,23	0,997	10,596	11,027	6,37E-05	-0,2939	0,8666	34,48	0	a
155.	18,36	0,997	10,730	11,166	6,43E-05	-0,2989	0,8649	34,41	0	a
156.	18,48	0,997	10,855	11,296	6,48E-05	-0,3032	0,8667	34,49	0	a
157.	18,61	0,997	10,981	11,426	6,54E-05	-0,3075	0,8689	34,57	0	a
158.	18,73	0,997	11,095	11,545	6,59E-05	-0,3125	0,8602	34,23	0	a
159.	18,86	0,997	11,220	11,674	6,64E-05	-0,3168	0,8621	34,30	0	a
160.	18,98	0,997	11,346	11,804	6,69E-05	-0,3211	0,8639	34,38	0	a
161.	19,17	0,997	11,543	12,008	6,78E-05	-0,3283	0,8628	34,33	0	a
162.	19,31	0,997	11,674	12,144	6,83E-05	-0,3333	0,8599	34,22	0	a
163.	19,42	0,997	11,783	12,257	6,88E-05	-0,3369	0,8630	34,34	0	a
164.	19,53	0,997	11,892	12,370	6,93E-05	-0,3406	0,8651	34,42	0	a
165.	19,64	0,997	12,001	12,483	6,98E-05	-0,3449	0,8615	34,28	0	a
166.	19,75	0,997	12,111	12,597	7,02E-05	-0,3492	0,8579	34,13	0	a
167.	19,86	0,997	12,233	12,723	7,08E-05	-0,3527	0,8665	34,48	0	a
168.	20,02	0,997	12,388	12,883	7,14E-05	-0,3585	0,8641	34,38	0	a
169.	20,14	0,997	12,501	13,001	7,19E-05	-0,3629	0,8609	34,26	0	a
170.	20,25	0,990	12,610	13,113	1,02E-04	-0,3672	0,8570	34,10	0	a
171.	20,36	0,983	12,717	13,224	1,03E-04	-0,3707	0,8603	34,23	0	a
172.	20,47	0,976	12,823	13,335	1,03E-04	-0,3750	0,8557	34,05	0	a
173.	20,57	0,968	12,929	13,444	1,04E-04	-0,3786	0,8577	34,13	0	a
174.	20,68	0,961	13,034	13,553	1,05E-04	-0,3829	0,8525	33,92	0	a
175.	20,81	0,953	13,153	13,677	1,06E-04	-0,3872	0,8523	33,91	0	a
176.	20,92	0,946	13,257	13,784	1,06E-04	-0,3908	0,8534	33,96	0	a
177.	21,03	0,939	13,359	13,890	1,07E-04	-0,3950	0,8484	33,76	0	a
178.	21,20	0,928	13,522	14,058	1,08E-04	-0,4007	0,8496	33,80	0	a
179.	21,33	0,919	13,634	14,174	1,09E-04	-0,4049	0,8480	33,74	0	a
180.	21,43	0,913	13,733	14,278	1,09E-04	-0,4090	0,8429	33,54	0	a
181.	21,56	0,904	13,847	14,395	1,10E-04	-0,4138	0,8358	33,26	0	a
182.	21,67	0,897	13,944	14,496	1,11E-04	-0,4172	0,8368	33,29	0	a
183.	21,78	0,890	14,042	14,597	1,12E-04	-0,4206	0,8378	33,33	0	a
184.	21,89	0,883	14,138	14,697	1,12E-04	-0,4246	0,8325	33,12	0	a
185.	22,01	0,875	14,248	14,811	1,13E-04	-0,4286	0,8320	33,10	0	a
186.	22,12	0,868	14,350	14,917	1,14E-04	-0,4325	0,8296	33,01	0	a
187.	22,24	0,860	14,450	15,021	1,14E-04	-0,4364	0,8267	32,89	0	a
188.	22,36	0,853	14,543	15,117	1,15E-04	-0,4397	0,8270	32,90	0	a
189.	22,47	0,846	14,649	15,226	1,16E-04	-0,4435	0,8268	32,90	0	a
190.	22,59	0,837	14,740	15,321	1,16E-04	-0,4480	0,8150	32,43	0	a
191.	22,70	0,830	14,831	15,415	1,17E-04	-0,4512	0,8156	32,45	0	a
192.	22,81	0,823	14,929	15,516	1,17E-04	-0,4543	0,8197	32,62	0	a
193.	22,94	0,815	15,023	15,613	1,18E-04	-0,4580	0,8164	32,48	0	a
194.	23,04	0,808	15,119	15,713	1,19E-04	-0,4617	0,8141	32,39	0	a
195.	23,25	0,795	15,282	15,882	1,20E-04	-0,4678	0,8118	32,30	0	a
196.	23,37	0,787	15,380	15,983	1,20E-04	-0,4714	0,8108	32,26	0	a
197.	23,50	0,779	15,477	16,084	1,21E-04	-0,4756	0,8039	31,99	0	a
198.	23,63	0,770	15,566	16,176	1,22E-04	-0,4791	0,8009	31,87	0	a
199.	23,73	0,763	15,657	16,271	1,22E-04	-0,4820	0,8046	32,01	0	a
200.	23,88	0,754	15,755	16,372	1,23E-04	-0,4861	0,7989	31,79	0	a
201.	24,02	0,745	15,861	16,481	1,24E-04	-0,4901	0,7967	31,70	0	a
202.	24,12	0,738	15,941	16,565	1,24E-04	-0,4935	0,7916	31,50	0	a
203.	24,23	0,731	16,021	16,648	1,25E-04	-0,4963	0,7924	31,53	0	a
204.	24,34	0,724	16,100	16,729	1,25E-04	-0,4996	0,7878	31,35	0	a
205.	24,45	0,716	16,185	16,818	1,26E-04	-0,5024	0,7905	31,45	0	a
206.	24,58	0,708	16,267	16,902	1,26E-04	-0,5062	0,7819	31,11	0	a
207.	24,69	0,701	16,350	16,989	1,27E-04	-0,5089	0,7849	31,23	0	a
208.	24,81	0,693	16,430	17,071	1,27E-04	-0,5121	0,7814	31,09	0	a
209.	24,92	0,686	16,504	17,149	1,28E-04	-0,5153	0,7764	30,89	0	a
210.	25,03	0,679	16,588	17,235	1,28E-04	-0,5179	0,7803	31,05	0	a
211.	25,15	0,671	16,662	17,312	1,29E-04	-0,5215	0,7713	30,69	0	a
212.	25,33	0,659	16,782	17,436	1,30E-04	-0,5256	0,7732	30,77	0	a
213.	25,45	0,651	16,858	17,515	1,30E-04	-0,5291	0,7655	30,46	0	a
214.	25,56	0,644	16,928	17,588	1,31E-04	-0,5316	0,7658	30,47	0	a
215.	25,67	0,637	16,997	17,659	1,31E-04	-0,5345	0,7618	30,31	0	a
216.	25,78	0,630	17,067	17,731	1,32E-04	-0,5370	0,7616	30,30	0	a
217.	25,89	0,623	17,134	17,801	1,32E-04	-0,5394	0,7620	30,32	0	a
218.	26,04	0,613	17,230	17,901	1,33E-04	-0,5432	0,7585	30,18	0	a
219.	26,15	0,606	17,296	17,969	1,33E-04	-0,5460	0,7543	30,01	0	a
220.	26,26	0,599	17,362	18,037	1,34E-04	-0,5488	0,7500	29,84	0	a
221.	26,37	0,592	17,432	18,110	1,34E-04	-0,5512	0,7511	29,88	0	a
222.	26,50	0,583	17,505	18,185	1,35E-04	-0,5539	0,7503	29,85	0	a
223.	26,62	0,575	17,571	18,254	1,35E-04	-0,5566	0,7472	29,73	0	a
224.	26,75	0,567	17,642	18,328	1,35E-04	-0,5597	0,7418	29,52	0	a
225.	26,86	0,560	17,711	18,399	1,36E-04	-0,5618	0,7455	29,66	0	a
226.	26,98	0,552	17,772	18,462	1,36E-04	-0,5649	0,7366	29,31	0	a
227.	27,09	0,545	17,832	18,524	1,37E-04	-0,5670	0,7369	29,32	0	a
228.	27,20	0,538	17,891	18,585	1,37E-04	-0,5692	0,7361	29,29	0	a
229.	27,38	0,526	17,981	18,679	1,38E-04	-0,5729	0,7317	29,11	0	a
230.	27,50	0,518	18,046	18,746	1,38E-04	-0,5754	0,7301	29,05	0	a
231.	27,61	0,511	18,107	18,809	1,39E-04	-0,5778	0,7278	28,96	0	a
232.	27,73	0,503	18,165	18,869	1,39E-04	-0,5801	0,7257	28,87	0	a
233.	27,86	0,495	18,229	18,935	1,39E-04	-0,5828	0,7218	28,72	0	a
234.	27,97	0,488	18,281	18,990	1,40E-04	-0,5847	0,7218	28,72	0	a
235.	28,13	0,477	18,360	19,072	1,40E-04	-0,5878	0,7192	28,61	0	a
236.	28,25	0,469	18,416	19,129	1,41E-04	-0,5900	0,7172	28,54	0	a
237.	28,37	0,461	18,472	19,188	1,41E-04	-0,5922	0,7154	28,47	0	a
238.	28,49	0,454	18,522	19,239	1,41E-04	-0,5944	0,7114	28,31	0	a
239.	28,60	0,447	18,571	19,290	1,42E-04	-0,5962	0,7108	28,28	0	a
240.	28,70	0,440	18,623	19,344	1,42E-04	-0,5983	0,7087	28,20	0	a
241.	28,83	0,432	18,673	19,395	1,42E-04	-0,6004	0,7057	28,08	0	a

242.	28,94	0,425	18,719	19,443	1,43E-04	-0,6024	0,7024	27,95	0	a
243.	29,05	0,418	18,765	19,491	1,43E-04	-0,6040	0,7027	27,96	0	a
244.	29,16	0,411	18,809	19,537	1,43E-04	-0,6057	0,7018	27,92	0	a
245.	29,30	0,402	18,870	19,600	1,44E-04	-0,6080	0,7006	27,88	0	a
246.	29,42	0,393	18,915	19,646	1,44E-04	-0,6102	0,6948	27,65	0	a
247.	29,53	0,386	18,957	19,690	1,44E-04	-0,6118	0,6941	27,62	0	a
248.	29,64	0,379	18,998	19,733	1,44E-04	-0,6136	0,6910	27,49	0	a
249.	29,77	0,371	19,048	19,784	1,45E-04	-0,6154	0,6908	27,48	0	a
250.	29,89	0,363	19,090	19,828	1,45E-04	-0,6172	0,6880	27,37	0	a
251.	30,02	0,355	19,135	19,874	1,45E-04	-0,6192	0,6840	27,22	0	a
252.	30,18	0,344	19,189	19,930	1,46E-04	-0,6215	0,6806	27,08	0	a
253.	30,29	0,337	19,225	19,968	1,46E-04	-0,6229	0,6797	27,04	0	a
254.	30,39	0,330	19,261	20,005	1,46E-04	-0,6243	0,6786	27,00	0	a
255.	30,50	0,323	19,297	20,042	1,46E-04	-0,6259	0,6754	26,87	0	a
256.	30,63	0,315	19,339	20,086	1,47E-04	-0,6275	0,6746	26,84	0	a
257.	30,75	0,307	19,374	20,122	1,47E-04	-0,6293	0,6694	26,63	0	a
258.	30,86	0,300	19,407	20,157	1,47E-04	-0,6306	0,6683	26,59	0	a
259.	30,97	0,293	19,439	20,190	1,47E-04	-0,6320	0,6657	26,49	0	a
260.	31,08	0,286	19,470	20,222	1,48E-04	-0,6332	0,6649	26,45	0	a
261.	31,19	0,279	19,501	20,253	1,48E-04	-0,6344	0,6639	26,41	0	a
262.	31,35	0,268	19,545	20,299	1,48E-04	-0,6363	0,6608	26,29	0	a
263.	31,47	0,260	19,575	20,330	1,48E-04	-0,6377	0,6577	26,17	0	a
264.	31,58	0,253	19,602	20,359	1,48E-04	-0,6390	0,6547	26,05	0	a
265.	31,69	0,246	19,629	20,387	1,49E-04	-0,6401	0,6534	26,00	0	a
266.	31,80	0,239	19,655	20,414	1,49E-04	-0,6413	0,6508	25,89	0	a
267.	31,91	0,232	19,681	20,440	1,49E-04	-0,6425	0,6480	25,78	0	a
268.	32,02	0,225	19,705	20,465	1,49E-04	-0,6435	0,6467	25,73	0	a
269.	32,17	0,214	19,741	20,502	1,49E-04	-0,6450	0,6445	25,64	0	a
270.	32,30	0,206	19,764	20,527	1,50E-04	-0,6461	0,6421	25,55	0	a
271.	32,41	0,199	19,786	20,550	1,50E-04	-0,6472	0,6390	25,43	0	a
272.	32,52	0,192	19,810	20,574	1,50E-04	-0,6480	0,6395	25,45	0	a
273.	32,66	0,183	19,833	20,598	1,50E-04	-0,6492	0,6359	25,30	0	a
274.	32,78	0,175	19,855	20,621	1,50E-04	-0,6503	0,6328	25,18	0	a
275.	32,90	0,168	19,873	20,640	1,50E-04	-0,6511	0,6314	25,12	0	a
276.	33,00	0,161	19,891	20,658	1,50E-04	-0,6518	0,6307	25,09	0	a
277.	33,11	0,154	19,907	20,675	1,50E-04	-0,6527	0,6277	24,98	0	a
278.	33,24	0,145	19,927	20,695	1,51E-04	-0,6536	0,6257	24,90	0	a
279.	33,37	0,136	19,945	20,714	1,51E-04	-0,6545	0,6232	24,80	0	a
280.	33,50	0,128	19,961	20,730	1,51E-04	-0,6554	0,6201	24,67	0	a
281.	33,61	0,121	19,975	20,745	1,51E-04	-0,6560	0,6191	24,63	0	a
282.	33,73	0,114	19,986	20,757	1,51E-04	-0,6567	0,6163	24,52	0	a
283.	33,83	0,107	19,998	20,769	1,51E-04	-0,6573	0,6145	24,45	0	a
284.	33,94	0,0997	20,009	20,780	1,51E-04	-0,6579	0,6125	24,37	0	a
285.	34,05	0,0925	20,019	20,791	1,51E-04	-0,6584	0,6112	24,32	0	a
286.	34,18	0,0844	20,029	20,802	1,51E-04	-0,6590	0,6090	24,23	0	a
287.	34,29	0,0771	20,038	20,811	1,51E-04	-0,6596	0,6064	24,13	0	a
288.	34,41	0,0690	20,046	20,819	1,51E-04	-0,6600	0,6052	24,08	0	a
289.	34,52	0,0619	20,053	20,826	1,51E-04	-0,6605	0,6027	23,98	0	a
290.	34,63	0,0547	20,059	20,832	1,51E-04	-0,6609	0,6008	23,91	0	a
291.	34,74	0,0476	20,064	20,838	1,52E-04	-0,6613	0,5987	23,82	0	a
292.	34,85	0,0405	20,068	20,842	1,52E-04	-0,6617	0,5963	23,73	0	a
293.	34,96	0,0334	20,072	20,846	1,52E-04	-0,6620	0,5947	23,66	0	a
294.	35,07	0,0263	20,075	20,849	1,52E-04	-0,6623	0,5927	23,58	0	a
295.	35,18	0,0193	20,077	20,851	1,52E-04	-0,6625	0,5915	23,53	0	a
296.	35,30	0,0110	20,078	20,852	1,52E-04	-0,6628	0,5890	23,44	0	a
297.	35,47	0	20,078	20,853	1,52E-04	-0,6631	0,5862	23,32	0	a
298.	35,60	0	20,078	20,853	0	-0,6634	0,5834	23,21	0	r
299.	41,90	-0,364	20,078	20,853	-0,00226	-0,6637	0,5827	23,19	0	r
300.	42,04	-0,372	20,077	20,851	-0,00226	-0,6637	0,5823	23,17	0	r
301.	42,16	-0,379	20,075	20,849	-0,00226	-0,6636	0,5825	23,18	0	r
302.	42,30	-0,387	20,071	20,845	-0,00226	-0,6636	0,5811	23,12	0	r
303.	42,45	-0,396	20,067	20,841	-0,00226	-0,6636	0,5795	23,06	0	r
304.	42,57	-0,403	20,061	20,835	-0,00226	-0,6637	0,5766	22,94	0	r
305.	42,70	-0,410	20,055	20,828	-0,00226	-0,6636	0,5753	22,89	0	r
306.	42,84	-0,418	20,046	20,819	-0,00226	-0,6635	0,5734	22,81	0	r
307.	42,99	-0,427	20,034	20,807	-0,00226	-0,6634	0,5702	22,69	0	r
308.	43,13	-0,435	20,024	20,797	-0,00225	-0,6632	0,5685	22,62	0	r
309.	43,26	-0,443	20,013	20,785	-0,00225	-0,6631	0,5656	22,51	0	r
310.	43,40	-0,451	19,999	20,771	-0,00225	-0,6629	0,5628	22,39	0	r
311.	43,54	-0,459	19,983	20,755	-0,00225	-0,6626	0,5601	22,29	0	r
312.	43,68	-0,467	19,968	20,739	-0,00225	-0,6624	0,5568	22,15	0	r
313.	43,81	-0,474	19,953	20,723	-0,00225	-0,6620	0,5553	22,09	0	r
314.	43,94	-0,482	19,934	20,703	-0,00224	-0,6617	0,5516	21,95	0	r
315.	44,09	-0,491	19,914	20,683	-0,00224	-0,6612	0,5496	21,87	0	r
316.	44,21	-0,498	19,896	20,664	-0,00224	-0,6607	0,5478	21,80	0	r
317.	44,37	-0,507	19,871	20,638	-0,00224	-0,6602	0,5440	21,64	0	r
318.	44,51	-0,515	19,847	20,613	-0,00224	-0,6596	0,5415	21,55	0	r
319.	44,65	-0,523	19,819	20,585	-0,00223	-0,6589	0,5386	21,43	0	r
320.	44,79	-0,531	19,795	20,559	-0,00223	-0,6581	0,5379	21,40	0	r
321.	44,92	-0,539	19,770	20,534	-0,00223	-0,6575	0,5351	21,29	0	r
322.	45,05	-0,546	19,739	20,502	-0,00222	-0,6568	0,5312	21,13	0	r
323.	45,20	-0,555	19,711	20,473	-0,00222	-0,6560	0,5291	21,05	0	r
324.	45,33	-0,562	19,683	20,444	-0,00222	-0,6551	0,5281	21,01	0	r
325.	45,47	-0,570	19,649	20,408	-0,00221	-0,6544	0,5228	20,80	0	r
326.	45,67	-0,582	19,602	20,360	-0,00221	-0,6528	0,5219	20,77	0	r
327.	45,82	-0,591	19,562	20,319	-0,00220	-0,6517	0,5188	20,64	0	r
328.	45,96	-0,599	19,525	20,280	-0,00220	-0,6505	0,5174	20,59	0	r
329.	46,09	-0,606	19,491	20,245	-0,00220	-0,6496	0,5143	20,46	0	r
330.	46,22	-0,614	19,453	20,206	-0,00219	-0,6487	0,5098	20,29	0	r
331.	46,42	-0,625	19,397	20,147	-0,00218	-0,6470	0,5066	20,16	0	r
332.	46,56	-0,634	19,351	20,101	-0,00218	-0,6457	0,5034	20,03	0	r
333.	46,70	-0,642	19,307	20,055	-0,00218	-0,6442	0,5026	20,00	0	r
334.	46,84	-0,650	19,266	20,012	-0,00217	-0,6428	0,5016	19,96	0	r
335.	46,98	-0,658	19,216	19,960	-0,00216	-0,6416	0,4959	19,73	0	r
336.	47,13	-0,667	19,166	19,909	-0,00216	-0,6400	0,4941	19,66	0	r
337.	47,28	-0,675	19,114	19,854	-0,00215	-0,6386	0,4893	19,47	0	r
338.	47,42	-0,683	19,067	19,806	-0,00215	-0,6368	0,4904	19,51	0	r
339.	47,64	-0,696	18,986	19,722	-0,00214	-0,6345	0,4844	19,28	0	r
340.	47,78	-0,704	18,928	19,663	-0,00213	-0,6328	0,4810	19,14	0	r
341.	47,92	-0,712	18,877	19,609	-0,00213	-0,6309	0,4816	19,16	0	r
342.	48,05	-0,720	18,817	19,547	-0,00212	-0,6294	0,4751	18,90	0	r
343.	48,20	-0,728	18,763	19,492	-0,00211	-0,6273	0,4768	18,97	0	r
344.	48,33	-0,736	18,711	19,438	-0,00211	-0,6257	0,4741	18,87	0	r

345.	48,51	-0,746	18,631	19,355	-0,00210	-0,6231	0,4714	18,76	0	r
346.	48,64	-0,754	18,576	19,298	-0,00209	-0,6215	0,4678	18,61	6,96	r
347.	48,76	-0,761	18,521	19,240	-0,00209	-0,6197	0,4659	18,54	8,65	r
348.	48,91	-0,770	18,445	19,162	-0,00208	-0,6177	0,4589	18,26	13,13	r
349.	49,07	-0,779	18,372	19,087	-0,00207	-0,6153	0,4567	18,17	14,25	r
350.	49,23	-0,788	18,303	19,015	-0,00206	-0,6128	0,4568	18,17	14,23	r
351.	49,37	-0,796	18,229	18,939	-0,00205	-0,6107	0,4515	17,97	16,63	r
352.	49,51	-0,804	18,165	18,872	-0,00205	-0,6081	0,4543	18,07	15,42	r
353.	49,71	-0,816	18,062	18,766	-0,00204	-0,6049	0,4496	17,89	17,43	r
354.	49,84	-0,823	17,997	18,698	-0,00203	-0,6030	0,4454	17,72	19,07	r
355.	49,98	-0,831	17,919	18,617	-0,00202	-0,6006	0,4412	17,56	20,55	r
356.	50,14	-0,840	17,840	18,536	-0,00201	-0,5977	0,4420	17,59	20,28	r
357.	50,26	-0,848	17,772	18,466	-0,00200	-0,5956	0,4387	17,46	21,40	r
358.	50,42	-0,856	17,680	18,370	-0,00199	-0,5928	0,4338	17,26	23,00	r
359.	50,56	-0,865	17,607	18,294	-0,00199	-0,5902	0,4335	17,25	23,10	r
360.	50,68	-0,872	17,535	18,219	-0,00198	-0,5876	0,4334	17,24	23,11	r
361.	50,83	-0,880	17,454	18,136	-0,00197	-0,5853	0,4276	17,01	24,86	r
362.	50,96	-0,888	17,366	18,044	-0,00196	-0,5826	0,4230	16,83	26,15	r
363.	51,11	-0,896	17,281	17,957	-0,00195	-0,5795	0,4237	16,86	25,96	r
364.	51,25	-0,905	17,202	17,875	-0,00194	-0,5767	0,4232	16,84	26,09	r
365.	51,41	-0,914	17,106	17,775	-0,00193	-0,5740	0,4157	16,54	28,09	r
366.	51,55	-0,922	17,017	17,684	-0,00192	-0,5707	0,4170	16,59	27,77	r
367.	51,75	-0,933	16,882	17,543	-0,00190	-0,5665	0,4105	16,33	29,41	r
368.	51,89	-0,941	16,797	17,455	-0,00189	-0,5636	0,4089	16,27	29,80	r
369.	52,02	-0,949	16,705	17,360	-0,00188	-0,5609	0,4030	16,03	31,22	r
370.	52,18	-0,958	16,600	17,252	-0,00187	-0,5574	0,4005	15,94	31,79	r
371.	52,32	-0,966	16,505	17,153	-0,00190	-0,5542	0,3984	15,85	32,29	r
372.	52,48	-0,966	16,398	17,042	-0,00188	-0,5506	0,3959	15,75	32,84	r
373.	52,61	-0,966	16,304	16,945	-0,00187	-0,5473	0,3953	15,73	32,98	r
374.	52,76	-0,966	16,194	16,831	-0,00186	-0,5440	0,3889	15,47	34,39	r
375.	52,90	-0,966	16,100	16,734	-0,00185	-0,5403	0,3921	15,60	33,69	r
376.	53,04	-0,966	15,998	16,628	-0,00184	-0,5369	0,3895	15,50	34,26	r
377.	53,17	-0,966	15,907	16,534	-0,00183	-0,5339	0,3868	15,39	34,83	r
378.	53,29	-0,966	15,814	16,438	-0,00182	-0,5309	0,3836	15,26	35,51	r
379.	53,42	-0,966	15,721	16,341	-0,00181	-0,5274	0,3850	15,32	35,22	r
380.	53,56	-0,966	15,614	16,230	-0,00180	-0,5244	0,3769	15,00	36,89	r
381.	53,73	-0,966	15,475	16,086	-0,00178	-0,5198	0,3730	14,84	37,68	r
382.	53,88	-0,966	15,361	15,968	-0,00177	-0,5156	0,3739	14,88	37,48	r
383.	54,03	-0,966	15,239	15,842	-0,00175	-0,5119	0,3675	14,62	38,75	r
384.	54,17	-0,966	15,138	15,737	-0,00174	-0,5081	0,3690	14,68	38,46	r
385.	54,29	-0,966	15,037	15,633	-0,00173	-0,5044	0,3697	14,71	38,32	r
386.	54,44	-0,966	14,923	15,514	-0,00172	-0,5012	0,3609	14,36	40,02	r
387.	54,59	-0,966	14,786	15,373	-0,00170	-0,4968	0,3559	14,16	40,96	r
388.	54,73	-0,966	14,677	15,260	-0,00169	-0,4929	0,3557	14,15	40,99	r
389.	54,86	-0,966	14,562	15,141	-0,00168	-0,4889	0,3547	14,11	41,18	r
390.	55,01	-0,966	14,427	15,001	-0,00166	-0,4849	0,3461	13,77	42,74	r
391.	55,15	-0,966	14,317	14,887	-0,00165	-0,4803	0,3525	14,03	41,58	r
392.	55,28	-0,966	14,199	14,765	-0,00163	-0,4768	0,3453	13,74	42,89	r
393.	55,42	-0,966	14,085	14,647	-0,00162	-0,4726	0,3464	13,78	42,68	r
394.	55,54	-0,966	13,974	14,532	-0,00161	-0,4690	0,3425	13,63	43,38	r
395.	55,75	-0,966	13,789	14,340	-0,00159	-0,4630	0,3362	13,38	44,48	r
396.	55,89	-0,966	13,664	14,211	-0,00157	-0,4587	0,3345	13,31	44,78	r
397.	56,01	-0,966	13,549	14,092	-0,00156	-0,4543	0,3371	13,41	44,32	r
398.	56,14	-0,966	13,434	13,973	-0,00155	-0,4505	0,3338	13,28	44,90	r
399.	56,26	-0,966	13,317	13,852	-0,00153	-0,4467	0,3299	13,13	45,57	r
400.	56,39	-0,966	13,200	13,730	-0,00152	-0,4423	0,3317	13,20	45,26	r
401.	56,58	-0,966	13,021	13,545	-0,00150	-0,4365	0,3256	12,96	46,29	r
402.	56,70	-0,966	12,898	13,418	-0,00149	-0,4326	0,3207	12,76	47,11	r
403.	56,83	-0,966	12,767	13,282	-0,00147	-0,4280	0,3194	12,71	47,33	r
404.	56,97	-0,966	12,637	13,148	-0,00146	-0,4233	0,3200	12,73	47,23	r
405.	57,11	-0,966	12,488	12,993	-0,00144	-0,4192	0,3077	12,24	49,23	r
406.	57,27	-0,966	12,333	12,833	-0,00142	-0,4138	0,3060	12,18	49,50	r
407.	57,41	-0,966	12,202	12,697	-0,00141	-0,4083	0,3138	12,49	48,25	r
408.	57,55	-0,966	12,062	12,552	-0,00139	-0,4042	0,3046	12,12	49,73	r
409.	57,67	-0,966	11,936	12,422	-0,00138	-0,3993	0,3085	12,27	49,11	r
410.	57,86	-0,966	11,748	12,227	-0,00136	-0,3922	0,3117	12,40	48,58	r
411.	58,00	-0,966	11,609	12,082	-0,00134	-0,3880	0,3039	12,09	49,84	r
412.	58,13	-0,966	11,474	11,943	-0,00132	-0,3830	0,3054	12,15	49,60	r
413.	58,27	-0,966	11,343	11,807	-0,00131	-0,3780	0,3085	12,27	49,11	r
414.	58,42	-0,966	11,187	11,646	-0,00129	-0,3729	0,3034	12,07	49,92	r
415.	58,61	-0,966	10,990	11,441	-0,00127	-0,3658	0,3035	12,08	49,90	r
416.	58,75	-0,966	10,859	11,306	-0,00125	-0,3607	0,3075	12,24	49,26	r
417.	58,88	-0,966	10,724	11,166	-0,00124	-0,3564	0,3022	12,03	50,10	r
418.	59,02	-0,966	10,593	11,030	-0,00122	-0,3505	0,3139	12,49	48,23	r
419.	59,16	-0,966	10,452	10,884	-0,00121	-0,3454	0,3143	12,50	48,17	r
420.	59,28	-0,966	10,328	10,755	-0,00119	-0,3411	0,3125	12,43	48,46	r
421.	59,41	-0,966	10,203	10,626	-0,00118	-0,3369	0,3098	12,33	48,89	r
422.	59,53	-0,966	10,078	10,496	-0,00117	-0,3326	0,3079	12,25	49,21	r
423.	59,66	-0,966	9,953	10,367	-0,00115	-0,3275	0,3138	12,49	48,25	r
424.	59,86	-0,966	9,738	10,145	-0,00113	-0,3211	0,3010	11,97	50,31	r
425.	60,02	-0,966	9,583	9,984	-0,00111	-0,3147	0,3092	12,30	48,99	r
426.	60,17	-0,966	9,438	9,833	-0,00109	-0,3090	0,3138	12,49	48,25	r
427.	60,30	-0,966	9,313	9,704	-0,00108	-0,3047	0,3119	12,41	48,55	r
428.	60,42	-0,966	9,188	9,575	-0,00106	-0,3004	0,3102	12,34	48,84	r
429.	60,56	-0,966	9,037	9,418	-0,00105	-0,2954	0,3060	12,17	49,51	r
430.	60,70	-0,966	8,907	9,283	-0,00103	-0,2903	0,3102	12,34	48,84	r
431.	60,83	-0,965	8,772	9,144	-9,99E-04	-0,2859	0,3058	12,17	49,53	r
432.	60,97	-0,956	8,641	9,008	-9,84E-04	-0,2809	0,3087	12,28	49,07	r
433.	61,11	-0,948	8,501	8,863	-9,68E-04	-0,2758	0,3092	12,30	48,99	r
434.	61,23	-0,941	8,376	8,733	-9,54E-04	-0,2708	0,3143	12,50	48,17	r
435.	61,36	-0,934	8,251	8,604	-9,40E-04	-0,2665	0,3124	12,43	48,48	r
436.	61,48	-0,927	8,126	8,474	-9,26E-04	-0,2622	0,3106	12,36	48,77	r
437.	61,61	-0,919	8,001	8,345	-9,12E-04	-0,2579	0,3087	12,28	49,07	r
438.	61,73	-0,912	7,876	8,216	-8,98E-04	-0,2529	0,3138	12,48	48,25	r
439.	61,92	-0,902	7,688	8,020	-8,77E-04	-0,2464	0,3112	12,38	48,67	r
440.	62,06	-0,893	7,548	7,876	-8,62E-04	-0,2414	0,3111	12,38	48,68	r
441.	62,19	-0,886	7,422	7,746	-8,48E-04	-0,2372	0,3080	12,25	49,19	r
442.	62,32	-0,879	7,300	7,618	-8,34E-04	-0,2322	0,3137	12,48	48,26	r
443.	62,44	-0,872	7,179	7,493	-8,21E-04	-0,2279	0,3134	12,47	48,32	r
444.	62,58	-0,863	7,035	7,345	-8,05E-04	-0,2228	0,3128	12,45	48,41	r
445.	62,72	-0,855	6,910	7,215	-7,90E-04	-0,2177	0,3186	12,67	47,47	r
446.	62,85	-0,848	6,792	7,092	-7,77E-04	-0,2134	0,3192	12,70	47,37	r
447.	62,97	-0,841	6,675	6,971	-7,64E-04	-0,2085	0,3260	12,97	46,23	r

448.	63,10	-0,834	6,558	6,850	-7,51E-04	-0,2043	0,3262	12,98	46,20	r
449.	63,22	-0,826	6,444	6,732	-7,38E-04	-0,2002	0,3261	12,97	46,22	r
450.	63,35	-0,819	6,330	6,614	-7,26E-04	-0,1954	0,3330	13,25	45,04	r
451.	63,47	-0,812	6,208	6,488	-7,12E-04	-0,1912	0,3314	13,19	45,31	r
452.	63,61	-0,804	6,091	6,366	-6,99E-04	-0,1864	0,3371	13,41	44,33	r
453.	63,74	-0,797	5,972	6,243	-6,86E-04	-0,1824	0,3344	13,31	44,80	r
454.	63,89	-0,787	5,834	6,100	-6,70E-04	-0,1770	0,3387	13,47	44,06	r
455.	64,04	-0,779	5,721	5,983	-6,58E-04	-0,1724	0,3441	13,69	43,10	r
456.	64,16	-0,772	5,614	5,872	-6,46E-04	-0,1685	0,3445	13,71	43,02	r
457.	64,28	-0,765	5,508	5,762	-6,34E-04	-0,1647	0,3445	13,71	43,03	r
458.	64,41	-0,758	5,403	5,653	-6,22E-04	-0,1602	0,3515	13,99	41,76	r
459.	64,53	-0,751	5,299	5,545	-6,11E-04	-0,1564	0,3521	14,01	41,66	r
460.	64,67	-0,742	5,174	5,417	-5,97E-04	-0,1520	0,3515	13,99	41,76	r
461.	64,82	-0,734	5,060	5,298	-5,84E-04	-0,1476	0,3543	14,10	41,26	r
462.	64,96	-0,726	4,954	5,189	-5,72E-04	-0,1433	0,3592	14,29	40,33	r
463.	65,08	-0,719	4,854	5,085	-5,61E-04	-0,1396	0,3603	14,34	40,13	r
464.	65,20	-0,712	4,747	4,974	-5,49E-04	-0,1354	0,3638	14,47	39,47	r
465.	65,35	-0,703	4,645	4,869	-5,38E-04	-0,1312	0,3691	14,68	38,45	r
466.	65,47	-0,696	4,549	4,769	-5,27E-04	-0,1277	0,3694	14,70	38,38	r
467.	65,61	-0,688	4,441	4,657	-5,15E-04	-0,1236	0,3717	14,79	37,93	r
468.	65,74	-0,681	4,347	4,559	-5,04E-04	-0,1201	0,3728	14,83	37,71	r
469.	65,88	-0,673	4,235	4,443	-4,92E-04	-0,1161	0,3725	14,82	37,78	r
470.	66,02	-0,665	4,131	4,335	-4,80E-04	-0,1115	0,3809	15,16	36,06	r
471.	66,16	-0,657	4,036	4,237	-4,69E-04	-0,1075	0,3867	15,38	34,86	r
472.	66,28	-0,649	3,946	4,144	-4,59E-04	-0,1042	0,3873	15,41	34,73	r
473.	66,41	-0,642	3,857	4,051	-4,49E-04	-0,1009	0,3882	15,45	34,52	r
474.	66,53	-0,635	3,768	3,960	-4,40E-04	-0,0977	0,3885	15,46	34,47	r
475.	66,67	-0,627	3,664	3,851	-4,28E-04	-0,0939	0,3889	15,48	34,37	r
476.	66,81	-0,619	3,574	3,759	-4,18E-04	-0,0896	0,3995	15,90	32,02	r
477.	66,94	-0,611	3,490	3,671	-4,08E-04	-0,0864	0,4012	15,96	31,64	r
478.	67,06	-0,604	3,399	3,577	-3,98E-04	-0,0833	0,3997	15,90	31,98	r
479.	67,20	-0,596	3,313	3,488	-3,89E-04	-0,0797	0,4047	16,10	30,82	r
480.	67,35	-0,588	3,221	3,393	-3,78E-04	-0,0762	0,4067	16,18	30,35	r
481.	67,47	-0,581	3,141	3,310	-3,69E-04	-0,0731	0,4088	16,27	29,83	r
482.	67,60	-0,573	3,062	3,228	-3,61E-04	-0,0697	0,4141	16,48	28,50	r
483.	67,72	-0,566	2,978	3,141	-3,51E-04	-0,0668	0,4130	16,43	28,78	r
484.	67,88	-0,557	2,880	3,040	-3,40E-04	-0,0630	0,4160	16,55	28,02	r
485.	68,02	-0,549	2,801	2,958	-3,31E-04	-0,0596	0,4214	16,77	26,60	r
486.	68,14	-0,542	2,725	2,879	-3,23E-04	-0,0569	0,4212	16,76	26,66	r
487.	68,27	-0,534	2,652	2,803	-3,15E-04	-0,0536	0,4278	17,02	24,80	r
488.	68,39	-0,527	2,573	2,722	-3,06E-04	-0,0509	0,4265	16,97	25,18	r
489.	68,55	-0,518	2,484	2,629	-2,96E-04	-0,0477	0,4263	16,96	25,22	r
490.	68,70	-0,509	2,402	2,544	-2,87E-04	-0,0442	0,4317	17,18	23,65	r
491.	68,83	-0,502	2,333	2,472	-2,79E-04	-0,0416	0,4328	17,22	23,31	r
492.	68,95	-0,495	2,264	2,401	-2,71E-04	-0,0386	0,4380	17,43	21,66	r
493.	69,08	-0,488	2,197	2,331	-2,64E-04	-0,0361	0,4389	17,46	21,36	r
494.	69,20	-0,480	2,125	2,257	-2,56E-04	-0,0337	0,4371	17,39	21,95	r
495.	69,35	-0,472	2,057	2,187	-2,48E-04	-0,0308	0,4417	17,57	20,41	r
496.	69,47	-0,465	1,993	2,120	-2,41E-04	-0,0283	0,4436	17,65	19,74	r
497.	69,59	-0,458	1,923	2,048	-2,33E-04	-0,0255	0,4463	17,76	18,71	r
498.	69,74	-0,450	1,860	1,982	-2,26E-04	-0,0228	0,4506	17,93	17,03	r
499.	69,86	-0,443	1,799	1,919	-2,19E-04	-0,0205	0,4516	17,97	16,60	r
500.	70,00	-0,434	1,732	1,849	-2,12E-04	-0,0178	0,4544	18,08	15,36	r
501.	70,13	-0,427	1,668	1,784	-2,05E-04	-0,0152	0,4577	18,21	13,79	r
502.	70,27	-0,419	1,608	1,721	-1,98E-04	-0,0129	0,4589	18,26	13,14	r
503.	70,39	-0,412	1,551	1,663	-1,92E-04	-0,0103	0,4644	18,48	9,77	r
504.	70,52	-0,405	1,496	1,605	-1,86E-04	-0,0082	0,4654	18,52	9,04	r
505.	70,64	-0,397	1,437	1,544	-1,79E-04	-0,0061	0,4652	18,51	9,16	r
506.	70,80	-0,388	1,371	1,476	-1,72E-04	-0,0034	0,4685	18,64	6,16	r
507.	70,94	-0,380	1,315	1,418	-1,65E-04	-0,0010	0,4725	18,80	0	r
508.	71,06	-0,373	1,260	1,361	-1,59E-04	0,0009	0,4718	18,77	0	r
509.	71,20	-0,365	1,204	1,302	-1,53E-04	0,0036	0,4782	19,03	0	r
510.	71,36	-0,356	1,143	1,239	-1,46E-04	0,0058	0,4784	19,04	0	r
511.	71,50	-0,348	1,093	1,188	-1,41E-04	0,0084	0,4864	19,35	0	r
512.	71,63	-0,341	1,043	1,136	-1,35E-04	0,0102	0,4864	19,35	0	r
513.	71,77	-0,332	0,995	1,086	-1,30E-04	0,0123	0,4901	19,50	0	r
514.	71,89	-0,325	0,951	1,040	-1,25E-04	0,0140	0,4911	19,54	0	r
515.	72,05	-0,316	0,897	0,984	-1,19E-04	0,0163	0,4946	19,68	0	r
516.	72,17	-0,309	0,854	0,940	-1,14E-04	0,0179	0,4954	19,71	0	r
517.	72,30	-0,302	0,813	0,898	-1,09E-04	0,0199	0,5005	19,91	0	r
518.	72,42	-0,294	0,771	0,853	-1,05E-04	0,0215	0,5011	19,94	0	r
519.	72,56	-0,286	0,726	0,807	-9,96E-05	0,0233	0,5030	20,01	0	r
520.	72,70	-0,278	0,686	0,766	-9,52E-05	0,0251	0,5068	20,16	0	r
521.	72,84	-0,270	0,645	0,724	-9,06E-05	0,0268	0,5089	20,25	0	r
522.	72,99	-0,262	0,605	0,682	-8,61E-05	0,0285	0,5114	20,35	0	r
523.	73,11	-0,255	0,571	0,646	-8,22E-05	0,0299	0,5130	20,41	0	r
524.	73,25	-0,246	0,533	0,607	-7,80E-05	0,0315	0,5154	20,51	0	r
525.	73,38	-0,239	0,498	0,571	-7,42E-05	0,0330	0,5179	20,61	0	r
526.	73,52	-0,231	0,465	0,537	-7,05E-05	0,0345	0,5210	20,73	0	r
527.	73,64	-0,224	0,433	0,503	-6,68E-05	0,0358	0,5223	20,78	0	r
528.	73,78	-0,216	0,402	0,472	-6,34E-05	0,0372	0,5253	20,90	0	r
529.	73,91	-0,209	0,374	0,443	-6,03E-05	0,0384	0,5271	20,97	0	r
530.	74,08	-0,199	0,337	0,404	-5,61E-05	0,0401	0,5307	21,12	0	r
531.	74,21	-0,191	0,312	0,378	-5,33E-05	0,0413	0,5335	21,23	0	r
532.	74,33	-0,184	0,285	0,350	-5,03E-05	0,0422	0,5330	21,21	0	r
533.	74,47	-0,176	0,260	0,325	-4,76E-05	0,0434	0,5361	21,33	0	r
534.	74,60	-0,169	0,236	0,300	-4,49E-05	0,0446	0,5394	21,46	0	r
535.	74,74	-0,161	0,214	0,276	-4,24E-05	0,0458	0,5432	21,61	0	r
536.	74,87	-0,153	0,189	0,251	-3,96E-05	0,0469	0,5454	21,70	0	r
537.	75,02	-0,144	0,170	0,230	-3,74E-05	0,0478	0,5472	21,77	0	r
538.	75,14	-0,137	0,152	0,212	-3,54E-05	0,0487	0,5497	21,87	0	r
539.	75,27	-0,130	0,135	0,194	-3,35E-05	0,0496	0,5525	21,98	0	r
540.	75,39	-0,123	0,117	0,176	-3,16E-05	0,0504	0,5543	22,05	0	r
541.	75,53	-0,115	0,100	0,159	-2,97E-05	0,0511	0,5552	22,09	0	r
542.	75,67	-0,107	0,085	0,143	-2,80E-05	0,0521	0,5595	22,26	0	r
543.	75,82	-0,0982	0,072	0,129	-2,65E-05	0,0528	0,5618	22,35	0	r
544.	75,94	-0,0912	0,060	0,117	-2,52E-05	0,0534	0,5636	22,42	0	r
545.	76,08	-0,0832	0,049	0,105	-2,39E-05	0,0541	0,5663	22,53	0	r
546.	76,21	-0,0758	0,039	0,095	-2,28E-05	0,0547	0,5688	22,63	0	r
547.	76,33	-0,0687	0,031	0,086	-2,19E-05	0,0552	0,5708	22,71	0	r
548.	76,47	-0,0604	0,022	0,078	-2,10E-05	0,0558	0,5737	22,83	0	r
549.	76,60	-0,0533	0,016	0,071	-2,03E-05	0,0562	0,5755	22,90	0	r
550.	76,72	-0,0460	0,011	0,066	-1,97E-05	0,0566	0,5775	22,98	0	r

551.	76,86	-0,0380	0,006	0,061	-1,91E-05	0,0571	0,5807	23,10	0	r
552.	77,02	-0,0290	0,003	0,057	-1,87E-05	0,0575	0,5834	23,21	0	r
553.	77,14	-0,0217	0,001	0,055	-1,85E-05	0,0578	0,5857	23,30	0	r
554.	77,27	-0,0142	0,000	0,054	-1,84E-05	0,0580	0,5874	23,37	0	r
555.	77,39	-0,00728	0,000	0,054	-1,84E-05	0,0582	0,5893	23,45	0	r
556.	77,52	0	0,000	0,054	-1,84E-05	0,0584	0,5913	23,53	0	r

## Meldungen

Messung bei symm. beschleunigter Plattformgeschwindigkeit (nur der Meniskus der Antastung wurde aktiv Korrigiert = 0,0847cm<sup>3</sup>).

**Temperaturangaben** beziehen sich auf die Skala der ITS-90. **Standardabweichungen:** Verschiedentlich werden Regressionsfunktionen mit Standardabweichungen bzw. Varianzen qualifiziert. Diese Angaben werden berechnet aus der Summe der Quadrate der Abweichungen der Einzelwerte zu jeweils berechneten Funktionswerten dividiert durch die Anzahl der Werte weniger 1. Sofern nicht anders bezeichnet, werden für ±(Standardmess-)Unsicherheiten einfache Standardabweichungen - ohne Erweiterungsfaktoren - angegeben, d.h. die Überdeckung betrifft 67% der Werte.

## IMPro

### Execution & Audit-Trail

Data created during execution of the IMPro "ContactAngle\_atConstantLevel, 06.05.23, 96945", type 4/4. Time Period of the Accomplishment: Mai., 08. 2023 between 19:08:45 and 19:12:35, elapsed time: four minutes. IMPro finished as projected. The complete Report first was presented on Mai., 08.23 at 19:45. Audit-Log: The Original data is unchanged, nevertheless there are entries to the Log, made while the IMPro was executing:

Start of this IMPro 19:10:58, - Backup of the IMPro configuration:

Time Variables: Abs. Positions/Way: Immersion\_Depth 20mm, Platform\_StartPosition 85mm.

Rel. Positions/Way: FeedRateAdv 0,2mm, FeedRateRec -0,2mm, FeedRate\_for\_adv\_rec\_turn -0,050mm.

Others: Determin\_0\_at\_Repetition -1 [Y/N].StirringTime 0s. Stirrer-Speed 0rps. Record\_Air\_Density -1, Temperature-Outside-Warning 0, Automatic\_Thermostat\_available -1.

\*

#BeschleunigungsStudie-isoVmax 20mm bei 1mm/s. Variation g von 18 bis 95% ... Pumpe••Conditioning time stoped / broken by user.

v<sub>2,17</sub>=87,6µL,

Measurement : dyn.Accel: 18 [%], dynSpeed 1 [mm/s], PFlussRate 50,27 [µL/s], PumpN°1 [n], Vol. 2,50 [cm<sup>3</sup>], FüllVolumen 0,5 [cm<sup>3</sup>], FreiVolumen 2 [cm<sup>3</sup>], VolBilanz 0,412cm<sup>3</sup>, DichteDerFlüssigkeit 0,691906 [g/cm<sup>3</sup>].

The Number **21893** refers to the Recordset in the Database '**imeterData38**' where all Information can be retrieved at any time.

## Prüfmittel

Das Wägesystem (WZA224) wurde zuletzt am 05.05.23 um 22:27, 3 Tage vor dieser Messung von M. Breitwieser justiert. Die letzte vollständige Prüfung der Positioniervorrichtung von **IMETER** (ID23903733) erfolgte am 29.02.20. **Technische Daten:** Auflösung des Wägesystems 0,1 mg, Messunsicherheit (Linearität) 0,2 mg, Dichte der Justiermasse  $\rho_{cal}$  8,00 g/cm<sup>3</sup>, Luftdichte  $\rho_{air}$  vgl. Tabelle unten; Schwerebeschleunigung  $g$  9,80769 m/s<sup>2</sup>. Pt100-Temperaturmessung: Auflösung 0,001 K, Messunsicherheit ±0,01 K,  $R^\circ$  100.0056  $\Omega$ , Kalibrierintervall 30 min (BN°1, -41/200°C, 3S, FS15,8, Korrekturfunktion: -0,0054 +0,997591· $\vartheta$ +2,20165E-05· $\vartheta^2$ -4,78431E-08· $\vartheta^3$ ). Die Messauflösung der sekundären Temperaturmessung beträgt 0,01 K, die Unsicherheit 0,03 K. Akquisitions-Softwareversion IMETER 7.4.20, LizenzN° \* 3037-4759\*, W. 6.2,9200- Betriebssystem auf PC Ser.N°6995684 (C, SSD).

### Meteorologische Angaben, Luftdichte:

Time [min]	$\phi$ [%]	$T_a$ [°C]	$p_a$ [kPa]	$\rho_{air}$ [kg/m <sup>3</sup> ]
0,1	51,18	25,04	96,49	1,1204

Obige Zusammenstellung gibt die Aufzeichnung der Atmosphärendaten für den Aufstellort wieder; darin bedeuten  $\phi$  relative Luftfeuchte (r.H.),  $T_a$  Lufttemperatur und  $p_a$  absoluter Luftdruck,  $\rho_{air}$  die Luftdichte; Die Luftdichte wird dabei aus den Druck-, Temperatur- und Luftfeuchtwerten berechnet.