# ID N° 23055 - Contact Angle Measurement - M4$^{s+}$

Executed on Aug 29, 2023, by M. Breitwieser

**Cu-Blech (0.7mm, s.)**

*** Platte mit Wasser/Tensid, µ-Fasertuch gereinigt, Wasser abgetupft, dann Messung.*

- **Kupfer / Isooktan 99.5+%** : (20,2°C, 8,9', 20mm, 0,0489mm/s - static; *θ-superwetting*)

  $\Theta_{C,s}$ = **0**$_{\pm 0°}$ CAH 0°, $^{a}\bar{E}_s$ = **19,003**$_{\pm 0,028}$ **mN/m** $^{a}H_s$ -0,026mN/m, $\bar{B}_{\%,s}$= **101,5%**

# Report

## 2. ===== Collection of Measurements in this Series Kupfer/Isooktan 99.5+% ======

*Tabelle 1.2: Conditions and Results*

| N° | IDN° ...erData39 | ϑ [°C] | Δτ [min] | $\bar{v}_z$ [mm/s] | $\bar{Ca}$ [1] | $t_{eq.}$ [s] | $\Theta_M$ [°] | CAH [°] | $^{a}H$ [mN/m] | $^{a}\bar{E}$ [mN/m] | ±σ [mN/m] | $\bar{S}$ [mJ/m²] | $\bar{B}_{\%,Isookta...}$ [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | **23055$_0$** | **20,155** | ****0**** | **»0,0469«** | **-** | ***3,12*** | ***<0>*** | ***<0>*** | **-0,026** | **19,003** | **±0,028** | **0,273** | **101,5%** |
| 2. | 23056$_1$ | 20,12 | +25,2 | 10,0 | 2,64E-4 | *5,7* | 19 | 25 | -3,8 | 17,9 | ±1,7 | -0,830 | 95,5% |
| 3. | 23057$_2$ | 20,07 | +26,9 | 5,00 | 1,32E-4 | *5,9* | *<20>* | *<-41>* | 9,08 | 18,75 | ±0,18 | 0,0200 | 100,1% |
| 4. | 23058$_3$ | 20,051 | +27,9 | 2,50 | 6,61E-5 | *5,7* | *<14>* | *<-27>* | 5,188 | 19,28 | ±0,13 | 0,550 | 102,9% |
| 5. | 23059$_4$ | 20,043 | +29,3 | 1,25 | 3,31E-5 | *5,2* | *<9>* | *<-19>* | 2,704 | 19,137 | ±0,096 | 0,407 | 102,1% |
| 6. | 23060$_5$ | 20,037 | +31,4 | 0,625 | 1,65E-5 | *5,5* | *<6>* | *<-12>* | 1,644 | 19,141 | ±0,045 | 0,411 | 102,1% |
| 7. | 23061$_6$ | 20,032 | +33,5 | 0,313 | 8,26E-6 | *6,4* | *<3>* | *<-6>* | 1,038 | 19,155 | ±0,014 | 0,425 | 102,2% |
| 8. | 23062$_7$ | 20,03 | +36,8 | 0,156 | 4,13E-6 | *0,4* | *<0>* | *<0>* | 0,471 | 19,138 | ±0,023 | 0,408 | 102,1% |
| 9. | 23063$_8$ | 20,032 | +42,4 | <0,947> | 2,50E-5 | *5,9* | *<5>* | *<-9>* | 2,194 | 19,594 | ±0,073 | 0,864 | 104,5% |
| 10. | 23064$_9$ | 20,032 | +44,0 | <0,710> | 1,87E-5 | *5,7* | *<6>* | *<-11>* | 2,335 | 19,578 | ±0,082 | 0,848 | 104,4% |
| 11. | 23065$_{10}$ | 20,03 | +45,8 | <0,318> | 8,43E-6 | *6,5* | *<2>* | *<-3>* | 1,091 | 19,288 | ±0,077 | 0,558 | 102,9% |
| 12. | 23066$_{11}$ | 20,027 | +48,9 | <0,357>* | 9,42E-6 | *0,1* | *<0,8>* | *<-2>* | 1,111 | 19,320 | ±0,059 | 0,590 | 103,0% |
| 13. | 23067$_{12}$ | 20,011 | +52,0 | <0,376>* | 9,92E-6 | *0,1* | *<1>* | *<-2>* | 1,154 | 19,36 | ±0,15 | 0,630 | 103,3% |
| 14. | 23068$_{13}$ | 20,001 | +54,8 | <0,392>* | 1,05E-5 | *0,1* | *<0,2>* | *<-0,4>* | 0,952 | 19,374 | ±0,075 | 0,644 | 103,3% |
| 15. | 23069$_{14}$ | 19,996 | +57,5 | <1,69> | 4,45E-5 | *0,0* | *<10>* | *<-19>* | 2,74 | 19,06 | ±0,31 | 0,330 | 101,7% |
| 16. | 23070$_{15}$ | 20,003 | +58,8 | <1,93> | 5,10E-5 | *0,0* | *<11>* | *<-21>* | 4,19 | 19,54 | ±0,33 | 0,810 | 104,2% |
| 17. | 23071$_{16}$ | 20,002 | +60,0 | <2,55> | 6,74E-5 | *0,0* | *<15>* | *<-29>* | 5,47 | 19,16 | ±0,41 | 0,430 | 102,2% |
| 18. | 23072$_{17}$ | 20,01 | +61,1 | <4,43> | 1,17E-4 | *0,0* | 21 | -40 | 8,99 | 18,6 | ±1,6 | -0,130 | 99,2% |
| 19. | 23073$_{18}$ | 20,011 | +62,0 | <6,70> | 1,77E-4 | *5,2* | *<0>* | *<0>* | -1,35 | 20,54 | ±0,37 | 1,81 | 109,5% |
| 20. | 23074$_{19}$ | 20,017 | +62,8 | »0,0484« | - | *3,10* | *<0>* | *<0>* | 0,052 | 19,165 | ±0,021 | 0,435 | 102,3% |
| 21. | 23075$_{20}$ | 20,2 | +78,6 | »0,0479« | - | *3,10* | *<0>* | *<0>* | -0,003 | 18,896 | ±0,017 | 0,166 | 100,9% |

*This table provides an overview of the measurements in this series. Each seperate M4 measurement is referenced by IDN°. The highlighted row indicates the data set of the measurement documented below. The column labeled **ϑ** shows the measurement temperature, **Δτ** the time interval to previous/following measurements, $\bar{v}_z$ the movement speed - where additional symbols clarify: **»n«** indicates static measurements, **<n>** represents distance-accelerated movement of the triple line, '*' stands for continous acceleration and a number without any symbol indicates a constant movement speed, $\bar{Ca}$ is the capillary number, $t_{eq.}$ is the equilibration time before turnaround - but for static measurements the number denotes the average equilibration time as a levelling time between the measurement points, $\Theta_M$ is the mean of the advancing and receding contact angle ('**<n>**' signs "errors"), contact angle hysteresis is given in degrees (**CAH**) and in energy units ($^{a}H$), $^{a}\bar{E}$ is the mean adhesion energy, and **±σ** is the corresponding standard deviation, $\bar{S}$ is the mean of the spreading parameter, and $\bar{B}_{\%,Isookta...}$ indicates the relative wettability ($B_{\%,lq|sl|md...}$= 100%·$^{a}E/\gamma$ ).*

*Tabelle 2.2: Summary of sample weights in the individual measurements (initial weight $W_0$ = 6,6487 g)*

| N° | $W_A$ [g] | $\Delta W_{A-0}$ [mg] | $W_E$ [g] | $\Delta W_{E-0}$ [mg] | $V_{E-0}$ [µL] | $\Delta V_{E-A}$ [µL] |
|---|---|---|---|---|---|---|
| 1. | **6,6487** | **0,0** | **6,6490** | **0,3** | **0,4** | **0,43** |
| 2. | 6,6490 | 0,3 | 6,6554 | 6,7 | 9,7 | 9,3 |
| 3. | 6,6546 | 5,9 | 6,6532 | 4,5 | 6,5 | -3,2 |
| 4. | 6,6531 | 4,4 | 6,6516 | 2,9 | 4,2 | -2,3 |
| 5. | 6,6515 | 2,8 | 6,6507 | 2,0 | 2,9 | -1,3 |
| 6. | 6,6505 | 1,8 | 6,6500 | 1,3 | 1,9 | -1,0 |
| 7. | 6,6499 | 1,2 | 6,6496 | 0,9 | 1,3 | -0,58 |
| 8. | 6,6496 | 0,9 | 6,6494 | 0,7 | 1,0 | -0,29 |
| 9. | 6,6493 | 0,6 | 6,6505 | 1,8 | 2,6 | 1,6 |
| 10. | 6,7521 | 103,4 | 6,6504 | 1,7 | 2,5 | -0,14 |
| 11. | 6,7522 | 103,5 | 6,6499 | 1,2 | 1,7 | -0,72 |
| 12. | 6,7517 | 103,0 | 6,6496 | 0,9 | 1,3 | -0,43 |
| 13. | 6,6495 | 0,8 | 6,6499 | 1,2 | 1,7 | 0,43 |
| 14. | 6,7515 | 102,8 | 6,6499 | 1,2 | 1,7 | ~0 |
| 15. | 6,7516 | 102,9 | 6,6516 | 2,9 | 4,2 | 2,5 |
| 16. | 6,7525 | 103,8 | 6,6519 | 3,2 | 4,6 | 0,43 |
| 17. | 6,7527 | 104,0 | 6,6525 | 3,8 | 5,5 | 0,87 |
| 18. | 6,7529 | 104,2 | 6,6545 | 5,8 | 8,4 | 2,9 |
| 19. | 6,7538 | 105,1 | 6,6547 | 6,0 | 8,7 | 0,29 |
| 20. | 6,6544 | 5,7 | 6,6489 | 0,2 | 0,3 | -8,4 |
| 21. | 6,6488 | 0,1 | 6,6484 | -0,3 | -0,4 | -0,72 |

*Symbols: $W_A$: Total weight before each measurement, $\Delta W_{0-A}$: Change in weight from the initial weight $W_0$ at the start of the series, $W_E$: Total weight after the measurement (possibly including the weight of any adherent fluid), $\Delta W_{E-0}$: Change in weight from the initial weight $W_0$ at the start of the series, $V_{E-0}$: Weight change interpreted as fluid volume, $\Delta V_{E-A}$: Fluid volume change calculated as the difference between $W_E$ and $W_A$. (Automated weighings without contact to the surface of the fluid).*

## 3. ===== Measurement IDN°23055: *Static* Contact Angle ======

Kupfer, cubic plate 25,5×0,684mm

**20mm Kupfer****Isooktan 99.5+%, γ =18,73mN/m** ϑ=20,2°C

| | |
|---|---|
| **Contact Angle, CA $\Theta_C$** | **<0 ±0°>** |

Contact Angle Hysteresis, $CAH_s$ <0°>

| | **Advancing $\Theta_{A,s}$** | **Receding $\Theta_{R,s}$** | Transition - mm |
|---|---|---|---|
| **Contact Angles, $\Theta_s$** | **0°** | **0°** | $0°_{adv.} \Rightarrow 0°_{rec.}$ |
| Rated measurements $n$ mm-range | 91 2,000 - 20,001mm | 103 20,001 - 2,000mm | 2 19,951 - 19,901mm |
| *avg. Triple line speed $\bar{v}_z$ [mm/s]* | *0,0489* ±0,0556 | *-0,0448* ±0,766 | |
| avg. Step distance $\bar{\Delta}h_0$ [mm] | 0,200 ±9,95E-05 | -0,178 ±0,0536 | |
| **avg. equilibration Time $\bar{t}_{eq.}$ [s]** | **3,22 ±0,628** | **3,02 ±0,575** | |

*Static Contact Angle Measurement: For superwetting - consider adhesion parameters for analysis. The avg. equilibration Time $t_{eq.}$ is the mean of the time between positioning and aquiring the wetting force. The criterion of force equilibrium is defined in the utilized IMPro. Diagramm(s) below presenting these results and further details in a graphical way.*

*¬ Diagramm 1.3: 'Contact Angle²' -- Data, Calculation and Results*

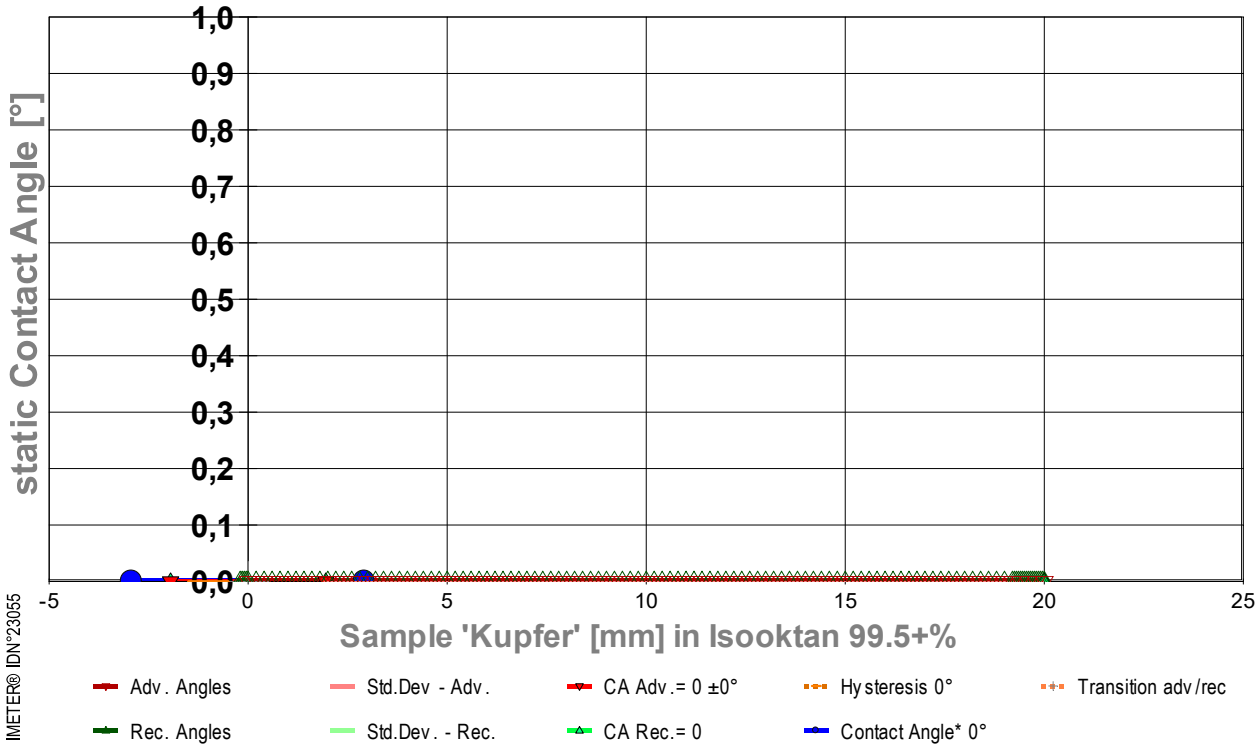


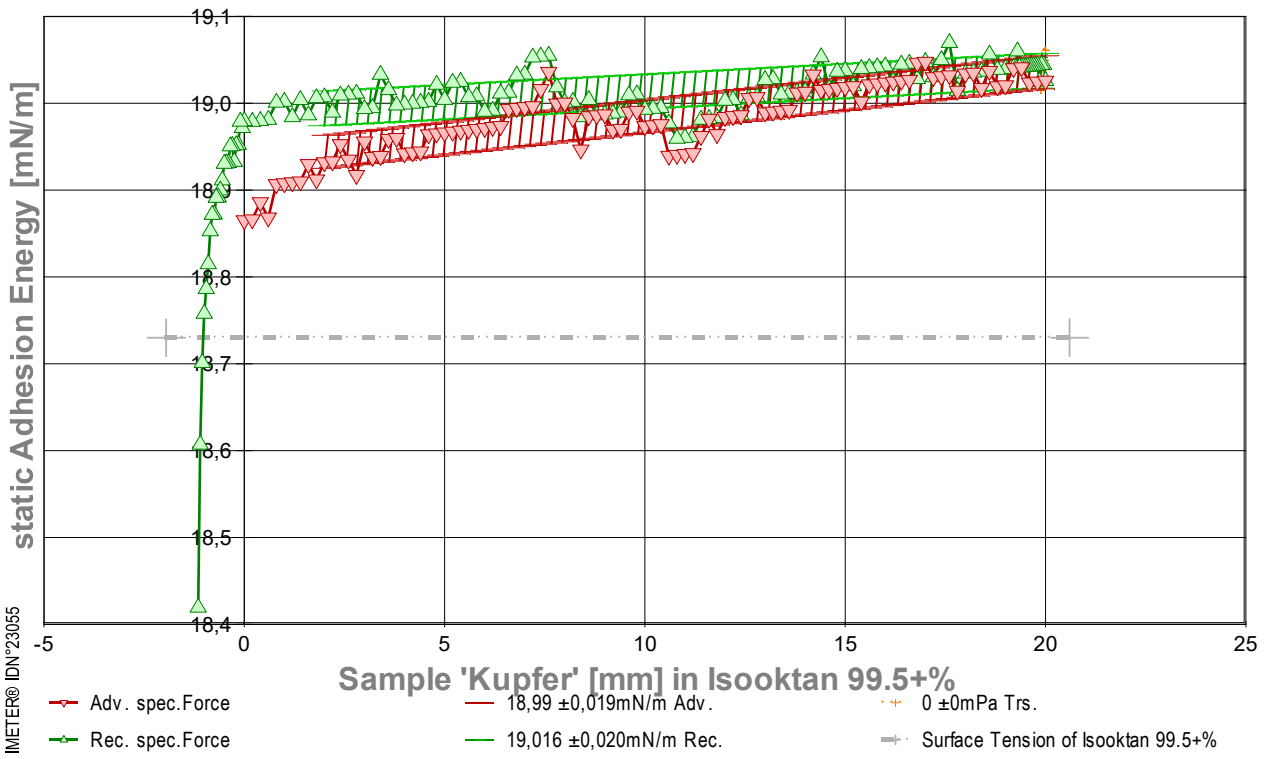

*Diagram 'Contact Angle²' gives a summary on this contact angle measurement: The small triangular marks show the individual contact angle values depending on the immersion depth of the sample. At '0' on the x-axis, the flatface front of the sample touches the surface of the liquid, to the right the depth 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 0,000 mm refers a sharp edge - the 'triple line' is fixed there while the immersion goes on until this hypertensive $\Theta_A$ max. 0,0° 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 equilibrium contact angle $\Theta_C$ is shown in blue.*

## Adhesion Force of the equilibrated Triple Line

| | |
|---|---|
| **Energy of Adhesion, $^a\bar{E}_S=(^aE_A+^aE_R)/2$** | **19,003 ±0,028 mN/m** |
| Hysteresis, $^aH_s = {}^aE_A - {}^aE_R$ | -0,026 mN/m |
| Parameter of spreading, $\bar{S}_s = {}^a\bar{E} - \gamma$ | 0,273 mJ/m² |
| relative wettability, $\bar{B}_{\%,s}=100\cdot{}^a\bar{E}/\gamma$ | 101,5% with Isooktan 99.5+% |

| | **Advancing $^aE_{A,s}$** | **Receding $^aE_{R,s}$** | Transition - mm |
|---|---|---|---|
| **Energy of Adhesion, $^aE_s$ [mN/m]** | **18,99** | **19,016** | $19{,}044_{<adv.>} \Rightarrow 19{,}025$ rec. |
| Standard deviation $^a\sigma$ [mN/m] | ±0,019 | ±0,020 | ±0 |
| Linear regression, slope [mPa] | 0,005 | 0,002 | 0 |
| correlation coefficient $r^2$ | 0,68 | 0,32 | 1,0 |
| Relative wettability, $B_{\%,s}$ | 101,4% | 101,5% | |

*¬ Diagramm 2.3: 'Triple-line Force²' static forces at the triple line, $\bar{v}_z$=0,047 mm/s*




- Das Diagramm zeigt den Verlauf der Adhäsionsenergie $^{a}E$ entlang der Probenoberfläche. Den Messwerte werden bei unbewegtem Pegel des Fluids am Probekörper als statische Gleichgewichtszustände bestimmt. Die roten ∇-Markierungen stehen für adv.-Messwerte (Eintauchen; von links nach rechts aufgezeichnet), grüne Δ-Markierungen gehören zu rec.-Werten (Rückzugsbewegung; von rechts nach links laufend). Die Oberflächenspannung von Isooktan 99.5+% ist als grau gestrichelte Horizontale bei 18,73 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 Kupfer übersteigt die Oberflächenspannung. Diese *Überbenetzung* (*Superwetting*) ist gekennzeichnet durch die *Kontaktwinkelproblematik*, weil formal $cos(\Theta)>1$ vorliegt. Insofern 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* - steigern und das Geschehen verändern könnten.

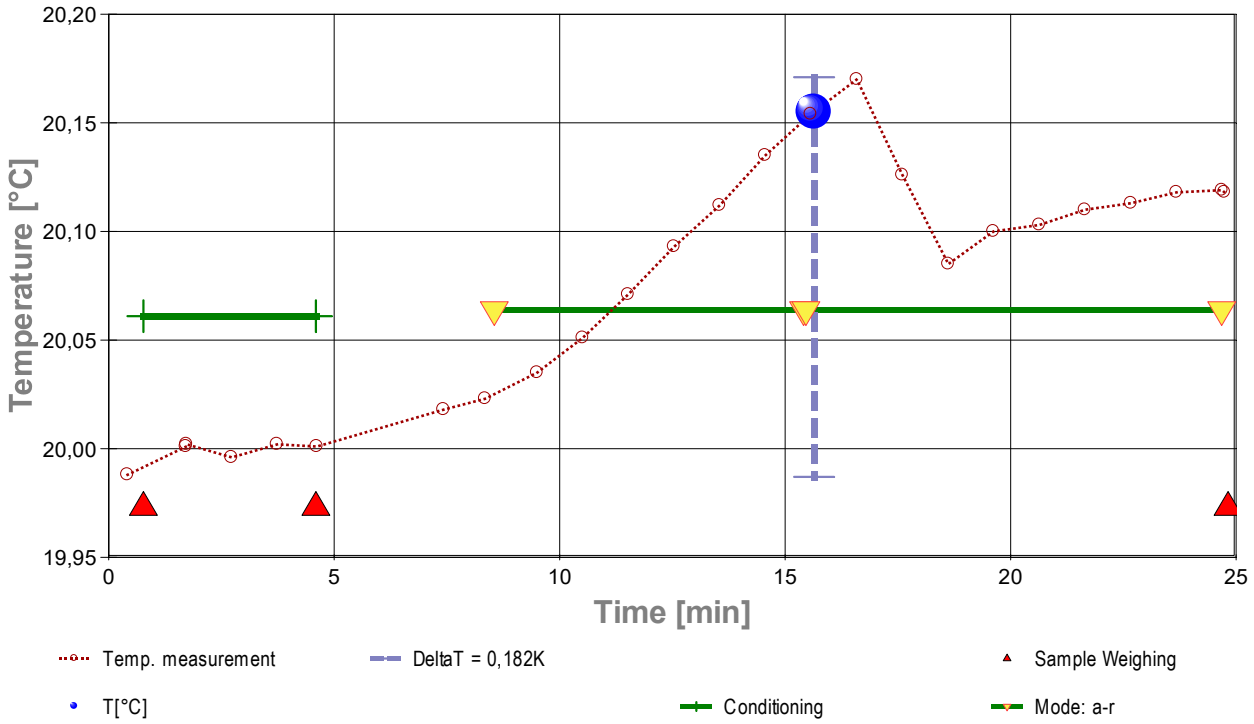
## 4. ===== Details on the Measurement and Setup ======

**Sample:** *'Kupfer'*, **Form:** cubic plate, face dimension 25,5 x 0,684 mm.
**Test Liquid:** *'Isooktan 99.5+%'* at 20,155°C: density 0,69178 g/mL, surface tension 18,73 mN/m, viscosity 0,4951 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 ∞ by *CLT*. - *The 'CLT' Constant-Level-Technic prevents rising/falling of the Isooktan 99.5+%-level in the vessel (surface 1452mm²) through immersion/emersion of the sample volume in the vessel by appropriate pumping of Isooktan 99.5+%.*

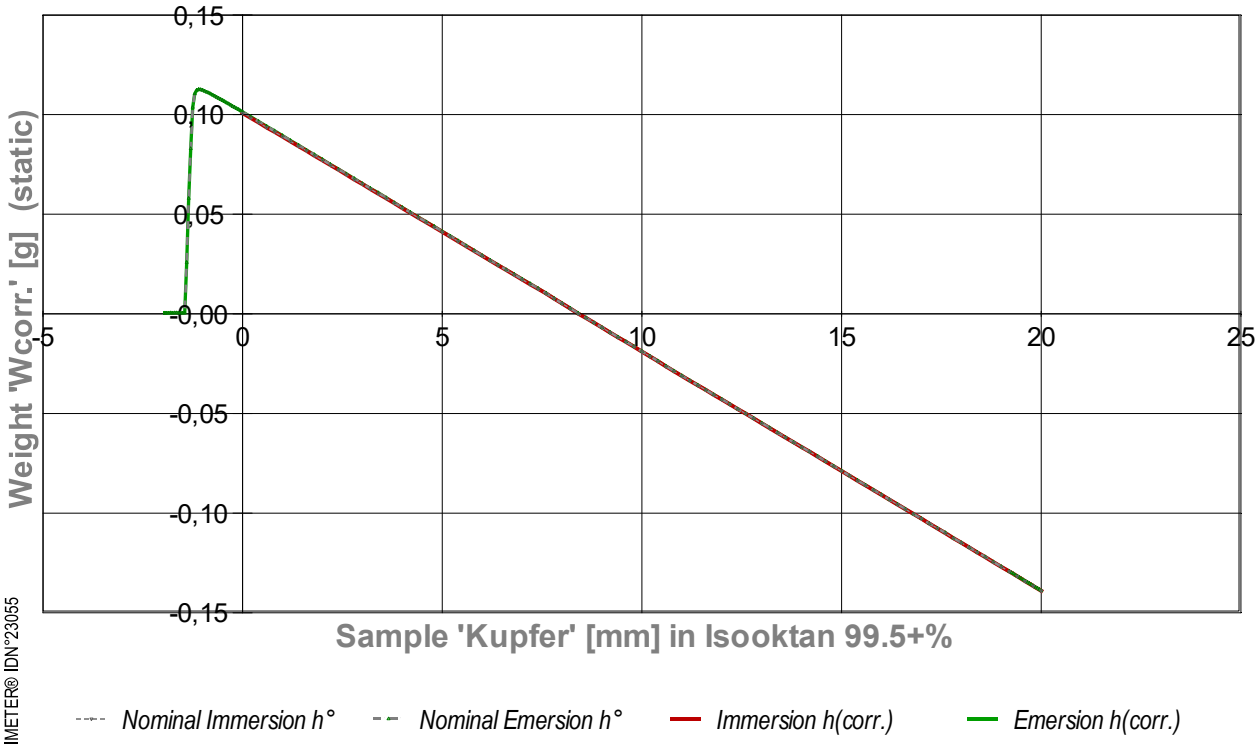
**Conditioning:** during 3,3 min in the measuring cell above the surface of the liquid.
**Sample Weight:** at start 6,6490 g, after conditioning 6,6487 g, after the measurement 6,6490 g.
*Loss in weight* during conditioning -0,0003 g (-45 ppm).
**Measurement algorithm:** static CA-measurement, acquisition of equilibrated values, stepwise movement. Maximum immersion of 20,001 mm and force equilibration at the inflection point for 3,7 s. Duration for immersion 6,9 min, for emersion 2,0 min.

**Time & Temperature:** 20 Minuten; Temperaturänderung im Bereich von 19,99 bis 20,17°C. ¬ *Diagramm 3.4: 'Temperature & Events²' -- Survey on Temperature and Time*




- Das Diagramm "Temperature & Events²" 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 (20,155°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 jweiliger Messmodi ('a-r' bedeutet *Advancing-* - und *Receding*-Bewegung). Die roten Dreiecke, unten im Diagramm, markieren die Zeitpunkte der Probenwägung von Kupfer (ohne Kontakt zur Fluidoberfläche).

¬ *Diagramm 4.4: 'RawData²' -- Acquired weights during immersion and emersion (raw data and immersion corrected lengths)*

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- Im Diagramm "RawData²" werden die Wägewerte zur statischen 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.
Weiterhin zeigt das Diagramm noch Werte zu *negativen Eintauchtiefen*. Diese Wertepaare gehören der *Kapillarbrücke (cb = capillary bridge)* an, die sich beim Herausziehen der Probe über das Flüssigkeitsniveau deutlich ausbilden kann; besonders, wenn das Probenende scharfkantig ist.

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

The table below provides the data for each contact angle measuring position in this experiment (*n*=237). - Within a row the column ***t*** lists the time of the CA-measurement. $t_{eq.}$ is the duration reach the equilibrated force after positioning (static measurement). 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*. With $W_{RAW}$ the stabilized total weight of the sample, sample holder, wetting force and buoyancy is printed. The $W_{corr.}$-values* are former weighing values when the weight of the sample and its holder is

subtracted. After buoyancy- correction, $^{a}F$ is the force excerted on the triple line. The Energy of Adhesion $^{a}E_{A,R} = {}^{a}F/p$ 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 **a**dvancing resp. **r**eceding state; **cb** tags values of a '**c**apillary **b**ridge' above the surface-level.

*(Resolving static force of wetting from $^{a}F = (W_{Raw}\text{-}W_0\text{-}W_{Buoy.})\cdot g + F_{Buoy.air}$)* *$^{*}W_{corr.} = W_{Raw}\text{-}W_0$ (with $W_0$= 6,6487 g).*

*Tabelle 3.5: Data table*

| N° | $t$ [min] | $t_{eq.}$ [sec] | $h_0$ [mm] | $h_{corr.}$ [mm] | $W_{RAW}$ [g] | $W_{corr.}$ [g] | $^{a}F$ [mN] | $^{a}E_{A,R}$ [mN/m] | $\Theta$ [°deg] | chr -- |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 0,00 | 4,2 | 0,000 | 0,000 | 6,7494 | 0,1007 | 0,9879 | 18,87 | 0 | a |
| 2. | 0,09 | 2,6 | 0,200 | 0,200 | 6,7470 | 0,0983 | 0,9880 | 18,87 | 0 | a |
| 3. | 0,14 | 3,0 | 0,400 | 0,400 | 6,7447 | 0,0960 | 0,9890 | 18,89 | 0 | a |
| 4. | 0,21 | 2,9 | 0,600 | 0,600 | 6,7422 | 0,0935 | 0,9881 | 18,87 | 0 | a |
| 5. | 0,27 | 5,4 | 0,800 | 0,800 | 6,7400 | 0,0913 | 0,9901 | 18,91 | 0 | a |
| 6. | 0,38 | 3,8 | 1,000 | 1,000 | 6,7376 | 0,0889 | 0,9902 | 18,91 | 0 | a |
| 7. | 0,46 | 3,0 | 1,200 | 1,200 | 6,7352 | 0,0865 | 0,9902 | 18,91 | 0 | a |
| 8. | 0,52 | 3,0 | 1,400 | 1,400 | 6,7328 | 0,0841 | 0,9903 | 18,91 | 0 | a |
| 9. | 0,59 | 3,4 | 1,600 | 1,600 | 6,7305 | 0,0818 | 0,9913 | 18,93 | 0 | a |
| 10. | 0,66 | 4,3 | 1,800 | 1,800 | 6,7280 | 0,0793 | 0,9904 | 18,91 | 0 | a |
| **11.** | **0,75** | **3,0** | **2,000** | **2,000** | **6,7257** | **0,0770** | **0,9914** | **18,93** | **0** | **a** |
| **12.** | **0,81** | **3,0** | **2,200** | **2,200** | **6,7233** | **0,0746** | **0,9915** | **18,93** | **0** | **a** |
| **13.** | **0,88** | **4,1** | **2,400** | **2,400** | **6,7210** | **0,0723** | **0,9925** | **18,95** | **0** | **a** |
| **14.** | **0,96** | **3,0** | **2,600** | **2,600** | **6,7185** | **0,0698** | **0,9916** | **18,93** | **0** | **a** |
| **15.** | **1,04** | **3,0** | **2,800** | **2,800** | **6,7160** | **0,0673** | **0,9907** | **18,92** | **0** | **a** |
| **16.** | **1,10** | **3,0** | **3,000** | **3,000** | **6,7138** | **0,0651** | **0,9927** | **18,96** | **0** | **a** |
| **17.** | **1,16** | **3,0** | **3,200** | **3,200** | **6,7113** | **0,0626** | **0,9917** | **18,94** | **0** | **a** |
| **18.** | **1,23** | **3,0** | **3,400** | **3,400** | **6,7089** | **0,0602** | **0,9918** | **18,94** | **0** | **a** |
| **19.** | **1,29** | **2,5** | **3,600** | **3,600** | **6,7066** | **0,0579** | **0,9928** | **18,96** | **0** | **a** |
| **20.** | **1,35** | **3,0** | **3,800** | **3,800** | **6,7042** | **0,0555** | **0,9929** | **18,96** | **0** | **a** |
| **21.** | **1,42** | **3,4** | **4,000** | **4,000** | **6,7017** | **0,0530** | **0,9920** | **18,94** | **0** | **a** |
| **22.** | **1,49** | **3,2** | **4,200** | **4,200** | **6,6993** | **0,0506** | **0,9920** | **18,94** | **0** | **a** |
| **23.** | **1,56** | **3,0** | **4,400** | **4,400** | **6,6969** | **0,0482** | **0,9921** | **18,94** | **0** | **a** |
| **24.** | **1,62** | **2,5** | **4,600** | **4,600** | **6,6946** | **0,0459** | **0,9931** | **18,96** | **0** | **a** |
| **25.** | **1,68** | **2,9** | **4,800** | **4,800** | **6,6922** | **0,0435** | **0,9932** | **18,97** | **0** | **a** |
| **26.** | **1,74** | **3,0** | **5,000** | **5,000** | **6,6898** | **0,0411** | **0,9932** | **18,97** | **0** | **a** |
| **27.** | **1,81** | **2,9** | **5,200** | **5,200** | **6,6874** | **0,0387** | **0,9933** | **18,97** | **0** | **a** |
| **28.** | **1,87** | **3,9** | **5,400** | **5,400** | **6,6850** | **0,0363** | **0,9933** | **18,97** | **0** | **a** |
| **29.** | **1,95** | **3,0** | **5,600** | **5,600** | **6,6826** | **0,0339** | **0,9934** | **18,97** | **0** | **a** |
| **30.** | **2,01** | **3,3** | **5,800** | **5,800** | **6,6802** | **0,0315** | **0,9934** | **18,97** | **0** | **a** |
| **31.** | **2,08** | **2,9** | **6,000** | **6,000** | **6,6778** | **0,0291** | **0,9935** | **18,97** | **0** | **a** |
| **32.** | **2,15** | **3,5** | **6,200** | **6,200** | **6,6754** | **0,0267** | **0,9936** | **18,97** | **0** | **a** |
| **33.** | **2,22** | **3,0** | **6,400** | **6,400** | **6,6730** | **0,0243** | **0,9936** | **18,97** | **0** | **a** |
| **34.** | **2,28** | **2,6** | **6,600** | **6,600** | **6,6707** | **0,0220** | **0,9946** | **18,99** | **0** | **a** |
| **35.** | **2,34** | **3,0** | **6,800** | **6,800** | **6,6683** | **0,0196** | **0,9947** | **18,99** | **0** | **a** |
| **36.** | **2,41** | **6,3** | **7,000** | **7,000** | **6,6659** | **0,0172** | **0,9948** | **19,00** | **0** | **a** |
| **37.** | **2,53** | **3,0** | **7,200** | **7,200** | **6,6635** | **0,0148** | **0,9948** | **19,00** | **0** | **a** |
| **38.** | **2,59** | **2,9** | **7,400** | **7,400** | **6,6612** | **0,0125** | **0,9958** | **19,02** | **0** | **a** |
| **39.** | **2,66** | **2,9** | **7,600** | **7,600** | **6,6589** | **0,0102** | **0,9969** | **19,04** | **0** | **a** |
| **40.** | **2,72** | **3,0** | **7,800** | **7,800** | **6,6563** | **0,0076** | **0,9950** | **19,00** | **0** | **a** |
| **41.** | **2,78** | **3,0** | **8,000** | **8,000** | **6,6539** | **0,0052** | **0,9950** | **19,00** | **0** | **a** |
| **42.** | **2,85** | **3,0** | **8,200** | **8,200** | **6,6514** | **0,0027** | **0,9941** | **18,98** | **0** | **a** |
| **43.** | **2,91** | **3,5** | **8,400** | **8,400** | **6,6488** | **0,0001** | **0,9922** | **18,95** | **0** | **a** |
| **44.** | **2,98** | **4,5** | **8,600** | **8,600** | **6,6466** | **-0,0021** | **0,9942** | **18,98** | **0** | **a** |
| **45.** | **3,07** | **3,9** | **8,800** | **8,800** | **6,6442** | **-0,0045** | **0,9943** | **18,99** | **0** | **a** |
| **46.** | **3,15** | **2,5** | **9,000** | **9,000** | **6,6418** | **-0,0069** | **0,9943** | **18,99** | **0** | **a** |
| **47.** | **3,21** | **3,0** | **9,200** | **9,200** | **6,6393** | **-0,0094** | **0,9934** | **18,97** | **0** | **a** |
| **48.** | **3,28** | **3,0** | **9,400** | **9,400** | **6,6369** | **-0,0118** | **0,9934** | **18,97** | **0** | **a** |
| **49.** | **3,34** | **3,0** | **9,600** | **9,600** | **6,6346** | **-0,0141** | **0,9945** | **18,99** | **0** | **a** |
| **50.** | **3,41** | **2,9** | **9,800** | **9,800** | **6,6322** | **-0,0165** | **0,9945** | **18,99** | **0** | **a** |
| **51.** | **3,47** | **3,4** | **10,000** | **10,000** | **6,6297** | **-0,0190** | **0,9936** | **18,97** | **0** | **a** |
| **52.** | **3,54** | **3,1** | **10,200** | **10,200** | **6,6273** | **-0,0214** | **0,9937** | **18,97** | **0** | **a** |
| **53.** | **3,61** | **3,4** | **10,400** | **10,400** | **6,6249** | **-0,0238** | **0,9937** | **18,98** | **0** | **a** |
| **54.** | **3,68** | **2,6** | **10,600** | **10,600** | **6,6223** | **-0,0264** | **0,9918** | **18,94** | **0** | **a** |
| **55.** | **3,74** | **2,9** | **10,800** | **10,800** | **6,6199** | **-0,0288** | **0,9919** | **18,94** | **0** | **a** |
| **56.** | **3,80** | **3,4** | **11,000** | **11,000** | **6,6175** | **-0,0312** | **0,9919** | **18,94** | **0** | **a** |
| **57.** | **3,88** | **3,0** | **11,200** | **11,200** | **6,6151** | **-0,0336** | **0,9920** | **18,94** | **0** | **a** |
| **58.** | **3,94** | **3,0** | **11,400** | **11,400** | **6,6128** | **-0,0359** | **0,9930** | **18,96** | **0** | **a** |
| **59.** | **4,00** | **3,5** | **11,600** | **11,600** | **6,6105** | **-0,0382** | **0,9940** | **18,98** | **0** | **a** |
| **60.** | **4,08** | **2,6** | **11,800** | **11,800** | **6,6080** | **-0,0407** | **0,9931** | **18,96** | **0** | **a** |
| **61.** | **4,14** | **3,0** | **12,000** | **12,000** | **6,6057** | **-0,0430** | **0,9942** | **18,98** | **0** | **a** |
| **62.** | **4,20** | **3,0** | **12,200** | **12,200** | **6,6033** | **-0,0454** | **0,9942** | **18,99** | **0** | **a** |
| **63.** | **4,27** | **3,1** | **12,400** | **12,400** | **6,6009** | **-0,0478** | **0,9943** | **18,99** | **0** | **a** |
| **64.** | **4,33** | **3,0** | **12,600** | **12,600** | **6,5986** | **-0,0501** | **0,9953** | **19,01** | **0** | **a** |
| **65.** | **4,40** | **3,4** | **12,800** | **12,800** | **6,5962** | **-0,0525** | **0,9954** | **19,01** | **0** | **a** |
| **66.** | **4,47** | **3,0** | **13,000** | **13,000** | **6,5937** | **-0,0550** | **0,9944** | **18,99** | **0** | **a** |
| **67.** | **4,53** | **2,6** | **13,200** | **13,200** | **6,5913** | **-0,0574** | **0,9945** | **18,99** | **0** | **a** |
| **68.** | **4,59** | **4,4** | **13,400** | **13,400** | **6,5889** | **-0,0598** | **0,9945** | **18,99** | **0** | **a** |
| **69.** | **4,68** | **2,9** | **13,600** | **13,600** | **6,5865** | **-0,0622** | **0,9946** | **18,99** | **0** | **a** |
| **70.** | **4,74** | **2,5** | **13,800** | **13,800** | **6,5842** | **-0,0645** | **0,9956** | **19,01** | **0** | **a** |
| **71.** | **4,80** | **2,9** | **14,000** | **14,000** | **6,5818** | **-0,0669** | **0,9957** | **19,01** | **0** | **a** |
| **72.** | **4,86** | **3,0** | **14,200** | **14,200** | **6,5795** | **-0,0692** | **0,9967** | **19,03** | **0** | **a** |
| **73.** | **4,93** | **3,4** | **14,400** | **14,400** | **6,5770** | **-0,0717** | **0,9958** | **19,02** | **0** | **a** |
| **74.** | **5,00** | **2,9** | **14,600** | **14,600** | **6,5746** | **-0,0741** | **0,9958** | **19,02** | **0** | **a** |
| **75.** | **5,06** | **3,5** | **14,800** | **14,800** | **6,5722** | **-0,0765** | **0,9959** | **19,02** | **0** | **a** |
| **76.** | **5,14** | **3,0** | **15,000** | **15,000** | **6,5698** | **-0,0789** | **0,9960** | **19,02** | **0** | **a** |
| **77.** | **5,20** | **3,4** | **15,200** | **15,200** | **6,5674** | **-0,0813** | **0,9960** | **19,02** | **0** | **a** |
| **78.** | **5,27** | **3,0** | **15,400** | **15,400** | **6,5649** | **-0,0838** | **0,9951** | **19,00** | **0** | **a** |
| **79.** | **5,34** | **3,4** | **15,600** | **15,600** | **6,5626** | **-0,0861** | **0,9961** | **19,02** | **0** | **a** |
| **80.** | **5,41** | **2,5** | **15,800** | **15,800** | **6,5602** | **-0,0885** | **0,9962** | **19,02** | **0** | **a** |
| **81.** | **5,47** | **3,0** | **16,000** | **16,000** | **6,5578** | **-0,0909** | **0,9962** | **19,02** | **0** | **a** |
| **82.** | **5,53** | **4,9** | **16,200** | **16,200** | **6,5554** | **-0,0933** | **0,9963** | **19,02** | **0** | **a** |
| **83.** | **5,63** | **3,0** | **16,400** | **16,400** | **6,5530** | **-0,0957** | **0,9963** | **19,03** | **0** | **a** |
| **84.** | **5,69** | **2,9** | **16,600** | **16,600** | **6,5506** | **-0,0981** | **0,9964** | **19,03** | **0** | **a** |
| **85.** | **5,76** | **4,0** | **16,800** | **16,800** | **6,5483** | **-0,1004** | **0,9974** | **19,05** | **0** | **a** |
| **86.** | **5,84** | **3,4** | **17,000** | **17,000** | **6,5459** | **-0,1028** | **0,9975** | **19,05** | **0** | **a** |
| **87.** | **5,91** | **2,5** | **17,200** | **17,200** | **6,5434** | **-0,1053** | **0,9966** | **19,03** | **0** | **a** |
| **88.** | **5,97** | **3,0** | **17,400** | **17,400** | **6,5410** | **-0,1077** | **0,9966** | **19,03** | **0** | **a** |
| **89.** | **6,03** | **4,9** | **17,600** | **17,600** | **6,5386** | **-0,1101** | **0,9967** | **19,03** | **0** | **a** |
| **90.** | **6,13** | **3,0** | **17,800** | **17,800** | **6,5361** | **-0,1126** | **0,9957** | **19,01** | **0** | **a** |
| **91.** | **6,19** | **3,1** | **18,000** | **18,000** | **6,5338** | **-0,1149** | **0,9968** | **19,03** | **0** | **a** |
| **92.** | **6,26** | **2,9** | **18,200** | **18,200** | **6,5314** | **-0,1173** | **0,9968** | **19,04** | **0** | **a** |
| **93.** | **6,32** | **3,0** | **18,400** | **18,400** | **6,5289** | **-0,1198** | **0,9959** | **19,02** | **0** | **a** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **94.** | **6,39** | **3,0** | **18,600** | **18,600** | **6,5266** | **-0,1221** | **0,9969** | **19,04** | **0** | **a** |
| **95.** | **6,45** | **3,4** | **18,800** | **18,800** | **6,5241** | **-0,1246** | **0,9960** | **19,02** | **0** | **a** |
| **96.** | **6,52** | **3,0** | **19,000** | **19,000** | **6,5217** | **-0,1270** | **0,9961** | **19,02** | **0** | **a** |
| **97.** | **6,59** | **2,9** | **19,200** | **19,200** | **6,5194** | **-0,1293** | **0,9971** | **19,04** | **0** | **a** |
| **98.** | **6,65** | **5,0** | **19,400** | **19,400** | **6,5170** | **-0,1317** | **0,9972** | **19,04** | **0** | **a** |
| **99.** | **6,75** | **3,0** | **19,601** | **19,601** | **6,5145** | **-0,1342** | **0,9962** | **19,02** | **0** | **a** |
| **100.** | **6,81** | **2,9** | **19,801** | **19,801** | **6,5121** | **-0,1366** | **0,9963** | **19,02** | **0** | **a** |
| **101.** | **6,88** | **3,1** | **20,001** | **20,001** | **6,5097** | **-0,1390** | **0,9963** | **19,03** | **0** | **a** |
| **102.** | **6,94** | **2,5** | **19,951** | **19,951** | **6,5104** | **-0,1383** | **0,9973** | **19,04** | **0** | **r** |
| ***103.*** | ***6,99*** | ***2,6*** | ***19,901*** | ***19,901*** | ***6,5110*** | ***-0,1377*** | ***0,9973*** | ***19,04*** | ***0*** | ***r*** |
| ***104.*** | ***7,04*** | ***2,6*** | ***19,851*** | ***19,851*** | ***6,5115*** | ***-0,1372*** | ***0,9963*** | ***19,03*** | ***0*** | ***r*** |
| **105.** | **7,11** | **3,1** | **19,801** | **19,801** | **6,5122** | **-0,1365** | **0,9973** | **19,04** | **0** | **r** |
| **106.** | **7,17** | **2,6** | **19,751** | **19,751** | **6,5128** | **-0,1359** | **0,9973** | **19,04** | **0** | **r** |
| **107.** | **7,23** | **2,5** | **19,701** | **19,701** | **6,5134** | **-0,1353** | **0,9972** | **19,04** | **0** | **r** |
| **108.** | **7,28** | **4,0** | **19,651** | **19,651** | **6,5140** | **-0,1347** | **0,9972** | **19,04** | **0** | **r** |
| **109.** | **7,36** | **2,6** | **19,601** | **19,601** | **6,5146** | **-0,1341** | **0,9972** | **19,04** | **0** | **r** |
| **110.** | **7,41** | **2,5** | **19,551** | **19,551** | **6,5152** | **-0,1335** | **0,9972** | **19,04** | **0** | **r** |
| **111.** | **7,46** | **2,5** | **19,501** | **19,501** | **6,5158** | **-0,1329** | **0,9972** | **19,04** | **0** | **r** |
| **112.** | **7,51** | **2,5** | **19,451** | **19,451** | **6,5164** | **-0,1323** | **0,9972** | **19,04** | **0** | **r** |
| **113.** | **7,57** | **4,1** | **19,401** | **19,401** | **6,5170** | **-0,1317** | **0,9972** | **19,04** | **0** | **r** |
| **114.** | **7,64** | **2,5** | **19,351** | **19,351** | **6,5176** | **-0,1311** | **0,9972** | **19,04** | **0** | **r** |
| **115.** | **7,70** | **2,5** | **19,301** | **19,301** | **6,5183** | **-0,1304** | **0,9981** | **19,06** | **0** | **r** |
| **116.** | **7,75** | **2,5** | **19,251** | **19,251** | **6,5188** | **-0,1299** | **0,9971** | **19,04** | **0** | **r** |
| **117.** | **7,80** | **2,6** | **19,201** | **19,201** | **6,5194** | **-0,1293** | **0,9971** | **19,04** | **0** | **r** |
| **118.** | **7,86** | **2,6** | **19,001** | **19,001** | **6,5218** | **-0,1269** | **0,9971** | **19,04** | **0** | **r** |
| **119.** | **7,92** | **2,6** | **18,801** | **18,801** | **6,5242** | **-0,1245** | **0,9970** | **19,04** | **0** | **r** |
| **120.** | **7,98** | **2,6** | **18,601** | **18,601** | **6,5267** | **-0,1220** | **0,9979** | **19,06** | **0** | **r** |
| **121.** | **8,04** | **3,0** | **18,401** | **18,401** | **6,5290** | **-0,1197** | **0,9969** | **19,04** | **0** | **r** |
| **122.** | **8,11** | **4,0** | **18,201** | **18,201** | **6,5314** | **-0,1173** | **0,9969** | **19,04** | **0** | **r** |
| **123.** | **8,19** | **3,0** | **18,001** | **18,001** | **6,5338** | **-0,1149** | **0,9968** | **19,03** | **0** | **r** |
| **124.** | **8,25** | **2,5** | **17,801** | **17,801** | **6,5361** | **-0,1126** | **0,9957** | **19,01** | **0** | **r** |
| **125.** | **8,31** | **2,6** | **17,601** | **17,601** | **6,5388** | **-0,1099** | **0,9986** | **19,07** | **0** | **r** |
| **126.** | **8,37** | **2,9** | **17,401** | **17,401** | **6,5411** | **-0,1076** | **0,9976** | **19,05** | **0** | **r** |
| **127.** | **8,43** | **3,0** | **17,201** | **17,201** | **6,5434** | **-0,1053** | **0,9966** | **19,03** | **0** | **r** |
| **128.** | **8,49** | **2,6** | **17,001** | **17,001** | **6,5459** | **-0,1028** | **0,9975** | **19,05** | **0** | **r** |
| **129.** | **8,55** | **2,9** | **16,801** | **16,801** | **6,5482** | **-0,1005** | **0,9965** | **19,03** | **0** | **r** |
| **130.** | **8,62** | **2,6** | **16,601** | **16,601** | **6,5507** | **-0,0980** | **0,9974** | **19,05** | **0** | **r** |
| **131.** | **8,67** | **3,9** | **16,401** | **16,401** | **6,5531** | **-0,0956** | **0,9973** | **19,04** | **0** | **r** |
| **132.** | **8,75** | **3,0** | **16,201** | **16,201** | **6,5554** | **-0,0933** | **0,9963** | **19,02** | **0** | **r** |
| **133.** | **8,82** | **3,0** | **16,001** | **16,001** | **6,5579** | **-0,0908** | **0,9972** | **19,04** | **0** | **r** |
| **134.** | **8,88** | **2,5** | **15,801** | **15,801** | **6,5603** | **-0,0884** | **0,9972** | **19,04** | **0** | **r** |
| **135.** | **8,94** | **3,9** | **15,601** | **15,601** | **6,5627** | **-0,0860** | **0,9971** | **19,04** | **0** | **r** |
| **136.** | **9,02** | **2,6** | **15,401** | **15,401** | **6,5651** | **-0,0836** | **0,9971** | **19,04** | **0** | **r** |
| **137.** | **9,08** | **3,4** | **15,201** | **15,201** | **6,5674** | **-0,0813** | **0,9960** | **19,02** | **0** | **r** |
| **138.** | **9,15** | **2,9** | **15,001** | **15,001** | **6,5699** | **-0,0788** | **0,9970** | **19,04** | **0** | **r** |
| **139.** | **9,21** | **3,0** | **14,801** | **14,801** | **6,5723** | **-0,0764** | **0,9969** | **19,04** | **0** | **r** |
| **140.** | **9,28** | **3,0** | **14,601** | **14,601** | **6,5746** | **-0,0741** | **0,9959** | **19,02** | **0** | **r** |
| **141.** | **9,34** | **2,6** | **14,401** | **14,401** | **6,5772** | **-0,0715** | **0,9978** | **19,05** | **0** | **r** |
| **142.** | **9,40** | **4,1** | **14,201** | **14,201** | **6,5795** | **-0,0692** | **0,9967** | **19,03** | **0** | **r** |
| **143.** | **9,48** | **2,5** | **14,001** | **14,001** | **6,5818** | **-0,0669** | **0,9957** | **19,01** | **0** | **r** |
| **144.** | **9,54** | **2,5** | **13,801** | **13,801** | **6,5842** | **-0,0645** | **0,9956** | **19,01** | **0** | **r** |
| **145.** | **9,60** | **2,5** | **13,600** | **13,600** | **6,5866** | **-0,0621** | **0,9956** | **19,01** | **0** | **r** |
| **146.** | **9,66** | **3,0** | **13,400** | **13,400** | **6,5890** | **-0,0597** | **0,9955** | **19,01** | **0** | **r** |
| **147.** | **9,72** | **3,0** | **13,200** | **13,200** | **6,5915** | **-0,0572** | **0,9965** | **19,03** | **0** | **r** |
| **148.** | **9,79** | **2,5** | **13,000** | **13,000** | **6,5939** | **-0,0548** | **0,9964** | **19,03** | **0** | **r** |
| **149.** | **9,85** | **3,5** | **12,800** | **12,800** | **6,5962** | **-0,0525** | **0,9954** | **19,01** | **0** | **r** |
| **150.** | **9,92** | **5,4** | **12,600** | **12,600** | **6,5986** | **-0,0501** | **0,9953** | **19,01** | **0** | **r** |
| **151.** | **10,02** | **2,6** | **12,400** | **12,400** | **6,6009** | **-0,0478** | **0,9943** | **18,99** | **0** | **r** |
| **152.** | **10,08** | **5,8** | **12,200** | **12,200** | **6,6034** | **-0,0453** | **0,9952** | **19,00** | **0** | **r** |
| **153.** | **10,19** | **3,9** | **12,000** | **12,000** | **6,6058** | **-0,0429** | **0,9951** | **19,00** | **0** | **r** |
| **154.** | **10,27** | **3,0** | **11,800** | **11,800** | **6,6081** | **-0,0406** | **0,9941** | **18,98** | **0** | **r** |
| **155.** | **10,34** | **2,9** | **11,600** | **11,600** | **6,6105** | **-0,0382** | **0,9941** | **18,98** | **0** | **r** |
| **156.** | **10,40** | **2,6** | **11,400** | **11,400** | **6,6129** | **-0,0358** | **0,9940** | **18,98** | **0** | **r** |
| **157.** | **10,46** | **4,0** | **11,200** | **11,200** | **6,6152** | **-0,0335** | **0,9930** | **18,96** | **0** | **r** |
| **158.** | **10,54** | **3,0** | **11,000** | **11,000** | **6,6176** | **-0,0311** | **0,9929** | **18,96** | **0** | **r** |
| **159.** | **10,60** | **3,0** | **10,800** | **10,800** | **6,6200** | **-0,0287** | **0,9929** | **18,96** | **0** | **r** |
| **160.** | **10,67** | **2,5** | **10,600** | **10,600** | **6,6225** | **-0,0262** | **0,9938** | **18,98** | **0** | **r** |
| **161.** | **10,73** | **3,0** | **10,400** | **10,400** | **6,6250** | **-0,0237** | **0,9947** | **18,99** | **0** | **r** |
| **162.** | **10,79** | **2,5** | **10,200** | **10,200** | **6,6274** | **-0,0213** | **0,9947** | **18,99** | **0** | **r** |
| **163.** | **10,85** | **3,0** | **10,000** | **10,000** | **6,6298** | **-0,0189** | **0,9946** | **18,99** | **0** | **r** |
| **164.** | **10,91** | **2,9** | **9,800** | **9,800** | **6,6323** | **-0,0164** | **0,9955** | **19,01** | **0** | **r** |
| **165.** | **10,98** | **2,6** | **9,600** | **9,600** | **6,6347** | **-0,0140** | **0,9955** | **19,01** | **0** | **r** |
| **166.** | **11,03** | **4,5** | **9,400** | **9,400** | **6,6370** | **-0,0117** | **0,9944** | **18,99** | **0** | **r** |
| **167.** | **11,12** | **3,0** | **9,200** | **9,200** | **6,6394** | **-0,0093** | **0,9944** | **18,99** | **0** | **r** |
| **168.** | **11,19** | **3,0** | **9,000** | **9,000** | **6,6418** | **-0,0069** | **0,9943** | **18,99** | **0** | **r** |
| **169.** | **11,25** | **3,6** | **8,800** | **8,800** | **6,6442** | **-0,0045** | **0,9943** | **18,99** | **0** | **r** |
| **170.** | **11,33** | **3,0** | **8,600** | **8,600** | **6,6467** | **-0,0020** | **0,9952** | **19,00** | **0** | **r** |
| **171.** | **11,39** | **2,9** | **8,400** | **8,400** | **6,6490** | **0,0003** | **0,9942** | **18,98** | **0** | **r** |
| **172.** | **11,46** | **4,0** | **8,200** | **8,200** | **6,6515** | **0,0028** | **0,9951** | **19,00** | **0** | **r** |
| **173.** | **11,54** | **2,6** | **8,000** | **8,000** | **6,6539** | **0,0052** | **0,9950** | **19,00** | **0** | **r** |
| **174.** | **11,60** | **3,9** | **7,800** | **7,800** | **6,6564** | **0,0077** | **0,9960** | **19,02** | **0** | **r** |
| **175.** | **11,68** | **3,6** | **7,600** | **7,600** | **6,6590** | **0,0103** | **0,9979** | **19,05** | **0** | **r** |
| **176.** | **11,75** | **3,0** | **7,400** | **7,400** | **6,6614** | **0,0127** | **0,9978** | **19,05** | **0** | **r** |
| **177.** | **11,82** | **2,6** | **7,200** | **7,200** | **6,6638** | **0,0151** | **0,9978** | **19,05** | **0** | **r** |
| **178.** | **11,88** | **3,0** | **7,000** | **7,000** | **6,6661** | **0,0174** | **0,9967** | **19,03** | **0** | **r** |
| **179.** | **11,94** | **3,0** | **6,800** | **6,800** | **6,6685** | **0,0198** | **0,9967** | **19,03** | **0** | **r** |
| **180.** | **12,01** | **2,9** | **6,600** | **6,600** | **6,6708** | **0,0221** | **0,9956** | **19,01** | **0** | **r** |
| **181.** | **12,07** | **4,0** | **6,400** | **6,400** | **6,6732** | **0,0245** | **0,9956** | **19,01** | **0** | **r** |
| **182.** | **12,15** | **3,5** | **6,200** | **6,200** | **6,6755** | **0,0268** | **0,9945** | **18,99** | **0** | **r** |
| **183.** | **12,22** | **3,0** | **6,000** | **6,000** | **6,6779** | **0,0292** | **0,9945** | **18,99** | **0** | **r** |
| **184.** | **12,29** | **2,6** | **5,800** | **5,800** | **6,6804** | **0,0317** | **0,9954** | **19,01** | **0** | **r** |
| **185.** | **12,35** | **3,0** | **5,600** | **5,600** | **6,6828** | **0,0341** | **0,9954** | **19,01** | **0** | **r** |
| **186.** | **12,41** | **3,0** | **5,400** | **5,400** | **6,6853** | **0,0366** | **0,9963** | **19,02** | **0** | **r** |
| **187.** | **12,48** | **2,5** | **5,200** | **5,200** | **6,6877** | **0,0390** | **0,9962** | **19,02** | **0** | **r** |
| **188.** | **12,53** | **3,0** | **5,000** | **5,000** | **6,6900** | **0,0413** | **0,9952** | **19,00** | **0** | **r** |
| **189.** | **12,60** | **3,0** | **4,800** | **4,800** | **6,6925** | **0,0438** | **0,9961** | **19,02** | **0** | **r** |
| **190.** | **12,66** | **2,8** | **4,600** | **4,600** | **6,6948** | **0,0461** | **0,9951** | **19,00** | **0** | **r** |
| **191.** | **12,73** | **3,0** | **4,400** | **4,400** | **6,6972** | **0,0485** | **0,9950** | **19,00** | **0** | **r** |
| **192.** | **12,79** | **3,0** | **4,200** | **4,200** | **6,6996** | **0,0509** | **0,9950** | **19,00** | **0** | **r** |
| **193.** | **12,86** | **2,9** | **4,000** | **4,000** | **6,7020** | **0,0533** | **0,9949** | **19,00** | **0** | **r** |
| **194.** | **12,92** | **3,5** | **3,800** | **3,800** | **6,7044** | **0,0557** | **0,9949** | **19,00** | **0** | **r** |
| **195.** | **12,99** | **3,0** | **3,600** | **3,600** | **6,7069** | **0,0582** | **0,9958** | **19,02** | **0** | **r** |
| **196.** | **13,06** | **2,9** | **3,400** | **3,400** | **6,7094** | **0,0607** | **0,9967** | **19,03** | **0** | **r** |

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|---|---|---|---|---|---|---|---|---|---|---|
| **197.** | **13,12** | **2,5** | **3,200** | **3,200** | **6,7116** | **0,0629** | **0,9947** | **18,99** | **0** | **r** |
| **198.** | **13,19** | **2,5** | **3,000** | **3,000** | **6,7140** | **0,0653** | **0,9946** | **18,99** | **0** | **r** |
| **199.** | **13,25** | **2,6** | **2,800** | **2,800** | **6,7165** | **0,0678** | **0,9956** | **19,01** | **0** | **r** |
| **200.** | **13,31** | **2,9** | **2,600** | **2,600** | **6,7189** | **0,0702** | **0,9955** | **19,01** | **0** | **r** |
| **201.** | **13,37** | **3,9** | **2,400** | **2,400** | **6,7213** | **0,0726** | **0,9955** | **19,01** | **0** | **r** |
| **202.** | **13,45** | **3,0** | **2,200** | **2,200** | **6,7236** | **0,0749** | **0,9944** | **18,99** | **0** | **r** |
| **203.** | **13,52** | **3,0** | **2,000** | **2,000** | **6,7261** | **0,0774** | **0,9954** | **19,01** | **0** | **r** |
| **204.** | **13,58** | **3,4** | **1,800** | **1,800** | **6,7285** | **0,0798** | **0,9953** | **19,01** | **0** | **r** |
| 205. | 13,65 | 2,6 | 1,600 | 1,600 | 6,7308 | 0,0821 | 0,9943 | 18,99 | 0 | r |
| 206. | 13,71 | 3,1 | 1,400 | 1,400 | 6,7333 | 0,0846 | 0,9952 | 19,00 | 0 | r |
| 207. | 13,78 | 3,5 | 1,200 | 1,200 | 6,7356 | 0,0869 | 0,9942 | 18,98 | 0 | r |
| 208. | 13,85 | 3,0 | 1,000 | 1,000 | 6,7381 | 0,0894 | 0,9951 | 19,00 | 0 | r |
| 209. | 13,92 | 2,6 | 0,800 | 0,800 | 6,7405 | 0,0918 | 0,9950 | 19,00 | 0 | r |
| 210. | 13,98 | 3,1 | 0,600 | 0,600 | 6,7428 | 0,0941 | 0,9940 | 18,98 | 0 | r |
| 211. | 14,05 | 3,0 | 0,400 | 0,400 | 6,7452 | 0,0965 | 0,9939 | 18,98 | 0 | r |
| 212. | 14,11 | 2,9 | 0,200 | 0,200 | 6,7476 | 0,0989 | 0,9939 | 18,98 | 0 | r |
| 213. | 14,17 | 2,7 | 0,000 | 0,000 | 6,7500 | 0,1013 | 0,9939 | 18,98 | 0 | r |
| 214. | 14,23 | 1,7 | -0,050 | -0,050 | 6,7506 | 0,1019 | 0,9935 | 18,97 | 0 | cb |
| 215. | 14,28 | 1,6 | -0,100 | -0,100 | 6,7512 | 0,1025 | 0,9939 | 18,98 | 0 | cb |
| 216. | 14,32 | 2,0 | -0,150 | -0,150 | 6,7517 | 0,1030 | 0,9925 | 18,95 | 0 | cb |
| 217. | 14,37 | 1,5 | -0,200 | -0,200 | 6,7523 | 0,1036 | 0,9925 | 18,95 | 0 | cb |
| 218. | 14,41 | 1,5 | -0,250 | -0,250 | 6,7528 | 0,1041 | 0,9915 | 18,93 | 0 | cb |
| 219. | 14,45 | 1,7 | -0,300 | -0,300 | 6,7535 | 0,1048 | 0,9924 | 18,95 | 0 | cb |
| 220. | 14,49 | 1,7 | -0,350 | -0,350 | 6,7541 | 0,1054 | 0,9924 | 18,95 | 0 | cb |
| 221. | 14,53 | 1,6 | -0,400 | -0,400 | 6,7546 | 0,1059 | 0,9914 | 18,93 | 0 | cb |
| 222. | 14,57 | 1,6 | -0,450 | -0,450 | 6,7552 | 0,1065 | 0,9914 | 18,93 | 0 | cb |
| 223. | 14,62 | 1,7 | -0,500 | -0,500 | 6,7558 | 0,1071 | 0,9914 | 18,93 | 0 | cb |
| 224. | 14,66 | 1,7 | -0,550 | -0,550 | 6,7563 | 0,1076 | 0,9903 | 18,91 | 0 | cb |
| 225. | 14,70 | 1,9 | -0,600 | -0,600 | 6,7568 | 0,1081 | 0,9897 | 18,90 | 0 | cb |
| 226. | 14,75 | 1,6 | -0,650 | -0,650 | 6,7574 | 0,1087 | 0,9893 | 18,89 | 0 | cb |
| 227. | 14,79 | 1,7 | -0,700 | -0,700 | 6,7580 | 0,1093 | 0,9893 | 18,89 | 0 | cb |
| 228. | 14,83 | 1,6 | -0,750 | -0,750 | 6,7585 | 0,1098 | 0,9883 | 18,87 | 0 | cb |
| 229. | 14,87 | 3,7 | -0,800 | -0,800 | 6,7591 | 0,1104 | 0,9883 | 18,87 | 0 | cb |
| 230. | 14,95 | 1,9 | -0,850 | -0,850 | 6,7596 | 0,1109 | 0,9873 | 18,85 | 0 | cb |
| 231. | 15,00 | 2,1 | -0,900 | -0,900 | 6,7600 | 0,1113 | 0,9853 | 18,81 | 0 | cb |
| 232. | 15,05 | 2,4 | -0,950 | -0,950 | 6,7604 | 0,1118 | 0,9838 | 18,79 | 0 | cb |
| 233. | 15,10 | 1,6 | -1,000 | -1,000 | 6,7609 | 0,1122 | 0,9823 | 18,76 | 0 | cb |
| 234. | 15,14 | 1,6 | -1,050 | -1,050 | 6,7612 | 0,1125 | 0,9793 | 18,70 | 3,18 | cb |
| 235. | 15,18 | 2,0 | -1,100 | -1,100 | 6,7613 | 0,1126 | 0,9744 | 18,61 | 6,57 | cb |
| 236. | 15,23 | 3,7 | -1,150 | -1,150 | 6,7609 | 0,1122 | 0,9646 | 18,42 | 10,45 | cb |
| 237. | 15,31 | 3,7 | -1,200 | -1,200 | 6,7591 | 0,1104 | 0,9410 | - | 16,38 | cb |

## Meldungen

Die Rückzugs- bzw. Receding- Bewegung ist aus 3 Zügen zusammengesetzt.

***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.*

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# IMPro Execution & Audit-Trail

Data created during execution of the IMPro *"ContactAngle_atConstantLevel, 02.06.23, 104997"*, type 4/4. Time Period of the Accomplishment: Aug., 29. 2023 between 11:46:02 and 12:11:13, elapsed time: 30 minutes. IMPro finished as projected. The complete Report first was presented on Aug., 29.23 at 14:28. Audit-Log: The Original data is unchanged, nevertheless there are entries to the Log, made while the IMPro was executing:

Start of this IMPro 11:54:31, - **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.
ab 8. Wdh mit Entnahme und Abtupfung ....*
**#Wilhelmy-Plate-Sequence (erstes statisch, dann speed-up dyn): 1x stat, dann v=v'*1.5 ... mm/s dyn, Beschl.g = 43 [%]**: Sequ.N° 1/21: _Equi_Time: 0,350s, _Equi_Crit: 0,0001g, _Equi_loops: 5s, _Equi_loopsRepeater: 2 [n]×. Immersion_Depth: 20mm, ConditioningTime: 180s.$v_{8,42}$=147µL,
**Measurement :** CLT STATIC, PumpN°1 [n], Vol. 2,50 [$cm^3$], FüllVolumen 0,5 [$cm^3$], FreiVolumen 2 [$cm^3$], VolBilanz 0,3527, PFlussRate 8,72µL/s, DichteDerFlüssigkeit 0,69189 [$g/cm^3$].

$v_{8,55}$=-3,49µL,$v_{8,61}$=-3,49µL,$v_{8,68}$=-3,49µL,$v_{8,74}$=-3,49µL,$v_{8,85}$=-3,49µL,$v_{8,93}$=-3,49µL,$v_{8,99}$=-3,49µL,$v_{9,06}$=-3,49µL,$v_{9,13}$=-3,49µL,$v_{9,22}$=-3,49µL,$v_{9,28}$=-3,49µL,$v_{9,35}$=-3,49µL,$v_{9,43}$=-3,49µL,$v_{9,51}$=-3,49µL,$v_{9,57}$=-3,49µL,$v_{9,63}$=-3,49µL,$v_{9,70}$=-3,49µL,$v_{9,76}$=-3,49µL,$v_{9,82}$=-3,49µL,$v_{9,89}$=-3,49µL,$v_{9,96}$=-3,49µL,$v_{10,03}$=-3,49µL,$v_{10,09}$=-3,49µL,$v_{10,15}$=-3,49µL,$v_{10,21}$=-3,49µL,$v_{10,28}$=-3,49µL,$v_{10,34}$=-3,49µL,$v_{10,42}$=-3,49µL,$v_{10,48}$=-3,49µL,$v_{10,56}$=-3,49µL,$v_{10,62}$=-3,49µL,$v_{10,69}$=-3,49µL,$v_{10,76}$=-3,49µL,$v_{10,81}$=-3,49µL,$v_{10,88}$=-3,49µL,$v_{11,00}$=-3,49µL,$v_{11,06}$=-3,49µL,$v_{11,13}$=-3,49µL,$v_{11,19}$=-3,49µL,$v_{11,25}$=-3,49µL,$v_{11,32}$=-3,49µL,$v_{11,38}$=-3,49µL,$v_{11,45}$=-3,49µL,$v_{11,54}$=-3,49µL,$v_{11,62}$=-3,49µL,$v_{11,68}$=-3,49µL,$v_{11,75}$=-3,49µL,$v_{11,81}$=-3,49µL,$v_{11,88}$=-3,49µL,$v_{11,94}$=-3,49µL,$v_{12,01}$=-3,49µL,$v_{12,08}$=-3,49µL,$v_{12,15}$=-3,49µL,$v_{12,21}$=-3,49µL,$v_{12,27}$=-3,49µL,$v_{12,35}$=-3,49µL,$v_{12,41}$=-3,49µL,$v_{12,47}$=-3,49µL,$v_{12,55}$=-3,49µL,$v_{12,61}$=-3,49µL,$v_{12,67}$=-3,49µL,$v_{12,74}$=-3,49µL,$v_{12,80}$=-3,49µL,$v_{12,87}$=-3,49µL,$v_{12,94}$=-3,49µL,$v_{13,00}$=-3,49µL,$v_{13,06}$=-3,49µL,$v_{13,15}$=-3,49µL,$v_{13,21}$=-3,49µL,$v_{13,27}$=-3,49µL,$v_{13,33}$=-3,49µL,$v_{13,40}$=-3,49µL,$v_{13,47}$=-3,49µL,$v_{13,53}$=-3,49µL,$v_{13,61}$=-3,49µL,$v_{13,67}$=-3,49µL,$v_{13,74}$=-3,49µL,$v_{13,81}$=-3,49µL,$v_{13,88}$=-3,49µL,$v_{13,94}$=-3,49µL,$v_{14,00}$=-3,49µL,$v_{14,10}$=-3,49µL,$v_{14,16}$=-3,49µL,$v_{14,23}$=-3,49µL,$v_{14,31}$=-3,49µL,$v_{14,38}$=-3,49µL,$v_{14,44}$=-3,49µL,$v_{14,50}$=-3,49µL,$v_{14,60}$=-3,49µL,$v_{14,66}$=-3,49µL,$v_{14,73}$=-3,49µL,$v_{14,79}$=-3,49µL,$v_{14,86}$=-3,49µL,$v_{14,92}$=-3,49µL,$v_{14,99}$=-3,49µL,$v_{15,06}$=-3,49µL,$v_{15,12}$=-3,49µL,$v_{15,22}$=-3,49µL,$v_{15,28}$=-3,49µL,$v_{15,35}$=-3,49µL,$v_{15,41}$=0,872µL,$v_{15,46}$=0,872µL,$v_{15,52}$=0,872µL,$v_{15,59}$=0,872µL,$v_{15,65}$=0,872µL,$v_{15,70}$=0,872µL,$v_{15,76}$=0,872µL,$v_{15,83}$=0,872µL,$v_{15,89}$=0,872µL,$v_{15,94}$=0,872µL,$v_{15,99}$=0,872µL,$v_{16,04}$=0,872µL,$v_{16,12}$=0,872µL,$v_{16,17}$=0,872µL,$v_{16,23}$=0,872µL,$v_{16,28}$=0,872µL,$v_{16,33}$=3,49µL,$v_{16,39}$=3,49µL,$v_{16,45}$=3,49µL,$v_{16,51}$=3,49µL,$v_{16,57}$=3,49µL,$v_{16,66}$=3,49µL,$v_{16,72}$=3,49µL,$v_{16,78}$=3,49µL,$v_{16,84}$=3,49µL,$v_{16,90}$=3,49µL,$v_{16,96}$=3,49µL,$v_{17,02}$=3,49µL,$v_{17,09}$=3,49µL,$v_{17,14}$=3,49µL,$v_{17,22}$=3,49µL,$v_{17,29}$=3,49µL,$v_{17,35}$=3,49µL,$v_{17,41}$=3,49µL,$v_{17,49}$=3,49µL,$v_{17,55}$=3,49µL,$v_{17,62}$=3,49µL,$v_{17,69}$=3,49µL,$v_{17,75}$=3,49µL,$v_{17,81}$=3,49µL,$v_{17,87}$=3,49µL,$v_{17,95}$=3,49µL,$v_{18,01}$=3,49µL,$v_{18,07}$=3,49µL,$v_{18,13}$=3,49µL,$v_{18,19}$=3,49µL,$v_{18,26}$=3,49µL,$v_{18,32}$=3,49µL,$v_{18,39}$=3,49µL,$v_{18,49}$=3,49µL,$v_{18,55}$=3,49µL,$v_{18,66}$=3,49µL,$v_{18,74}$=3,49µL,$v_{18,81}$=3,49µL,$v_{18,87}$=3,49µL,$v_{18,93}$=3,49µL,$v_{19,01}$=3,49µL,$v_{19,07}$=3,49µL,$v_{19,14}$=3,49µL,$v_{19,20}$=3,49µL,$v_{19,26}$=3,49µL,$v_{19,32}$=3,49µL,$v_{19,38}$=3,49µL,$v_{19,45}$=3,49µL,$v_{19,50}$=3,49µL,$v_{19,59}$=3,49µL,$v_{19,66}$=3,49µL,$v_{19,72}$=3,49µL,$v_{19,80}$=3,49µL,$v_{19,87}$=3,49µL,$v_{19,93}$=3,49µL,$v_{20,01}$=3,49µL,$v_{20,07}$=3,49µL,$v_{20,15}$=3,49µL,$v_{20,22}$=3,49µL,$v_{20,29}$=3,49µL,$v_{20,35}$=3,49µL,$v_{20,41}$=3,49µL,$v_{20,48}$=3,49µL,$v_{20,54}$=3,49µL,$v_{20,62}$=3,49µL,$v_{20,69}$=3,49µL,$v_{20,76}$=3,49µL,$v_{20,82}$=3,49µL,$v_{20,88}$=3,49µL,$v_{20,95}$=3,49µL,$v_{21,00}$=3,49µL,$v_{21,07}$=3,49µL,$v_{21,13}$=3,49µL,$v_{21,20}$=3,49µL,$v_{21,26}$=3,49µL,$v_{21,33}$=3,49µL,$v_{21,39}$=3,49µL,$v_{21,46}$=3,49µL,$v_{21,53}$=3,49µL,$v_{21,59}$=3,49µL,$v_{21,66}$=3,49µL,$v_{21,72}$=3,49µL,$v_{21,78}$=3,49µL,$v_{21,84}$=3,49µL,$v_{21,92}$=3,49µL,$v_{21,99}$=3,49µL,$v_{22,05}$=3,49µL,$v_{22,12}$=3,49µL,$v_{22,18}$=3,49µL,$v_{22,25}$=3,49µL,$v_{22,32}$=3,49µL,$v_{22,39}$=3,49µL,$v_{22,45}$=3,49µL,$v_{22,52}$=3,49µL,$v_{22,58}$=3,49µL,$v_{22,64}$=3,49µL,$v_{22,71}$=0,0578µL,$v_{22,75}$=0,809µL,$v_{22,79}$=0,925µL,$v_{22,84}$=0,665µL,$v_{22,88}$=0,867µL,$v_{22,92}$=0,723µL,$v_{22,96}$=1,01µL,$v_{23,01}$=0,867µL,$v_{23,05}$=0,723µL,$v_{23,09}$=0,867µL,$v_{23,13}$=0,867µL,$v_{23,18}$=0,723µL,$v_{23,22}$=0,781µL,$v_{23,27}$=0,809µL,$v_{23,31}$=0,867µL,$v_{23,35}$=0,723µL,$v_{23,42}$=0,867µL,$v_{23,47}$=0,723µL,$v_{23,52}$=0,578µL,$v_{23,58}$=0,65µL,$v_{23,62}$=0,65µL,$v_{23,66}$=0,434µL,$v_{23,71}$=0,145µL,$v_{23,78}$=-0,578µL,$v_{23,86}$=-2,60µL,$v_{23,94}$=-9,83µL,$v_{24,01}$=-29,9µL,$v_{24,09}$=-36,1µL,$v_{24,17}$=-46,5µL,$v_{24,24}$=-36,5µL,$v_{24,28}$=-0,145µL,$v_{24,32}$=0,00µL,$v_{24,37}$=0,00µL,$v_{24,44}$=0,145µL,$v_{24,48}$=0,00µL,$v_{24,52}$=-0,13µL,$v_{24,56}$=0,13µL,$v_{24,61}$=-0,145µL,$v_{24,65}$=0,00µL,$v_{24,70}$=0,00µL,

The Number **23055** refers to the Recordset in the Database ***'imeterData39'*** where all Information can be retrieved at any time.

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## Prüfmittel

Die Kraftmesseinrichtung (WZA224) wurde um 22:09, am Vortag dieser Messung von Augsburg-Lab justiert. Die letzte vollständige Prüfung der Positioniervorrichtung von ***IMETER*** (ID23903733) erfolgte am 01.08.23. Technische Daten: Auflösung des Wägesystems 0,1 mg, Messunsicherheit (Linearität) 0,2 mg, Dichte der Justiermasse $\rho_{cal}$ 8,00 g/cm$^3$, Luftdichte $\rho_{air}$ vgl. Tabelle unten; Schwerebeschleunigung $g$ 9,80769 m/s$^2$. Pt100-Temperaturmessung: Auflösung 0,001 K, Messunsicherheit ±0,01 K, $R°$ 100.0056 Ω, 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 7.4.21, 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$^3$] |
|---|---|---|---|---|
| 0,3 | 51,73 | 25,83 | 95,145 | 1,10137 |

*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 Luftfeuchtewerten berechnet.*

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