

Operating instruction Set for density determination

KERN ALS/PLS-A01

Version 1.5

04/2008

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Version 1.5 04/2008

Operating instruction

**Set for density determination for precision and analytical
balances KERN ALT, KERN PLT, KERN ALS/ALJ, KERN
ALS..N/ALJ..N, KERN PLS/PLJ**

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1 Introduction

When acquiring a density set as accessory for your electronic balance there are 2 models available:

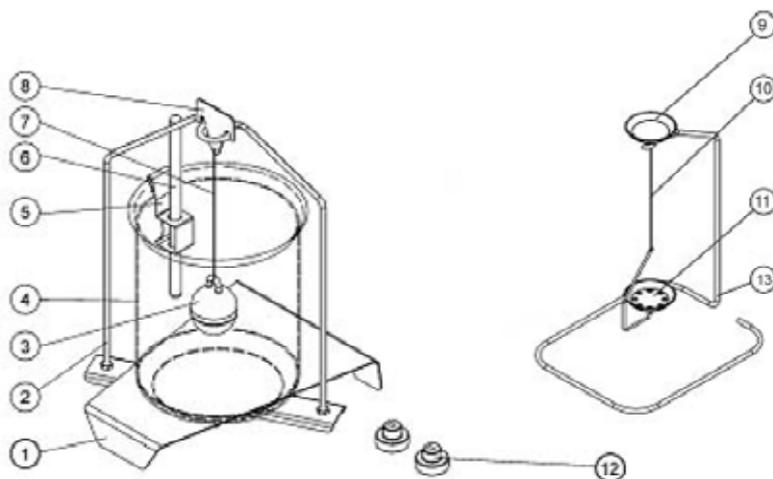
KERN ALS-A01 for analysing balances of the **KERN ALT, KERN ALS/ALJ** and **KERN ALS..N/ALJ..N** series (only suitable for models with readability $d = 0.1$ mg).

KERN PLS-A01 for analysing balances of the **KERN PLS/PLJ** and **KERN PLT** series (only suitable for models with readability $d = 1$ mg).

This manual only describes working with the density determination set. For further information concerning operation of your balance please refer to the operating manual of the respective balance.

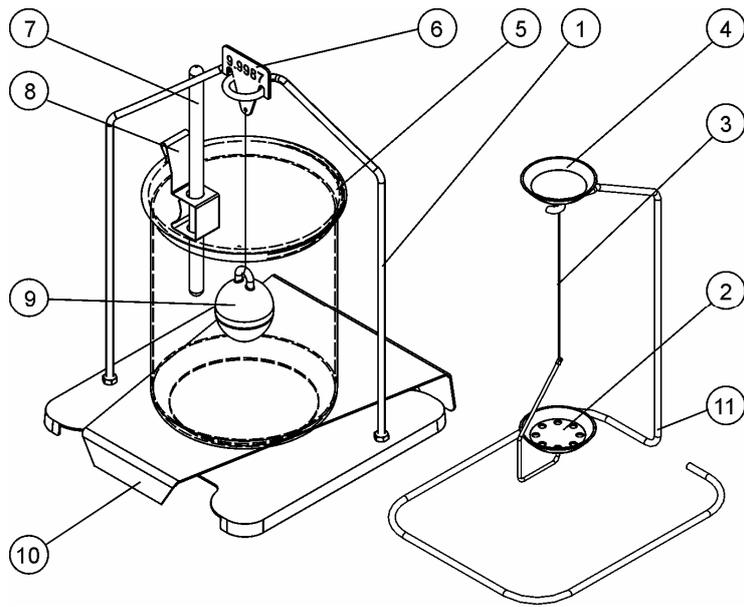
1.1 Scope of delivery

KERN ALS-A01:



No.	Denomination	No.	Denomination
1	Platform for beaker	9	Sample dish
2	Frame	10	Wire
3	Glass sinker	11	Sieve dish
4	Beaker	12	Additional weights (see chap. 5)
5	Holder for thermometer	13	Additional frame (Storage for sample dishes/sinker)
6	Thermometer		Pincers w/o picture
7	Wire		Operating instruction
8	Hook for sinker		

KERN PLS-A01

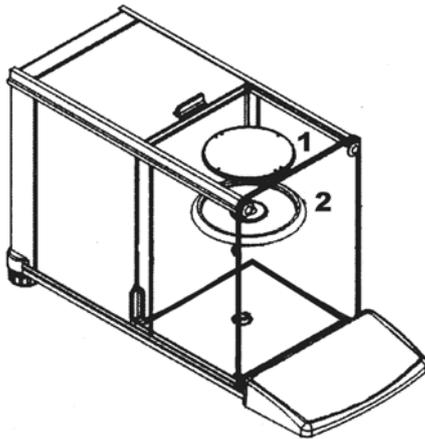


No.	Denomination		
1	Frame	7	Thermometer
2	Sieve dish	8	Holder for thermometer
3	Wire	9	Glass sinker
4	Sample dish	10	Platform for beaker
5	Beaker	11	Additional frame (Storage for sample dishes/sinker)
6	Hook for sinker		Pincers w/o picture
			Operating instruction

2 Installation of density determination set

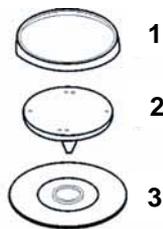
⇒ Remove the following parts from the balance

Model KERN ALT:

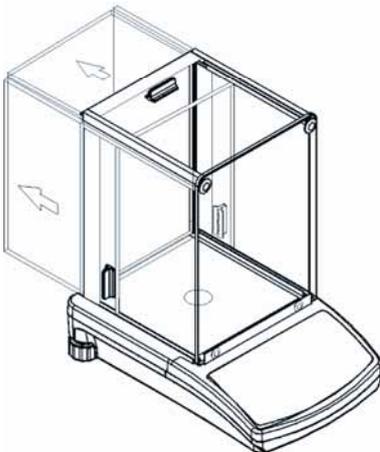


- (1) Weighing plate
- (2) Screening ring

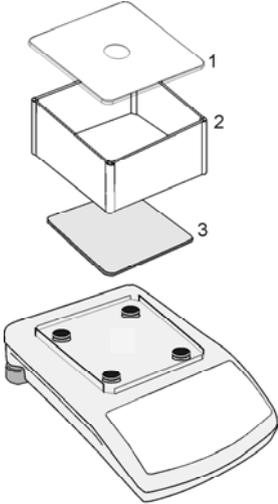
Model KERN ALS/ALJ:



- (1) Weighing plate
- (2) Support for weighing plate
- (3) Screening ring



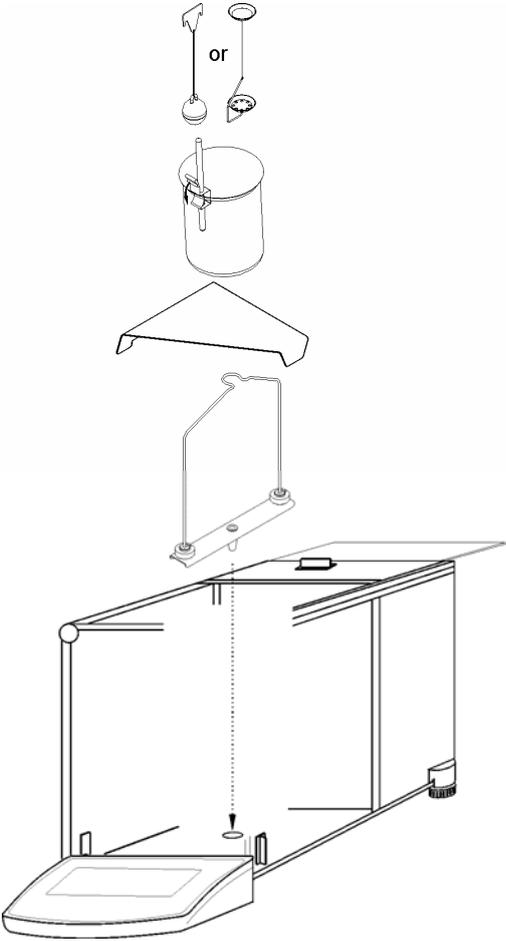
Model KERN PLS/PLJ, PLT:



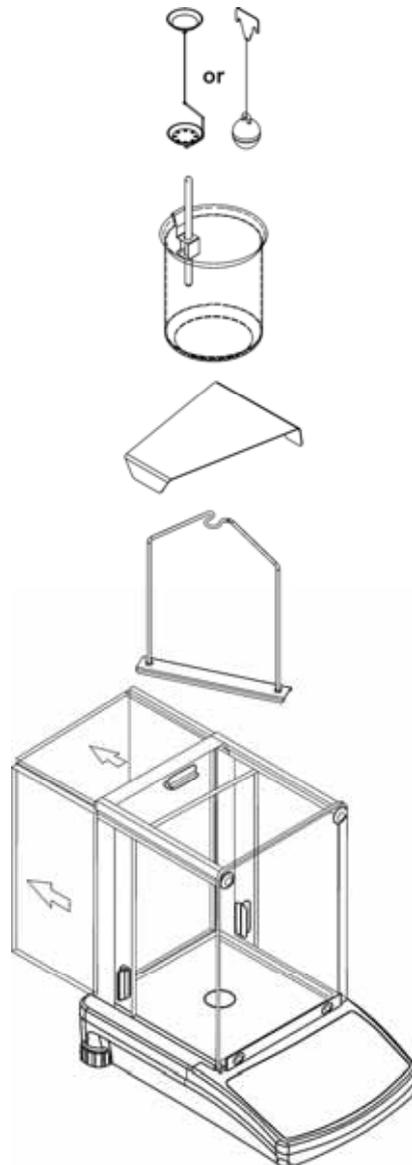
- (1) Windshield cover
- (2) Windshield
- (3) Weighing plate

⇒ Installation of density determination set

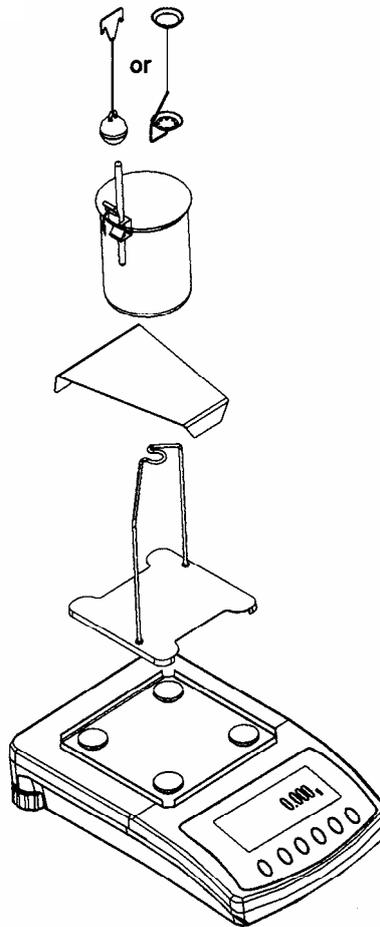
Models KERN ALS/ALJ, KERN ALT: Central 1-point receptacle



Models KERN ALS..N/ALJ..N: Central 1-point receptacle



Models KERN PLS/PLJ, PLT: 4-point receptacle



Attention:

- **The platform for the beaker must not touch the frame!**
- **When the density set is installed, adjustment is not possible. For adjustment, re-install weighing plate.**

3 Principle of density determination

Three physical magnitudes are the **volume** and the **mass** of bodies as well as the **density** of matter. Mass and volume are connected with each other in density:

Density [ρ] is the relation of mass [m] to volume [V].

$$\rho = \frac{m}{V}$$

SI-unit of density is kilogram divided by cubic meter (kg/m^3). 1 kg/m^3 equals the density of a homogenous body that, for a mass of 1 kg, has the volume of 1 m^3 .

Other frequently used units are:

$$1 \frac{\text{g}}{\text{cm}^3}, \quad 1 \frac{\text{kg}}{\text{m}^3}, \quad 1 \frac{\text{g}}{\text{l}}$$

Using our set for density determination in combination with our balances KERN ALS/ALJ/PLS/PLJ, KERN PLT and KERN ALT enables you to determine the density of solids and liquids fast and correctly. Our set uses the "**Principle of Archimedes**" to determine density:

Buoyancy is a force. It affects a body that is immersed in a liquid. A body's buoyancy is as large as the weight of the liquid it displaces. Buoyancy is effective vertically upwards.

Thus, density is calculated according to the following formulas:

For density determination of solids

Our balances enable you to weigh solids in air [A] as well as in water [B]. If the density of the buoyancy medium is known [ρ_0] the density of the solid [ρ] is calculated as follows:

$$\rho = \frac{A}{A-B} \rho_0$$

- ρ = Density of the sample
- A = Weight of the sample in air
- B = Weight of the sample in measuring liquid
- ρ_0 = Density of the measuring liquid

For density determination of liquids

The density of a liquid is determined by using a sinker, whose volume ([V] is known see embossment). The sinker is weighed in air [A], as well as in sample liquid [B].

According to the law of Archimedes, a body that immersed in a liquid is exposed to buoyancy [G]. The absolute value of this force equals the weight of the liquid displaced by the volume of the body.

The volume [V] of the immersed body equals the volume of the displaced liquid.

$$\rho = \frac{G}{V}$$

G = Buoyancy of the sinker

Buoyancy of the sinker =

Weight of the sinker in air [A] - weight sinker in sample liquid [B]

Thus follows:

$$\rho = \frac{A-B}{V} + \rho_L$$

ρ = Density of sample liquid

A = Weight of sinker in air

B = Weight of sinker in sample liquid

V = Volume of the sinker

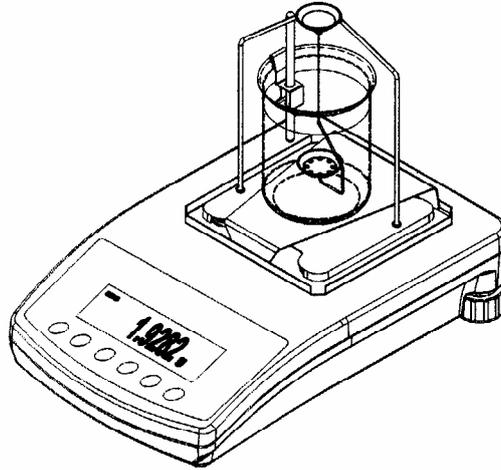
ρ_L = Air density (0.0012 g/cm³)

3.1 Influencing magnitudes and error sources

- ⇒ Air pressure
- ⇒ Temperature
- ⇒ Volume deviance of the sinker ($\pm 0,005 \text{ cm}^3$)
- ⇒ Surface tension of the liquid
- ⇒ Air bubbles
- ⇒ Immersion depth of the sample dish of sinker
- ⇒ Porosity of the solid

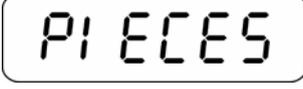
4 Density determination of solids

Prepare balance as in chapter 2 "Installation of density determination set".



- ⇒ Install holder for the thermometer on beaker rim.
- ⇒ Suspend thermometer
- ⇒ Fill your measuring liquid, whose density ρ_0 is known, into the beaker. Filling height should be approx. $\frac{3}{4}$ of the capacity.
- ⇒ Place beaker in the centre of the platform
- ⇒ Suspend sample dishes from the centre of the frame
- ⇒ Heat measuring liquid until temperature is constant.

4.1 Models KERN ALS/ALJ/PLS/PLJ

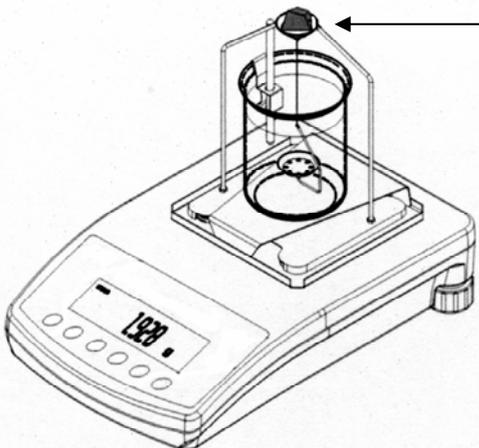
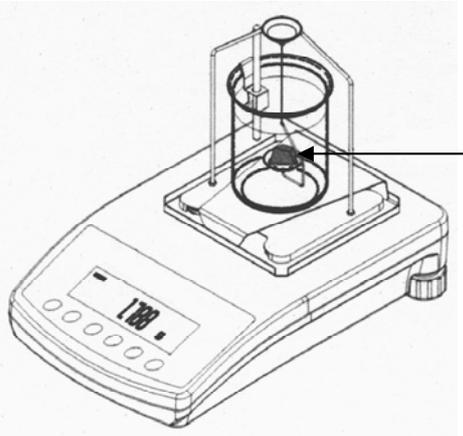
Key	Display	Description
		Turn on balance; balance will carry out self-check.
		Wait until the stability and balance zero-display shows
  	 or 	Menu selection: Press TARE -key; the display shows horizontal lines; while this display is shown, press the F -key. The first function “ Add ” or “ Pieces ” appears.
		Keep the F –key pressed until the density function for solids “ Co ” is displayed.
		Confirm your selection. The balance is now in density determination mode for solids.

Select measuring liquid:		
	<div style="border: 1px solid black; padding: 5px; text-align: center; margin-bottom: 5px;">H2O</div> <div style="border: 1px solid black; padding: 5px; text-align: center; margin-bottom: 5px;">C2H5OH</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">NOTHER</div>	<p>Use the F -button to choose between the following settings:</p> <p>H₂O = Distilled water C₂H₅OH = Ethanol nother = Measuring liquid of your choice, whose density is known</p>
<p>If you selected distilled water or ethanol as measuring liquid, enter the temperature of the measuring liquid in the next menu step.</p>		
	<div style="border: 1px solid black; padding: 5px; text-align: center; margin-bottom: 5px;">H2O</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">TE-L 00</div>	<p>Confirm your selection.</p> <p>Read the temperature of the measuring liquid from the suspended thermometer and then enter it as follows (current number is blinking).</p>
	<div style="border: 1px solid black; padding: 5px; text-align: center;">TE-L 20</div>	<p>Use the F – key to change the value of the number</p>
	<div style="border: 1px solid black; padding: 5px; text-align: center;">TE-L 20</div>	<p>Use the ON/OFF – key to select the place you want to change, the currently active place is blinking</p>
		<p>Confirm your entry.</p>

If you selected “nothEr” as measuring liquid enter the density of your measuring liquid in the next menu step.

	 	<p>Confirm your selection.</p> <p>Enter the density of your measuring liquid (the current number is blinking).</p>
		<p>Use the ON/OFF – key to select the place you want to change, the currently active place is blinking</p>
	 	<p>Use the F – key to change the value of the number</p>
		<p>Confirm your entry.</p>

After entering the parameters for the measuring liquid follow the automatic user interface of the balance.

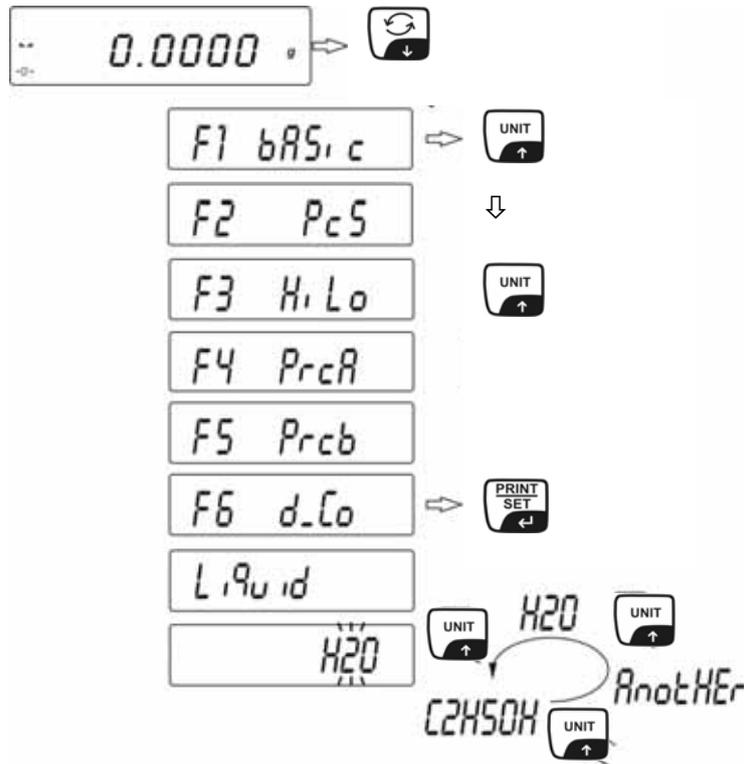
	<p style="text-align: center;">LQADA</p> <p style="text-align: center;">~ 0.000 g →0←</p> 	<p>Place the solid in the upper sample dish</p>
	<p style="text-align: center;">~ 1.928 g</p>	<p>Wait until the weight display of the balance is stable. Actuating the PRINT -key will save the weight of the sample in air.</p>
	<p style="text-align: center;">LQADL</p> <p style="text-align: center;">~ 0.000 g →0←</p> 	<p>The display Load L prompts you to remove the sample from the upper sample dish and to place it into the lower sieve dish. To do this, use the supplied pincers and ensure that there are no air bubbles adhere to the solid.</p>

		<p>Wait until the weight display of the balance is stable. Actuating the PRINT – key will save the weight of the sample in measuring liquid.</p>
		<p>The density of the sample (ρ) is now automatically calculated and shown on the display [g/cm³].</p>
		<p>Data output to the serial interface RS 232. The result is issued in g/cm³.</p>
<p>Remove sample; the measuring result still on display.</p>		
		<p>Use the TARE -key to return to weighing mode.</p>

4.2 Models ALJ..N/ALS..N

Procedure:

- Press key . Pressing **UNITS** key, choose **F6 d_Co**.
- Press **PRINT** to start density function.
- Press **UNITS** key and select liquid in with density will be determined.



Thickness of solids can be tested in one of 3 liquids:

- H₂O (distilled water),
 - C₂H₅OH (spirit 100% +/- 0.1% in temp. 20°C),
 - AnotHEr (another liquid with known thickness).
- After selecting liquid confirm by **PRINT**.
 - If **H₂O** or **C₂H₅OH** are selected the program moves to following step, introducing actual liquid temperature. The information on the display enables to introduce liquid temperature from the thermometer. Enter the temperature using **UNITS** or  key.



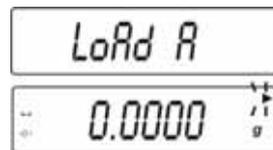
- After adjusting the temperature, press **PRINT** key to confirm it.

If **AnotHEr** liquid was selected after pressing **PRINT** key the program moves to following step when the density of the liquid should be noted. Introduce the density value of this liquid by function key of the balance.

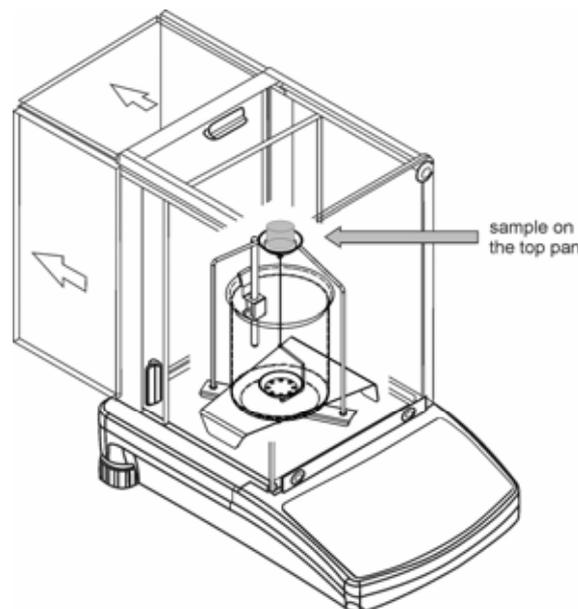


- Press the **UNITS** or  key to change the digit value.
- Press the **F** key to select the digit.
- After adjusting the temperature press **PRINT** key to confirm it.

After writing information about the liquid parameters the balance software moves to following process steps automatically. Commands which inform user that the software is ready to receipt following data (mass of the sample in air and in liquid) necessary to correct counting density of examined sample.

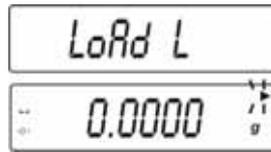


When the balance shows **LOAD A**, then zero, put sample on the top pan. Sample mass in air is presented on the display.

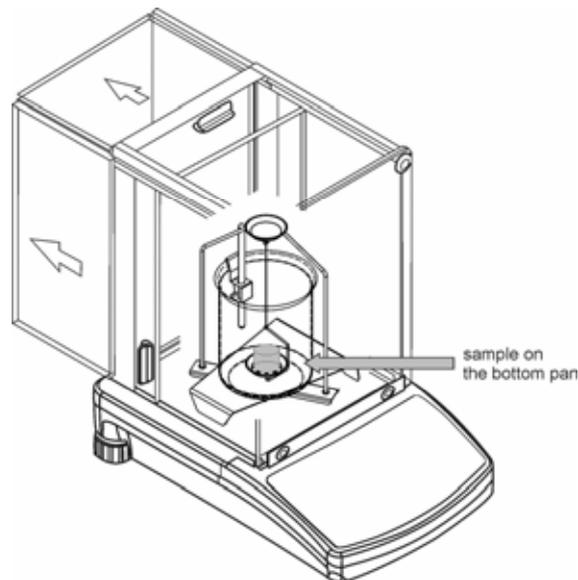


Press the **PRINT** key when the result is stable. This mass is recorded in the balance memory as mass in the air.

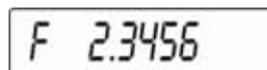
- **LoAd L** appears on the display.



It is order to take a sample off top pan and put it on the bottom pan.



Press the **PRINT** key when the result is stable. This mass is noted in the balance memory as mass in liquid and density of a sample is counted automatic.



Check if there are any air bubbles fastened to a sample. It could cause errors during measurements.

Key function after procedure



printout result of density



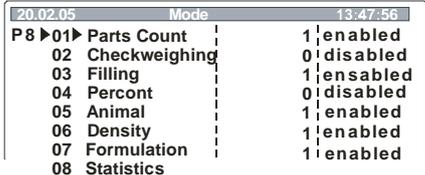
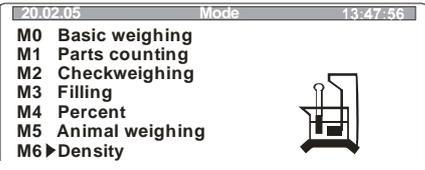
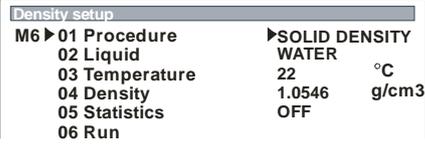
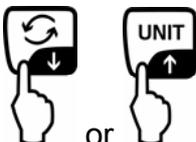
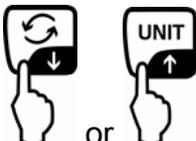
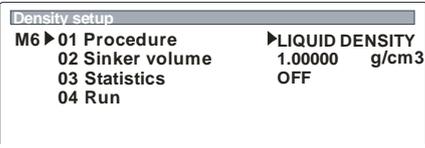
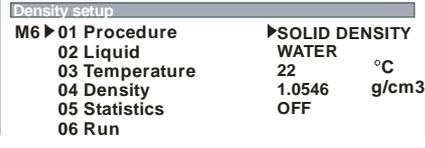
start next procedure of solids density



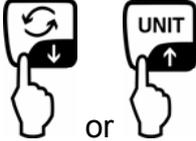
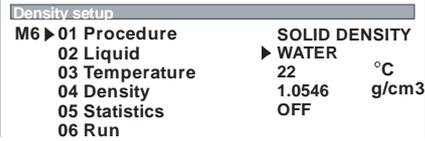
return to menu

The result is presented on the display in [**g/cm³**]. It does not change even when the sample is taken off. Press **F** key to do back to menu.

4.3 Models KERN ALT, PLT

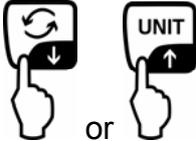
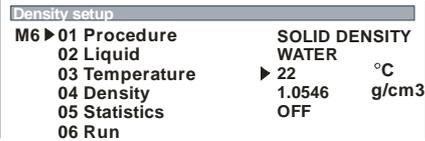
Key	Display	Description
		Activate "Density" in the operation mode menu (see operating instructions Balance)
		Use the cursor (▶) to select menu item "M6 Density"
		The parameter selection is displayed. Here, your parameters for density determination are saved.
		Use the cursor (▶) to select parameter.
Parameter 01 Procedure		
		The current menu item is blinking
		Activate setting for "Solid"
		Confirm your selection. The balance is now in density determination mode for solids.

Parameter 02 Liquid

		<p>The current menu item is blinking</p>
		<p>Select your measuring liquid:</p> <p>Water = Distilled water Alcohol = Ethanol Other = Measuring liquid of your choice whose density is known</p>
		<p>Confirm your selection.</p>

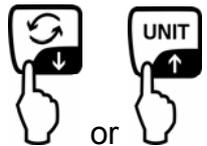
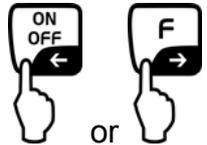
If you selected **distilled water** or **ethanol**, enter the temperature of the measuring liquid in the next menu step:

Parameter 03 Temperature

		<p>The current menu item is blinking</p>
		<p>Read the temperature of the measuring liquid from the suspended thermometer and enter it using the arrow keys (value between 15°C – 35°C)</p>
		<p>Confirm your selection.</p>

If you selected **Other** as measuring liquid enter the density of your measuring liquid (temperature dependent) in the next menu step.

Parameter 04 Density

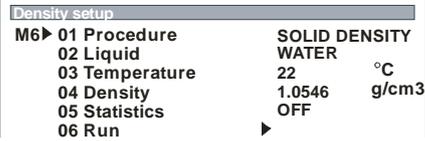
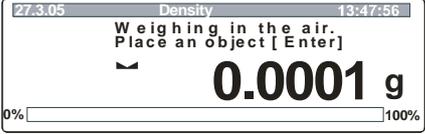
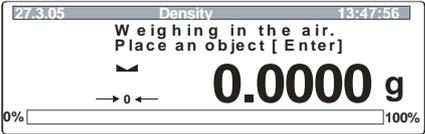
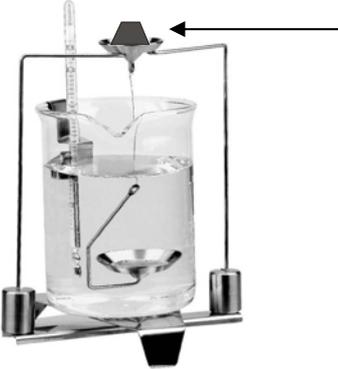
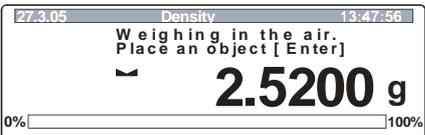
		<p>Enter the density of your measuring liquid (the current menu item is blinking)</p>
		<p>Change the value of the number</p>
		<p>Select the place to be changed, the active place is blinking</p>
		<p>Confirm your selection.</p>

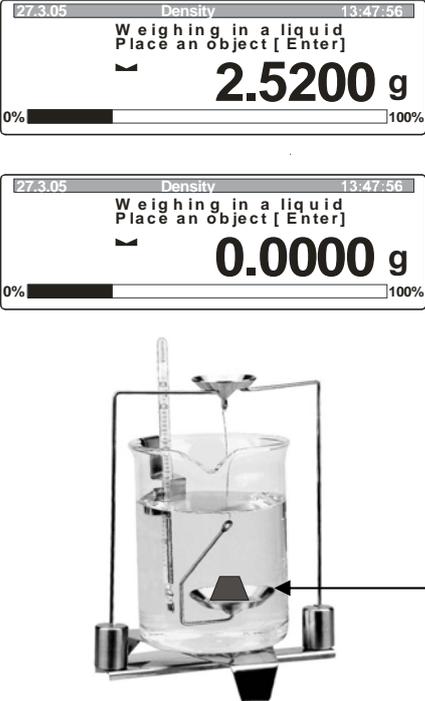
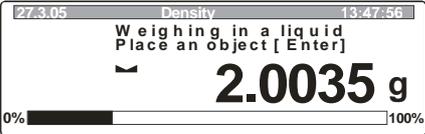
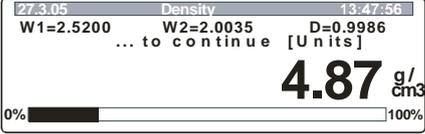
Parameter 05 Statistics

When activating the combination density/statistics, actuating the " **UNIT** -key" will accept the value for the statistics (see operating instructions balance).

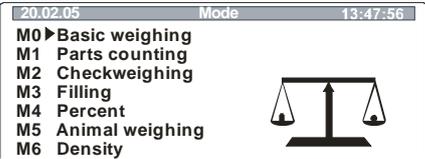
Parameter 06 Run

After entering the parameters, follow the automatic user interface of the balance to determine density.

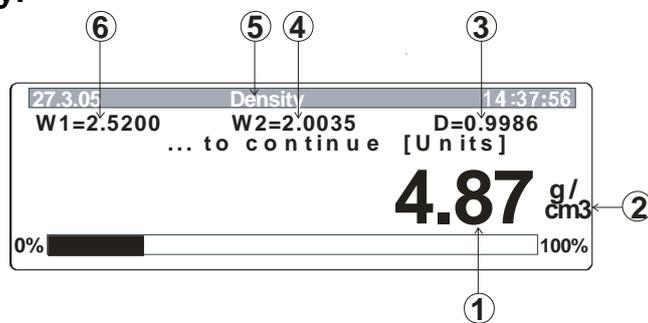
	 	<p>With the parameter selection "06 Run" to get into density determination mode and the graphic display appears.</p>
	 	<p>Wait until the stability and balance-zero display shows.</p> <p>Place the solid into the upper sample dish.</p>
		<p>Wait until the weight display of the balance is stable. Actuating the PRINT-key will save the weight of the sample in air.</p>

		<p>You will be prompted to remove the sample from the upper sample dish and place it into the lower sieve dish.</p> <p>To do this, use the supplied pincers and ensure that there are no air bubbles adhere to the solid.</p>
		<p>Wait until the weight display of the balance is stable. Actuating the PRINT-key will save the weight of the sample in the measuring liquid.</p>
		<p>The density of the sample (ρ) is now automatically calculated and shown on the display [g/cm³].</p>
<p>Remove sample; the measuring result still on display.</p>		
		<p>To start a new measuring cycle, press the UNIT-key.</p>
		<p>Data output to the serial interface RS 232. The result is issued in g/cm³.</p>

Return to weighing mode:

		<p>Cursor (▶) to „M0 Basic weighing“</p>
		

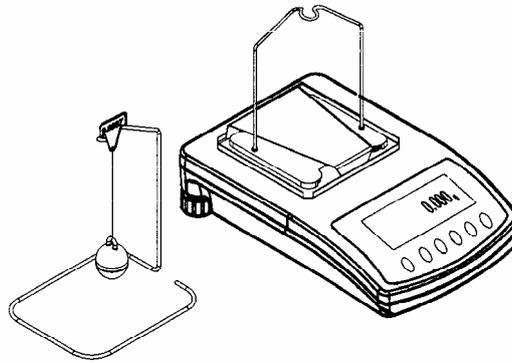
Overview of display:



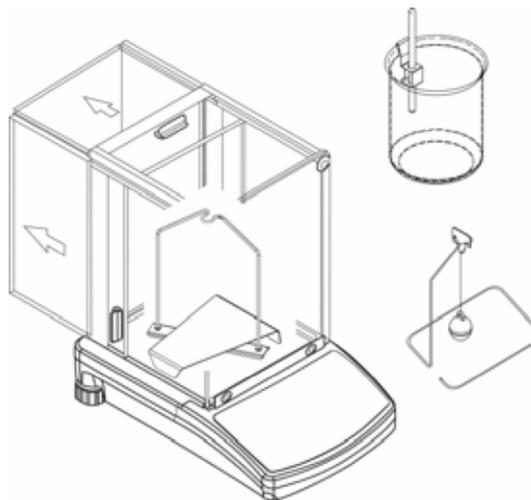
1. Density of the sample (ρ)
2. Measurement unit of the density
3. Dense measuring liquid
4. Weight of the sample in measuring liquid
5. Operating mode (status bar)
6. Weight of the sample in air

5 Density determination of liquids

Prepare balance as described in chapter 2 "Installation of density determination set".



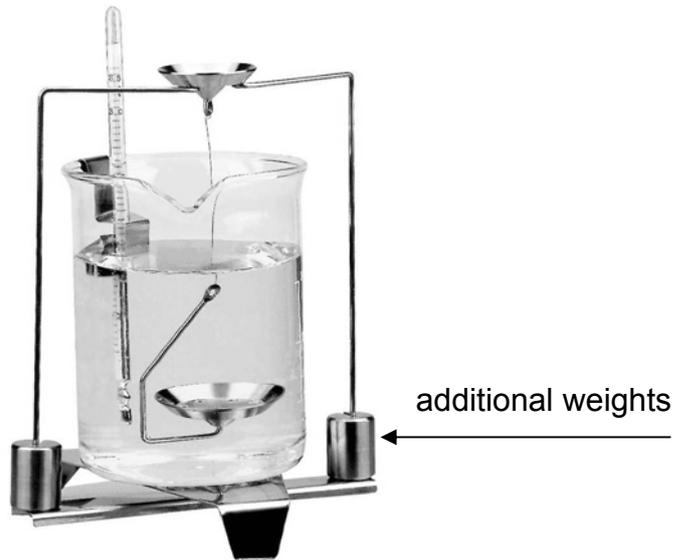
PLS/PLJ



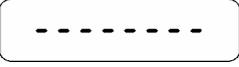
ALS/ALJ

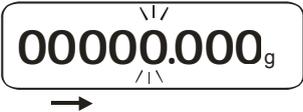
- ⇒ Install holder for the thermometer on beaker rim.
- ⇒ Suspend thermometer
- ⇒ Fill your measuring liquid into the beaker. Filling height should be approx. $\frac{3}{4}$ of the capacity.
- ⇒ Heat measuring liquid until temperature is constant.
- ⇒ Prepare glass sinker

⇒ If the display shows the error message "noKK", mount the additional weights for balancing the removed weighing plate on the side of the frame.

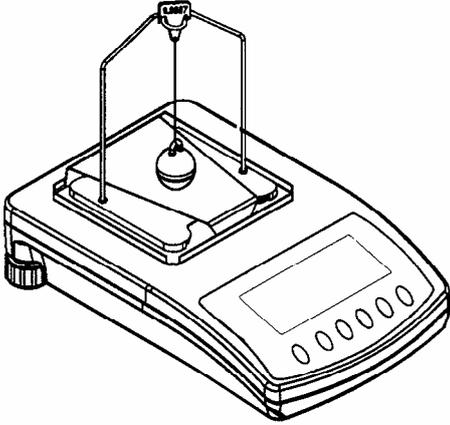


5.1 Models KERN ALS/ALJ/PLS/PLJ

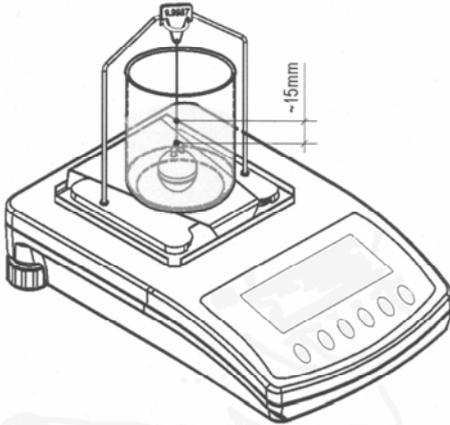
Key	Display	Description
		Turn on balance; balance will carry out self-check.
		Wait until the stability and balance zero-display shows
  		Menu TARE -key; the display shows horizontal lines; while this display is shown, press the F -key. The first function “ Add ” appears.
		Keep the F - key pressed, until the density function for liquids die “ Li ” appears.
		Confirm your selection. The balance is now in density determination mode for liquids. The display vol prompts you to enter the volume of the sinker (see embossment on suspension hook). Enter as many decimal digits as the balance can display.

		For first commissioning, the display will only show zeroes.
		If density determinations have been carried out previously the volume of the sinker last used is displayed.
Enter the volume of the sinker (see embossment on suspension hook, information in cm ³ e.g. 9.9984 cm ³):		
		Use the ON/OFF – key to select the place you want to change, the currently active place is blinking
		Use the F – key to change the value of the number
		Confirm your entry.
		Entry is saved.
		
		Wait until the stability and balance zero-display shows

Determination of the **weight sinker in air**

		<p>Suspend sinker from the centre, Measurement is carried out without beaker</p>
		<p>Wait until the weight display of the balance is stable. Actuating the PRINT – key will save the weight of the sinker in air.</p>

Determination of the **weight sinker in sample liquid**

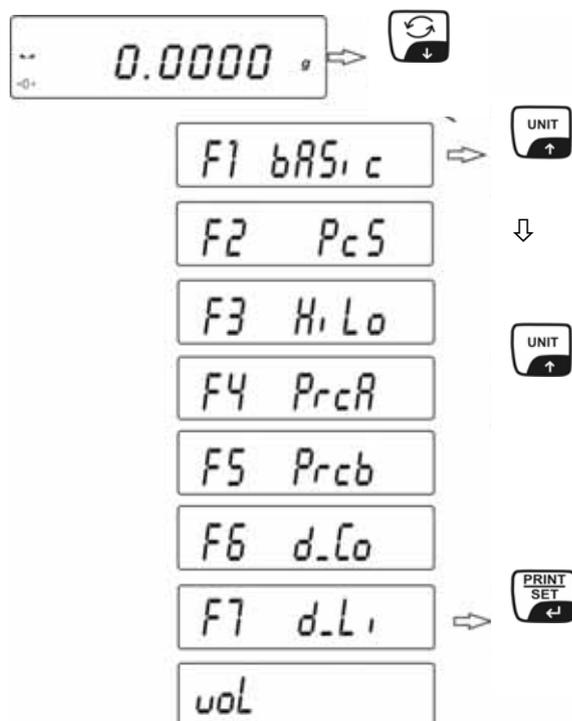
	 	<p>Remove sinker</p> <p>Place beaker with measuring liquid in the centre of the platform. Immerse sinker in measuring liquid and suspend from frame. The measuring liquid should cover the sinker at 10 -15 mm.</p>
--	--	---

		<p>Wait until the weight display of the balance is stable. Actuating the PRINT – key will save the weight of the sinker in the sample liquid.</p>
		<p>The density of the liquid (ρ) is now automatically calculated and shown on the display [g/cm³].</p>
		<p>Data output to the serial interface RS 232. The result is issued in g/cm³.</p>
<p>Remove sample; the measuring result still on display.</p>		
		<p>Use the TARE -key to return to weighing mode.</p>

5.2 Models KERN ALJ..N/ALS..N

Procedure:

- Press key . Pressing **UNITS** key, choose **F7 d_Li**.



- Press **PRINT** to start density function.
- Order to write float capacity **vol** appears on the display.
- The volume of float can be noted with the same accuracy as the balance shows. If actual scale interval is 0.001 g in the balance the volume stamped on the float hook should be noted with accuracy to 3rd place after the decimal point.

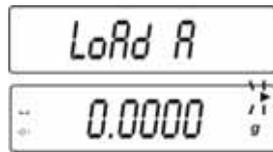
Write the volume of float using the keys:

- Press the  or **UNITS** key to change the digit value.
- Press the **F** key to select the digit.
- Press **PRINT** key to confirm value.

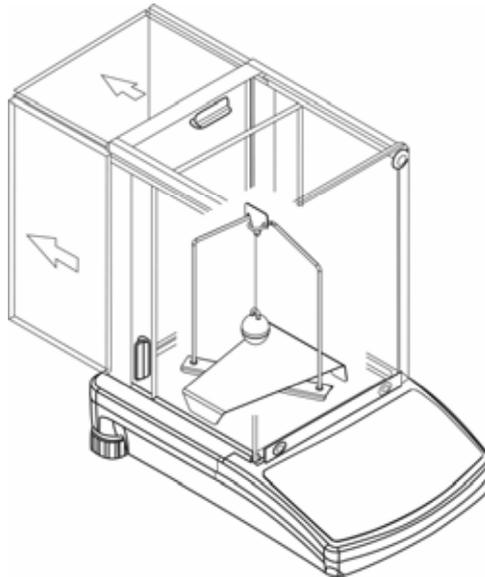
If the density of liquid is performed last float capacity appears on the display. Check if it is the same as the volume of the float stamped on the hook.

00 10.0000

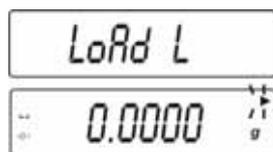
The volume of the float is noted into the balance memory. **LoAd A** and **0.000** appears on the display.



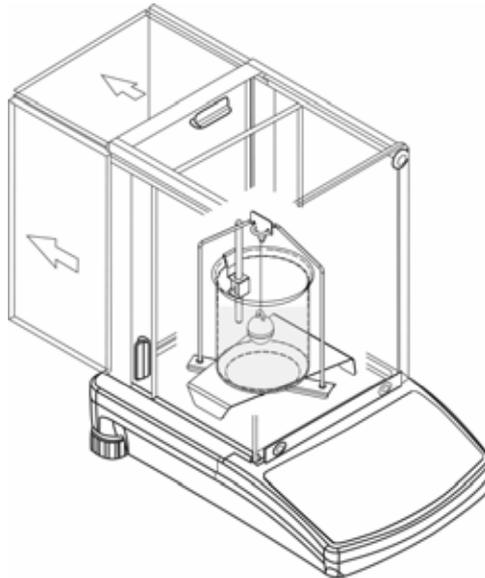
Weight the float in air, hook it on the pan stand without beaker.



- To note this value into the balance memory, press the **PRINT** key when result is stable.
- **LoAd L** appears on the display – it is order to weight float in examined liquid.



Take float off pan stand and set beaker with liquid on beaker stand. Adjust the amount of liquid in order float was immersed 10 - 15mm below the liquid surface. Immerse float in liquid and hook it on stand. Its mass in the liquid appears on the display.



- When the result is stable, press the **PRINT** key to note this value into the balance memory.
- The result of liquid density is presented and kept on the display.
- To avoid mistakes in measure units the letter F is before the result.

F 2.3456

Check if there are any air bubbles fastened to a float. It could cause errors during measurements.

Key function after procedure

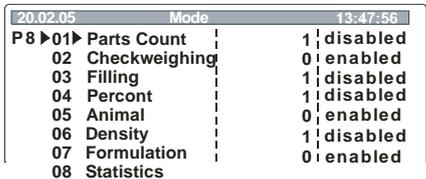
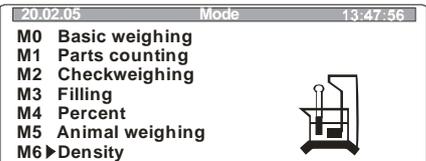
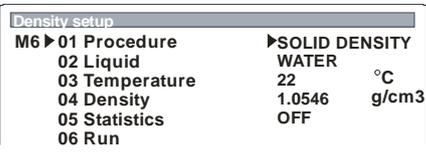
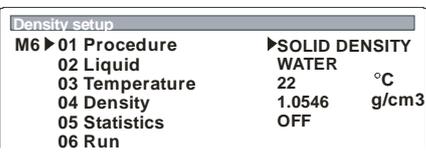
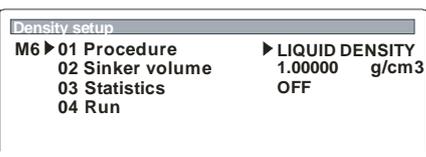
 printout result of density

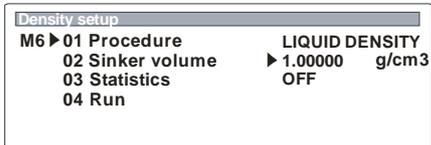
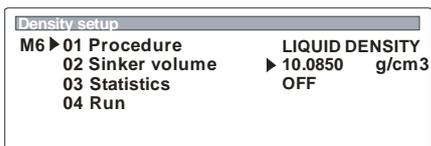
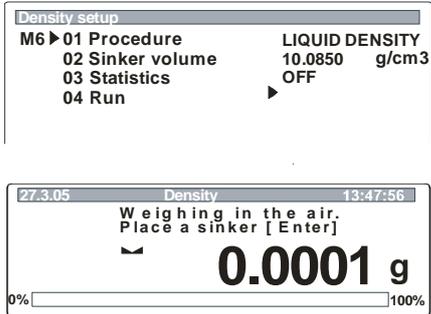
 start next procedure of solids density

 return to menu

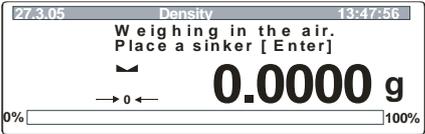
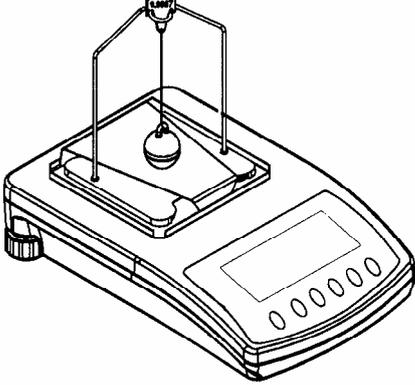
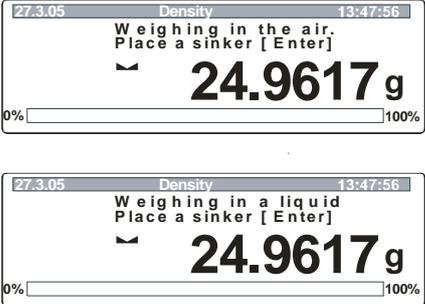
The result is presented on the display in [**g/cm³**]. It does not change even when the sample is taken off.

5.3 Model KERN ALT, PLT

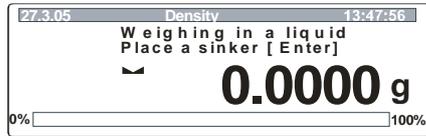
Key	Display	Description
		Activate "Density" in the operation mode menu (see operating instructions Balance, chapter 8.1)
		Use the cursor (▶) to select menu item "M6 Density"
		The parameter selection is displayed. Here, your parameters for density determination are saved.
  or		Use the cursor (▶) to select parameter.
Parameter 01 Procedure		
		The current menu item is blinking
  oder		Activate setting for "Liquid"
		Confirm your selection. The balance is now in density determination mode for liquids.

Parameter 02 sinker volume		
Enter the volume of the sinker (see embossment on suspension hook, information in cm ³ e.g. 10.085 cm ³):		
		The current menu item is blinking
 or 		Change the value of the number
 or 		Select the place to be changed, the active place is blinking
		Confirm your setting.
Parameter 03 Statistics		
When activating the combination density/statistics, actuating the " UNIT -key" will accept the value for the statistics (see operating instructions balance).		
Parameter 04 Run		
After entering the parameters, follow the automatic user interface of the balance.		
		With the parameter selection " 04 Run " to get into density determination mode and the graphic display appears.

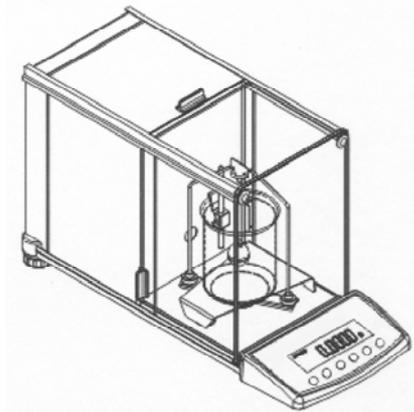
Determination of the weight sinker in air

	 	<p>Wait until the stability and balance-zero display shows.</p> <p>Suspend sinker from the centre, Measurement is carried out without beaker</p>
		<p>Wait until the weight display of the balance is stable.</p> <p>Actuating the PRINT – key will save the weight of the sinker in air .</p>

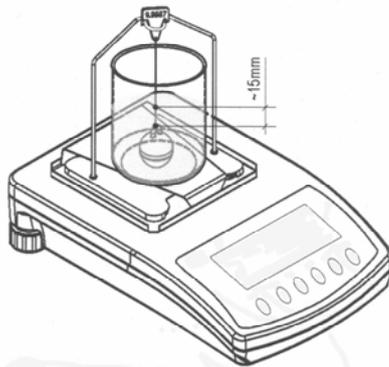
Determination of the weight sinker in sample liquid



KERN ALT:

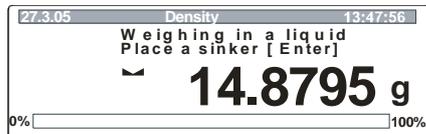


KERN PLT:

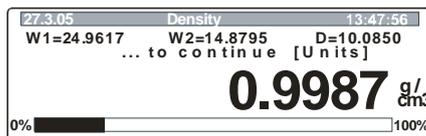


Remove sinker,
place beaker with sample liquid in
the centre of the platform.
Immerse sinker in the measuring
liquid and suspend above from the
suspension eyelet.

The sample liquid should cover the
sinker at 10 -15 mm.



Wait until the weight display of the
balance is stable.
Actuating the **PRINT**-key will save
the **weight of the sinker in
sample liquid**.

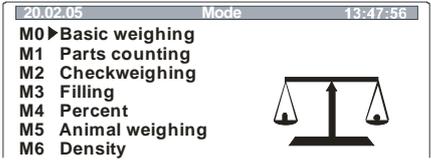


The **density of the sample liquid
(ρ)** is now automatically calculated
and shown in the display [g/cm³].

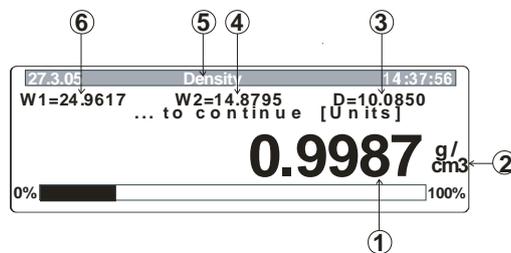
Remove sample or sinker, the measuring result is still on display.

		<p>To start a new measuring cycle, press the UNIT-key.</p>
		<p>Data output to the serial interface RS 232. The result is issued in g/cm³.</p>

Return to weighing mode:

		<p>Cursor (▶) to „M0 Basic weighing“</p>
		

Overview of display:



1. Density of the sample liquid (ρ)
2. Measurement unit of the density
3. Volume of the sinker
4. Weight of sinker in sample liquid
5. Operating mode (status bar)
6. Weight of sinker in air

6 Density table for water

t_{90} [°C]	ρ_w [kg m ⁻³]									
	+0.0	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9
0	999.843	.849	.856	.862	.868	.874	.880	.886	.891	.896
1	999.902	.906	.911	.916	.920	.924	.928	.932	.936	.940
2	999.943	.946	.949	.952	.955	.957	.959	.962	.964	.966
3	999.967	.969	.970	.971	.972	.973	.974	.974	.975	.975
4	999.975	.975	.975	.974	.974	.973	.972	.971	.970	.968
5	999.967	.965	.963	.961	.959	.957	.954	.952	.949	.946
6	999.943	.940	.936	.933	.929	.925	.921	.917	.913	.909
7	999.904	.900	.895	.890	.885	.879	.874	.868	.863	.857
8	999.851	.845	.838	.832	.825	.819	.812	.805	.798	.791
9	999.783	.776	.768	.760	.752	.744	.736	.728	.719	.711
10	999.702	.693	.684	.675	.666	.656	.647	.637	.627	.617
11	999.607	.597	.587	.576	.566	.555	.544	.533	.522	.511
12	999.499	.488	.476	.464	.453	.441	.429	.416	.404	.391
13	999.379	.366	.353	.340	.327	.314	.301	.287	.274	.260
14	999.246	.232	.218	.204	.189	.175	.160	.146	.131	.116
15	999.101	.086	.071	.055	.040	.024	.008	.993*	.977*	.961*
16	998.944	.928	.912	.895	.878	.862	.845	.828	.811	.793
17	998.776	.759	.741	.724	.706	.688	.670	.652	.634	.615
18	998.597	.578	.560	.541	.522	.503	.484	.465	.445	.426
19	998.406	.387	.367	.347	.327	.307	.287	.267	.246	.226
20	998.205	.185	.164	.143	.122	.101	.080	.058	.037	.015
21	997.994	.972	.950	.928	.906	.884	.862	.839	.817	.794
22	997.772	.749	.726	.703	.680	.657	.634	.610	.587	.563
23	997.540	.516	.492	.468	.444	.420	.396	.372	.347	.323
24	997.298	.273	.248	.223	.198	.173	.148	.123	.097	.072
25	997.046	.021	.995*	.969*	.943*	.917*	.891*	.865*	.838*	.812*
26	996.785	.759	.732	.705	.678	.651	.624	.597	.570	.542
27	996.515	.487	.460	.432	.404	.376	.348	.320	.292	.264
28	996.235	.207	.178	.149	.121	.092	.063	.034	.005	.976*
29	995.946	.917	.888	.858	.828	.799	.769	.739	.709	.679
30	995.649	.619	.588	.558	.527	.497	.466	.435	.405	.374
31	995.343	.311	.280	.249	.218	.186	.155	.123	.091	.060
32	995.028	.996*	.964*	.932*	.899*	.867*	.835*	.802*	.770*	.737*
33	994.704	.672	.639	.606	.573	.540	.506	.473	.440	.406
34	994.373	.339	.305	.272	.238	.204	.170	.136	.102	.067
35	994.033	.998*	.964*	.929*	.895*	.860*	.825*	.790*	.755*	.720*
36	993.685	.650	.615	.579	.544	.508	.473	.437	.401	.365
37	993.329	.293	.257	.221	.185	.149	.112	.076	.039	.003
38	992.966	.929	.892	.855	.818	.781	.744	.707	.670	.632
39	992.595	.557	.520	.482	.444	.407	.369	.331	.293	.255
40	992.217	.178	.140	.102	.063	.025	.986*	.947*	.908*	.870*

* The star indicates that the numeral to the left of the decimals is decreased by 1.

Table from "Mass determination" by M. Kochsiek, M. Gläser

7 Recommendations

- To form a reproducible mean value several density measurement are necessary
- Remove fat from solvent-resistant sample /glass sinker /beaker.
- Regularly clean sample dishes/glass sinker/beaker, do not touch immersed part with your hands
- Dry sample/glass sinker/pincers after each measurement.
- Adjust sample size to sample dish (ideal sample size > 5 g).
- Only use distilled water.
- When immersing for the first time, lightly shake sample dishes and sinker, in order to remove air bubbles.
- Always ensure that, when re-immersing into the liquid no additional bubbles adhere; it is better to use pincers to place the sample.
- Remove firmly adherent air bubbles with a fine brush or a similar tool.
- To avoid adherent air bubbles smoothen samples with rough surface.
- Ensure that when weighing "Sample in measuring liquid", no water drips from the pincers onto the upper sample dish.
- In order to reduce the surface tension of water and the friction of the liquid on the wire, add three drops of a common detergent (washing-up liquid) to the measuring liquid (the changed density of distilled water by adding detergent is negligible).
- Oval samples can be held more easily with pincers when you cut grooves into them.
- The density of porous solids may only be determined approximately. When immersing into the measuring liquid, not all the air is displaced from out of the pores, which leads to buoyancy errors.
- To avoid great vibrations of the balance, place sample carefully.
- Avoid static charging, e.g. Only use cotton cloth to dry glass sinker.
- If the density of your solid only deviates slightly from that of distilled water, ethanol can be used a measuring liquid. Please check in advance whether the sample is solvent resistant. Furthermore, when working with ethanol, always observe the valid safety regulations.
- Handle glass sinker with care
(no warranty claims in case of damage).