



AE DENSITY DETERMINATION KIT
(For PW and PGW BALANCES)
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1.0 INTRODUCTION

The Density Determination Kit from Adam Equipment allows the users of PW and PGW series of balances to determine the density of solids and liquids directly using the internal program of the balance.

2.0 FEATURES

- Easy to use - all the activities are described by a message on the display for user.
- Reliable (all the calculations are done by the balance).
- Speed of test (the result is shown immediately after the sample is placed into the water or the float is placed into the liquid).
- Accuracy (before every measurement the balance is automatically zeroed. The user also enters the temperature of the liquid to account for density variations due to temperature or can enter the density of the liquid directly).
- Possibility to print the results or to send them to a PC for further analysis.

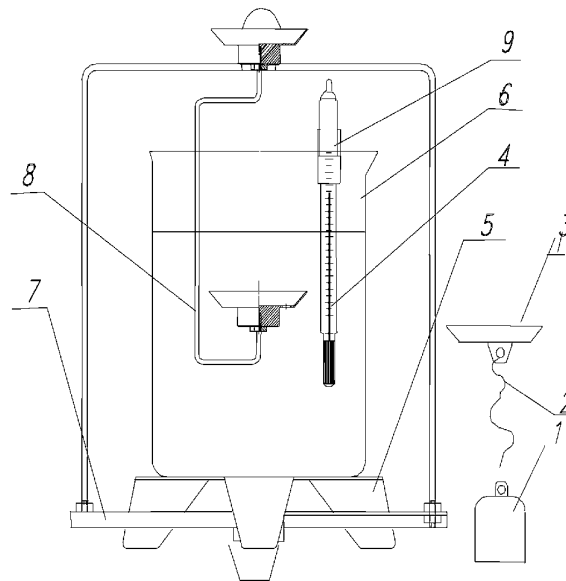
3.0 COMPONENTS

The kit consists of the following components-

1. Glass Float of known volume, with
2. String
3. Hook
4. Thermometer
5. Base to support beaker
6. Beaker
7. Pan and Hanger – This replaces the original pan of the balance during density determination. Pan provided in the kit is different for use with PW and PGW. For PW, this comes as a single part. For PGW, this comes in two separate parts and need to be assembled (see section 4)
8. Sample pan consists of Top Pan, String and bottom pan
9. Clamp for thermometer

} One unit

A spare wire frame is provided to store the glass float in the hanging position when not in use (not shown in the diagram).

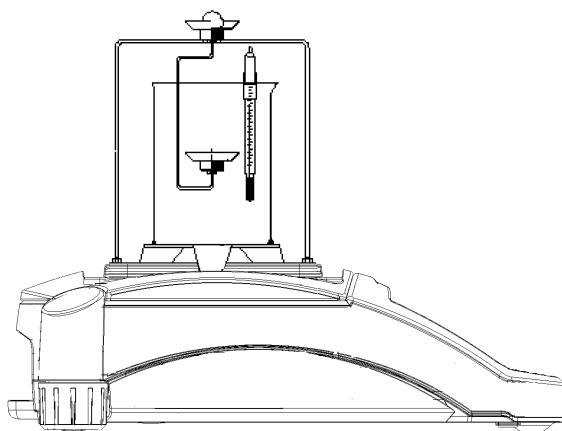


4.0 INSTALLATION

- Replace the original pan with the pan and hanger (7) supplied with the kit.

NOTE: For the kit supplied for PGW, the pan with hanger (7) needs to be assembled. Remove the two nuts from the hanger ends, insert the two ends through the holes of the substitute pan from top and fasten the nuts at the bottom of the pan to keep the hanger in the upright position.

- Place the beaker support (5) over the hanger so that they do not touch each other.
- Fill the beaker (6) with either distilled water at room temperature, alcohol or another liquid of known density. For determination of a liquid's density add the liquid to the beaker. **NOTE:** The liquid used to fill the beaker must cover the bottom pan of the sample pan (8) as well as the solid item being put in this pan.
- Fix the thermometer clip (9) on the beaker wall and insert the thermometer (4) into the liquid.
- Hang the sample pan (8) on the hanger (7) if the kit is to be used for density determination of solid.
- Hang the glass float (1) on the hanger (7) when the kit is being used for the density determination of liquid.



PGW with the Density Kit installed

5.0 MEASUREMENT OF SOLID DENSITY

To perform the density of solids test, the user must have a method to immerse the solid item in a chosen liquid. The density of the liquid must be known or determined from a look-up table.

For water and ethanol the density will be calculated based on the temperatures entered using the numeric entry method, when asked by the balance.

Numeric Entry Method-

To set a value when required, use the keys as given below-

- **[Up]** and **[Down]** keys to increase or decrease the flashing digit,
- **[Advance]** and **[Back]** keys to advance or move back the digit and
- **[Enter]** key to accept the value

Steps:

- After installing the Density Determination Kit, tare the balance by pressing the **[→0/T←]** key
- Press **[Mode]** and then **[Up]** and **[Down]** keys to select “Density”
- Press **[Enter]** to enter the Density mode
- Press the **[Up]** and **[Down]** keys to select the Solid or Liquid method when “DENSITY SOLId” or “DENSITY LIqUId” is displayed
- Press **[Enter]** to select the “DENSITY SOLId” method
- Press **[Up]** or **[Down]** to select the liquid of choice- Water, Ethanol or Other
- Press **[Enter]** to select the choice. For water and Ethanol the temperature will be asked for. Enter the temperature using the numeric entry method
- For the “Other” choice the density will be asked for. Enter the

density (g/cc) using the numeric entry method

- Press **[Enter]** to continue
- The balance will request for the weight of the sample in air by displaying “AIR WEIGHT”. Place the solid item on the top pan. When the sample pan is stable, press **[Enter]** to determine the value
- After completion of the air weighing, the balance will request for the weight in liquid by displaying “LIQUID WT”. Submerge the solid item into the liquid. When stable, press **[Enter]** to start the liquid weighing. The balance will compute the density of the sample and display it as “DENSITY XXXX g/cc”
- After completion of the liquid weighing, remove the solid item from the pan
- Press **[Mode]** to continue with a new sample or press **[Esc]** to return to normal weighing

6.0 MEASUREMENT OF LIQUID DENSITY

When finding the density of a liquid, it is necessary to weigh a sample of known volume in air and then in the chosen liquid. The volume of the sample must be entered using the numeric entry method. The last known volume is stored for use at any time.

In the AE density determination kit, a glass float has been provided with the volume of the float marked on its support, i.e. 10.5089

Steps:

- After installing the Density Kit, tare the balance by pressing the **[→0/T←]** key
- Press **[Mode]** and then **[Up]** and **[Down]** to select Density
- Press **[Enter]** to select the Density mode
- Use **[Up]** and **[Down]** to scroll through the solid or liquid method

- When “DENSITY LIqUId” is displayed, press **[Enter]**
- The volume will be asked for. Enter the volume using the numeric entry method or continue using the last volume entered
- Press **[Enter]** to continue
- The balance will request for the weight in air by displaying “AIR WEIGHT”. Place the glass plumb supplied with the density determination kit in air on the weighing pan. When stable press **[Enter]** to start the air weighing
- On completion of the air weighing, the balance will request for the weight in liquid by displaying “LIQUID WT”. Submerge the glass float in the liquid. When stable press the **[Enter]** key. The balance will compute the density of the liquid and display it as “DENSITY XXXX g/cc”
- Remove the float
- Press **[Mode]** to continue with a new liquid sample or press **[Esc]** to return to normal weighing

NOTE:

For best accuracy follow these suggestions-

- Samples should be tested more than once and the average value be taken.
- Only distilled water should be used.
- The water should be at a stable temperature.
- The sample must be degreased.
- The sample should not be porous. If it is porous then special preparation might be necessary.
- Ensure that the sample is completely covered by about 10mm of the liquid at the top.

- Be certain any air bubbles are removed.
- Dry the sample completely between tests.
- Be very careful not to transfer water to the top pan when using tweezers.
- Samples should be 5 grams or greater.
- Degrease the glass float before using.
- Dry the float completely between each test. Be careful not to put a static electric charge on the glass float. It may be necessary to use an anti-static cleaner on the float.
- Wash the beaker before filling it with any liquid.
- Place the sample on the weighing pans carefully to avoid shocks to the balance. Wait till the sample pan unit (8) or the glass float (1), whichever is in use is stable before pressing the **[Enter]** key during the operation.

APPENDIX A

A method to determine the volume of the float

To determine the volume of the float the following equation can be used.

$$V = \frac{A - B}{\rho - d} [\text{cm}^3]$$

A - mass of float in air	[g]
B - mass of float in distilled water	[g]
V - float volume	[cm ³]
ρ - density of distilled water	[g/cm ³]
d - density of air	

The following formula is used to determine the density of air (d) to use in the above equation.

$$d = \frac{0,0012932}{1 + 0,0036728 \times t} \times \frac{\rho}{1013,25}$$

Where,

0,0012932 is the density of air [g/cm³] at 0°C and standard air pressure (1013,25 in Millibars)

0,0036728 is the "Temperature Co-efficient" (the amount by which the air expands in volume at a constant pressure as the temperature changes)

t - temperature of air [°C]

ρ - pressure of air in Millibars [mb]

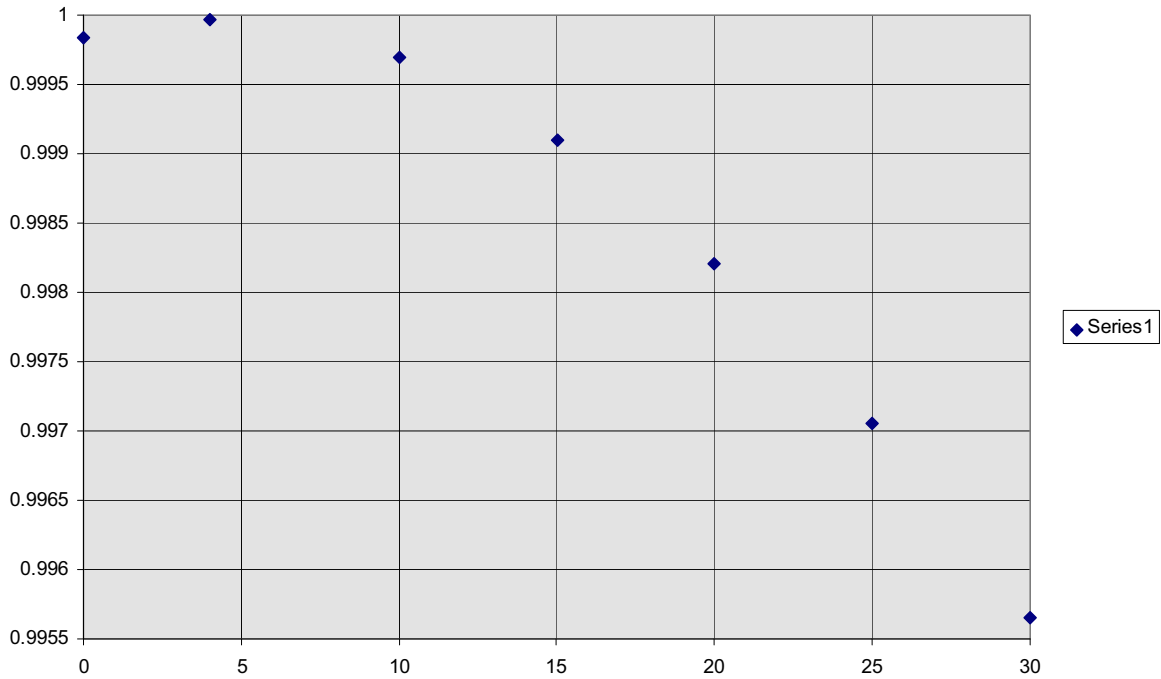
The procedure would be to measure the mass of the float in air (value A) and the mass while it is submerged in distilled water (value B) and then put the values in for the water density (ρ) and air density (d) at the temperature and pressure measured using other instruments.

The values for water density at various temperatures can be found in most chemistry or physics reference texts. A partial list is given in the following Appendix.

APPENDIX B

DENSITY OF DISTILLED WATER

WATER TEMPERATURE	DENSITY
0°C	0.99984 g/cm ³
4°C	0.99997 g/cm ³
10°C	0.99970 g/cm ³
15°C	0.99910 g/cm ³
20°C	0.99821 g/cm ³
25°C	0.99705 g/cm ³
30°C	0.99565 g/cm ³



Density of Distilled Water versus temperature

°C	0	1	2	3	4	5	6	7	8	9
0	0.99984	0.99990	0.99994	0.99996	0.99997	0.99996	0.99994	0.99990	0.99985	0.99978
10	0.99970	0.99961	0.99949	0.99938	0.99924	0.99910	0.99894	0.99877	0.99860	0.99841
20	0.99820	0.99799	0.99777	0.99754	0.99730	0.99704	0.99678	0.99651	0.99623	0.99594
30	0.99565	0.99534	0.99503	0.99470	0.99437	0.99403	0.99368	0.99333	0.99297	0.99259

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