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Examination Procedures

Goods sold by weight

- Attain random sample of the inspection lot
- Determine the gross weight of each sample
- Complete the tare procedure and fulfils scenario 1 or 2
- Gravimetric (non-destructive) testing is completed
- Deduct the average tare weight from the actual quantity of each sample
- Complete the reference test (apply the three packers rules)

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Examination Procedures

Goods sold by weight

- Attain random sample of the inspection lot
- Determine the gross weight of each sample
- Tare procedure is completed and fulfils scenario 3
- Gravimetric (destructive) testing is completed
- Deduct the tare weight of each sample from the gross weight
- Complete the reference test (apply the three packers rules)

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Examination Procedures

Goods sold by weight

Practical notes:

- If using used dry tare, remember to number the samples in the order you took the gross weights to avoid attaining incorrect actual quantities
- If using unused dry tare, the tare procedure can be completed before random samples of the inspection lot are taken

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Examination Procedures

Goods sold by volume

There are four methods commonly used for examining a lot of goods that are sold by volume:

- Direct comparison – Volumetric (destructive)
- Direct comparison – Template (non-destructive)
- Displacement bath (destructive)
- Gravimetric (non-destructive)

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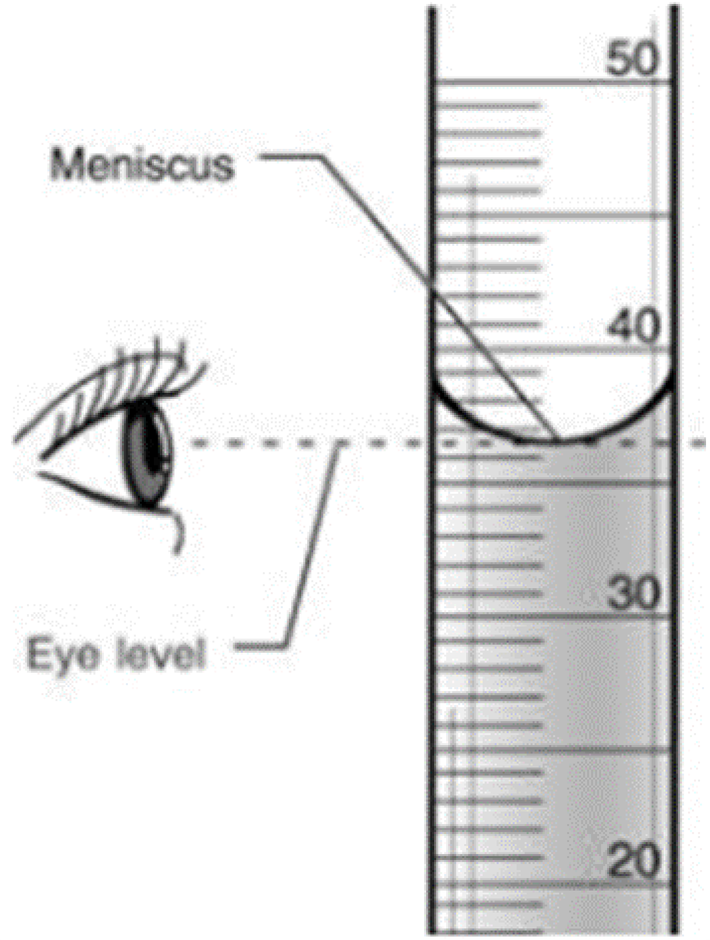
Method 1 – Volumetric

Direct comparison involves opening each individual sample and empty all of the contents into a graduated cylinder

The error is then read from the bottom of the meniscus



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Method 1 – Volumetric

Example test sheet

Actual Quantity (mL) -	Stated Quantity (mL) =	Individual Package error (mL)
512	500	+ 12
510	500	+ 10
507	500	+ 7
506	500	+ 6
493	500	- 7
470	500	- 30

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Method 1 – Volumetric

- This method involves destroying the product, as each sample package is opened and transferred to a graduated cylinder
- There may also be issues in extracting all of the product that adheres to the internal surfaces of the packing material
- More suitable for transparent liquids, as the bottom of the meniscus is used as a datum point

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Method 2 – Template

- Templates are a non-destructive direct comparison method
- They are used to determine the quantity contained in a prepackages
- The individual package error is determined directly from a template associated with that packaging
- Variability in the packing material has to be controlled

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Method 2 – Template

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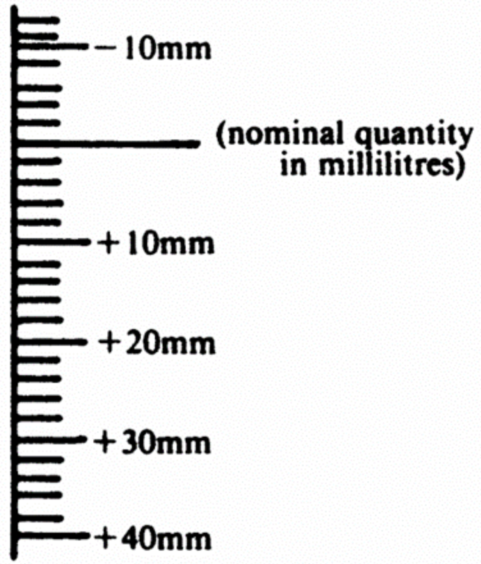
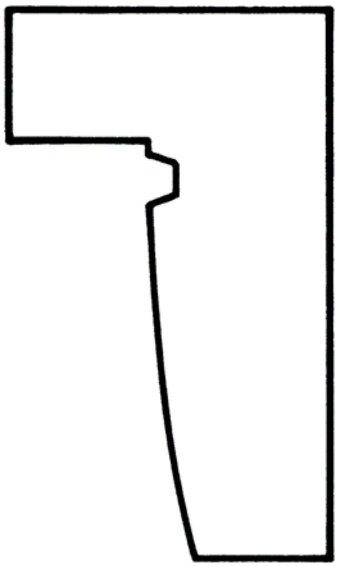
Method 2 – Template





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Method 2 – Template

- This method is used to measure the distance between the top of the contents in the prepackage and the upper edge of the package (the empty space) without the package having to be opened
- Ultimately a controlled method of a visual fill height check
- The template is usually marked with a graduated scale from which a direct reading from the top of the contents to the top of the container can be made
- This scale is in units of volume so the volume of the fill can be directly read

Method 2 – Template

Packaging requirements:

- Must be transparent
- Must be made of a stable material that holds its shape
- The internal and external dimensions of the container must be sufficiently constant
- Glass bottles are the usual containers that meet these requirements

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Method 2 – Template

Packaging requirements:

- The type of cap (i.e. screw on or press on) approved for use with the bottle should be marked on the template
- The template must be easily identifiable with the bottle it is approved for use with

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Method 2 – Template

Using a template:

- The bottle being tested must be placed vertically on a level surface
- The template is placed over the top of the bottle
- Read error – bottom of meniscus to the top of the line

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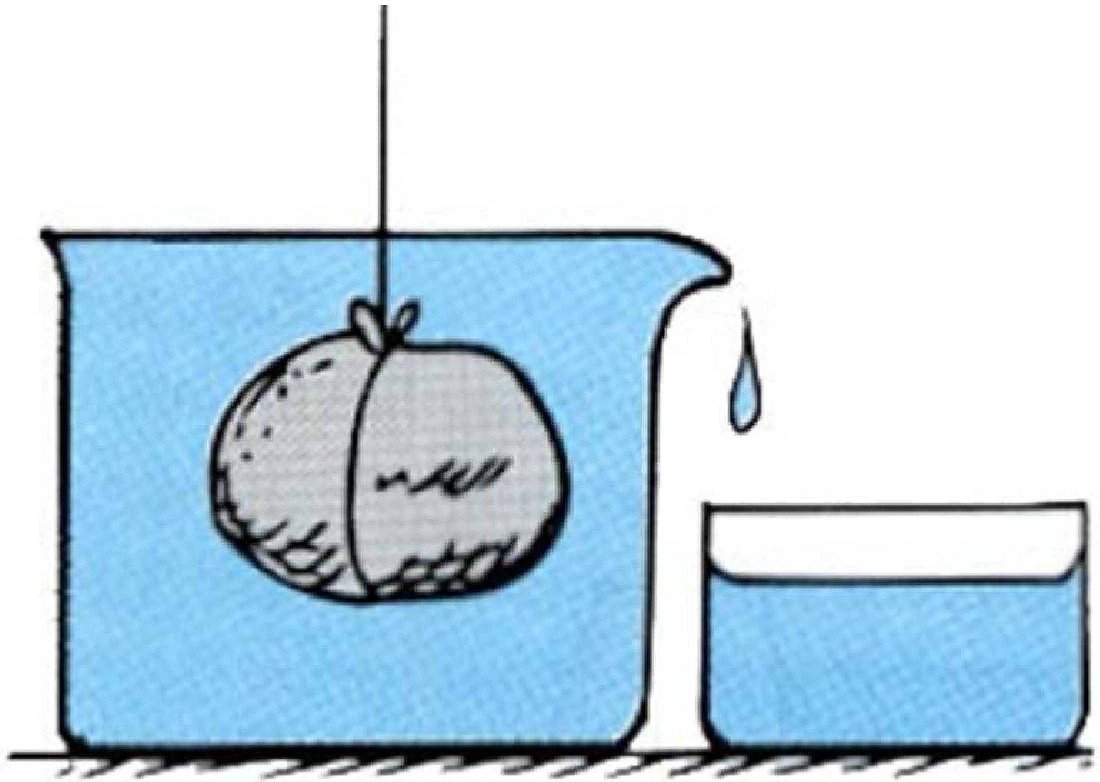
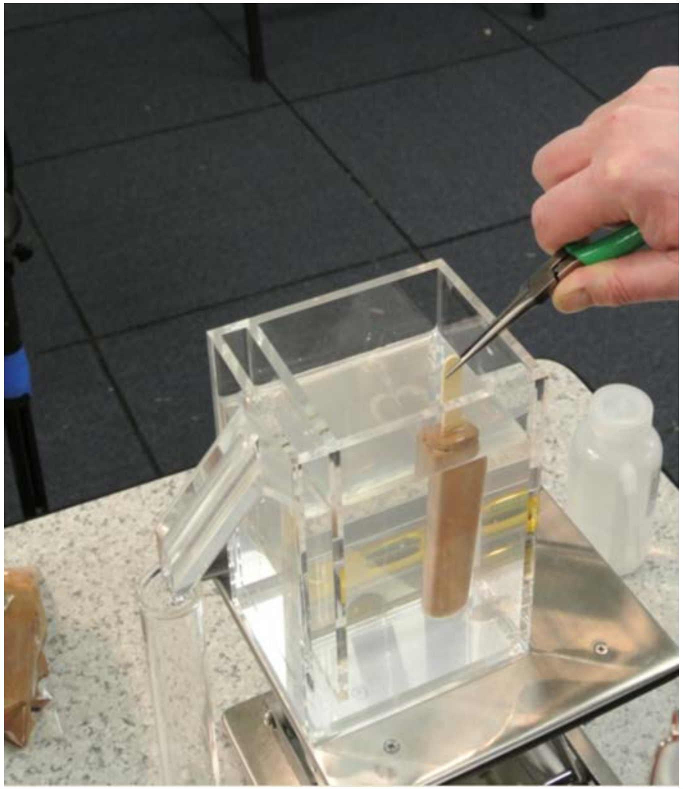
Method 3 – Displacement bath

- Based upon **Archimedes'** principle
- The volume of displaced fluid is the volume of the object
- Commonly this method used to determine the volume of ice cream products

Method 3 – Displacement bath



Method 3 – Displacement bath



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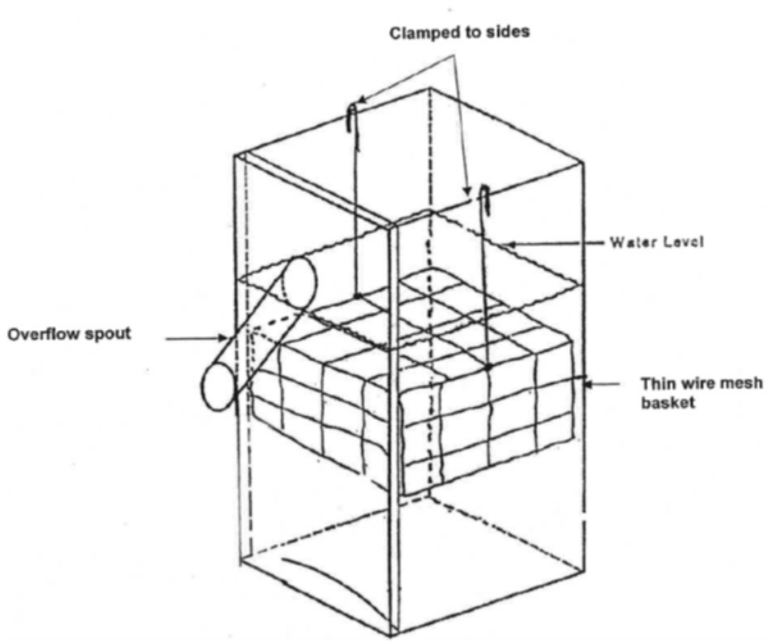
Method 3 – Displacement bath



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Method 3 – Displacement bath

Equipment required:

- **Displacement bath;** appropriate size for the product under test
- **Ice water** maintained at 1˚C to 3˚C
- **Freezer**
- **Graduated volumetric measure**
- **Thermometer**

Method 3 – Displacement bath

Procedure:

1. Products sampled are stored in a manner to ensure product integrity is maintained
2. Place displacement bath in freezer overnight
3. Place water in freezer until 1˚C to 3˚C is reached
4. Set up displacement bath and graduated cylinder on a stable level surface
5. Check water temperature is within 1˚C to 3˚C
6. Place graduated cylinder under spout

Method 3 – Displacement bath

Procedure:

7. Fill displacement bath with water until it overflows from the spout; wait for all visible flow to cease from the spout on the displacement bath into a tub
8. Wait for all visible flow to cease from the spout on the displacement bath into a tub
9. Check water temperature is within 1˚C to 3˚C
10. Place graduated cylinder under spout
11. Remove a single sample of the product from the freezer and open

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Method 3 – Displacement bath

Procedure:

12. Remove wire mesh cage and hold above displacement bath. Place sample in cage and slowly submerge
13. Once all visible flow has ceased from the spout on the displacement bath to graduated measure, read and record actual volume
14. Recheck temperature to ensure within 1˚C to 3˚C; if not, disregard result

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Method 3 – Displacement bath

Procedure:

15. Repeat for each sample; complete steps 5 to 14 for each sample

This method is not full proof and many variable make it difficult to attain consistent and reliable results

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Method 4 – Gravimetric volume

Determining a volume gravimetrically:

- This method requires an accurate **density** figure to be determined
- The volume is then determined using the following calculation:

$$\textit{volume} = \textit{mass} \div \textit{density}$$

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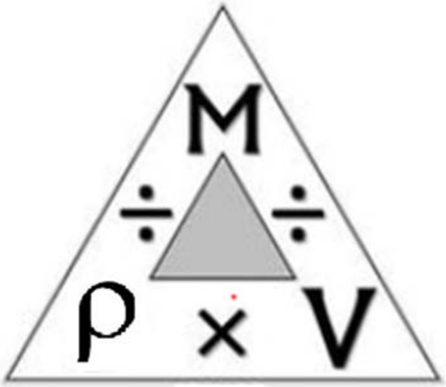
Method 4 – Gravimetric volume

Density = ρ

Mass = M

Volume = V



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Density measurement

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Density measurement

Example density figures:

Material	Density
Rubbing Alcohol	.79
Lamp Oil	.80
Baby Oil	.83
Vegetable Oil	.92
Ice Cube	.92
Water	1.00
Milk	1.03
Dawn Dish Soap	1.06
Light Corn Syrup	1.33
Maple Syrup	1.37
Honey	1.42

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Density measurement

Gravimetric testing – example reference test

Gross Weight (g)	-	ATW (g)	=	Actual Quantity (g)	÷	Density P g/mL	=	Actual Quantity (mL)	-	Nominal Quantity (mL)	=	Individual package error (mL)
748		225		523		1.025		510		500		+ 10
745		225		520		1.025		507		500		+ 7
744		225		519		1.025		506		500		+ 6
730		225		505		1.025		493		500		- 7
707		225		482		1.025		470		500		- 30

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Density measurement

OIML guide G 14 [Edition 2011] details a variety of methods and procedures to determine density

R87 suggests a reference temperature of 20°C

Next we will look at four methods:

1. Hydrometer
2. Pycnomter (including a practical exercise)
3. Electronic density meter
4. Container filled to the brim with water

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Density measurement

Hydrometer

A device used to directly determine the density of a liquid

- It usually consists of a thin glass tube closed at both ends, with one end enlarged into a bulb that contains fine lead shot to cause the instrument to float upright in a liquid.
- In the glass tube is a scale so calibrated that when floating in a liquid, for which it is in the density range for, it will indicate the number of times heavier than liquid it is when read at the liquid surface

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Hydrometer

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Density measurement

Hydrometer

- The function of the hydrometer is based on Archimedes principle that a body suspended in a liquid will be buoyed up by a force equal to the weight of the liquid displaced
- Thus, the lower the density of the substance, the lower the hydrometer will sink

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Density measurement

Hydrometer procedure:

1. To use the hydrometer, a glass cylinder with an inside diameter of at least 50 mm is required
2. The glass cylinder is filled with the sample under test
3. The hydrometer is lowered carefully into the sample until it floats under its own weight
4. After the hydrometer has settled the density is read; the reading is taken on the line determined by the meniscus

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Density measurement

Hydrometer

- Calculate the density of the product:

$$p = \text{reading} + \text{any correction factor.}$$

- The correction factor will be stated individually on the calibration certificate for each hydrometer

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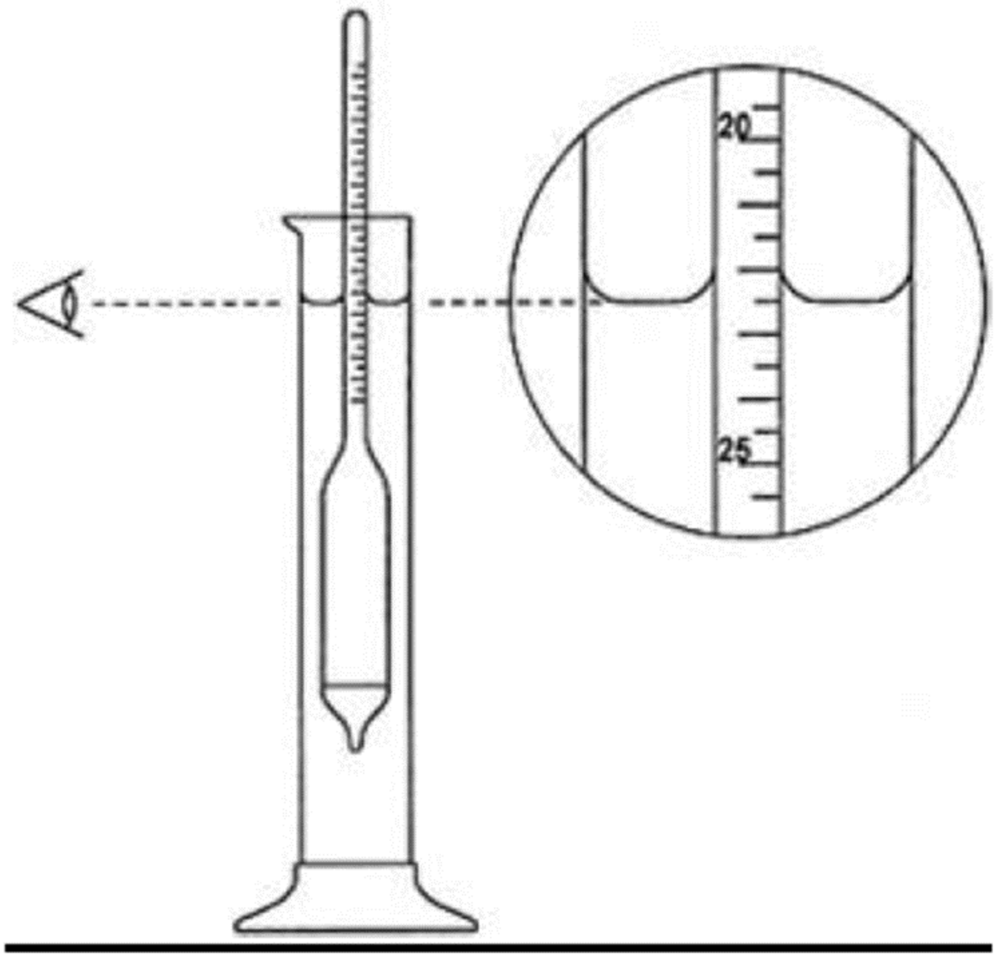

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Density measurement

Pycnometer

Pycnometer, also known as a density cup, are glass or metal containers with a precisely determined volume that are used to determine the density of a liquid

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Density measurement

Pycnometer procedure:

1. Weigh the empty density cup with a known volume (V) and glass/metal strike (m_T)
2. Record the result
3. Brim fill the density cup with product
4. Slide the glass strike across the brim/place lid or stopper on top
   – Ensure no air is trapped
   – Top up through the hole in the glass strike

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Density measurement

Pycnometer procedure:

4. Carefully clean any overflowed product from the density cup and dry thoroughly
5. Weigh the density cup, glass strike and product to find the product weight (m_L) and record the result
6. Calculate the density (*p*)

$$\boldsymbol{p} = (m_L - m_T) \div V$$

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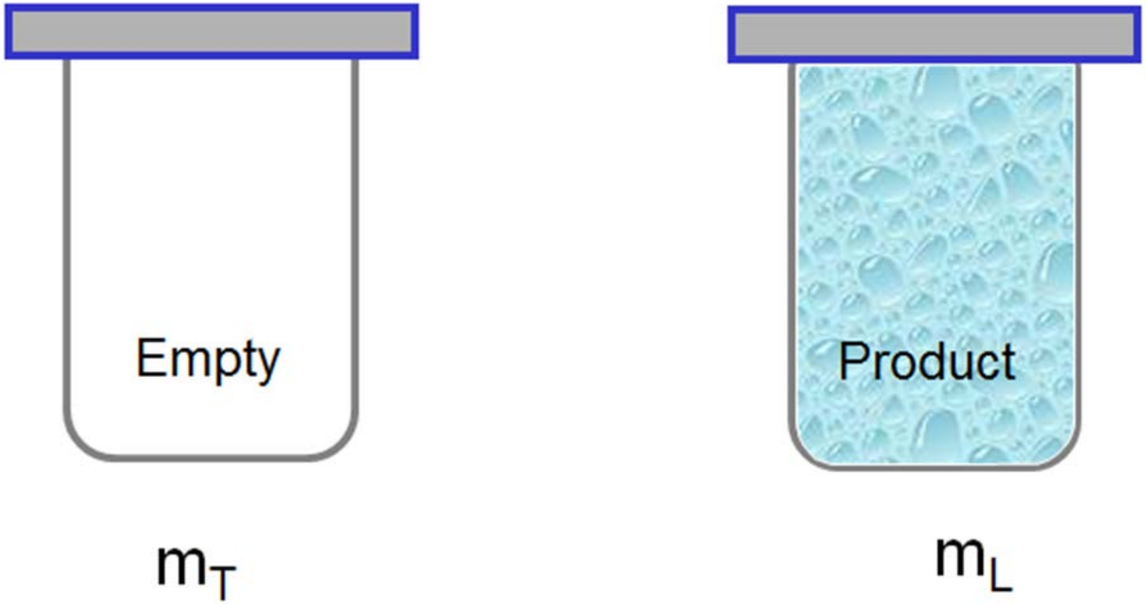
Density measurement

Pycnometer



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Density measurement

Pycnometer

Now you can complete a practical exercise using a glass pycnometer or metal density cup or graduated cyclinder

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Density measurement

Electronic density meter

- These instruments calculate the density and display it on the digital readout
- The advantages of using these instruments are:
  - Only a small amount of product is required to measure the density
  - They are easy to clean
  - The time taken to determine the density is very short

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Density measurement

Electronic density meter

- To use:
  - Calibrate the instrument using distilled water
  - Insert the tube into the product and suck product into the vibrating tube
  - Read the density from the display

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Density measurement

Container filled to the brim with water

This method uses the product container as a pycnometer but with a strike glass as the lid

- Not suitable for porous products as requires test liquid to be added to the empty space

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Density measurement

Container filled to the brim with water

Requirements of the container:

- Not be deformable
- Have a flat edge
- Be so designed that air cannot be entrapped after complete filling

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Density measurement

Container filled to the brim with water

Required equipment:

- Suitable weighing instrument
- Strike for the top of container
- Distilled water; with an assumed density of 1 g/mL

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Density measurement

Container filled to the brim with water procedure:

1. Allow the prepackages to stand to settle the product
2. Remove the lid and ensure any product that has adhered to the lid is removed and placed in the prepackage
3. Lightly grease the edge of container with Vaseline
4. Ensure the weighing instrument reads zero
5. Weigh the prepackage and the strike plate and record the result on the test report (M_P)

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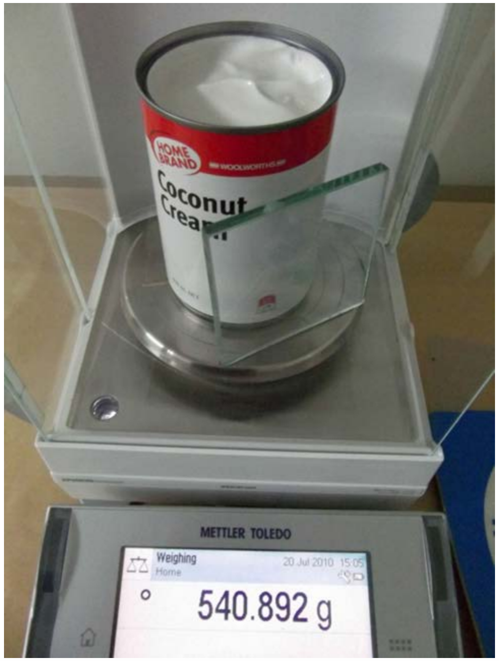
Density measurement

Container filled to the brim with water procedure:



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Density measurement

Container filled to the brim with water procedure:

6. Deliver the distilled water into the top of the product until it is almost level with the brim
7. Use a strike plate to ensure the prepackage is filled to the brim
8. Record the weight on the test report (M_S)
9. Note: If the container overfills, the test is void

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Density measurement

Container filled to the brim with water procedure:

10. Determine the weight of the test liquid by subtracting the weight determined in step 8 from the weight determined in step 5

$$M_S - M_P = M_{SP}$$

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Density measurement

Container filled to the brim with water procedure:

11. Remove all product from the prepackage and thoroughly clean and dry the empty package
12. Zero the weighing instrument and weigh the packing material (empty package) and the strike plate
13. Record the tare weight on the test report (M_T)
14. Fill the package to the brim with the distilled water using the strike plate.
15. Record the gross weight of the prepackage and test liquid (M_W)

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Density measurement

Container filled to the brim with water procedure:

16. Determine the net weight of the test liquid by subtracting the tare weight (step 13) from the gross weight (step 15)

$$M_W - M_T = M_{WT}$$

17. Determine the weight of the test liquid, which substituted for the product being tested, by subtracting the weight determined in step 16 from the weight determined in step 10

$$\text{Weight of test liquid} = M_{TW} - M_{SP}$$

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Density measurement

Container filled to the brim with water procedure:

18. Determine the volume of product being tested by dividing the weight of test liquid determined in step 17 with the density of the test liquid used in step 8 & 15 (distilled water has a density of 1)
19. Determine mass of product by subtracting M_P from M_T
20. Determine the density of the product by dividing mass (step 19) with the volume (step 18)

density = mass ÷ volume

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Density measurement

When you have calculated the density of the product this can then be applied to the actual weight (mass) of the product to determine the volume

volume = mass ÷ density