

## Examination Procedures

### Goods sold by weight

When examining a lot of goods that are sold by weight:

- Gravimetric (non-destructive) testing is completed

\*Assuming the tare weights satisfy either scenario 1 or 2 of the tare procedure\*

\*\*A practical exercise will be completed to demonstrate this method\*\*

## Examination Procedures

### Goods sold by volume

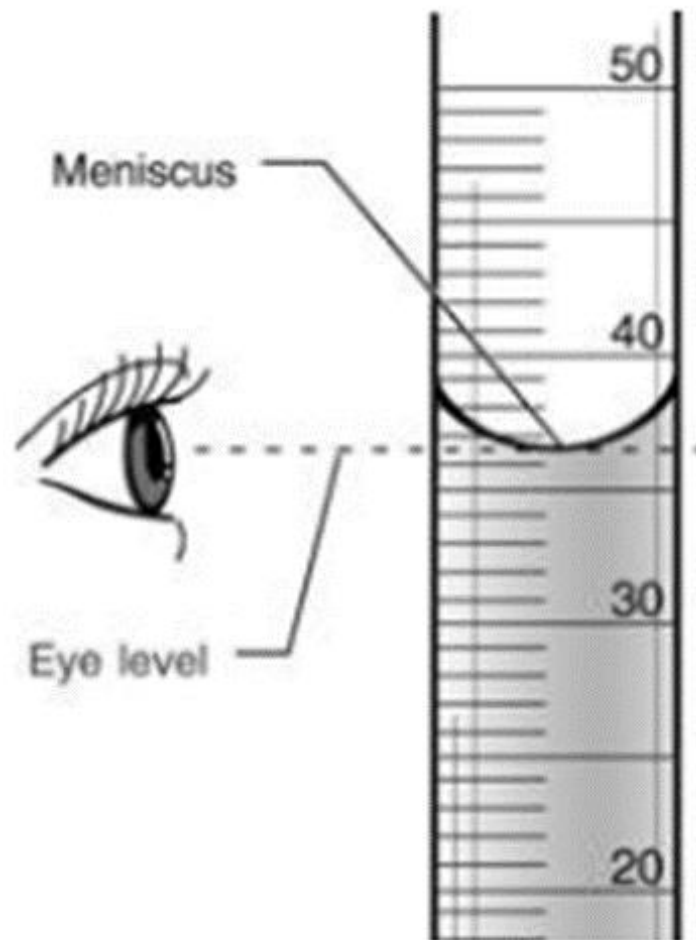
There are four methods commonly used for examining a lot of goods that are sold by volume:

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

## Method 1 – Volumetric

Individually opening each sample and empty all the contents into a graduated cylinder

- Read error – bottom of meniscus to the top of the line





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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                          |

## Method 1 – Volumetric

- This method normally involves destroying the product as each sample package is opened and transferred to a graduated standard
- Method has limitations in extracting product that adheres to the internal surfaces
- Suitable for transparent liquids, as the bottom of the meniscus is used as a datum point.

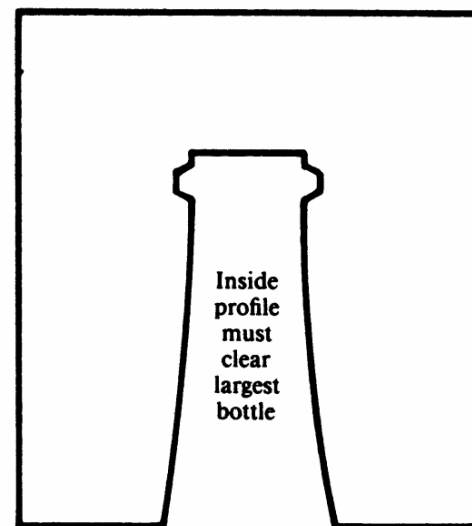
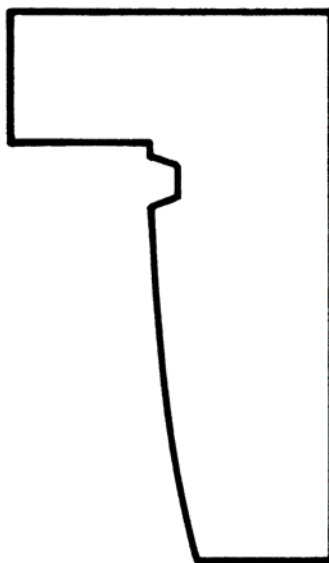
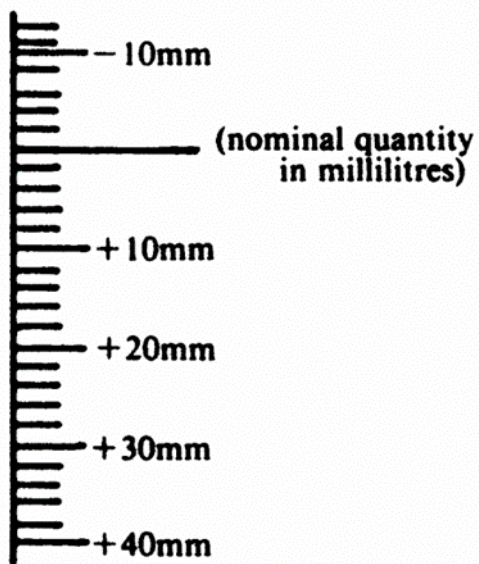
## Method 2 – Template

- Templates 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

## Method 2 – Template



## Method 2 – Template





## 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
- 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:

- The packaging must be transparent
- The packaging 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

## 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

## Method 2 – Template

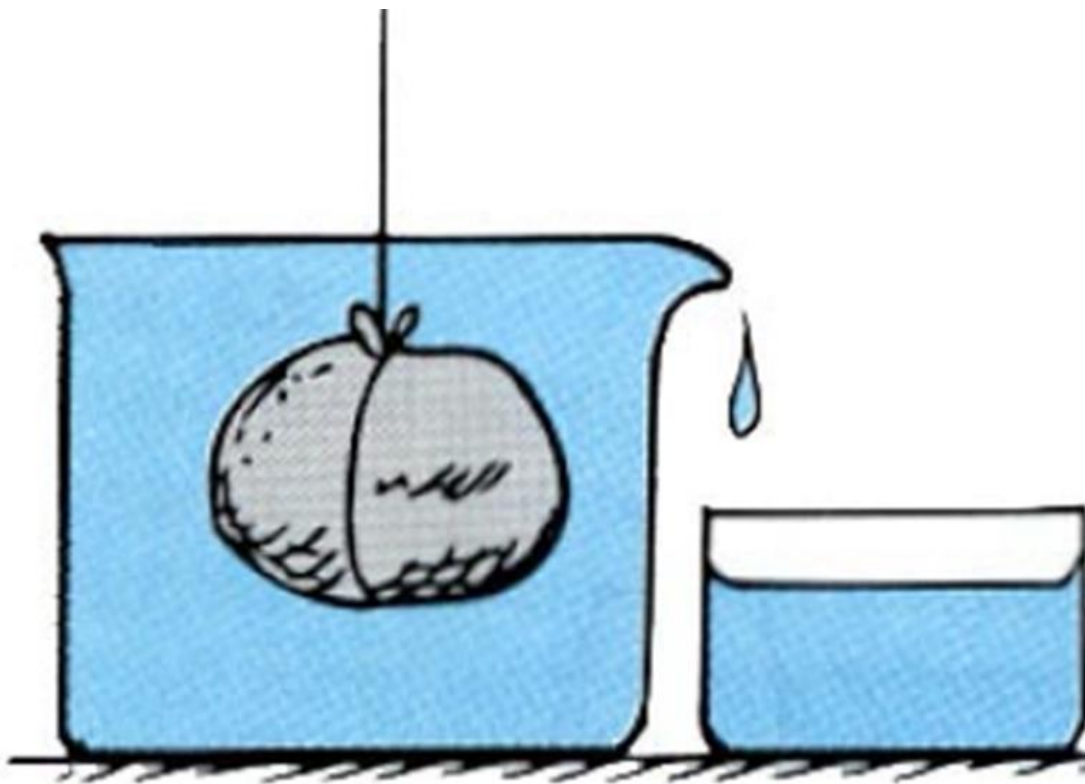
Using a template:

- 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

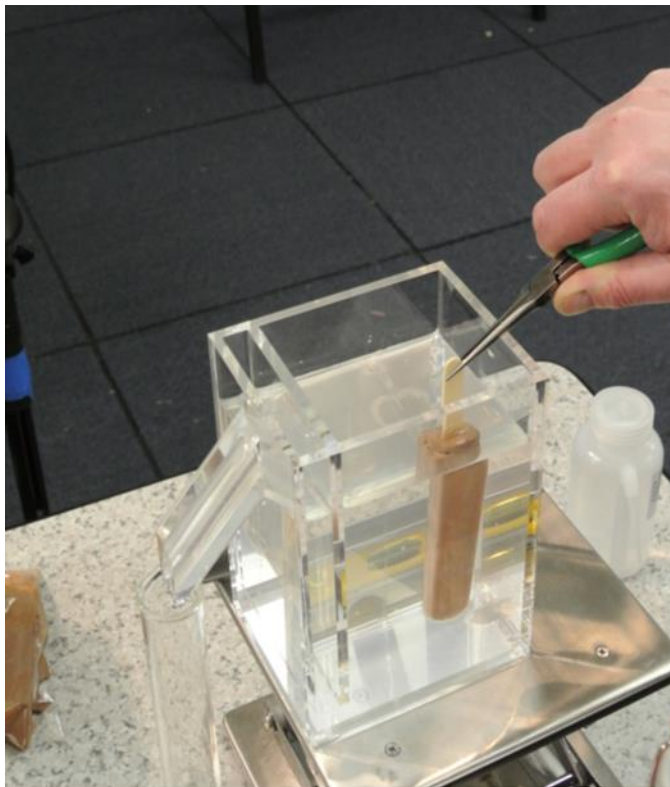
## Method 3 – Displacement bath

- 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

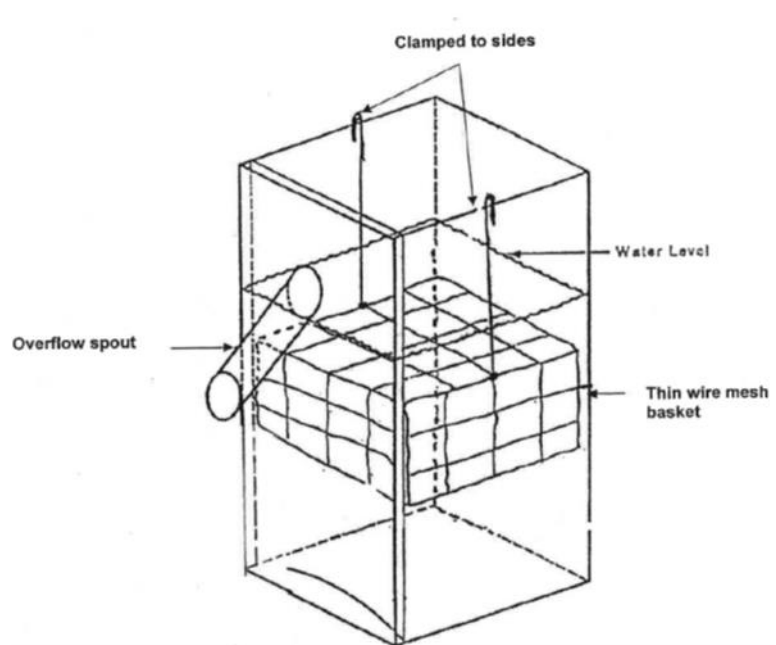
## Method 3 – Displacement bath



## Method 3 – Displacement bath



## Method 3 – Displacement bath





## 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. 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

## Method 3 – Displacement bath

### Procedure:

6. Wait for all visible flow to cease from the spout on the displacement bath into a tub
7. Check water temperature is within 1°C to 3°C
8. Place graduated cylinder under spout
9. Remove a single sample of the product from the freezer and open

## Method 3 – Displacement bath

### Procedure:

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

## Method 3 – Displacement bath

Procedure:

13. Repeat for each sample; complete steps 6 – 12

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

## Method 4 – Gravimetric volume

Determining a volume gravimetrically:

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

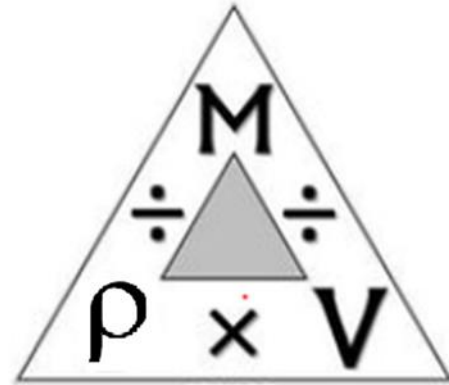
$$\text{volume} = \text{mass} \div \text{density}$$

## Method 4 – Gravimetric volume

Density =  $\rho$

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    |

## 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                          |

## 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

This training session will focus on four methods:

1. Hydrometer
2. Pycnomter
3. Electronic density meter
4. Container filled with water to the brim

## 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



## 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

## 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

## Density measurement

### Hydrometer

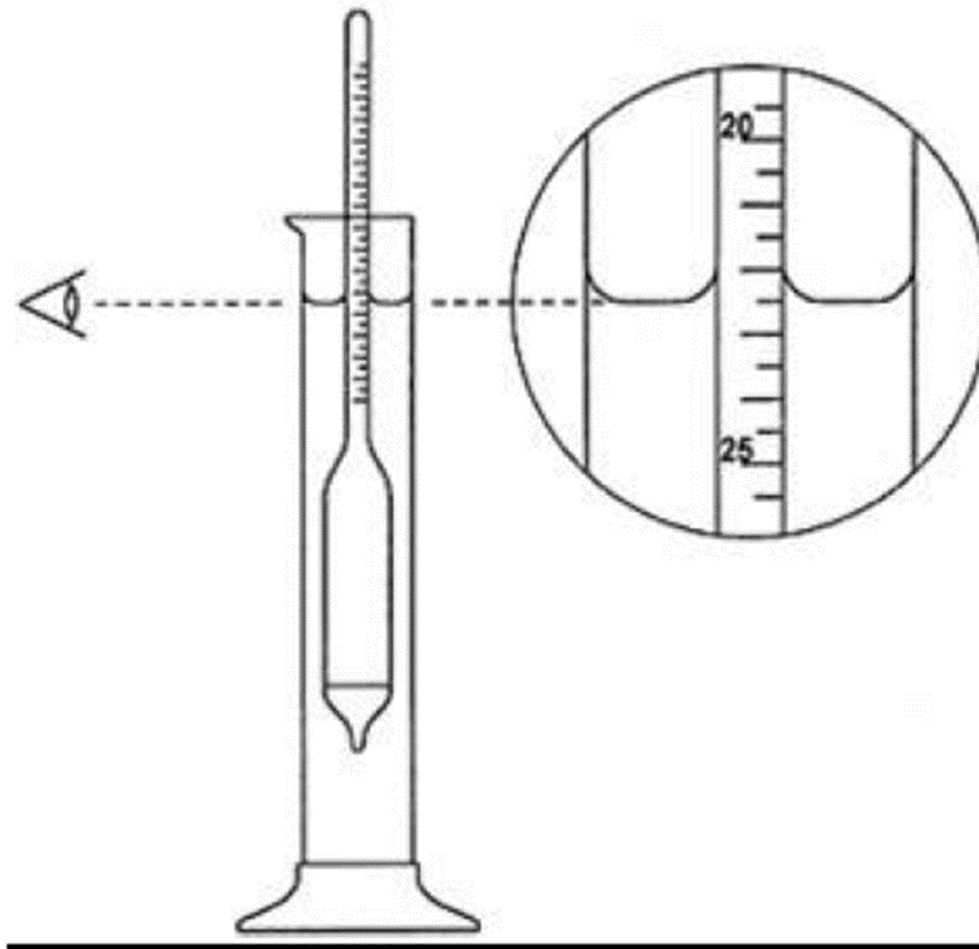
- Calculate the density of the product:

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

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



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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



## 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
  - Ensure no air is trapped
  - Top up through the hole in the glass strike.

## Density measurement

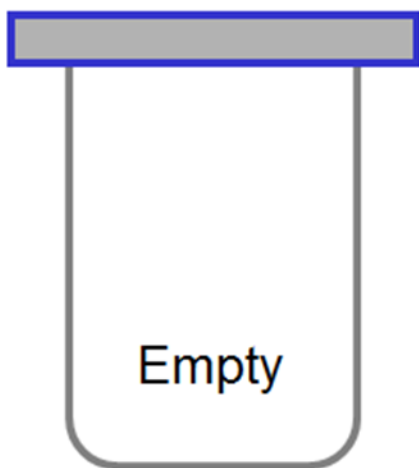
### Pycnometer procedure:

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 ( $\rho$ )

$$\rho = (m_L - m_T) \div V$$

## Density measurement

### Pycnometer



$m_T$



$m_L$

## 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



## 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



## 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

## 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

## 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<sub>p</sub>)

## Density measurement

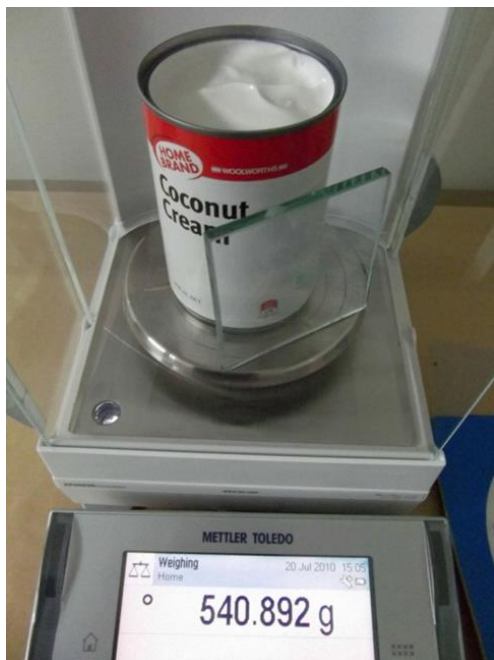
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4. Ensure the weighing instrument reads zero
5. Weigh the prepackage and the strike plate and record the result on the test report (M<sub>p</sub>)

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## Density measurement

Container filled to the brim with water procedure:



## 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

## 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 ( $M_w$ )

## 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

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

## 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)

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



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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

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