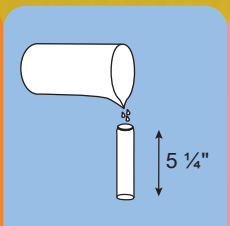
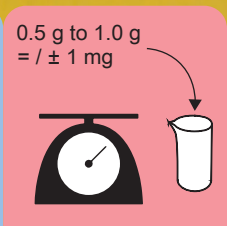
Lovibond® Colour Measurement

Tintometer® Group

Handbook of Methods

Analytical procedures for the measurement of edible oils and fats





How to use this guide

The Lovibond® guide to the measurement of colour in edible oils and fats has been designed to enable the accurate and repeatable communication of colour data throughout the edible oil supply chain.

We recommended that, whether creating a new operating procedure or reviewing your existing procedures, you work through the guide from the beginning.

The guide can also be used for troubleshooting any problems arising from differences in your product's colour measurements.

Whilst we have taken every care to ensure that all aspects of edible oil measurement are covered within this guide, we are always available to support our customers via our website www.lovibond.com or directly by email at support@lovibond.uk.

Taking a Sample

Follow standards such as ISO 5555:2001 Animal and vegetable fats and oils — Sampling.

The key aspects of this standard include:

- Use of stainless-steel sampling containers as these are the most suitable
- Types of suitable sampling instrument:
  - Weighted sample can
  - Weighted cage for sample bottle
  - Valve sampling cylinder (sinker sampler)
  - Bottom sampler
  - Sampling tubes and scoops
- The importance of clean or gloved hands
- Protection of the sample from contamination (rain or dust etc.)
- Heating of oils to facilitate sampling
- Homogenisation of the oil to be sampled
- The taking and preparation of inhomogeneous fats

It is most important to ensure that the sample has not been contaminated and is a representative sample of the homogeneous bulk of oil concerned.

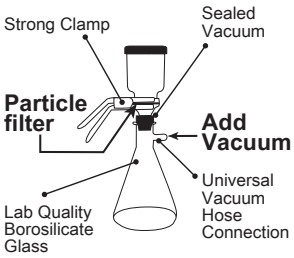
Sample Preparation

This is one of the most important steps to ensuring accurate and repeatable measurements not only in the single laboratory but also when comparing results across multiple laboratories. Care taken here will reduce errors and provide better measurements.

Filtration

The sample should be clear and free of particles before it is measured.

Filtration of oil samples can be achieved through a process of heating (for samples that are highly viscous at room temperature) and gravity or vacuum filtration.

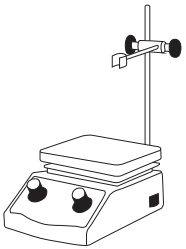


Typical vacuum filtration equipment

The choice of filter pore size should be based upon the sample oil. Some experimentation will be required to obtain the optimum pore size which provides sample clarity in a suitable timeframe.

Sample Cloud Point & Heating

If the oil is solid at room temperature then heating will be required so that it becomes liquid and clear. This can be achieved by heating in an oven or stirrer hotplate. The sample should be heated to 10 Degrees Celsius above its cloud point.



When placed into a cold measurement instrument, some samples may crystallise quickly upon contact with the cooler surface of the sample cuvette.

To avoid this, warm the instrument (if applicable, see section on measuring equipment) with the empty sample cuvette before use.

Please note that some instruments provide heated sample chambers. These are not intended for use in bringing the sample to a suitable temperature but to maintain temperature while the measurement is taken.

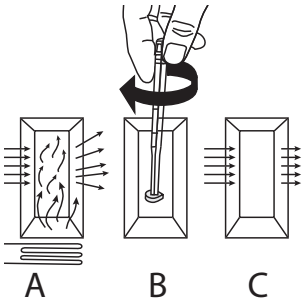
Sample Convection Currrents

If the temperature is not consistent throughout the sample, small thermal currents can form within it.

These refract the light passing through the sample affecting the amount of light detected. This refracted light can cause inaccurate measurement results as well as repeatability problems.

The sample should be gently stirred within the measurement cuvette using a clean stirring rod just prior to measurement.

Thermal currents:



Thermal currents forming within a sample

After stirring the sample

The heater in the instrument is not intended to be used for heating samples up to temperature as it will be quite slow. It is only intended to stop heat being taken away from the sample during the measurement cycle.

Measurement Decisions

There are four key decisions that must be made prior to measuring colour in oil consistently:

1) The choice of colour scale to be used in communicating the colour data.
2) Visual versus automatic measurement.
3) The path length across which the colour will be measured.
4) Possible dilution of the sample

Choice of Scale

Colour scales are designed to replicate the range of colours specific to an application-type or sample colour-type. There are a number of scales which are used for measuring edible oil colour. Your supplier or customer will be working to an existing scale and it is important to try and maintain colour communication within a single scale.

Common Scales and Applicable Standards

Lovibond® RYBN

- AOCS Cc 13e, Color of Fats and Oil, Lovibond (ISO Method) – 13e92 Lovibond Method Using Color Glasses Calibrated in Accordance with the Lovibond Tintometer Color Scale
- AOCS Cc 13j, Color of Fats and Oils, Automated Method
- ISO 15305, Animal and vegetable fats and oils - Determination of Lovibond colour
- ISO 27608, Animal and Vegetable Fats and Oils - Determination of Lovibond Colour - Automatic Method
- Department of Standards Malaysia MS 252: Part 16, ANIMAL AND VEGETABLE FATS AND OILS: PART 16: DETERMINATION OF COLOUR
- Department of Standards Malaysia MS 817: PART 12, PALM OIL AND PALM OIL PRODUCTS: PART 12: DETERMINATION OF LOVIBOND COLOUR (ISO 15305:1998, MOD)

The Lovibond® Scale is based on 84 calibrated glass colour standards of different densities of magenta (red), yellow, blue and neutral, graduating from desaturated to fully saturated. Sample colours are matched by a suitable combination of the three primary colours together with neutral filters, resulting in a set of Lovibond® RYBN units that define the colour.

Since several million combinations are available, it is possible to match the colour of almost any sample; it is particularly popular for measuring the colour of oils and fats.

Designed originally for visual colour assessment, this scale has been since digitised and can now be expressed using automatic equipment.

Lovibond® RYBN utilises a combined numbering system to express a value representing:

- Red
- Yellow
- Blue
- Neutral

The neutral element of the scale performs the function of adjusting for “brightness” overall light intensity in visual glass-based measurement systems. Care must be taken

if users of visual measurement systems employ neutral filters to dull a bright sample, but omit to report this in their results.

A Neutral standard of a particular value is equivalent to a combination of Red, Yellow and Blue standards, so if there is a match using all four colours, it can be simplified by removing the smallest number from all the colours. For example, 1.5R, 7.8Y, 0.2B, 0.5N is equivalent to, and should only be reported as, 1.3R, 7.6Y, 0.3N.

Practical Aspects of Lovibond® RYBN Measured in Visual Systems

The Lovibond® RYBN colour scale is the preferred colour scale when measuring Lovibond colour as it most closely correlates with the way in which visual instruments are designed to be used.

There are two working practices which are sometimes used in visual systems, to simplify the comparison of samples with glass colour standards.

Lovibond® RY

Uses only the Red and Yellow glass standards when comparing two samples (or sample with a standard). This will often lead to lower values in the reported match due to the brightness difference in visual measurement systems. A higher variation between users will be seen, as a more subjective decision on the match at different brightness levels is being made. An RY result may be correct, but often a complete result requires Neutral values as well.

Lovibond® RY 10:1

In some sample oils, there is a useful relationship between Yellow and Red colour values (where Yellow is approximately ten times the Red value). The 10:1 ratio is often a useful point to start from when making a colour match, then improved to a more precise match using the full gamut of Red, Yellow, Blue and Neutral. The RY 10:1 ratio is a step in the process of achieving a good RYBN match, but it is not a final result.

American Oil Chemists Society (AOCS) AOCS-Tintometer Scale.

- AOCS Cc 13b-45, Color of Fats and Oils, Lovibond (Wesson) Wesson Method Using Color Glasses Calibrated in Accordance with the AOCS-Tintometer Color Scale
- AOCS Cc 8d-55, Refined and Bleached Color in Tallow and Greases Intended for Soap Production
- AOCS Cc 13j-97, Color of Fats and Oils, Automated Method

The AOCS-Tintometer colour scale is a scale of Red and Yellow colour values only. The scale differs in its values from the Lovibond® RYBN scale so measurements between the two scales are not comparable.

The AOCS-Tintometer scale also uses a different viewing system for visual measurement: in the Lovibond® RYBN method the sample and coloured glass are side by side while in AOCS-Tintometer, the sample and coloured glass are shown in separate circles of colour.

Chlorophyll

- AOCS Cc-13d-55, Chlorophyll Pigments in Refined and Bleached Oils

Whilst not a colour scale, the content of chlorophyll in a number of edible oils can be determined by light absorbance. The relationship between absorbance (optical density) at 670nm, 630nm and 710nm is dependent upon the chlorophyll content of the oil. The sample pathlength is used in the calculation of chlorophyll content and should be

chosen such that the optical density at 670nm is between 0.3 and 0.8.

Beta Carotene

- BS 684 (section 2.20) Determination of carotene in vegetable oils

Beta Carotene is seen in some oils (e.g. Palm Oil) as the orange/red hue. This can be measured as light absorbance at 445nm. It should be noted that as a purely quantitative method, any sample that absorbs light at 445nm will give a result (which may not necessarily be constituted of beta carotene).

Scale	Summary	Reported Units
Lovibond® RYBN	Red, Yellow, Blue and Neutral. Most closely correlates with use of visual instruments	0.1 to 70 Red, Yellow 0.1 to 40 Blue 0.1 to 3 Neutral
Lovibond® RY	Uses only Red and Yellow. Lack of brightness factor can lead to lower reported values and higher variation between users in visual systems	0.1 to 70 Red, Yellow
Lovibond® RY 10:1	Uses an approximation of the Red value as being ten times that of yellow in order to make visual measurement easier.	0.1 to 20 Red 1.0 to 70 Yellow
AOCS Tintometer	Red and Yellow only. Sample and adjusted match colour are separated	0.1 to 20 Red 1 to 70 Yellow
Chlorophyll	Calculation made using absorbance (optical density) at 670nm, 630nm and 710nm	Parts per million / mg per kg
Beta Carotene	Absorbance at 445nm in some oils	Parts per million / mg per kg

Visual vs Automatic Measurement Systems. Advantages and Disadvantages

Visual Measurement

- Human assessment is usually the final arbiter of colour matching. Regardless of what any instrument reports, a human consumer will make their own subjective assessment of the suitability of colour to them.
- Measurements must be assessed by a number of people and aggregated to provide a result consistent with an “average viewer”. Two groups of “average viewers” may present different results on the same sample due to biological variations in colour perception and subjective variations (mood can affect colour perception).
- You must ensure that operators pass a colour vision test administered by a qualified optician. They should be re-tested every five years.

Automatic Measurement

- Consistent repeatability of results between instruments of the same principle and design.
- Only requires a single operative to provide a result.

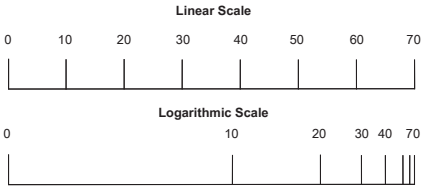
Path length selection

Selecting a suitable pathlength cuvette for your sample.

Many standards reference a 5 1/4 " or 133.4mm cell but provision is made to use shorter pathlength cells.

Because of the logarithmic nature of the Lovibond® RYBN colour space, when measuring in Lovibond® RYBN, it is recommended to select a cell with a pathlength such that the total of colour units required to match is not greater than 20 (R + Y + B or N <20).

Doing so will improve repeatability and reproducibility.



Sample dilution

Sample Dilution for Lovibond® RYBN, Lovibond® RY, Lovibond® RY 10:1 or AOCS Tintometer

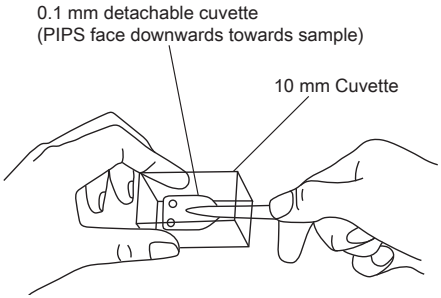
Sample dilution is not recommended. Selection of a suitable pathlength will ensure repeatable and reproducible results.

Sample Dilution for Beta Carotene

Dilute your sample in analytical grade cyclohexane at a dilution of 1:100. The PFXi and Model Fx firmware assumes that the dilution is correct, so one must weigh out precisely 1 g of oil, measured as accurately as possible (BS684 2:20 states one should use scales accurate to 1mg) and dilute to 100 ml with cyclohexane.

Then measure in a 10mm pathlength cuvette.

One can avoid solvent dilution by using an undiluted sample and measuring in a 0.1 mm pathlength cuvette (part number 606700) with the measurement instrument pathlength set at 10 mm.



Equipment Verification

As with any measurement device it is important that the instrument used for colour measurement is checked to ensure that it is working within its specified parameters.

With colour measurement instruments this done by measuring standards with known values against which the results can be compared.

Colour reference standards

Reference colour standards will come with a certificate that states the colour values and the tolerances. It is often helpful to understand how the colour values are derived and how the tolerances are determined.

With visual instrumentation we know that the measured result is subjective, so trying to put an absolute value to that is problematic at the best of times. At the Tintometer Ltd. the procedure adopted is to use 3 to 5 operators that have been tested for any colour deficiency and found to have normal colour vision. Visual measurements are made independently. The results are reviewed with any outliers being removed. The average of the results is taken. Tolerance levels for the visual system have been developed using a larger population of users and samples. The data from this study is used for the tolerance levels shown on a certificate.

Any instrument has repeatability and inter-instrument reproducibility tolerances. These are calculated by repeating many measurements with many samples over a defined period as well as measuring on several instruments. The tolerances then defined for the repeatability and reproducibility of the instrument are added to the tolerance value specified with the colour standard.

Types of verification standard

The Tintometer Ltd. produces two types of verification standard: solid glass and liquid reference standards.

Glass Reference standards

Glass reference standards have the benefit of not having a shelf life. They can however become dirty and care should be taken to ensure they are kept clean. They are very good for validating the instrument’s performance, many users check their instrument each day or week using glass standards. It is recommended that they are recalibrated periodically to ensure no damage has occurred that may affect the colour values.

Liquid Reference Standards

The liquid reference standards can be used in the same way as glass standards for verifying that an instrument is working correctly. They do have certain benefits over the glass standards in that they better replicate the way in which normal samples are measured. This can be useful for also detecting operator faults such as not cleaning cuvettes correctly. Dirty cuvettes can lead to errors in measurements. The use of liquid references can also detect the incorrect placement of the cuvette in the instrument. When using liquid reference standards also be sure to use the cuvette pathlength recorded on its certificate.

The Sample

All vegetable oils contain the same fatty acids, oleic acid, linoleic acid, palmitic acid and stearic acid. However, other fatty acids can also occur in sometimes significant amounts and the matrix in which these fatty acids are contained are very different. This leads to large practical differences in the physical and optical properties of these oils.

Sample Types

Lovibond® products are designed to measure all types of edible oils. The most common oils covered in these methods are listed here:

- Soya bean oil
- Palm oil
- Rapeseed/Canola oil
- Sunflower seed oil
- Groundnut (peanut) oil
- Cottonseed oil
- Coconut oil
- Palm kernel oil
- Olive oil
- Corn oil
- Sesame oil
- Linseed oil

The viscosity, density and optical properties of these vary between each oil and with temperature. This variance, along with the oil´s common visible spectral characteristics influences both the way it is prepared for measurement and the colour scale to which it may be measured.

Troubleshooting

Common Issue	Solution
Our Automatic Instrument (Lovibond Model Fx or PFXi) is showing higher Blue values when compared to our Visual Tintometer Model F.	Your samples are not transparent, they require filtering or heating.
Our samples are heated and transparent, but we are experiencing differences between our Automatic Instrument (Lovibond Model Fx or PFXi) and Visual Tintometer Model F.	Convection currents in your samples could be causing issues. Please stir them before measuring.
Despite transparency, appropriate cell path length and stirring we are still experiencing differences between our Automatic Instrument (Lovibond Model Fx or PFXi) and Visual Model F.	Your instruments and cells should be clear and in a good state of repair. Oil contamination and damage can negatively impact results.
Where can I get my instrument serviced?	Please contact The Tintometer Ltd for advice. We are happy to help.
Despite transparency, appropriate cell path length, stirring and cleanliness we are still experiencing differences between our Automatic Instrument (Lovibond Model Fx or PFXi) and Visual Model F.	Review the relevant standard (e.g. AOCS 13e-92) for recommended tolerances. Visual instruments are less repeatable than automatic.
We are getting different results from another site.	Check you are using the same colour scale, cell path length, temperature and sample preparation technique.
Our Automatic Instrument (Lovibond Model Fx or PFXi) is showing Neutral values when compared to our Visual Tintometer Model F.	Are you correctly compensating for brightness when using your Tintometer Model F?
Our Automatic Instrument (Lovibond Model Fx or PFXi) is reporting Blue and Neutral Values that we do not report on our Visual Tintometer Model F.	Check you are applying the correct colour scale. Lovibond RYBN reports Red, Yellow, Neutral and Blue values. AOCS Tintometer reports Red and Yellow only.
How can I check inter-instrument agreement between a Lovibond Model Fx, PFXi and/or Tintometer Model F.	We recommend checking with a Lovibond Universal Verification Standard set.
When using our Visual Tintometer Model F instrument we wish to round down Y values to the nearest 10.	We strongly advise against this poor practice.

Common Issue	Solution
When using our Visual Tintometer Model F instrument we wish to round down R values to the nearest 1.	We strongly advise against this poor practice.
We wish to fix a R (Red) or Y(Yellow) value, then colour match.	We strongly advise against this poor practice.
We are seeing a lot of variation in readings between the operators of our Visual Tintometer Model F.	We recommend colour vision testing for all operators at least every 5 years.
We only have one operator using our Visual Tintometer Model F.	As per the standards, we recommend at least two operators make independent visual assessments with a 3rd available to adjudicate.
We are unsure what International Standard to apply for the oils we are handling?	Please contact The Tintometer Ltd for advice. We are happy to help.
What tolerances should we apply to our "Red" and "Yellow" values?	Please contact The Tintometer Ltd for advice. We can advise you what is dictated in the applicable International Standard.

Lovibond® RYBN Colour CM1

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
Model Fx, PFXi-880/IP17, PFXi-880/IP 17 heated, PFXi-880/L, PFXi-880/S, PFXi-880/S heated, PFXi-880L heated, PFXi-950, PFXi-950 heated, PFXi-995, PFXi-995 heated, PFXi-995/P, PFXi-995/P heated	1/16" - 6"	0 - 70 R, 0 - 70 Y, 0 - 30 B, 0 - 3 N
Model F, Model F (BS 684) with Compensating slides	1/16" - 6"	0 - 79.9 R, 0 - 79.9 Y, 0 - 39.9 B, 0 - 3.9 N

Application List

- Food and Beverage
- Household Products
- Petroleum Oils and Waxes
- Edible Oils and Fats
- Chemicals

Applicable Standard

- AOCS Cc 13j-97
- ISO 27608
- MS 252 : Part 16
- MS 817 : Part 12
- AOCS Cc 13e-92
- BS684
- ISO 15305

Liquid Reference Standards

Title	Packaging Unit	Part Number
Lovibond® RYBN Colour 0.8R 2.0Y 0.1N (5¼)	500 ml	134080
Lovibond® RYBN Colour 2.0R 7.0Y 0.5N (5¼)	500 ml	134100
Lovibond® RYBN Colour 2.1R 11.0Y 0.5N (5¼)	500 ml	134110
Lovibond® RYBN Colour 3.1R 22.0Y 0.8N (5¼)	500 ml	134130
Lovibond® RYBN Colour 3.4R 30.0Y 0.9N (5¼")	500 ml	134230
Lovibond® RYBN Colour 1.4R 4.0Y 0.5N (5¼)	500 ml	134090
Lovibond® RYBN Colour 2.5R 14.0Y 0.7N (5¼)	500 ml	134120

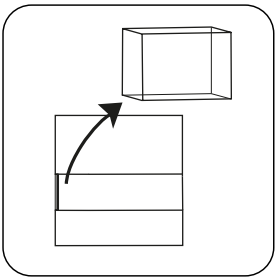
Glass Standards

Title	Packaging Unit	Part Number
Lovibond Red, Yellow, Neutral Filter Set (Model F, E, D)	1 pc.	185000
Lovibond Red, Yellow, Blue (Model F, E, D)	1 pc.	186000
Lovibond Red, Yellow, Neutral (Model F, E, D)	1 pc.	184000
Lovibond Red, Yellow, Neutral Filter Set (PFXi 995/950/880)	1 pc.	139590
Lovibond Red, Yellow, Neutral Filter Set (PFXi 995/950/880)	1 pc.	139610
Lovibond Red, Yellow, Blue Filter Set (PFXi 995/950/880)	1 pc.	139620
Lovibond Red, Yellow, Neutral (PFXi 995/950/880)	1 pc.	139630
Lovibond Red, Yellow, Neutral (Fx)	1 pc.	169630
Lovibond Red, Yellow, Neutral Filter Set (Fx)	1 pc.	169610
Lovibond Red, Yellow, Blue Filter Set (Fx)	1 pc.	169620
Lovibond Red, Yellow, Neutral Filter Set (Fx)	1 pc.	169590

Implementation of the provision Lovibond RYBN Colour

Using colorimeter: Model F, Model Fx, PFXi
Select the colour scale on the device: Model Fx, PFXi
For this colour scale, a baseline measurement must be carried out in the following devices: Model Fx, PFXi

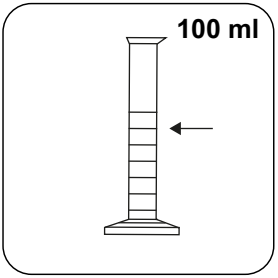
Perform Baseline Measurement (Automatic Instruments)



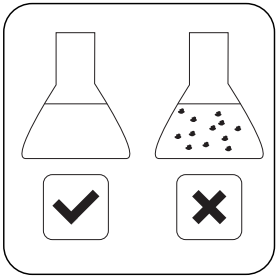
Ensure the measurement chamber is empty and close the lid.

Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

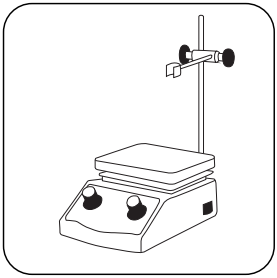
Sample Preparation



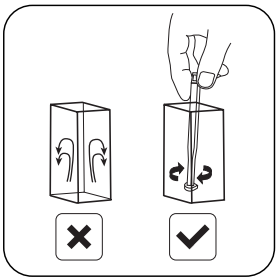
Sample volume of 100 ml required.



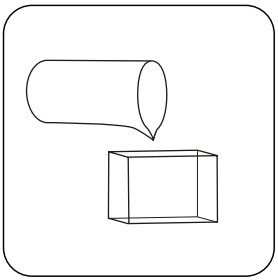
Vacuum filter to remove particles.



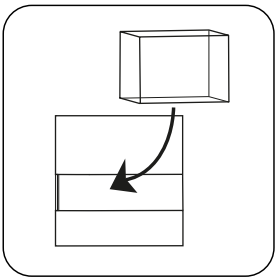
Heat sample to 10 °C above cloud point.
If available, set the device heating.



Stir sample to disturb convection currents.



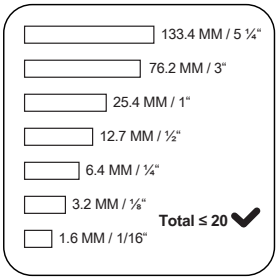
Fill prepared sample in the sample cuvette to 75 % of maximum.



Place cuvette containing Sample in the sample chamber. Pay attention to the positioning.

Cuvette Pathlength Selection

Set the path length in the devices: Model Fx, PFXi

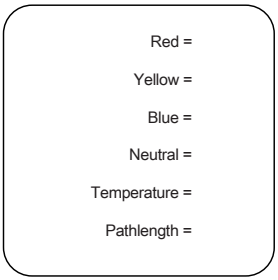


Choose a pathlength which allows a match using ≤ 20 Colour units in total.

Taking Measurement

Performing a Test: Model Fx, PFXi

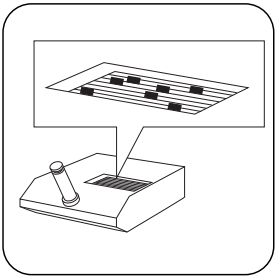
Press the **READ** button (Model Fx: √ button) to take measurement.



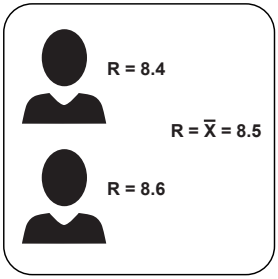
Record results.

Taking Measurement

Performing a Test: Model F



Using all of the glass standards, slide the standards until the colour of the standards match the colour of the sample.
With some lighter oils an approximate initial match can be achieved by sliding the red values to match the samples, then sliding the yellow values by 10x that value.
This estimation should be adjusted to improve the colour match by adding neutral values and changing the reds and yellows to compensate.



It is recommended to take at least two values from two operators and use the average of each value. This helps to reduce the effect of subjective colour assessment.

Troubleshooting

Common Issue	Solution
We are measuring Lovibond RYBN values of R+Y+B or N >20.	Shorten the cell path length used for more precise results.
We wish to measure Lovibond RYBN, but only report (R)Red and (Y)Yellow.	Select Lovibond RY on your Lovibond Model Fx.
We wish to measure Lovibond RYBN, but wish to fix the ratio at 1:10.	Select Lovibond 1:10 on your Lovibond Model Fx.

AOCS-Tintometer Colour CM2

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
AF 710-3, Model Fx, PFXi-880 AT heated, PFXi-880/AT, PFXi-950, PFXi-950 heated, PFXi-995, PFXi-995 heated	1/4", 1", 5 1/4"	0 - 20 R, 0 - 70 R

Application List

- Food and Beverage
- Household Products
- Edible Oils and Fats

Applicable Standard

- AOCS Cc 13b-45
- AOCS Cc 8d-55
- AOCS Cc 13j-97

Liquid Reference Standards

Title	Packaging Unit	Part Number
AOCS-Tintometer Colour 0.4R 2.0Y (5¼")	500 ml	134240
AOCS-Tintometer Colour 1.6R 9.0Y (5¼")	500 ml	134250
AOCS-Tintometer Colour 1.9R 12.0Y (5¼")	500 ml	134260
AOCS-Tintometer Colour 2.5R 20.0Y (5¼")	500 ml	134270
AOCS-Tintometer Colour 3.0R 28.0Y (5¼")	500 ml	134280

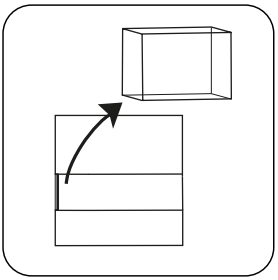
Glass Standards

Title	Packaging Unit	Part Number
AOCS-Tintometer Filter Set (Fx)	1 pc.	166900
AOCS-Tintometer Filter Set (PFXi 995/950/880)	1 pc.	136900
AOCS-Tintometer Colour (AF 710-3)	1 pc.	109720

Implementation of the provision AOCS-Tintometer Colour

Using colorimeter: Model Fx, PFXi, AF710-3
Select the colour scale on the device: Model Fx, PFXi
For this colour scale, a baseline measurement must be carried out in the following devices: Model Fx, PFXi

Perform Baseline Measurement (Automatic Instruments)

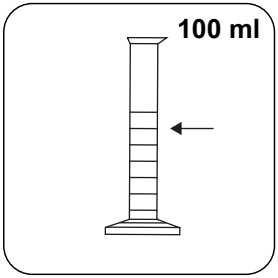


Ensure the measurement chamber is empty and close the lid.

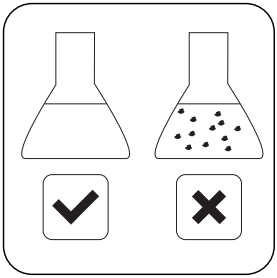
Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

Sample Preparation

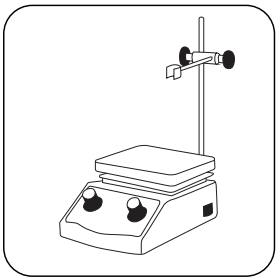
Prepare sample according to published standards.



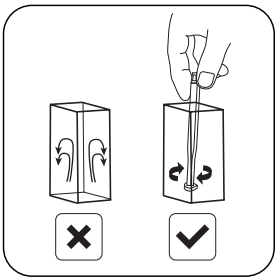
Sample volume of 100 ml required.



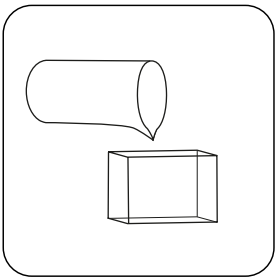
Vacuum filter to remove particles.



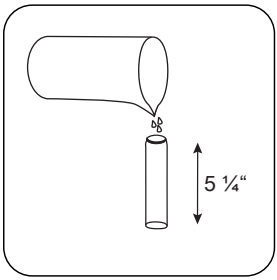
Heat sample to 10 °C above cloud point.
If available, set the device heating.



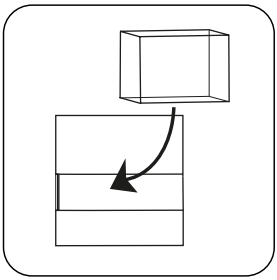
Stir sample to disturb convection currents.



Fill prepared sample in the sample cuvette to 75 % of maximum.



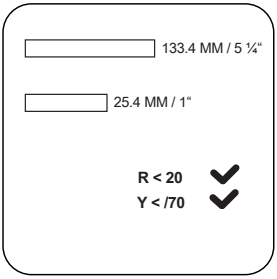
AF710-3: Fill one of the tubes to 5 ¼” mark. Insert into AF710-3.
Adjust focus of telescopic viewing tube for comfort.



Place cuvette containing Sample in the sample chamber. Pay attention to the positioning.

Cuvette Pathlength Selection

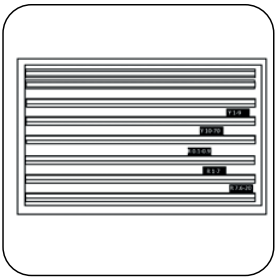
Set the path length in the devices: Model Fx, PFXi



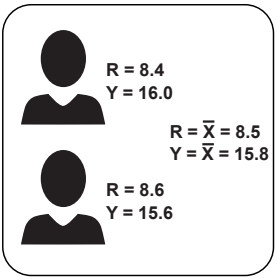
AOCS Cc 13b-45 only recommends reducing the path length to 1” if R >40. However, an oil that is darker than the maximum will appear on the screen as 20R or 70Y, so it would be advisable to reduce the path length to get a better idea of the true colour.

Taking Measurement

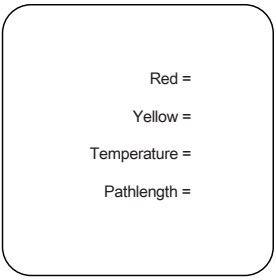
Performing a Test: AF710-3



Adjust Red and Yellow glass standards using highest values first by sliding racks until a colour match is achieved.
If a match is not possible reduce volume of oil to 1" mark on tube.
Record Red and Yellow total values.



It is recommended to take at least two values from two operators and use the average of each value. This helps to reduce the effect of subjective colour assessment.

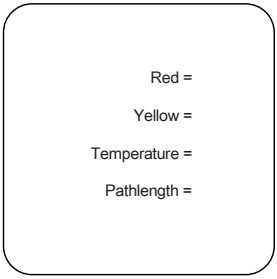


Record results.

Taking Measurement

Performing a Test: Model Fx, PFXi

Press the **READ** button (Model Fx: √ button) to take measurement.



Record results.

Chlorophyll CM3

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
Model Fx, PFXi-995, PFXi-995 heated	10 mm	unlimited

Application List

- Food and Beverage
- Edible Oils and Fats

Applicable Standard

- AOCS Cc 13d-55

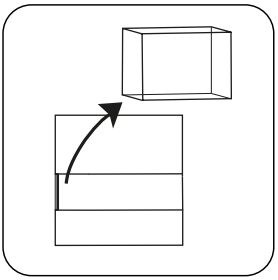
Glass Standards

Title	Packaging Unit	Part Number
Chlorophyll A (PFXi 995/950/880)	1 pc.	139530
Chlorophyll A (Fx)	1 pc.	169530

Implementation of the provision Chlorophyll

Using colorimeter: Model Fx, PFXi
Select the colour scale on the device: Model Fx, PFXi

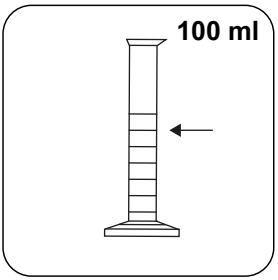
Perform Baseline Measurement (Automatic Instruments)



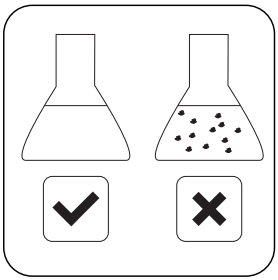
Ensure the measurement chamber is empty and close the lid.

Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

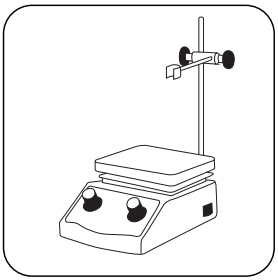
Sample Preparation



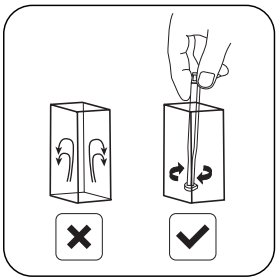
Sample volume of 100 ml required.



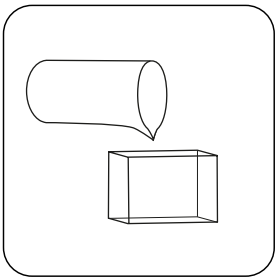
Vacuum filter to remove particles.



Heat sample to 30 °C or ≤ 10 °C above sample melting point.
If available, set the device heating.



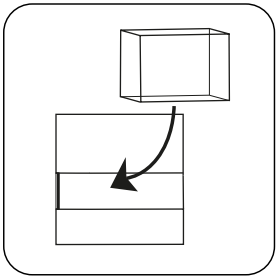
Stir sample to disturb convection currents.



Fill prepared sample in the sample cuvette to 75 % of maximum.

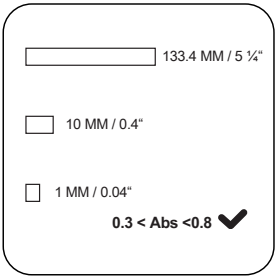
Cuvette Pathlength Selection

Set the path length in the devices: Model Fx, PFXi



Place cuvette containing Sample in the sample chamber. Pay attention to the positioning.

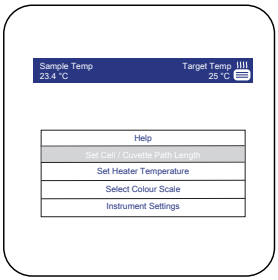
Press the **READ** button (Model Fx: √ button) to take measurement.



The method suggests adjusting the cell path length to ensure that the absorbances at 630, 670 and 710 nm all fall between 0.3 and 0.8 A. As a rough guide, 0 – 10 ppm can be measured at 1" to 5 ¼", 10 – 20 ppm at 10 mm and >20 ppm at 1 mm.

Setting Path Length

Select chosen path length in the PFXi menu and press ESC. The path length is used in the calculation of the result. If the setting in the instrument is different from the cell, the result will be incorrect.

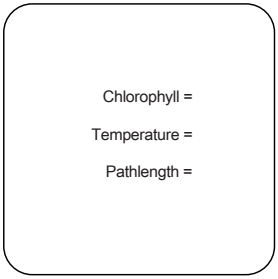


Select chosen path length in the Model Fx menu and press Enter. The path length is used in the calculation of the result. If the setting in the instrument is different from the cell, the result will be incorrect.

Taking Measurement

Performing a Test: Model Fx, PFXi

Press the **READ** button (Model Fx: √ button) to take measurement.



Record results.

Red and Yellow Values to Indian Standard - Sesame Oil, Mustard Oil, Mahua Oil

CM4

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
Model F, Model F (BS 684) with Compensating slides, Model Fx, PFXi-880/IP17, PFXi-880/IP 17 heated, PFXi-880/L, PFXi-880/S, PFXi-880/S heated, PFXi-880L heated, PFXi-950, PFXi-950 heated, PFXi-995, PFXi-995 heated, PFXi-995/P, PFXi-995/P heated	1/4"	0 - 79.9 R, 0 - 79.9 Y, 0 - 49.9 B, 0 - 3.9 N

Application List

- Food and Beverage
- Household Products
- Petroleum Oils and Waxes
- Edible Oils and Fats
- Chemicals

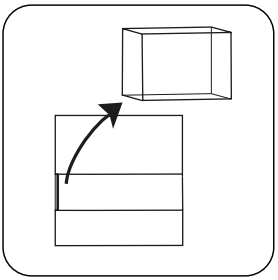
Applicable Standard

- IS 548 (part 1)-2010

Implementation of the provision Red & Yellow Values to Indian Standard - Sesame Oil, Mustard Oil & Mahua Oil

Using colorimeter: Model F, Model FX, PFXi
Select the colour scale on the device: Model Fx, PFXi
For this colour scale, a baseline measurement must be carried out in the following devices: Model Fx, PFXi

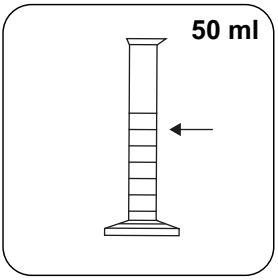
Perform Baseline Measurement (Automatic Instruments)



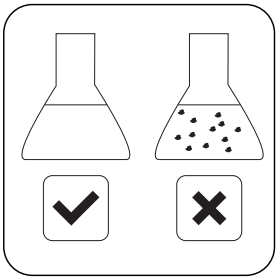
Ensure the measurement chamber is empty and close the lid.

Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

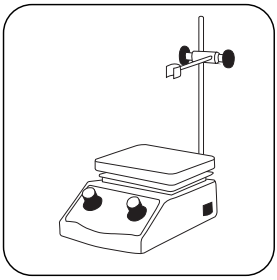
Sample Preparation



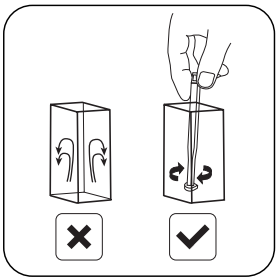
Sample volume of 50 ml required.



Vacuum filter to remove particles.



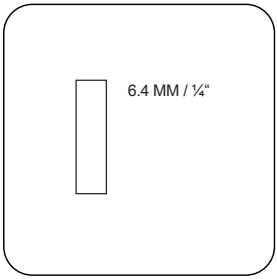
Heat sample to 10 °C above cloud point.
If available, set the device heating.



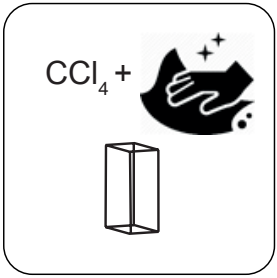
Stir sample to disturb convection currents.

Cuvette Pathlength Selection

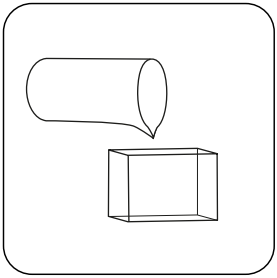
Set the path length in the devices: Model F



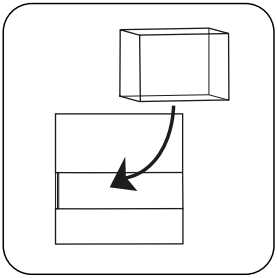
Clean Cell



Clean the cuvette.



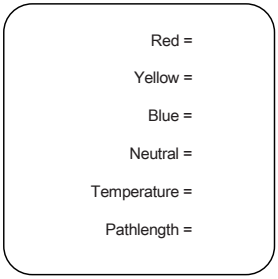
Fill prepared sample in the sample cuvette to 75 % of maximum.



Place cuvette containing Sample in the sample chamber. Pay attention to the positioning.

Taking Measurement

Performing a Test: Model Fx, PFXi

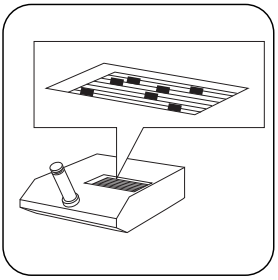


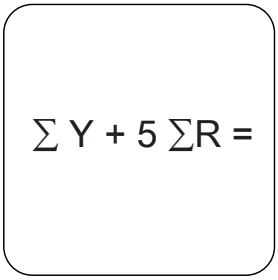
Press the **READ** button (Model Fx: √ button) to take measurement.

Record results.

Taking Measurement

Performing a Test: Model F





Using all of the glass standards.
Slide the standards until the colour of the standards match the colour of the sample.

Total the values on the Yellow sliding standards.
Total the values on the Red sliding standards.
Multiply the total Red values by five and add to total Yellow values to give result.

Red and Yellow Values to Indian Standard - Castor, Ground Nut, Coconut Oil

CM5

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
Model F, Model F (BS 684) with Compensating slides, Model Fx, PFXi-880/IP17, PFXi-880/IP 17 heated, PFXi-880/L, PFXi-880/S, PFXi-880/S heated, PFXi-880L heated, PFXi-950, PFXi-950 heated, PFXi-995, PFXi-995 heated, PFXi-995/P, PFXi-995/P heated	1"	0 - 79.9 R, 0 - 79.9 Y, 0 - 49.9 B, 0 - 3.9 N

Application List

- Food and Beverage
- Household Products
- Petroleum Oils and Waxes
- Edible Oils and Fats
- Chemicals

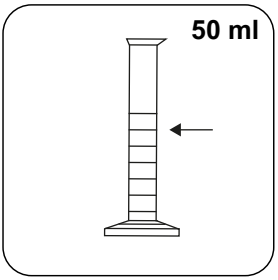
Applicable Standard

- IS 548 (part 1)-2010

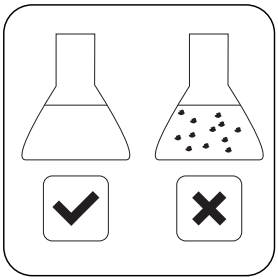
Implementation of the provision Red & Yellow Values to Indian Standard - Castor Oil, Ground Nut Oil & Coconut Oil

Using colorimeter: Model F, Model Fx, PFXi
Select the colour scale on the device: Model Fx, PFXi

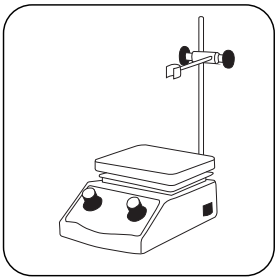
Sample Preparation



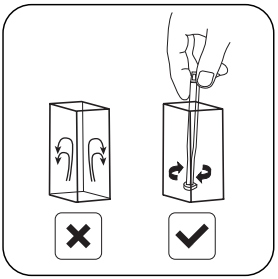
Sample volume of 50 ml required.



Vacuum filter to remove particles.



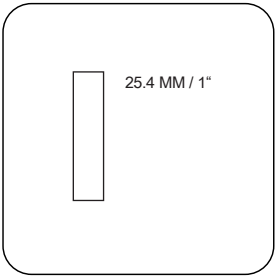
Heat sample to 10 °C above cloud point.
If available, set the device heating.



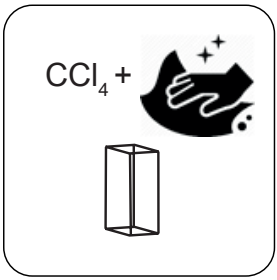
Stir sample to disturb convection currents.

Cuvette Pathlength Selection

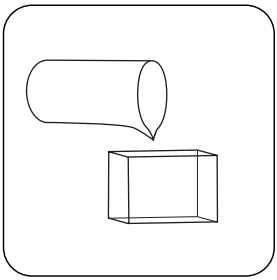
Set the path length in the devices: Model F, Model Fx, PFXi



Clean Cell

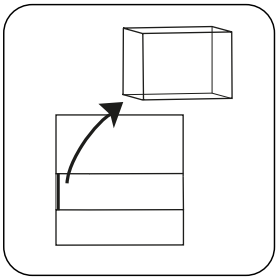


Clean the cuvette.



Fill prepared sample in the sample cuvette to 75 % of maximum.

For this colour scale, a baseline measurement must be carried out in the following devices: Model Fx, PFXi

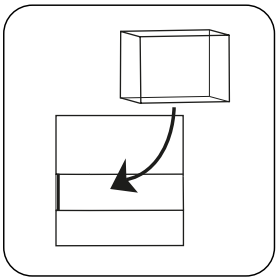


Ensure the measurement chamber is empty and close the lid.

Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

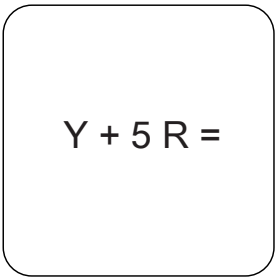
Taking Measurement

Performing a Test: Model Fx, PFXi



Place cuvette containing Sample in the sample chamber. Pay attention to the positioning.

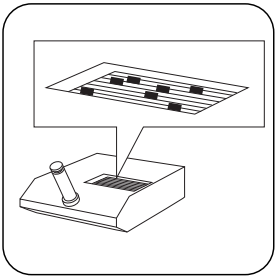
Press the **READ** button (Model Fx: √ button) to take measurement.



Multiply the total Red values by five and add to total Yellow values to give result.

Taking Measurement

Performing a Test: Model F



Using all of the glass standards.
Slide the standards until the colour of the standards match the colour of the sample.

$$\sum Y + 5 \sum R =$$

Total the values on the Yellow sliding standards.
Total the values on the Red sliding standards.
Multiply the total Red values by five and add to total Yellow values to give result.

Red and Yellow Values to Indian Standard - Castor, Ground Nut, Coconut Oil

CM6

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
Model F, Model F (BS 684) with Compensating slides, Model Fx, PFXi-880/IP17, PFXi-880/IP 17 heated, PFXi-880/L, PFXi-880/S, PFXi-880/S heated, PFXi-880L heated, PFXi-950, PFXi-950 heated, PFXi-995, PFXi-995 heated, PFXi-995/P, PFXi-995/P heated	1/4"	0 - 70 R, 0 - 70 Y, 0 - 40 B, 0 - 3.9 N

Application List

- Food and Beverage
- Household Products
- Petroleum Oils and Waxes
- Edible Oils and Fats
- Chemicals

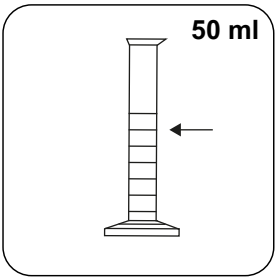
Applicable Standard

- IS 548 (part 1)-2010

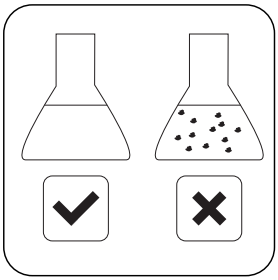
Implementation of the provision Red & Yellow Values to Indian Standard - Castor Oil, Ground Nut Oil & Coconut Oil

Using colorimeter: Model Fx, PFXi
Select the colour scale on the device: Model Fx, PFXi

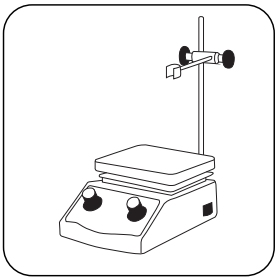
Sample Preparation



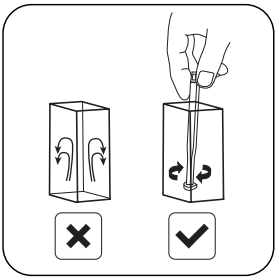
Sample volume of 50 ml required.



Vacuum filter to remove particles.



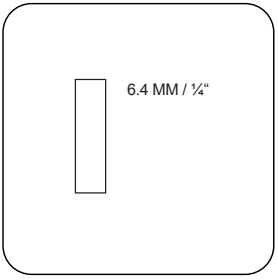
Heat sample to 10 °C above cloud point.
If available, set the device heating.



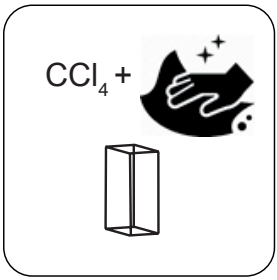
Stir sample to disturb convection currents.

Cuvette Pathlength Selection

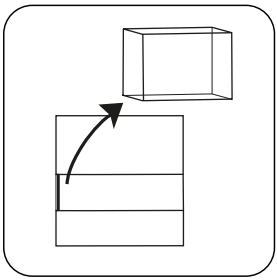
Set the path length in the devices: Model Fx, PFXi



Clean Cell



Clean the cuvette.
For this colour scale, a baseline measurement must be carried out in the following devices: Model Fx, PFXi

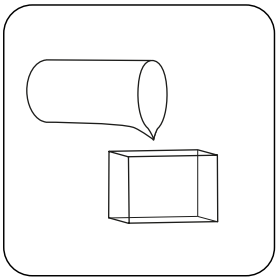


Ensure the measurement chamber is empty and close the lid.

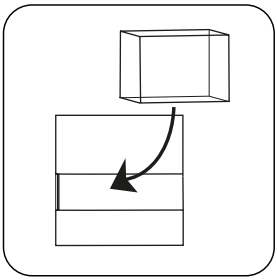
Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

Taking Measurement

Performing a Test: Model Fx, PFXi

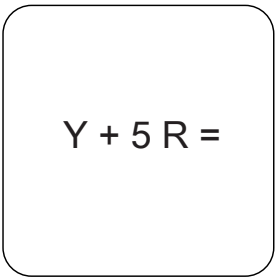


Fill prepared sample in the sample cuvette to 75 % of maximum.



Place cuvette containing Sample in the sample chamber. Pay attention to the positioning.

Press the **READ** button (Model Fx: √ button) to take measurement.



Multiply the total Red values by five and add to total Yellow values to give result.

Red and Yellow Values to Indian Standard - Cottonseed Oil

CM7

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
Model F, Model F (BS 684) with Compensating slides, Model Fx, PFXi-880/IP17, PFXi-880/IP 17 heated, PFXi-880/L, PFXi-880/S, PFXi-880/S heated, PFXi-880L heated, PFXi-950, PFXi-950 heated, PFXi-995, PFXi-995 heated, PFXi-995/P, PFXi-995/P heated	1/4"	0 - 79.9 R, 0 - 79.9 Y, 0 - 49.9 B, 0 - 3.9 N

Application List

- Food and Beverage
- Household Products
- Petroleum Oils and Waxes
- Edible Oils and Fats
- Chemicals

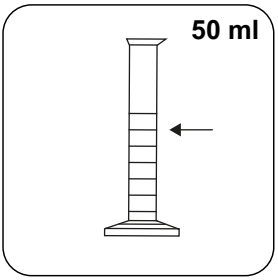
Applicable Standard

- IS 548 (part 1)-2010

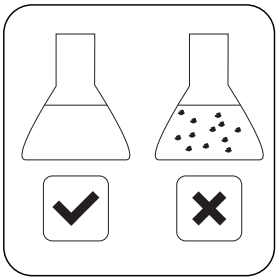
Implementation of the provision Red & Yellow Values to Indian - Cottonseed Oil (washed & refined)

Using colorimeter: Model F, Model Fx, PFXi
Select the colour scale on the device: Model Fx, PFXi

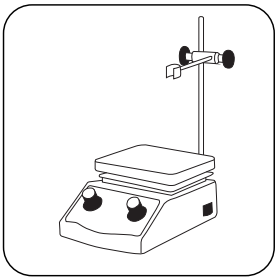
Sample Preparation



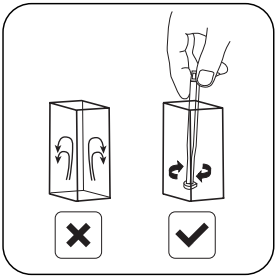
Sample volume of 50 ml required.



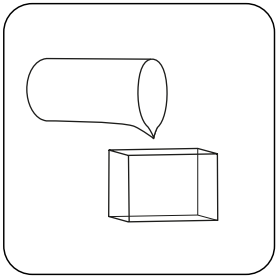
Vacuum filter to remove particles.



Heat sample to 10 °C above cloud point.
If available, set the device heating.



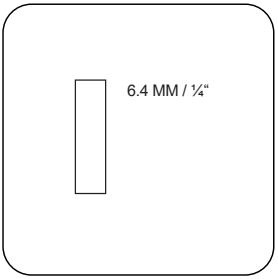
Stir sample to disturb convection currents.



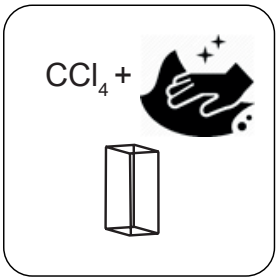
Fill prepared sample in the sample cuvette to 75 % of maximum.

Cuvette Pathlength Selection

Set the path length in the devices: Model F, Model Fx, PFXi



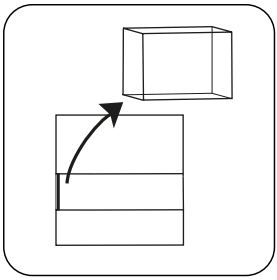
Clean Cell



Clean the cuvette.

Perform Baseline Measurement (Automatic Instruments)

For this colour scale, a baseline measurement must be carried out in the following devices: Model Fx, PFXi



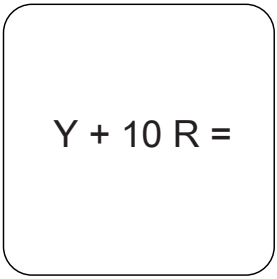
Ensure the measurement chamber is empty and close the lid.

Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

Taking Measurement

Performing a Test: Model Fx, PFXi

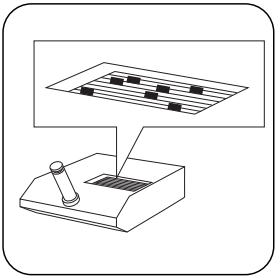
Press the **READ** button (Model Fx: √ button) to take measurement.



Multiply the total Red values by ten and add to total Yellow values to give result.

Taking Measurement

Performing a Test: Model F



Using all of the glass standards.
Slide the standards until the colour of the standards match the colour of the sample.

$$\sum Y + 10 \sum R =$$

Total the values on the Yellow sliding standards.
Total the values on the Red sliding standards.
Multiply the total Red values by ten and add to total Yellow values to give result.

Beta Carotene CM8

Instrument specific information

The test can be performed on the following devices. In addition, the required path length and the range of the colour scale are indicated.

Title	Scale Path Length	Scale Range
Model Fx, PFXi-995, PFXi-995 heated	10 mm	0 - 1000 ppm

Application List

- Food and Beverage
- Edible Oils and Fats

Applicable Standard

- BS684 Section 2.20

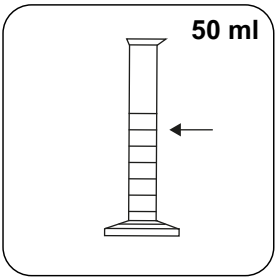
Glass Standards

Title	Packaging Unit	Part Number
Beta carotene (PFXi 995/950/880)	1 pc.	139520
Beta carotene (Fx)	1 pc.	169520

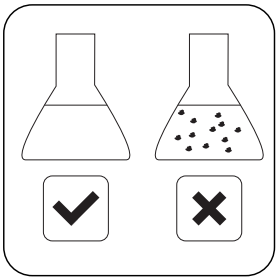
Implementation of the provision Beta Carotene

Using colorimeter: Model Fx, PFXi
Select the colour scale on the device: Model Fx, PFXi

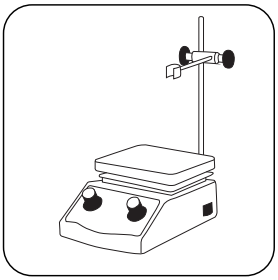
Sample Preparation



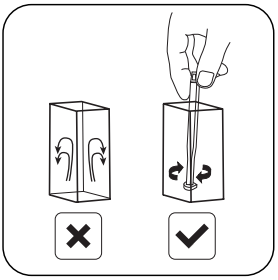
Sample volume of 50 ml required.



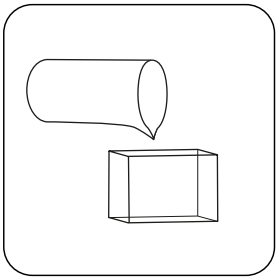
Vacuum filter to remove particles.



Heat sample to 10 °C above cloud point.
If available, set the device heating.

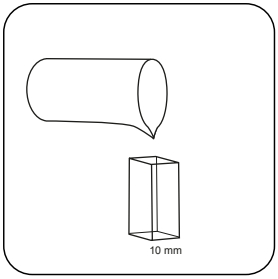


Stir sample to disturb convection currents.

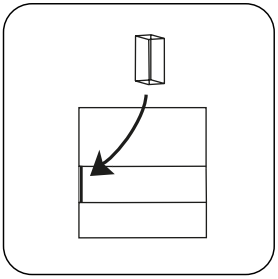


Fill prepared sample in the sample cuvette to 75 % of maximum.

Perform Baseline Measurement (Automatic Instruments)



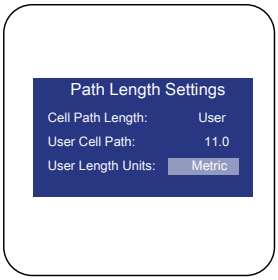
Fill 10 mm cuvette with Cyclohexane



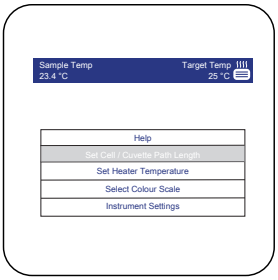
Place sample vial in the sample chamber. • Pay attention to the positioning.

Press the **ZERO** button (Model Fx: **Ø** button) to perform a baseline.

Setting Path Length

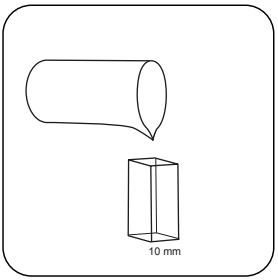


Select chosen path length in the PFXi menu and press ESC. The path length is used in the calculation of the result. If the setting in the instrument is different from the cell, the result will be incorrect.

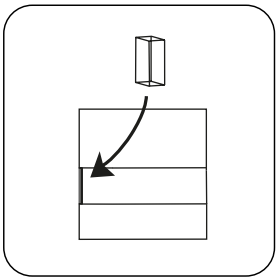


Select chosen path length in the Model Fx menu and press Enter. The path length is used in the calculation of the result. If the setting in the instrument is different from the cell, the result will be incorrect.

Taking Measurement

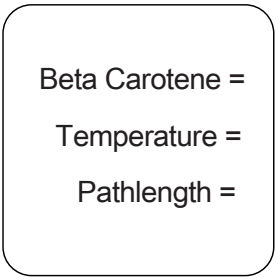


Fill cuvette with prepared sample in solution with cyclohexane. Please note it is important for the oil content to be as close to 1g in 100 ml as possible for the best accuracy.



Place sample vial in the sample chamber. • Pay attention to the positioning.

Press the **READ** button (Model Fx: √ button) to take measurement.



Record results.

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