Operator Instruction Manual Lovibond® Model F

Lovibond® Colour Measurement

Contents

Introduction

The Lovibond Colour Scale

This is the original Lovibond scale and was developed more than 100 years ago. This scale designed for visual measurement, remains in use today in many different industries. It employs 84 calibrated glass colour filters of different densities of magenta (red), yellow, and blue, graduating from desaturated to fully saturated, and a range of neutral filters which can be used in various combinations to reproduce any required colour match. Since several million combinations are possible, an excellent match can be made, and a sample's colour can thus be accurately defined in terms of the filter combination necessary to produce that match.

The Lovibond Unit of colour is an arbitrary one which, through long and world wide use, has gained international acceptance. The system is easily understood by anyone, and has proved satisfactory for most colour measuring purposes provided that all users obey the same conventions. The system must be used as intended or discrepancies will result. The system has the outstanding merit, frequently mentioned by writers of many nationalities, that a match obtained by the use of its three "subtractive primary colours" is much nearer an "energy match" than that obtainable by any other means. The visual colour produced by a combination of Lovibond glasses is likely to be the same composition in its various constituent parts as the colour of the natural object being matched. Hence there is a greater likelihood of agreement between observers.

If, for any reason, an operator alters the method of use or changes any convention, it is important that he should give details when recording results, otherwise confusion could ensue (see section **Recording results).** For example, observers employ neutral glasses to dull a bright sample, but omit to report the fact. In other cases, they endeavour to make the best possible match without using neutral glasses although they were needed, or use different colours in combination only in a fixed ratio according to some arbitrary convention.

Colour Nomenclature

The Lovibond system provides its own simple language of colour which can fully describe the appearance of any colour in the least possible number of words and figures to avoid language difficulties. For convenience of laboratory records, or in communicating readings between laboratories, many industries record their results on a three colour basis, quoting the Red, Yellow and Blue instrumental values as they stand. These values cover every possible requirement.

Some industries find it more convenient to simplify these terms by using the six divisions of the spectrum.

Red

- Orange - combination of red and yellow.

Yellow

- Green - combination of yellow and blue.

Blue

- Violet - combination of red and blue.

These six terms are used in combination with "bright" and "dull".

A sample is described as being bright when the nearest possible match appears dull in comparison. When this occurs, neutral values are introduced and recorded as sample brightness.

A sample is described as being dull when red, yellow and blue are required to make a match. The value of the colour which is least is expressed as dullness.

Description

Introduction

The Lovibond Tintometer Model F (BS 684) is a versatile and easy to use visual colorimeter for measuring the colour of liquid oils and fats in terms of Lovibond Red, Yellow, Blue and Neutral units. It is specified for

measurement of Lovibond Colour in a number of National and International Standard Specifications: BS 684 Section 1.14, ISO/FDIS 15305 and AOCS Method Cc 13e - 92. It is different to the standard

version of the Tintometer Model F in that racks containing the coloured glass filters are fitted with clear colourless glasses in the sample field. The instrument also includes a black plastic cell cover to prevent light from entering the sides of the sample cell. Because of these variations' measurements obtained on the Lovibond Tintometer BS (684) should not be compared directly with those obtained on a standard version of the Lovibond Tintometer. They are, however, compatible with those obtained on the AF 905 Version of the Tintometer Model E which was superseded by the Model F (BS 684) in 1997.

The Instrument

The Tintometer Model F (BS 684) comprises a cabinet containing two lamps; the light they generate passes through diffusing glasses into a central integrating chamber. This arrangement ensures identical conditions for both sample and reference fields. An optical system allows the colour of a sample to be determined by moving sets of standard coloured filters into view until a colour match is obtained.

The main components of the instrument are:

- a sheet steel cabinet finished in a tough, textured-finish, grey paint
- two quartz-halogen lamps
- a light diffusing system
- a prismatic viewing system with integral blue filter for light correction
- 11 black plastic racks containing graduated Lovibond glass colour standards and glass compensating slides
- a disposable white plastic sample chamber liner with a channel for cell location and a replaceable Halon standard white reflector
- positive illuminating on/off switch on the top of the cabinet (IP68 sealed)
- a 12 Volt power pack which is selectable to suit either a 110 Volt or 220 Volt supply
- Halon standard white reflector

- fittings for the presentation of solid samples
- fused optical glass cells, (1/16", 1/8", 1/4", 1/2", 1", 5 1/4")
- a black plastic cell cover (use optional)

The Racks

The colour standards are housed in eleven black plastics racks, each rack containing a graduated range of the Lovibond Red, Yellow, Blue and Neutral scales. Only coloured glass manufactured by The Tintometer Limited Glassworks is used. It is acknowledged that Lovibond glass standards are colour stable over very long periods.

For consistent results the racks should always be assembled in the following order with the first rack towards the back of the instrument.

- Rack (1) Red 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9
- Rack (2) Red 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
- Rack (3) Red 10.0, 20.0, 30.0, 40.0, 50.0, 60.0, 70.0

- Rack (4) Yellow 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9
- Rack (5) Yellow 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
- Rack (6) Yellow 10.0, 20.0, 30.0, 40.0, 50.0, 60.0, 70.0

- Rack (7) Blue 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9
- Rack (8) Blue 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
- Rack (9) Blue 10.0, 20.0, 30.0, 40.0

- Rack (10) Neutral 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9
- Rack (11) Neutral 1.0, 2.0, 3.0

Method of operation

Electrical safety warning - before connecting the instrument to the mains supply, please read the instructions below. Always disconnect from mains before removing the cover.

The Lovibond Tintometer Model F (BS 684) comes complete with a purpose-built external power supply unit. Before using the instrument check that the correct voltage setting has been selected for the local supply voltage. The voltage selector switch is located on the power supply unit and can be adjusted, if necessary, with a suitable screwdriver.

The instrument is supplied with a power lead fitted with a moulded plug which should conform to local requirements. If however, the plug is not of the correct type, a replacement should be obtained. Please note when replacing plugs or leads that this unit must be earthed.

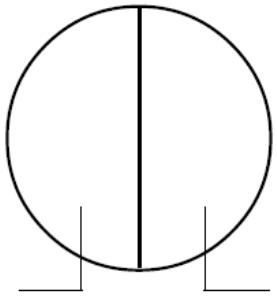
Set up

Place the instrument so that ambient light from windows or other bright sources does not shine into the eyes of the operator when making colour matches. Facing a neutral coloured blank wall is the ideal position. The height of the instrument should be such that the observer can look straight into the eyepiece without undue physical strain.

The instrument should be set up as follows:

- open the sample chamber lid
- check that there are no obstructions or samples in the chamber
- ensure that the removable sample chamber insert is not soiled by the residue from previous samples. Any discoloration will affect the colour of the illumination and the result of any measurement. The insert is easy to replace if necessary (see section **Cleaning or replacing sample chamber**).
- connect the instrument to an appropriate power supply
- switch the instrument on
- check that both lamps are working
- ensure that the Halon white standard is clean and in position
- close the sample chamber lid
- push all racks to their extreme left position
- look into the eyepiece
- both semi-circular fields should now appear uniform.

Diagram of Viewing aperture



Sample colour Matched colour

Presentation of samples

Samples can be divided into transparent and non-transparent, i.e. those which require to be viewed by transmitted light and those which need to be viewed by reflected light. Standardisation of sample presentation is extremely important for the reproducibility of results. The colour of Transparent liquids should be measured by placing the liquid in one of the W600 range of Lovibond glass cells. The windows of the glass cells must be clean otherwise discrepancies in measurement will occur. (See section **Choice of Cell Path length and section Sample Preparation).**

Non-transparent samples may include materials such as solid surface colours, inks, jam, powders, sauces, pastes, cloths, yarns etc. Viscous liquids, pastes and powders may be poured into a W600/OG/1" Lovibond glass cell. This is placed either in the cell channel at the rear of the sample chamber or held against the outside of the lower aperture using the Solid Sample Holder. Any solid should be presented against the rear of the instrument in the same manner. Very large samples may be pushed against the rear of the cabinet.

Note: The coloured glass filters must always be viewed against the Halon standard white reference (see section Accessories and Spares).

Choice of cell path length

Unless working to particular specification, the optical path length of the cell used should be related to the colour intensity of the sample. As a guide, it is advisable that the depth of colour should never be greater than that which may be matched by a total of 20 Lovibond units. This is because slight differences are most easily perceived in intensities ranging between approximately 3 and 10 units of the predominating colour. Discrimination of small differences falls off with increasing intensity. It is essential that the cell size used is recorded (see section **Recording results).**

Measurement

Having placed the sample in position, focus the viewing tube until a sharp image of the aperture is obtained. Slide the tabs controlling the coloured filters to the right. The proportions of Red, Yellow and Blue must be adjusted until a colour match is obtained. Before commencing the match, a rough estimate of the colour may be made and set up, thus avoiding time wasted on unlikely combinations of colours. If the sample requires the employment of only one or two of the colour series and glasses appear duller than the sample, neutral slides should be used over the sample. If a combination of all three colour series appears duller than the sample, then a reduction of the colour series with the

lowest value should be made. Where all three colour series in combination are used neutral slides should NEVER be used over the sample. (See section **Use of Neutral Racks).**

Do not stare into the eyepiece for longer than necessary; discrimination decreases with fatigue. Rest the eyes by looking away, preferably at a neutral coloured surface for a few seconds, then recheck, arriving at a measurement in short steps rather than in one long observation. The values, in Lovibond Units, for the colour match may be read in the indicator apertures in the slotted guide plate (See also section **Recording Results).**

Use of Neutral Racks

The two neutral racks, marked with black numerals on a white background, should be used for dulling the colour of the sample. If the colour of the sample appears bright when viewed against one or two of the colour series in combination, neutral filters should be introduced over the sample until a colour match is obtained. It is important that brightness is adjusted; brightness difference of the sample to the glass standards may cause errors in the colour match. **The amount of neutral used should be recorded (see section Recording Results).**

Note: Neutral racks must not be used if all three colour series are used to produce a colour match, the colour with the lowest value should be reduced to adjust the dullness of the matching colour slides.

Recording results

A colour measurement record sheet is supplied with the Lovibond Tintometer Model F. This can be used as a master for photocopying (order code 18 11 19). The following is a suggested record for each colour measurement:

- date
- time (if relevant)
- name of observer
- description of sample
- sample reference number (if relevant)
- temperature of sample if heated
- any comments on condition of sample (e.g. turbid or dirty etc.)
- path length of optical cell
- colour match (Lovibond Red, Yellow and Blue values)
- neutral values used (must be recorded for reference)
- any other information required by the organisation
- any comment relevant to the colour match.

Preparation of Samples

Introduction

The Tintometer Model F will accept samples of most materials providing that they fit into the lower field of view in the instrument without interfering with the reference filter field; alternatively the sample may be located at the rear of the sample chamber for surface colour measurement (see section Non transparent Samples below).

Transparent Samples

Non viscous transparent liquids should be poured into an optical glass cell which is placed within the channel in the sample chamber insert. Please ensure that the optical glass window of the cell is positioned flush against the front lower aperture. When measuring transparent samples inside the instrument the Halon standard white reflector must cover top and bottom apertures at the rear of the sample chamber (see section **Presentation of sample).**

There will possibly be standard procedures relating to the measurement of many substances. In the absence of any direct rules which require otherwise the optical path length of the cell should be chosen to suit the intensity of colour to be measured (see section **Choice of Cell Path Length).**

To obtain accurate results, cells must be absolutely clean.

Transparent solids such as glass or gelatine may be placed over the lower front aperture and measurements made as for liquids

Samples which require heating

In the case of fats, tallows etc. some form of heating to about 10 degrees above their melting point will be necessary. Some oils are turbid and need to be warmed before measuring.

Where hot samples are to be used it is recommended that Borosilicate Cells (W600/B/range) are employed. Cells should be warmed before filling with hot fats otherwise the fat may start to solidify around the windows.

Any spills inside the sample chamber should be dealt with immediately; discoloration of the white sample chamber may lead to errors (see section Care of instrument).

Non transparent samples

Opaque or translucent samples may be measured by reflected light in the Tintometer Model F (see section **Presentation of sample**). Alternatively, reflected colours may be measured by placing the sample immediately against the rear lower aperture on the outside of the instrument using the solid sample clamp.

Note: Always remove the white sample chamber insert when measuring samples outside the instrument.

Measurements on other solid samples can be carried out as above providing that samples placed outside of the cabinet are adequately illuminated. Granular and other non-uniform samples may cause problems in measurement. Please contact The Technical Services Department at The Tintometer Limited for advice.

It is essential that methods used in sample presentation are accurately recorded and repeated for subsequent measurements otherwise differences and errors will result.

Treatment of results

Application of Beer/Lambert Laws

It is entirely misleading to measure a liquid in a half inch cell and then to double this and report it as the value of a one inch cell. The popular interpretation of the Beer/Lambert laws should be relied upon. In an extremely simplistic version, these laws may be translated that for a given wavelength, the transmission of a liquid is proportional to its concentration and/or thickness through which the observer looks. This is commonly taken to mean that the colour of a liquid is halved when viewed in half the thickness or double the dilution. It is important to note that the laws refer to" a given wavelength", i.e. monochromatic light and not white light. Many liquids are dichroic and do not obey these laws when viewed in white light. Dichroic substances show entirely different colours when viewed at varying thicknesses, a liquid that appears green when viewed through a one inch thickness may look red at six inches. Even with those liquids which appear to have a colour which varies in proportion to the layer thickness, it is unsafe to assume that simple proportional reckoning can be used with the Tintometer. The transmission curves of the sample and the combination of glasses will almost certainly be dissimilar, therefore no such relationship will hold.

Relevance of colour in difference in colour readings

It is important to remember that although every increment of one unit in the Lovibond Scale is an equal physical one, the eye becomes less sensitive to increases when the colour value is high. For example, one unit added to thirty units is a less obvious change than one unit added to three units. This is especially true in yellow, where a typical observer will see little apparent difference between thirty and thirty five units. This leads to the suggestion that the operator selects the cell path length to obtain colour readings between three and ten units in the predominant colour. (See section Choice of Cell). This must be taken into account when considering differences between colour matches e.g. large discrepancies above thirty units are far less significant than smaller discrepancies at a lower level.

Maintenance

Care of instrument

To maintain the performance of the Tintometer Model F (BS 684), spillages on the instrument or in the sample chamber should be cleaned immediately.

Care of filters

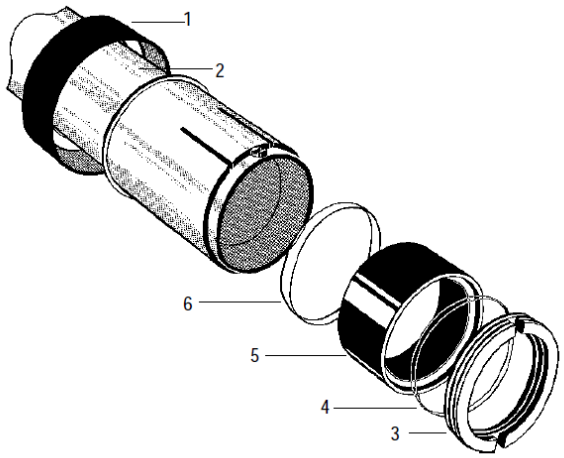
Coloured glass filters should be kept as clean as possible or errors may be introduced into measurements. The glass may be cleaned using a soft, lint-free cloth or cotton bud. Glass filters are retained in the plastics rack by a stainless steel circlip; care should be taken not to remove the glass from the rack. If glasses are accidentally removed from the rack they must be returned to their original position or readings will be invalidated.

Care of the viewing tube

The viewing tube can be dismantled for cleaning as shown in the diagram below.

- Carefully unscrew the locking bezel (1) and remove the draw tube (2) from the main base tube.
- Unscrew the slotted locking nut (3) from the bottom of the draw tube which will release the blue correction filter (4), the black spacer (5) and finally the focusing lens (6).
- Clean the lens (6) and replace it, followed by the spacer (5), ensuring the rebated end is facing the bottom of the draw tube.
- Clean the blue correction filter (4) and locate it back into the rebate on the spacer.
- Finally screw in the slotted locking nut to secure all the internal optical components. Check the draw tube for optical clarity and retighten the locking bezel.

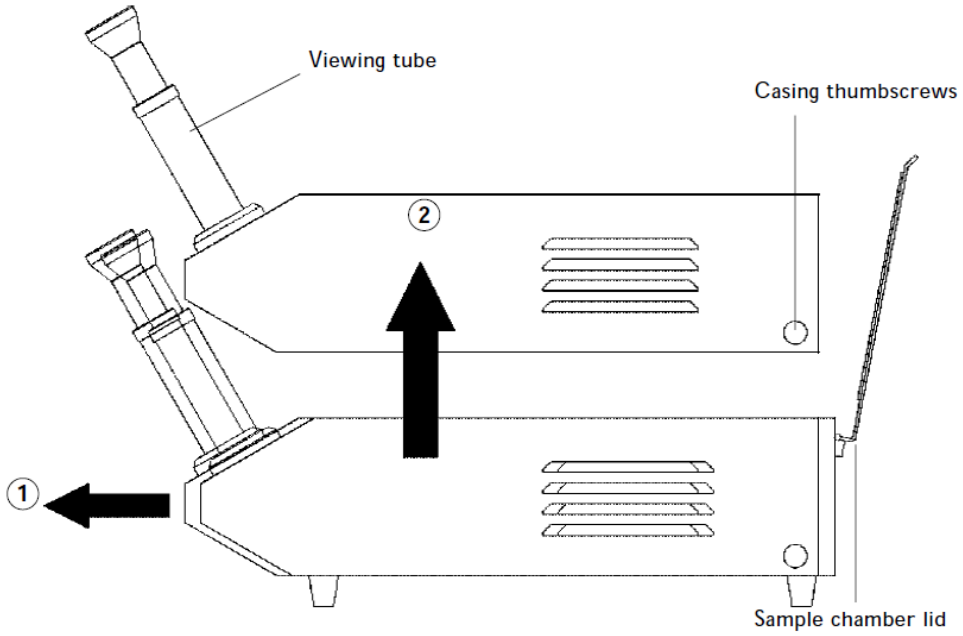
Note: Always use a suitable soft lens cloth for cleaning optical components.



Replacing the lamp

Always disconnect the instrument from the power supply before opening to replace lamps or clean/replace sample chamber.

- Open the sample chamber lid to its natural extent.
- Unscrew and remove the two casing thumbscrews on the sides of the instrument and place in a safe place.
- Next, slide the instrument top cover forward (1) and then lift upwards (2) as shown in the diagram below, using the viewing tube as a gripping point.



- Lift the cover clear of the base of the instrument and turn upside down to give easy access to the lamps located on the underside of the lid.
- Remove the old lamps (always replace in pairs) and dispose of carefully. Carefully replace with the new lamps using the protective plastic sleeving.

Avoid touching the lamps directly with fingers as this will significantly reduce the life of the lamps.

- Return the top cover to its original position ensuring that it has located properly on the front overhang. This will allow all the optics to align and will lock the top cover securely in position once the thumbscrews have been replaced.

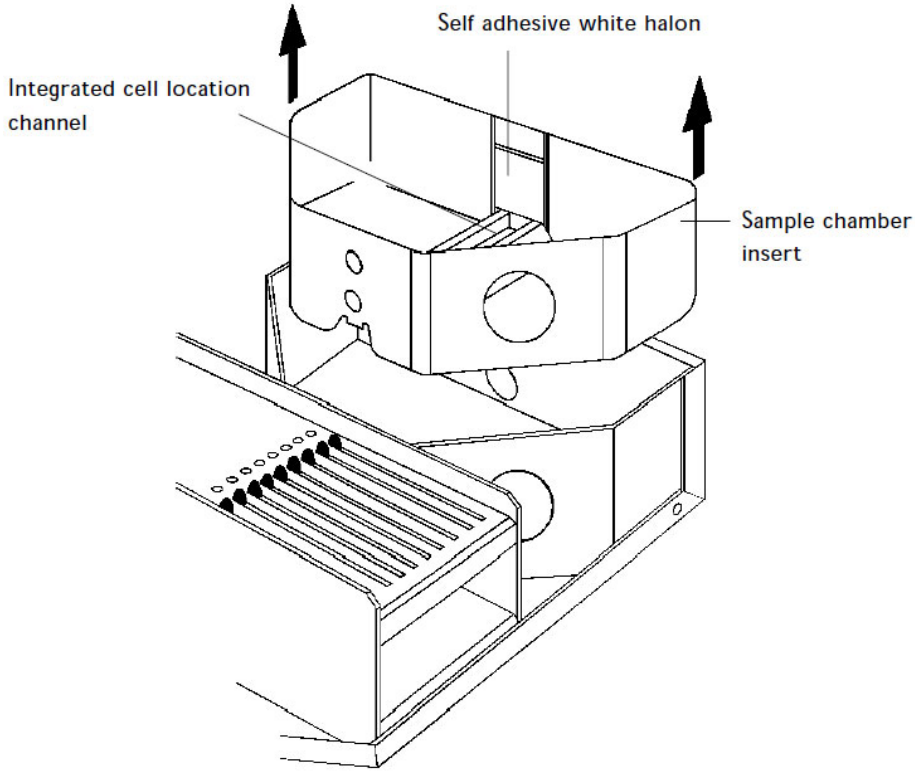
Cleaning or replacing the sample chamber

To maintain the performance of the Tintometer Model F (BS 684) spillages on the instrument or in the sample chamber should be cleaned immediately.

Should a spillage occur in the sample chamber, the Tintometer Model F (BS 684) has been specially designed to ensure that cleaning or replacing the sample chamber is as quick and simple as possible.

- Remove the top cover as described in the section '**Replacing the Lamps'** and lift clear of the instrument base.

- The Tintometer Model F (BS 684) has a sample chamber insert with an integrated cell location channel, which can be removed from the instrument as shown below.



- The sample chamber insert can be either rinsed clean or replaced entirely depending on age and discoloration. Alternatively, the tray can be cleaned and a new self-adhesive white halon reference can be positioned if necessary.

- Replacement packs for sample chambers are listed in the '**Accessories & Spares'** section.

- Replace the cleaned/new sample chamber insert to its original position, ensure the back edge locates securely under the rear lip of the instrument.

- Replace the top cover and thumbscrews and check optical alignment.

Cleanliness is fundamental to the accuracy and repeatability of test results. Discoloration of the white sample chamber will lead to errors especially in higher tolerance measurements.

Care of Glass cells

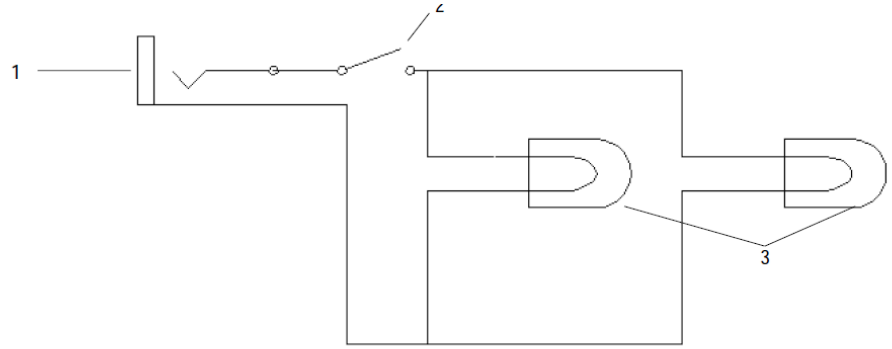
Cells should be cleaned immediately after use and examined for cleanliness before reuse in order to preserve the true transmittance of the sample. The type of cleaning will depend upon the nature of the material under test.

The cells should be immersed in a suitable strength warm solution of laboratory detergent e.g. Decon 90 for several hours if necessary. When the soiling is removed rinse thoroughly in deionised water, and finally in alcohol or acetone, before allowing to dry.

Never attempt to clean cells by pushing a piece of cloth down inside it, the leverage may crack the windows.

When cells are not in use, store where the windows will be protected from accidental damage.

Wiring Diagram



1 2 connector power input jack (3.5mm)
2 lamp on/off switch
3 12V 10W tungsten halogen lamps

Technical Specification

Item	Specification
Light source	2 x 12V 10 Watt tungsten halogen lamps
Optical system	Fully prismatic and adjustable with manual focusing
Sample requirements	Completely liquid, clear and bright.
Instrument housing	Fabricated steel with durable textured 'Trimite' paint finish
Power pack	Input Voltage: 110/220 V AC switchable
	Output Voltage: 12V AC
Instrument Input voltage	12V AC
Input frequency	50 - 60 Hz
Power consumption	2 amps 20 Watts (max.)
Environmental Requirements	Temperature range Operating: -10°C to +70°C
Dimensions	Width: 330 mm Depth: 410 mm Height: 230 mm
Instrument weight	8.3 kg
Technical assistance	The Tintometer Ltd, Lovibond House, Sun Rise Way, Amesbury. UK, SP4 7GT Tel: +44 (0)1980 664800 E-mail: Sales@Lovibond.uk

Accessories and Spares

Replacement Parts

Description	Pt No
Model F Solid Accessories Pack	18 01 00
Lamp 12V 10W pair	12 41 02
Replacement sample chamber insert	18 10 39
Replacement sample chamber insert (pack of 3)	18 01 10
Self-adhesive halon white reference	18 30 79
Black cell cover	18 11 49
Set of racks Model F (BS 684) Tintometer	18 02 10
Red rack 0.1 - 0.9 Model F (BS 684)	18 05 00
Red rack 1.0 - 9.0 Model F (BS 684)	18 05 10
Red rack 10.0 - 70.0 Model F (BS 684)	18 05 20
Yellow rack 0.1 - 0.9 Model F (BS 684)	18 05 30
Yellow rack 1.0 - 9.0 Model F (BS 684)	18 05 40
Yellow rack 10.0 - 70.0 Model F (BS 684)	18 05 50
Blue rack 0.1 - 0.9 Model F (BS 684)	18 05 60
Blue rack 1.0 - 9.0 Model F (BS 684)	18 05 70
Blue rack 10.0 - 40.0 Model F (BS 684)	18 05 80
Neutral rack 0.1 - 0.9 Model F (BS 684)	18 05 90
Neutral rack 1.0 - 3.0 Model F (BS 684)	18 06 00
Master Record Sheet	18 11 19

Optical Cells

Metric Optic Cells Supplied in the following pathlengths	
Type	**Order Code**
W600/OG/2.5mm	60 59 40
W600/OG/5mm	60 59 50
W600/OG/10mm	60 59 60
W600/OG/15mm	60 59 70
W600/OG/20mm	60 59 80
W600/OG/25mm	60 59 90
W600/OG/33mm	60 60 10
W600/OG/40mm	60 60 20
W600/OG/100mm	60 60 30

Imperial Optic Cells Supplied in the following pathlengths	
Type	**Order Code**
W600/OG/1/16”	60 60 40
W600/OG/1/8”	60 60 50
W600/OG/1/4”	60 60 60
W600/OG/1/2”	60 60 70
W600/OG/1”	60 60 80
W600/OG/2”	60 60 90
W600/OG/3”	60 61 00
W600/OG/4”	60 61 10
W600/OG/5”	60 61 20
W600/O/5 ¼”	60 61 30
W600/OG/6”	60 61 50