MODEL 6051

COLORIMETER

OPERATING MANUAL

605 023

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OPERATING MANUAL

CONTENTS

6051/REV D/01-96

SAFETY

Please read this information carefully prior to installing or using this equipment.
1. The unit described in this manual is designed to be operated only by trained personnel. Any adjustments, maintenance or repair must be carried out as defined in this manual, by a person qualified to be aware of the hazards involved.

2. It is essential that both operating and service personnel employ a safe system of work, in addition to the detailed instructions specified in this manual.

3. The covers on the unit should only be removed by personnel who have been trained to avoid the risk of shock.

4. Reference should always be made to the Health & Safety data supplied with any chemicals used. Generally accepted laboratory procedures for the safe handling of chemicals should be employed.

5. If it is suspected that safety protection has been impaired in any way, the unit must be made inoperative and secured against any intended operation. The fault condition should immediately be reported to the appropriate servicing authority.

SECTION 1

INTRODUCTION

1.1 INSTRUMENT DESCRIPTION

The Model 6051 is a general purpose laboratory colorimeter housed in a custom designed case.
The visible spectrum is covered by eight gelatin filters incorporated within the unit. Optional interference filters are available to enable other visible wavelengths to be obtained over the expanded range of 400 - 800nm.
Results are displayed in either %Transmittance, Absorbance or Concentration units via a 17mm L.C.D. readout.
Samples may be presented to the 6051 in 10mm square cuvettes of standard or semi-micro volumes, test-tubes or Pour-in/Suck-out cells. Additional accessories are available to allow the use of 20mm and 40mm cells, multiple sampling with the four cell carriage and a heated cell block for temperature dependent measurements.
An analogue output of 1mV per digit is available on the rear panel.
User maintenance is minimal.
The 6050 has been designed to operate on 230/115Vac or from an external 12Vd.c. source.

1.2 INSTRUMENT SPECIFICATIONS

Wavelength Range:	400 - 710nm (400 -800nm extended with optional interference filters)
Wavelength Selection:	8 gelatin filters on a switched wheel. Peak wavelengths of 430, 470, 490, 520, 540, 580, 600 and 710nm
Bandpass:	Typically 40nm gelatin (10nm for interference filters)
Display:	2½ digit, 17mm LCD display
Measurement Ranges:	Transmittance 0 to 100% Absorbance 0 to 1.50A Concentration 0.1 to 1000
Resolution:	1%T 0.01Abs 0.1 to 1 Conc
Warm-up Time:	2% per hour after 15 minutes warm-up
Zero Drift (Abs Mode):	Less than 0.02 Abs/hour after warm-up
Photometric Linearity:	1%T or ±0.01Abs whichever is greater
Sample System:	10mm square plastic cuvettes (standard or semi-micro volume) or test-tubes 20mm and 40mm cells
Light Source:	Tungsten filament
Detector:	Silicon photocell
Recorder Output:	Analogue 10mV per digit
Power:	230 or 115V a.c. ±15% 50/60Hz 12V d.c. external
Size:	300 x 355 x 120mm
Weight:	3kg

SECTION 2

INSTALLATION

2.1. UNPACKING

Remove the Model 6051 from the packaging and ensure the following items are present:

1. 6051 Colorimeter
2. Mains Cable
3. Pack 100 Disposable Plastic Cuvettes
4. Test Cuvette
5. Optional accessories (as ordered)

2.2. INSTALLATION

MAINS SUPPLY

The 6051 is designed to operate on 230 or 115V a.c. supplies (±15%) 50/60Hz.
The standard 2 metre mains lead supplied with the unit is fitted with an IEC type connector which can be plugged directly into the POWER IN socket on the rear panel.

Fuse ratings: 230V = 250mA (Anti-surge)
115V = 500mA (Anti-surge)

NOTE: The unit should be positioned within 1.5 metres of an earthed mains supply.

VOLTAGE SELECT

Before connecting the unit to the mains supply ensure the VOLTAGE SELECT switch on the rear panel is set to the correct position for the mains supply to be used (230 or 115).

MAINS CONNECTIONS

A suitable plug should be connected to the 3 wires on the mains lead. These are colour coded to conform to the internationally recognised standard such that:

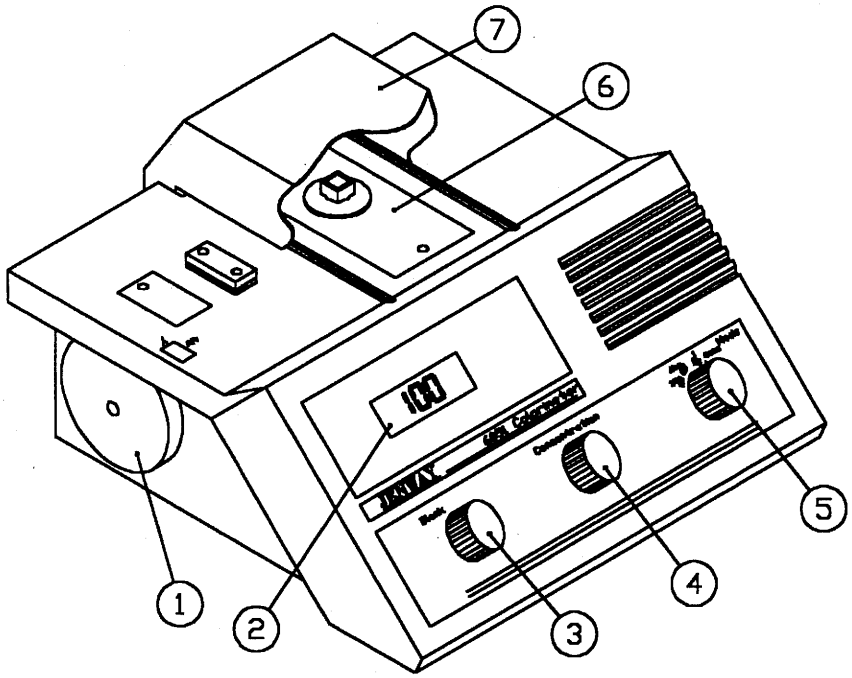
BROWN	**LIVE**
BLUE	**NEUTRAL**
GREEN/YELLOW	**EARTH**

IMPORTANT - THE UNIT MUST BE EARTHED

The Green/Yellow wire in the a.c. supply must be connected to a properly grounded terminal.

2.3 DISPLAYS/CONTROLS

Fig. 2.3.1 Front Panel Displays and Controls



1. **WAVELENGTH SELECT** — Thumbwheel used to select the correct wavelength for the specific tests being performed.

2. **MAIN DISPLAY** — 2½ Digit LCD

3. **BLANK CONTROL** — This control is used when standardising the unit. Normal practice is to set the Abs or %T value with a cuvette of deionised water. The BLANK control is then set to give the correct reading.

4. **CONC** — This control is used when the mode switch is in the CONC 1 and 2 positions. These ranges are extensions of the Absorbance mode, allowing the reading obtained to be set to a value convenient to the standard concentration.

5. **FUNCTION SWITCH** — This control determines the operating mode of the unit.

%T (%Transmission) — This is the ratio of light passing through the sample (It) to the light falling on to the sample (Io)

$$\%\text{Transmission} = \frac{It}{Io} \times 100\%$$

Transmission expressed as a percentage is non-specific about

the concentration of the sample being illuminated. A more useful unit of measurement is Absorbance.

ABS (Absorbance or Optical Density)

Absorbance has a direct relationship to the concentration of the coloured solution being analysed. The relationship is known as Beer's Law.
This can be defined as being equal to:

$$\log_{10} \frac{100}{\%T}$$

$$\log_{10} \frac{Io}{It}$$

In practice the intensity of the light is not directly measured and the relationship is better stated as:

$$\text{Absorbance} = \log_{10} \frac{\text{Intensity of light transmitted by reference liquid}}{\text{Intensity of light transmitted by sample}}$$

Concentration Ranges

These ranges are extensions of the absorbance mode, allowing the reading to be set to a value convenient to the reference solution concentration. The reading may be increased or decreased by up to a factor of ten.

6. **SAMPLE AREA**

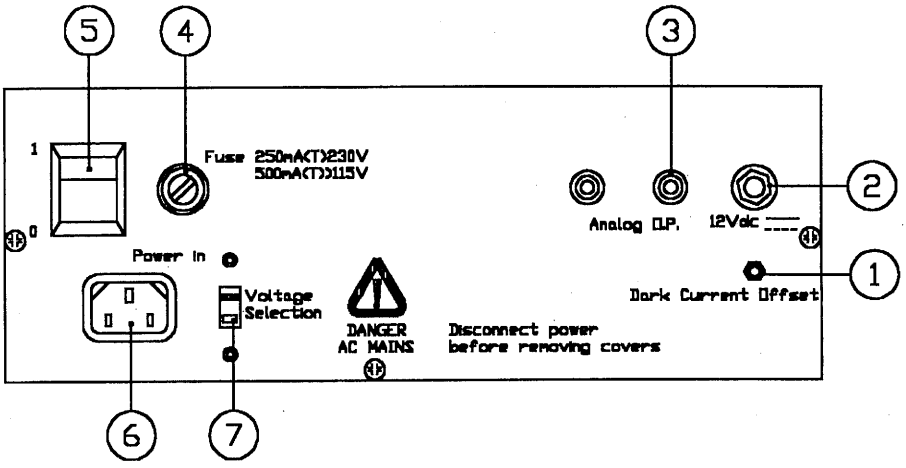
Samples may be presented in 10x10mm cuvettes of standard or semi-micro volumes or test tubes. 10x20 and 10x40mm cells may also be used with the optional cell holders.

7. **SAMPLE AREA LID**

The lid should be kept closed, when necessary to eliminate the possibility of erroneous results caused by the ingress of stray light. For many determinations the lid may be left open.

2.4 INPUTS/OUTPUTS

Fig. 2.4.1. Rear Panel Layout



1. **ZERO** — A preset control which should rarely require adjustment and is provided to offset photocell dark current.

2. **JACK SOCKET** — Connection socket for the external 12Vdc supply.

3. **4mm PIN SOCKETS** — An analogue voltage of 10mV per digit is available on these sockets.

4. **FUSE HOLDER** — Screw in holder for the mains fuse.
   Fuse ratings 230V = 250mA (T)
   115V = 500mA (T)

5. **ROCKER SWITCH** — On/Off switch for the unit.

6. **POWER IN SOCKET** — IEC type connection socket for mains cable.

7. **VOLTAGE SELECT** — 2 position slide switch for selection of line voltage (230 or 115V a.c).

SECTION 3

OPERATION

3.1 INITIAL SET-UP

1. Connect the unit to the mains supply and switch on. Select %T by use of the MODE switch. Allow 15 minutes warm-up period at this point to ensure the optical and electronic systems have sufficient time to stabilise.

2. Insert the test cuvette (black cuvette supplied with the unit) into the sample chamber. The wavelength reading is not critical at this point. The display should read zero. Adjustment to this reading can be made by use of the DARK CURRENT OFFSET control located on the rear panel. If adjustment is required the blank and zero settings should be re-checked until they are both correct.

3. Remove the test cuvette from the sample chamber.

4. Fill a cuvette to within 1cm of the top with distilled or deionised water and place in the sample chamber. Close the sample chamber lid. Select the required wavelength or interference filter. Set the display to read 100 using the BLANK control. The reading should be stable.

5. Remove the cuvette from the unit. The 6051 is now ready for use.

NOTE: **During sample measurement the sample area lid should ideally be kept in the closed position to eliminate the possibility of erroneous results caused by the ingress of stray light. For many determinations, however, the lid may be left open without causing significant errors.**

3.2. SAMPLE MEASUREMENT

1. Allow 15 minute Warm-Up prior to use (Refer Section 3.1).

2. Select the required filter position for maximum absorbance. If this is not known, the colour complimentary to that of the standard solution can be selected from the list given below. The chart may be read from left to right or right to left, i.e. a blue sample requires a yellow filter / a yellow sample requires a blue filter.

Blue	-	Yellow
Greenish/Blue	-	Orange
Bluish/Green	-	Red
Green	-	Red or Blue

Standard filter wavelengths and colours are as follows:

430nm	-	Violet
470nm	-	Blue
490nm	-	Blue/Green
520nm	-	Green
540nm	-	Yellow/Green
580nm	-	Yellow

600nm	-	Orange
710nm	-	Red

3. Place a blank solution into the sample compartment.

4. Select ABS by use of the MODE switch. Set the display to read zero by use of the BLANK control.

5. Place a cuvette containing a standard of known concentration into sample compartment.

NOTE: **For routine use operating with absorbances between the range of 0 and 0.6 is recommended. In some applications higher absorbances may produce non-linear results.**
If the standard solution is outside this range then either sample dilution or concentration should be considered.

6. The unit is now ready for operation in the Absorbance mode.

7. Operation in the %Transmittance mode can be performed by selecting %T using the MODE switch. The unit will now read directly in %T and the blank sample should read 100%T.

8. Operation in the Concentration mode can be performed by selecting either CONC 1 or 2 using the MODE switch. The standard value should be set to a convenient reading using the CONCENTRATION control. The unit will now read directly in sample concentration.

NOTE: **To ensure optimum performance refer to Section 3.3 GOOD PRACTICE GUIDELINES.**

9. When using separate interference filters set the filter wheel to one of the "F" positions. Remove the blanking filter from the filter compartment and insert the interference filter to be used. The "F" positions have varying degrees of light attenuation to cater for the wide spread of transmission characteristics encountered with interference filters.

The degree of attenuation varies from zero on position F1 through to a maximum on F4. In most normal circumstances position F1 will be most appropriate. If, however, lower than expected absorbance values are obtained, it is probable that the detector circuit is saturating and a range with more attenuation should be selected. The unit is now ready for use.

3.3 GOOD PRACTICE GUIDELINES

1. For optimum performance blank and sample calibration should be carried out at the beginning and end of every sample batch.

2. To ensure accurate results are obtained the sample area lid should be kept in the closed position when necessary.

3. The styrene cuvettes supplied with the unit are disposable (i.e. ideally they should be used once and then thrown away). Some repeat use is possible providing extreme care is taken during cleaning to ensure no damage occurs to the polished surfaces.

4. Plastic cuvettes are not suitable for use with organic solvents.

5. Glassware used in the preparation of standards should be made of a high grade borosilicate glass. The use of soda glass should be avoided wherever possible as leaching can occur during prolonged contact giving erroneous results.

6. Chemical reagents should, wherever possible, be of analytical grade. Contamination can cause problems, even if at very low levels.

7. There are some substances which do not follow Beer's Law. When attempting a new method it is advised that linearity checks should be performed over the range of concentrations being used. This can be carried out by preparing a quantity of known strength solutions and checking the results.

   a) Deviations from Beer's Law may occur at high concentrations by association of molecular ionic species.
   b) Deviations from Beer's Law may occur at low concentrations by variation in hydration introducing changes in the nature of complex ions.
   c) Absorption which does not obey Beer's Law will require a graph of known standards to be plotted. This should indicate Reading vs Concentration. The reading obtained from the unknowns can then be related to concentration from the graph.

SECTION 4

MAINTENANCE

4.1. GENERAL

The 6051 has been designed to give optimum performance with minimum maintenance. It is only necessary to keep the external surfaces clean and free from dust. To give added protection when not in use the unit should be disconnected from the mains supply and covered with the optional dust cover. For longer term storage or re-shipment it is recommended that the unit be returned to the original packing case.

4.2 LIGHT SOURCE REPLACEMENT

The only routine maintenance which may be required is the replacement of the light source if this fails. Failure should be suspected if the reading remains at zero in %T mode or reads overrange in ABS or CONC modes. This can be confirmed by looking into the cuvette chamber.
The tungsten filament lamp is a focused lens-end lamp 5.0V, 775mA Base type 1/2-20UNF-2A, available from the Manuafacturer or your local Distributor.

NOTE: DISCONNECT THE UNIT FROM THE MAINS SUPPLY PRIOR TO CARRYING OUT THIS PROCEDURE.

1. Check that the sample chamber is empty. Remove any separate interference filters or filter holder from the compartment on top of the unit.

2. Place the unit face down onto a clean, flat surface (protection by use of a soft cloth is advised). Unscrew the 7 retaining screws from the base and the 3 retaining screws located on the rear panel. Remove the base cover, taking care not to strain the earth bonding connection.

3. Carefully return the unit to the correct way up. Remove the small lamp fixing panel, (located to the left of the top of the unit), to expose the two lamp mount fixings. Remove the two lamp mount retaining screws and place carefully to one side.

4. Place the unit face down and remove the lamp, together with its mount and PTFE insulator. Disconnect the lamp cable from the PCB by gently easing off the connector. Unscrew the lamp from its mounting.

NOTE: When fitting the new lamp ensure any fingerprints are removed from the glass envelope. Removal should be carried out by using a soft cloth.

5. Insert the new lamp into the mount, ensuring that it is screwed fully home, but do not overtighten. Re-connect the lamp cable to the PCB connector. Turn the unit onto its side and place the lamp holder into position, ensuring the PTFE insulator is re-fitted between the lamp holder and chassis. Replace the securing screws while holding the lamp holder assembly in position. Replace the base cover, taking care to re-fit all the fixings. Care should be taken to ensure the earth wire is not trapped between the chassis when re-assembling the unit. Return the unit to the correct way up and re-fit the lamp access panel.

6. Connect the unit to the correct mains supply and switch on. Ensure the lamp is illuminated by looking into the sample chamber. The unit is now ready for use.

SECTION 5

OPTIONAL ACCESSORIES

5.1 OPTIONAL ACCESSORIES

The following list of items are available as optional accessories for use with the Model 6051:

060 084	Pack of 100 (10mm) Plastic Cuvettes (3ml)
060 087	Pack of 100 (1ml) Plastic Semi-micro Cuvettes (1ml)
605 004	10 x 20mm Cell Holder
605 005	10 x 40mm Cell Holder
605 006	Multi Cell Holder
605 007	Heated Cell Holder
035 025	Flow-through Cell
035 026	Pour-in/Suck out Cuvette
035 027	10 x 10mm Glass Cell
035 056	10 x 20mm Glass Cell
035 029	10 x 40mm Glass Cell
605 065	Dust Cover

Interference Filters

606 016	Wavelength 400nm
606 017	Wavelength 405nm
606 018	Wavelength 540nm
606 019	Wavelength 620nm

5.2 SPARES

The following list of items are available as spares for the Model 6051:

605 064	Tungsten filament lamp assembly
016 005	250mA Anti-surge Fuse
016 043	500mA Anti-surge Fuse
605 003	10 x 10mm Cell Holder

EC Declaration of Conformity

Jenway Model 6051 Colorimeter complies with the following European Standards:

EN 50081-1:1992 Electromagnetic compatibility - Generic emission standard

EN 50082-1:1992 Electromagnetic compatibility - Generic immunity standard (Performance criterion B)

EN 61010-1:1993 Safety requirements for electrical equipment for measurement, control and laboratory use

Following the provision of:

EMC Directive - 89/336/EEC and Low Voltage Directive - 73/23/EEC

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