

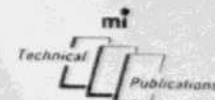
Instruction Manual

No. EB 933B

for

Moisture Meter

TF 933B



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1968

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

C. P. 2. 2k
3/68/A

EB 933B
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Chapter

I

General information

1.1 FEATURES

The moisture meter measures the percentage moisture content of a wide of hygroscopic materials, particularly those of organic origin, in the field or

The test cell which is of the compression type and is stowed in the instru when not in use, is suitable for granular, powdery or fibrous substances and fo specimens in the form of sheets or boards up to once inch in thickness. An ir function of the test cell is the application of considerable pressure to the speci under test in order to bring the sample to a uniform state and minimize packin

Direct reading temperature-correcting calculator scales can be slipped o the instrument for the commoner materials, such as cereal grains, cigarette t and rice, while a large number of calibration charts are available for substanc ranging from apple rings to wool socks.

The standard model is powered by internal dry batteries but these may be by an a. c. mains unit which is available as an optional accessory.



Fig. 1.1 The moisture meter with compression cell electrode and calculator scale fitted

RANGE:	Moisture contents from below air-dry to near saturation.
ACCURACY:	The basic accuracy of the instrument is $\pm 0.5\%$ m. c. , but variations due to the nature of the samples may reduce this to $\pm 1\%$ m. c. The accuracy tends to fall at high moisture contents.
SELF-CHECK FACILITY:	The instrument may be checked against the internal standard resistance of $1\text{ M}\Omega$ at a meter reading of 40.
CALIBRATION:	The calibrations, which are made by comparison with standard analytical procedures, are based on ground samples wherever possible.
SCALES:	The standard apparatus includes any one of the direct reading scales listed below, as ordered.
Cereal grains and agricultural seeds:	9 to 25% for wheat, rye and maize; 8 to 24% for barley and oats. Temperature -1 to 38°C (30 to 100°F). The scales are based on oven drying for four hours at 120°C (248°F). Tables are provided covering agricultural seeds.
Flour and wheat:	9 to 25% for ground wheat; 10 to 20% for flour. Temperature -1 to 38°C (30 to 100°F); outside the range 10 to 30°C (50 to 86°F) there may be a slight fall in accuracy. The scales are based on oven drying for four hours at 120°C (248°F). Tables are given for other mill stocks and products.
Cigarette tobacco:	8 to 20% for 'cigarette rag' (equivalent to cut whole leaf) and 9 to 21% for cut lamina. Temperature 10 to 30°C (50 to 86°F). The scales are based on oven drying for sixteen hours at 100°C (212°F).

Paper: 4 to 13% for paper; 6 to 22% for chemi-
c pulp and boards. Temperature 10 to 30°C
(50 to 86°F). Supplementary information
provided covering many types of wood p-
paper and boards. The scales are based
on oven drying to constant weight at 102°C
(215.5 to 221°F).

Tick beans: 9 to 22.5% for ground beans. Tempera-
ture 10 to 30°C (50 to 86°F). The scale is
based on oven drying for fifteen hours at 105°C
(221°F).

Rice: 10 to 22% for polished rice. Temperat-
ure 10 to 30°C (50 to 86°F). The scale is based
on oven drying for fifteen hours at 105°C (221°F).

POWER SUPPLY: Internal batteries: one 67.5 V and two

DIMENSIONS:	Height	Width	Depth
	7 3/4 in (1970 mm)	11 3/8 in (2880 mm)	5 1/4 in (1350 mm)

WEIGHT: 8 lb (3.65 kg) with compression cell ele-
ments and batteries.

1.3 ACCESSORIES

Accessories supplied

1. Compression Cell Electrode Assembly type TM 4113A (complete with Cla-
TC 22429, Electrode TM 4178A, Ring TB 22425/2, Plunger TB 22425/1 and
3 ft Connecting Cable TM 4130A).
2. One set of Calibration Data, TM 4473A series, as ordered - see under
Accessories available. A set of calibration data comprises a slip-on
calculator scale and a booklet, card or sheet giving supplementary inform-
ation on substances covered by the calculator scale and in some cases, allied
3. One 67.5 V battery; Exide type DM501 or Ever Ready type B101, Vidor 1
or equivalent.
Two 1.5 V cells; Exide type T21 or Ever Ready type LPU2, Vidor LPV2,
equivalent.
4. One 4 BA hexagonal wrench, **mi** type 22951-006; for carrying out the sta-
bilization test detailed in Sect. 4.2.
5. One Instruction Manual No. EB 933B.

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RANGE:	Moisture contents from below air-dry to near saturation.
ACCURACY:	The basic accuracy of the instrument is $\pm 0.5\%$ m.c., but variations due to the nature of the samples may reduce this to $\pm 1\%$ m.c. The accuracy tends to fall at high moisture contents.
SELF-CHECK FACILITY:	The instrument may be checked against the internal standard resistance of $1\text{ M}\Omega$ at a meter reading of 40.
CALIBRATION:	The calibrations, which are made by comparison with standard analytical procedures, are based on ground samples wherever possible.
SCALES:	The standard apparatus includes any one of the direct reading scales listed below, as ordered.
Cereal grains and agricultural seeds:	9 to 25% for wheat, rye and maize; 8 to 24% for barley and oats. Temperature -1 to 38°C (30 to 100°F). The scales are based on oven drying for four hours at 120°C (248°F).
	Tables are provided covering agricultural seeds.
Flour and wheat:	9 to 25% for ground wheat; 10 to 20% for flour. Temperature -1 to 38°C (30 to 100°F); outside the range 10 to 30°C (50 to 86°F) there may be a slight fall in accuracy. The scales are based on oven drying for four hours at 120°C (248°F). Tables are given for other mill stocks and products.
Cigarette tobacco:	8 to 20% for 'cigarette rag' (equivalent to cut whole leaf) and 9 to 21% for cut lamina. Temperature 10 to 30°C (50 to 86°F). The scales are based on oven drying for sixteen hours at 100°C (212°F).

Paper:	4 to 13% for paper; 6 to 22% for chert pulp and boards. Temperature 10 to 90 °F). Supplementary information provided covering many types of wood paper and boards. The scales are based on oven drying to constant weight at 102 (215.5 to 221 °F).						
Tick beans:	9 to 22.5% for ground beans. Temperature 10 to 30 °C (50 to 86 °F). The scale is based on oven drying for fifteen hours at 102 (221 °F).						
Rice:	10 to 22% for polished rice. Temperature 10 to 30 °C (50 to 86 °F). The scale is based on oven drying for fifteen hours at 105 °C.						
POWER SUPPLY:	Internal batteries: one 67.5 V and two 1.5 V cells.						
DIMENSIONS:	<table><tr><th>Height</th><th>Width</th><th>Depth</th></tr><tr><td>7 3/4 in (1970 mm)</td><td>11 3/8 in (2880 mm)</td><td>5 1/4 in (1350 mm)</td></tr></table>	Height	Width	Depth	7 3/4 in (1970 mm)	11 3/8 in (2880 mm)	5 1/4 in (1350 mm)
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7 3/4 in (1970 mm)	11 3/8 in (2880 mm)	5 1/4 in (1350 mm)					
WEIGHT:	8 lb (3.65 kg) with compression cell and batteries.						

1.3 ACCESSORIES

Accessories supplied

1. Compression Cell Electrode Assembly type TM 4113A (complete with C TC 22429, Electrode TM 4178A, Ring TB 22425/2, Plunger TB 22425/1 3 ft Connecting Cable TM 4130A).
2. One set of Calibration Data, TM 4473A series, as ordered - see under Accessories available. A set of calibration data comprises a slip-on calculator scale and a booklet, card or sheet giving supplementary information on substances covered by the calculator scale and in some cases, allied substances.
3. One 67.5 V battery; Exide type DM501 or Ever Ready type B101, Vidor or equivalent.
Two 1.5 V cells; Exide type T21 or Ever Ready type LPU2, Vidor LP1 or equivalent.
4. One 4 BA hexagonal wrench, m1 type 22951-006; for carrying out the calibration test detailed in Sect. 4.2.
5. One Instruction Manual No. EB 933B.

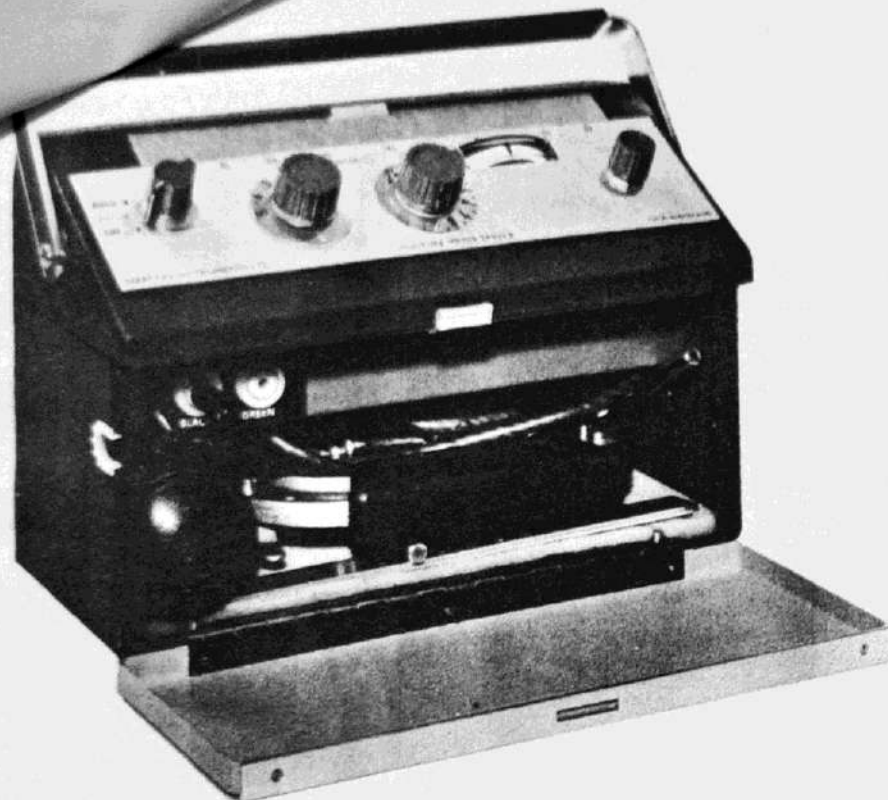


Fig. 1.2 The moisture meter showing accessories fitted in the stowage compartment

Accessories available

1. Standard Calibration Data:

Cereal grains and agricultural seeds	...	...	TM 4473A/1
Flour and wheat	...	...	TM 4473A/2
Tick beans	...	...	TM 4473A/3
Paper	...	...	TM 4473A/4
Cigarette tobacco	...	...	TM 4473A/8
Polished rice and paddy	...	...	TM 4473A/9

2. Special Calibration Data; can be supplied to order for a wide range of materials.

3. Mains Unit TM 9689; for supplies of 90 V to 130 V and 194 V to 264 V, 40 to 100 Hz; replaces internal batteries.

4. Small hand-operated Mill TB 40884; for grinding whole grain etc.
5. Spare Standard Electrode TM 4178A; for compression cell electrode assembly
6. Large Electrode Unit TM 4178A/3 (complete with Ring TC 22433/1 and F TC 22433/2); for use with compression cell electrode to accommodate large samples. The unit has a diameter of about 2 inches and holds about 10 g

4.1 CONTROLS AND CONNECTIONS

Moisture Controls

The moisture meter is designed to measure the moisture content of a wide range of materials. It is a portable, self-contained unit which can be used in the laboratory or in the field. The meter is operated by a hand-cranked motor which drives a set of rollers. The rollers are used to compress the sample material, which is then placed in a compression cell. The cell is connected to a standard electrode, which is used to measure the moisture content of the sample.

The meter is calibrated to give readings in per cent moisture. The readings are displayed on a scale which ranges from 0 to 100. The meter is also equipped with a range of accessories, including a standard electrode, a spare standard electrode, and a large electrode unit.

The meter is designed to be used with a range of materials, including cereal grains, agricultural seeds, flour, wheat, tick beans, paper, cigarette tobacco, and polished rice and paddy.

The meter is also equipped with a range of accessories, including a standard electrode, a spare standard electrode, and a large electrode unit.

The meter is designed to be used with a range of materials, including cereal grains, agricultural seeds, flour, wheat, tick beans, paper, cigarette tobacco, and polished rice and paddy.

The meter is also equipped with a range of accessories, including a standard electrode, a spare standard electrode, and a large electrode unit.

The meter is designed to be used with a range of materials, including cereal grains, agricultural seeds, flour, wheat, tick beans, paper, cigarette tobacco, and polished rice and paddy.

2.1 INSTALLATION

NOTE: The performance of this instrument may be impaired by length exposure to a damp atmosphere. Drying for a short period in warm dry atmosphere will restore it to give normal performance.

- (a) Check that the dry batteries (67.5 V and 1.5 V) are correctly positioned regard to polarity, as shown by the battery cover plate.
- (b) If mains operated, check that the position of the voltage selector switch a. c. mains unit corresponds with the supply voltage used.
- (c) Ensure that the instrument is switched off before connecting any leads a switched on when actually taking measurements (to prolong the life of the battery).

2.2 CONTROLS AND CONNECTIONS

Balance controls

The electrical principle employed in the instrument is the variation of conductivity of the specimen with moisture content. Conductivity is measured by adjustable coarse and fine BALANCE controls to give a standard meter indication; the meter reading is then easily converted into moisture content by reference to the scale on the instrument or to a chart supplied with it.

In addition to the two BALANCE controls there is a rotary switch marked ZERO-READ and a red ZERO knob for standardizing the instrument before taking a measurement.

NOTE: If either of the BALANCE controls becomes loose it must not be tightened without first carrying out the standardization test detailed in Sect. 4.2.

Electrode connections

The compression cell electrode is normally stowed in the lower front compartment of the moisture meter. Also inside this compartment are three sockets labeled GREEN and BLACK. Connect one end of the electrode 2-core cable to the RED or BLACK sockets, observing the correct colour coding. Connect the other end of the electrode 2-core cable to the two sockets on the compression cell electrode connected to the specimen, polarity not being important. (The GREEN socket is not connected to the compression cell electrode on this instrument.)

sockets labelled CALIBRATION CHECK are provided for connection to
and BLACK sockets for test purposes.

Calculator scales

If a scale is available for the substance to be tested slide the scale into position - see Fig. 1.1. If there is no scale available then select the appropriate calibration data sheet.

The following sections give the general method of operating the instrument. Detailed procedures that apply to particular materials are given in the calibration data supplied for each group of substances.

2.3 PREPARATION OF SAMPLE

Granular or powdery substances

The instrument may be used in two ways:

- (a) On whole grain
- (b) On the flour or meal produced by coarse grinding

Tests on unground granular substances are strongly influenced by the surface moisture. Tests on whole grains of wheat indicate substantially the bran moisture. For this reason it is advisable to test the sample both whole and ground, to give an indication of the moisture distribution as well as its average value.

The fineness of grinding is not important but the loss of moisture which may occur, especially with damp samples, must be minimized. Therefore avoid very fine grinding. The mill quoted in Sect. 1.3 has an adjusting screw to vary the fineness of grinding which is set during manufacture to suit grain of normal moisture content. After grinding, the mill should be flushed out with the sample to be tested and the first ground sample discarded.

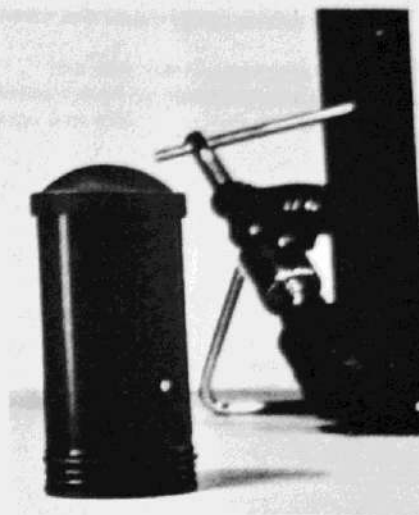
Fibrous material

In general the procedure is the same as for granular materials.

The cavity for the test cell should be approximately half filled with the specimen until packed uniformly, pressing the specimen down in much the same manner as filling a pipe. After the test the compressed plug should be about 1/16 inch thick, or 1/8 inch for the large cell.

2.4 LOADING THE COMPRESSION CELL

The following description may appear complicated because each detail is mentioned but the procedure will be found quite simple and convenient.



THE MILL - compact and easy to use.



① Remove the top and dump sample into the upper



② Replace and rotate the knurled top.



③ Unscrew the base to dump ground sample. (The inside of the lower cavity fineness.)

Fig. 2.1 Using mill to grind sample of grain

clamp. Withdraw the test cell. Take out the plunger.

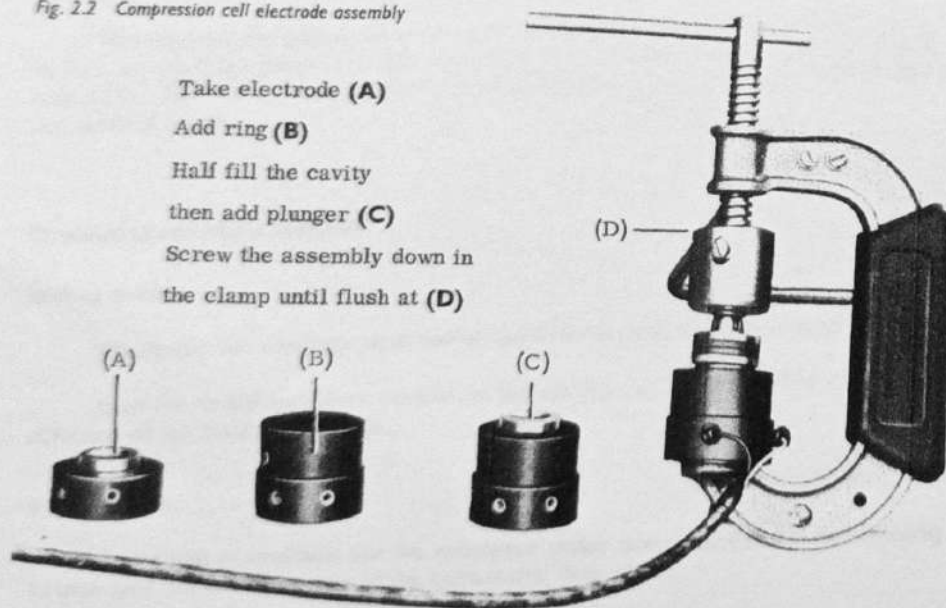
Ensure that the insulating ring is well seated on the electrode. In handling the electrode, hold by the edges. Do not handle the upper surface as this may deposit moisture on the insulating surface between the two electrode rings.

- (3) (a) For whole grains put enough into the test cell to form a single layer.
(b) For ground samples half fill the test cell with meal. After the test the compressed plug should be about 1/16 inch (or 1/8 inch for the larger test cell). Ensure that the sample is lying uniformly in the bottom of the test cell; a gentle shake will ensure this in most cases.
- (4) Insert the plunger and hold it down (to prevent the sample slipping to one side) then slide the complete test cell into the clamp.
- (5) Screw the clamp down until the two parts of the cylindrical spring housing, mounted on the end of the screw, become flush.

CAUTION

The spring is compressed solid by about a half turn of the screw beyond standard thrust at which tests are made. The solid point can easily be felt on the tommy-bar. DO NOT ATTEMPT to tighten beyond this point as it is possible for a strong operator to strain the clamp.

Fig. 2.2 Compression cell electrode assembly



Sheets and boards (e.g. cardboard)

The ring and plunger of the test cell are not required for these materials sheets should be folded to give a thickness of about 0.01 inch, or 0.06 inch for large test cell.

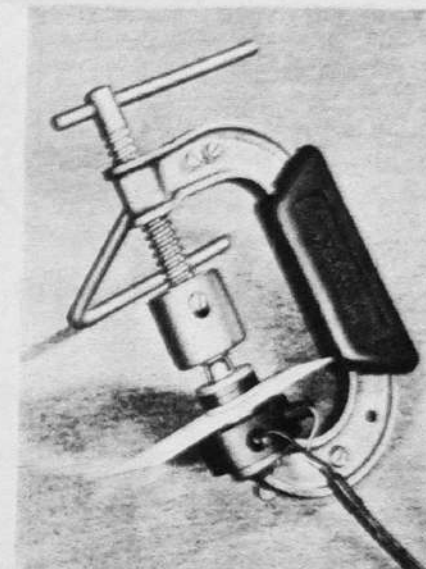


Fig. 2.3 Use of compression cell with thin sheet materials

Place the electrode in position on the base of the clamp. Put the sheet tested on the electrode and screw down the clamp until the two parts of the cylindrical spring housing, mounted on the end of the screw, become flush.

2.5 READING THE INSTRUMENT

Set scale

Slide the calculator scale between the central retaining clip and the BAL scale graduations as shown in Fig. 1.1. Move the scale along until the vertical line on the central retaining clip is in alignment with the ambient temperature on the temperature scale. (See Sect. 2.6 if the material under test is not at ambient temperature.) Fig. 2.4 illustrates the sequence of operations.

Set ZERO

Switch to ZERO. The meter pointer will deflect.

Turn the red ZERO knob until the pointer rests at the centre mark.

The 'tens' dial (left-hand BALANCE knob) should not be on the 0 position when setting zero. As this is the most sensitive range, traces of leakage due to atmospheric humidity and effect of electrostatic induction may cause the reading to be a little unsteady. Switch to any range other than 0 to set zero.

Switch position ZERO is the 'stand-by' position during a series of measurements.

Read

The accuracy of the instrument may be checked against the internal standard resistance if required - see Sect. 4.2.

- (1) Having filled the cell, switch to READ.
- (2) Set the units dial (the right-hand BALANCE knob) to approximately 0.
- (3) Rotate the tens dial (the left-hand BALANCE knob) until the pointer crosses the centre line on the meter.
- (4) Adjust the units dial to bring the pointer to the line. If the reading is on the negative part of the dial move the tens dial one step counter-clockwise (unless it is already at 0) and rebalance. The negative section of the dial should never be used if a reading can be obtained on the positive section.

The figures appearing against the dial index marks constitute the dial reading. Except for readings above 50, little is gained by recording the figure more closely than half a unit. For readings between 50 and 60 the figure should be determined to one tenth of a unit.

Convert to moisture content

Sliding scales

Transpose the readings obtained on the knob dials to the fixed black scale.

Read the actual moisture content on the sliding red scale opposite the point obtained on the fixed black scale.

Paper charts

If no scale is available for the substance under test, convert the dial reading to moisture content by means of the calibration data sheet.

Switch OFF when measurements are completed in order to conserve power.

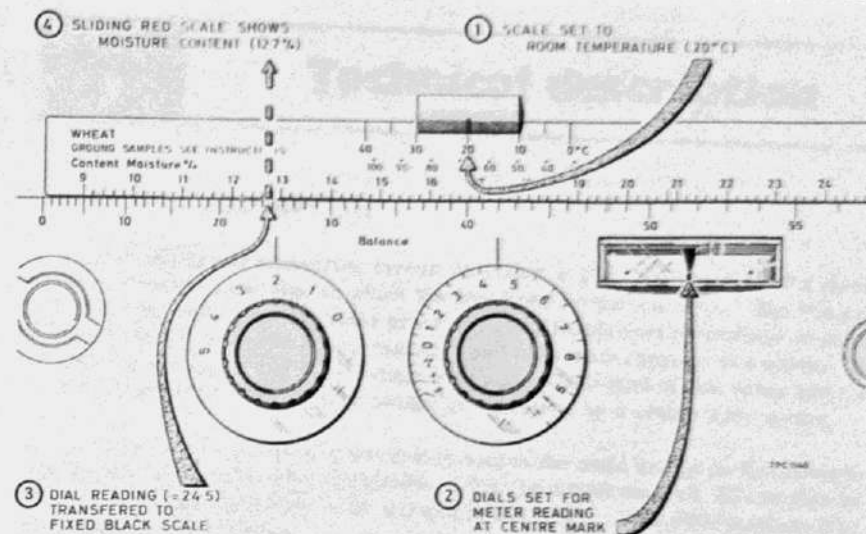


Fig. 2.4 Sequence of reading moisture content

2.6 AVOIDING ERRORS

Sampling errors

If several samples are tested from a stock of material the readings generally will vary a little. These variations are due to local differences in the moisture content of the bulk and not to inaccuracies in the instrument. To get a representative reading it is therefore necessary to test enough samples to make sure a good average is obtained.

At least two readings should be taken. If these differ, one or two more should be taken. For work of ordinary accuracy, two readings are usually sufficient if they differ by not more than two units for readings up to 40, one unit for readings between 40 and 50 and half a unit from 50 to 55. Between 55 and 60 the equivalent moisture content scale contracts rapidly and readings should agree within about 0.1 unit.

Correcting for sample temperature

The temperature corrections included in the calibration data scales are only valid if the sample and cell are at the same temperature. Although this is normally the case, temperature differences can occur in situations such as testing grain that is still hot after passing through a drying process. Unless the time can be taken to let the grain cool down the reading will not be correct. If the normal scale temperature correction is made for the temperature of the sample, the possible mean inaccuracy is as shown below; this includes the basic inaccuracy of $\pm 0.5\%$.

If error is not acceptable it may be possible to save time by gently warming the test cell to match the temperature of the grain.

Temperature difference between
cell and sample, °C

Total inaccuracy
% moisture content

5 °	1.0%
10 °	1.6%
15 °	2.1%
20 °	2.7%

This shows that if the total error must be within say, 2%, the maximum permissible temperature difference is 14 °C (25 °F).

Chapter 3

Technical description

3.1 CIRCUIT DESCRIPTION

The electrical measuring circuit as shown in Fig. 7.1 consists of a modified form of Wheatstone bridge in which the specimen forms one arm. The two capacitance controls form the ratio arms while the fourth arm comprises an auxiliary bridge in which three arms are resistive and the fourth consists of a valve. The off-balance voltage of the main bridge is applied to the grid of this valve and the balance current of the auxiliary bridge is measured by a centre zero meter.

At the ZERO position of the rotary switch the main bridge is disconnected leaving the auxiliary bridge energized. The red ZERO control, R5, is then used to balance the auxiliary bridge with no input to the valve. The OFF position disconnects the supply to both bridges.

Preset resistor R3 is adjusted during test to ensure that the instrument is correctly balanced when standard resistors are used in place of the electrode.

4.1 INTRODUCTION

This chapter contains information for keeping the equipment in good working order and for checking the overall performance. In case of trouble or for advice on servicing this instrument, please write or telephone your nearest representative, whose name and address can be found on the label affixed to the inside front cover of the instrument.

Screw fasteners

Screw threads used on this instrument are of the following sizes: 4 BA, 6 BA and 8 BA.

Cruciform headed screws are of the Pozidriv pattern; to avoid damaging them the correct Pozidriv screwdriver should be used.

4.2 TESTING

To check that the instrument is working correctly the following simple tests may be carried out.

Calibration

Join the RED and BLACK sockets in the front compartment to the CAL CHECK sockets, using the electrode lead. Set zero and check that the dial reading is 40 ± 0.25 . If this is in error because of a loose BALANCE knob, set zero by rotating the spindle and then secure the knob at the position where the dial reading is 40. Use the 4 BA hexagonal wrench provided in the front stowage compartment.

Continuity of leads, etc.

Connect the electrode and set zero. Put the electrode in position in the clamp, without the ring. Short circuit the electrode rings with a piece of wire or close the clamp down on a piece of metal foil. The dial reading should be 60.

Leakage

Having checked continuity as above, unscrew the clamp and secure the electrode down on the base by means of the empty electrode ring.

Take the dial reading which should, ideally, be off scale below -6.

A high reading on the dial shows leakage which may be in the electrode leads. It can be located by removing these parts individually.

In connection with leakage across the electrode face it is important to the following rule:

The instrument reading on the empty test cell (without plunger) should be least 10 divisions below, or preferably 15 to 20 below, the reading obtained sample in position. For testing very dry samples the 'empty' reading should be 0 but for normal use a reading as high as 25 is tolerable. Application of it save wasting time on unnecessary cleaning.

4.3 CLEANING

The test cell electrode must be kept clean. The surface area in the the socket holes and especially the thin insulating ring between the annular electrodes should receive particular attention. A brisk rub with a dry cloth all that is needed but the part may be washed with water and may also be dried by heat (max. 50°C) if necessary.

It is inadvisable to use wax polishes to clean the insulating parts of the instrument as the materials from which these parts are constructed are superior to wax repellent.

If sticky or oily substances are tested as a matter of routine, it is advisable to have one or two spare electrodes which can be used while the others are cleaned.

4.4 LUBRICATION

Keep the moving parts of the clamp lubricated and free from grit. The swivel and-claw joint of the swivel nose should be washed from time to time to remove old grease and dirt and relubricated with grease or heavy oil. The screw should be cleaned and greased occasionally. Inadequate lubrication may cause rapid wear and will make the clamp stiff: it should be possible to turn the tommy-bar with the clamp at the 'flush' setting.

4.5 ACCESS AND LAYOUT

The diagram Fig. 4.1 illustrates the accessibility of the components of the Moisture Meter TF 933B.

Access to the replaceable parts such as the dry batteries and the valve for the fitting of the a.c. mains unit is explained in the relevant sections.

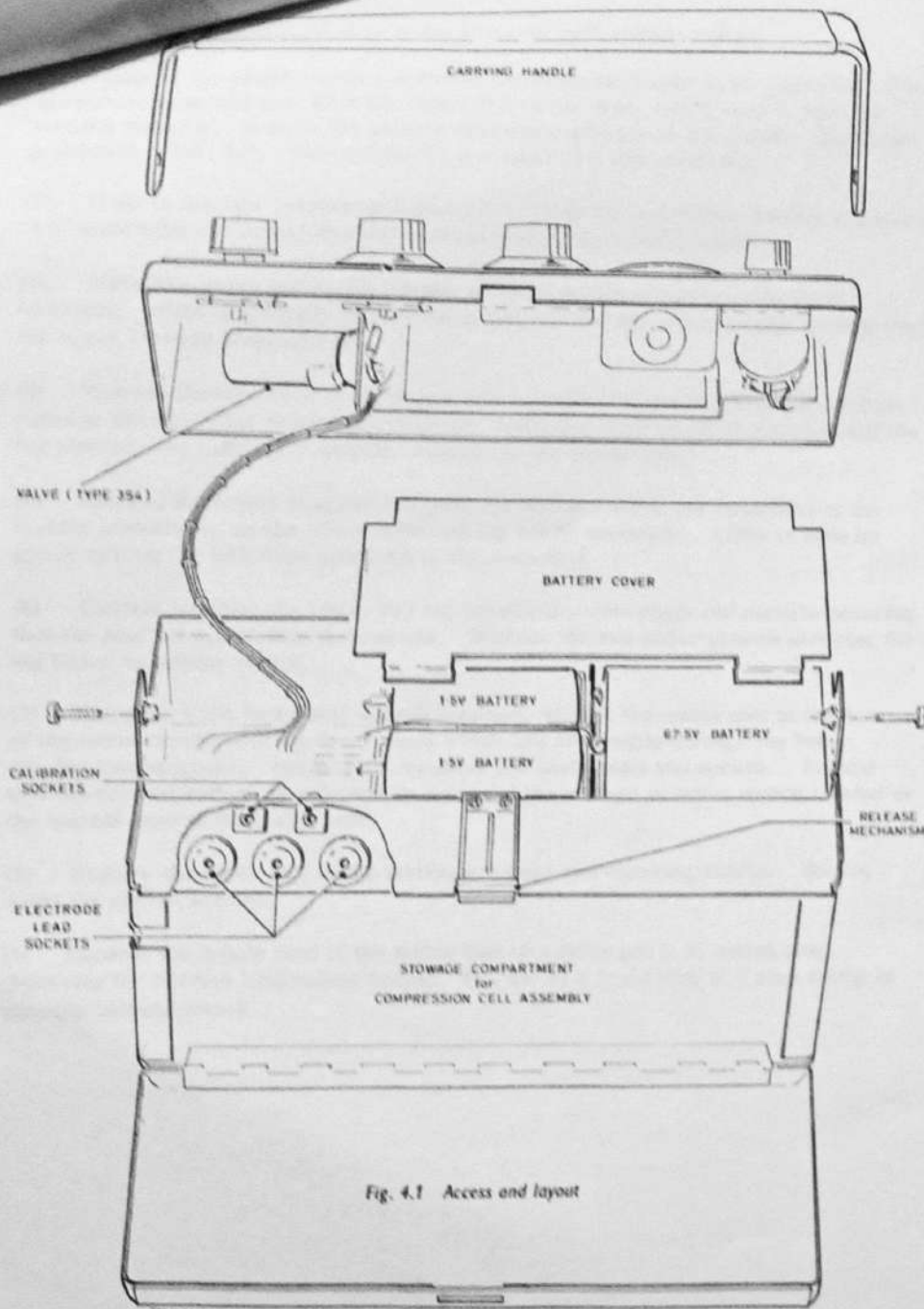


Fig. 4.1 Access and layout

NOTE:

On moisture meters dispatched without batteries the internal battery cover is fitted in the front cover of the lower stowage compartment

4.6 CHANGING THE BATTERIES

The 67.5 V battery should be changed every year. The 1.5 V batteries last for about 100 working hours - corresponding to about 6 months use if the instrument is switched off when not in use. Even if not used to this extent they should be changed every year. For type numbers see Replaceable Parts list.

To obtain access to the batteries, release the two slotted screws securing carrying handle and ease back the upper half of the instrument case.

Both batteries then can be easily removed by using firm finger pressure in recesses of the metal battery cover, pressing the cover downwards and towards front of the instrument. The cover will then spring upwards to expose the batteries. The 67.5 V battery can be removed simply by releasing the red (positive) and blue (negative) battery leads. The 1.5 V batteries are removeable by depressing their batteries from left to right and lifting upwards.

NOTE:

The correct polarity must be observed when replacing the batteries.

4.7 CHANGING THE VALVE

The valve used is a specially treated 384. If a replacement untreated valve is fitted it may suffer from the effect of moisture on the valve base. Suitable treated valves can be ordered from Marconi Instruments Ltd. - see Replaceable Parts list.

To obtain access to the valve, release the slotted screws securing the carrying handle and ease back the upper half of the instrument case as in the battery change procedure. The valve canister protecting the valve can be removed by gentle finger pressure towards the valve base and simultaneously turning the canister in a counter-clockwise direction. Ensure that the replacement valve bears the correct type number (384).

4.8 FITTING THE A.C. MAINS UNIT

NOTE:

The mains unit is 'live' when the mains plug is connected. Ensure that the unit is disconnected from the mains when carrying out the following instructions.

A. C. Mains Unit type TM 9689 is suitable for operation from 90 V to 130 V and 194 V to 264 V a.c. supplies (40 to 100 Hz), and replaces both h.t. and l.t. units. Fig. 7.2 is the circuit diagram of the unit.

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Mr. Sainty

Installation procedure is the same for both voltage ranges.

- (1) Release the slotted screws securing the carrying handle to the upper half of the instrument case and ease back the upper half of the case, taking care to provide suitable support. Remove the battery cover as explained in the 'battery changing' procedure, Sect. 4.6. Remove the 67.5 V and 1.5 V dry batteries.
- (2) Release the four countersunk screws securing the two plastic battery containers and remove the containers and the interconnecting tag board assembly.
- (3) Place the mains unit in the recess which normally accommodates the dry batteries. Route the supply lead of the mains unit through the grommet leading into the lower stowage compartment.
- (4) Remove the top cover of the mains unit by releasing the two securing screws. Release the two pillar screws securing the insulating strip on which are mounted the tag board 6-way connector sockets, situated in the mains unit.
- (5) Release the 6-way plug section from the sockets which are connected to the battery containers, on the interconnecting tag board assembly. (This is done by gently pulling the jack-type plugs out of the sockets.)
- (6) Connect together the two 6-way tag board connector plugs and sockets ensuring that the lead terminals face downwards. Replace the two pillar screws securing the tag board connector strips.
- (7) Using the 4 BA hexagonal wrench supplied, secure the mains unit to the base of the metal recess with the two screws which are accessible through the lower storage compartment. Replace the cover of the mains unit and secure. Ensure that the correct voltage is selected by means of the voltage selector switch located on the outside case of the mains unit.
- (8) Replace the upper half of the instrument case and carrying handle. Secure using the slotted screws.
- (9) Connect the supply lead of the mains unit to a three pin a. c. mains plug, observing the correct lead colour coding. The use of a fused plug of 5 amp rating is strongly recommended.

Chapter

6

Replaceable parts

Introduction

This chapter lists replaceable parts in alphabetical order of the circuit references. The following abbreviations and symbols are used

C	: capacitor	SKT	: socket
Carb	: carbon	T	: transformer
Cer	: ceramic	TP	: terminal
Elec	: electrolytic	V	: valve
FS	: fuse	Var	: variable or preset
ILP	: illumination lamp	WW	: wirewound
JK	: jack	†	: value selected during nominal value listed
M	: meter	W	: watts at 70 °C
MR	: semiconductor diode	W*	: watts at 55 °C
PL	: plug	W**	: watts at 40 °C
Plas	: plastic	W***	: watts at 20 °C
PLP	: pilot lamp	W ^o	: watts at unspecified temperature
R	: resistor		
S	: switch		

Ordering

Orders for replacement parts should be sent to our Service Division the address on the back cover of the Instruction Manual. Specify the following information for each part required:

1. Type and serial number of instrument.
2. Circuit reference.
3. Description.
4. M.I. code number.

If a part is not listed state its function, location and description when ordering.

Circuit reference	Description	M.I. code
B1	Battery 67.5V (Exide DM501 or Ever Ready B101 or Vidor L5500)	23721-543
B2	Battery 1.5V (Exide T21 or Ever Ready LPU2 or Vidor LPV2)	23711-105
B3	Battery 1.5V (Exide T21 or Ever Ready LPU2 or Vidor LPV2)	23711-105
C1	Plas 330pF $\pm 5\%$ 350V	26516-373
M1	Meter f.s.d. 150-0-150 μ A	44558-411
R1	Carb 3.3k Ω $\pm 10\%$ 1W*	24343-094
R2	Carb 18k Ω $\pm 10\%$ 1W*	24343-116
R3	WW Var 10k Ω $\pm 10\%$ 2W	25817-503
R4	Carb 15k Ω $\pm 10\%$ 1W*	24343-114
R5	WW Var 5k Ω $\pm 10\%$ 2W	25817-494
R6	Carb 3.3k Ω $\pm 10\%$ 1W*	24343-094
R7	Carb 10k Ω $\pm 10\%$ 1W*	24343-191
R8	Carb 10k Ω $\pm 10\%$ 3/4W	24175-100
R9	Carb 100M Ω $\pm 10\%$ 0.1W**	24288-171
R10	Carb 10M Ω $\pm 5\%$ 3/4W	24236-190
R11	Carb 1M Ω $\pm 1\%$ 1W	24217-100
R12	Carb 100k Ω $\pm 1\%$ 3/4W	24176-100
R13	Carb 10k Ω $\pm 1\%$ 3/4W	24175-100
R14	Carb 1.1k Ω $\pm 1\%$ 3/4W	24174-110
R15	WW Var 2k Ω $\pm 10\%$ 1W	25853-220
R17	Carb 4.7k Ω 10% 1W	24343-126
R18	Carb 1M Ω $\pm 5\%$ 1/4W	24232-166
SA	Switch 12 position	44322-139
SB	Switch 12 position	44325-403
-	1" Bar Knob assembly	41145-237
-	11/16" Knob assembly	41141-701
V1	Valve 3S4 special	44515-002
-	Valve holder B7G	28237-221
-	Can, screening	28237-539

For symbols and abbreviations see introduction to this chapter

A.C. Mains Unit TM 9689

Circuit reference	Description	M.I. code
C1	Paper 0.1 μ F $\pm 10\%$ 350V	26174-173
C2	Elec 25 μ F $\pm 50-20\%$ 150V	26417-484
MR1-MR5	Diode Texas 1S923 200V P.I.V.	28356-018
R1	Carb 10 Ω $\pm 5\%$ 1/2W	24333-020
R2	Carb 10 Ω $\pm 5\%$ 1/2W	24333-020
SA	Switch D.P.D.T.	23467-119
T1	Transformer assembly	43461-025

For symbols and abbreviations see introduction to this chapter

Circuit diagrams

Circuit notes

1. COMPONENT VALUES

Resistors: no suffix = ohms, k = kilohms, M = megohms.

Capacitors: no suffix = microfarads, p = picofarads.

† = value selected during test, nominal value shown.

2. SYMBOLS

→ arrow indicates clockwise rotation of knob.

[RANGE] etc., external front or rear panel marking.

 tag on printed board.

—○— other tag.

Ⓢ preset control.

■ printed board designation.

3. VOLTAGES

Shown in italics adjacent to point to which the measurement refers. D.C. relative to chassis unless otherwise stated.

4. SWITCHES

Rotary switches are drawn schematically.

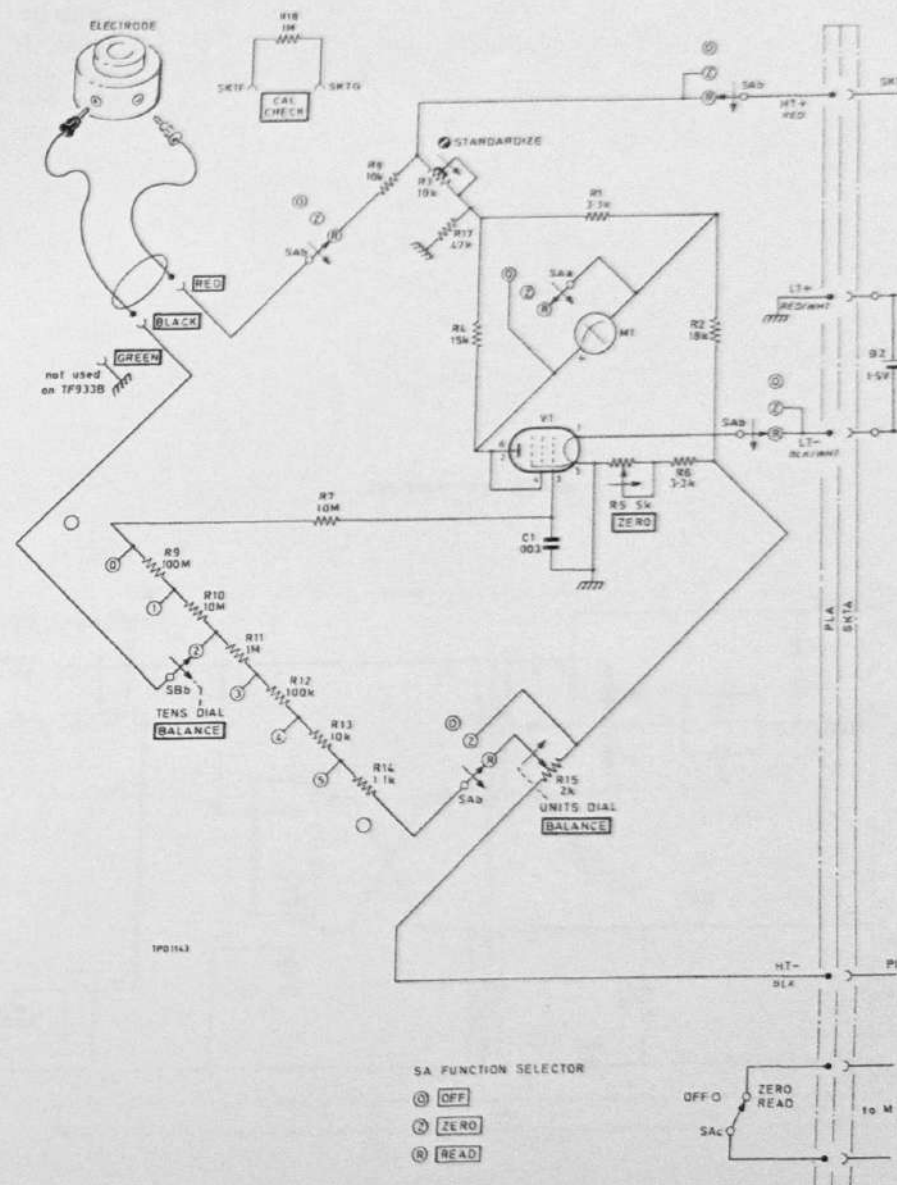


Fig. 7.1 Moisture meter

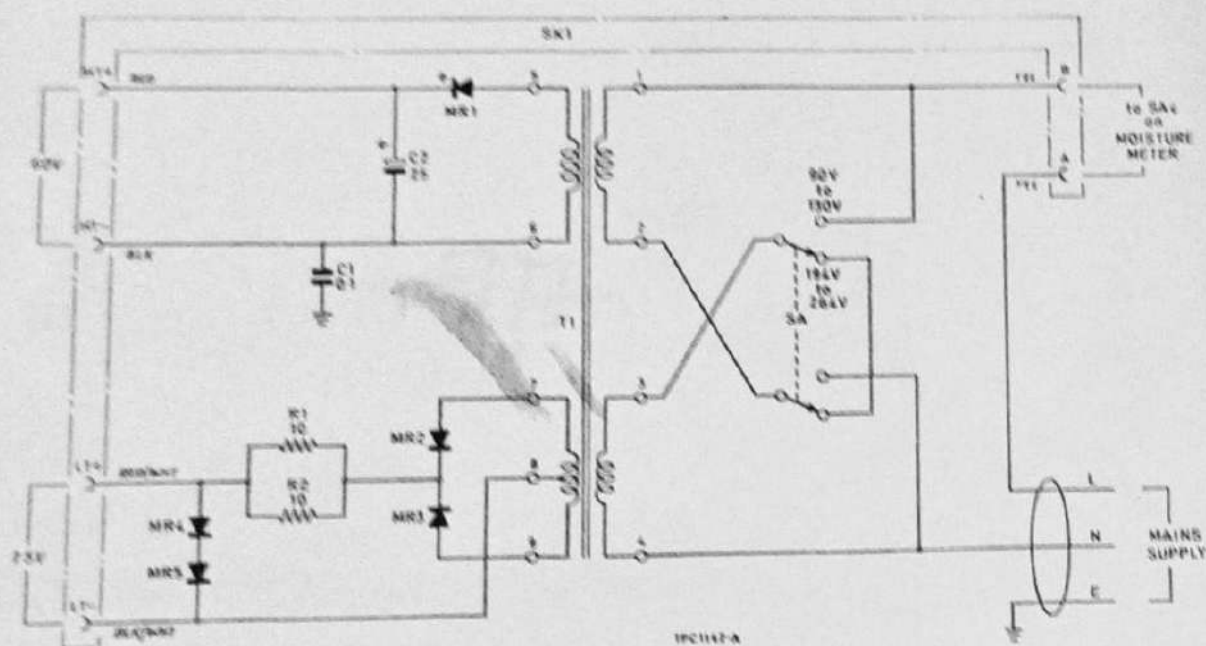


Fig. 7.2 A.C. mains unit

