

1963

TF 933A

Moisture Meter

OPERATING INSTRUCTIONS

**MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND**

HANDBOOK CHANGE for Moisture Meter Type TF 933A

TEMPERATURE CORRECTION

The temperature corrections included in the calibration data scales or sheets are only valid if the sample and cell are at the same temperature. Although this will normally be so, 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 spared 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 measurement inaccuracy is as shown below; this includes the basic inaccuracy of $\pm 0.5\%$.

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

Temp. difference between cell and sample, °F.	Total inaccuracy in % moisture content.
10°	
20°	1.1%
30°	1.7%
40°	2.3%
	2.9%

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



OPERATING INSTRUCTIONS
No. EB 933A
for

Moisture Meter TF 933A

Copyright © 1963

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

C. P. 1.6k
5/64/D

EB 933A
12a - 9/63

CONTENTS

GENERAL INFORMATION

Features	...	...	...	...	...	...	...	3
Data Summary	...	...	...	...	...	...	...	3

OPERATION

General	...	...	...	...	...	...	...	6
Preparation of Sample	...	...	...	...	...	...	...	6
Loading the Cell	...	...	...	...	...	...	...	8
Connections	...	...	...	...	...	...	...	9
Reading the Instrument	...	...	...	...	...	...	...	10
Sampling Errors	...	...	...	...	...	...	...	11
Use of Probe Electrode	TM 4397	...	...	...	...	...	...	11
Use of Sword Electrode	TM 4280	...	...	...	...	...	...	12

MAINTENANCE

Circuit Description	...	...	...	...	...	...	...	13
Testing	...	...	...	...	...	...	...	13
Cleaning	...	...	...	...	...	...	...	14
Lubrication	...	...	...	...	...	...	...	14
Changing the Batteries	...	...	...	...	...	...	...	14
Changing the Valve	...	...	...	...	...	...	...	15
Fitting an A.C. Mains Unit	...	...	...	...	...	...	...	15

ILLUSTRATIONS

Moisture Meter TF 933A	...	...	...	...	...	...	...	1
Using Mill to grind samples of grain	...	...	...	...	...	...	...	7
Loading the Compression Cell	...	...	...	...	...	...	...	8
Using Cell for measurements on boards	...	...	...	...	...	...	...	9
Reading Scale A3	...	...	...	...	...	...	...	11
Using Probe Electrodes for baled hay	...	...	...	...	...	...	...	12
Using Sword Electrodes for stacked paper	...	...	...	...	...	...	...	12
Arrangement of batteries	...	...	...	...	...	...	...	15

CIRCUIT DIAGRAMS

A.C. Mains Unit	...	...	...	...	...	...	...	15
Moisture Meter	...	...	...	...	...	...	...	16

GENERAL INFORMATION

FEATURES

Moisture Meter TF 933A is designed for the rapid and accurate determination of the moisture content of a wide range of hygroscopic materials - particularly those of organic origin - under field or controlled conditions.

The test cell, which is of the compression type and is stowed in the instrument when not in use, is suitable for granular, powdery or fibrous substances and for specimens in the form of sheets or boards up to one inch in thickness. An important function of the test cell is the application of considerable pressure to the specimen under test, in order to bring the sample to a uniform state and minimize packing errors.

Direct reading temperature-correcting calculator scales are available for cereal grains, flour, cigarette tobacco, paper and tea, and a large number of calibration charts have been compiled which embrace substances ranging from Apple Rings to Wool Socks. In addition, special electrodes can be supplied for stacked paper and for baled wood wool, etc.

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

The standard model takes its supply from long-life internal dry batteries, but these may be replaced by an a.c. mains unit which is available as an optional accessory.

DATA SUMMARY

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.

CALIBRATION:

The calibrations, which are made by comparison with standard analytical procedures, are based on ground samples wherever possible.

SCALES:

Agriculture:
(Scale A3)

Milling:
(Scale M3)

Cigarette Tobacco:
(Scale C3)

Paper:
(Scale P1)

Tea:
(Scale T1)

Cocoa:
(Scale K1)

POWER SUPPLY:

DIMENSIONS & WEIGHT:

The standard apparatus includes any one of six direct reading scales listed below, as ordered.

9 to 25% for wheat, rye and maize; 8 to 24% for barley and oats. Temperature 30 to 100°F (-1 to 38°C). The scales are based on oven drying for four hours at 120°C.

Tables are provided covering agricultural seeds.

9 to 25% for ground wheat; 10 to 20% for flour. Temperature 30 to 100°F (-1 to 38°C); outside the range 50 to 85°F (10 to 30°C) there may be a slight fall in accuracy. The scales are based on oven drying for four hours at 120°C. Tables are given for other mill stocks and products.

8 to 29% for 'cigarette rag' (equivalent to cut whole leaf) and 9 to 21% for cut lamina. Temperature 50 to 90°F (10 to 30°C). The scales are based on oven drying for sixteen hours at 100°C.

4 to 13% for paper; 6 to 22% for chemical wood pulp and boards. Temperature 50 to 90°F (10 to 32°C). Supplementary information is provided covering many types of wood-pulp, paper and boards. The scales are based on oven drying to constant weight at 102 to 105°C.

8 to 18%. Temperature 50 to 86°F (10 to 30°C). The scale is based on oven drying for fifteen hours at 105°C.

4.6 to 12.6%. Temperature 50 to 86°F (10 to 30°C). The scale is based on oven drying for fifteen hours at 105°C.

L. T. : One 1.5 V dry cell.
H. T. : One 45 V dry battery.

Height	Width	Depth	Weight
12 in	10 in	8½ in	14 lb
(31 cm)	(26 cm)	(22 cm)	(16.4 kg)
			complete

933A (12)

ACCESSORIES SUPPLIED

- (1) Compression Cell Assembly TM 4113A, stowed in instrument and complete with Clamp, Standard 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 4473 series, as ordered - see under Accessories Available. A set of Calibration Data comprises a clip-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.

ACCESSORIES AVAILABLE

- (1) Standard Calibration Data:

A3 for cereal grains and agricultural seeds	...	...	TM 4473/1
M3 for flour and other mill products	...	...	TM 4473/2
C3 for cigarette tobacco	...	...	TM 4473/3
P1 for paper	...	...	TM 4473/4
T1 for tea	...	...	TM 4473/5
K1 for cocoa	...	...	TM 4473/6

- (2) Special Calibration Data can be supplied to order for a wide range of materials.
- (3) Mains Unit TM 3981B for supplies of 100 to 125 V and 200 to 250 V, 40 to 100 c/s; replaces internal batteries.
- (4) Standard Electrode TM 4178A (spare) for Compression Cell Assembly.
- (5) Large Electrode Unit TM 4178A/3 complete with Ring TC 22433/1 and Plunger TC 22433/2, to accomodate larger samples. This has a diameter of about 2 inches and holds about 10 grams.
- (6) Sword Electrode TM 4280 (pair required) for stacked paper, cardboard and baled wood-pulp.
- (7) Probe Electrode TM 4397 (pair required) for bales of wood-wool, straw, etc.
- (8) Small hand-operated Mill TB 40884 for grinding whole grain, etc.

OPERATION

GENERAL

THE PERFORMANCE OF THIS INSTRUMENT MAY BE IMPAIRED BY LENGTHY EXPOSURE TO A DAMP ATMOSPHERE. DRYING FOR A SHORT PERIOD IN A WARM DRY ATMOSPHERE WILL RESTORE IT TO NORMAL WORKING.

There are only four controls: a switch which controls the function, marked OFF - ZERO - READ; a round knob marked SET ZERO, which standardizes the instrument, and two bar-knobs carrying the dials used in making a measurement.

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.

PREPARATION OF SAMPLE

GRANULAR OR POWDERY SUBSTANCES

The instrument may be used in two ways:

- (a) On whole grains.
- (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.

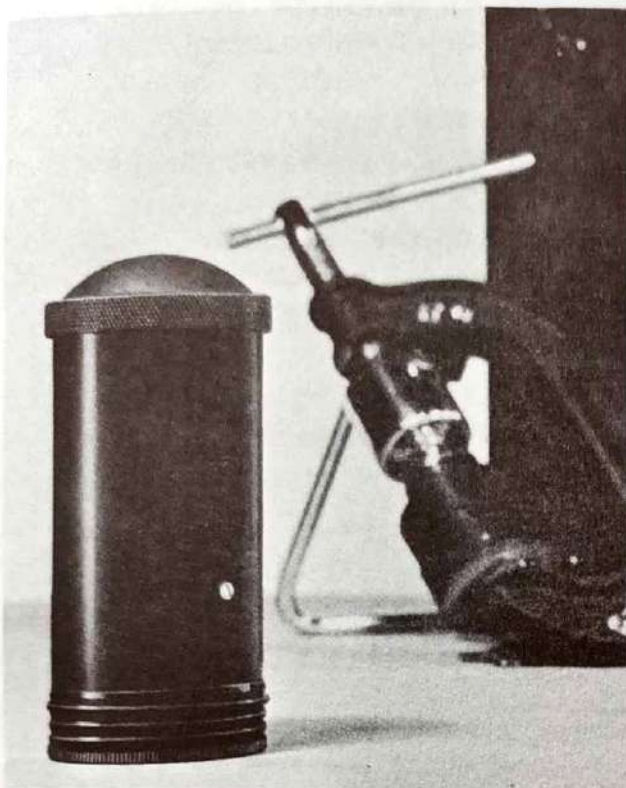
The fineness of grinding is not important, but the loss of moisture which may occur, especially with damp samples, must be minimized; therefore avoid very fine grinding. The mill quoted in Data Summary has an adjusting screw to vary the fineness of grinding; this is set during manufacture to suit grain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

FIBROUS MATERIALS

The procedure is, in general, as for granular materials.

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

USING MILL TO GRIND SAMPLES OF GRAIN



THE MILL - compact and easy to use.



1 Remove the top and feed the sample into the upper cavity.



2 Replace and rotate the knurled top.



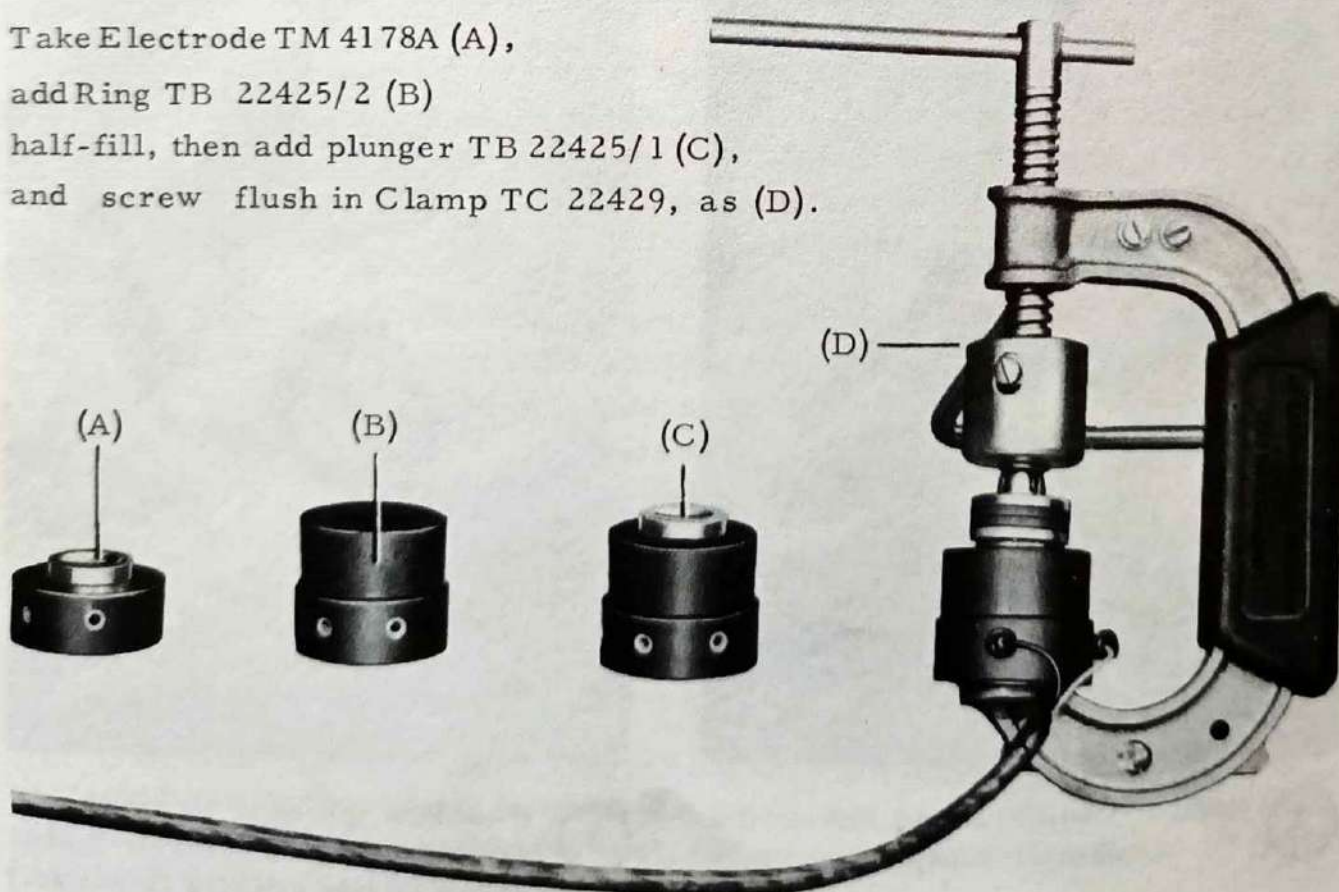
3 Unscrew the base to obtain the ground sample. (Screw inside lower cavity adjusts fineness.)

LOADING THE CELL

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

- (1) Unscrew the clamp; withdraw the test cell; take out the plunger.
- (2) See that the insulating ring is well seated on the electrode. In handling the electrode, hold it 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). See 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); slide the complete test cell into the clamp.

Take Electrode TM 4178A (A),
add Ring TB 22425/2 (B)
half-fill, then add plunger TB 22425/1 (C),
and screw flush in Clamp TC 22429, as (D).

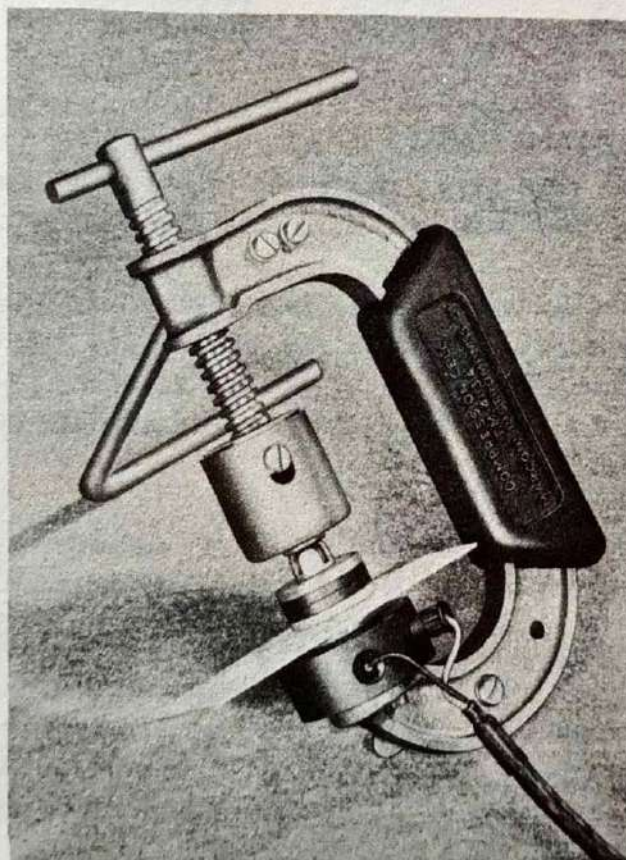


- (5) Screw the clamp down until the two parts of the cylindrical spring housing, mounted on the end of the screw, become flush.

Note: 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.

SHEETS AND BOARDS (e.g. cardboard)

The ring and plunger of the test cell are not required for these materials. Thin sheets should be folded to give a thickness of about .01 inch, or .06 inch for the large test cell.



Place the electrode in position on the base of the clamp. Put the sheet to be 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.

CONNECTIONS

To connect the test cell to the indicator unit, insert the plugs at one end of the lead into the RED and BLACK sockets of the indicator unit and the other end into the two sockets of the electrode.

READING THE INSTRUMENT

SET ZERO

Switch to ZERO. The meter pointer will deflect.

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

Note: The 'tens' dial (left-hand bar knob) should not be on the red 0 position when setting zero. On this, the most sensitive range, traces of leakage due to atmospheric humidity, and effects 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

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

The figures appearing in the window 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.

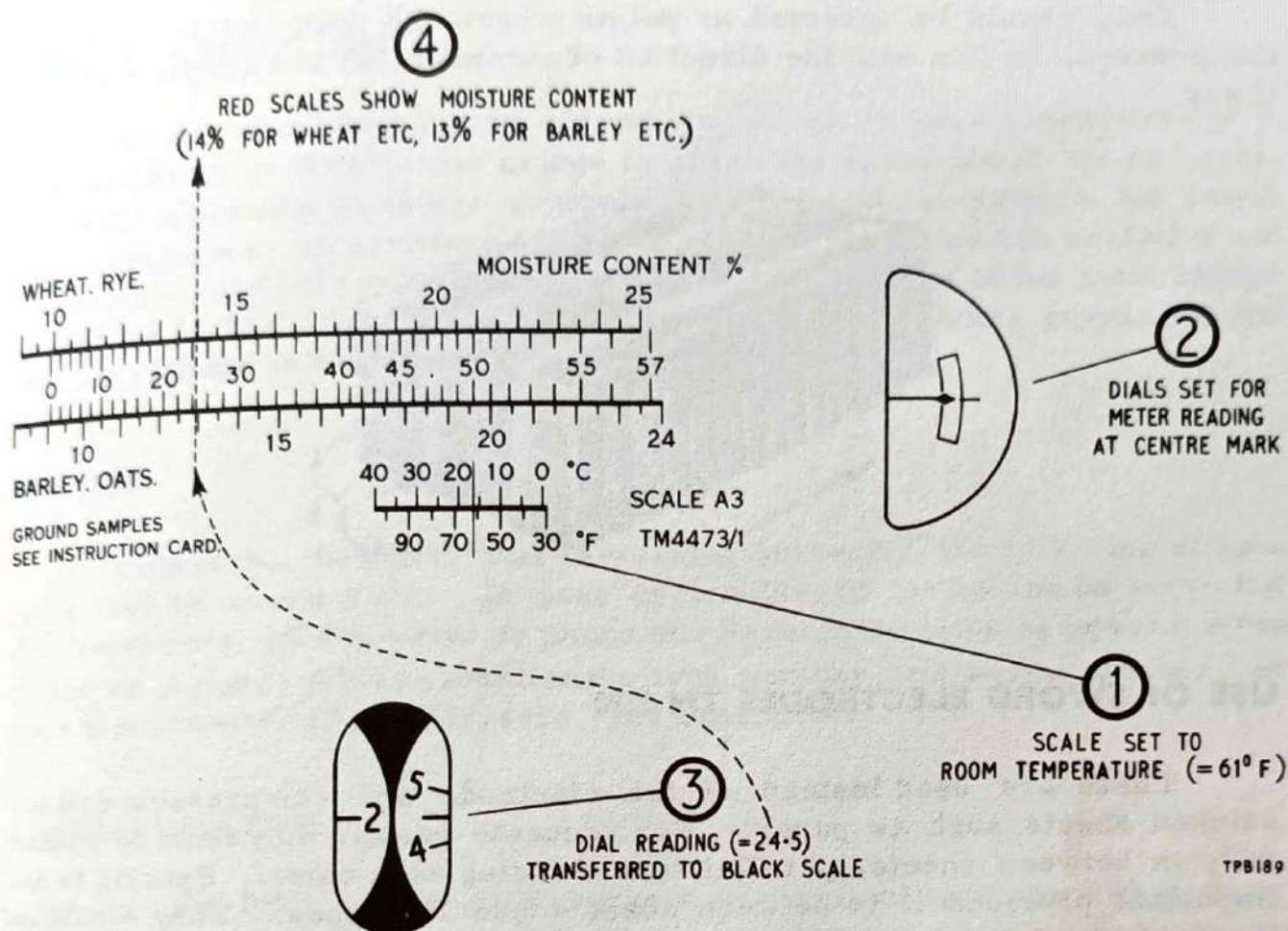
MOISTURE CONTENT

The dial reading obtained can be converted to moisture content by means of the clip-on calculator scale, if one is available for the particular substance, or by the calibration data.

CALCULATOR SCALE

Release the scale by pressing on the rubber boss at the top of the window, while lifting the top edge of the scale at one end. Move the scale along until the vertical index line comes opposite the room temperature on the temperature scale. Clip the scale back into place.

Read the moisture content on the red scale opposite the dial reading on the appropriate black scale.



SAMPLING ERRORS

If several samples are tested from a stock of material the readings will generally 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.

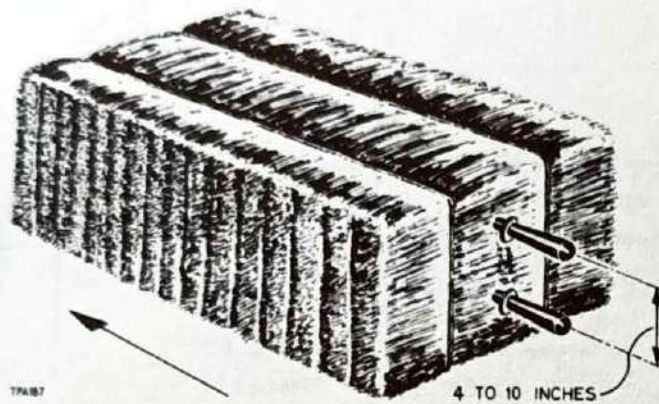
At least two readings should be taken; if these differ, take one or two more. For work of ordinary accuracy, two readings are usually sufficient if they differ by not more than two units for readings up to 40, one unit for readings between 40 and 50, and half a unit from 50 to 55. Between 55 and 60 the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

USE OF PROBE ELECTRODES TM 4397

These are used instead of the electrode and compression cell for measurements on baled materials such as hay.

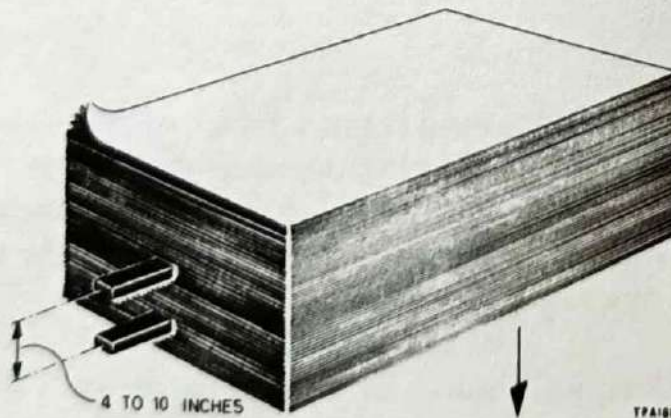
For accurate results they must be pushed fully in, parallel to each other. Spacing is not important provided it is between about 4 and 10 inches.

They should be inserted at points where the material is uniformly compressed, in line with the direction of compression and across the grain if any.



USE OF SWORD ELECTRODES TM 4280

These are used instead of the electrode and compression cell for stacked sheets such as paper. For accurate results they must be pushed fully in between sheets, parallel to and facing each other. Spacing is not important provided it is between about 4 and 10 inches. They should be inserted at points where the material is compressed, that is, well down the stack.



MAINTENANCE

CIRCUIT DESCRIPTION

The electrical measuring circuit as shown on page 16 consists of a modified form of Wheatstone bridge in which the specimen forms one arm. The two calibrated moisture 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 out of balance voltage of the main bridge is applied to the grid of this valve and the out of balance current of the auxiliary bridge is measured by a centre zero meter.

TESTING

To check that the instrument is working correctly, the following simple tests may be carried out. In case of trouble, or for advice on servicing this instrument, please write or phone our Service Division or nearest Area Office or Agent. Always mention the type number and serial number of your instrument. (For addresses, see rear cover).

STANDARDIZATION

Join the RED and BLACK sockets on the panel together with a short piece of wire. Set zero and take the reading from the dials, which should be approximately 60. An even better test is to connect an accurately known resistance of $1\text{ M}\Omega$ between the RED and BLACK sockets, and check that the reading is 40 ± 0.5 .

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 hold the electrode down on the base by means of the empty 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 or the leads; it can be located by removing these parts one by one.

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

The instrument reading on the empty test cell (without plunger) should be at least 10 divisions below, and preferably 15 to 20 below, the reading obtained with the sample in place; for testing very dry samples the 'empty' reading should be below 0, but for normal use a reading as high as 30 might be tolerable. Application of this rule will save wasting time on unnecessary cleaning.

CLEANING

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

It is inadvisable to use wax polishes to clean the insulating parts of the test cell, as the materials from which these parts are constructed is superior to wax as a water repellent.

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

LUBRICATION

Keep the moving parts of the clamp lubricated and free from grit. The ball-and-claw joint of the swivel nose should be washed out from time to time, to remove the 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 one finger with the clamp at the 'flush' setting.

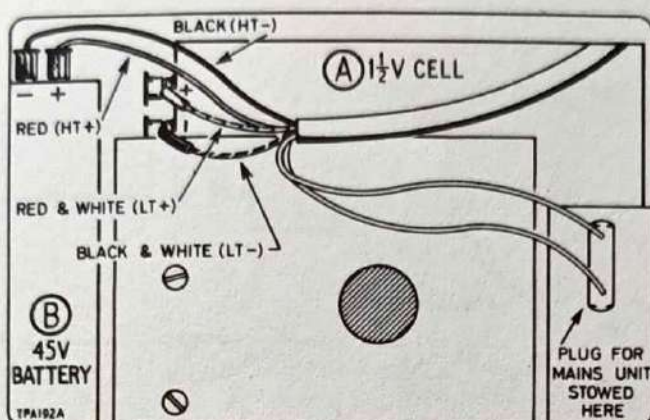
CHANGING THE BATTERIES

The 1½ V battery should last for at least 500 working hours - corresponding to about 6 months use - if the instrument is switched off when not in use.

The 45 V battery should be changed every year.

Suitable types: 1½ V: Exide BT 11
45 V: Exide DM 504

To reach the batteries, undo the two knurled screws underneath the case, and pull away the back half. Undo the two screws in the plate which covers the batteries; when this plate is removed, take out the wooden spacer and then the batteries. Before discarding the h.t. battery ('B') try a new l.t. cell ('A').



CHANGING THE VALVE

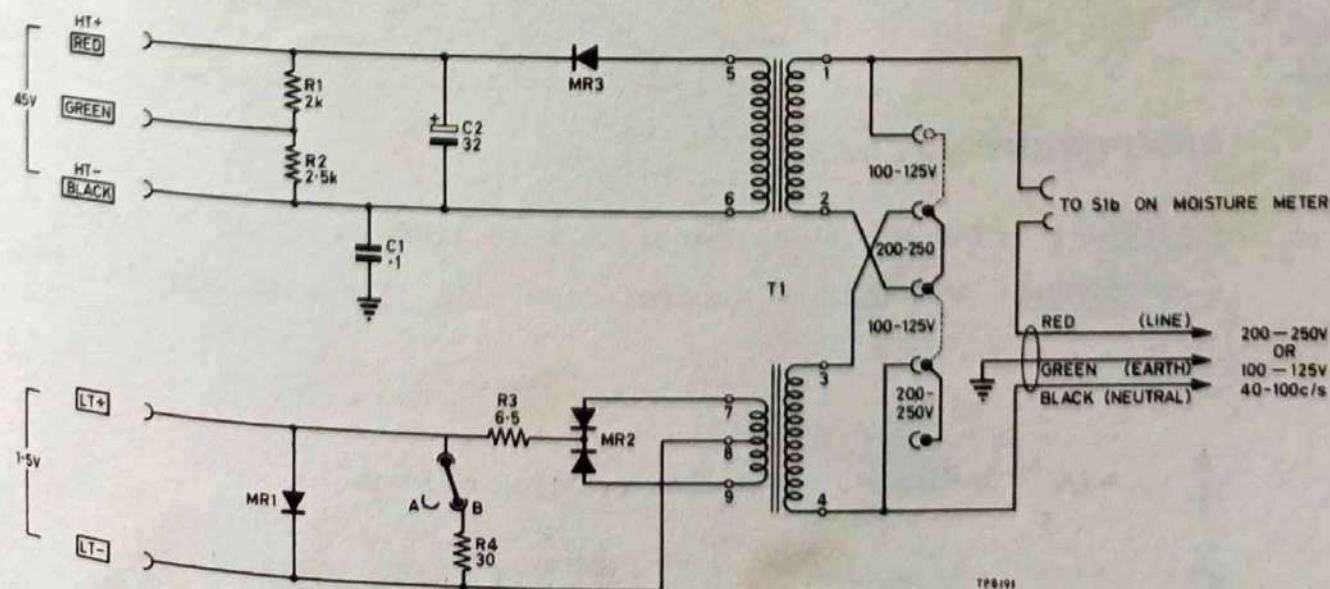
The valve used is a specially treated N17 or 3S4 and, if a replacement untreated valve is fitted, it may suffer from the effect of moisture on its base. Suitable treated valves can be ordered from Marconi Instruments Ltd.

To get at the valve, remove the back and battery cover as for battery changing, and unscrew the bulkhead which separates the front and back compartments.

FITTING AN A.C. MAINS UNIT

A.C. Mains Unit Type TM,3981B is for operation from 100 to 125V or 200 to 250 V a. c. supplies and replaces both h.t. and l.t. internal batteries.

Instructions for fitting this unit are supplied with it, and its circuit diagram is given below.

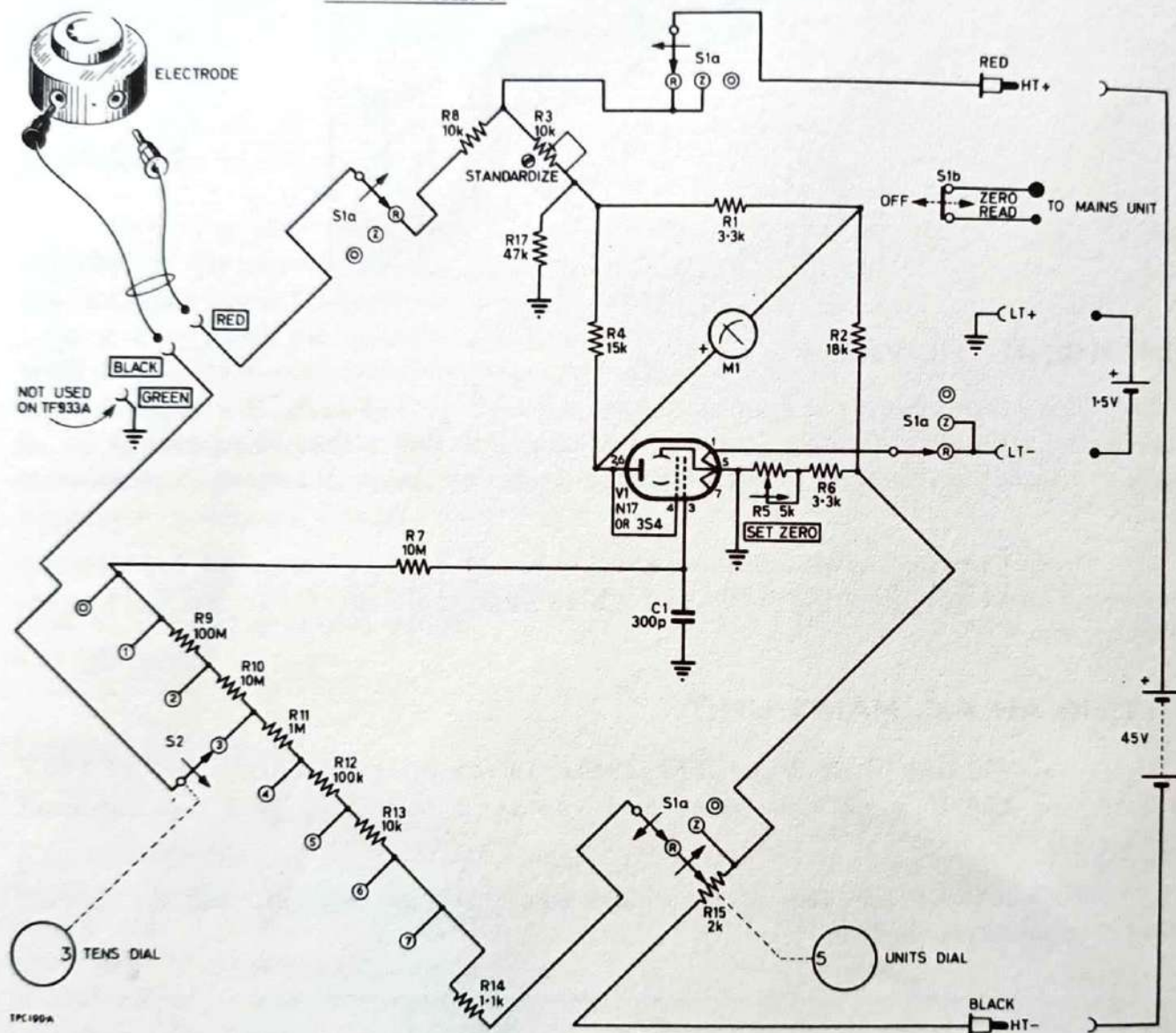


933A (12a)

CIRCUIT DIAGRAM

⊖ — OFF
 ② — ZERO
 Ⓡ — READ

S1 FUNCTION SELECTOR



COMPONENT VALUES

Resistors: No suffix = ohms. k = kilohms. M = megohms

Capacitors: No suffix = microfarads. p = picofarads.

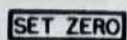
SYMBOLS



arrow indicates clockwise rotation of knob



preset component



panel marking

MARCONI INSTRUMENTS LIMITED
ST. ALBANS, HERTS., ENGLAND

Telephone: St. Albans 59292
Telex: 23350

TF 933A

SERVICE DIVISION

HEDLEY ROAD, ST. ALBANS, HERTS.

Telephone: St. Albans 50731
(Ansafone)

**LONDON and the
SOUTH**

**ENGLISH ELECTRIC HOUSE, STRAND,
LONDON, W.C.2**

Telephone: COVent Garden 1234
Telex: 22572

MIDLANDS (East)

LONGACRES, ST. ALBANS, HERTS.

Telephone: St. Albans 59292
Telex: 23350

MIDLANDS (West)

40 WHITELADIES ROAD, BRISTOL, 8

Telephone: Bristol 39639

NORTH

23-25 STATION SQUARE, HARROGATE

Telephone: Harrogate 67454
Telex: 5723

U.S.A.

**111 CEDAR LANE, ENGLEWOOD,
NEW JERSEY**

Telephone: LOwell 7-0607

**FEDERAL REPUBLIC
OF GERMANY**

**MARCONI MESSTECHNIK G.m.b.H.
WOLFRATSHAUSER STRASSE 243,
MÜNCHEN-SOLLN**

Telephone: 797321
Telex: 524642

WORLD-WIDE REPRESENTATION

