HYDROMETTE

M 4050

Instruction Manual

GANN

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EU Declaration of Conformity

as defined by machinery directive 89/392/EEC Annex II A

We hereby declare that the handheld moisture meter(s)

HYDROMETTE M-4050

supplied by us conform to the relevant safety- and health-related requirements of the appropriate EU Directive as well as to the EU Directive on Electromagnetic Compability (89/336/EU) in version 93/31/EU. This declaration becomes void if the moisture meters are modified without our approval.

Applied harmonized standards in particular:

EN 55011/03.91 - DIN VDE 0875-11/07.92
DIN EN 50082-1/03.93

Applied national technical standards and specifications:

IEC 1000-4-2/1995 - IEC 1000-4-4/01.95
IEC 801-3/1984 - IEC 65A/77B

Important preliminary remarks

- ☐ It is of great importance to carefully read and understand the following instructions. Warranty claims for any damage caused by non-observance of these instructions cannot be accepted. In no event will the manufacturer be liable for damages, including lost profits, lost savings or other incidental or consequential damages or injury to persons arising out of the use of or inability to use the product, even if the manufacturer has been advised of the possibility of such damages, or for any claim by any other party.

- ☐ All instructions for use of the product and its accessory should be strictly followed to avoid measuring errors which frequently occur when trying to simplify the measuring procedure.

- ☐ Make sure in any case by suitable means prior to drilling holes for measuring probes or before driving electrode pins into walls, ceilings or floors that this happens away from power lines, water pipings or other supply pipes.

- ☐ Any use of the measuring instrument and its probes under unfavourable environment conditions should be avoided. This could cause damage to the sensitive electronic circuitry of the meter and its measuring probes.

- ☐ Unfavourable environment conditions are among other things
  -- too high an ambient air humidity (>90 %),
  -- dampness,
  -- dust and inflammable gases or vapours as well as air containing solvents,
  -- ambient temperatures exceeding 50 °C,
  -- ambient temperatures below the freezing point.

- When using the measuring probes and connecting to or disconnecting them from the measuring instrument do not use force and do not pull on the cable.

- The measuring instrument, connecting cable and measuring probes must not be used or stored in aggressive or air containing solvents.

- Every printer connected to the measuring instrument must command the XON/XOFF requirements.

- It should be noticed that measurements using the active electrodes B 50 and B 60 have always to be taken with the meter set for battery operation. In case of mains operation the measuring field can be changed what may result in measuring errors.

- **Static Electricity** - At low air humidity circumstances such as friction during timber handling or highly insulated surroundings may cause static electricity of very high voltages. This may result not only in fluctuating or negative readings, but can also destroy transistors and ICs used in manufacturing the moisture meter.
  The operator too may contribute by his clothing or shoes made of man-made fibre to build up a static charge. The results can markedly improved, if the operator stands perfectly still and avoids moving the meter and the measuring cable while taking the reading.

- Frozen wood with moisture content in excess of 20 % cannot be measured.

- The information and tables on admissible or usual moisture conditions as well as the general terms and definitions contained in the instructions were taken from the specialist literature. The manufacturer or supplier of the measuring instrument cannot be held responsible for the correctness of this information. The conclusions to be drawn from the measurement results by each

user are governed by the individual circumstances and experiences and knowledge gained in the course of his professional practice.

- ☐ The measuring instrument meets the stronger demands laid down in class B of the pertinent regulations for interference emission and may, therefore, be used also in living areas.

- ☐ The measuring instrument and its standard and optional accessory must only be used as described in this manual.

- ☐ In view of the electromagnetic compatibility and the reliability of measurement, only the standard and optional accessory described in this manual must be used with the measuring instrument.

GANN HYDROMETTE M 4050

The **HYDROMETTE M 4050** is a microprocessor operated instrument for measurement of wood moisture, structural moisture, air humidity and temperature. It is designed for storage of these measurements and for statistic evaluation according to medium value, highest and lowest reading and for standard deviation. The meter can memorize up to 30 series of measurements of up to 100 readings each.

Along its upper edge the meter has a BNC connector for connection of the measuring probes for moisture measurements in wood and set building materials according to the resistance method electrode, a 7-pin connector for the temperature probes and active electrodes, a socket for a power supply unit and a RS 232 interface connector for connection of a printer or for data transfer into an AT or XT compatible personal computer. All entries take place via the membrane-covered 21-key pad; all data are displayed on a 4-line matrix display.

The measurement of structural moisture can be performed by three different measuring procedures. When using the resistance method the readings are displayed direct in percent of dry weight and according to the CM measuring procedure. The measuring ranges extend from 0.5 to 25 % of dry weight and from 0.5 to 12 % CM.

The second, non-destructive measuring method is based on the capacity or dielectric constant measuring principle using the active electrodes B 50, B 60 and MB 35. The measurement is performed in scanning mode and reveals moisture distribution and concentrations in walls or ceilings, e.g. ascending moisture or water damages.

The third measuring method provides measurement of air humidity in a bore hole. The readings are converted into percent of dry weight according to definite curves (sorptions isothermes).

For measurement of the air relative humidity as well as the air temperature and the dew point, the optionally available active electrodes RF-T 28, RF-T 31, RF-T 32 and RF-T 36 can be used with the Hydromette M 4050.

For temperature measurement in solid materials, liquids, air and flue gas a wide range of PT 100 temperature probes in 4-conductor design are available.

The ram-in electrode M 18 and the drive-in electrode M 20 finally are provided for wood moisture measurement in the range between 5 and 100 % m.c. The additionally available active electrode MH 34 is exclusively designed for measuring coniferous wood with a moisture content between 40 and 200 % m.c. The wood temperature affecting the accuracy of measurement can be compensated either by manually entering the wood temperature or, in case of measurements during kiln drying timber, automatically by means of a temperature probe.

When printing out memorized measuring values, the printouts show the code number of the respective building material or species of wood, the type of material, in case of wood moisture values also the entered or measured temperature as well as date and time of measurement. All memory positions can be erased at will and reused for new measurements. By means of the plus and minus keys the individual memory positions can be called up at any time.

Technical Specifications

Readout:	4-line LCD matrix readout
Resolution:	0.1 % / 0.1 digit
Response time:	< 2 sec.
Meter adjustment:	fully automatic adjustment
Admissible ambient conditions for storing:	5 to 40 °C, temporarily -10 to 60 °C not condensing
Admissible ambient eration:	0 to 50 °C, temporarily -10 to 60 °C not conditions for op- condensing
Power supply:	one 9 V dry cell type IEC 6 LR 61, optionally 9 V re-chargeable battery or mains unit 12
Power consumption:	26 to 36 mA (depending on probe used)
Dimensions:	plastic casing 190 mm long, 116 mm wide 56 mm high.
Auto-switch-off:	after approx. 30 seconds.

Measuring Ranges

Wood Moisture:

between 5 and 100 % m.c. with ram-in electrode M 18 and drive-in electrode M 20,

between 40 and 200 % m.c. with live electrode MH
34, 5 to 30 % m.c. if used in the manufacture of laminated beams according to DIN 1052 using code No. 373 and the M 18 and M 20 electrodes.

Structural Moisture:

0.3 to 25 % of dry weight or 0.3 to 12 % CM for measurements according to the resistance method and input of code number, or

0 to 80 digits according to the resistance method (scanning range), or

0 to 199 digits for non-destructive measurement with live electrodes B 50 and B 60 (scanning range), or

0.3 to 8.5 % CM for non-destructive measurement with live electrodes B 50 and B 60 and input of code number, or

2 to 8 % of dry weight for non-destructive measurements of concrete surfaces with live electrode MB 35 and input of code number, or

0.3 to 6.5 % CM for non-destructive measurements of concrete surfaces with live electrode MB 35 and input of code number, or

0.2 to 3.7 % of dry weight, direct reading of converted sorptions isothermes.

Measuring Ranges

Air Temperature:	5 to 98 % R.H. using live electrodes RF-T 28, RF-T 31, RF-T 32 and RF-T 36.
Temperature:	-30 to 170 °C depending on PT temperature probe used or 0 to 170 °C with infrared temperature probe IR 40.

Battery Check

If battery voltage drops below 7.5 V, »WARNING - BATTERY VOLTAGE TOO LOW« appears on the LCD readout when the meter is switched on. In general a few measurements are still possible but the battery should be replaced or recharged soon. The cover of the battery compartment can be lifted by means of a screw driver or a coin inserted into the slot.

Power Source

The meter is fitted, as standard equipment, with a 9 V dry cell IEC 6 LF 22 or IEC 6 LR 61. It is recommended to use alkaline batteries.

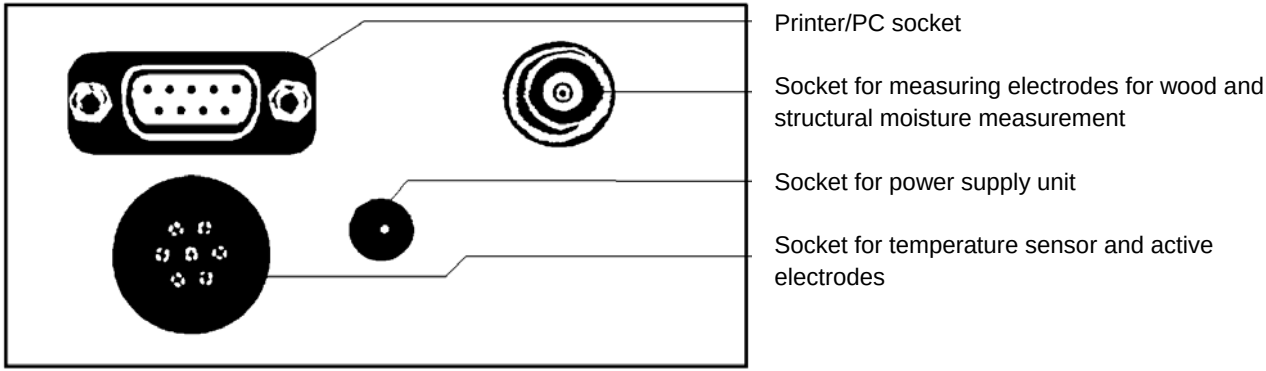
A rechargeable nickel-cadmium battery can be fitted optionally. It can be recharged from any AC lighting supply socket by means of the charging unit supplied with this special battery. Charging time is about 12 hours at 230 V.

Mains Operation

The meter can optionally be equipped with a power supply unit which is particularly recommended for data transfers to a printer or PC.

Connecting Sockets

Along the top edge of the instrument there are four sockets for connection of the measuring electrodes for wood and structural moisture, for connection of a temperature sensor or active electrodes, for connection of a printer or PC and for connection of a power supply unit.

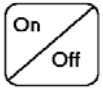


For connection of a printer or a PC, special cables (MK 17 or MK 19) are necessary which are available as optional accessory.

For measurement of wood moisture, structural moisture, air humidity or temperature, all measuring electrodes of the GANN HYDROMETTE program can be used.

The use of the power supply unit is recommended for lengthy data transmittals to a printer or PC.

Function of the keys



ON/OFF Key - Upon pressing this key the main menu appears. At the position of the blinking cursor code number of the material to be measured ensuring automatic species correction of the readings is to be entered.

Numerical Keys - These keys serve for all numerical inputs such as code numbers, the value for wood temperature compensation or the number of the series of measurements under which the readings are to be stored.

Measuring Key - After driving the pins of the measuring electrode into the material to be measured or application of any other measuring probe, the reading will be displayed on the right hand side of the top line upon pressing this key.

»ENTER« Key - All entries including selections made via the »ARROW Keys« must be verified by pressing this key. The processor will only then accept the entry.

Memory Key - By pressing the memory key, the reading displayed including the measured or entered wood temperature and the date and time can be stored under a series number (1 to 30) and the individual number of the reading (1 to 100).

Minus Key - This key serves for the entry of a negative temperature value as well as for back browsing in the register of materials in alphabetical sequence and for back browsing in the register of charge numbers and the numbers of individual readings for viewing of stored readings.

Plus Key - This key serves for forward browsing in the register of materials in alphabetical sequence and for forward browsing in the register of charge numbers and the numbers of individual readings for viewing of stored readings.

Arrow Down Key - This key serves to move to the next entry position.

Arrow Up Key - This key serves to return to the previous entry position.

Menu Key - This key serves to call up the »Statistics Menu« and the menu for cancellation of readings stored under a specific series number, for dialogue with the PC and for printing of the stored readings by means of a printer connected to the meter.

Print Key - To start printing of the last moisture and temperature measurement including time and date of measurement.

Period Key.

Setting the Instrument to Work

Setup Menu

The setup menu is called up with the meter switched off and holding the **»0«** key depressed while briefly depressing the **»ON/OFF«** key.

This is only necessary if the inputs for date and time and the baud rate have to be changed or if all data memorized shall be deleted using the selftest function of the meter. The following setup menu will be displayed:

```
Sprache / Language          [ * ]

Selftest                    [ * ]

Baudrate                    [ * ]

Date / Time                 [ * ]
```

By pressing one of the two **»ARROW«** keys the cursor must be placed in the line »SPRACHE/LANGUAGE«. This must be acknowledged by pressing the **»ENTER«** key. For choosing the dialogue language the following language menu is displayed on the screen:

Language Menu

```
UK          [ * ]
```

The **HYDROMETTE M 4050** is available with software in different languages.
The asterisk in the above menu indicates the language provided for the respective meter.

Date / Time Menu

To set the date and the time the Setup Menu must be brought up. To do so, with the meter switched off, hold down the **»0«** key while pressing the **»ON/OFF«** key.
On the Setup Menu place the cursor in the line »Date / Time« by pressing the **»ARROW«** key and acknowledge this selection by pressing the **»ENTER«** key. The following Date / Time Menu appears:

```
 Date                Time

DD MM YY             HH MM

01/02/91             07:43
```

The numbers must be entered in groups of two digits (e.g. day 02) and must be verified by pressing the **»ENTER«** key. The time is entered as military time (e.g. 15:24). All of these entries must be made in groups of two digits and each entry of two numbers must be verified by pressing the **»ENTER«** key. The cursor can be moved to the left with the **»ARROW UP«** key and to the right with the **»ARROW DOWN«** key. Upon completion of the date and time entry, the »Setup Menu« can be brought up by pressing the **»MENU«** key once, and the »Main Menu« is brought up by pressing the **»MENU«** key twice.

Main Menu

Upon pressing the

key the Main Menu appears, e.g.:

```
385 : Concr_B25                    %

Tmes        C          Tcmp        C

Batch No.                           5

Sample No.                         87
```

The »Main Menu« is used for measurement of wood moisture, structural moisture, air relative humidity, temperature and of the dew point. It further serves for entering the kind of material to be measured and in case of wood moisture measurement for entering the temperature value for automatic correction of he reading. If the readings are to be memorized, also the batch number must be entered in this menu.

If no temperature sensor is connected, Tcmp (compensation temperature) has to be entered by means of the **»NUMERICAL«** keys. The entered value will be shown in the position of Tmes as well.

For automatic species correction of the readings, the material to be measured may either be entered by its three-digit code number or by using the built-in alphabetical register of the various materials. If the code number is entered, it must be verified by pressing the **»ENTER«** key.

The code numbers of the materials to be measured can be found at the end of this manual. Code numbers entered by means of the **»Numerical«** keys have to be acknowledged by pressing the **»ENTER«** key.

The built-in alphabetical directory permits by forward or return browsing search and entry of the material to be measured without entering its respective code number. Some species are abbreviated as only space for 10 characters is available on the matrix display. With the cursor put in the first line of the menu, the alphabetical listing can be browsed forward or back by pressing the **<+>**- or the **<->**-keys. Each stroke of these keys advances the listing by one kind of material in alphabetic order. No confirmation by pressing the **»ENTER«** key is required in this case.

Continued hold-down of the <+> or <-> keys advances the listing to the next initial letter of the alphabet. Once the initial letter of the desired material has been reached, the species will be found by pressing the **<+>** or **<->** key repeatedly to advance the listing in single steps. In this manner the search can be speeded up.

Automatic compensation for the wood temperature can be accomplished by measurement with a temperature sensor or, if the wood temperature is known, by entry using the **»Numerical«** keys. When the temperature is being measured by a sensor connected to the meter - the temperature is continuously updated - one needs only to press the **»ENTER«** key after the cursor has been placed in the second line of the Main Menu by means of the **»Arrow«** keys. After pressing the **»ENTER« k**ey, the measured value is also displayed in the position of Tcmp for automatic compensation of the moisture reading rounded off without decimal place.

If an otherwise determined wood temperature is to be used for compensation, it has to be entered by means of the **»Numerical«** keys. The input must be confirmed by pressing the **»ENTER«** key. If, subsequently, the **»M«** key is pressed, the temperature-compensated moisture reading will be shown in the first line of the menu.

If the measurement is to be memorized for later print-out or for transfer into a PC, the number of the batch under which the reading is to be stored, must be entered in the third line of the menu. Numbers from 1 to 30 may be entered after first placing the cursor in the third line of the menu via the **»AR-ROW«** keys. This entry must be acknowledged by pressing the **» ENTER«** key.

Upon pressing the **»MEM«** key, the code number of the measured material, the reading displayed, the temperatures »Tmes« and »Tcmp« as well as the date and time will be memorized under the number which was displayed in line three of the menu before pressing the **»MEM«** key. Upon pressing the **»MEM«** key the reference number of the memory position shown in line four will be increased by the figure 1. If, for example, the number 34 is shown in the fourth line of the menu, this means that under the aforementioned series number altogether 33 readings have been stored so far.

The series number can also be brought up in the menu by pressing the »+« or »-« keys. No confirmation is required in this case. Entry of the series number is only necessary, if the next reading is to be stored under another series number, otherwise the **»MEM«** key for storing the reading can be pressed directly after confirming the temperature value.

By entering the number of a reading, with the cursor placed in the fourth line, and verification by the **»ENTER«** key, a specific memory position can brought up on the menu so as to view the reading memorized or to store the value of a new reading. The entire memory can be leafed through by pressing the **»+«** or **»-«** keys. If one of these keys is held down, the advance runs faster. If a selected number shows no reading in the first line of the menu, that memory position has not been used yet.

Statistics Menu

The Statistics Menu offers a review of the scatter of the stored individual readings. Listed by series number, the number of readings stored, their minimum (**MIN**) and maximum (**MAX**) value as well as the average value (**MEAN**) of all readings stored under the batch number in line 1 and the standard deviation (**STD**) are displayed.

```
Stat. Series No.          22

Total Samples             87

Min      5.3      Max     6.4

Mean     6.0      Std     0.6
```

In the first line the number of the series to be displayed must be entered, and acknowledged by pressing the **»ENTER«** key, whereupon the number of readings stored under this series number is shown in line two. The lowest and highest readings are shown in line three, while the average value and the standard deviation are displayed in line four.

Standard deviation is defined as mean square deviation of all readings from their average value. It indicates the width of scatter. The lower this value the smaller the scatter (0 = no scatter).

Menu for Special Functions

This menu serves for erasing, printing and PC transfer of complete series of stored readings.

```
Printer                    [ ]

PC-Comms                   [*]

Delete batch               [ ]
```

With the cursor in the upper line, the printer menu can be called up by pressing the key **»ENTER«**.

With the cursor in the middle line and pressing the key **»ENTER**«, a dial-up to a PC can be performed via the serial interface of the meter. <**SIO READY**> is then displayed on the matrix readout. The transfer program **»DIALOG«** (optional accessory) must now be initiated at the PC.
It should be noted that the baud rate of the PC is also adjusted on the Hydromette M 4050. On delivery, the meter is adjusted to a transmittal rate of 4800 baud.

Caution

In this mode of operation the automatic switch off device is deactivated. Therefore, it is recommendable to use the optionally available mains unit for lengthy data transmittals. By pressing the key **»MENU«,** the preceding menu is displayed again.

In the lower line, the reference No. of the series of measurements that shall be erased can be entered. The input has to be confirmed by pressing the **»ENTER«** key. To prevent erroneous erasure, the **»ENTER«** key has to be pressed twice. The erasure order can be cancelled by pressing the **»MENU«** key instead.

Printer Menu

If in the menu for special functions the key **»ENTER«** is pressed with the cursor placed in the upper line, the following Printer Menu comes into view:

```
Print batch                [ ]

Print all batches          [ ]

Width:      80 [*]     20  [ ]

add statistics             [ ]
```

Single series of measurement or all memorized readings can now be printed out by a printer connected to the serial interface. According to the printer used, a printing width of 20 or 80 characters per line can be selected.

Note: The printer must command the XON/XOFF software system.

For printing out a single series of measurement, place the cursor in the first line using the **»ARROW«** keys, enter the number of the series to be printed and confirm by pressing the **»ENTER«** key. If only a printout of the momentarily displayed series is desired, just press the **»ENTER«** key.

If all memorized readings are to be printed, place the cursor in the second line and confirm by pressing the **»ENTER«** key. Be aware of the time required and of the necessary paper supply. The print width to be selected depends on the available printer. Place the cursor in the respective field by means of the **»ARROW«** keys and confirm by pressing the **»ENTER«** key.

In the fourth line, it can be determined, whether the printout is desired with an additional statistics section. If so, move the cursor into the fourth line by means of the **»ARROW«** keys and press the key **»ENTER«** whereupon an asterisk is displayed at the end of the line. Pressing the **»ENTER«** key a second time deactivates the print-out of the statistics section again.

Specimen Printout of Memorized Readings

GANN HYDROMETTE M 4050

Batch No.: 18 Total samples: 14

Minimum: 47.4 Maximum: 64.6

Mean: 58.8 Standard deviation: 10.8

	Material	Code	Moisture	Tmes	Tcmp	Date	Time
M 1	CONCR_B15	383	1.2 %	-	-	26.10.96	10.12
M 2	CONCR_B15	383	1.4 %	-	-	26.10.96	10.14
M 3	CONR_B25CM	386	0.4 %	-	-	26.10.96	10.20
M 4	IR-PROBE	430		17.0 °C	-	27.10.96	14.12
M 5	PINE	207	17.2 %	-	20.0 °C	28.10.96	08.18
M 6	PINE	207	18.3 %	22.4 °C	22.4 °C	29.10.96	15.28
M 7	MH 34	429	50.6 %	-	-	30.10.96	11.48
M 8	RF-T	427	43.0 %	21.3 °C	-	30.10.96	11.50
M 9	MERANTI DA	231	14.5 %	-	24.0 °C	03.11.96	13.06
M10	MERANTI DA	231	15.7 %	-	25.0 °C	03.11.96	13.10
M11	CEM MORTAR	408	3.1 %	-	-	06.11.96	09.12
M12	CEM MORTAR	408	2.9 %	-	-	06.11.96	09.15
M13	CEM MORTAR	408	2.7 %	-	-	06.11.96	09.17
M14	CEM MORTAR	408	3.0 %	-	-	06.11.96	09.20
M15							
M16							
M17							
M18							

The specimen printout overleaf has been composed at random. It shall give the user only an idea of the form of such a printout and the data it may contain. Needless to say that it would make no sense to choose a statistic evaluation of readings obtained from different kind of materials as shown in the specimen printout.

M1-M2 + M11-M14	The data is the outcome of structural moisture measurements according to the resistance method. The moisture value refers to the dry weight of the building material.
M3	This is also a structural moisture measurement according to the resistance method, but the reading has been converted into % CM.
M4	Shows the temperature measured by means of the infrared probe IR 40.
M5+ M9-M10	The data is the outcome of wood moisture measurements where the wood temperature for automatic compensation of the readings has been manually entered.
M6	Here the wood temperature has been measured by a measuring probe and taken over for automatic compensation.
M7	This data represents the reading obtained with the active electrode MH 34 on coniferous wood.
M8	These air humidity and air temperature readings have been obtained by means of an active electrode RF-T.

Baudrate Menu

To select the baudrate (speed of transmittal) of the serial interface, the cursor must be placed in the third line (SIO BAUDRATE) of the Setup Menu and confirmed by pressing the **»ENTER«** key. The display shows the following Baudrate Menu:

```
9600          [ ]

4800          [*]

2400          [ ]

1200          [ ]
```

One of the four transmittal speeds can be selected, using the **»ARROW«** keys to place the cursor in the appropriate field. The baudrate to be selected depends on the printer or PC to be used. Confirm your selection of the baudrate by pressing the **»ENTER«** key. The baudrate selected remains in memory when the instrument is switched off. Data transmittal takes place via 8 databits, 2 stopbit, without parity.

Instrument Selftest

To test the performance of the instrument, the cursor must be placed in the second line of the Setup Menu and confirmed by pressing the **»ENTER«** key. Because the data base will be totally erased during this test, the following warning appears in the display:

```
* * *  W  A  R  N  I  N  G  * * *

Batch memory will be

erased! Confirm

with <ENTER>
```

If the memory shall not be erased, one can abort the test by pressing the **»MENU**« key.

If the test is to be performed, the **»ENTER«** key must be pressed. The display goes blank at first, then characters are displayed in alphanumerical sequence.

The above menu can be called up by holding the key **»0«** depressed while pressing the key **»ON/OFF«**.

Instructions for Wood Moisture Measurement

using measuring electrodes M 18, M 20, M 20-OF 15 and M 20-HW

Connect measuring electrode to the BNC socket of the meter by means of the measuring cable MK 8 usually supplied with the meter.

Then switch on the meter by pressing key **»ON/OFF«**.

Enter the code number of the species of wood to be measured while the cursor is on the first position of the upper line of the menu. Confirm the input by pressing the key **»ENTER«** when the wood name appears behind the code number for verification of the input. The code numbers can be found in the table of wood species.

Move the cursor to the input position »Tcmp« in the second line by means of the key »↓« and enter the wood temperature. If a temperature probe has been connected to the meter, the measured temperature is displayed on the first position (»Tmes«) of the second line and can be used for temperature compensation by pressing the key **»ENTER«** instead of manually entering a temperature value.

Then drive-in, stick-in or press the electrode onto the wood to be measured. After pressing the key **»M«** the measured moisture content is displayed at the end of the first line.

For memorizing the reading, move the cursor first to the third line and enter the batch number (reference number of a series of measurements) under which it shall be stored. After confirming the input by pressing the key **»ENTER«** and then press the key **»Mem«** for storing the reading.

Memorizing Readings

For storing readings, 3,000 memory positions are available which are divided into 30 series of measurement with 100 individual positions. First the batch No. must be defined in the third line of the basic menu. The reference number of the individual memory position needs not be defined unless the reading shall be stored under another position than displayed in the fourth line of the menu. After erasing a series of measurements, the figure »1« is displayed again in the fourth line.

Table of Species of Wood

Many species of wood are also commercialized under other names than those stored. If any name cannot be found when leafing through the alphabetical register, it is possibly contained in the table of wood species with the code No. to be entered. If not, ask the supplier of the meter stating the botanical name for exact identification.
Particleboards and fibreboards are listed at the end of the table of wood species. As different types of resin and glue mixtures are used in the manufacture of these artificial products which may be unknown to user of the meter, the same accuracy of readings as obtainable on solid wood is not ensured.

Compensation of Wood Temperature

The wood temperature affects the accuracy of readings. Its influence can be compensated either by manually entering the temperature or by taking over the measured temperature. For measurements during kiln drying, the drying temperature should be entered.

Frozen wood with moisture content in excess of 20 % cannot be measured.

Measuring Non-Memorized Species of Wood

As generally known, the accuracy of electrical moisture meters is affected by different electrical properties of the various species of wood. Therefore, individual calibration curves of a great number of wood species have been stored in the software of the Hydromette M 4050 to ensure maximum accuracy of readings.

If any species is to be measured which cannot be found in the register of the meter nor in the attached table of wood species, proceed as follows:

First, a sample of the species in question, with well equilibrated moisture content, is to be measured using the code Nos. 351, 352, 353 and 354. Then the moisture content of the test sample must be determined by an oven test immediately after the aforementioned measurements have been taken. For future measurements use that code No., the reading obtained with it is nearest to the value obtained by the oven test. It should be noted, however, that the accuracy of such readings is not equal to those obtained with individually stored wood species.

Oven test:

After weighing the test sample, the oven test should be run at 100 - 105 °C until the weight remains constant. The moisture content in percent is calculated according to the following formula:

$$\frac{\text{Loss in weight} \times 100}{\text{Dry weight}} = \text{wood moisture in \% of dry weight.}$$

Handling of the electrodes for wood moisture measurement

Connection of the electrodes

The meter can be used with various types of measuring electrodes according to the respective application. The electrodes M 6, M 18, M 20, M 20-OF 15 and M 20-HW are connected to the meter socket by means of the measuring cable MK 8. On the meter side, this cable is fitted with a BNC plug. Turn clockwise to lock it. To disconnect, turn notched fastening ring anti-clockwise. ***Do not use force and do not pull on the cable***.

Grain Direction

GANN wood moisture meters have been calibrated for taking readings with electrode pins driven into the test sample across the grain. As the electrical resistance is greater across the grain than parallel to the grain, too high a reading will be obtained if the electrode pins of GANN meters are applied parallel to the grain. The effect can be neglected at readings below 10 % m.c., whereas around 20 % m.c. the meter will read about 2 % m.c. higher.

Thickness of Wood

Electrodes with pins having a penetration of 10 mm can be used on wood up to 30 to 40 mm thick, whereas pins with a penetration of 17 mm are designed for wood thicknesses up to 50 to 65 mm. For thicker boards or planks, the ram-in electrode M 18 should be used which permits the use of pins with a penetration depth of up to 54 mm. For stock with equilibrated moisture content, non-insulated pins can be used, whereas for all other applications insulated pins making contact only with their uncoated tip regardless of the penetration depth, should be used.

Any change in meter readings taken with insulated pins at different penetration depths clearly reflect an actual change in moisture content representing the existing moisture gradient.

Drive-in Electrode M 20

Drive the electrode into the wood with the needles across the grain (the electrode body is made of impact-resistant plastic). When withdrawing the electrode, the pins can be loosened by slight sideways rocking movements across the grain.

For determining the average moisture content, the pins have to be driven to a depth of approx. 1/4 to 1/3 of wood thickness.

When the M 20 electrode is supplied with the meter as initial equipment, 10 spare pins 16 and 23 mm long are included in the delivery. They are suitable for testing wood up to 30 mm and 50 mm thick respectively.

If thicker boards or planks are to be measured, the needles can be replaced by longer ones. Naturally, the liability to breakage and/or bending increases with the length of the pins, especially when withdrawing them. Therefore, it is recommended to use the ram-in electrode M 18 for testing thicker wood.

The cap nuts should be tightened by means of a spanner. Loose needles may easily break.

Surface Electrodes M 20-OF 15

Surface measurements should only be taken when the wood moisture content is below 30% m.c. For surface measurements on already machined stock or for veneer measurements, the two hexagon cap nuts have to be unscrewed and replaced with the surface measuring caps. For measurement, the two contact pads have to be pressed across the grain onto the stock to be measured or onto the veneer. The measuring depth is about 3 mm, so several veneer layers have to be laid on top of one another for measurement of thinner veneer. ***Do not measure on metal bases.***
Wood particles adhering to the measuring surface should be removed at regular intervals. If the flexible plastic pads are damaged, new ones can be ordered *(Ref. No. 4316)* and stuck on using a commercially available instant adhesive on cyanate basis.

Ram-in Electrode M 18

The two needles of the ram-in electrode have to be driven to the required measuring depth, across the grain, using the sliding hammer. For determining the average moisture content, the same measuring depth as described with electrode M 20 is required.
The needles are withdrawn by striking upwards with the sliding hammer. Prior to a series of measurements, the cap nuts should be tightened by means of a spanner. Loose needles may easily break.

Note

The pins ***must not*** be driven into the wood until the cap nuts are in touch with the wood. There must remain a space between cap nut and wood of about 4 to 5 mm. This should be observed particularly when using insulated pins.

When the M 18 electrode is supplied with the meter, 10 spare pins 40 mm and
60 mm long (without insulated shank) are included in the delivery. They are suitable for measuring wood up to 120 mm and 180 mm thick respectively. For testing timber with higher shell m.c. than core m.c., e.g. if boards were exposed to rain, electrode pins with insulated shank should be used. They are available in packets of 10 pins and in lengths of 45 mm *(Ref. No. 4550)* and 60 mm *(Ref. No. 4500)*.

Stick-in Electrode M 20-HW

Remove hexagonal union nuts with standard electrode pins on the electrode M 20 and replace by electrode pins M 20-HW. Tighten firmly.

When testing chips and woodwool it is recommended to compress the material.
To do so, the shavings should be loaded with a weight of about 5 kg. Woodwool bales need not to be compressed.

Test Standard

The optionally available test standard *(Ref. No.6070) permits the user to check* proper function of the wood moisture measuring section of the meter as well as of the connecting cable MK 8 and of the measuring electrodes M 18 and M 20 at any time. To do so, connect the cable to the meter and insert the two plugs in the bushings of the test adapter. If an electrode is to be included in the check, connect it to the cable and insert the two pins into the bushings.

After the meter has been switched on, enter the Code No. 354 and as Tcom 20 °C. Upon pressing the key **»M«**, 21.0 % should be displayed in the upper line of the menu if the meter, cable and electrode are in good order. A tolerance of ± 0.5 % is admissible.

General Information on Wood Moisture Measurement

The measuring principle of the most GANN Hydromette moisture meters is based on the electrical resistance or conductivity measuring method well known for many years. This method is based on the fact that the electrical resistance is dictated to a large extent by the wood moisture content. The conductivity of bone-dry timber is very poor and its resistance very high so that no current worth mentioning can flow. The conductivity of wood increases with increasing moisture content whereas its electrical resistance decreases.

In the range above the fibre saturation point (about 30 % m.c.) readings become progressively less accurate depending on the species of wood, its specific weight and temperature. With European conifers and some exotic woods such as Meranti/ Lauan, greater measuring errors must be expected in the range above 40 % m.c. whereas relatively accurate readings can be obtained with oak, beech, white afara, etc. up to a range of 60 - 80 % m.c.

To achieve as accurate readings as possible, the samples selected should be measured at several spots. It should always be observed that the minimum penetration depth of the electrode pins, driven into the wood across the grain, is 1/4 and the maximum depth 1/3 of wood thickness. Testing frozen wood with a moisture content in excess of 20 % is not possible.

For measurement of coniferous wood with high moisture content (40 to 200 % m.c.) the active electrode MH 34 should be used.

Effects of Wood Preservers

Treatment of wood with organic preservers or impregnating agents has, in general, little effect on the meter readings. Treatment with preservatives containing salts or other inorganic constituents that change the conductivity of wood, however, has a great effect on the accuracy of the readings and as it is erratic, a suitable table correction cannot be provided.

Moisture Checks on Plywood

Some of the various types of glue used in the manufacture of plywood have a lower electrical resistance than the wood. This will affect the accuracy of electrical resistance moisture meters when the electrode pins get in touch with a glue line. The meter will then show too high a moisture content.

To find out whether a conductive glue has been used in manufacturing the plywood to be tested, drive the electrode pins to a depth of no more than half the thickness of the first ply and read the result. Then drive the pins further into the plywood until they come in contact with the first glue line. If the reading now displayed is not noticeable higher than before, the glue may be considered to have no effect on the accuracy of the meter readings.

Static Electricity

At wood moisture contents below 10 %, circumstances such as low air relative humidity, friction during timber handling or highly insulated surroundings may cause static electricity of very high voltages. The operator too may contribute, e.g. by his clothing or shoes made of man-made fibre, to build up a static charge. This may result not only in fluctuating or negative readings, but can also destroy transistors and integrated circuits used in manufacturing the moisture meter.

The results can be markedly improved, if the operator stands perfectly still and avoids moving the meter and the measuring cable while taking the reading.

Especially at the outlet of veneer dryers, very high static charges have to be expected. Therefore, moisture measurements of dried veneer should be made only after the static charge has been sufficiently reduced, what can be sped up by employing suitable grounding measures.

Wood Moisture Equilibrium - Equilibrium Moisture Content

When storing wood for a sufficiently long space of time in a constant ambient atmosphere, it will adopt the moisture content that corresponds to this climate which is called **Wood Moisture Equilibrium**.

Once the wood has reached its moisture equilibrium, it will neither give off moisture nor absorb it from the air, unless the ambient atmosphere changes. The following table shows some moisture equilibrium values which wood adopts at the various conditions specified.

Wood Moisture Equilibrium					
	Air Temperature in °C				
Air relative Humidity	10°	15°	20°	25°	30°
	Wood Moisture Content				
20 %	4.7 %	4.7 %	4.6 %	4.4 %	4.3 %
30 %	6.3 %	6.2 %	6.1 %	6.0 %	5.9 %
40 %	7.9 %	7.8 %	7.7 %	7.5 %	7.5 %
50 %	9.4 %	9.3 %	9.2 %	9.0 %	9.0 %
60 %	11.1 %	11.0 %	10.8 %	10.6 %	10.5 %
70 %	13.3 %	13.2 %	13.0 %	12.8 %	12.6 %
80 %	16.2 %	16.3 %	16.0 %	15.8 %	15.6 %
90 %	21.2 %	20.8 %	20.6 %	20.3 %	20.1 %

Instructions for Use of the Active Electrode MH 34

Connect electrode to the meter on the 7-pin socket.

Press or cautiously drive the pins of the electrode into the wood to be measured up to the cap nuts - ***both cap nuts must be in touch with the wood***.

Switch on meter and enter code No. 429. Confirm input by pressing key **»ENTER«.**

Press key **»M«** and read off result**.**

The reading can be stored by pressing the key **»Mem«.**

The live electrode MH 34 has been developed specially for measurement of very high moisture contents in coniferous wood (pine, fir, spruce). It is suitable particularly for pre-sorting of freshly cut timber for kiln drying and for monitoring waterborne storing.

The measuring range extends from 40 to 199 % m.c. and the reading is displayed direct in per cents of moisture. Moisture values below 40 % m.c. are beyond the measuring capacity of this special electrode and readings below 40 % m.c. should, therefore, be disregarded. For measurements in the range below 40 % m.c. the electrodes M 18 and M 20 should be used.

The live electrode MH 34 is equipped and also adjusted to pins 23 mm in length, and the readings obtained represent the average moisture content of that section of the board or piece of wood penetrated by the pins. We do not recommend using longer or shorter pins as this will affect the accuracy of reading.

When withdrawing the electrode, the pins can be loosened by slight sideways rocking movements across the grain. The cap nuts should be tightened by means of a spanner prior to a series of measurements.

Monitoring Kiln Drying Timber

The HYDROMETTE M 4050 allows continual control and supervision of wood moisture content, equilibrium moisture (EMC) and drying temperature inside the closed drying kiln. The portable meter can be used to supervise any number of dry kilns, while the measuring station equipment is separately required for each kiln.

The monitoring system is suitable for both brick-built and pre-fabricated compartment kilns of any design. In each kiln, any desired number of wood moisture measuring points can be provided. For monitoring equilibrium moisture content and temperature measurement only one each measuring point is required unless the fans are periodically reversed. In the latter case, one each EMC and temperature measuring should be installed at the two opposite sides in direction of air flow as these readings should always be taken at the air entry side of the kiln load.

For taking moisture measurements on wood in the dry kiln during the drying process, enter the code No. of the species of wood to be dried and the drying temperature (Tcmp). If a temperature probe has been installed in the kiln, press the key **»ENTER«** with the cursor in position Tcomp to take over the measured temperature for automatic compensation of the wood moisture readings. For EMC measurement enter the code No. 355.
For M.C. and E.M.C. measurements in dry kilns, special electrodes and probes have to be used. They should be connected with the measuring point selector switch TKMU by means of Teflon insulated, heat-proof special cables. Whenever readings are to be taken, the Hydromette moisture meter is to be connected to the measuring point selector switch using the measuring cable MK 8.

The measuring point selector switch TKMU is available for connection of up to 6 or 10 MC and EMC measuring points, and also optionally with connection device for one or two temperature measuring points.

Warning

The measuring instrument ***must not*** be used inside timber dry kilns because of the high temperatures and the particular kiln atmosphere frequently contaminated by exudations from the timber.
For arrangement of the wood moisture and equilibrium moisture measuring points in the dry kiln, proceed as described hereinafter.

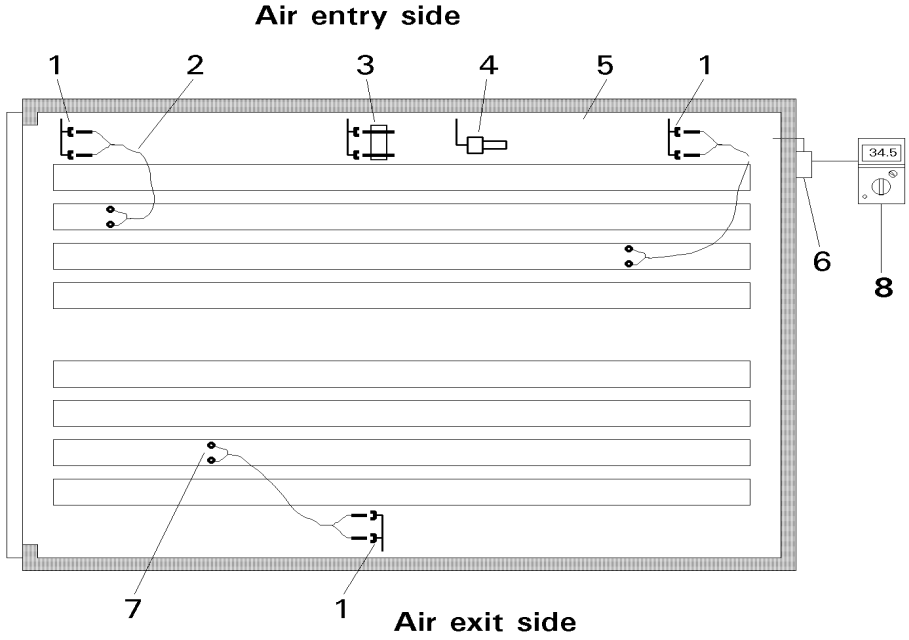
Assembly Instructions

Installation involves merely the installation of the measuring point selector switch **(6)** outside the kiln, mounting a wall connector **(1)** for each MC and EMC measuring point inside the kiln, and installing the main cables **(5)**.

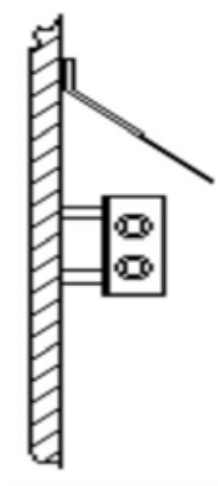
The picture on the next side shows a possible installation in a double track compartment kiln. The wall connector **(1)** for each MC and EMC measuring point is bolted to the inside kiln wall. Where several kiln trucks are in use, it is advisable to arrange the wall connectors near the end of each truck so that the electrode connecting cables **(2)** can be conveniently connected when the trucks are in position. Suitable mounting screws and spacers are included in the delivery of complete measuring point assemblies.

The EMC **(3)** and temperature **(4)** measuring points are to be installed on the air entry side of the kiln load. In case of reversing type dry kilns, i.e. where the fans run alternately in forward and inverse direction, EMC and temperature measuring points are to be installed on either side in direction of the air flow. The HYDROMETTE wood moisture meter **(8)** is connected to the selector switch by means of the standard cable MK 8. For taking temperature measurements, the cable MK 15 is to be used.

Fig. 1



Typical layout of an installation with one each EMC and temperature measuring point and three wood moisture measuring points.



The wall connector for the EMC probe is best mounted near the existing dry and wet bulb thermometer or hygrometer. The probe should lie directly in the air flow, but not close to the spraying system. It should be protected against drip water by an aluminium cover as shown in Fig. 2. Further, it should also be protected against direct radiating heat.

The measuring station selector switch should be installed outside the kiln in a position combining ready accessibility with the shortest cable lines to the wall connectors inside the kiln. The selector switch can also be mounted outdoors, but should then be protected against direct exposure to influence of the weather.

Fig. 2

Cables should be run from the kiln interior to the outside in an aluminium or plastic conduit. In brick-built kilns, the tube should be grouted in with a slight downward angle to the outside. In prefabricated kilns, it should be welded in or mounted with a sealing flange and should also slope at a slight downward angle.

In all cases, the cable duct should be sealed on the inside after cables have been installed, either by sealing compound or drilled rubber plug.

The main cables **(5)** joining the wall connectors **(1)** up to the measuring point selector switch **(6)** are fitted on one end with cable shoes which need only be plugged over the terminal pins in the selector switch. The other end of the cable must be plugged into the cable shoes mounted onto the wall connectors after stripping the ends of the two conductors. Then the sockets of the two cable shoes must be crimped to tighten the two conductors and to ensure good contact.

Inside the kiln, cables should be fixed direct to the kiln wall by means of the cable strings included in the delivery. They must not be laid in conduits, unless they are laid in dry kilns made of wooden panels.

Each standard wood moisture measuring point consists of two stainless steel electrodes 10, 15 and 25 mm long, one electrode cable 4 m long, one wall connector including spacers and fastening screws and one main cable 10 m long with cable strings and fastening screws. The 15 mm and 25 mm electrodes are also available with Teflon insulation upon special request. For very thick woods also electrodes 40 mm long are available in insulated and uninsulated design.

The penetration depth should be 1/3 of the thickness of the boards to be measured but at least 10 mm.

Preparing Wood Moisture Measuring Points

Measuring points should always be arranged roughly in the centre of the stack.
Where several kiln trucks are used or stacks loaded into the kiln, it is recommendable to distribute the measuring points among several stacks and at different levels.

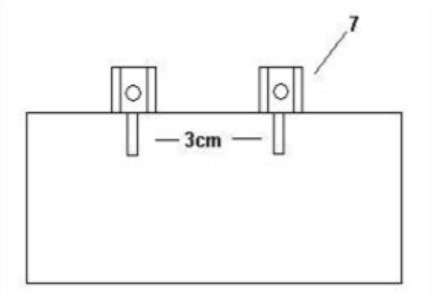


Fig. 3

When loading the kiln truck or piling the pallets, drill holes of 3 mm dia. to the full electrode penetrating depth into the board selected. Holes should be across the grain, 3 cm apart (Fig. 3). Drive the electrodes into the board using the special electrode tool available for driving in and extracting electrodes. Insert the plugs of the electrode cable into the connecting bores of the electrodes and lead the cable around the side or back of the stack.

Take care not to damage the cable when stacking the remainder of the wood on the truck or pallet.

When the truck or pallet is in position, connect the electrode cable to the wall connector in the kiln.

EMC Measuring Point

The EMC measuring point consists of an electrode holder with 50 wooden EMC sensors, one wall connector and a main cable 10 m long with fastening strings.
Pull the plug-in type electrode holder from the wall connector and loosen knurled nuts as far as the stop. EMC is measured on a thin specimen of White Afara. The sensor has to be placed between the clamps of the electrode holder, with the grain at right angles to them. Then tighten the knurled nuts as far as they will go. Now plug the holder into the sockets of the wall connector.

The sensor has to be replaced after each drying cycle.

Temperature Measuring Point

In addition to MC and EMC measuring points also a temperature measuring point can be installed and connected to the measuring point selector switch for taking readings with the Hydromette M 4050. It should preferably be placed close to the EMC measuring point. The temperature probe is supplied in standard design with a connection cable 10 m long and a fastening bracket. Longer cables, also for MC and EMC measuring points, are available on request.

Final Remarks

The meaning of the term »***wood moisture***« is obvious and requires no explanation, except perhaps that the moisture percentage always refers to the dry weight.

»***Wood equilibrium moisture***« (EMC), however, a factor of the greatest importance in effective drying, is not always clearly understood. It means the degree of moisture a piece of wood attains if stored long enough in a given atmosphere, i.e. at a definite ambient temperature and air humidity.

The ***»drying gradient***« finally is the ratio between wood moisture and equilibrium moisture. This can be expressed in the formula

$$\frac{\text{Wood Moisture}}{\text{Equilibrium Moisture}} = \text{Drying Gradient}$$

Conventional drying schedules frequently refer to the air relative humidity or wet bulb depression (psychrometric difference). The following table permits converting wet bulb depression values into EMC values and vice versa.

Wet bulb depression	Dry Bulb Temperature (°C) (Drying Temperature)										
	35	40	45	50	55	60	65	70	75	80	85
	EMC Values										
25			1.6	2.5	3.2	3.4	3.6	3.7	3.8	3.9	3.9
20	2.0	3.0	3.5	4.2	4.6	4.7	4.8	4.9	4.9	4.8	4.7
18	3.0	3.9	4.3	4.9	5.2	5.3	5.4	5.4	5.4	5.3	5.3
16	4.0	4.9	5.3	5.7	5.8	5.9	6.0	6.0	6.0	5.9	5.8
14	5.4	5.9	6.2	6.5	6.7	6.7	6.7	6.6	6.6	6.5	6.4
12	6.5	7.0	7.2	7.5	7.7	7.7	7.5	7.5	7.4	7.3	7.2
10	7.8	8.2	8.4	8.6	8.7	8.6	8.5	8.4	8.3	8.2	8.0
9	8.5	8.9	9.1	9.3	9.3	9.2	9.1	9.0	8.8	8.7	8.5
8	9.3	9.6	9.7	9.8	9.9	9.8	9.7	9.6	9.5	9.3	9.2

Wet bulb depression	Dry Bulb Temperature (°C) (Drying Temperature)										
	35	40	45	50	55	60	65	70	75	80	85
	EMC Values										
6	11.2	11.4	11.5	11.6	11.5	11.4	11.3	11.1	10.8	10.7	10.5
5	12.2	12.4	12.6	12.7	12.6	12.5	12.4	12.2	11.8	11.7	11.4
4	13.6	13.8	13.9	13.9	13.8	13.7	13.6	13.4	13.1	12.8	12.6
3	15.3	15.7	15.7	15.5	15.4	15.3	15.0	14.8	14.5	14.3	14.0
2.5	16.7	16.9	16.8	16.6	16.4	16.3	16.1	15.8	15.5	15.3	14.9
2	18.0	18.0	18.0	17.8	17.6	17.4	17.1	16.8	16.5	16.3	16.0
1.8	18.6	18.7	18.7	18.5	18.3	18.0	17.6	17.3	17.0	16.7	16.4
1.6	19.3	19.4	19.4	19.2	19.0	18.7	18.3	18.0	17.7	17.3	17.0
1.4	19.9	20.0	20.0	19.8	19.6	19.3	19.0	18.6	18.3	17.9	17.6

Instructions for Structural Moisture Measurement

According to the resistance principle using measuring electrodes M 6, M 20 and M 21

Connect measuring electrode to the BNC socket of the meter by means of the measuring cable MK 8 usually supplied with the meter and stick it into the material to be measured.

Then switch on the meter by pressing key **»ON/OFF«**.

Enter the code number of the building material to be measured while the cursor is on the first position of the upper line of the menu. Confirm the input by pressing the key **»ENTER«** when the abbreviated name of the building material appears behind the code number for verification of the input. The code numbers can be found in the table annexed to this manual.

Press the key **»M«** when the measured moisture content is displayed at the end of the first line.

With several building materials the moisture content can be displayed in percents of dry weight or in percents CM by entering the respective code No. (see table attached).

For memorizing the reading, move the cursor first to the third line and enter the batch number (reference number of a series of measurements) under which it shall be stored. After confirming the input by pressing the key **»ENTER«** move the cursor to the fourth line and press the key **»Mem«** for storing the reading.

Scanning Function Using the Resistance Measuring Method

If only a indication of the moisture condition, without conversion into percentage readings, of any material not listed in the annexed table is required, the meter can be switched over to the scanning mode by entering the code No. 434. This mode of testing has proved quite satisfactory for judgment of the moisture condition of, for instance, insulating materials.

The range of indication extends from 0 to 80 digits. It should be noted, however, that a closer assessment of the readings requires comparisons with the outcome of a series of oven tests.

Readings obtained in the scanning mode cannot be memorized.

Connection of the Measuring Electrodes

The meter can be used with various types of measuring electrodes according to the respective application. They are connected to the meter socket by means of the measuring cable MK 8. On the meter side, this cable is fitted with a BNC plug. Turn clockwise to lock it. To disconnect, turn notched fastening ring anti-clockwise. ***Do not use force and do not pull on the cable***.

Testing Set Building Materials

On measurement of set inorganic building materials the reading is displayed directly in percent of dry weight or, depending on the entered code No., in percent CM after pressing the key **»M«**. For measurement of soft building materials such as plaster the stick-in electrode M 20 should be used, whereas for measurement of cement flooring and concrete the special electrode M 6 or M 21 in conjunction with contact paste are to be used.

For measurement of silencing or heat insulating material beneath a cement flooring, the flat electrodes M 6-Bi 200/300 are provided for insertion in the float-type joint. Especially thin electrodes M 6-150/250 are available for measurements in the cross joints of tile covered areas.

The special electrode M 20-Bi equipped with pins 200 mm or 300 mm long with insulated shank is designed particularly for measurements on insulated flat roofs or rear ventilated façades.

Special measurement caps type M 20-OF 15 are available for surface measurements, e.g. on concrete, etc. They can be used only in conjunction with the handle of the electrode M 20.

Drive-in Electrode M 20

For penetration measurements, up to a depth of 70 mm, on soft, set building materials (gypsum, plaster, etc.), drive electrode pins into the material to be tested (the electrode body is of impact resistant plastic). Take care that both pins of the electrode are driven only into the material to be tested.

When withdrawing the electrode, the pins can be loosened by slight sideways rocking movements. The cap nuts should be tightened by means of a spanner prior to a series of measurements. Loose pins may easily break.

When the meter is supplied with the M 20 electrode as initial equipment, 10 spare pins 16 and 23 mm long (commercial steel nails) are included in the delivery. They can be used for measurements up to a depth of 20 mm or 30 mm respectively. For measurements to greater depths, they can be replaced by longer pins but it should be noted that the liability to breakage or bending increases with the length of the pins.

Surface Measurement Caps M 20-OF 15

For surface measurements on smooth materials, the two hexagonal union nuts have to be unscrewed and replaced by the surface measurement caps. To perform the measurement, the two contact surfaces should be firmly pressed onto the material being measured. The measurement depth is about 3 mm. Particles adhering to the measurement surface should be regularly removed. If the elastic plastic pads should once be damaged, they can be ordered and stuck on using a commercially available instant adhesive on cyanate basis.

Measuring errors can be caused by a contaminated or dirty surface *(e.g. oil).*

Stick-in Electrode M 6

The two electrodes exclusively designed for moisture checks on set building materials are pressed, at approx. 10 cm apart, into the material to be tested. Both electrodes have to be inserted into the same type of building material. Also, the section to be measured must be coherent and not be crossed by another material. If the material is too hard to press in the electrodes by hand (e.g. cement flooring, concrete, etc.) drill 6 mm holes and fill them with contact paste. Then stick the pins into the contact paste.

When the meter is supplied with the M 6 stick-in electrodes as initial equipment, two pins 23 mm, 40 mm and 60 mm long are included in the delivery. They are suitable for measurements in depths up to 30 mm, 50 mm or 70 mm respectively.

The cap nuts should be tightened by means of a spanner. To ensure good contact, drilled holes should be tightly filled to their full depth with contact paste.

Where hard building materials are involved and no contact paste is used, a considerable measuring error must be expected (the values indicated will be too low).

Flat Electrodes M 6-Bi 200/300

These electrodes are exclusively designed for measurement of insulating material through the edge joint of the cement flooring. Spaced about 5 to 10 cm, they have to be pushed forward through the edge joint along the cement flooring up to the insulating layer. Particular care should be taken to avoid that the shrinking hose of the pins is not damaged as otherwise a moist cement flooring can cause measuring errors. Measurements should be performed in the scanning mode according to the resistance measuring method, using the code No. 434.

Stick-in Electrodes M 6-150/250

The very thin electrode pins are specially designed for testing building or insulating materials for moisture content, if the pin holes shall be kept as small as possible. The two 2 mm dia. pins, made of ductile, high-grade steel, can, for example, be sticked approx. 3 to 5 cm apart through the edge joint of the cement flooring into the insulating layer.

For use of the pins M 6-150 3 mm in dia. being specially designed for measurements through the cross joint of tiles, a special 3 mm dia. hard-metal drill 160 mm long *(Ref.No. 6078)* is available. It permits drilling a hole through the cement flooring up to the insulating layer. The electrode pins should be spaced, if possible, no more than 10 cm (maximum 15 cm).

The pins can be used both with the handle of the M 20 electrode *(Ref.No.3300)* and the electrodes M 6 *(Ref.No. 3700)*.

As the readings obtained on insulating material cannot be converted into percent of moisture, measurements should be made in the scanning mode using code No. 434.

Deep Electrode M 21-100/250

These two electrodes, exclusively designed for the measurement of set building materials, allow a measuring depth of up to 100 mm or 250 mm respectively.
Insulated sleeves prevent the results from being distorted by a high degree of surface moisture such as dew or rain.

Drill two 8 mm or 10 mm dia. blind holes approx. 10 cm apart (the section to be measured must be coherent and consist of the same material).

It is very important that a sharp drill is used at low speed. Where a lot of heat is generated in the hole, it is necessary to wait at least 10 minutes before introducing the electrodes or contact paste. Insert the tube point 30 mm vertically into the contact paste in order to fill it with paste. Clean the outside of the electrode tube right to the point and insert into blind hole.

Prepare the second hole in the same way. Connect measuring cable to the electrode rod and insert the latter into the electrode tube. Press the contact paste to the end of the hole by exerting pressure with the rod. Connect the measuring cable to the meter, press measuring key **»M«** and read off result in percent of moisture. The reading displayed in the upper line of the menu can be stored as described previously.

Warning

The readings may under some circumstances be distorted if there is too much contact material in the electrode tube or if an electrode tube contaminated with contact paste is repeatedly removed and inserted.

Contact Paste

The contact paste is supplied in quantities of approx. 450 g in a plastic box sealed with a screw cap. It is used to produce a good contact between the electrode point and the building material to be measured or to serve as an extension to the electrode point. The moisture displaced by the drilling process is reconducted to the material to be measured by the water contained in the
highly conductive contact paste.

The surface of the material to be measured must not be smeared with the contact paste as the latter has a high conductivity. When using the M 6 electrodes, it is advisable for an appropriate amount of the paste to be rolled into a thin strand and pressed into the hole with the reverse end of the drill.

It is possible to keep the contact paste mouldable by adding normal tap water. The quantity contained in a box is generally sufficient for approx. 50 measurements.

Stick-in Electrode M 20-Bi 200/300

For measurement of hidden beams in framework buildings and, particularly, in insulated flat roofs or façades.

In order to prevent damage to the insulation of the points, it is advisable not to drive them into hard building materials (plaster, gypsum plaster boards, etc.). Insulating materials such as fibre glass, rock wool, etc. can, of course, be easily penetrated. Otherwise, preliminary 10 mm dia. holes have to be drilled. The insulated points allow correct measurement uninfluenced by the moisture content of other material traversed by the electrode pins.

Remove hexagonal union nuts with standard electrode pins from the electrode M 20 and fit electrode pins M 20-Bi. Tighten firmly.

Test Standard for Structural Moisture Measuring Section

The optionally available test standard *(Ref. No.6071) permits the user to check* proper function of the structural moisture measuring section of the meter as well as of the connecting cable MK 8 and of the measuring electrodes M 6 and M 20 at any time.

To do so, connect the cable to the meter and insert the two plugs in the bushings of the test adapter. If an electrode is to be included in the check, connect it to the cable and insert the two pins into the bushings.

After the meter has been switched on, enter the Code No. 393. Upon pressing the key **»M«**, 4.2 % should be displayed in the upper line of the menu if the meter, cable and electrode are in good order. A tolerance of ± 0.2 % is admissible.

Equilibrium Moisture Values in Percents of Dry Weight

Building Materials	at 20°C and 50% R.H. approx.	at 20°C and 65% R.H. approx.	at 20°C and 90% R.H. approx.
Cement flooring (compressed, laid relatively dry)	1.5	1.7 – 1.8	3.1
Cement flooring (not compressed, laid relatively wet)	2.0	2.4 – 2.6	3.8
Cement mortar 1 : 3	1.5	1.7 – 1.8	3.2
Lime mortar 1 : 3	1.6	1.8 – 1.9	3.4
Gypsum plaster, gypsum boards	0.5	0.6 – 0.7	1.0
Plaster flooring	0.6	0.8 – 0.9	1.3
Magnesite flooring	7.0	8.3 – 8.7	13.0
Stone-wood flooring acc. to DIN	11.0	13.5 – 14.5	16.7
Aerated concrete (Hebel)	8.5	11.0 – 12.0	18.0
Elastizell flooring	1.6	1.8 – 2.2	2.8
Anhydrite flooring	0.5	0.6 – 0.7	0.9
Concrete (200 kg cement / cbm sand)	1.4	1.6 – 1.7	3.0
Concrete (350 kg cement / cbm sand)	1.6	1.8 – 2.0	3.4
Concrete (500 kg cement / cbm sand)	1.8	2.0 – 2.2	3.8

Equilibrium Moisture Content

What are generally referred to as equilibrium moisture value relates to an ambient temperature of 20 °C and an ambient air humidity of 65 % R.H. These values are frequently also termed »***air dry***«. They must not however be confused with the values at which the material can be processed or worked.

Before painting or laying a floor, the diffusion capacity of the covering and future ambient conditions in the room must be taken into consideration. When laying PVC flooring in a centrally heated room with an anhydrite subfloor, the PVC floor cannot be laid until the subfloor has dried to approx. 0.5 % m.c.

On the other hand, parquetry flooring can be laid on a cement floor in a room with normal stove heating, with a moisture range of 2.5 to 3.0 % m.c.

The long term ambient conditions must also be taken into account when assessing wall surfaces. Lime stuff in an old vaulted cellar may have a moisture content of 2.6 %, whereas a moisture content above only 1 % is considered too high for gypsum plaster in a centrally heated room.

It is of prime importance to consider ambient conditions when determining the moisture content of a building material. All materials are exposed to constantly changing temperatures and air humidities. The effect on the moisture content of the material basically depends on the thermal conductivity, heat capacity, resistance to diffusion of water vapour and the hygroscopic properties of the material. The »desired« moisture content of a material, therefore, corresponds to its mean equilibrium moisture under the changing ambient conditions which the material is constantly exposed to.

Air humidity values for Central Europe lie in the range of approx. 45 to 65 % R.H. in summer and approx. 30 to 45 % in winter. A lot of damage occurs in winter, particularly in centrally heated rooms, as a result of these great swings.

It is not possible to define universally valid values. It always requires the craftsman's and the expert's experience to draw correct conclusions from any readings.

For inorganic building materials, the water content is generally defined as a percentage of dry weight. The hygroscopic water content of any material is to a large extent proportional to its density, i.e. for all apparent densities of a building material, the same value is shown when giving the moisture in percentage of dry weight, but at twice the apparent density, a reading in percentage of volume would be twice as great.

Equilibrium moisture values

The moisture ranges shown in the graphs have the following meaning:

Ambient climate % RH

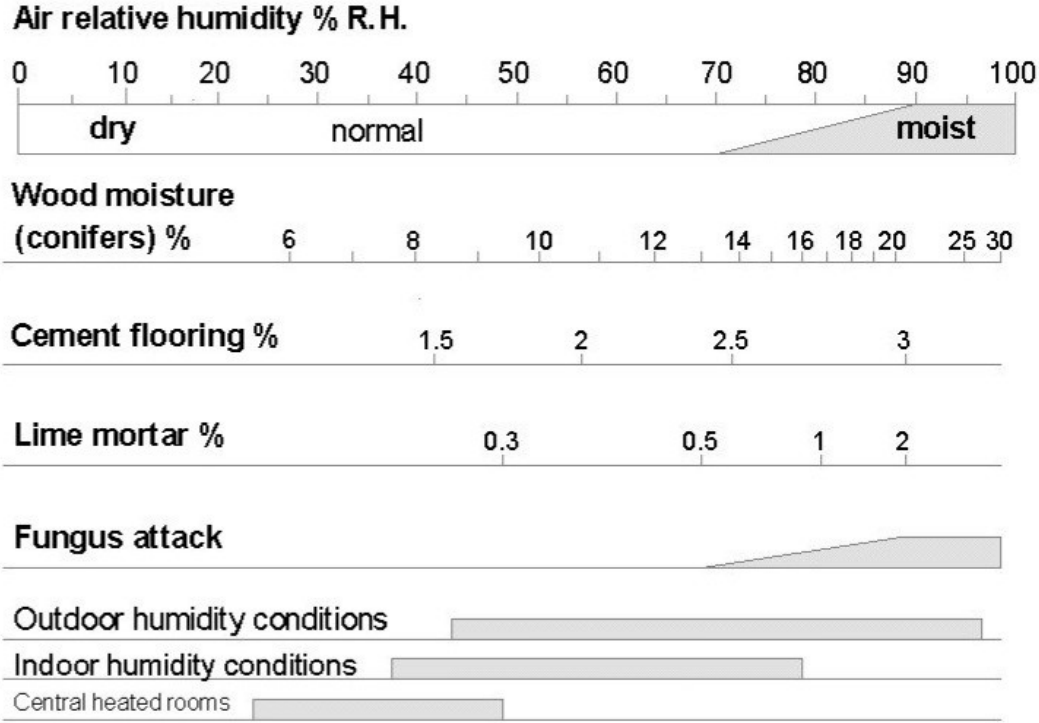
Condition of material dry equalizing range moist

White section:	dry	equilibrium moisture attained
White-black section:	equilibrating phase	**Caution:** Floor covering or glues impervious to moisture should not yet been processed
Black section:	moist	Performing any work should be avoided

It should be noticed that a state of complete moisture equilibrium is usually achieved only after 1-2 years. Vapour barriers and long term ambient humidity are decisive factors.

Comparison Graph

Air Humidity - Wood Moisture - Structural Moisture



Building or Insulating Materials Not Assignable to One of the Code Nos. Listed in the Table Annexed

Some building materials, e.g. brick, sand lime brick, etc., cannot be measured with the usual accuracy due to their varying mineral additives or burning times. This does not however mean that comparative measurements on the same material and on the same site would be of no value.

Obtaining various high values may, for example, show the extent of a damp patch due to water damage. Or comparative measures on the dry inside and the damp outside of a wall may show how the drying process is progressing.

Insulating materials, e.g. rock or glass wool, plastic foams, etc., cannot be measured in their dry condition due to their great insulating capacity. Readings fluctuate widely and even give minus values, due to endogenous statics. Damp to wet insulating materials can be measured in the range of 20 - 100 digits or scale divisions. Conversion to percentage by weight or volume percentage is, however, not possible. It is important that the insulating material is not over-
penetrated by the electrodes. If this is done, an incorrect value may be shown as the underlying support is usually of a much higher moisture content.

Recommendation

For testing solid building materials with different additives, it is recommended to use the active electrodes B 50 or B 60 if the user knows the specific weight.

Instructions For Non-Destructive Measurement of the Moisture Content of Concrete Surfaces Using the Active Electrode MB 35

Connect the electrode to the meter and press the key **»ON/OFF»**. Then enter the code No. 411 (for readings in % of dry weight) or code No. 412 (if readings in % CM are desired) and confirm input by pressing the key **»Enter«**.

Press electrode on the concrete surface and push measuring key **»M«**. Read off result in the upper line of the menu. The reading can be stored by pressing the key **»Mem«.**

Active Electrode MB 35

The active electrode MB 35 has specially been developed for surface moisture measurement on concrete and subfloors and are suitable particularly for moisture checks prior to coating or gluing.

The measuring range extends from 2.0 to 8.0 % of dry weight (according to oven test). The reading is displayed direct in per cent of moisture (by weight or CM).

The electrode is fitted, as standard equipment, with the surface measuring caps M 20-OF 15 with elastic contact pads of conductive plastic material. The pads are glued on their support which in turn are screwed on the electrode handle. Make sure that the measuring caps are properly screwed down. Exchange the elastic measuring pads in case of wear or damage. Fix the new pads on the support plate by means of a commercially available instant adhesive on cyanate basis.

The surface of the concrete should be cleaned from dust and separating agents or other contaminations to ensure correct measuring results.

Test Standard for Active Electrode MB 35

The optionally available test standard *(Ref. No.6073) permits the user to check* proper function of the active electrode MB 35 together with the meter. To do so, connect the electrode to the meter and press its plastic pads onto the metal disks of the test standard. After the meter has been switched on, enter the Code No. 411. Upon pressing the key **»M«**, 4.6 % should be displayed in the upper line of the menu if the meter, cable and electrode are in good order. A tolerance of ± 0.3 % is admissible.

Instructions For Non-Destructive Moisture Measurement of Building Materials Using the Active Electrodes B 50 and B 60

Connect electrode to the meter and press the key **»ON/OFF»**. Then enter the appropriate code No. of the material to be tested (see table attached) and confirm input by pressing the key **»Enter«**.

Put electrode on the material to be tested and push measuring key **»M«**. Read off result in the upper line of the menu in % of dry weight or % CM according to the code No. entered. The reading can be stored by pressing the key **»Mem«.**

It should be noted that battery operation must be chosen for measurements with the active electrodes B 50 and B 60, because connection to the mains supply would affect the proper function of the electrodes and cause measuring errors.

The readings computed by the measuring instrument and displayed directly in percent of dry weight or percent CM are **guide values**. They refer to a **normal** drying progress and the usual moisture gradient between surface and the possible measuring depth which depends on the density of the material tested. If the building material dries too fast, e.g. by hot air, dehumidifier, floor heating, etc., the readings may be too low because of the reduced surface moisture.

The measuring depth depends in the main on the respective density of the building material and the surface moisture. The readings refer to a normal thickness of the plaster walls or cement floors.

Scan Mode of Operation

For fast and extended location of moisture absorption and moisture distribution, the B 50 and B 60 electrodes can be used in scan mode of operation after entering the code No. 433. The range of indication extends from 0 to 199 digits, but it should be noted that the readings cannot be stored.

The active electrodes B 50 and B 60 are dielectric moisture sensors with integrated circuitry. They are intended specifically for determining moisture absorption and moisture distribution in building materials such as for example brickwork, concrete, screed, wood, insulating materials, etc.

The basis of measurement is the dielectric constant measurement method. Between the ball electrode and the material to be measured with which it comes into contact, a measurement field is set up, which is affected by the density of the building material to be measured and its moisture content. If the density of the material is constant, changes in the capacity field can be matched to a change in the moisture content of the material being measured.

If measurements are carried on the same building materials under the same ambient conditions, changes in the measured values indicate a change in the moisture content. The higher the measured value, the higher the moisture content of the material being measured. In this way it is easy to locate moisture distribution and moisture concentrations in walls, ceilings or floors.

Drawing conclusions about the actual moisture content in percent of dry weight or percent CM is only permissible in the case of a normal drying process. The density of the building material to be measured is in this case a factor of influence which has to be taken into account. High bulk densities lead to higher displayed values, independently of the moisture content.

The list below is intended to serve as a guide to the displayed values to be expected in practice and their classification:

Wood	dry	25 -	40 digits
	moist	80 -	140 digits
Living area brickwork	dry	25 -	40 digits
	moist	100 -	150 digits
Basement brickwork	dry	60 -	80 digits
	moist	100 -	150 digits

Depending on the bulk density, displays of more than 130 digits would indicate the presence of free water. In the case of covered metal parts (reinforcing steel, pipes, power lines, plaster supporting strips, etc.) even if the environment is otherwise dry the display jumps to approximately 80 digits (if the covering is very thin, even higher). This should be taken into account when assessing the displayed values.

Use of active electrode B 50 and B 60

In order to avoid influencing of the measurement result by the hand of the operator, the electrode should only be held by its lower half during checking and measurement. The upper half of the electrode must remain free.

Checking

Connect electrode to the socket on top of the measuring instrument. Hold the electrode in the air and press the measuring key **»M«**. The value displayed must be between -5.0 and 5.0 digits. If it fails to

display an admissible value, increase or, as the case may be, reduce the reading by slightly turning the potentiometer located behind an opening in the upper half of the grey plastic handle of the active electrode by means of a small screwdriver.

Measurement

Press the measuring key of the moisture meter and bring the electrode ball into contact with the surface to be tested. The electrode ball must be in firm contact with the material. As far as possible the electrode should be held perpendicularly to the surface being measured. In corners measurement is only possible up to a distance of approx. 8 - 10 cm from the edge.

Special equipment of electrode B 60

The active electrode B 50 is equipped with an acoustic signal generator which permits to use the electrode without looking permanently on the LCD readout. Whenever the reading exceeds the preset limit value a whistle signal sounds.

In the range between 30 and 70 digits, the signal tolerance is ± 2 digits and on the range between 80 and 140 digits ± 3 digits.

Display Values (Digits) in Relation to the Material Bulk Density

Bulk density kg / m3	Corresponding Relative Air Humidity 30 -------- 50 -------- 70 -------- 80 -------- 90 -------- 95 -------- 100 Display in Digits					
	very dry	normal dry	semi dry	moist	very moist	wet
up to 600	10 - 20	20 - 40	40 - 60	60 - 90	90 - 110	more than 110
600 - 1200	20 - 30	30 - 50	50 - 70	70 - 100	100 - 120	more than 120
1200 - 1800	20 - 40	40 - 60	60 - 80	80 - 110	110 - 130	more than 130
above 1800	30 - 50	50 - 70	70 - 90	90 - 120	120 - 140	more than 140

Note

The references and data concerning permissible or customary moisture proportions in practice contained in the Operating Instructions and the general definitions have been taken from the specialist literature. No guarantee of correctness can therefore be given. The conclusions each user may draw for his own purposes from the measurement results are based on the individual circumstances and the knowledge he has gained from his professional activities.

Instructions for Moisture Measurement in Building Materials on the Basis of the Measurement of the Relative Air Humidity

using the active electrodes RF-T 31 and RF-T 36

Prepare bore hole, insert measuring probe and connect it to the measuring instrument.

Switch on the meter by pressing the key **»ON/OFF«**.

Enter the Code No. (see table attached) and confirm input by pressing the key **»Enter«**.

Press measuring key **»M«** and read off result in percent of dry weight. By pressing the key **»Mem«** the reading can be stored, if desired.

Technical specifications

Measuring range:	5 to 98 % R.H. for short periods. For continuous or long period measurements in the range above 80 % R.H., a special calibration is required for the measuring sensors.		
Admissible operating temperature for the meter and the electrodes:	10 °C	to	60 °C for short periods,
	0 °C	to	50 °C for long periods.
Admissible ambient conditions for the storage of the meter and the electrodes:	-10 °C	to	60 °C for short periods
	5 °C	to	40 °C for long periods.
	5 %	to	98 % R.H. for short periods *)
	35 %	to	70 % R.H. for long periods *)

*) not condensing

This method is usually used for depth measurements in old buildings (sandstone, rough stone, wet walls with efflorescence, etc.) where measurements based on the resistance measurement method give no reproducible results. For this purpose the active electrode RF-T 31 with special tube lengths of 250 and 500 mm is used. In the case of measurements over a longer period at several points or at various depths, the drilled holes should be secured and closed by means of a masonry sleeve / bore hole adapter.

The method of measuring the relative air humidity / equilibration moisture in cement flooring is chiefly used in Great Britain and the Scandinavian countries. The active electrode RF-T 36 has been specially developed for this measuring procedure. Compared with non-destructive measurement or resistance measurement, it is however very time-consuming and requires relatively large holes. Reliability for the floor layer/finisher is but on the other hand very good, if it is possible to wait for moisture balance (relative air humidity of the surroundings equal to that of the hole). This method also increases reliability in cases where there is not adequate information concerning the composition of the cement flooring.

Use of the active electrode RF-T 31

For deep measurements in building materials by means of the relative air humidity, in addition to the probe with a sensing tube length of 250 or 500 mm a bore hole adapter consisting of a masonry sleeve of 150, 250 or 500 mm length should be used.

For the measurement a blind hole of 16 mm diameter should be drilled down to the required measuring depth. It is important to use a sharp drill, with a high number of impacts and low speed. If the hole should heat up strongly it is necessary to wait for temperature equalization (30 - 60 minutes) before taking the measurement. The hole should be cleared of dust (by blowing). Then the bore hole adapter should be introduced as far as the end of the hole, pressed in and at the same time turned to the right. The adapter should be tightened to such an extent that the entire screw thread sits firmly in the brickwork, concrete, etc. Then the closure rod for sealing or the electrode RF-T 31 should be inserted.

The moisture balance in the hole is achieved when temperature equalization exists (the same temperature in the hole, adapter and sensor tube) after approximately 30 minutes.

Use of the active electrode RF-T 36

For the measurement a blind hole of 12 - 14 mm diameter and minimum 25 mm and maximum 50 mm deep must be drilled. The depth of drilling depends on the required measurement depth or thickness of the cement floor.
Blow the hole clear of dust and wait for temperature equalization. Push the piece of foam enclosed onto the electrode tube of the probe to adjust the distance and to seal it, then introduce it into the hole.

The moisture balance in the hole is achieved when temperature equalization exists (the same temperature in the hole, adapter and sensor tube) after approximately 30 minutes.

Damage to the Sensor

The sensor can be rendered irreparable as a result of various mechanical or environmental influences. These include in particular:

- direct contact between the sensor and the fingers,
- direct contact with solid or adhesive materials or objects,
- measurement in atmospheres containing solvents, oil vapours and other high proportions of harmful substances.

Measuring Errors

Measurements below 20 % relative humidity and above 80 % relative humidity should be avoided over a long period as far as possible. Other measured value distortions can occur as a result of screening with parts of the body (e.g. the hand) or blowing or speaking/breathing in the direction of the sensor.

Note

The sensor is not designed for continuous measurements above 80 % relative humidity. If continuous measurements have to be made in extreme regions a special adjustment should be made by means of sensorcheck and a calibration liquid.

Instructions for Air Humidity Measurement and Determination of the Dew Point

using the active electrodes RF-T 28, RF-T 31, RF-T 32 and RF-T 36

Air humidity measurement

Switch on the meter by pressing the key **»ON/OFF«**.

Connect electrode to the meter socket.

Enter code No. 427 and confirm by pressing the key **»Enter«**.

Press measuring key **»M«** and read off result displayed (in % R.H.) in the upper line of the LCD matrix readout.

By pressing the key **»Mem«** the reading can be stored, if desired.

Dew point temperature

Proceed as described above.

Enter code No. 428 and confirm input by pressing the key **»Enter«**. Press measuring key **»M«** when the dew point temperature is displayed in °C in the second line of the menu as Tcmp. Additionally, the air humidity is displayed in the first line and the air temperature in the second line as Tmes.

By pressing the key **»Mem«** the reading can be stored, if desired.

Technical Specifications

Measuring range:	5 to 98 % R.H. for short periods. For continuous or long period measurements in the range above 80 % R.H., a special calibration is required for the measuring sensors.
Admissible operating temperature for the electrodes:	-10 °C to 60 °C for short periods, 0 °C to 50 °C for long periods.
Admissible ambient conditions for the storage of the electrodes:	-10 °C to 60 °C for short periods 5 °C to 40 °C for long periods. 5 % to 98 % R.H. for short periods *) 35 % to 70 % R.H. for long periods *) *) not condensing

Damage to the Sensor

The sensor can be rendered irreparable as a result of various mechanical or environmental influences. These include in particular:

- direct contact between the sensor and the fingers,

- direct contact with solid or adhesive materials or objects,

- measurement in atmospheres containing solvents, oil vapours and other high proportions of harmful substances.

Measuring Errors

Measurements below 20 % relative humidity and above 80 % relative humidity should be avoided over a long period as far as possible. Other measured value distortions can occur as a result of screening with parts of the body (e.g. the hand) or blowing or speaking/breathing in the direction of the sensor. When the measured value exceeds the measuring range of the meter (by bedewing), the overflow sign **»>«** appears in front of the reading.

Note

The sensor is not designed for continuous measurements above 80 % relative humidity. If continuous measurements have to be made in extreme regions a special adjustment should be made by means of sensorcheck and a calibration liquid.

Use of the active electrode RF-T 28

Hold the electrode in the air or fasten it at the desired measurement site and start the measuring process. For particularly precise measurements, especially below the usual room temperature (abt. 20 °C) or if there are substantial temperature differences between the electrode or meter and their surroundings, they should be exposed to the ambient atmosphere for approx. 10 - 15 minutes until temperature equalization. The sensor adapts itself to the surrounding atmosphere even in the switched-off condition.

Response time of the air humidity sensor

The response time of the sensor is very short so even gently moving air (generated by a slightly opened door or a window being not tight) may affect the reading. This is why no absolute standstill of the value displayed can be achieved unless the sensor is installed in an airtight box.
The response time of the sensor in gently moving air is as follows for ambient temperatures from 20 °C to 25 °C

for 90 % of the humidity difference, approx. 20 seconds,
for 95 % of the humidity difference, approx. 30 seconds.

The adjustment time in still air or at very low air movement can be reduced by moving or turning the electrode (ventilating the sensor).

Filter cap for electrode RF-T 28

For measurements in dust laden air, at emission of harmful substances or at high air speed, a sintered filter cap can be fitted after removal of the protection cap with venting slots. For protection of the sintered filter, fix then the plastic cap again. If the filter becomes dirty it can be washed in residue-free

cleaning liquid and/or blown from inside outwards with compressed air. With the sintered filter inserted, the response time will be considerably prolonged.

Use of the active electrode RF-T 31

The sensor RF-T 31 can be supplied with insertion length of 250 or 500 mm and is mainly used for measuring the relative air humidity or the AW value in places difficult of access, in air ducts, in bulk materials or, in combination with a special adapter, in solid substances (e.g. brickwork, concrete, etc.).

Hold the electrode at the point of measurement in the air or insert it or attach it at the required point with a fixture and start the measurement process. For particularly precise measurements, in particular at temperatures below usual room temperature (abt. 20 °C) or when there are considerable temperature differences between the actual temperature of the electrode or of the measuring instrument and that of the surrounding atmosphere, the instrument with its electrode should be exposed to the ambient climate for approximately 10 to 15 minutes or until temperature equalization.

Here too, the sensor adapts itself to the surrounding atmosphere without being switched on. If it becomes dirty, the sintered filter cap can be washed in residue-free cleaning liquid and/or blown from inside outwards with compressed air.

Response time of the air humidity sensor RF-T 31

The response time is delayed by the sintered filter cap. In exceptional cases it can be unscrewed. However, if this is done the danger of damage to the sensor is increased considerably. The response time of the air humidity sensor in moving air, with an ambient temperature of 20 to 25 °C is

- for 90 % of the moisture difference without filter approx. 20 sec., with filter approx. 5 min., and
- for 95 % of the moisture difference without filter approx. 30 sec., with filter approx. 15 min.

Use of the active electrode RF-T 32

The sensor RF-T 32 is available with insertion lengths of 250 and 500 mm and is mainly used for measuring the relative air humidity or the AW value in places difficult of access or in stacks of paper, leather, textile, tobacco, etc.

Hold the electrode at the point of measurement in the air or place it at the required point and start the measurement process. For particularly precise measurements, in particular at temperatures below usual room temperature (abt. 20 °C) or when there are considerable temperature differences between the actual temperature of the electrode or of the measuring instrument and that of the surrounding atmosphere, the instrument with its electrode should be exposed to the surrounding atmosphere for approximately 10 to 15 minutes or until temperature equalization. The sensor adapts itself to the surrounding atmosphere even if it is switched off.

Note

If it becomes dirty, the filter cloth inserted cannot be washed in cleaning liquids and/ or blown clear with compressed air from inside to outside. Therefore its use in dusty media should be avoided. Cleaning should only be carried out from outside using a soft brush.

Response time of the air humidity sensor RF-T 32

The response time is delayed by the filter cloth and the metal tube. The response time of the air humidity sensor in moving air, with an ambient temperature of 20 to 25 °C is:

approx. 3 minutes for 90 % of the humidity difference, and
approx. 10 minutes for 95 % of the humidity difference.

Use of the active electrode RF-T 36

The electrode RF-T 36 was developed among other things for semi-stationary (electrode remains at the measuring point - display unit is mobile when in use) air humidity and air temperature measurement in interiors, storage bays, etc.

Attach the electrode at the measuring location or at the required point and start the measuring process. For particularly precise measurements, in particular at temperatures below room temperature (abt. 20 °C) or if there are significant temperature differences between the temperature of the electrode itself and that of the surrounding atmosphere (measurement immediately after assembly) the electrode should be exposed to the surrounding atmosphere for approximately 10 to 15 minutes or until temperature equalization. The sensor adapts itself to the surrounding atmosphere even while being switched-off.

Response time of the air humidity sensor RF-T 36

The response time is delayed by the filter cap. In exceptional cases it can be unscrewed. However, if this is done the danger of damage to the sensor is increased considerably. The response time of the air humidity sensor in moving air, with an ambient temperature of 20 to 25 °C is:

approx. 20 sec. for 90 % of the humidity difference without filter or approx. 3 min. with filter, and approx. 30 sec. for 95 % of the humidity difference without filter, or approx. 10 min. with filter.

Synoptical table of dew point temperatures as dictated by the air temperature and air relative humidity

Air temperature °C	Dew point temperature in °C at an air relative humidity of							Saturation moisture = quantity of water in g/m³
	30 %	40 %	50 %	60 %	70 %	80 %	90 %	
	°C	°C	°C	°C	°C	°C	°C	
+ 30	10.5	14.9	18.5	21.2	24.2	26.4	28.5	30.4
+ 28	8.7	13.1	16.7	19.5	22.0	24.2	26.2	27.2
+ 26	7.1	11.3	14.9	17.6	19.8	22.3	24.2	24.4
+ 24	5.4	9.5	13.0	15.8	18.2	20.3	22.2	21.8
+ 22	3.6	7.7	11.1	13.9	16.3	18.4	20.3	19.4
+ 20	1.9	6.0	9.3	12.0	14.3	16.5	18.3	17.3
+ 18	0.2	4.2	7.4	10.1	12.4	14.5	16.3	15.4
+ 16	- 1.5	2.4	5.6	8.2	10.5	12.5	14.3	13.6
+ 14	- 3.3	- 0.6	3.8	6.4	8.6	10.6	12.4	12.1
+ 12	- 5.0	- 1.2	1.9	4.3	6.6	8.5	10.3	10.7
+ 10	- 6.7	- 2.9	0.1	2.6	4.8	6.7	8.4	9.4
+ 8	- 8.5	- 4.8	- 1.6	0.7	2.9	4.8	6.4	8.3
+ 6	-10.3	- 6.6	- 3.2	- 1.0	0.9	2.8	4.4	7.3
+ 4	-12.0	- 8.5	- 4.8	- 2.7	- 0.9	0.8	2.4	6.4
+ 2	-13.7	-10.2	- 6.5	- 4.3	- 2.5	- 0.8	0.6	5.6
+ 0	-15.4	-12.0	- 8.1	- 5.6	- 3.8	- 2.3	- 0.9	4.8

Test and Calibrating Instructions for the Relative Humidity Circuitry of the Electrodes RF-T 28, 31 and 32 Using the Sensorcheck

General Comments

In general one has to differentiate between a test, a possibly necessary re-calibration and a special calibration for continuous measurement of more than 80 % humidity. Three test and calibrating liquids are available for the ranges of 10 to 50 %, 50 to 90 % and 80 to 98 %. The latter liquid is intended for special calibration of the high humidity range and is not to be used for general test or calibrating purposes. For testing or calibration of the standard moisture range, the liquid SCF 70 is to be employed.

During testing or calibration, the electrode, the sensorcheck and the liquid must be of the same temperature. This temperature must be maintained throughout the procedure. Changes of temperature may be caused by a draft, by breathing or blowing or by holding the electrode tube, the sensorcheck or the liquid-ampoule in one's hand. Wrapping these components in Polystyrene or similar insulating material is recommended.

Please follow the instructions stated on the wrapper of the liquid-ampoule regarding test, calibration and nominal value data closely.

Testing

Different sensorcheck top pieces are required for each of the three types of electrodes.
The following test sequence must be observed:

1. Unscrew sensorcheck top from bottom.

2. ***Electrode RF-T 28:*** **Carefully pull-off the protective cap. If used, remove the** dust cap first.

   Electrode RF-T 31: Unscrew the sinter filter cap and withdraw it carefully **only along the axis of the tube extension**. Tilting the sinter filter may cause damage to the moisture sensor.

   Electrode RF-T 32: This electrode requires no special preparation. Do not dismantle it.

3. ***Electrode RF-T 28:*** Plug the top of the sensorcheck to the electrode and push it on lightly (conical fit).

   Electrode RF-T 31: Plug the top of the sensorcheck over the moisture sensor of the electrode and screw to the thread of the electrode tubing. **Use no force and do not tighten it securely**.

   Electrode RF-T 32: Insert the oval tubing of the electrode, perforated side downward, horizontally into the top part of the sensorcheck. Make sure that the perforations are inside the sensorcheck. To avoid temperature change, do not handle the metal tubing of the electrode unnecessarily.

4. Store the electrode, the sensorcheck and the test liquid at a temperature-stable location until all components have assumed the temperature given on the packaging of the test-ampoule (e.g. 23 °C ± 2°C.).

5. Remove a piece of fleece from the plastic bag and place it in the bottom section of the sensorcheck. Close the plastic bag containing the remaining pieces of fleece tightly.

6. Pick an ampoule containing the desired type of test liquid. Hold it vertically and tap it lightly to return all liquid into the lower part of the ampoule. Hold the ampoule tightly and break its neck off at the white marking. Pour all of the liquid in the ampoule onto the fleece in the lower part of the sensorcheck.

7. Screw the lower part of the sensorcheck onto the upper part. To prevent a change of temperature hold the items as briefly as possible or wear gloves.

8. Connect the electrode to the Hydromette M-4050 by means of its cable.

9. ***Electrode RF-T 28:*** While avoiding a change of temperature, allow the electrode to be exposed to the atmosphere of the sensorcheck as stated on the packaging (e.g. 10 min**.** ± 1 min.)***.***

   Electrode RF-T 31: Proceed in the same way as with the electrode RF-T 31.

   Electrode RF-T 32: When testing the RF-T 32 electrode, ***double*** the exposure time stated on the packaging of the ampoule (e.g. 20 min. ± 2 min.). Avoid a change of temperature.

10. At the end of the above stated exposure time, press the measuring key of the Hydromette and obtain an air humidity reading. A deviation of ± 2 % from the nominal value given on the package of the ampoule is permissible.

Recalibration

Recalibration of the sensors used with the electrodes RF-T is hardly ever necessary. Existing deviations of measurement are almost always caused by improper storage of the electrode in surroundings which are too dry or too moist. Prior to every recalibration of the electrode, it should be exposed to a

conditioning process. This means exposing the electrode to an average relative humidity of from 45 % to 65 % R.H. for 24 hours. If the measured humidity is too low by more than 5 %, it is suggested to expose the electrode to a high humidity of 70 % to 75 % R.H. for the first 12 hours.
If the measured humidity is too high, a similar conditioning process in a dry climate of 40 % to 45 % R.H. is recommended. At completion of such a conditioning process, a recalibration may be found unnecessary, as the original deviation had been caused by the effect of sorption. If recalibration is needed, the test and calibration fluid SCF 70 should be used. Preparation and general procedure is as outlined in paragraph »*Testing*« 1 to 9 c.

Recalibration is done by means of a small straight screwdriver with a maximum blade width of 2 mm (3/16 inch). A trimming potentiometer is located behind an opening in the middle of the black plastic handle. By careful, clockwise turning of the trimming potentiometer, the measured humidity can be increased; it can be decreased by turning counter-clockwise. One full rotation corresponds approx. to a change of 7 % R.H. The recalibration should begin exactly at the end of the exposure time of 10 resp. 20 minutes and should take no longer than 2 to 4 minutes.

Special Calibration

Special calibration may become necessary if continuous measurements of high humidity (more than 80 % R.H.) or of very low humidity (less than 35 % R.H.) are to be conducted. Test liquids SCF 90 and SCF 30 are available for this purpose. To eliminate measuring or calibrating mistakes caused by the sorption effect, it is necessary to allow an exposure time of 6 to 7 hours for the electrode RF-T 32.

This special calibration is done, under consideration of the longer exposure times, following the instructions given in paragraphs »*Testing*« and »*Recalibration*«. To return a specially calibrated electrode to normal usage, it must be recalibrated according to paragraph »*Recalibration*« after it had been subjected to a conditioning period of 24 hours.

Operating Instructions for Temperature Measurement

Measurement using active electrodes RF-T 28, RF-T 31 and RF-T 32 and RF-T 36 as well as **PT 100 temperature probes ET 10, OT 100** etc.

Connect temperature probe to the meter socket.

Switch on the meter by pressing the key **»ON/OFF«**.

Enter code No. 427 and confirm input by pressing key **»Enter«**.

Press measuring key **»M«** and read off result in °C in the second line of the menu at »Tmes«.

By pressing key **»Mem«** the reading can be stored, if desired.

General Information About Temperature Measurement

A temperature balance must be achieved between the measuring sensor and the object to be measured, for correct readings to be made. This is easy to achieve when measuring liquids in large quantities or large objects with high heat content. One must ensure that the sensor tube and head are not affected by another temperature such as ambient air temperature.

Therefore, it is recommended that the sensor be totally immersed or a screen be fitted to the tube. This screen can be made of polyester or of foam rubber about 3 cm dia., and sufficiently long to protect the exposed length of the tube which will be pushed through the middle. In the case of surface measurements with temperature probe OT 100, the block of polyester or rubber foam with a length of side of at least 30 mm will be sufficient to protect against convection heat or cold when taking temperature measurements on walls.

In the case of materials which are poor heat conductors or of low heat content (e.g. rockwool, glasswool, etc.) it is often not possible to achieve a correct temperature measurement with electrical sensors. To obtain utilizable results, it may become necessary either to take into account the ambient temperature or to carry out approximate measurements.

When measuring insulating materials whose surface temperature generally corresponds to the ambient temperature, the infrared measuring probe IR 40 should be used. For interior or depth measurements, also the probe ET 50 can be used in an auxiliary capacity.

Use of the active electrodes RF-T 28, RF-T 31 and RF-T 32

Hold the probe in the air at the measuring location and start the measuring by pressing the measuring key **»M«**. The electrodes RF-T 28, RF-T 31 and RF-T 32 are only suitable for measuring the air temperature (besides of the air humidity) not for temperature measurements on solid material and liquids.

For particularly precise measurements, in particular at temperatures below +10 °C or above +40 °C or if there are significant temperature differences between the temperature of the electrode itself or of the measuring instrument and that of the surrounding atmosphere, the electrode should be exposed to the surrounding atmosphere of the measuring location for approximately 10 to 15 minutes or until temperature equalization.

The measuring range from -10 to +80 °C only applies to the sensor tip (length of the protective cap) of the electrode. The electrode tube with electronics and the measuring instrument may be exposed to temperatures above 50 °C only for a short time. For the instrument and probes if possible do not allow the operating temperature to fall below 0 °C or rise above +50 °C.
Falsification of the measured values can occur by screening with parts of the body (e.g. the hand) or by blowing or speaking/breathing in the direction of the sensor.

The response time of the air temperature sensor for 90 % of the temperature jump is in the case of moving air for the probe RF-T 28 approximately 120 sec., for the probes RF-T 31 and RF-T 32 approximately 5 minutes.

The air temperature sensor adjusts to the surrounding atmosphere also if not switched on.

Use of the Surface Temperature Probe OT 100

The OT 100 is a special probe with low mass for measuring surface temperatures.
At rough surfaces coat the sensor head with heat conducting paste and press it against the object to be measured. The sensor head must lie totally flat and in good contact. There must be no air (only a thin layer of heat conducting paste) between the sensor head and the object to be measured.
The response time ranges between 10 and 40 seconds depending on the material to be measured. In order to achieve good results, sufficient heat content and heat conductivity of the material to be measured is indispensable.

Note

Avoid damage to the spring loaded tip of the probe by exerting excessive pressure or by bending the tip.

Use of the Surface Temperature Probe OTW 90

The OTW 90 is an angled special probe with low mass for measuring surface temperatures. It is specially designed for measurements in plate presses with an aperture of at least 10 mm. For measurements on rough surfaces coat the sensor head with heat conducting paste and press it against the object to be measured. The sensor head must lie totally flat and in good contact. There must be no air (only a thin layer of heat conducting paste) between the sensor head and the object to be measured.

The response time ranges between 20 and 60 seconds depending on the material to be measured. In order to achieve good results, sufficient heat content and heat conductivity of the material to be measured is indispensable.

Silicone Heat Conducting Paste

The heat conducting paste is supplied in packages containing 2 tubes of 30 g each. Its purpose is to improve the transfer of heat between the sensor and the object being measured. Temperature measurements with the probes OT 100 and OTW 90 on rough surfaces should generally be carried out in conjunction with heat conducting paste.

Use of the Stick-in Temperature Probe ET 10

The stick-in probe ET 10 is a simple probe for measuring temperatures in liquids and semi-solid materials (e.g. frozen materials), and for measuring core temperatures in pre-drilled holes.

Dip the sensor tip to a depth of at least 4 cm into the liquid or stick it into the material to be measured and take the reading. When measuring core temperatures, keep the hole as small as possible. Remove dust from the hole and wait for heat generated during drilling to dissipate. Coat sensor tip with heat conducting paste, insert and take the reading. Shallow holes can be directly filled with heat conducting paste.

Depending on the material to be tested, the response time lies between approx. 20 seconds (liquids) and 180 seconds.

Use of the Stick-in Temperature Probe ET 50

The stick-in probe ET 50 is a special sensor for measuring temperatures in liquids and soft materials, and for measuring core temperatures in pre-drilled holes.

Dip the sensor into the liquid or insert it into the soft material to be measured, in both cases at least as far as the first swelling (or approx. 6 cm deep), and take the reading. When measuring core temperatures, keep the hole as small as possible. Remove dust from the hole and wait for heat generated dur-

ing drilling to dissipate. Coat sensor tip with heat conducting paste, insert and take the reading. Shallow holes can be directly filled with heat conducting paste.

Depending on the material to be tested, the response time lies between approx. 10 seconds (liquids) and 120 seconds.

Use of the Air/Gas Temperature Probe LT 20

The LT 20 is a special probe for measuring temperatures in air or gaseous mixtures. Hold measuring tip at least 4 cm deep into the medium to be measured and take the reading. Owing to its length of 480 mm, it is particularly suitable for measurements in air-ducts.

Depending on the speed of the air or gas-flow, the response time lies between 10 and 30 seconds for 10 °C each of change in temperature.

Use of the Immersion and Combustion Gas Temperature Probe TT 30

The immersion probe TT 30 is a special sensor for measuring temperatures in liquids and core temperatures in pre-drilled holes as well as in combustion and waste gas of burners. The sensor tube has a length of 230 mm.

Dip the sensor tip at least 6 cm deep into the medium to be measured, and take the reading. When measuring core temperatures, keep the hole as small as possible. Remove dust from the hole and wait for heat generated during drilling to dissipate. Coat sensor tip with silicone heat conducting paste, insert and take the reading.

Depending on the material to be measured, the response time lies between approx. 10 seconds (liquids) and 180 seconds.

Use of the Immersion and Combustion Gas Temperature Probe TT 40

The immersion probe TT 40 is a special sensor for measuring temperatures in liquids and core temperatures in pre-drilled holes as well as in combustion and waste gas of burners. The sensor tube has a length of 480 mm.

Dip the sensor tip at least 6 cm deep into the medium to be measured, and take the reading. When measuring core temperatures, keep the hole as small as possible. Remove dust from the hole and wait for heat generated during drilling to dissipate. Coat sensor tip with silicone heat conducting paste, insert and take the reading.

Depending on the material to be measured, the response time lies between approx.
10 seconds (liquids) and 180 seconds.

Use of the Flexible Temperature Probes of FT Series

For correct temperature measurement temperature equalization must be created between the measurement sensor and the object being measured. This is easily possible in the case of measurements on liquids in larger quantities or on large objects with high heat retention. Here care must be taken to ensure that the sensor (length of the shrinkable sleeve) is not influenced at certain points by another temperature (surrounding air temperature). Therefore it is recommended
paying particular attention to ensuring that in the case of temperatures below 60 °C the sensor be immersed in the medium completely (minimum 6 cm).

For measuring interior temperatures (storage bays, dry kilns, etc.) the sensor should be attached to a well ventilated point. For measurement in bulk materials, ensure that the complete sensor tip (shrinkable sleeve with at least 10 cm cable) is buried. The temperature sensors FT can be used up to +120 °C. The teflon cable makes use in slightly corrosive media also possible.

Test Standard for Pt 100 Temperature Measurement

The optionally available test standard *(Ref. No.6072) permits the user to check* proper function of the PT 100 temperature measuring section of the Hydromette M 4050 but not of the temperature sensors.

Connect the test standard to the meter socket. After pressing the **»ON/OFF«** key, enter code No. 427 and confirm input by pressing the key **»Enter«**.

The reading at »Tmes« should be 0 °C. A tolerance of ± 0.5 °C is permissible.

Temperature Measurement with Active Electrode IR 40

Connect temperature probe IR 40 to the meter socket.

Switch on the meter by pressing the key **»ON/OFF«**.

Enter code No. 430 and confirm input by pressing key **»Enter«**.

Press measuring key **»M«** and read off result in °C in the second line of the menu at »Tmes«.

By pressing key **»Mem«** the reading can be stored, if desired.

Handling of Infra-Red Surface Temperature Probe IR 40

Technical Specifications

Measuring range:	0 °C to +170 °C. ***Resolution:*** 0.1 °C.
Emission factor:	95 %, permanently set.
Dimensions:	length 180 mm, diameter 33/36 mm, coiled cable 300/1200 mm long.

Admissible ambient conditions

Storage:	5 °C to +40 °C; 80 % R.H. maximum, not condensing
Operation:	0 °C to +50 °C; 90 % R.H. maximum, not condensing.

General Information Concerning Infra-Red Temperature Measurement Technique

All bodies with a temperature above the »absolute zero« (= 0 °K or -273 °C) emit infra-red radiation, also known as thermal radiation. The intensity of this thermal radiation serves as an indication of the surface temperature, having regard to the degree of emission. The infra-red measurement head receives the emitted thermal radiation in a contactless manner and converts it into a voltage signal. This signal is converted in the display device into the measurement unit »Degrees Centigrade«.

Advantages over contact measurement

- ☐ Very quick response and short measurement time
- ☐ No removal of heat from the measurement object
- ☐ No damage or contamination of the measurement surface
- ☐ Measurement of electrically live or moving parts.

Measure

Insert the plug of the connection cable into matching meter socket and engage by gently turning clockwise. Follow the reverse procedure to remove the plug. **Do not apply force and do not stretch the cable.**

After entry of the code No. 430 and confirming the input by pressing the key **»Enter«,** the reading is displayed in °C or °F at the position »Tmes«. Depending on the temperature variation, the measured value is displayed immediately or within a few seconds. Fluctuations of the last digit (1/10 °C) around ± 0.2 °C are completely normal. Even the second digit (1 °C) may jump backwards and forwards on account of the sensitivity of the sensor and its extremely quick reactivity. The damping of the display was intentionally omitted.

During the measurement the measuring sensor should be held only at its lower end (cable insert). With measurements of more than 10 seconds' duration in the immediate vicinity of hot or cold parts (waste gas pipe, radiant heater or refrigeration equipment) the measurement value may be falsified. After waiting for about 10 minutes (to allow temperature equalization between the sensor housing and the ambient temperature), the measurement can be repeated. In order to obtain accurate measurements, the sensor should have adopted the ambient temperature. The accuracy of the measurement depends on the temperature uniformity of the measurement device, measurement sensor (all parts e.g. at room temperature) as well as on the relevant degree of emission of the measurement object.

In order to avoid measurement errors and to protect the equipment against damage, you should not

- press the sensor opening of the measurement sensor directly against the object being measured,
- measure in an atmosphere that is contaminated or contains vapour,
- measure through a strongly heated atmosphere (flickering)
- measure objects directly exposed to strong sunlight (shade the objects),

- measure objects in the immediate vicinity of strongly heat-emitting or cold emitting equipment (interrupt heat/cold radiation),
- expose the high-quality measurement device to the influence of strong heat or cold sources (transport in the baggage boot),
- expose the measurement device to high atmospheric humidity (condensing),
- stretch the connecting cable or excessively twist the spiral cable,
- carry out measurements in rapid succession (wait approx. 5 seconds between each measurement),
- perform measurements in the immediate vicinity of electromagnetic or electrostatic sources.

Degree of emission

The measurement sensor is set to a degree of emission of 95 %. This value covers most building materials, synthetic materials, textiles, paper and non-metallic surfaces.

The following list is used to estimate the emission factor, which is affected by, among other things, the shine and roughness of the object being measured. Flat and shiny surfaces reduce the degree of emission while rough and dull surfaces increase the degree of emission. Since with metals the emission factor ranges from 10 % to 90 % depending on the surface (shiny, oxidised or rusty), an exact measurement is not possible. It is, therefore, recommended to use special paper stickers with a factor of 95 % for metals or metallically shiny surfaces and objects with variable emission factors.

A correction between the temperature measurement value and the emission factor requires a knowledge of the ambient temperature and the temperature compensation between the measurement sensor and the ambient temperature.

The correction is calculated according to the following equation:

$$\frac{(T\ \text{display} - T\ \text{ambient}) \times 100}{\text{Degree of emission (\%)}} + T\ \text{ambient} = T\ \text{measurement object.}$$

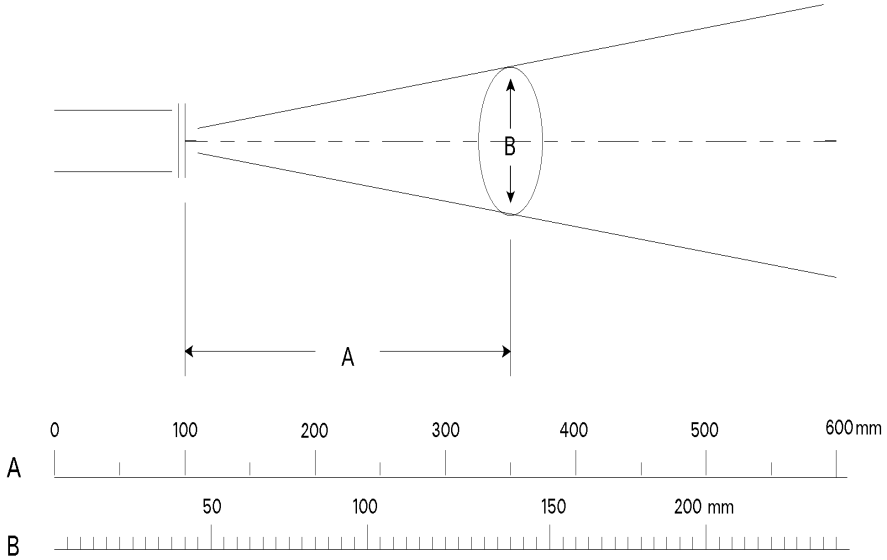
Table of degree of emission (%) for the range 0 - 200 °C

Asbestos		95 %	Marble	90 to	95 %
Asphalt	90 to	95 %	Paints *	90 to	95 %
Bitumen	98 to	100 %	Paper *		95 %
Brickwork (rough)	90 to	95 %	Plaster	90 to	95 %
Cement	90 to	95 %	Plastic materials		90 %
Ceramics	90 to	95 %	Roofing fabric		95 %
Clay		95 %	Sand		90 %
Concrete		95 %	Textiles *		95 %
Earth		95 %	Wallpaper *		95 %
Glass	90 to	95 %	Water		93 %
Gypsum	85 to	90 %	Wood	90 to	95 %
Limestone		95 %			

*) non-metallic

Size of the measurement spot

The measurement spot diameter depends on the distance from the sensor and has a size of 8 mm immediately in front of the measurement sensor opening. The measurement spot diameter increases proportionally in a ration of approx. 2.5 : 1 the greater the distance between the measurement sensor and object. At a distance of 100 mm the measurement spot diameter is 45 mm. A measurement distance between the object to be measured and the sensor of 20 to 50 mm is recommended.
The relevant diameter can be determined with the aid of the following diagram.



A = Distance between the measuring sensor and the object to be measured
B = Diameter of the measurement spot.

Measuring electrodes and other accessory

Drive-in Electrode M 20 *(Ref. No. 3300)*

for surface and subsurface measurements on wood up to 50 mm thick. Also for testing chipboard, fibreboard and set construction materials (plaster, mortar, etc.), with measuring pins

- 16 mm long *(Ref. No. 4610), penetration depth 10 mm*
- 23 mm long *(Ref. No. 4620)*, penetration depth 17 mm.

Surface Measuring Caps M 20-OF 15 *(Ref. No. 4315)*

for moisture measurements on surfaces (e.g. veneer, concrete) without damaging the material (only in conjunction with electrode M 20).

Ram-in Electrode M 18 *(Ref. No. 3500)*
for testing timber up to 180 mm thick, with uninsulated pins, as standard equipment,

- 40 mm long *(Ref. No. 4640), penetration depth 34 mm*
- 60 mm long *(Ref. No. 4660)*, penetration depth 54 mm, or

optionally

with pins with insulated shank
- 45 mm long *(Ref. No. 4550)*, penetration depth 25 mm
- 60 mm long *(Ref. No. 4500)*, penetration depth 40 mm.

Stick-in Electrode pins M 20-HW 200/300

uninsulated pins, for testing chips, wood-wool, veneer piles (only in conjunction with electrode M 20), with pins

- 200 mm long *(Ref. No. 4350)*
- 300 mm long *(Ref. No. 4355)*

Stick-in Electrode pins M 20-Bi

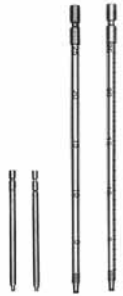
for measurements in depth of non-apparent materials behind another panel, with insulated shank (only in conjunction with the handle of the electrode M 20)

- 200 mm long *(Ref. No. 4360)*
- 300 mm long *(Ref. No. 4365)*.

Stick-in Electrodes M 6 *(Ref. No. 3700)*

for testing hard building materials, using contact paste and pre-drilled holes, with pins

- 23 mm long *(Ref. No. 4620)*
- 40 mm long *(Ref. No. 4640)*
- 60 mm long *(Ref. No. 4660)*



Deep Electrodes M 21-100/250

for deep measurements in set building materials, in conjunction with contact paste and pre-drilled holes

- 100 mm long *(Ref. No. 3200)*
- 250 mm long *(Ref. No. 3250)*.

Contact Paste *(Ref. No. 5400)*

to ensure good contact between electrode pins and tested building materials. For moisture measurements in hard building materials (cement flooring, concrete, etc.) with electrodes M 6 and M 21.

Live electrode MH 34 (Ref.No. 3350)

with integrated measuring circuit, for measurement of high moisture contents in coniferous wood, specially in case of water-borne storage and pre-sorting of freshly cut timber for kiln drying.

Measuring range: 40 to 200 % m.c.

Flat Electrode Pins M 6-Bi 200/300

for measurements in insulating material of cement flooring through the edge joint (with insulated shank) for use with the handle of the electrode M 6

- size 10 x 0.8 x 200 mm *(Ref. No. 3702)*
- size 10 x 0.8 x 300 mm *(Ref. No. 3703)*.

Stick-in Electrode Pins M 6-150/250

especially thin and uninsulated pins for testing building and insulating materials through the joint or cross joint of tiles

Size 150 x 3 mm Ø *(Ref. No. 3706)*
Size 250 x 2 mm Ø *(Ref. No. 3707)*

Hard-metal drill 160 x 3 mm Ø *(Ref. No. 6078)*

for tiles (cross joint). cement flooring etc.

Active electrode MB 35 *(Ref.No*. 3770)

with integrated measuring circuit, designed for surface measurement of concrete, in particular prior to coating or gluing.

Measuring range: 2 to 8 % m.c. of dry weight according to oven test.

Active electrode B 50 *(Ref. No. 3750)*

with integrated measuring circuit, designed for non-destructive location of moisture concentration in construction materials and moisture distribution in walls, ceilings and floors. It works according to a patented measuring procedure and generates a concentrated high frequency field with substantial penetration depth.

Measuring range: 0 to 199 digits, classification by table,

0.3 to 8.5 % of dry weight, automatic conversion into % of moisture on entry of code number.

0.3 to 6.5 % CM, automatic conversion of reading on entry of code number.

Active electrode B 60 *(Ref. No. 3760)*

with integrated measuring circuit, designed for non-destructive location of moisture concentration in construction materials and moisture distribution in walls, ceilings and floors. It works according to a patented measuring procedure and generates a concentrated high frequency field with substantial penetration depth. With built-in limit value selector for a range of 20 to 240 digits and acoustic signal generator.

Measuring range: 0 to 199 digits, classification by table,

0.3 to 8.5 % of dry weight, automatic conversion into % of moisture on entry of code number.

0.3 to 6.5 % CM, automatic conversion of reading on entry of code number.

Special electrode RF-T 28 *(Ref.No. 3155)*

with integrated measuring circuit, for measurement of air humidity air temperature, complete with connection cable.

Measuring range: 7 to 98 % R.H. and -10 to +80 °C
Response time: about 20 seconds for 90 % of the humidity difference at an ambient temperature of 20 °C, or about 120 seconds for 90 % of temperature variation.

Filter Cap *(Ref. No. 3156)*

of sintered bronze for use with electrode RF-T 28 in dust laden air or at high air speed

Special electrode RF-T 36 *(Ref. No. 3136)*

for measurement of air humidity and air temperature, water activity value or equilibrium moisture in rooms, warehouses or solid substances (e.g. concrete, subflooring, masonry, etc.)

Measuring Range: 5 to 98 % R.H. and -5 to +60 °C
Dimensions: 82 x 80 x 55 mm
Sensor tube: length 55 mm, dia. 12 mm

Special electrode RF-T 31

for measurement of atmospheric moisture, water activity value or equilibrium moisture in bulk materials and solid substances, e.g. brickwork and other building materials.

Measuring range: 7 to 98 % R.H. and -10 to +80 °C.
Sensor tube: dia. 10 mm
Sintered filter tip 32 mm long.
Insertion length 250 mm *(Ref. No. 3131)*
Insertion length 500 mm *(Ref. No. 3132)*

Bore hole adapter

with closing plug, for use with plug-in sensor RF-T 31 for equilibrium moisture measurement in brick-work or building materials.

For bore holes up to 150 mm in depth *(Ref. No. 5615)*
For bore holes up to 250 mm in depth *(Ref. No. 5625)*
For bore holes up to 500 mm in depth *(Ref. No. 5650)*

Blade Sensor RF-T 32

for measurement of atmospheric humidity, water activity value and equilibrium moisture in paper, leather, textile and tobacco stores, etc.

Measuring Range: 7 to 98 % R.H.
-10 to 80 °C.
Flat elliptical probe abt. 10 x 4 mm.

Insertion length 250 mm *(Ref. No. 3133)*
Insertion length 500 mm *(Ref. No. 3134)*

Sensor Check

Test and calibrating box for

Probe RF-T 28 *(Ref. No. 5728)*
Probe RF-T 31 *(Ref. No. 5731)*
Probe RF-T 32 *(Ref. No. 5732)*

Test and Calibrating Fluid

for checking and recalibrating all electrodes type RF-T.
Package of 5 ampoules of test fluid for sensor check, including absorbing fleece, sufficient for 5 tests or recalibrations.

SCF 30 for the range of 10 to 50 % R.H. *(Ref. No. 5753)*
SCF 70 for the range of 50 to 90 % R.H. *(Ref. No. 5757)*
SCF 90 for the range of 80 to 98 % R.H. *(Ref. No. 5759)*

Infra-red Surface Temperature Sensor IR 40

(Ref. No. 3150)

Contactless temperature measurement from -20 to 199.9 °C, resolution 0.1 °C, emissivity permanently set at 95 %, ratio of measured area to distance 2.5:1 (∅ 45 mm at a distance of 100 mm), sensor length 185 mm x 36 x 33 mm, coiled cable 320/1200 mm.

An ideal sensor for detection of heat bridges, determination of the dew point temperature, measurement of live, moving or vibrating components as well as measurement of components with low heat capacity, e.g. wood, glass, insulating materials, etc.

Matt-black stickers IR 30/E 95 *(Ref. No. 5833)*

Measurement spot 30 mm ∅, emissivity 95 %, e.g. for measurement of metallic surfaces.

Pt 100 Temperature Probes

Temperature Probe ET 10 *(Ref. No. 3165)*
Robust stick-in temperature probe for solid and bulk materials and liquids, measuring range -50 to 250 °C.

Temperature Probe TT 40 *(Ref. No. 3180)*.
Robust immersion and combustion gas temperature probe with long sensor tube, measuring range -50 to 350 °C.

Temperature Probe LT 20 *(Ref. No. 3190)*
Quick responding air/gas temperature probe with long sensor tube, measuring range -20 to 200 °C.

Temperature Probe TT 30 *(Ref. No. 3185)*
Robust immersion and combustion gas temperature probe with short sensor tube, measuring range -50 to 350 °C.

Temperature Probe ET 50 *(Ref. No. 3160)*
Quick responding air/gas temperature probe for soft solid substances, bulk materials and fluids, measuring range -50 to 250 °C.

Temperature Probe OTW 90 *(Ref. No. 3175)*
Angled special surface temperature probe, e.g. for veneer presses, etc., measuring range -50 to 250 °C.

Temperature Probe OT 100 *(Ref. No. 3170)*
Spring loaded, low mass surface temperature probe, e.g. for wall surfaces, etc., measuring range -50 to 250 °C.

Silicone Heat Conducting Paste *(Ref. No. 5500)*

To improve heat transmission on rough surfaces or if there are contact problems. Unconditionally recommended with temperature probe OT 100.

Flexible Temperature Probes with Teflon insulated connection cable, for solid and bulk materials as well as liquids up to 120 °C.

FT 2 with Teflon cable 2 m long *(Ref. No. 3195)*
FT 5 with Teflon cable 5 m long *(Ref. No. 3196)*
FT 10 with Teflon cable 10 m long *(Ref. No. 3197)*
FT 20 with Teflon cable 20 m long *(Ref. No. 3198)*

Carrying Case V *(Ref. No. 5085)*

for storing and transport of the measuring instrument and the standard and optional accessory

Measuring Cable MK 8 *(Ref. No. 6210)*

for connection of the electrodes M 6, M 18, M 20, M 20-HW M 20-Bi and M 21

Measuring Cable MK 15 (Ref. No. 6710)

for connection of the measuring instrument to the measuring point selector TKMU for taking in-kiln temperature measurements

Rechargeable Battery with charging unit *(Ref. No. 5100)*

for use instead of 9 V dry cell supplied as standard.

Test Devices

Test Standard *(Ref. No. 6070)*

for checking the wood moisture measuring section of the measuring instrument.

Test Standard *(Ref. No. 6071)*

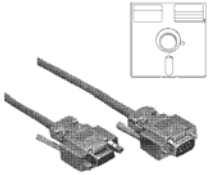
for checking the measuring section for building materials.

Test Standard *(Ref. No. 6072)*

for checking the temperature measuring section of the meter.

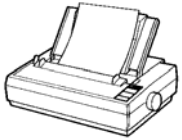
Test Standard *(Ref. No. 6073)*

for checking the active electrode MB 35.



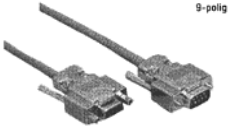
Program DIALOG *(Ref.-No. 6080)*

The PC transmission package **DIALOG** comprises the special cable MK 19 for connecting the HYDROMETTE M 4050 to an IBM compatible PC as well as the necessary software for further processing and for printouts The software is supplied both on a 3.5" diskette.



Printer

For printing memorized data a printer with serial interface (RS232) and a printing width for 20 or 80 characters is required. The printer must command the XON/XOFF software system.

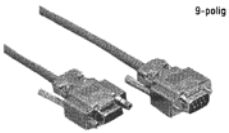


Connection Cable MK 17 *(Ref.-No. 6950)*

Special cable for connection of the measuring instrument to a printer with serial interface.

Power supply unit 12 *(Ref. No. 5150)*

for 220 V/12 V = stabilized
To preserve the battery during lengthy data transmittals to a PC or a printer.



Connection Cable MK 19 *(Ref. No. 6900)*

Special cable for connection of the measuring instrument to an IBM compatible PC.

PC Adapter *(Ref. No. 6910)*

For connection of the special cable MK 19 to a PC with 25-pin input.

Accessory for monitoring kiln drying timber

Measuring Point Selector Switch

The measuring point selector switch serves as central inquiry station for taking readings from wood moisture, EMC and temperature measuring points located inside a lumber dry kiln.

For taking wood moisture and EMC measurements the meter is to be connected by means of the measuring cable MK 8 which is usually supplied with each meter.

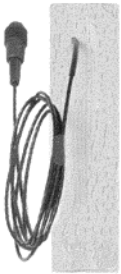
For temperature measurements the connection cable MK 15 is required. The kiln or wood temperature, according to the type of sensor used, and the wood moisture or EMC reading are simultaneously shown on the display of the HYDROMETTE M 4050.

The selector switch is available for connection of 6 or 10 wood moisture or E.M.C. measuring points and (optional feature) 1 or 2 temperature measuring points:

For 6 wood M.C. or E.M.C. measuring points	*(Ref. No. 7100)*
- additionally for 1 temperature measuring point	*(Ref. No. 7101)*
- additionally for 2 temperature measuring points	*(Ref. No. 7102)*
For 10 wood M.C. or E.M.C. measuring points	*(Ref. No. 7110)*
- additionally for 1 temperature measuring point	*(Ref. No. 7111)*
- additionally for 2 temperature measuring points	*(Ref. No. 7112)*

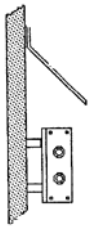
Kiln Temperature Sensor Pt

with fastening bracket and connecting cable for measurement of the drying temperature during kiln drying lumber. The end of the cable is prepared for connection to the measuring point selector switch.
Length of connecting cable 10 m *(Ref. No. 7500)*
Length of connecting cable 20 m *(Ref. No. 7520)*



Wood Temperature Sensor Pt *(Ref. No. 7550)*

in standard design with connection cable 10 m (30 ft.) in length, for measurement of the wood temperature during kiln drying lumber. The sensor is provided for insertion into a pre-drilled hole prepared in a representative board of the kiln load. The end of the cable is prepared for connection to a measuring point selector switch. A suitable plug can be fitted instead for direct connection to the measuring instrument. State desired design and length when ordering the temperature sensor.

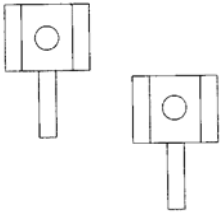


Wall Connector *(Ref. No. 7354)*

for connection of the MC and EMC measuring points inside the dry kiln, complete with wall plug, fastening screw and spacers.

Protective Cover *(Ref. No. 7355)* to protect wall connector against drip water.

Drive-in Electrodes



without insulation, for wood moisture measurement inside dry kilns, with a penetration depth of

- up to 10 mm *(Ref. No. 7201)*
- up to 15 mm *(Ref. No. 7202)*
- up to 25 mm *(Ref. No. 7203)*
- up to 40 mm *(Ref. No. 7204)*
- up to 70 mm *(Ref. No. 7205)*

Electrodes with insulation, with penetration depth of

- up to 15 mm *(Ref. No. 7207)*
- up to 25 mm *(Ref. No. 7208)*
- up to 40 mm *(Ref. No. 7209)*
- up to 70 mm *(Ref. No. 7210)*

Electrode Tool *(Ref. No. 7250)*
for driving the electrodes into the wood and for extracting them after the drying cycle has been completed.

Electrode Connecting Cables

- 4 m long *(Ref. No. 7304)*
- 5 m long *(Ref. No. 7305)*
- 6 m long *(Ref. No. 7306)*

Measuring Point Connecting Cables
for linking up wall connector with measuring point selector TKMU

- 10 m long *(Ref. No. 7330)*
- 20 m long *(Ref. No. 7340)* ***Other cable lengths on request***

Remarks on preceding table of wood species

Many species of wood are commercialised under different trade names even in one and the same country. Apart from wood names in other languages, the table contains wood names as commonly used in English speaking countries.

In the software of the Hydromette M 4050 only the chiefly used name of every species of wood has been stored. Therefore, it should be noted that another name may be displayed in the field of the menu following the code No. when entering the code No. found in the table for the species to be measured.

If any species of wood cannot be found in the table, ask the manufacturer or supplier of the meter for the code No., stating the botanical name of the wood species to be measured for exact identification. Statement of the botanical name is indispensable because several trade names are being used for different species of wood.

When using the ***active electrode MH 34*** for moisture measurement in confers with a moisture content between 40 and 200 % m.c., the code number 429 has to be entered. No other code number must be entered when using this special measuring sensor nor can it be used for measurement in the moisture range below 40 % m.c.

Code Numbers for Measurement of Structural Moisture, Air Humidity and Temperature

Building materials

Measurement according to the resistance method using the measuring electrodes M 6, M 20 and M 21, reading displayed in % of dry weight

Building material	Menu Indication	Code No.
Durament flooring	DUR.FLOOR.	380
Ardurapid-Cem.Flooring	ARDURAPID	382
Concrete B 15	CONCR_B15	383
Concrete B 25	CONCR_B 25	385
Concrete B 35	CONCR_B 35	387
Elastizell flooring	ELASTIZELL	389
Aerated concrete	AER.CONCR.	390
Gypsum flooring	GYPS.FLOOR	391
Plaster	PLASTER	393
Cement bonded chipboard	CEM-CHIPBO	410
Wood cement flooring	WO.CEM.FLO	395
Bitumen based softboard	SOFTB.BITU	396
Lime mortar	LIM.MORTAR	397
Cork	CORK	399
Xylolith	XYLOLITH	400
Polystyrene	POLYSTYREN	401
Cement flooring without additives		
- except setting accelerator	C-FLOOR-AD	402

Building material	Menu Indication	Code No.
Cement flooring with addition - of synthetics	C-FLOOR+SY	404
Cement flooring with addition - of bitumen	C-FLOOR+BI	406
Cement mortar	CEMENT MORTAR	408
Scan function using the resistance - measuring method, reading in - digits (0-80), no percentage - reading	RES-DIGIT	434

For display of equivalent readings in % CM as obtained when using the carbide pressure method

Durament flooring	DUR.FLO.CM	381
Concrete B 15 CM	CONC_B15CM	384
Concrete B 25 CM	CONC_B25CM	386
Concrete B 35 CM	CONC_B35CM	388
Gypsum flooring CM	GY-FLORRCM	392
Plaster CM	PLASTER CM	394
Cement mortar CM	CEM MORTCM	409
Lime mortar CM	LIM.MORTCM	398
Cement flooring without additives - except setting accelerator	C-FLO-ADCM	403
Cement flooring with addition - of synthetics CM	C.FLO+SYCM	405
Cement flooring with addition - of bitumen CM	C.FLO+BICM	407

Set building materials

Measurement according to the capacity method using the **active electrodes B 50 and B 60**, reading displayed in % of dry weight

Building material	Menu Indication	Code No.
Cement flooring	CEM.FL B50	413
Durament flooring	DU.FL B50	415
Concrete	CON. B50	417
Cement mortar	CEM.MO.B50	419
Lime mortar	LIM.MO B50	421
Lime cement mortar	L_C_PL B50	423
Plaster	PLAST. B50	425
Scan function using the active - electrodes B 50 and B 60, - reading in digits (0-199), no - percentage reading	B50_DIGIT	433

For display of equivalent readings in % CM as obtained when using the carbide pressure method

Cement flooring CM	CE.FLB50CM	414
Durament flooring	DU.FLB50CM	416
Concrete	CON.B50_CM	418
Cement mortar	CE.M.B50CM	420
Lime mortar	LI.MOB50CM	422
Lime cement mortar	LCPL B50CM	424
Plaster	PLASTB50CM	426

Measurement on the basis of the air humidity using the active electrodes RF-T 31 and RF-T 36, display of readings in % of dry weight

Building material	**Menu Indication**	**Code No.**
Cement flooring / concrete	SORP.CF,CO	431
Plaster / Durament flooring	SORP.PL,DF	432

Moisture measurement on concrete surfaces using the active electrode MB 35 readings in % of dry weight

Building material	**Menu Indication**	**Code No.**
Concrete and cement flooring surfaces	MB 35	411
for readings converted into % CM:	MB35_CM	412

	Menu Indication	**Code No.**
Measurement of air relative humidity using the active electrodes RF-T 28, RF-T 31, RF-T 32 and RF-T 36	RF-T	427
Calculation of dew point using the active electrodes RF-T 28, RF-T 31, RF-T 32 and RF-T 36	DEWP.-RFT	428

Temperature measurement using Pt 100 temperature probes in 4-conductor technology or active electrodes RF-T 28, RF-T 31, RF-t 32 and RF-T 36

	Menu Indication	**Code No.**
Display of reading in the field Tmes of the menu	RF-T	427
Surface temperature measurement using the active electrode IR 40	IR-PROBE	430

Warranty

GANN warrants for six months from date of purchase or one year from date of delivery from his factory whichever period elapses first, to correct by repair or replacement of defective parts free of charge any product defect due to faulty material or poor workmanship. Replacement or repair of any part does not constitute a new warranty period.

When lodging a warranty claim, return the meter complete with all accessories, postage paid, to GANN or to the supplier, together with a description of the fault noticed.

This warranty does not cover batteries, cables and electrode pins. GANN assumes no responsibility for damage or faulty performance caused by misuse or careless handling or storage, or where repairs have been made or attempted by the owner or third party. Proof of purchase is required.

EC Declaration of Conformity

in accordance with the EC Directive on Electromagnetic Compatibility
89/336/EEC in version 93/31/EEC

We hereby declare that the handheld moisture meter

GANN HYDROMETTE M-4050

corresponds to the aforementioned directive both with respect to its conception and type of construction and the design as marketed by us.

This declaration becomes void if the moisture meters are modified without our approval.

Applied harmonized standards in particular:

EN 55011/03.91 - DIN VDE 0875-11/07.92
DIN EN 50082-1/03.93

Applied national technical standards and specifications:

IEC 1000-4-2/1995 - IEC 1000-4-4/01.95
IEC 801-3/1984 - IEC 65A/77B

GANN Mess- u. Regeltechnik GmbH, Stuttgart, Germany