

MODEL PM-80

Operation and Calibration Instructions

Part No. MRC000357

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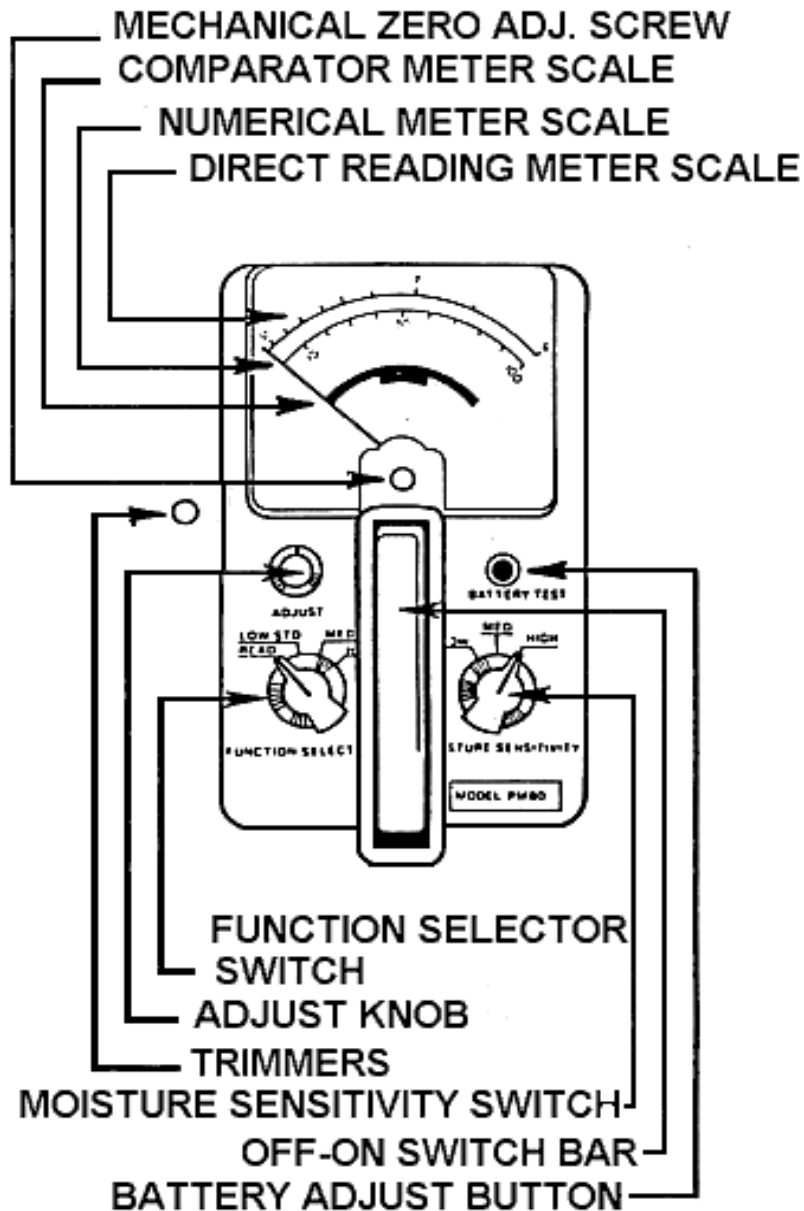
Model PM-80

Operating Instructions And Calibration Charts

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Introduction

Moisture Register Model PM-80 has been designed primarily as a production line tool for measuring the moisture content of paper rolls in motion on the paper machine. Wet or dry streaks and moisture trends can be detected RIGHT NOW and the proper corrective actions be taken immediately. The ball bearing roller electrodes permit testing on the fastest paper machines, as well as testing on stationary rolls or stacks of paper. Three moisture sensitivity range, three meter scales and full scale meter suppression provide the versatility to handle nearly every paper application and moisture range. The Model PM-80 is light weight, battery powered and portable

Since the PM-80 is such a highly versatile instrument, read these instructions carefully to obtain the maximum utility from the instrument.

Definitions and Details

HANDLE SWITCH: The bar in the center of the plastic handle turns the instrument "ON". Merely squeeze the handle or depress the bar with thumb pressure.

ROLLER ELECTRODES: Each of the roller electrodes has a Radio Frequency Field which radiates into the sample, penetrating to a depth of two inches. Since the reading from both of the rollers are additive, both rollers must be in firm contact with the paper sample during all moisture tests.

RADIO FREQUENCY FIELD: The RF Field is about twice the size of the instrument, covering an area 12" x 16" and 2" deep. When the PM-80 is used to measure samples smaller than this size, then the REFERENCE SETTING and the calibration data must be established on this same size sample.

TRIMMER AND COVER PLATE: Located on the left side of the instrument box. The trimmer can be used to readjust the meter pointer to maintain instrument accuracy.

ADJUST KNOB: This knob, on the left side of the panel, is used to position the meter pointer as required. It has sufficient adjustment to provide up to 100 dial divisions of suppression when desired.

MOISTURE SENSITIVITY SWITCH: This switch, located on the right side of the panel, is used to vary the instrument's sensitivity to moisture. For the same sample, HIGH position will read about 3x more than MED position. MED will read about 4x more than LOW position. For the greatest dial deflections and the most spread between adjacent moistures, use the highest sensitivity that permits on-scale readings.

FUNCTION SELECTOR SWITCH: This switch is located on the left side panel. It is used to connect the built-in electrical standards to the circuit. Since the different value standards are used for each of the sensitivity positions, it is very important that only the HIGH STD be used with HIGH SENSITIVITY, only the MED STD be used with the MED SENSITIVITY and only the LOW STD be used with the LOW SENSITIVITY.

The READ position of this switch removes all standards from the circuit while making moisture readings. ALL MOISTURE READINGS MUST BE TAKEN IN THE "READ" POSITION.

REFERENCE SETTING: A reference setting is the adjustment necessary in order to use the PM-80 instrument with a particular meter scale. The REFERENCE SETTING consists of knowing the position of the SENSITIVITY switch, the position of the FUNCTION switch and the NUMERICAL meter reading which has been set by the ADJUST knob.

METER SCALES: The lower colored Comparator Scale is used without reference to moisture percentages. The upper Direct Reading Percentage Scale is used for simplified testing of moisture percentages on average papers. The 0-100 Numerical Scale is used with calibration charts. It is also used when making the REFERENCE SETTINGS.

How to Make Tests Using the Comparator Scale

The colored comparator scale on the PM-80 meter dial is provided so that the meaningful moisture tests can be made without any reference to actual moisture percentages. Now various samples of the same type of paper can be compared to each other and the plus or minus variations determined. Once a "best" sample has been set to the "OK" line, then other samples will read "DRY" or "WET" in the colored zones. Out-of-tolerance limits can be established anywhere in these zones depending upon the job requirements.

This scale is particularly useful when a large number of paper types must be tested in a variety of moisture ranges.

1. Carefully select a sample of paper typical of the type and the size to be tested and known from previous experience or use to have the "best" or "most desirable" moisture condition.
2. Pick the PM-80 up by the handle and depress the switch bar on the handle to turn the instrument "ON".
3. Set MOISTURE SENSITIVITY switch to HIGH position.
4. Set FUNCTION SELECTOR switch to READ position.
5. Press both rollers firmly against the paper sample.
6. Rotate the ADJUST KNOB as necessary to position the meter pointer to the "OK" line in the center of the green zone. If the pointer cannot be brought down to the line, reduce sensitivity by setting the SENSITIVITY switch to MED or to LOW as necessary.
7. Without changing any adjustments, lift the PM-80 at least 6" clear of any object and note the NUMERICAL dial reading. If below "0", reset FUNCTION switch to the same position as SENSITIVITY switch position, the FUNCTION switch position and the NUMERICAL dial reading, as the REFERENCE SETTING. For example, this might be listed as "HIGH - READ - 10". Record this REFERENCE SETTING on the blank chart provided (Appendix 1).

TO TEST THE SAME TYPE OF PAPER AGAIN IN THE FUTURE

1. Adjust SENSITIVITY switch, FUNCTION switch and NUMERICAL dial reading to the previously recorded REFERENCE SETTING.
2. Set FUNCTION switch to READ position.
3. Press both rollers firmly against the paper and note the meter reading. The closer the meter pointer is to the "OK" line, the closer the moisture condition of the paper sample is to being correct.

How to Make Tests Using the Direct Reading Scale

The Direct Reading Percentage scale on the PM-80 reads in percent moisture content. This is not an exact curve for any one particular paper, but is the average of several curves made for common papers such as Kraft, Chip, etc. Many papers can be used with this scale with good results. Best accuracy will result when the sample used to lock-in the REFERENCE SETTING is at the control point or "best" moisture. Locking –in requires one check point sample very carefully selected, tested with PM-80 and then oven dried.

1. Carefully select a typical sample of paper which can be assumed to have moisture content close to the control point. This sample, to be tested by the PM-80, must be at least 12"x16"x2" thick and uniform in moisture.
2. Set MOISTURE SENSITIVITY switch to HIGH, FUNCTION switch to READ, and depress switch bar to turn instrument "ON".
3. Press both of the electrode rollers firmly against the paper sample and rotate the ADJUST knob until the meter pointer reads the same moisture percentage as that assumed for the paper sample. (If the pointer cannot be brought down to the same setting the SENSITIVITY switch to MED or to LOW as necessary).
4. Without changing any of the adjustments, lift the PM-80 at least 6" clear of any object and note the NUMERICAL dial reading. (If below "0", reset the FUNCTION switch to the same position as the SENSITIVITY switch). Record the SENSITIVITY switch position, the FUNCTION switch position and the NUMERICAL dial reading as the assumed REFERENCE SETTING. For example, this might be listed as "HIGH – HIGH – 40".

In the rare instance when no NUMERICAL dial reading can be obtained in either READ or STD position of the FUNCTION switch, the instrument is over-suppressed. Reduce the sensitivity by switching to a lower SENSITIVITY switch position and then repeat steps 3 and 4 above.

5. Cut out a sample of paper 8" x 8" x 1/4" thick from directly beneath the electrode rollers. Quickly weigh this sample and then dry it in a forced draft oven at 105° C (225° F) until constant weight is reached. Compute the moisture content.

For more detailed instructions on how to make good oven tests, read the procedures on pages .

6. The actual moisture content of the check point sample as determined by the oven test may be somewhat different from what it was assumed to be. If so, determine from the numerical and the direct reading meter scales, how many numerical dial divisions there are between the assumed and the actual percentages. Adjust the assumed REFERENCE SETTING by this same amount. For example: A sample assumed to be 5% was set to read 5% (numerical 30) using a REFERENCE SETTING of HIGH – HIGH – 40. The sample actually was 5 1/2% (numerical 35). This is 5 dial divisions higher on the numerical scale. This five dial division was added to the REFERENCE SETTING, making it HIGH – HIGH – 45 for future tests on this particular type of paper. List the final REFERENCE SETTING on the blank chart provided in the back of the book.

TO TEST THE SAME TYPE OF PAPER AGAIN IN THE FUTURE

1. Adjust the SENSITIVITY switch, the FUNCTION switch, and the NUMERICAL dial reading to the previously recorded REFERENCE SETTING.
2. Set the FUNCTION switch to the READ position.
3. Press both rollers firmly against the paper and read the moisture content on the Direct Reading Percentage scale.

Once properly adjusted, the same REFERENCE SETTING should be used for all tests on that particular paper. Further check points taken at other percentages may show deviations and less accuracy near the ends of the Direct Reading Percentage scale. This merely indicates that the calibration curve for that paper does not accurately fit all

of the calibration figures on the direct reading scale. For greater accuracy, an individual calibration curve can be made as outlined in Figure 1. For most practical purposes however, the accuracy becomes more and more unimportant as the sample moistures get further away from the control point.

The 0-9% Direct Reading scale is plotted on the graph in Figure 1 and is marked as H – H – 40. That REFERENCE SETTING of HIGH – HIGH – 40 can be used for many Kraft papers, etc. as an assumed setting, subject to adjustment as above if necessary.

How to Calibrate the Model PM-80 for Paper Rolls

Calibration consists of making PM-80 readings on paper rolls, cutting samples from beneath the instrument and then oven drying these samples. Percentages and readings are plotted on a graph and a curve drawing. In order to locate good areas on paper rolls for calibrations, use PM-80 to scan across rolls of paper in storage, or after rewound on the machine. Try to find rolls which give several readings. These areas of different readings should be broad, not with narrow streaks of wet or dry paper. If the PM-80 can be moved around over an area of about 16" square, and the dial reading holds constant, that area is a good one for taking a calibration sample. When a good area has been located, mark the 16" square area.

Cut and discard 3 or 4 outer layers from the 16" square to eliminate any possibility of differences due to temperature or humidity changes. Press both PM-80 rollers firmly against the exposed area and record the reading. Use REFERENCE SETTING H-H-100 or H-H-0, whichever is on scale. If working with high moisture or high density material, it might be best to also record the MEDIUM and LOW sensitivity readings.

Immediately after taking the PM-80 reading, cut from the center of the exposed area a sample approximately 8" square and ¼" thick. Weigh this sample at once on a scale placed near the roll. Work FAST since a thin sample exposed to plant humidity and temperature can change moisture content in a few seconds. Once weighed, there is no rush to dry the sample. If the sample must be transported to the lab for weighing, try to seal it in a vapor proof container. When in the lab, discard the outer 1/16" layers and weigh only the protected center 1/8" layer.

Spread sample cut in a forced draft, thermostat controlled oven and dry at 105°C (225°F) until constant weight has been reached. Compute moisture percentage and plot this and the PM-80 reading on a graph (Appendix 3).

Locate, read and dry 5-6 other samples to cover the required moisture range. Draw a curve through the points and if desired, re-locate the curve to a more useful portion of the meter dial. List the percentages and the dial readings on the blank chart (Appendix 4). Be sure to list the REFERENCE SETTING used for the curve.

How to Calibrate the Model PM-80 for Paper Stacks

Proceed exactly as outlined for rolls above, except work with samples existing in stack form, either in the warehouse or just after cutting and stacking from the machine. Be certain to keep a minimum scale size of 12" x 16" x 2" thick and do not let the PM-80 rollers come closer than 3" from the edges of the paper stack.

How to Make Tests Using the Calibration Charts

When check points indicate that the direct reading scale does not properly fit the type of paper being tested, or when the utmost accuracy is required, then a specific calibration chart should be made up and used in conjunction with the numerical scale. With such a calibration chart available, making moisture tests is very simple as follows:

1. Adjust PM-80 to the REFERENCE SETTINGS recorded on the calibration chart for this type of paper.
2. Set FUNCTION SELECTOR switch to READ position.
3. Press both rollers firmly against the paper and read the numerical scale.
4. Convert this reading into percent content by looking on the calibration chart opposite the numerical reading obtained.

How to Use Suppression with Calibrations

The ability to use full scale (100 division zero) suppression with the PM-80 effectively doubles the meter scale length to 200 divisions in each of the three sensitivity positions. Understanding how to apply and to use the suppression will make calibrating the instrument easier. Refer to the graph and the curves shown in Figure 1. This is an actual five point calibration curve made for average papers using High Sensitivity position. The curve is in two parts. When no suppression was used (REFERENCE SETTING HIGH-HIGH-100), the calibration curve started at 65 for 0% and went off scale at 6%. When maximum suppression was used (REFERENCE SETTING HIGH-HIGH-0) the calibration curve started at 0 for 6% and went off scale at about 10.2%. In this particular case only the moisture range between 4% and 8% was required, and required the use of two different REFERENCE SETTINGS. A partial suppression of 60 divisions was applied to lower the curve on the graph and to make possible the use of only one REFERENCE SETTING. A new REFERENCE SETTING of HIGH-HIGH-40 was selected. Note that every reading along this curve is 60 divisions lower than H-H-100 and 40 divisions higher than H-H-0. Note also that the calibration curve shape has NOT changed, only the LOCATION of the curve on the dial readings.

It will be simpler while running calibration data to use both H-H-100 REFERENCE SETTINGS. After the two curves have been drawn, decide if an in-between, relocated curve would be better and if so, simply plot and draw it in.

If the REFERENCE SETTINGS of MED-MED-100 and MED-MED-0 are used, a different, flatter curve will be obtained but at a higher moisture peak. If LOW-LOW-100 and LOW-LOW-0 are used, a still flatter curve and a still higher moisture peak will result. These lower sensitivities are used primarily for high moisture ranges, or for high density samples. It may be best to record data on all three sensitivities on such papers until the best sensitivity can be chosen.

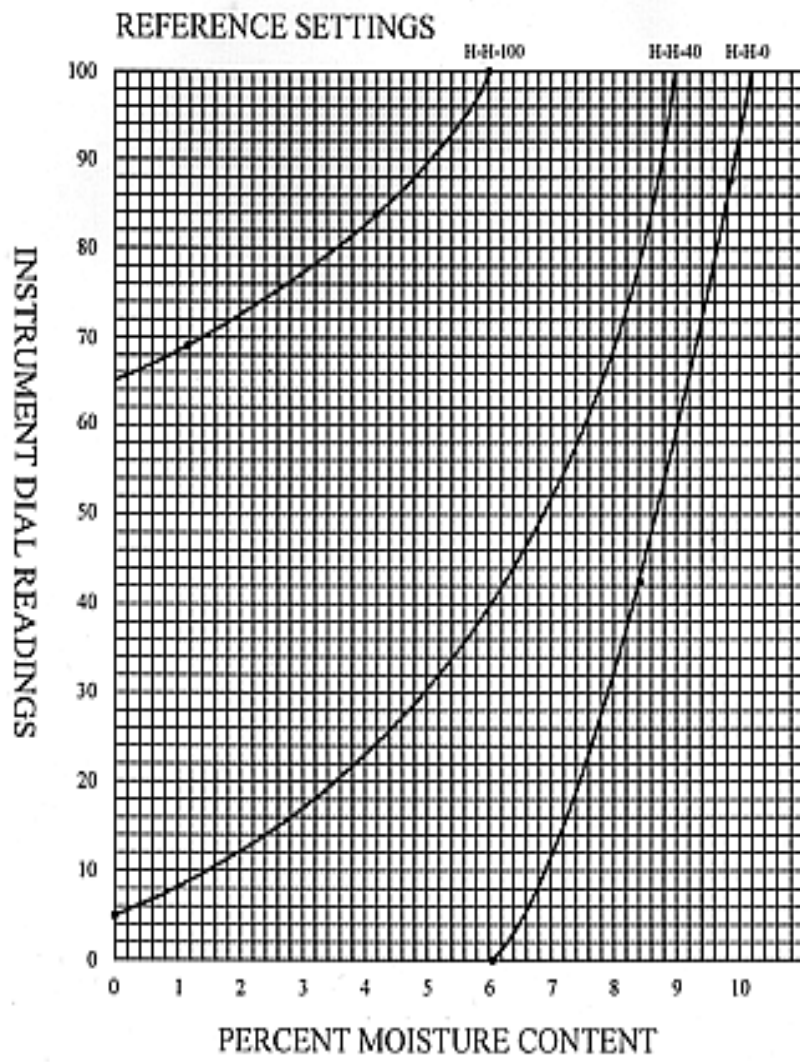


Figure 1

Oven Testing VS the PM-80

Accurate determination of moisture by oven drying methods requires top-grade equipment, careful sample selection and accurate work. The sample must be dried at the temperature that will vaporize all of the water, but not cause the loss of any other volatile material in the paper. Drying must continue until constant weight is obtained. Best accuracy requires thermostat heat control to close limits, good air circulation and accurate weighing scales.

Even the best oven test can only determine the average moisture content of the sample as it existed at the moment of weighing. A hot, dry sample will rapidly pick moisture up from the surrounding air, especially with high humidity conditions. By the time a sample has been cut from a roll, moved through the air, put in a plastic bag, carried to the lab and then finally weighed, the moisture content can be entirely different than it was originally on the roll.

Many "oven tests" being used today are highly questionable. Samples are dried by wrapping around hot pipes, placed on hot plates, placed in apron type photo dryers, put into convection ovens having severe hot spots, etc. Samples are dried at excessive temperatures for set periods regardless of moisture removal. Often it is said "Our oven tests are accurate, they always repeat". Accurate? Or always the same error?

The PM-80 tells the moisture of the sample beneath the rollers at the instant they are pressed against the sample. PM-80 excels in locating wet or dry streaks and in picking up changes in paper condition. It is used on the wind-up reels to show instantly what the drying trends are. Here an oven test is impossible; no sample can be cut out. To check a PM-80 reading here against an oven test taken later on is meaningless. Both may be correct, yet different because of a change in moisture during the delay interval. Streaks of moisture found by the PM-80 on the wind-up reel may dissipate, yet their existence may be a clue to troubles starting to occur in the drying equipment. Early detection can save money.

To compare PM-80 tests against oven tests, the same sample must be tested by both with no time delay between tests. The "across-the-roll tear strip sample" so widely used for oven tests is not adequate for making check points against PM-80. Make the Pm-80 reading on freshly exposed area of paper, cut out an 8" square x ¼" thick sample from beneath the rollers, instantly weigh that sample, then oven dry it properly.

If adequate equipment is not available in plant to make an accurate oven test to check or to calibrate the PM-80, it may be necessary to obtain help from commercial testing labs. However, using PM-80 as a comparator or with the simple direct reading scale is as good as and probably a lot better than many of the "oven tests" in use today.

Maintenance Items

KEEP ROLLERS CLEAN – Dirty rollers will influence accuracy. Use an air gun to blow any dirt from around the rollers and their housings. If necessary, remove the two screws at the ends of the rollers and lift them out of the housings. After cleaning, remount and tighten the screws firmly. The ball bearings are sealed and should not be lubricated.

METER POINTER ADJUSTMENT – The meter pointer should always be exactly "OFF". If necessary, reset it by turning the screw located on the meter cover at the pointer pivot.

CHECK CALIBRATION ACCURACY – The accuracy of the Model PM-80 can be checked at any time by using the built-in electrical standards. Monthly checks are sufficient, unless severe temperature changes have taken place since the previous check. Check accuracy before making calibration curves.

TO CHECK – Turn **MOISTURE SENSITIVITY** to **HIGH** position and **FUNCTION SELECTOR** to **READ** position. Turn "ON" and hold so both rollers are at least 6 inches clear of any object. Rotate **ADJUST** knob until meter pointer is in the center of the left circle marked "STD OUT CALIB CHECK". Turn **FUNCTION SELECTOR** to **HIGH STD** position. Meter pointer should be within the right circle marked "CALIB CHECK STD IN". If it is not, Trimmer #4 will have to be adjusted. **TO ADJUST**: Remove one screw and swing aside the Trimmer Cover Plate. With a screw driver, carefully adjust the Trimmer #4 until the standard IN reading is correct. Now recheck Standard Out (READ) and Standard In (HIGH) readings. Repeat until both readings are correct. This procedure of checking the calibration accuracy and of resetting Trimmer #4 when necessary will insure that the instrument accuracy is correct on all three moisture sensitivity ranges.

NEW BATTERY CHECK CIRCUIT – To check condition of batteries, push “Battery Check” button. Pointer should fall in the green area of the comparator scale. When meter pointer falls below that point, replace the batteries.

REPLACING BATTERIES – The new Model PM-80 is equipped with two (2) standard “C” size 1.5 volt. To replace, remove plate cover on rear of instrument. Remove batteries and insert replacements.

Servicing and Repairs

If the PM-80 cannot be reset to calibration accuracy and this cannot be corrected after replacing the batteries, then the instrument should be returned to the factory for servicing and/or repair. It is recommended that the Model PM-80 should be returned to the factory for a thorough check-up at least two or three years.

Qualified instrument technicians can make use of the Schematic Circuit Diagram to analyze minor malfunctions in the power supply and different amplifier circuits. This can be done without affecting instrument alignment. Precision electrical and physical standards, along with special techniques, are required to properly check and/or correct the electrical alignment of the high frequency oscillator circuits. Any attempt to change the components, alter their value, or to change wiring in the RF oscillator will cause misalignment beyond the ability of the built-in Standards and Trimmers to correct it.

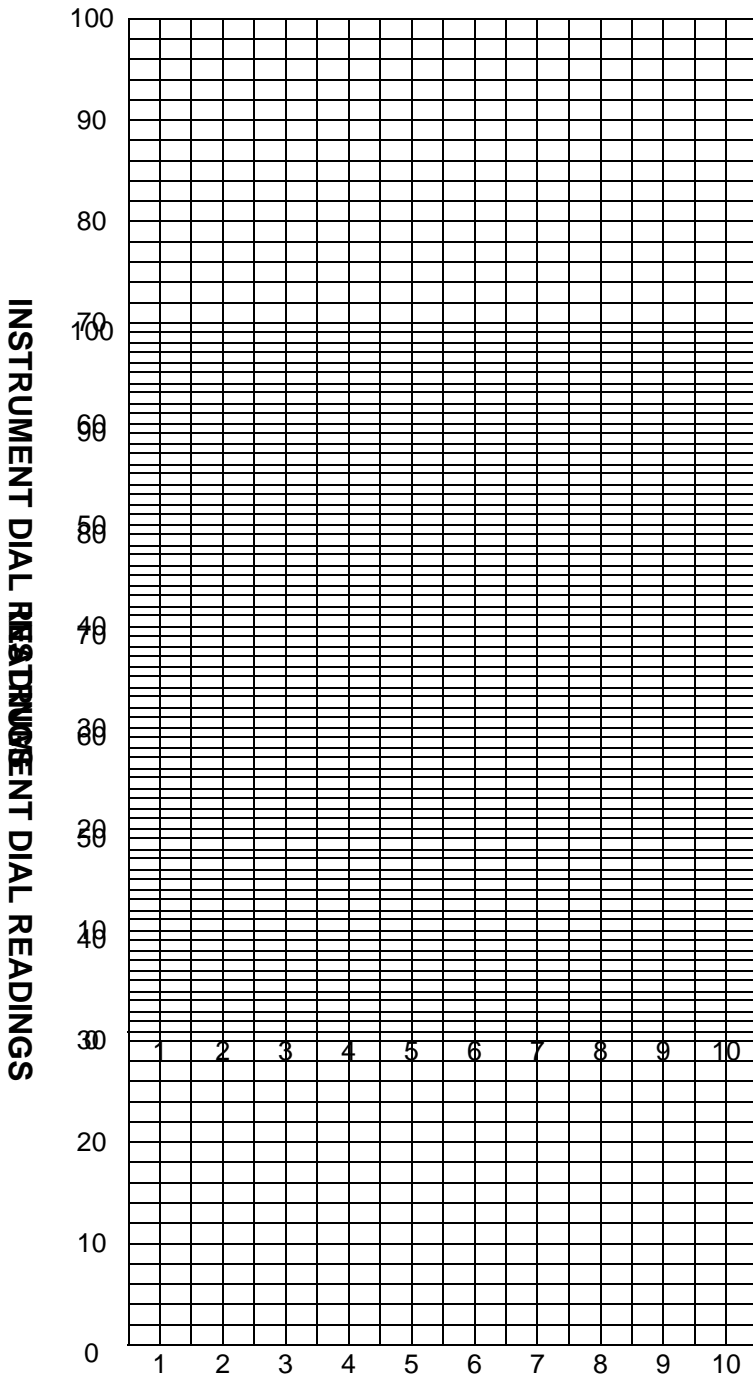
Erratic readings when using the Model PM-80 usually can be traced to low battery, loose screws, dirty rollers, dirty switch contacts, broken solder connections, or sticking meter needle. These problems are easily remedied.

Since the Model PM-80 utilizes etched circuit board construction, great care must be used on the circuit board. Too much soldering heat can cause delaminating of the copper pattern, while any use of acid flux solder will corrode and ruin it. Damaged circuit boards are quite expensive items to replace.

Appendix 3

Calibration Curve for Model PM-80

Calibrated for _____
Reference setting used: _____
Sensitivity _____ Function _____ Dial _____



PERCENT MOISTURE CONTENT Calibration Curve for Model PM-80

Calibrated for _____
Reference setting used: _____
Sensitivity _____ Function _____ Dial _____

PERCENT MOISTURE CONTENT

Appendix 4 Calibration Chart

NAME OF MATERIAL				
SENSITIVITY POSITION				
FUNCTION POSITION				
NUMERICAL SCALE READING	% MOISTURE	% MOISTURE	% MOISTURE	% MOISTURE
0				
5				
10				
15				
20				
25				
30				
35				
40				
45				
50				
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				

Notes:

Moisture Register Products manufacture Continuous On-Line Systems and Hand-Held Portable Meters that are designed for optimum performance, essential convenience and complete reliability to accomplish a multitude of applications in a wide range of industries.

Our Continuous On-Line Systems offer Near Infrared and Radio Frequency Sensors to constantly measure your process moisture. These systems assist you in analyzing, recording and controlling moisture on your product line.

Our Hand-Held Portable Moisture Meters offer on the spot measurement as well as flexibility for use on a variety of materials such as:

Moisture Register Products has portable moisture meters for use on a wide variety of materials, some of which are listed below.

**LUMBER
PLASTER WALL
GYPSUM BOARD
NONWOVENS
CORK**

**VENEER
DRY WALL
TEXTILES
PAPER PRODUCTS
AIRCRAFT RADOMES**

Moisture Register Products and AQUA Measure Instrument Company are fully committed in providing products and services at a quality level that continues to improve and that meets our customer's expectations.

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