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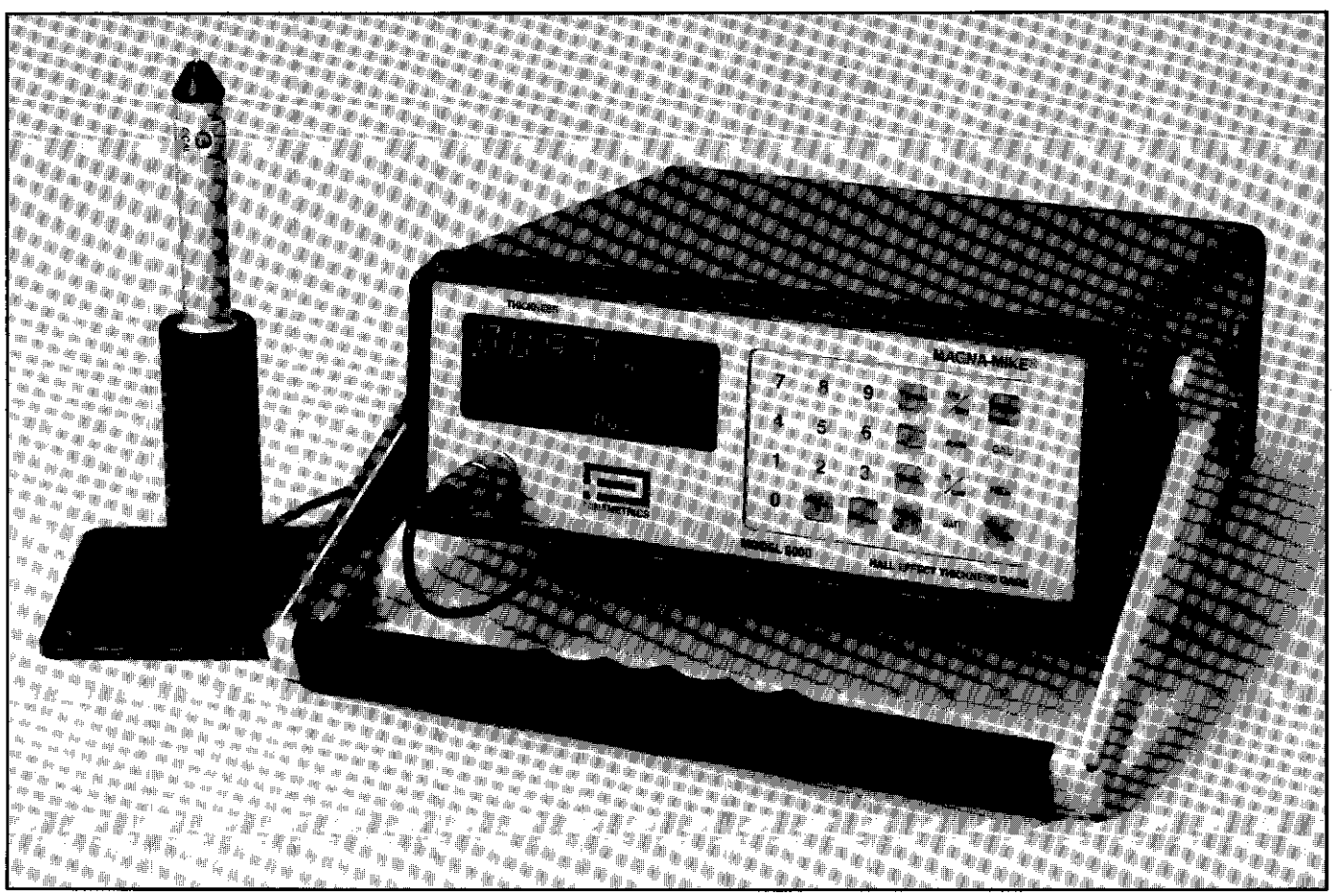
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INSTRUCTION MANUAL

MAGNA-MIKE®

MODEL 8000



PANAMETRICS 221 Crescent Street, Waltham, MA 02154, Tel: (617) 899-2719

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Preface

The Magna-Mike Model 8000 has been designed and manufactured as a precision instrument. Under normal working conditions it will provide long, trouble-free service.

Damage in transit - Inspect the unit thoroughly immediately upon receipt for evidence of external or internal damage that may have occurred during shipment. Notify the carrier making the delivery immediately of any damage, since the carrier is normally liable for damage in shipment. Preserve packing materials, waybills, and other shipping documentation in order to establish damage claims. After notifying the carrier, contact Panametrics so that we may assist in the damage claims, and provide replacement equipment, if necessary.

Warranty

Panametrics guarantees the Model 8000 to be free from defects in materials and workmanship for a period of two years from date of shipment. The warranty only covers equipment that has been used in a proper manner as described in this instruction manual and has not been subjected to excessive abuse, attempted unauthorized repair, or modification. DURING THIS WARRANTY PERIOD, PANAMETRICS' LIABILITY IS STRICTLY LIMITED TO REPAIR OR REPLACEMENT OF A DEFECTIVE UNIT AT ITS OPTION. Panametrics does not warrant the Model 8000 to be suitable for intended use, and assumes no responsibility for unsuitability for intended use. Panametrics accepts no liability for consequential or incidental damages including damage to property and/or personal injury.

Panametrics warranties the probe, probe cable, and battery for a period of 90 days. This warranty applies only to defects in workmanship that render the probe inoperative. Normal wear and tear on the probe tip or any defects caused by misapplication or abuse is not covered. Panametrics reserves the right to judge whether the probe shall be covered under warranty.

The customer will pay shipping expense to the Panametrics plant for warranty repair; Panametrics will pay for the return of the repaired equipment. (For instruments not under warranty, the customer will pay shipping expenses both ways.)

Panametrics reserves the right to modify all products without incurring the responsibility for modifying previously manufactured products. Panametrics does not assume any liability for the results of particular installations, as these circumstances are not within our control.

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Table of Contents

1 INTRODUCTION
1.1 SET-UP AND POWER ON 1-2

2 CALIBRATION
2.1 BEFORE CALIBRATING THE GAGE 2-1
2.2 WHEN TO CALIBRATE 2-1
2.3 THE CALIBRATION PROCEDURE 2-2
2.4 ABORTING THE CALIBRATION PROCEDURE 2-6
2.5 STORING AND RECALLING LOOK-UP TABLES 2-6
2.6 PROTECTING LOOK-UP TABLES 2-7

3 THICKNESS MEASUREMENTS
3.1 MAINTAINING ACCURACY 3-3
3.1.1 QUICK CALIBRATION 3-3
3.1.2 WHEN YOU USE A NEW TARGET BALL OF THE SAME SIZE 3-3

4 GAGE FUNCTIONS
4.1 THICKNESS DISPLAY RESOLUTION 4-1
4.2 MINIMUM AND MAXIMUM DISPLAY 4-1
4.3 HIGH AND LOW ALARMS 4-2
4.4 DISPLAY BRIGHTNESS 4-3
4.5 REFERENCE LOCK 4-3
4.6 KEYBOARD LOCK 4-3
4.7 GENERAL RESET 4-4
4.8 MASTER RESET 4-4
4.9 MEASUREMENT RATE 4-5
4.10 AUDIO FEEDBACK (BEEP) 4-5
4.11 FOOTSWITCH FUNCTION 4-5
4.12 BLANK KEY FUNCTION 4-6
4.13 MAX BUTTON CONFIGURATION 4-6

5 DATALOGGER AND COMMUNICATION FEATURES
5.1 DATA LOGGER 5-1
5.1.1 SETUP AND SELECT MODULI 5-2
5.1.2 SET-UP THE DATA SAVE FEATURE 5-2
5.1.3 ID NUMBERS 5-3
5.1.4 STORING 5-4
5.1.5 ERASING 5-4
5.2 COMMUNICATION 5-4
5.2.1 CABLES 5-5
5.2.2 COMMUNICATION PARAMETERS 5-5
5.2.3 SOFTWARE 5-6
5.3 OTHER COMMUNICATION SETUP FUNCTIONS 5-7
5.4 TRANSMITTING 5-8

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6 PORTABLE OPERATION

7 SPECIFICATIONS

8 MAINTENANCE, REPAIR & TECHNICAL ASSISTANCE
8.1 ROUTINE CARE AND MAINTENANCE OF INSTRUMENT 8-1
8.2 PROBE MAINTENANCE 8-1
8.3 ERROR MESSAGES AND COMMON PROBLEMS 8-1
8.4 DIAGNOSTIC TESTS 8-4
8.4.1 DATA ROM TEST, PRESS [1] 8-4
8.4.2 PROGRAM ROM TEST, PRESS [2] 8-4
8.4.3 DISPLAY TEST, PRESS [3] 8-4
8.4.4 ANALOG TO DIGITAL CONVERTER TEST, PRESS [4] 8-5
8.4.5 BURN-IN TEST, PRESS [5] 8-5
8.5 REPAIR AND TECHNICAL ASSISTANCE 8-5
8.6 SOFTWARE UPGRADES 8-5

APPENDICES

APPENDIX I - RS232 SERIAL PORT TRANSMISSION
APPENDIX II - PRINTER CONNECTOR
APPENDIX III - DATA OUTPUT FORMAT
APPENDIX IV - SOFTWARE PROTOCOL
APPENDIX V - REMOTE CONTROL COMMANDS
APPENDIX VI - SELECTING A TARGET BALL SIZE
APPENDIX VII - QUICK REFERENCE
APPENDIX VIII - FUNCTION INDEX BY GAGE MODE AND KEY
APPENDIX IX - PROBES, FIXTURES, AND TARGETS FOR SPECIAL APPLICATIONS

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1 INTRODUCTION

In addition to this manual, unpack the following items from the shipping container:

Control Unit
Power Cord
Magnetic Probe
Probe Cable
Probe Stand
Footswitch with cable
Quick Reference Card
Computer Diskette, 5 and 1/4 inch diameter
Data Interface Cable (if ordered)
An Accessory container with:
- Three Containers of Target Balls
- Three Calibration Reference Fixtures (blue labels)
- Three Target Ball Alignment Fixtures (red labels)

NOTE: Do not drop the probe or place it flat on a steel table. To avoid damage, the probe is best stored upright in its stand, away from large steel objects.

The Magna-Mike Model 8000 is a nondestructive gage for measuring the thickness of nonferrous materials such as plastics, glass, paper, aluminum, and titanium. Its accuracy is generally not affected by the shape or internal properties of these materials.

Wall thickness is measured by placing a small steel target ball on one side of the material to be measured and a magnetic probe on the other. The ball is held directly opposite the probe tip by magnetic attraction, and the gage senses the magnetic field strength between the ball and probe tip. The field strength varies in a known manner as the distance between the ball and the probe changes, and an internal microprocessor calculates and displays the corresponding material thickness.

The Magna-Mike Model 8000 will display thicknesses in English or metric units. The standard probe employs 1/16" (1.6 mm), 1/8" (3.2 mm), or 3/16" (4.8 mm) diameter target balls. The Model 8000 also has datalogging and data transmission capabilities.

An internal battery allows portable use, and this battery is automatically charging whenever line power is attached to the unit.

This manual covers the operation, calibration, and datalogging procedures for the Magna-Mike when it is equipped with the standard 801 or 802 probe and standard software (revision P1.7, D2.4). When using the gage with non-standard probes, refer to Appendix IX, then follow the procedures in this manual, substituting non-standard items for standard ones where necessary.

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In the text, the names of front panel keys are enclosed by [brackets], or will be shown graphically. Items appearing on the display will be shown either in **bold face** or graphically.

When multiple key sequences are being described, "press [A] [B]" always means press key [A] and hold it while key [B] is pressed, then release both keys.

> **NOTE:** The probe contains a strong magnet. Physical shock or close contact with other magnetic materials can damage the probe or change its magnetic properties. To ensure accurate operation of the Magna-Mike, do not drop the probe or allow it to come in contact with steel, iron, or another magnet or probe. Please be particularly careful to avoid forceful impacts to the tip, as this is the most fragile part of the probe.

1.1 SET-UP AND POWER ON

1. Set the control unit on a table top. You may rotate the handle on the control unit to any one of eleven positions to allow convenient viewing of and access to the front panel. Press the two black buttons located at the center of each handle hub to release the handle lock. The buttons will snap out automatically to lock the handle at each position.

2. Visually examine the front and rear panels of the Control Unit. Using Figures 1A and 1B, identify each item for future reference. Note that the front panel display is divided into three parts. They are referred to as the THICKNESS, STATUS, and LOWER displays, as shown in Figure 1A.

3. Locate the AC POWER connector on the Control Unit rear panel. Slide the clear plastic cover aside to observe the line voltage setting of the unit and confirm that it matches the line voltage available at your location. If not, pull the voltage selector card out of the AC POWER assembly and re-insert it so that the correct line voltage is visible. Plug the line cord into its receptacle in the rear panel. Connect the other end to a line power outlet.

> **NOTE:** With the voltage selector card set properly, the Magna-Mike will operate at nominal voltages of 100, 120, 220 and 240 volts, and at nominal frequencies of 50 or 60Hz. The fuse installed in the AC POWER connected should be rated for 1/4 Ampere at line voltages of 100 and 120 volts, and should be rated for 1/8 Ampere at line voltages of 220 and 240 volts. The gage may be used on a bench or desk with the line cord attached, or may be disconnected from line power and used portably.
>
> The Model 8000 comes equipped with an internal, rechargeable, maintenance-free battery which will provide approximately eight hours of portable operation once fully charged. This battery is automatically charging whenever line voltage is connected via the AC POWER connector. Please refer to Section 6 for details regarding portable operations.

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4. Plug the footswitch into the FOOTSWITCH receptacle on the control unit rear panel.

5. Plug one end of the probe cable into its mating receptacle on the control unit front panel. Rotate the connector collar until the connector is secure. Plug the probe into the other end of the cable, and place the probe in the probe stand, as shown in Figure 2. You may adjust the height of the probe and secure it in place by tightening the white nylon screw on the side of the stand.

6. Press the green [ON/OFF] key to turn the unit on. An audio transducer located inside the control unit will beep once and characters on the front panel display will illuminate. The current measurement units ("in" for inches or "mm" for millimeters) are shown in the status display. You may change them by pressing [in/mm].

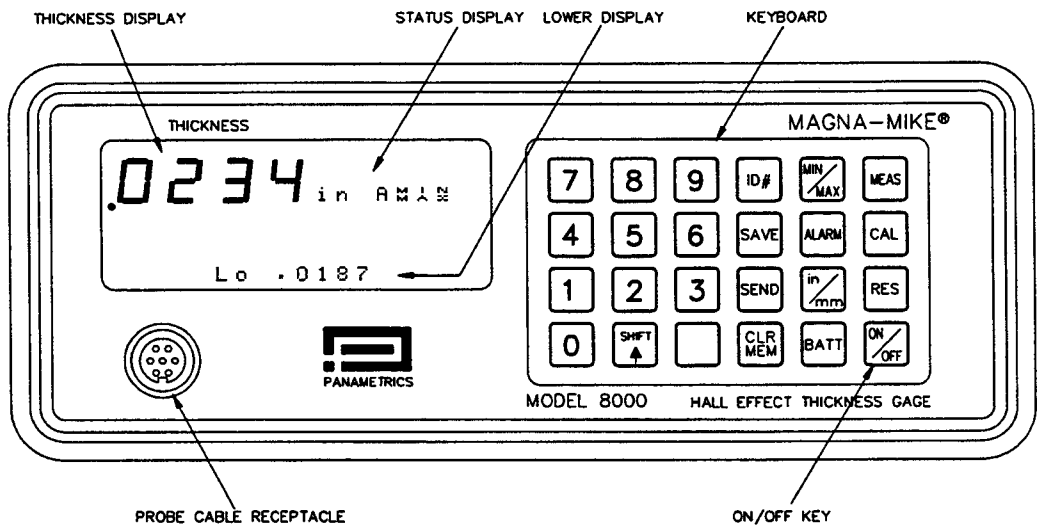


Figure 1A - Front Panel

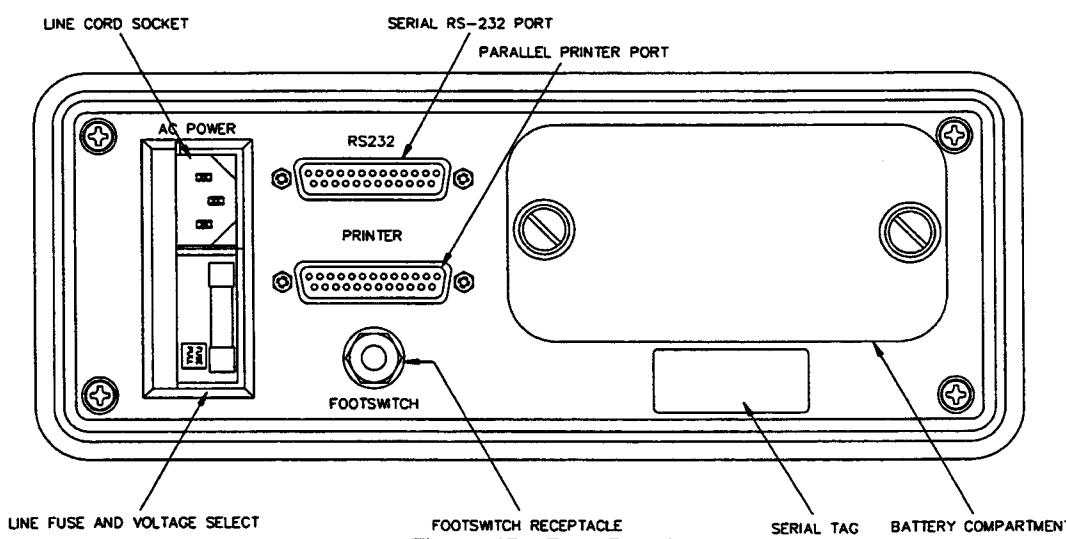


Figure 1B - Rear Panel

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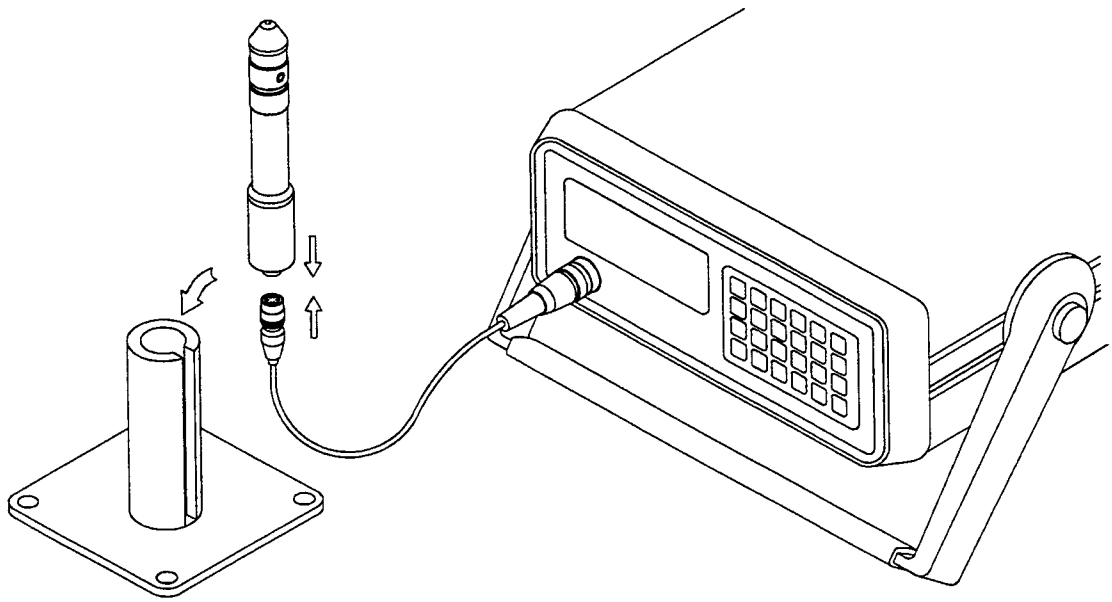


Figure 2

7. You may reduce the display brightness by pressing [SHIFT][0], then releasing both keys. Repeating this key sequence will reduce the brightness further, then restore the display to maximum brightness. Select a brightness which is comfortable and easily seen.

8. Before you attempt to employ the gage, please read the next two sections, CALIBRATION and THICKNESS MEASUREMENTS. It is essential that the gage be properly calibrated, and that measurements are performed as described in this manual, to ensure accurate readings.

9. Once you understand the fundamental operation of the gage, as described in Sections 2 and 3, please read the subsequent sections and appendices. These contain instructions for additional gage functions such as display resolution, alarms, and data logging. An index of all functions, organized by gage mode and key, is contained in Appendix VIII.

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2 CALIBRATION

The Model 8000 probe contains a strong permanent magnet. A sensor located behind the steel tip of the probe continually measures the strength of the magnetic field in the tip.

A nonmagnetic sample, such as a plastic sheet, when placed on the tip, has no effect upon the field strength. A steel target ball, however, placed on the sample, is attracted to the tip. The ball distorts the magnetic field and causes the field strength in the tip to increase.

As the sample thickness changes, the field strength in the probe tip also changes, from a minimum when the ball is far away, to maximum when the ball rests, centered, on the tip. These field strengths, however, are different for each size of target ball, and also vary from probe to probe. The control unit therefore employs a numerical look-up table, specific to one probe and one size of target ball, to translate these changes in field strength into thickness values.

The purpose of calibration is to create this look-up table. This table is valid only for the probe and size of target ball employed in its creation. Once created, the table is stored in the memory of the gage, and will remain there, being used to create thickness values, until it is deliberately removed by a reset or new calibration procedure.

Only after the calibration procedure is performed, and only if the calibrated state of the instrument is maintained as directed in this manual, will the thickness values obtained from the Model 8000 be accurate and meaningful.

2.1 BEFORE CALIBRATING THE GAGE

If you are not familiar with the Model 8000, please review the earlier sections of this manual to ensure that the gage is properly assembled. If the gage has just been turned on, please allow it to warm up, with the probe connected to the control unit, for at least fifteen minutes before starting the calibration procedure.

It is also necessary, before calibrating the gage, to choose the one or two target ball sizes which will be used in subsequent measurements. If this has not already been done, please refer to Appendix VI, Selecting a Target Ball Size.

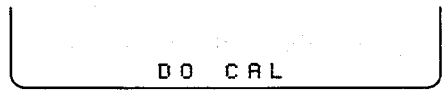
When performing calibration or thickness measurements, you must employ only the target balls supplied with the Model 8000, or exact replacements supplied by Panametrics. Use of other, apparently identical balls may cause inaccurate measurements.

2.2 WHEN TO CALIBRATE

Re-calibration should be done once per month, or if the probe is replaced, dropped, or contacts another magnet, probe, or large piece of steel or if the tip wears from contact with an abrasive material. Re-calibration is also advisable if you are uncertain of the unit's recent history. Calibration should be done only after the gage has been on, with the probe connected, for at least fifteen minutes.

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Certain reset procedures erase existing look-up tables, causing the control unit lower display to request:

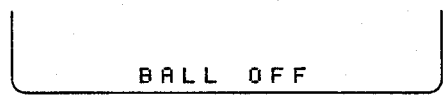


In this case, a calibration procedure is necessary before any measurements can be made.

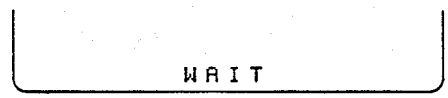
2.3 THE CALIBRATION PROCEDURE

A. BASIC PHASE

1. With the probe sitting in the probe stand, press the [CAL] key. The lower display of the control unit will respond with the instruction:

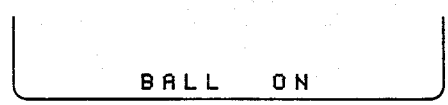


2. Remove any target ball from proximity to the probe tip, and press [CAL], the QCAL button on the probe, or the footswitch. The lower display will change to:



for about five seconds, while the gage measures the field strength at the probe tip.

The display will then change to:



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At the same time, the **MIN** indication will flash on the status display, and the thickness display will show a four digit number.

3. Select the target ball which you will be using in subsequent measurements, along with the red labelled alignment fixture for that ball size. The fixture will ensure that the target ball is centered as it rests on the probe tip. Drop the target ball into the funnel at the top of the fixture. Place the fixture over the tip of the probe and slide it down until it stops, as shown in Figure 3. Please note that the target ball should be placed into the fixture before it is placed on the probe. Repeated dropping of the target ball into the fixture while it sits on the probe may pit the tip of the probe and cause small measurement inaccuracies.

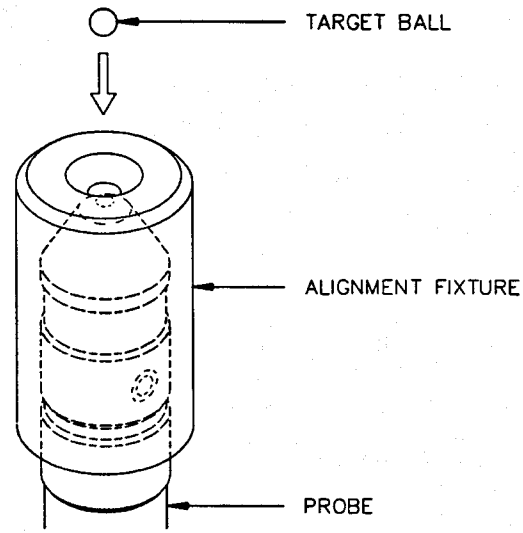
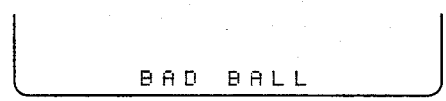


Figure 3

4. Once the ball is resting, centered, on the probe tip, press [CAL] or the footswitch. Please note that this will cause a new look-up table to be made, and will erase any existing table for the chosen target ball size. A brief **WAIT** message will appear on the lower display while the gage again measures the field strength.

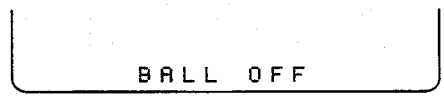
(If the lower display indicates:



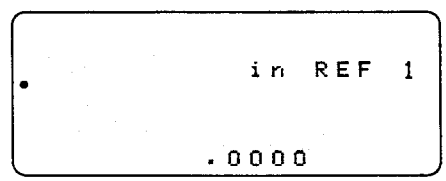
verify that the ball is actually resting on the probe tip and that the number on the thickness display changes as the ball approaches the probe tip. If not, refer to the troubleshooting guide, or seek technical assistance.)

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5. When the **WAIT** message ends, the lower display will request:



Remove the fixture and target ball from the probe tip. The lower display will flash **WAIT** for about 15 seconds while the control unit creates a BASIC look-up table for the probe and target ball being employed. When the **WAIT** indication stops flashing, the gage will display:



(Note that the decimal point locations and units of measure will differ from this example if you are using metric units.)

6. The BASIC calibration phase is now complete. You may press the [MEAS] key to return to the measure mode and perform measurements using thet BASIC look-up table. To ensure accurate measurements, however, it is recommended that you DO NOT press [MEAS], but continue on to the REFERENCE phase of the calibration procedure.

B. REFERENCE PHASE

1. In this phase of calibration, up to eight reference thickness values may be entered into the Magna-Mike. After these values are entered, the look-up table is re-written to conform to these actual values, rather than the typical values contained in the BASIC table.

   For best results, references should be chosen which correspond closely to any pass/fail values in your application, and to the upper and lower thickness bounds of the application.

   Panametrics manufactures a variety of reference fixtures, each containing a non-magnetic disk of known thickness. Three fixtures (identified by the blue labels) are included with the standard Magna-Mike. If you require other references, or must replace a reference, please contact Panametrics. Fixtures currently are available in 0.004, 0.010, 0.020, 0.040, 0.080, 0.160, and 0.240 inch values. Alternately, you may employ known samples of your own material. It is important, however, that the value assigned to any sample be true, as any inaccuracy in the reference value will be trasferred directly to the Magna-Mike.

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2. Put the target ball used in the BASIC phase into the top of one reference fixture.

3. Place one fixture on the probe and slide it down until the disk is resting on the probe tip. Do not drop the fixture onto the tip, or use excessive force, as this may dent the disk surface. The gage will display the thickness of the disk according to the BASIC look-up table. This value should be very similar to, but may not agree with, the thickness printed on the blue label.

   (If no value appears on the THICKNESS display, then the disk thickness is beyond the measurement range for that target ball. In this case, return to step 2, but use a thinner disk.)

4. Using the yellow numerical keys, enter the precise thickness of the disk as printed on the blue label. For example, if the label says, ".1602 in," press keys [1], [6], [0], and [2]. This value will appear in the lower display. If you make a mistake, simply re-enter the correct value. Use the millimeters value if the gage is operating with metric units.

5. Once the precise thickness is entered, press [CAL] or the footswitch. The REF number on the status display will increment.

   (If the measured and entered thickness values differ by more than 25%, the REF number will not increment, and the lower display will request the operator to:

   RE-ENTER

   Re-enter the reference value and press [CAL] again. If the value is accepted, then the original entry was keyed incorrectly. If the new entry is not accepted, then refer to the troubleshooting guide, or seek technical assistance.)

6. Repeat the procedure for each of the remaining reference fixtures.

7. When all of the thickness values have been entered, press [MEAS]. The lower display will flash **WAIT** for about 20 seconds while the Model 8000 modifies the look-up table to agree with the reference values entered by the operator. The gage will then automatically return to measure mode, and will now operate at REFERENCE accuracy.

   Before using the gage, please refer to the next section of the manual, "Thickness Measurements" with particular attention to section 3.1, Maintaining Accuracy.

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2.4 ABORTING THE CALIBRATION PROCEDURE

The calibration procedure may be terminated, and the gage returned to measure mode at any time, by pressing [SHIFT][MEAS]. If the procedure is terminated during the BASIC phase, no look-up table will be created, and the gage will return to its previous calibration state. If the procedure is terminated during the REFERENCE phase, the gage will keep only the new, unmodified BASIC table.

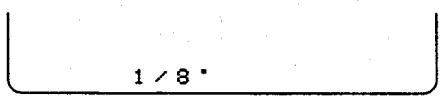
2.5 STORING AND RECALLING LOOK-UP TABLES

When a new look-up table is created for a particular ball size, that table is referred to as the active table, and it is used to generate thickness values while the gage is in measure mode.

If a new calibration is done with the same ball size, the active table will be erased and replaced by the newly created table.

If calibration is done with a different ball size, a new active table will likewise be created. The original active table, however, will not be erased, but will be preserved as the inactive table. Only one inactive table can be stored at one time, and its target ball size must differ from the active table's ball size.

From measure mode, you may request the ball size and probe type of the active table by pressing [SHIFT][4]. The display will briefly answer, as shown below, and then return to measure mode.



The probe type will be shown on the status display. The ball size will appear as a diameter in inches. All standard probes are type 1.

If active and inactive tables both exist, you may reverse the status of the tables by pressing [SHIFT][5]. The probe type and ball size of the newly active table will briefly appear on the display. In this way, an operator can switch between two different ball sizes without re-calibrating the gage. The operator should, however, press the QCAL Button as described in Section 3.1.1, after each [SHIFT] [5] to ensure the accuracy of subsequent measurements.

NOTE: If the newly active target ball is "new" (ie. just taken from the target ball supply to replace a lost target ball), then [SHIFT] [5] and QCAL should not be done to switch lookup tables. In this case, perform a "ball calibration" as described in 3.1.2. The tables will be automatically switched and the newly active table made to operate with the new target ball.

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If no inactive table exists when the operator presses [SHIFT][5], no switch will be made, and the lower display will say:



Note that there is only one inactive table. If calibration is done with a third target ball size, different from both the active and inactive tables, then the active table will become inactive and the original inactive table will be lost.

2.6 PROTECTING LOOK-UP TABLES

Both the active and inactive look-up tables will be preserved in the gage memory even if the gage power is turned off, the line cord is disconnected, and the main battery is removed. They can only be erased by a calibration procedure, or by certain gage resets.

While the gage is in measure mode, you may prevent a new calibration procedure by pressing [SHIFT][2]. The lower display will briefly say **REF LOCK**, and the gage will return to measure mode. Any subsequent attempt to calibrate the gage will cause the **REF LOCK** message to reappear. To unlock the gage, press [SHIFT][2] again. The lower display will say **UNLOCK**, and calibration will again be possible.

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3 THICKNESS MEASUREMENTS

Once calibrated for a particular target ball size, the Model 8000 will provide a continuously updated reading of the distance between the probe tip and target ball, provided that the ball is within the gage's range for that ball size.

To obtain accurate readings, care must be taken to ensure that the probe and target ball are positioned correctly, and that the gage's calibration is maintained.

Following a five minute warm-up after power-on, and calibration if necessary, press the [MEAS] key to place the unit in measure mode. The digital THICKNESS display on the front panel of the control unit will give a continuously updated reading of the material thickness between target ball and probe tip.

Place the target ball used in the active calibration (press [SHIFT][4] to determine current ball size) on one side of the material to be measured and the probe tip on the other side. To measure a container wall, drop the target ball into the container, apply the probe tip to the outside, and 'catch' the ball in the magnetic grip of the probe. The ball is attracted to the probe through the nonmagnetic material and follows the probe's movement as long as the probe tip is contacting the material and the material contours do not obstruct the movement of the ball.

The probe may be placed in its stand, or, if necessary, held by hand. If the probe is left in its stand, the material or container may be moved over the tip of the probe to locate the points at which measurements are to be made. If practical, this is the best method, as it better protects the probe from temperature changes and physical or magnetic shock. Keep the probe roughly perpendicular to the material being measured. This will keep the target ball aligned with the probe axis and ensure an accurate measurement, as in Figure 4A.

The maximum thickness range of the gage varies depending upon the target ball employed during calibration and measurements. Nominal maximum ranges are:

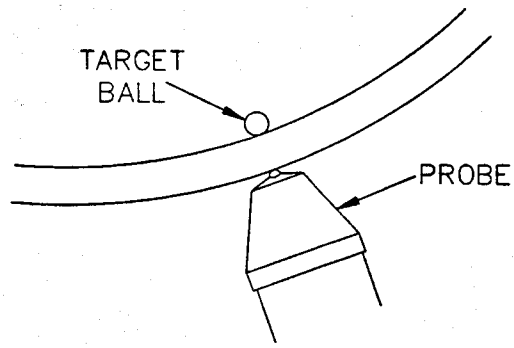
BALL DIAMETER	MAXIMUM RANGE
1/16 inch (1.59mm)	0.090 inch (2.29mm)
1/8 inch (3.2mm)	0.180 inch (4.57mm)
3/16 inch (4.76mm)	0.250 inch (6.35mm)

Be careful to move the probe and material so as to assure good, well-aligned contact of the target ball and probe tip on directly opposed surfaces of the material being measured, as shown in Figure 4A. Inaccurate measurements may result from obstructions of the ball or probe tip, or from poor alignment of the probe, as shown in Figures 4B to 4E.

For example, a 1/8 inch diameter ball will accurately retain contact with a minimum surface curvature of 1/16 inch (1.59 mm) radius, while a 1/16 inch diameter ball will be required to measure surfaces with radii as small as 1/32 inch (0.79 mm).

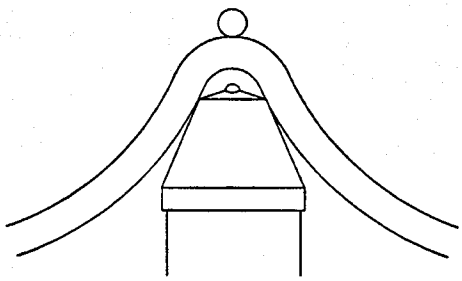
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Please note that the probe is not designed to measure iron, steel, nickel, cobalt or other magnetic alloys. Contact with large masses of these materials should be avoided to preserve accuracy. Remember to retrieve the target ball after measuring a container.



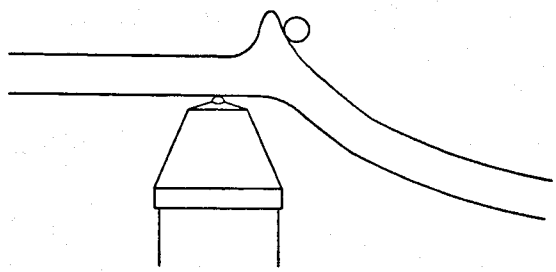
CORRECT METHOD FOR
THICKNESS MEASUREMENTS

Figure 4A



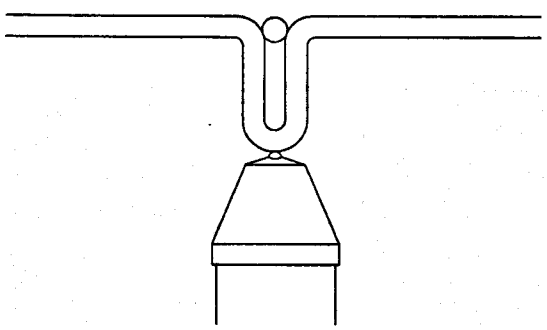
INACCURATE MEASUREMENT
DUE TO OBSTRUCTION OF
PROBE TIP

Figure 4B



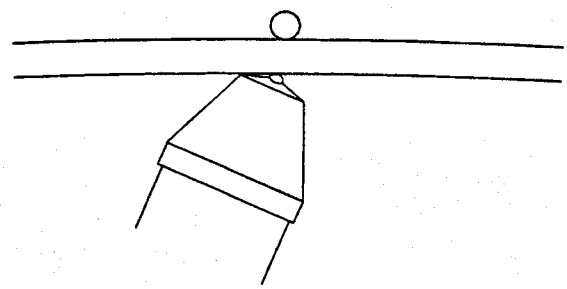
INACCURATE MEASUREMENT
DUE TO OBSTRUCTION OF
TARGET BALL

Figure 4C



INACCURATE MEASUREMENT
DUE TO SURFACE CURVATURE

Figure 4D



INACCURATE MEASUREMENT
DUE TO BAD PROBE
ALIGNMENT

Figure 4E

3.1 MAINTAINING ACCURACY

3.1.1 QUICK CALIBRATION

1. WHAT IS QUICK CALIBRATION

Quick calibration is a simple method to correct for drift due to changes in temperature or ambient magnetic fields. It may be performed at any time while the unit is in measure mode, and should be performed at least once every half hour.

2. WHEN TO DO A QUICK CALIBRATION

You should perform quick calibrations more frequently if measuring thicknesses

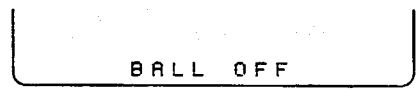
- near the maximum range,
- at mid-range when using high resolution,
- when the ambient or sample temperature is unstable,
- when the probe tip may be heated by friction.

In some high resolution applications, it may be necessary to do a quick calibration between each measurement. Please contact Panametrics for applications assistance.

3. HOW TO DO A QUICK CALIBRATION

To perform a quick calibration, simply remove the target ball from proximity of the probe tip, move the probe tip away from any magnetic objects (such as steel), orient the probe as it will be used during measurements, and press the [QCAL] button located on the side of the probe. The control unit will beep once and immediately return to measure mode.

If a target ball is left in proximity of the probe tip during quick calibration the control unit will display:



Remove the target ball and again press QCAL to return to the measure mode.

3.1.2 WHEN YOU USE A NEW TARGET BALL OF THE SAME SIZE

Small variation do exist between target balls of the same size. To preserve the accuracy of the gage, you should perform the following ball calibration procedure whenever you start using a new target ball. Given that the target balls, to the eye, are identical, assume that any ball left by a previous operator is "new".

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The purpose of this procedure is to compensate for minor differences between target balls while preserving the existing look-up table for that ball size.

Repeat only steps 1, 2, and 3 of the BASIC phase of the calibration procedure. In place of step 4, press [MEAS]. The gage will display a brief **WAIT** message, and request **BALL OFF**. Remove the alignment fixture and target ball. The gage will display an unblinking **WAIT** message for 10 seconds, then return automatically to measure mode. This procedure is known as Ball Calibration which distinguishes it from the procedure which creates a new lookup table.

Be careful not to press [CAL] at step 4 of the procedure, as this will cause the gage to erase the existing look-up table and replace it with the BASIC table. You may protect the existing table by using the REF LOCK feature, accessed by the [SHIFT] [2] keys.

Note that when in measure mode, the active ball size can be queried by pressing [SHIFT][4].

If Ball Calibration is done with a ball size corresponding to the inactive table, the table status will be automatically reversed and the procedure will be completed for the newly active ball and table.

If Ball Calibration is done with a ball size corresponding to neither table, a basic accuracy table will be created in the active location, the previously active table will become inactive, and the previously inactive table will be lost. Please note that REF LOCK will not prevent this sort of table replacement.

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4 GAGE FUNCTIONS

4.1 THICKNESS DISPLAY RESOLUTION

The Magna-Mike calculates thickness readings to a resolution of four digits (**.XXXX in** or **X.XXX mm**). Three digit display resolution may be employed when your application does not require four digits, or when you are measuring in the upper third of a target ball's range, where the large uncertainty associated with the measurements causes the fourth digit to lose meaning.

Press the [RES] key to change the display resolution. You may choose to display all four digits, or to round the fourth digit and display only three digits.

The resolution setting applies to values displayed on the THICKNESS display, **MIN** or **MAX** values, and to any values datalogged or sent to an external device.

4.2 MINIMUM AND MAXIMUM DISPLAY

The [MIN/MAX] key is used to scan a region of interest (such as the circumference of a container) and record a minimum or maximum reading. This function is particularly useful when doing pass/fail testing for thin walls in blow-molded or embossed plastic.

Press [MIN/MAX] once to activate the minimum function. **MIN** appears on the status display, and the current thickness appears on the lower display. The THICKNESS display operates normally, but each new measurement is compared to the value on the lower display, with the lesser of the two held on the lower display.

Press [MIN/MAX] again to activate the maximum function. **MAX** appears on the status display, and a maximum value will be shown on the lower display. This value is determined by the either the **MAX-SCAN** or **MAX-DSCT** method, which is chosen by SP-1 menu, key [7].

MAX-SCAN operates in the same way as the minimum function, except that the larger value is held on the lower display. This method is convenient, but must be used carefully, as it is prone to some errors. False maxima may be recorded if the target ball lags behind the moving probe tip, or as the sample and target ball are removed from contact with the probe tip.

MAX-DSCT (discrete) causes the gage to perform its maximum comparisons only when it is triggered to do so. This method may be used to avoid the errors associated with **MAX-SCAN**, described above. To trigger the gage, press [SHIFT][6], the MAX button (only found on '802' style probes), or the footswitch (after setting SP-1, key [6] for **FTSW= MAX**).

Press [MIN/MAX] again to simultaneously activate the minimum and maximum functions. **MIN** and **MAX** will both appear on the status display. Both functions operate exactly as described above, with the minimum value shown on the lower display. The maximum value momentarily appears when [SHIFT][MIN/MAX] is pressed, or when a discrete maximum is triggered.

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From **MIN MAX** mode, press [MIN/MAX] again to turn the lower display off and return to simple measure mode.

You may [SAVE] or [SEND] **MIN** or **MAX** values. In the SP-1 menu, key [8], choose **MODE DEP** to instruct the gage to [SAVE] or [SEND] values from the lower display, instead of from the THICKNESS display. If **MIN** and **MAX** are both active when [SAVE] or [SEND] is done, then both values will be saved to consecutive ID locations, or sent consecutively.

[MEAS] will clear the **MIN** and **MAX** values, so that a new region can be measured. When SP-1 key [9] is set to **Clr mM**, these values will be cleared after a [SAVE] or [SEND]. If you do not want these values to be cleared after [SAVE] or [SEND], choose **NoClr mM**.

Please note that scanning **MIN** and **MAX** values are updated only at the measurement rate of the gage, which is normally 5 measurements per second. If you suspect that small minimum or maximum areas are being missed by a rapid scan, you may increase the measurement rate with the SP-4 menu, key [SHIFT][1]. The choices are 1, 2, 5, 10, or 25 measurements per second.

4.3 HIGH AND LOW ALARMS

The Magna-Mike has **Lo** and **Hi** alarms which may be programmed to alert when thickness readings fall outside of acceptable limits.

While in measure mode, press [SHIFT][ALARM] to turn both alarms on. The lower display will briefly say **ALARM ON**, and an indicator will appear in the status display. An **A** indicates that alarms are active, but an alarm condition does not exist. The **A** is replaced by a flashing **L** when the measured thickness is equal to or less than the **Lo** alarm value, and by a flashing **H** when the thickness is equal to or greater than the **Hi** alarm value. Please note that **L** or **H** conditions are always judged according to the THICKNESS display value, and not **MIN** or **MAX** values.

If the gage audio beeper is **ON** (see the SP-4 menu, key [3]), the Magna-Mike will emit a short audio beep when an **H** or **L** condition is detected. Pressing [SHIFT][3] will suppress the beep, or re-activate the beep if it has been suppressed. Please note that [SHIFT][3] operates only when alarms are on, and that other audio beeper functions are not affected by [SHIFT][3].

Press [SHIFT][ALARM] again to turn both alarms off. **ALM OFF** will briefly appear on the lower display and the **A** indicator will disappear.

Press [ALARM] to show the **Lo** alarm value in the lower display. You may leave the value unchanged, or enter a new value with the yellow numeric keys. Press [ALARM] again to show the **Hi** alarm value. Again, leave the value unchanged, or enter a new value. Press [ALARM] to return to measure mode with both alarms off.

Alarm values may be set to any value between zero and .3936 inches (9.999 mm). Values beyond this range are not allowed. You may disable the **Lo** alarm by setting its value to zero. You may disable the **Hi** alarm by setting it to any allowed value greater than the maximum range of the probe and target ball being used. If the **Hi** alarm value is set lower than the **Lo** alarm value, the Magna-Mike will automatically swap the values.

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Any alarm status (**A, L,** or **H**) will be attached to values saved in the datalogger or sent via the PRINTER or RS232 ports.

If the gage is turned off and then back on, the alarm values will remain unchanged, but the alarm status will be inactive (off). [SHIFT][ALARM] will re-activate the alarms.

4.4 DISPLAY BRIGHTNESS

The brightness of the display is adjustable to match ambient lighting conditions. There are seven available brightness levels to choose from. To help preserve battery life, the brightness is automatically set to 50% (or lower depending on battery remaining capacity) at turn-on when operating on battery power. The brightness may be set manually to any level unless battery capacity is low.

To change the display brightness, press [SHIFT] [0]. Each keypress cycles the brightness to the next lower level, eventually returning to full brightness. The brightness may be changed at any time.

4.5 REFERENCE LOCK

From measure mode, [SHIFT][2] activates or deactivates the reference lock feature. When this feature is active, pressing [CAL] during the BALL ON step of calibration will cause the gage to warn REF LOCK, protecting the look-up tables from erasure. If REF LOCK appears, the operator should press [MEAS] to complete a ball calibration, or [SHIFT][MEAS] to abort.

4.6 KEYBOARD LOCK

The keyboard lock feature prevents any changes to either the calibration or the set-up and prevents any saving or sending of data from the keyboard.

To toggle the keyboard lock status, press [SHIFT] [1]. The lower display will momentarily show either **KBD LOCK** or **UNLOCK** as a verification. When any disabled key is pressed when the keyboard lock is on, there is no beep and the message **KBD LOCK** is shown momentarily on the lower display.

Keyboard lock disables every function except [SHIFT] [1], QCAL, the Max button on an 802 probe, the footswitch, and the [ON/OFF] key.

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4.7 GENERAL RESET

A simple key sequence may be used to quickly restore the gage to the default set-up shown below. This may be useful to new operators while becoming familiar with the individual advanced feature set-ups described elsewhere in this section. This may also be useful to experienced operators as an efficient short-cut to a known configuration.

The default set-up performed by this reset is as follows:

- All previous calibration is voided
- Units are set to INCHES
- Resolution is set to three digits
- Enables the alarm & key board AUDIO beeper
- Alarm set-points are changed to (default):
  LOW ALARM SET POINT: 0.000 inches
  HIGH ALARM SET POINT: 0.394 inches
- Maximum Measurement Mode is set to SCAN MAXIMUM
- [MAX] button (on a 2 button probe) is configured to MAX
- [FOOTSWITCH] is configured to SAVE
- [BLANK] key is configured to BLANK
- Measurement rate is made 5 meas/sec
- Number of communications buffers = 2
- SAVE/SEND type is set to ACTIVE
- Brightness level is set to maximum

To do a general reset, press [SHIFT] [BLANK], then [4] to get into SP-4, then [2].
Press [MEAS] to return to Measure Mode.

4.8 MASTER RESET

Master reset is a combination of communications reset, (see Section 5.2.2), general reset (see Section 4.7), and data logger modulus reset (clears all moduli except for default 9999), Section 5.1.1.

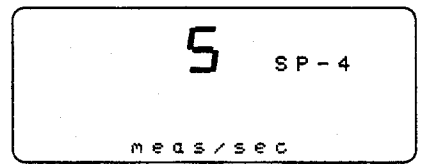
To do a master reset, press [SHIFT] [BLANK], then [4] to get into SP-4, then [SHIFT] [CLR MEM].
Press [MEAS] to return to Measure Mode.

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4.9 MEASUREMENT RATE

The rate at which measurements are updated to the thickness display is adjustable from 1 measurement per second to 25 measurements per second. The default rate is 5 measurements per second and this should be good for most applications.

To view the present measurement rate, press [SHIFT] [BLANK], then [4] to get into SP-4, then [SHIFT] [1].



To change to a different rate, repeatedly press [SHIFT] [1] until the desired rate is shown. The available rates are 1, 2, 5, 10, and 25.

Press [MEAS] to return to Measure Mode.

4.10 AUDIO FEEDBACK (BEEP)

All valid keystrokes or function changes are normally signalled with a tone burst or beep. This beep may be disabled. To toggle the status of the beeper (on or off), press [SHIFT] [BLANK], then [4] to get into SP-4, then [3]. The change will be indicated by a **BEEP ON** or **BEEP OFF** message on the lower display.

Press [MEAS] to return to Measure Mode.

4.11 FOOTSWITCH FUNCTION

By default, the footswitch is programmed to function as a duplicate [SAVE] key. However, it may be changed to function as a [SEND] key, a discrete max command, or as a minimum or maximum reset command.

To display or change the footswitch configuration, press [SHIFT] [BLANK], then [1] to get into SP-1. Then press [6] to view the current configuration. The lower display will show one of the following:

FTSW= SND	Send
FTSW= SAV	Save
FTSW= MAX	discrete maximum
FTSW= MEA	min or max reset

To change configuration to the next function on the list, press [6] again.
Press [MEAS] to return to Measure Mode.

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4.12 BLANK KEY FUNCTION

By default, the [BLANK] key is configured to function only with the [SHIFT] key as the means to enter the SP modes. However, it may be programmed to duplicate the QCAL button also.

To view or change the current [BLANK] key configuration, press [SHIFT] [BLANK], then press [1] to get into SP-1. Then press the QCAL button on the probe to view the current configuration. The lower display will show one of the following:

BLN= BLNK	blank
BLN= QCAL	QCAL button

To change the configuration to the other function, press QCAL again.
Press [MEAS] to return to Measure Mode.

4.13 MAX BUTTON CONFIGURATION

By default, the MAX button on the optional 2-button probe is programmed to function as a discrete maximum command. However, it may be changed to function as a min or max reset ([MEAS]) key, a [SEND] key, or a [SAVE] key.

To display or change the MAX button configuration, press [SHIFT] and [BLANK], then [1] to get into SP-1. Then press the MAX button to view the current configuration. The lower display will show one of the following:

MXSW= MAX	discrete maximum
MXSW= MEA	min or max reset
MXSW= SND	Send
MXSW= SAV	Save

To change the configuration to the next function on the list, press the MAX button again.
Press [MEAS] to return to Measure Mode.

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5 DATA LOGGER AND COMMUNICATION FEATURES

Two powerful and useful features of the Model 8000 are the internal data logger and the full duplex RS232 communication interface. The data logger is a facility for saving and recalling thickness measurements at specified locations.

The communication interface allows stored or live data to be transmitted to an external printer, computer or other data logger. The communication interface also allows complete set-up and control of the gage from a remote computer.

The set-up and operation of the data logger and of the communication interface is discussed in this section. For additional related information see the following appendices.

1. Serial Interface Description
2. Parallel Interface Description
3. Data Output Formats
4. Remote Control Commands

5.1 DATA LOGGER

The Model 8000 data logger contains a battery backed up memory. This memory battery is separate from the main rechargeable operating battery. The memory can hold up to 1024 thickness readings. Each stored reading has a unique location or identification number (ID#) which will be explained below. Each reading also has a set of "flags" stored with it which completely describe the type of measurement. Furthermore, each stored reading has a "set-up number" stored with it which specifies gage parameter values which are relevant to the stored reading.

A new ID# may be manually entered for each saved measurement, but the gage has a versatile facility for organizing and automatically incrementing the location numbers or ID# 's. As the gage is shipped, the available range of ID# s is set-up to be from 1 to 9999. i.e. a one dimensional list.

However, the ID# 's may be organized into a two dimensional array composed of an X column # and Y row # . In operation, the Y part of the ID# increments until a specified maximum Y value called the "modulus" is reached, then the X part of the ID# is incremented and the Y part resets to 1 and so on. The utility of this feature comes from associating the X part of the ID# with a product sample number and the Y part with a particular physical measurement location on the product. For example, if your job is to measure a sample of 100 bottles for wall thickness at 6 different locations on each bottle, you could set up the data logger to start at ID# 001, 1 representing bottle 1 measurement 1. Then auto increment to ID# 001, 2 (bottle 1, meas 2), etc. up to ID# 001, 6, (bottle 1, meas 6) and then ID# 002, 1, bottle 2, meas) 1 etc.

Any size of modulus (maximum Y part) from 1 to 9999 may be specified. The gage will automatically limit the maximum ID# X part so that the maximum X= 9999/specified modulus.

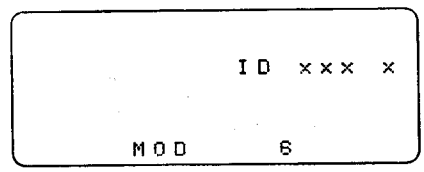
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Up to 10 different moduli may be preset into the gage at once. However, only one such preset modulus may be selected to be active at a time. This allows the data structure for several different product measurement applications to be pre-programmed and then the appropriate one to be selected when needed.

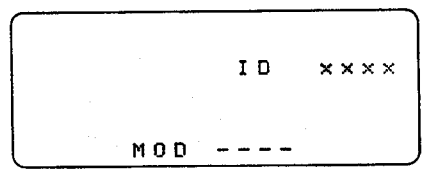
5.1.1 SETUP AND SELECT MODULI

- To view, change or select the active and available data logger moduli, first get into SP-2 by pressing [SHIFT] [BLANK] then [2]. Then ...

- To show the current or next modulus, press [ID#]. The division of the total ID# digits between the X part and the Y part will be shown in the status display. The value of the modulus i.e. the maximum Y part will be shown in the lower display. For example:



Each time [ID#] is pressed the display cycles to the next of the ID possible data logger modulus set-ups. If a modulus set-up has not been defined, then the following will be displayed.



When a modulus set-up screen is being displayed, the modulus shown may be directly changed using the numeric keys.

- To change the active modulus to the one being displayed and return to the measure mode, press [MEAS].

- To retain the previous modulus, throw away any edited modulus and advance to the next modulus, set-up, press [SHIFT] [MEAS].

- To delete the displayed modulus, press [CLR MEM]. The new modulus displayed will be the first non-zero modulus in the list of 10 moduli. If all moduli are deleted, the gage automatically creates the default modulus, i.e. 9999.

- Data Logger Reset. To clear all moduli and reset modus # 1 to 9999 (default), press [SHIFT] [BLANK] followed by [4]. Then press [4] again to do the reset.

5.1.2 SET-UP THE DATA SAVE FEATURE

The data logger may be set-up to store either the actual thickness measurement being displayed or the minimum or maximum value. Also the footswitch may be programmed to function as the [SAVE] key.

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- To view or toggle the Save (and Send) function to either active (stores actual thickness measurement) or mode dependent (stores minimum, maximum or both if a min or max measure mode is selected else stores the actual thickness), press [SHIFT] [BLANK], then [1] to get into SP-1, then press [8]. The current save function will be shown on the lower display. Press [8] again to toggle to the alternate save function. The default save condition is active.

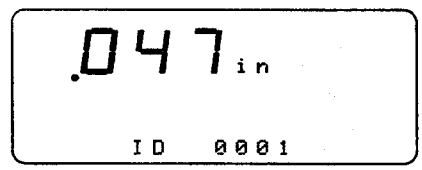
- To enable or disable the footswitch save function, press [SHIFT] [BLANK], then [1] to get into SP-1, then press [6] to view the current footswitch configuration. The lower display will show one of the following:

FTSW= SND	Send
FTSW= SAV	Save
FTSW= MAX	discrete maximum
FTSW= MEA	Min or Max reset

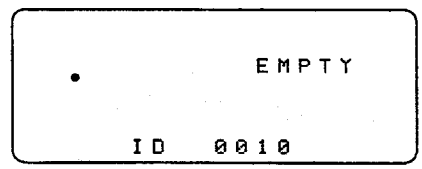
To change the configuration, repeatedly press [6] until the desired configuration is shown.

5.1.3 ID NUMBERS

- To view or change the current data logger ID# and view its contents press [ID#]. The current ID# will be shown on the lower display, and if there is a stored value at that location it will be shown on the thickness display. Otherwise the message EMPTY will be shown in the status display.



or



- To change the displayed current ID# press the numerical digits for the desired ID# . You should enter the number as you would write it beginning with the leftmost non zero digit. When you change the ID# the new number will be shown in the lower display and the current modulus in status display. To view the contents of a just entered ID# , press [ID#] once.

- To return to the measure mode after viewing the ID# and its contents and/or changing the ID# , press [MEAS]. The current ID# will be changed to the last one displayed.

- To view the first used ID# in the active modulus, press [MIN MAX] once while in the view ID# and contents mode. To view the last used ID# in the active modulus, press [MIN MAX] again. Each time [MIN MAX] is pressed subsequently, the display will alternate between the first and last used ID# 's.

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- To abort any editing of the ID# and return to the measure mode with the ID# unchanged, press [SHIFT] [MEAS].

- From the measure mode, to momentarily show the current ID# while remaining in the measure mode, press [SHIFT] [ID#].

5.1.4 STORING

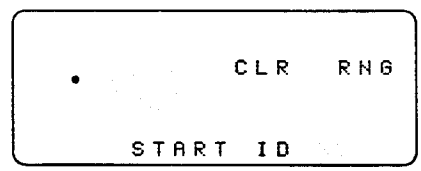
- To save the selected displayed value (either active or mode dependent - see above) at the current ID# , press the [SAVE] key (or the footswitch or MAX button on the optional 2-button probe, if enabled). The ID# which is being saved to will be briefly shown in the lower display as a confirmation. Then the current ID# is automatically incremented. If the minimum/maximum measure mode is selected, the minimum and/or maximum value will be reset.

5.1.5 ERASING

Stored thickness data may be erased from a single ID location, from a range of ID locations or from an entire modulus.

- To erase the data stored at a specified ID# , press [ID#], the value of the location to be cleared, then [ID#] again to show both the ID# and its contents. Then press [CLR MEM] to erase the stored contents of the displayed ID location. The displayed contents will change to EMPTY in the status display when the erasure has been done.

- To erase the stored data in a specified range of ID locations, press [CLR MEM]. This will be acknowledged with the following:



Enter the ID# value at one end of the range to be erased. Press [CLR MEM]. The FINAL ID will be requested. Enter the ID# value at the other end of the range to be cleared. Press [CLR MEM]. The contents of the specified range inclusive will be cleared and the gage will return to the measure mode.

- To erase all the stored data in an entire modulus area, press [CLR MEM], then [SHIFT] [CLR MEM].

5.2 COMMUNICATION

The communication features include the capacity to transmit either a specified portion of stored data or the displayed thickness (either active, maximum or minimum) over a "serial RS232" cable to a computer or other data logger. The same data may also be sent directly to a printer over a "parallel interface" cable.

The Model 8000 also receives and executes commands sent to it over the serial RS232 cable from a remote computer. All keyboard controlled functions may be duplicated using the remote command communication feature.

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In order to enable the Model 8000 to talk or communicate with a computer or datalogger, the following four things must be done. 1) The gage and computer must be connected with the proper cable, 2) The communication parameters of the gage must be equal to those of the computer, 3) The computer must run a communication or data gathering program, 4) The gage must be set to RS232 communications mode. Note that a parallel printer does not require communication parameters to be set, nor special software. These three requirements will be explained in detail below.

5.2.1 CABLES

The gage must be connected to the computer with the proper cable. Since all computers do not have the same serial port connector the correct cable must be ordered from Panametrics. Panametrics provides the following cables which are compatible with most computer or data logger serial connectors:

COMPUTER OR DATA LOGGER INTERFACE CABLES

I/O CABLE PART NUMBER	EXTERNAL DEVICE I/O CONNECTOR DESCRIPTION	TYPICAL DEVICE	MODEL 8000 CONNECTOR NAME
8025F	25 male (pin) "D" type	PC, XT Some PS-2	RS232
8009F	9 male (pin) "D" type	AT, some PS-2	RS232
80DM8	Circular 12 socket	Datamyte 862/762	RS232
80DM2	Circular 8 socket	Datamyte 2003	RS232
80DM9	Circular 8 socket	Datamyte 953	RS232
80PLP	Centronix 36 contact female	Parallel printer	Printer

NOTE: Even matching cables and connectors do not guarantee compatibility. To verify that a particular device serial port is compatible with a particular cable, the wiring information in Appendix 1, Serial I/O Interface Description must be compared to the serial port wiring information given in the operators manual for the remote device. If there is a wiring compatibility problem, sometimes software or hardware switches may be set in the remote device to change the connections. Otherwise, Panametrics may be able to supply a special cable for the application.

5.2.2 COMMUNICATION PARAMETERS

The communication parameters of the Model 8000 must match those of the computer. Usually the communication parameters of a computer can be changed from within the computer. In some data loggers it may be difficult to change the communication parameters. In any case they must be determined in order to verify or adjust them from the gage end.

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- To view or change the communication parameters on the gage:

  a. Determine the settings used in the receiving device for baud rate, word length, number of stop bits, and parity bit.

  b. Press [SHIFT] [BLANK], then [1] to get into SP-1.

  c. Press [1] to show the current baud rate. Press [1] repeatedly if necessary, until the displayed baud rate matches the baud rate used in the remote device. The following rates are available: 150, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200 and 9600.

  d. Press [2] to show the current word length. Press [2] again if necessary to match the word length used in the remote device. The available word lengths are 7 and 8.

  e. Press [3] to show the current number of stop bits. Press [3] again if necessary to match the number of stop bits used in the remote device. Either 1 or 2 stop bits are available.

  f. Press [4] to show the current parity type. Press [4] repeatedly if necessary to match the parity type used in the remote device. Note that **E** = even, **O** = odd, and **N** = no parity.

  g. Press [5] to show the active communications port, and press [5] again to change the port. If a serial device (computer, datalogger, or serial printer) is connected to the rear panel RS232 port, choose RS232. If a parallel printer is connected to the PRINTER port, choose PRINTER. If devices are connected to both ports, press [SHIFT][5] to enable both ports.

- To quickly reset the communication parameters to the following default values, press [SHIFT] [BLANK], then [4] to get into SP-4. Then press [1] to perform communication reset.

  - Baud Rate: 1200
  - Word Length: 7
  - Stop Bits: 2
  - Parity: None
  - Mode: RS232

5.2.3 SOFTWARE

To communicate with a remote computer, the computer must be running some form of communication software. For IBM PC compatibles, a general purpose communication program such as PROCOMM may be used or the more specialized LOTUS MEASURE, an interface for Lotus 1,2,3 (Measure and 1,2,3 are trademarks of Lotus Development Corp.). Also to get you started, a simple interface program is provided on diskette with each Model 8000.

To use the Panametrics Interface Program, follow the directions provided with each diskette.

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5.3 OTHER COMMUNICATION SETUP FUNCTIONS

The gage may transmit over a (parallel) printer cable, a (serial) computer cable or both.

- To specify the connected device, press [SHIFT] [BLANK], then [1] to get into SP-1. Then press [5] to show the current active communications port. Press [5] to toggle between printer and computer. Press [SHIFT] [5] to select both printer and computer.

- To enable or disable the footswitch send function, press [SHIFT] [BLANK], then [1] to get into SP-1. Then press [6] to view the current footswitch configuration. The lower display will show one of the following:

FTSW= SND	send
FTSW= SAV	save
FTSW= MAX	discrete maximum
FTSW= MEA	min or max reset

  To change the configuration to the next function in the list, press [6] again.

- To enable or disable the Max button send function when using the optional 2-button probe, press [SHIFT] [BLANK], then [1] to get into SP-1. Then press the MAX button to view the current configuration.

  The lower display will show one of the following:

MXSW= MAX	discrete maximum
MXSW= MEA	min or max reset
MXSW= SND	send
MXSW= SAV	save

  To change the configuration to the next function on the list, press the MAX button again.

- OUTPUT FORMAT - The format of the transmitted data may be changed from the default full output described in Appendix III to a format similar to the full format but without the Setup Table or to one consisting of just the thickness values with no ID # 's, flags or setup information. These alternative formats are to accommodate the various needs of attached data processing hardware and software.

  To view the current output format, press [SHIFT] [BLANK], then [1] to get into SP-1. Then press [SEND]. The lower display will show:

All Data:	for Panametrics standard format
No SuTbl:	for no setup table
Thk Only:	for thickness value only

  Press [SEND] again if necessary to cycle to the required format.

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- To view or toggle the single send (and save) function between active (sends actual thickness measurement) and mode dependent (sends either minimum, maximum or both if a min or max measure mode is selected else sends the actual thickness), press [SHIFT] [BLANK], then [1] to get into SP-1. Then press [8]. The current save function will be shown on the lower display. Press [8] again to toggle to the alternative send function. The default send condition is mode dependent.

5.4 TRANSMITTING

- To setup for transmission of any data to a specified device.

  a. Confirm that the receiving device is connected and configured properly. See this Section 5.2 and Appendices I and II as well as the operators manual for the receiving device and for the receiving software.

  b. Setup the matching communication parameters on the Model 8000. See Section 5.2 above.

  c. Run any applicable software on the computer.

- To Transmit a specified displayed thickness value.

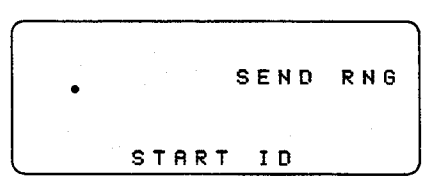
  a. Setup the measure mode on the gage.

  b. Make a thickness reading.

  c. Press [SEND].

  d. The specified displayed thickness value will be transmitted to the specified device. Appropriate flags will be sent but no ID# (see Appendix III). When no measurement is being made, then "----" with flags will be transmitted.

- To transmit a specified ID# range of data, press [SHIFT] [SEND]. Range send will be acknowledged with:



  Enter the ID# of one end of the range to be sent. Then press [SEND].

  The final ID# will be requested. Enter the ID# of the other end of the range to be sent. Then press [SEND] again. The contents of the specified range will be transmitted.

  To transmit all data in the active modulus, press [SHIFT] [SEND]. When prompted for START ID, press [SHIFT] [SEND] again.

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Note: The message DSR LOW on the lower display following [SEND] means that there is a communication problem. This may be due to a disconnected cable, improper cable or a low DTR output from the computer. When this occurs, the fault must be corrected to continue with data transmission. Otherwise the gage must be turned off and then back on to resume operation.

The message XOFF'ed on the lower display following [SEND] means the computer has turned off the gage data transmission by sending an XOFF character. Normally the computer will send an XON character to allow data transmission to continue. If not, the gage must be turned off and on and the transmission begun again.

The number of communication buffers may affect the time in which the gage keyboard is disabled during transmission of a large block of data. There are as many as 32 available buffers, but the default number of 2 should be fast enough for most applications.

To change the number of communication buffers, press [SHIFT] [BLANK], then [4] to get into SP-4. Then press [SHIFT] [5] to view the current number of buffers. To cycle through the other available number of buffers, pres [SHIFT] [5] repeatedly.

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6 PORTABLE OPERATION

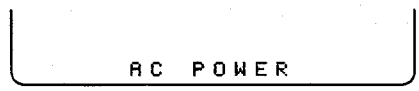
The Model 8000 is equipped with an optional 6 volt, 4 amp-hour, maintenance-free rechargeable battery. While the line cord is providing AC power to the control unit, this battery is being charged. If the line cord is unplugged from the control unit, this battery will automatically provide uninterrupted power to the gage.

Once fully charged, the battery will provide the Model 8000 with approximately 8 hours of operation. The gage will automatically turn off when the battery charge is depleted. Leave the control unit plugged into AC power to recharge the battery. If the gage is turned off, the battery will recharge in approximately 8 hours. The battery should provide service through several hundred discharge cycles before replacement is required.

The current battery status may be displayed momentarily on the front panel. This provides the operator with a rough estimate of hours of operation before the battery charge is depleted and the gage automatically shuts off. The estimate will be presented on the lower display, and assumes that the display brightness is set to approximately mid-range.

To view the battery status press [BATT]. The battery status message will be displayed for a couple of seconds. The battery status may be requested at any time.

If power is being provided via the line cord (and for several seconds after the line cord is disconnected), the lower display will momentarily show,



when battery status is requested.

Running the display at the brightest levels will deplete the battery charge at an accelerated rate. If you desire the maximum battery operation period, use the [SHIFT][0] key combination to reduce the display brightness to the lowest reasonable level. Also, when the unit is on, but not being used, keep the ball off the probe tip. As the battery charge is depleted, the Model 8000 will automatically reduce the display brightness to conserve battery charge.

If the battery has less than one hour of estimated charge left, the **in** or **mm** display will blink to serve as a warning.

After several hundred discharge cycles, you may discover that the battery no longer provides an adequate battery operation period. To replace the battery, remove the door to the battery compartment located on the rear panel of the control unit. Unplug the battery cable from the circuit board immediately behind the door and withdraw the battery from the compartment. Place the new battery in the same position and plug it into the circuit board.

Datalogged thicknesses, lookup tables, all setups and configurations are preserved while the battery is disconnected.

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7 SPECIFICATIONS

MEASURABLE MATERIALS:	Any entirely nonferrous material including composite materials which is hard enough to withstand deformation by the probe or target ball. The measured product must have a minimum outside concave radius of curvature of 0.062" or 1.59mm at the point of measurement and a minimum inside concave radius of curvature no less than 0.031" or 0.79mm when using the 1/16" ball, 0.062" (1.59mm) when using the 1/8" ball, and 0.094" (2.38mm) when using the 3/16" ball.
DEFINITIONS:	
RANGE:	The thickness at which the specified basic and reference accuracy is guaranteed and at which the Effective Resolution is less than or equal to 5 least significant display digits. Note the minimum measurable thickness extends down to zero.
BASIC ACCURACY:	The difference between the actual thickness and the displayed thickness shall be less than the specified basic accuracy amount if basic and quick calibrations have been performed per Sections 3.2 and 3.3. It is expressed as a percent of reading plus a fixed amount.
REFERENCE ACCURACY:	The difference between the actual thickness and the displayed thickness shall be less than the specified reference accuracy if reference calibration and quick calibration have been performed per Section 3.1 and 3.3. It is expressed as a percent of reading plus a fixed amount.
EFFECTIVE RESOLUTION:	The actual attainable measurement resolution may be limited to an amount greater than a least significant display digit (see Figures 5A & 5B for probe types 801PR & 802PR).
MEASUREMENT RATE:	5 measurements/second standard. Can be programmed to 1, 2, 5, 10, or 25 measurements per second.
MINIMUM MEASUREMENT:	A selectable display mode which shows the lowest thickness measured since being reset.
MAXIMUM MEASUREMENT:	A selectable display mode which shows the highest thickness measured since being reset.
HIGH AND LOW ALARMS:	A selectable feature which sounds an audible beep and displays a visual flag when the measured thickness is lower than the low alarm setpoint or higher than a high alarm setpoint.
DISPLAY:	Red LED type composed of a 4 digit seven segment display section with 0.45" high characters and two 8 character 5 x 7 dot matrix display sections with 0.25 high characters.

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ACCURACY FOR PROBES 801PR AND 802PR				
TARGET BALL SIZE		**1/16 inch 1.6mm)**	1/8 inch 3.2mm	**3/16 inch 4.8mm**
NUMBER OF DECIMAL DIGITS	LOW RESOL.	0.XXX inch X.XX mm	0.XXX inch X.XX mm	0.XXX inch X.XX mm
	HIGH RESOL.	0.XXXX inch X.XXX mm	0.XXXX inch X.XXX mm	0.XXXX inch X.XXX mm
RANGE	--	0.090 inch 2.29 mm	0.180 inch 4.57 mm	0.250 inch 6.35 mm
* **BASIC ACCURACY**	LOW RESOL.	5% + .001 inch 5% + .025 mm	4% + .001 inch 4% + .025 mm	3% + .001 inch 3% + .025 mm
	HIGH RESOL.	5% + .0001 in. 5% + .003 mm	4% + .0001 inch 4% + .003 mm	3% + .0001 inch 3% + .003 mm
REFERENCE ACCURACY	LOW RESOL.	3% + .001 inch 3% + .025mm	2% + .001 inch 2% + .025 mm	1% + .001 inch 1% + .025 mm
	HIGH RESOL.	3% + .0001 inch 3% + .003 mm	2% + .0001 inch 2% + .003 mm	1% + .0001 inch 1% + .003 mm

***** Basic accuracy is assured for new probes only. Reference calibration is recommended to ensure accuracy of measurements.

NOTE: For thicknesses greater than .075 inch, or 1.90mm, please refer to Figures 5A and 5B for actual resolution for each thickness, target ball, and gage resolution setting. Substitute this resolution for .001, .0001 inch, or .025, .003mm in the table above.

KEYPAD

24 keys, 4 rows by 6 columns. Sealed, tactile feel, beep for active key functions, similar functions grouped by color.

INTERNAL DATA LOGGER

-1024 thickness storage capacity
-Location of ID number from 1 to 9999
-Full setup and measurement information stored with each reading
- 10,000 available ID#'s may be organized into two dimensional arrays of X columns by Y rows in which the columns represent X different measurement points and the rows represent Y products to be measured.

RS232 OUTPUT:

25 "D" male connector on rear panel
Full duplex transmit & receive capability
Selectable communication parameters:
150 to 9600 baud rate
7 or 8 word length
1 or 2 stop bits
Even, odd, or no parity
XON/XOFF and DSR/DTR flow control

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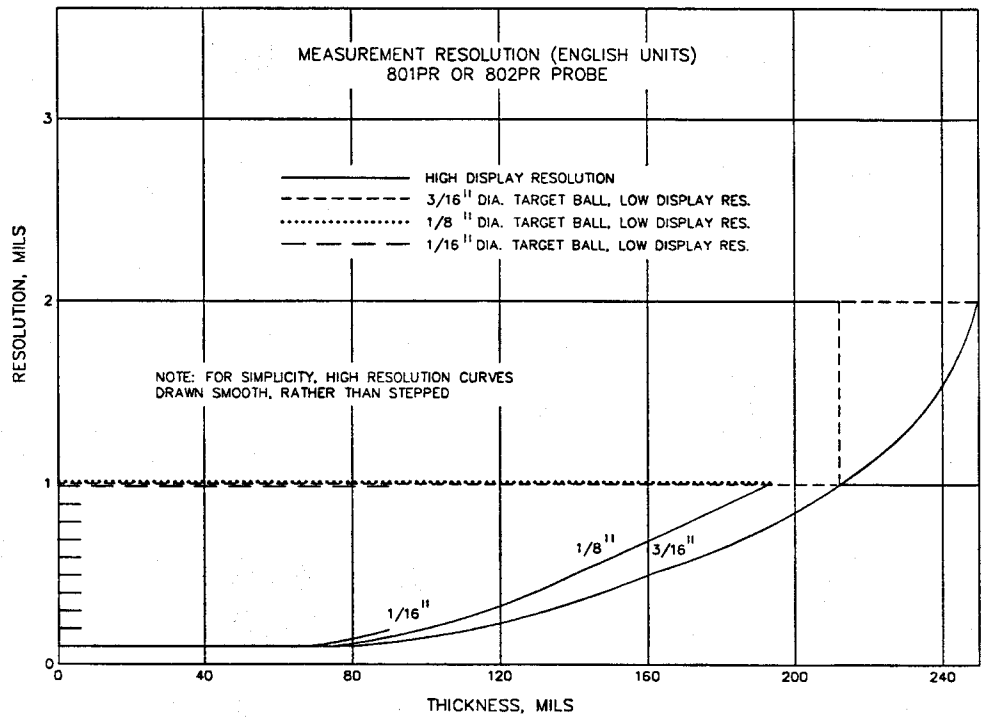


Figure 5A

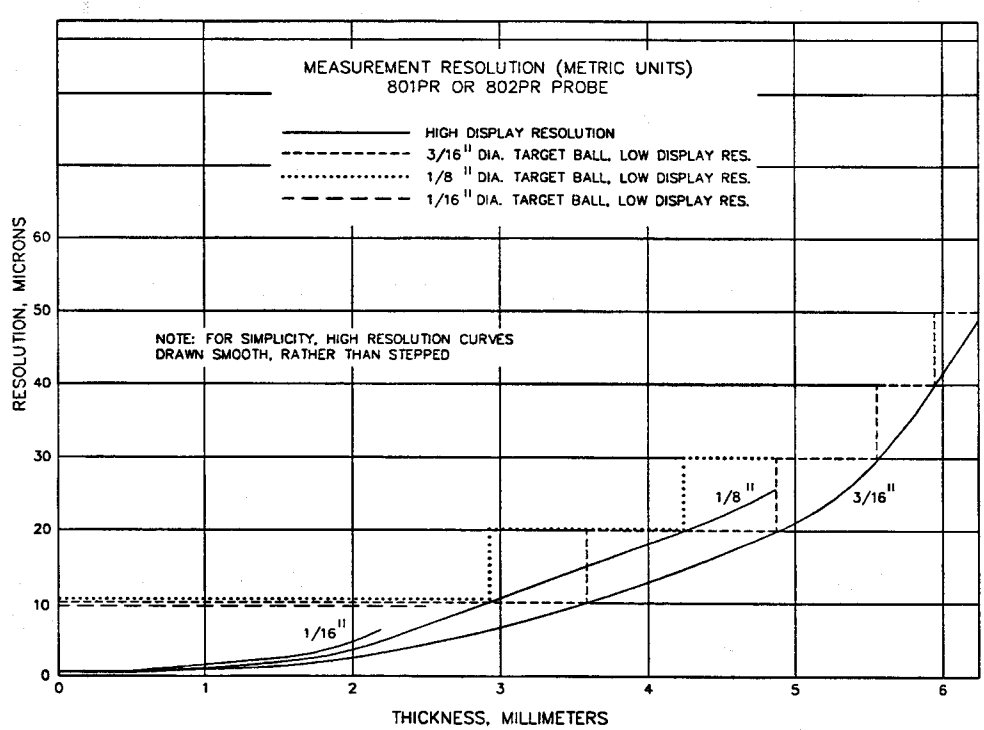


Figure 5B

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PRINTER OUTPUT	25 "D" female connector on rear panel. Connects to any Centronics (parallel) printer.
BATTERY TYPE:	6 Volts, 4A-h, sealed maintenance free, rechargeable lead-lead dioxide.
BATTERY OPERATION PERIOD:	5 to 18 hours, depending on display brightness setting and content. 8 hours nominal.
BATTERY ACCESS:	Easy access from rear panel.
BATTERY RECHARGE PERIOD:	8 hours, with control unit connected to AC power and gage off.
MEMORY BACKUP:	3V Lithium coin cell, user-changeable. Estimated life > 5 years.
POWER REQUIREMENTS:	100, 120VAC ± 10%, 47 to 63Hz, 0.2A max, or 220, 240VAC ± 10%, 47 to 63Hz, 0.1A max or 6VDC from internal battery.
FUSING:	1/4A Slow Blow for 100 or 120VAC 1/8A Slow Blow for 220 or 240VAC
LINE CORDS, PLUGS:	NEMA 15-5P (US, Can, Jpn), CEE 7/7 (Europe), BS1363 (UK), or specials on request.
AMBIENT TEMPERATURE:	0°C to 50°C (32°F to 125°F) if measurement taken within 15°C of calibration temperature.
CONTROL UNIT DIMENSIONS (not including handle)	**LENGTH** 10.4 inch (264mm) **WIDTH** 10.2 inch (259mm) **HEIGHT** 4.2 inch (107mm)
WEIGHT:	10.4 lbs. (4.73 Kg)
PROBE:	Approximately 0.85" dia. x 6.0" long. Tip radius 0.062". Quick disconnect cable. Adjustable probe stand Integral Quick-Calibration button.

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8 MAINTENANCE, REPAIR & TECHNICAL ASSISTANCE

8.1 ROUTINE CARE AND MAINTENANCE OF INSTRUMENT

The Model 8000 is a reliable, industrial quality electronic instrument which should provide years of trouble-free operation. There are no user serviceable parts or adjustments inside the unit.

To clean the outside of the instrument, turn the unit off and remove the line cord. Wipe with a damp (NOT WET) cloth. A mild cleaning agent such as windex may be used on the front panel.

8.2 PROBE MAINTENANCE

The probe is reliable and durable when the following care is taken:

1. Do not hit the probe with any object.
2. Do not allow the probe to come in contact with any large metal objects.
3. Do not drop the probe on a hard surface.
4. Avoid rubbing the tip over abrasive surfaces (such as ceramics).

8.3 ERROR MESSAGES AND COMMON PROBLEMS

Listed below are the most commonly seen error messages and problems. Follow the diagnostic recommendations listed. If the problem persists, please contact Panametrics or your local sales and service representative for technical assistance.

- **BALL OFF message during quick calibration (QCAL)**

This is not an error message, but a warning. If the target ball has been removed from the tip, and this message appears, it indicates that the BALL OFF probe signal has drifted farther than what is typical between QCALs. This may be due to a large change in temperature, probe orientation, or ambient magnetic field. Be certain to remove any target ball or magnetic material, orient the probe as it will be used, and press QCAL again to force the gage to compensate for the new BALL OFF signal. If this warning appears often, please contact Panametrics for assistance.

- **CAL FAIL, or WAIT message that will not end.**

This message is caused by a malfunction in the calibration process, typically caused by an electronic failure inside the instrument. Please contact Panametrics for assistance.

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- **BAD BALL message during calibration, or misidentification of target balls**

This message indicates that the gage has been unable to identify the target ball. This may be caused by a probe failure, or be due to the target ball failing to rest on the top center of the probe tip. Verify that the ball is in the alignment fixture, that the fixture moves freely and is seated correctly on the probe, and that the ball has come to rest on the probe tip. (If the alignment or reference fixtures do not slide onto the probe freely, the target ball can be held at an incorrect distance away from the tip.)

During the **BALL ON** phase of calibration, a four-digit number will be shown in the THICKNESS display, relating to the amplitude of the probe signal. With no target ball near the tip, this number is typically between 1000 and 3000. Numbers beyond this range may be evidence of an electrical problem in the probe or probe cable. If you press directly on the probe tip with a nonmagnetic object (such as plastic), this number should not change by more than one count. Changes greater than this indicate that the tip is damaged and unable to provide reliable signals to the gage.

During the **BALL ON** phase of calibration, as the target ball approaches and then rests, aligned, on the probe tip, the four-digit number in the THICKNESS display should drop in value, very approximately, by the following number of counts:

a. for a 1/16 inch diameter ball: 100 counts

b. for a 1/8 inch diameter ball: 250 counts

c. for a 3/16 inch diameter ball: 500 counts

If the problem persists, change the probe and probe cable (if substitutes are available).

- **BAD PRB message**

This message results from a failure in the identification circuit for the probe, and it is typically caused by a connection failure in the probe cable. Verify that the cable is connected to both the gage front panel and the probe, and that the cable is not damaged in some way. Replace the cable, if a substitute is available.

- **RE-ENTER message during reference calibration**

This message is caused by the manually entered value (in the lower display) being different from the measured value in the THICKNESS display by more than 25 percent. Typically, this is due to simple mis-keying of the entered value (ie. **.0040** instead of **.0400**). Verify that the reference fixture moves freely and is seated correctly on the probe. Terminate the procedure by pressing [SHIFT][MEAS], then press [SHIFT][4] to verify that the gage has correctly identified the target ball. If not, read through the section describing **BAD BALL** and misidentification errors. If the target ball identification is correct, then the reference fixture may be, in some way, defective (wrong thickness standard inside, mislabelled, damaged, etc.).

Pressing [SHIFT][CAL] after a RE-ENTER message will force the instrument to accept the entered thickness, whether it is correct or not. This feature exists to allow special tables to be created for non-standard targets, or to permit calibration with probes that have suffered a high degree of abrasive tip wear. It should not be used routinely.

- **Thickness readings drifting beyond accuracy specifications**

Verify that a QCAL is being performed at least every half hour, and more often if the sample thicknesses are in the upper half of a target ball's range. If QCAL must be used excessively (ie. between each reading) to preserve accuracy, then there is probably an electrical problem in the probe or probe cable. Some

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probes manufactured prior to September 1992 are sensitive to the static electric charge created by friction with plastic materials. If you suspect that this is a problem, Panametrics can supply an electrically conductive "anti-static" coating for the probe, with application instructions.

- **Off-Line or Pr-Fault message after a SEND**

This message occurs when the gage is configured to SEND thickness data through the rear panel PRINTER port, but the gage fails to receive the correct "ready" signals from the external printer (typically the SEL signal). Verify that the printer is powered on, is "on-line", set to "parallel" mode, and has not jammed or run out of paper. Examine the interface cable to be sure that it is securely fastened at both ends. External device is a "serial" type and is connected to the gage's RS232 port, then change the gage's active output port (SP-1 menu, key [5]) to **RS232**.

- **DSR Low message after a SEND**

This message occurs when the gage is configured to SEND thickness data through the rear panel RS232 port, but the gage fails to receive the correct "ready" (DSR) signal from the external datalogger. Verify that the external device is powered on, set to "serial" or "RS232" mode and has no malfunction. If the receiving device is a PC, verify that it is running appropriate datalogging software. Verify also that the interface cable is securely fastened at both ends. If the external device is a "parallel" type and is connected to the PRINTER port, then change the gage's active output port (SP-1 menu, key [5]) to **PRINTER**. Verify that the cable being used is correct for the equipment being used, and is not damaged.

- **No data or garbled data received by external datalogger**

If configured for serial or RS232 mode, verify that the **COMPORT** (SP-1 menu) parameters of the gage and external datalogger agree.

- **XOFFed message after a SEND**

The message XOFF'ed on the lower display following SEND means the computer has turned off the gage data transmission by sending an XOFF character. Normally the computer will send an XON character to allow data transmission to continue. If not, the gage must be turned off and on and the transmission begun again.

- **The footswitch does not work**

If pressing the footswitch does not have the expected effect, check its configuration (SP-1 menu, key [6]). Verify also that the footswitch is fully plugged into its jack on the gage rear panel.

- **DO CAL message**

This is not necessarily an error message. It indicates that the active lookup table is either missing, or is not valid for the type of probe connected to the gage. If you know that the inactive table does match the probe, simply press [SHIFT][5] and QCAL, or perform a ball calibration, to bring the inactive table forward. This message will always appear when returning to measure mode immediately after a general or master reset. If the message appears at power on without explanation, then the lithium battery employed to power the gage's computer memory while power is off may be defective or depleted. The battery is located inside the gage, just under the main battery. Replacement is a Panasonic BR2330 or equivalent, and is available from Panametrics. This battery should last for several years. Premature failure may be an indication of an electronic problem.

- **Blinking in or mm on status display**

This indicates that the gage is running on its battery, and that the battery has less than one hour's estimated life before the gage automatically shuts off. Connnect the gage to line power to recharge the battery. If the gage is already connected to line power, read the next paragraph and try to diagnose the problem.

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- **Gage shuts off soon after start-up**

Press [BATT] to check the battery status. With the line cord connected and plugged in, the lower display should indicate AC POWER. If it does not, verify that the line voltage setting in the fuse compartment (rear panel) matches the line voltage in your locality. Verify that the line fuse is present and has not blown open. If the battery is several years old, or has been recharged several hundred times due to portable operation of the gage, it may require replacement. Replacement is a Yuasa NP4-6W or equivalent, and is available from Panametrics.

8.4 DIAGNOSTIC TESTS

To aid in localizing a suspected hardware problem or simply to verify correct gage operation several tests may be performed from the keyboard. These tests are explain below.

To enter the diagnostic test mode, press [SHIFT] and [BLANK], then [3]. Select any of the following tests with keys [1] through [5]:

8.4.1 DATA ROM TEST, PRESS [1]

Performs a checksum on the data ROM and displays the data ROM version on the lower display. If the checksum test fails, the message **LUT FAIL** is displayed on the lower display.

8.4.2 PROGRAM ROM TEST, PRESS [2]

Performs a checksum on the program ROM and displays the program version on the lower display. If the checksum test fails, the message **PGM FAIL** is displayed on the lower display.

8.4.3 DISPLAY TEST, PRESS [3]

Initiates a complete display test. This function initiates an internal test of the status display and the lower display. At the same time the following characters are rotated from left to right on the thickness display:

. 0 1 2 3 4 5 6 7 8 9

At the end of the sequence, if the status and lower displays have passed their tests, the message PASS is displayed on both the displays, else the message FAIL is displayed. This sequence is repeated until either the unit is shut off or the [MEAS] key is pressed. To freeze the thickness display test, the [SHIFT] key may be pressed and the display status is frozen until the [SHIFT] key is released. No control can be exercised over the status and lower display test.

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8.4.4 ANALOG TO DIGITAL CONVERTER TEST, PRESS [4]

For this test to work predictably, the Model 8000 must be powered by AC source. On completion of the test, a value will be displayed on the thickness display. If this value is in the range of 3600 to 3900, the ADC can be assumed to be working.

8.4.5 BURN-IN TEST, PRESS [5]

This is a combination of all the above tests. This test can be aborted at any time by pressing the [MEAS] key. This test can be frozen for the duration of holding the [SHIFT] key down. The beeper may be disabled during this test by pressing [SHIFT] and [BLANK], [4], then [3] once or twice until **BEEP OFF** is displayed. Do this prior to entering SP-3.

8.5 REPAIR AND TECHNICAL ASSISTANCE

You may contact a Panametrics service representative via the telephone numbers shown below. Please have available your company name, address, and telephone number, as well as the model and serial number of your unit and a description of the problem or request.

If it is necessary to return your equipment, you will be given an RA (Return Authorization) number to attach to your packing slip. This will allow prompt handling and tracking of your equipment during repair.

If your unit might require out of warranty repair or replacement parts, please also have ready your purchase order number.

Within the United States, call (800) 225-8330
Outside the United States, call (617) 899-2740
Telefax (617) 899-1552 - Telex 6817337

Outside the United States, please contact your local sales representative or Panametrics office.

Please ship Magna-Mike units requiring service to:

Panametrics, Inc.
223 Crescent Street
Waltham, MA 02154
USA
Attn: NDT Repair

Please remember to use your RA Number.

8.6 SOFTWARE UPGRADES

Panametrics may offer revisions of the Model 8000 operating or data software. Such revisions may include improvements or fixes to any minor bugs discovered after release of the current software. Usually the changes are minor but occasionally may include significant new features.

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Any software upgrades within six months of gage purchase will be performed at no charge. After six months, standard rates may apply. Software upgrades are contained in two integrated circuits (called read-only memories, or ROMs). They typically should be installed at a Panametrics repair facility, but can be installed on-site if this is necessary.

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APPENDIX I- RS232 SERIAL PORT TRANSMISSIONS

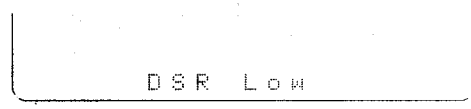
The gage is able to transmit a string of serial data from the RS232 port when the RS232 mode has been selected in SP 1.

PINOUT OF RS232 CONNECTOR (rear panel of control unit) & I/O CABLES

PIN NUMBER MODEL 8000 RS232 CONNECTOR	SIGNAL NAME	CABLE PIN NUMBER				
		8025F IBM-XT	8009F IBM-AT	80DM8 Datamyte 862/762	80DM2 Datamyte 2003	80DM9 Datamyte 953
Pin 1	Chassis Ground	——	——	Shell	Shell	Shell
Pin 2	Data transmitted from gage	3	2	6,12	6	5
Pin 3	Data received by gage	2	3	——	——	3
Pin 6	Data Set Ready input to gage	20	4	See Note 1	See Note 1	See Note 1
Pin 7	Signal Ground	7	5	9	7	4
Pin 20	Data Terminal Ready output from gage	6	6	See Note 1	See Note 1	See Note 1

Note 1: When transmitting to a device which does not provide a "ready" or handshake signal, Model 8000 pins 6 (DSR) and 20 (DTR) should be connected together.

The gage will typically transmit a 38 character string followed by a <CR> and <LF> when the [SEND] key is pressed (or the footswitch configured for SND is pressed) and DSR (pin 6) is pulled high by the receiving device (serial printer, computer, or other data logger). If DSR is not pulled high when [SEND] is pressed, the lower display will show the error message:



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The Magna-Mike 8000 has three data transmission formats:

"All Data" is the standard format
"No Sutbl" sends all but the setup table
"Thk Only" sends thickness readings only

"All Data" and "No Sutbl" may be converted using Lotus or SQC conversion routines. "Thk Only" cannot be converted to Lotus or SQC.

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APPENDIX II- PRINTER CONNECTOR

PIN NUMBER	PIN NAME	DESCRIPTION
1	STROBE*	data valid
2	DATA 0	character data
3	DATA 1	
4	DATA 2	
5	DATA 3	
6	DATA 4	
7	DATA 5	
8	DATA 6	
9	DATA 7	
10	ACK*	
11	BUSY	printer busy
12	PE	paper out
13	SEL	printer select
14	AUTOFEED*	automatic linefeed
15	ERR*	error flag
16	INIT	printer reset/initialize
17	SLCTIN*	
18	nc	
19	GND	signal/chassis ground
20	GND	
21	GND	
22	GND	
23	GND	
24	GND	
25	GND	

*** Active Low**

If SEL (Pin 13) is not pulled high when **[SEND]** is pressed, the lower display will show the error message **Off-Line**. Intermittant connections or printer malfunction may also cause the error message **Pr-Fault** to appear.

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APPENDIX III- DATA OUTPUT FORMAT

The following data stream is transmitted when a single SEND is initiated by pressing [SEND] while in measure inches mode. X represents a single decimal character from 0 through 9.

Character #	Character	Decimal ASCII Code	Comment
1-10	space	32	
11	0	48	thickness
12	.	46	
13	X	48 through 57	
14	X	48 through 57	
15	X	48 through 57	
16	X or SPACE	48 through 57 or 32	X in hi res only
17-20	SPACE	32	
21	i	105	units
22	n	110	
23-28	SPACE	32	
29	- or A or H or L	45 or 65 or 72 or 76	flag
30	- or m or M	45 or 109 or 77	flag
31-38	SPACE	32	
39	CR	13	carriage return
40	LF	10	line feed

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The following data stream is transmitted when a single SEND is initiated by pressing [SEND] while in metric measure mode. X represents a single decimal character from 0 through 9.

Character #	Character	Decimal ASCII Code	Comment
1-10	SPACE	32	
11	X	48 through 57	thickness
12	.	46	
13	X	48 through 57	
14	X	48 through 57	
15	X or SPACE	48 through 57 or 32	X in hi res only
16-20	SPACE	32	
21	m	109	units
22	m	109	
23-28	SPACE	32	
29	- or A or H or L	45 or 65 or 72 or 76	flag
30	- or m or M	45 or 109 or 77	flag
31-38	SPACE	32	
39	CR	13	carriage return
40	LF	10	line feed

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When RANGE SEND is requested, and no data is stored in the specified range, the following characters are transmitted.

Character #	Character	Decimal ASCII Code	Comment
1	SPACE	32	
2	N	78	"NO"
3	O	79	
4	SPACE	32	
5	D	68	"DATA"
6	A	65	
7	T	84	
8	A	65	
9	SPACE	32	
10	S	83	"STORED"
11	T	84	
12	O	79	
13	R	82	
14	E	69	
15	D	68	
16	SPACE	32	
17	I	73	"IN"
18	N	78	
19	SPACE	32	
20	T	84	"THE"
21	H	72	
22	E	69	
23	SPACE	32	
24	R	82	"RANGE"
25	A	65	
26	N	78	
27	G	71	
28	E	69	
29	SPACE	32	
30	R	82	REQUESTED
31	E	69	
32	Q	81	
33	U	85	
34	E	69	
35	S	83	
36	T	84	
37	E	69	
38	D	68	
39	CR	13	carrage return
40	LF	10	line feed

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1	SPACE	32	
2	O	79	
3	K	75	
4-38	SPACE	32	
39	CR	13	carrage return
40	LF	10	line feed

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When RANGE SEND is requested, the following header is transmitted before transmitting a thickness table.

Character #	Character	Decimal ASCII Code	Decimal ASCII Code
1-38	SPACE	32	blank line
39	CR	13	
40	LF	10	
1	SPACE	32	header line
2	I	73	"ID# "
3	D	68	
4	#	35	
5-8	SPACE	32	
9	T	84	"THICKNESS"
10	H	72	
11	I	73	
12	C	67	
13	K	75	
14	N	78	
15	E	69	
16	S	83	
17	S	83	
18-19	SPACE	32	
20	U	85	"UNITS"
21	N	78	
22	I	73	
23	T	84	
24	S	83	
25-27	SPACE	32	
28	F	70	"FLAGS"
29	L	76	
30	A	65	
31	G	71	
32	S	83	
33-34	SPACE	32	
35	S	83	setup number
36	U	85	
37	#	35	
38	SPACE	32	
39	CR	13	carriage return
40	LF	10	line feed
1-38	SPACE	32	blank line
39	CR	13	carriage return
40	LF	10	line feed

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The following data stream is transmitted for each stored thickness within the requested range of a RANGE SEND. The consecutively thickness data forms a thickness table. N represents a single decimal character from 0 through 9. Z represents the modulus delimiter character (default is SPACE).

Character #	Character	Decimal ASCII Code	Comment
1	SPACE	32	
2	N	48 through 57	ID#
3	N or Z	48 through 57	One delimiter occurs when using modulus
4	N or Z	48 through 57	
5	N or Z	48 through 57	
6	SPACE or N	32 or 48 through 57	N when using modulus
7-10	SPACE	32	
11-40	Same as single SEND data stream. If as stored location is EMPTY, then character X becomes a -. At the end of the thickness table, the following stream is transmitted.		
1	SPACE	32	
2	O	79	
3	K	75	
4-38	SPACE	32	
39	CR	13	carriage return
40	LF	10	line feed
1-38	SPACE	32	blank line
39	CR	13	carriage return
40	LF	10	line feed
A setup table is transmitted after completion of the thickness table.			

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The following header is transmitted after completion of a thickness table and before transmission of a setup table.

Character #	Character	Decimal ASCII Code	Comment
1	SPACE	32	
2	S	83	
3	U	85	
4	#	35	
5-6	SPACE	32	
7	L	76	
8	O	79	
9	-	45	
10	A	65	
11	L	76	
12	M	77	
13-14	SPACE	32	
15	H	72	
16	I	73	
17	-	45	
18	A	65	
19	L	76	
20	M	77	
21-22	SPACE	32	
23	U	85	
24	N	78	
25	I	73	
26	T	84	
27	S	83	
28-30	SPACE	32	
31	P	80	
32	I	73	
33	D	68	
34	SPACE	32	
35	B	66	
36	I	73	
37	D	68	
38	SPACE	32	
39	CR	13	carriage return
40	LF	10	line feed
1-38	SPACE	32	blank line
39	CR	13	carriage return
38	D	68	
39	CR	13	carriage return
40	LF	10	line feed

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The following data stream is transmitted for each setup number (SU#) listed in the proceeding data table. The consecutively transmitted setup data forms a setup table. X represents character 0-9. Target ball numbers are : 1 for 1/16" (1.6mm), 2 for 1/8" (3.2mm), and 3 for 3/16" (4.8mm).

Character #	Character	Decimal ASCII Code	Comment
1	X or SPACE	48 through 57 or 32	setup number
2	X	48 through 57	
3-6	SPACE	32	
7	X	48 through 57	lo alarm setpoint
8	.	46	
9-10	X	48 through 57	
11-12	X or SPACE	48 through 57 or 32	depends on units & res.
13-14	SPACE	32	
15	X	48 through 57	hi alarm setpoint
16	.	46	
17-18	X	48 through 57	
19-20	X or SPACE	48 through 57 or 32	depends on units & res.
21-23	SPACE	32	
24	i or m	105 or 109	units
25	n or m	110 or 109	
26-29	SPACE	32	
30	X	48 through 57	probe ID number
31-34	SPACE	32	
35	X	48 through 57	target ball number
36-38	SPACE	32	
39	CR	13	carriage return
40	LF	10	line feed

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The following data stream is sent at the end of each setup table.

Character #	Character	Decimal ASCII Code	Comment
1	SPACE	32	
2	O	79	
3	K	75	
4-38	SPACE	32	
39	CR	13	carriage return
40	LF	10	line feed

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APPENDIX IV- SOFTWARE PROTOCOL

The Model 8000 uses dual software protocol to regulate data reception and transmission on its RS232 interface. The various terms used in the protocol description are defined below:

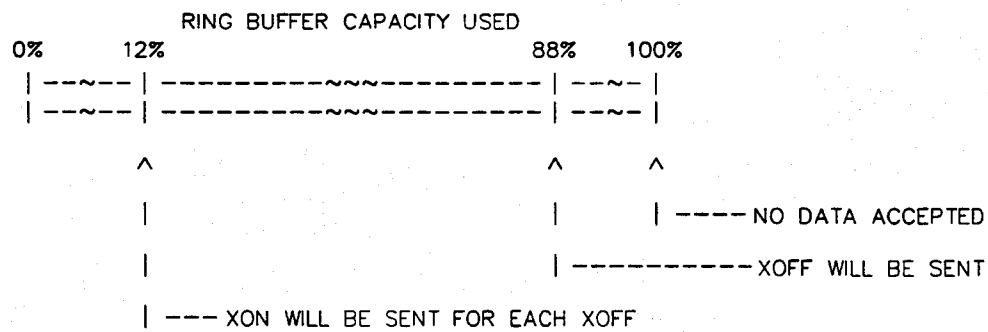
1. Host: The external device connected to the RS232 interface which can send commands/data to the gage. Ex. computer with serial port such as an IBM PC or compatible, Apple Macintosh, etc. or a dumb terminal such as Wyse 50. A serial printer or serial plotter cannot be called a host.

2. XON: This is an ASCII character used to indicate that communication can begin/continue. This character is the same as DC1 in the ASCII chart or more popularly known as Control Q. XON = decimal 17 or hexadecimal 11.

3. XOFF: This is an ASCII character used to indicate that communication must be suspended. It is the complement of XON. This character is same as DC3 in the ASCII chart or more popularly known as Control S. XOFF = decimal 19 or 19 or hexadecimal 13.

The two protocols used by the Model 8000 are:

1. Auto XON/XOFF: The Model 8000 has a full duplex RS232 standard interface. This means that it can not only send stored data, but receive command/data from a host on the serial port (see Remote Control Commands) at the same time. The rate at which the Model 8000 can execute a command is much slower than the rate at which it can receive them. Therefore, it is possible that commands sent by the host will be lost. To minimize this occurrence, the Model 8000 uses separate 256 byte ring buffers for transmitting and receiving data. The ring buffers have two trip-points shown below:



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When more than 88% (30 characters) of the receive buffer is full, an XOFF command will be sent to the host. If the host disregards this command, then, following reception of 27 commands, after XOFF was sent, the gage will stop accepting any further commands until it has finished servicing the 88% (226 commands) of the received commands. Having sent an XOFF, the gage will send an XON command to the host when 12% (30) of the received commands remain to be serviced. Following this, the gage is once again open to receiving commands from the host.

Note: Each XOFF command sent by the gage will be balanced by an XON command.

External XON/XOFF: The host is always at liberty to suspend the gage data transmission by sending an XOFF command to the gage (even while the gage is sending data to the host). It is the responsibility of the host to send a balancing XON command to the gage to resume data transmission. If the gage is XOFF'ed for more than 6 seconds, and the gage had/has requested for some form of data transmission, the message XOFF'ed will be displayed on the lower display.

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APPENDIX V- REMOTE CONTROL COMMANDS

Most functions executed via the keypad can also be executed via the RS232 command set. This command set is case sensitive. The following is a list of all RS232 equivalent of the keyboard:

KEY NAME	UNSHIFTED	SHIFTED
MEAS	m	M
CAL	c	C
RES	r	R
MINMAX	n	N
ALARM	a	A
UNITS	u	U
BATT	b	B
ID	i	I
SAVE	s	S
SEND	t, d	T, D
CLRMEM	e	E
BLANK	z	Z
0	0	)
1	1	!
2	2	@
3	3	#
4	4	$
5	5	%
6	6	^
7	7	&
8	8	*
9	9	(

Additionally, "~ "makes the gage transmit the Active lookup table.

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APPENDIX VI- SELECTING A TARGET BALL SIZE

Three different sized target ball sets are provided with the Model 8000. Before you calibrate the Model 8000, you need to choose which target balls to employ for your application.

The three criteria you should consider are:

- The maximum thickness you want to measure;
- The accuracy you require for these measurements;
- The minimum surface curvature of the material.

In general, the 1/8 inch (3.2mm) diameter target ball serves all standard applications, such as plastic blow molded bottles with simple shapes and wall thicknesses up to 0.180 inch (4.6mm).

The 1/16 inch (1.6mm) target ball is required for applications where material has intricate contours. The small diameter allows the target ball to roll into these contours and maintain close (and accurate) contact with the measured surface. Use of the smaller ball, however, offers a restricted thickness range and less accuracy than the 1/8 inch target ball.

The 3/16 inch (3.2mm) target ball is useful for applications where high accuracy is required, or where material is thicker than the range offered by other target balls. The 3/16 inch ball, however, should be used only on materials free of intricate contours to ensure that the ball will maintain good contact with the surface immediately opposite the probe tip. This ball will not be appropriate for materials which can be compressed by the forceful magnetic attraction between the target ball and the probe tip.

The Model 8000 will operate with a single target ball, or can be switched to operate with two different target ball sizes. You may therefore choose one or two target ball sizes for your application. Please refer to the chart below, and experiment with the mobility of each ball in your application, to decide which target balls to employ.

TARGET BALL DIAMETER	MAXIMUM THICKNESS RANGE	MEASUREMENT ACCURACY*	MINIMUM SURFACE RADIUS
1/16 inch (1.59mm)	0.090 inch (2.29mm)	3%	1/32 inch (0.79mm)
1/8 inch (3.18mm)	0.180 inch (4.57mm)	2%	1/16 inch (1.59mm)
3/16 inch (4.76mm)	0.250 inch (6.35mm)	1%	3/32 inch (2.38mm)

* Assuming a reference level calibration has been done.

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APPENDIX VII- QUICK REFERENCE

QUICK CALIBRATION

WHEN - At least every half hour, and more frequently when the ambient temperature is not stable, when material temperature differs from ambient, or when the orientation of the probe changes.

HOW - Remove any target ball from the probe tip. Press the QCAL button on the probe.

BALL CALIBRATION

WHEN - Before measuring with a new target ball, whose size corresponds to the active or inactive look-up table.

HOW - Perform the following sequence:

ACTION	DISPLAY RESPONDS WITH:
1 Press [CAL]	BALL OFF
2. Remove any ball from probe	
3. Press [CAL]	WAIT then BALL ON
4. Place red labelled fixture and target ball onto probe	
5. Press [MEAS]	WAIT then BALL OFF
6. Remove fixture and ball	WAIT

The gage automatically returns to measure mode.

REFERENCE CALIBRATION

WHEN - At least once per month, after changing to a new probe, after a probe has been subjected to mechanical shock, and before measuring with a target ball for which no look-up table exists. CAUTION - This procedure creates a new active look-up table and may delete an existing table.

HOW - Do steps 1 to 4 of BALL CALIBRATION, then substitute:

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ACTION	DISPLAY RESPONDS WITH:
5. Press [CAL]	Wait then BALL OFF
6. Remove fixture and ball	Flashing WAIT then REF 1
7. Place blue labelled fixture and target ball onto probe	Measured thickness
8. Enter true fixture thickness	Entered value
9. Press [CAL]	REF 2
10. Repeat steps 7, 8, and 9	
11. Press [MEAS] when done	flashing WAIT

For best accuracy, use the thicker fixtures first, then thinner. If steps 7 through 10 are eliminated, the gage operates at basic accuracy.

CHANGE INACTIVE TABLE TO ACTIVE

TWO METHODS - Perform a BALL CALIBRATION using the inactive table ball, or press [SHIFT][5] and do a QUICK CALIBRATION.

TO SET AND ENABLE ALARMS

EXAMPLE - Change Lo and Hi alarm levels to .037 and .125:

ACTION	DISPLAY RESPONDS WITH:
1. Press [ALARM]	Lo .000 (or old level)
2. Press [0], [3], [7]	Lo .037 (new Lo level)
3. Press [ALARM]	Hi . (or old level)
4. Press [1], [2], [5]	Hi .125 (new Hi level)
5. Press [ALARM]	

The gage will return to measure mode with alarms disabled. Press [SHIFT][ALARM] to enable both alarms, press again to disable. Substituting [MEAS] for [ALARM] in step 3 above returns gage to measure mode with only Lo alarm enabled. Substituting [MEAS] in step 5 enables both alarms.

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TO DO MIN and MAX MEASUREMENTS

Press [MIN/MAX] to cycle through MIN, MAX, both, or neither. Maximum readings can be scanned or discrete. If discrete, press [SHIFT][6] or the probe MAX button. Use the SP-1 menu to select the type of maximum measurement.

TO SAVE THICKNESS READINGS

Press [SAVE] to store a thickness in the next datalogger location, which will appear on the lower display. Use the SP-1 menu to select active or mode dependent readings. Use the SP-2 menu to change the structure of the datalogger.

TO VIEW DATALOGGED READINGS

Press [ID#] to view the contents of a datalogger location. Location appears on lower display. To view a new location, enter the location number on keyboard and press [ID#] again. Press [MEAS] to return to measure mode.

TO TRANSMIT DATA

Use the SP-1 menu to set up communications parameters and to select active or mode dependent readings. Use SP-1 [5] to select the PRINTER or RS-232. Press [SEND] to transmit the current reading. To transmit data from the datalogger, press [SHIFT][SEND], enter START ID, press [SEND], enter FINAL ID, and press [SEND]. Press [SHIFT][SEND] twice for all data.

TO ERASE STORED DATA

To erase one location, press [ID#], enter location, and press [CLR MEM]. To erase a range, press [CLR MEM], enter START ID, press [CLR MEM], enter FINAL ID, and press [CLR MEM]. To erase all data, press [CLR MEM], then [SHIFT][CLR MEM].

BATTERY STATUS

Press [BATT] for an estimate of hours of battery life before automatic shutdown. AC POWER will appear if the battery is charging.

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APPENDIX VIII - FUNCTION INDEX BY GAGE MODE AND KEY

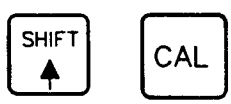
MEASURE MODE FUNCTIONS INDEXED BY KEY



Remain in measure mode or return to it from any other mode. Also resets minimum and maximum readings.



Enter calibration mode. Repeat to move to next step of calibration procedure. Press [MEAS] to complete, [SHIFT][MEAS] to abort a calibration procedure. See the CALIBRATION section of the operator's manual.



Erase the active look-up table and replace it with a basic accuracy table for the same probe and target ball.



Change thickness reading resolution. Repeat to choose between three or four significant digits.



Turn gage power off. Also restores power if gage power is off. Gage will always start in Measure Mode after power on.



Enable the minimum and maximum thickness reading functions. Repeat to choose **MIN**, **MAX**, or both.

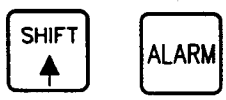
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Momentarily show the maximum thickness value (only operative when using minimum and maximum thickness reading function).



Enter alarm mode. Repeat to query or set alarm levels and return to measure mode with alarms disabled.



Toggle alarm **ON** (enabled) or **OFF** (disabled).



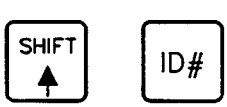
Change units of measure. Repeat to choose between inches (**in**) or millimeters (**mm**).



Query battery status. If gage usage is portable, status is expressed in nominal hours of operation before automatic power off. Gage returns automatically to measure mode.



Repeat to query contents of datalogger sequentially, starting with the current location. Set current location via numerical keypad.



Momentarily show current ID Number while remaining in measure mode.



Save either the active or mode dependent thickness reading in the current datalogger location, then increment to the next location. Select active or mode dependent reading with the SP-1 mode.

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SEND

Send either the active or mode dependent thickness reading to an external device via the RS232 or PRINTER ports. Select port, communications parameters, and active or mode dependent reading with the SP-1 mode.

SHIFT ▲ SEND

Send stored thickness readings from the datalogger to an external device via the RS232 or PRINTER ports. The gage will ask for the range of locations to be sent.

CLR MEM

Enter clear memory mode. Erase part of datalogger contents by entering location range via numerical keypad. Erase entire datalogger by pressing [SHIFT][CLR MEM] while in clear memory mode.

[QCAL]

Perform a quick calibrate sequence to compensate for temperature induced drift of probe (QCAL button located on the probe).

[MAX]

Take a maximum reading, if the gage is in discrete MAX measure mode (selected with the [MIN/MAX] key and the SP-1 mode). May also be configured with SP-1 mode to be equivalent to [SAVE], [SEND], or [MEAS] (Max button located on 802 probes only).

[FOOTSWITCH]

May be configured with SP-1 mode to be equivalent to [SAVE], [SEND], [MAX], or [MEAS].

Equivalent to [QCAL] if so configured in SP-1 mode. Otherwise no function.

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SHIFT ▲ + [ ] — Enter the SP MODES menu. Choose SP modes 1, 2, 3, or 4 via numerical keypad.

SHIFT ▲ + [0] — Repeat to change the display brightness to each of seven levels. (Brightness may be automatically dimmed by the gage during portable operation.)

SHIFT ▲ + [1] — Keyboard lock/unlock.

SHIFT ▲ + [2] — Calibration lock/unlock.

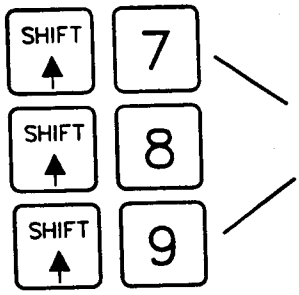
SHIFT ▲ + [3] — Toggle audible beep during alarmed measure mode. Key is functional only when the alarm is enabled. Otherwise no function.

SHIFT ▲ + [4] — Query probe type and ball size of the active look-up table.

SHIFT ▲ + [5] — Switch the active and inactive look-up tables.

SHIFT ▲ + [6] — Equivalent to [MAX].

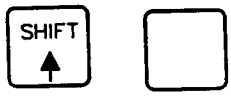
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No Function

SP MODES

From the SP MODES menu, press [1], [2], [3], or [4] to enter one of the SP Modes. The following keys retain their original functions while the gage is in any SP Mode:



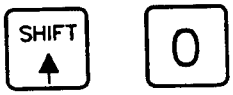
Return at any time to the SP MODES Menu.



Return at any time to measure mode.



Query battery status at any time.



Adjust display brightness at any time.



Turn gage power off. Also restores power if gage power is off. Gage will always start in measure mode.

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SP-1 MODE: COMPORT

0	No function.
1	Query current RS-232 Baud Rate, expressed in bits per second. Repeat to change.
2	Query current RS-232 Word Length, expressed in bits. Repeat to change.
3	Query current number of RS-232 Stop Bits. Repeat to change.
4	Query current RS-232 Parity status. Repeat to choose **N** (None), **O** (Odd), or **E** (Even).
5	Query current active data transmission port. Repeat to choose **RS-232** serial or **PRINTER** parallel port.
SHIFT ▲ 5	Activate both the serial and parallel ports.
6	Query current footswitch configuration. Repeat to choose equivalence to [SAVE], [MAX], [MEAS], or [SEND].

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7 — Query the current type of MAX measurement. Repeat to choose **SCAN** (scanning) or **DSCT** (discrete).

8 — Query which measurement will be sent or saved. Repeat to choose **ACTIVE** or **MODE DEP** (mode dependent).

9 — Query if mode dependent (min or max) value will be cleared by [SAVE] or [SEND]. Repeat to choose **Clr mM** or **No Clr mM**

SEND — Query the current output string format. Repeat to choose **All Data, No SuTbl** (no setup table), or **Thk Only** (thickness only).

[QCAL] — Query the current [BLANK] key function. Press [QCAL] again to choose **BLNK** (blank, or no function) or **QCAL** (equivalent to pressing the [QCAL] button). The [QCAL] button is located on the side of all probes.

[MAX] — Query the current [MAX] button configuration. Repeat to choose equivalence to [MEAS], [SEND], [SAVE], or [MAX]. (The [MAX] button is located on the side of 802 probes only).

SP-2 MODE: DL-SETUP

ID# — View current datalogger modulus. Repeat to change current modulus to one of ten stored setups. Edit current modulus with numerical keypad, or delete it with [CLR MEM].

SP-3 MODE: TEST

1 — Query Data ROM version.

2 — Query Program ROM version.

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[3] Display Test, stop by pressing [MEAS].

[4] Analog to Digital Converter Test.

[5] Burn-In Test, (combination of all test). Stop by pressing [ON/OFF].

[SHIFT ▲] [1] Start RAM test. Stop by pressing [ON/OFF]. When power is restored, gage reconfiguration and recalibration is necessary.

SP-4 MODE: RESET

[0] No function.

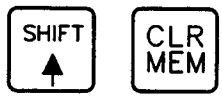
[1] Communications parameters reset.

[2] General reset: Erase look-up tables, set gage configuration to defaults. Re-calibration of gage is necessary after this is done.

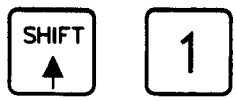
[3] Query status of audio beeper. Repeat to turn on or off.

[4] Datalogger reset: Clear all datalogger moduli.

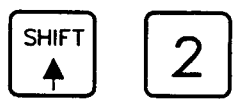
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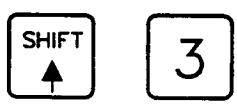
Master reset: Combination of communications [1], general [2], and datalogger [4] resets. Recalibration of gage is necessary after this is done.



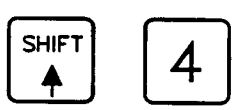
Query number of measurements displayed by gage per second. Repeat to change. Default value is 5.



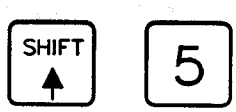
Query number of probe signal measurements averaged to produce calibration data. Repeat to change. Default value is 16.



Query number of probe signal measurements averaged to produce a displayed thickness measurement. Repeat to change. Default value is 16.



Query number of probe ID signal measurements averaged to determine probe type. Repeat to change. Default value is 16.



Query number of communications buffers. Repeat to change. Default value is 2.

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APPENDIX IX- PROBES, FIXTURES, AND TARGETS FOR SPECIAL APPLICATIONS

The standard 801 probe will perform quite adequately for the majority of blow-molded plastic bottle applications. Several accessories have been designed, however, for measuring special applications. A brief description of each follows. New probes may have been designed since this writing, and Panametrics will evaluate requests for special modifications. Please contact Panametrics for more complete information regarding applications, price, and delivery.

802 style probes have a second button, labeled [MAX], located next to the [QCAL] button. The function of this button can be chosen (in the SP-1 menu) to be equivalent to the [MEAS], [SEND], or [SAVE] keys, allowing an operator to perform these functions when access to the front panel or footswitch is inconvenient. It can also be made to send a discrete maximum command when [SHIFT][6] or the footswitch cannot be conveniently used for this purpose. The connector at the base of 802 probes is different from that on 801 probes, so probe cables 802PC or 802CC must be employed with 802 probes.

Probes with special tips are designated by a three digit suffix (for example, 802PR-102). With standard software (P1.6, D2.4 or later) installed in the 8000 control unit, all of the probes listed below can be employed. The gage automatically identifies these probes by type, and thus knows which targets and look-up tables to assign. The gage will display the probe type and target of its active look-up table when [SHIFT][4] is pressed. The standard tip 801 and 802 probes are type 1.

The -102 probe is a standard probe with a standard 1/16 inch (1.6 mm) radius tip. The tip, however, has been chemically hardened to help resist tip wear from abrasive materials. This probe is employed with the three standard target balls.

The -105 probes have a tip modified to fit into the groove of an automotive air-bag tear seam, or other narrow areas. The targets for these probes are a 1/16 inch (1.6 mm) diameter ball, a 3/16 inch (4.8 mm) diameter disk with a sharp edge, and a 1/2 inch (12.7 mm) diameter disk with a square 1/32 inch (0.79 mm) wide edge. The disks are used in exactly the same way as target balls, but are meant to align with the shape of the tip.

The -109 probe has a 1/4 inch (6.4mm) radius tip, and is used for measurements up to 0.400 inch (10mm). The targets employed with this probe are a 1/8 inch (3.2mm) diameter ball, a 3.16 inch (4.8mm) diameter ball and a 1/4 inch (6.4) diameter ball. The -109 is a type 6 probe.

The -110 probe is the same as -109, except that the connector is mounted on the side, 90 degrees from its normal location.

The -111 is a standard probe with a super wear-resistant material added to the tip. This probe uses standard target balls.

The 80FXV is a V-shaped plastic fixture which fits over the tip of any probe and helps to align some items, such as tubing, over the axis of the probe.

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The accuracy specification for the -109 and -110 extended range probes should be quoted for all target balls (1/8", 3/16", and 1/4") as follows:

Basic Accuracy: + or -3%, + or - (a resolution error)

Reference Accuracy: + or - 1%, + or - (a resolution error)

The "resolution error" is described as the greater of the following values:

Fundamental resolution error:

High resolution mode: 0.0001; Low resolution mode: 0.001

As the thickness increases however, the following resolution error values will supersede the fundamental error if greater than the fundamental:

At 0.1200 inches or above, 0.0005

At 0.2000 inches or above, 0.0010

At 0.3000 inches or above, 0.0020

For example, at a thickness or 0.1600, the Basic Accuracy is + or - (0.0048 + 0.0005) or 0.0053. A 0.1600 inch reference could, therefore, read as low as 0.1547 and as high as 0.1653.

Please note that the Basic Accuracy is only guaranteed in a probe that is in good or new condition. Tip distortion due to abrasive materials or magnetic shock may cause the probe, during its lifetime, to not meet Basic Accuracy specifications. Unless this distortion becomes extreme, however, inaccuracies can be corrected and Multi-Point Accuracy can still be achieved by employing the Multi-Point Calibration procedure described in Section 2 of this manual.

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