PocketMIKE

Operating Manual

Part of GE Inspection Technologies

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PocketMIKE

Operating Manual version 2.0

STRESSTEL
Part of GE Inspection Technologies

Important Notice

The following information must be read and understood by any user of a GE Inspection Technologies ultrasonic thickness gauge. Failure to follow these instructions can lead to errors in thickness measurements or other test results. Decisions based on erroneous results can, in turn, lead to property damage, personal injury or death.

General Warnings

Proper use of ultrasonic test equipment requires three essential elements:

- Selection of the correct test equipment.
- Knowledge of the specific "test application requirements."
- Training on the part of the instrument operator.

This operating manual provides instruction in the basic set up and operation of the GE Inspection Technologies thickness gauge.

There are, however, additional factors which affect the use of ultrasonic test equipment. Specific information regarding these additional factors is beyond the scope of this manual. The operator should refer to textbooks on the subject of ultrasonic testing for more detailed information.

Operator Training

Operators must receive adequate training before using ultrasonic test equipment. Operators must be trained in general ultrasonic testing procedures and in the set up and performance required by a particular test. Operators must understand:

- Soundwave propagation theory.
- Effects of the sound velocity of the test material.
- Behavior of the sound wave where two different materials are in contact.
- Areas covered by the sound beam.

More specific information about operator training, qualification, certification, and test specifications is available from various technical societies, industry groups, and government agencies.

Testing Limitations

In ultrasonic testing, information is obtained only from within the limits of the sound beam. Operators must exercise great caution in making inferences about the test material outside the limits of the sound beam. For example, when testing large materials it may be impossible or impractical to inspect the entire test piece. When a less-than-complete inspection is to be performed, the operator must be shown the specific areas to inspect. Inferences about the condition of areas not inspected, based on data from the evaluated areas, should only be attempted by personnel fully qualified and trained in applicable standards of statistical evaluation. In particular, materials subject to erosion or corrosion, in which conditions can vary significantly in any given area, should only be evaluated by fully trained and experienced operators.

Sound beams reflect from the first interior surface encountered. Because of part geometry and overlapped flaws or overlapped surfaces, thickness gauges may measure the distance to an internal flaw rather than to the back wall of the material. Operators must take steps to ensure that the entire thickness of the test material is being examined.

Ultrasonic Thickness Measurement Critical Operating Procedures

The following operating procedures must be observed by all users of ultrasonic thickness gauges in order to minimize errors in test results.

1. Calibration of Sound Velocity

The principle of operation of an ultrasonic thickness gauge is that the instrument measures the time of flight of an ultrasonic pulse through the test piece and multiplies this time by the sound velocity of the material. Thickness measuring error is minimized by ensuring that the sound velocity to which the instrument is calibrated is the sound

velocity of the material being tested. Actual sound velocities in materials often vary significantly from the values found in published tables. In all cases, best results are obtained if the instrument is calibrated on a velocity reference block made from the same material as the test piece; this block should be flat and smooth and as thick as the maximum thickness of the test piece.

Operators should also be aware that the sound velocity may not be constant in the material being tested; heat treating, for example, can cause significant changes in sound velocity. This must be considered when evaluating the accuracy of the thickness provided by this instrument. Instruments should always be calibrated before testing, and the calibration should be checked after testing, to minimize testing errors.

2. Probe Zero Procedure

Probe zeroing is the process of measuring the time of flight of sound through the transducer. The transducer time of flight is then automatically removed from each measurement so that only the test piece time of flight is used to calculate and display the thickness value. The probe zeroing process is performed automatically while the probe is coupled.

3. Effects of Temperature on Calibration

Temperature variations change the sound velocity of materials and transducer delay lines and, therefore, calibrations. All calibrations should be performed on-site, and with test blocks at the same temperature as the test piece, to minimize errors due to temperature variations.

4. Transducer Selection

The transducer used in testing must be in good condition without noticeable wear of the front surface. Badly worn transducers will have a reduced effective measuring range. The specified range of the transducer must include the complete range of thicknesses to be tested. The temperature of the material to be tested must be within the transducer's temperature range.

5. Use of Couplants

Operators must be familiar with the use of ultrasonic couplants. Testing skills must be developed so that couplant is used and applied in a consistent manner to minimize variations in couplant layer thickness and errors in test results. Calibration and actual testing should be performed under similar coupling conditions, using a minimum amount of couplant and applying consistent pressure on the transducer.

6. Doubling

Ultrasonic thickness gauges will, under certain conditions, display readings which are twice (or, in some cases, three times) the actual material thickness being measured. This effect, commonly known as "doubling," can occur below the minimum specified range of the transducer. If the transducer being used is worn, doubling is possible at a thickness greater than the minimum of the specified range.

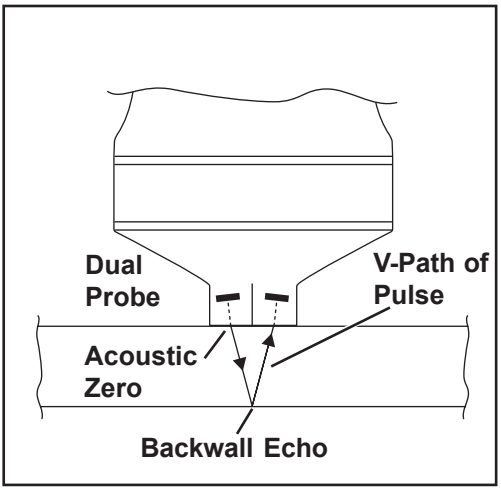
When using a new transducer, any reading which is less than twice the minimum specified range of the transducer may be a "doubled" reading, and the thickness of the material being tested should be verified by the use of other methods. If the transducer shows any sign of wear, doubling may occur at a thickness greater than twice the minimum of the specified range. This thickness should be determined by calibrating the PocketMIKE on reference blocks that represent the complete range of possible thicknesses that may be encountered in testing. This is particularly important when the test piece is being ultrasonically measured for the first time or in any case where the history of thickness of the test specimen is unknown.

Physics of Ultrasound

These instruments operate on the ultrasonic pulse-echo principle, similar to sonar. A short ultrasonic pulse is transmitted into the part by a probe (transducer). The pulse travels through the material under test until it encounters an interface, that is a material with substantially different physical characteristics, such as air or liquid, at the back surface of the part. At the interface, the pulse is reflected back to the probe.

The time needed for the pulse to make this round trip is divided by two and multiplied by the sound velocity of the material under test. The result is the thickness of the material.

The figure below illustrates the pulse-echo principle of ultrasonic thickness measurement.



Dual Element Thickness Measurement

Contents

Getting Started

Chapter 1

To begin using your PocketMIKE, you need only install a battery in the instrument and power it on.

1.1 Installing the Battery

- The instrument is powered by one "AA" size Alkaline battery.
- An alkaline battery will provide approximately 80 hours of service life.
- Replace the battery as soon as possible after the low battery indicator (▭) appears on the instrument's display.

To install the battery, refer to Figure 1-1 and follow these steps:

Step 1—Unscrew the probe locking ring and remove the probe from its sealed position.

Step 2—Insert one "AA" battery in the instrument. Make sure the battery poles are oriented as shown in Figure 1-1. The instrument will not function if the battery is inserted incorrectly.

Step 3—Reinstall and finger tighten the probe locking ring until the ring is seated against the instrument body.

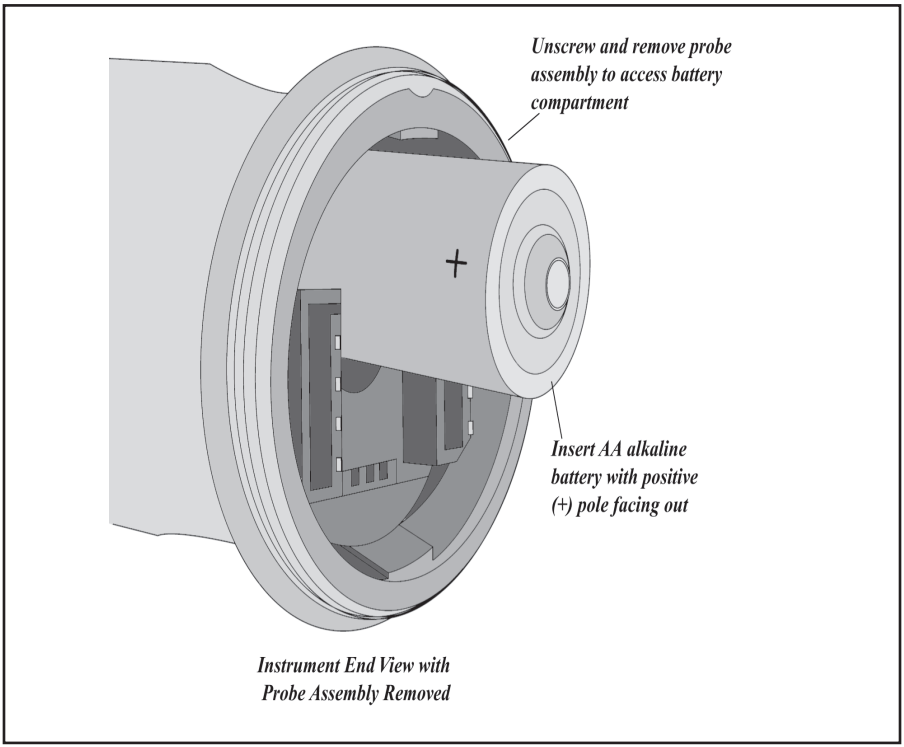


Figure 1-1—Battery Replacement

NOTE: Avoid using tools which may over-tighten the probe locking ring.

NOTE: When the low battery indicator (▭) lights, replace the battery as soon as possible. When the battery is too weak for reliable operation, the instrument automatically powers off. Instrument settings are saved and restored when batteries are replaced and the instrument is again powered on.

1.2 Powering On the Instrument

To power on the instrument, simply press CAL ON. Pressing and holding this key for more than three seconds, when the instrument is on, will cause it to power off. If the instrument is uncoupled and no keys are pressed for three minutes, the instrument will automatically power off.

Quick Help for Interpreting the Keypad and Display Screen

Chapter 2

PocketMIKE controls and settings are displayed in the instrument's screen and adjusted using various combinations of key presses. This chapter identifies the display screen's features, the keypad functions, and the general display structure. Topics covered include:

- Keypad Operations (section 2.1)
- Display Indicators (section 2.2)
- On-Screen Menu Structure (section 2.3)

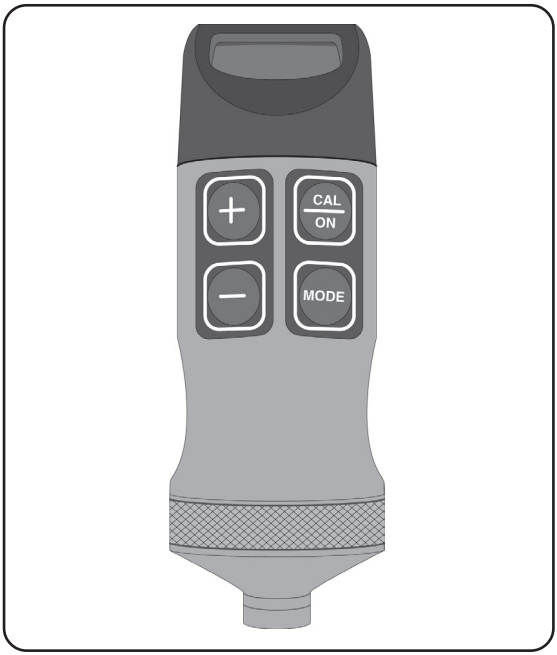


FIGURE 2-1—PocketMIKE

2.1 Keypad Operations

The following is a brief summary of each key's function. For more complete information, refer to the referenced manual section.

Powers the instrument on and off (section 1.2)

Launches and ends the thickness calibration process (section 3.2)

Reverses display orientation (section 3.5)

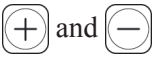
Changes on-screen values when in thickness and velocity calibration modes (sections 3.2 and 3.3)

Changes setting when in Backlight Adjustment mode (section 3.1)

Reverses display orientation (section 3.5)

Changes on-screen values when in thickness and velocity calibration modes (sections 3.2 and 3.3)

Changes setting when in Backlight Adjustment mode (section 3.1)



Simultaneous pressing of these keys selects measurement units and resolution (section 3.4)

Simultaneous pressing and HOLDING these keys activates and deactivates SAFE mode in which most instrument controls are disabled (section 3.7)

Launches and ends the Velocity Calibration process and activates Backlight Adjustment mode (sections 3.3 and 3.1)

2.2 Display Indicators

The PocketMIKE display (Figure 2-2) includes indicators (icons) around its perimeter and text or numerical values in its center. Indicators and other display contents vary in response to instrument settings, key presses, and measurement status. The following is a summary of display indicators. For more complete information, refer to the referenced manual section.

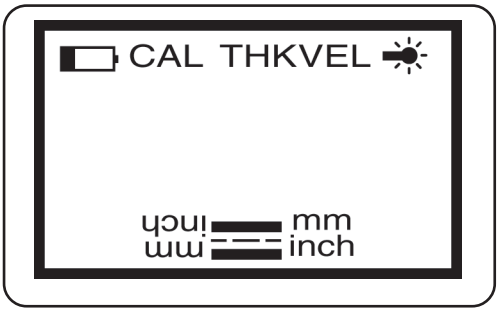


FIGURE 2-2—Each of these screen indicators are displayed only under certain conditions.

THK	Indicates instrument is in Thickness Measurement mode when display is not inverted (chapter 4).
CAL THK	Thickness Calibration mode is in process (section 3.2).
CAL VEL	Velocity Calibration mode is in process (section 3.3).
☀	Indicates instrument is in Backlight Adjustment mode (section 3.1).
▭	Indicates a low battery condition (section 1.1).
▬	Displayed when probe is coupled (chapter 4).
inch	Unit of measurement set to inches (Imperial Units) (section 3.4).
mm	Unit of measurement set to millimeters (Metric Units) (section 3.4).

SAFE	Control lockout is activated, instrument controls are locked out (section 3.7).
donE	Displayed when lockout mode has been disabled (section 3.7).
HOT	Instrument's internal temperature has exceeded defined limits (chapter 4)
FAIL	(Diagnostic Message displayed after power-up) Instrument memory is corrupted. Return for service.
CAL	Calibration mode for sound velocity is active. Thickness may be calibrated.

2.3 Types of Display Screens

The PocketMike offers three general display screen modes, similar to the three shown below:

- Thickness Measurement Display (Figure 2-3)
- Calibration Mode (Figure 2-4)
- Backlight Adjustment Mode (Figure 2-5)

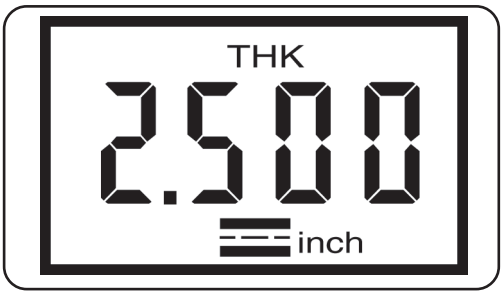


FIGURE 2-3—In thickness measurement mode, THK appears along the display's upper edge. Other on-screen indicators are shown here. See Chapter 4 for more details related to Thickness Measurement mode and related display indicators.

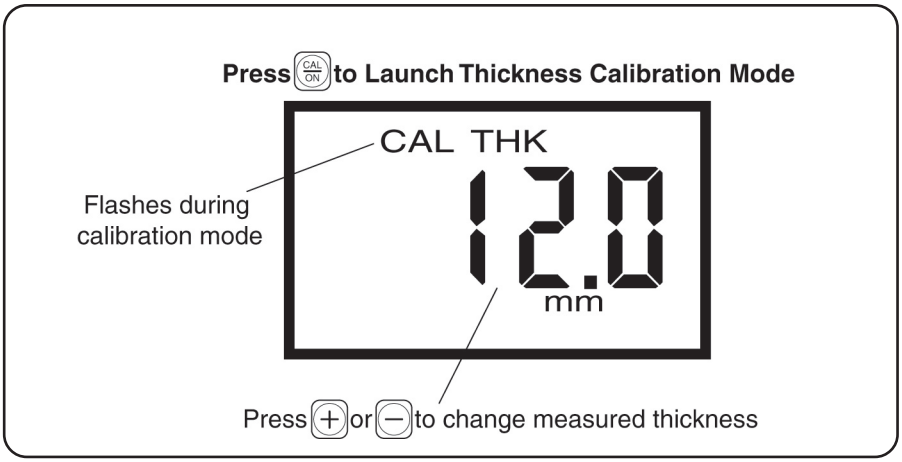


FIGURE 2-4—While the calibration process is underway, CAL appears (and flashes) along the display's edge. The calibration display varies depending on whether velocity or thickness calibration mode is indicated. See sections 3.2 and 3.3 for more details related to instrument calibration.

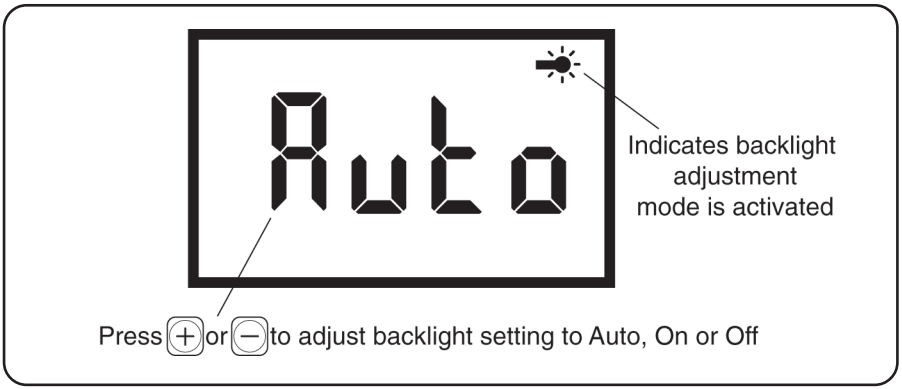


FIGURE 2-5—Pressing MODE twice (when operating in Thickness Measurement mode) launches the Backlight Adjustment mode. Pressing + or − sets backlight to On, OFF, or Auto (section 3.1).

Setting Up the Instrument

Chapter 3

Instrument settings can be configured to match your test conditions. This chapter explains how to configure the instrument to measure thickness. Topics covered include:

- Adjusting Display Brightness or Backlighting (section 3.1)
- Thickness Calibration (section 3.2)
- Velocity Calibration (section 3.3)
- Setting the Measurement Units and Resolution (section 3.4)
- Reversing the Instrument's Display Orientation (section 3.5)
- Replacing a Probe (section 3.6)
- Disabling All Adjustment Controls (section 3.7)
- Rotating the Display (section 3.8)

NOTE: Prior to setting up an instrument, a battery must be installed and the instrument must be powered on. Refer to Chapter 1 for information on installing a battery and turning the instrument on.

NOTE: Before using this instrument, read the "Important Notices" at the beginning of this manual, and *Chapter 6 — Application Considerations,* for important information on test conditions that affect measurement results.

3.1 Adjusting the Display's Brightness (Backlight)

The instrument's backlight feature illuminates the display to improve visibility when operating in low light conditions. Note that using the backlight feature reduces battery life.

Press MODE one or two times to activate the Backlight Adjustment mode. When this mode is active,  appears in the display's corner. Press ⊕ or ⊖ to select between the following backlight modes:

- On
- OFF
- Auto

When Auto mode is selected, the backlight automatically illuminates each time a key is pressed or when the probe is coupled. The backlight remains illuminated for approximately 4 seconds after which it automatically extinguishes. It will re-illuminate with the next key press or coupling.

3.2 Thickness Calibration

NOTE: Worn, cracked, or otherwise damaged probe tips will affect the accuracy of thickness measurements. Refer to section 3.6 for information on probe replacement.

The instrument offers two calibration modes, thickness and velocity (section 3.3). To launch thickness calibration mode, press CAL ON anytime the instrument's display shows the THK indication. Note that throughout the calibration process, CAL appears (and flashes) along the display's upper edge. Figure 3-1 illustrates the displayed parameters and key presses required to navigate through the thickness calibration process. Note that calibration should be performed with the instrument set to its highest resolution.

NOTE: Calibration standards of known thickness should be of the same material, sound velocity, and curvature of the material being tested. Best results are achieved with a standard that is slightly thicker than the thickest expected test piece.

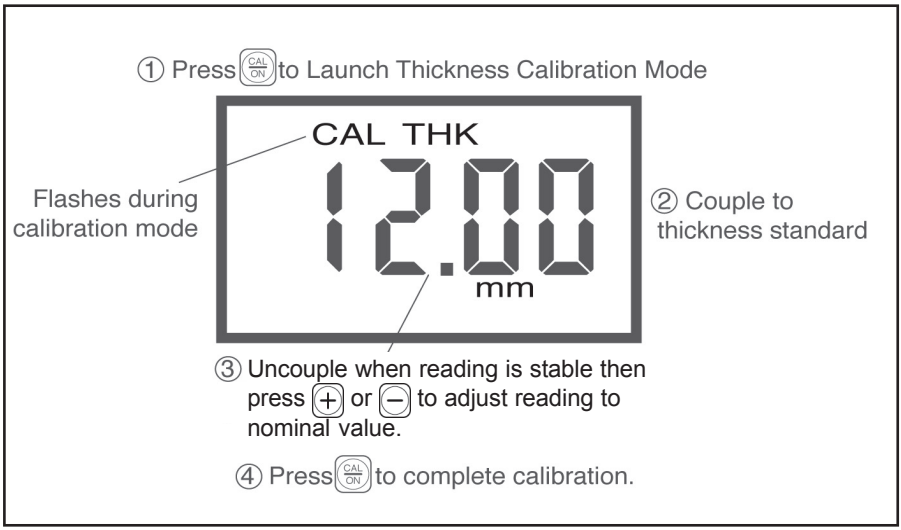


FIGURE 3-1—Thickness Calibration Procedure

3.3 Velocity Calibration

The user can directly specify the acoustic velocity of the material being tested. To launch velocity calibration mode, press MODE anytime the instrument's display shows THK. The instrument displays the currently set acoustic velocity (in units of inches-per-microsecond or meters-per-second depending on units-of-measurement settings).

Note that throughout the velocity calibration process, CAL appears (and flashes) along the display's upper edge. Figure 3-2 illustrates the displayed parameters and key presses required to navigate through the velocity calibration process.

NOTE: A thickness standard is not required to perform a velocity calibration. However, following a velocity calibration the instrument's accuracy should be checked using a sample of known thickness and with a sound velocity that matches the user-inputted value. A table of approximate sound velocities for various materials can be found in Chapter 9.

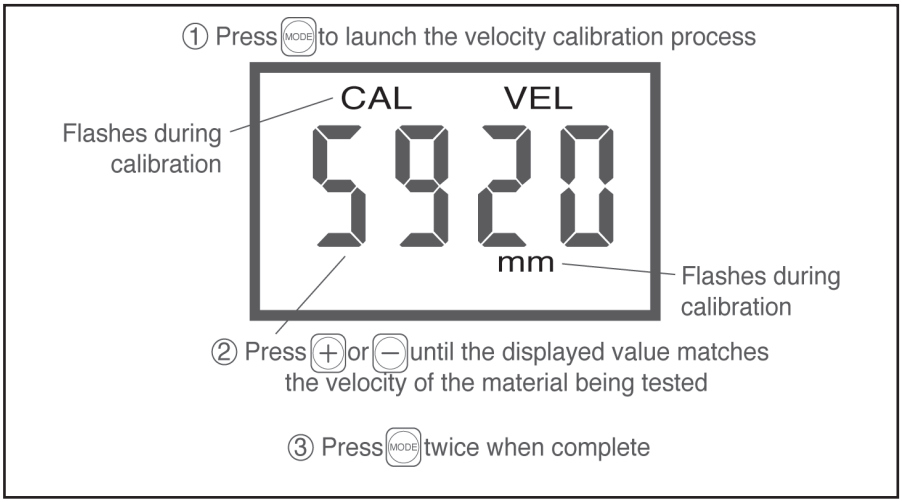


FIGURE 3-2—Velocity Calibration Procedure

3.4 Setting the Measurement Units and Resolution

Measured thickness can be displayed in either metric or imperial units and to one of two levels of resolution. Available measurement units and resolution include:

— 0.00 inches — 0.0 mm

— 0.000 inches — 0.00 mm

Notice that the active units of measurement are indicated by inch or mm, which appear along the bottom of the display. To select the unit and resolution of measurement. Press (+) and (−) simultaneously anytime THK is displayed. The unit of measurement selected will also determine the units in which acoustic velocity is displayed.

NOTE: Selecting a resolution setting of 0.0 mm or 0.00 inch may increase battery life.

3.5 Reversing the Display's Orientation

The displayed thickness and units of measurement (inch or mm) can be reversed (displayed upside down) to allow for easy display-screen reading with the instrument in either the probe up or probe down orientation. To reverse the display, simply press (+) or (−) anytime the instrument's display shows THK. A second press of either key will return the display to its original orientation. Note that the orientation of other on-screen indicators do not change. A press of the key (MODE) will return the display to its normal orientation and enter velocity calibration mode.

3.6 Replacing the Probe

Worn, cracked, or otherwise damaged probe (transducer) contact surfaces can affect measurement accuracy. The probe and locking ring are replaced as an assembly. Refer to Figure 3-3 for the probe replacement procedure. Always recalibrate the instrument after the probe is replaced or removed.

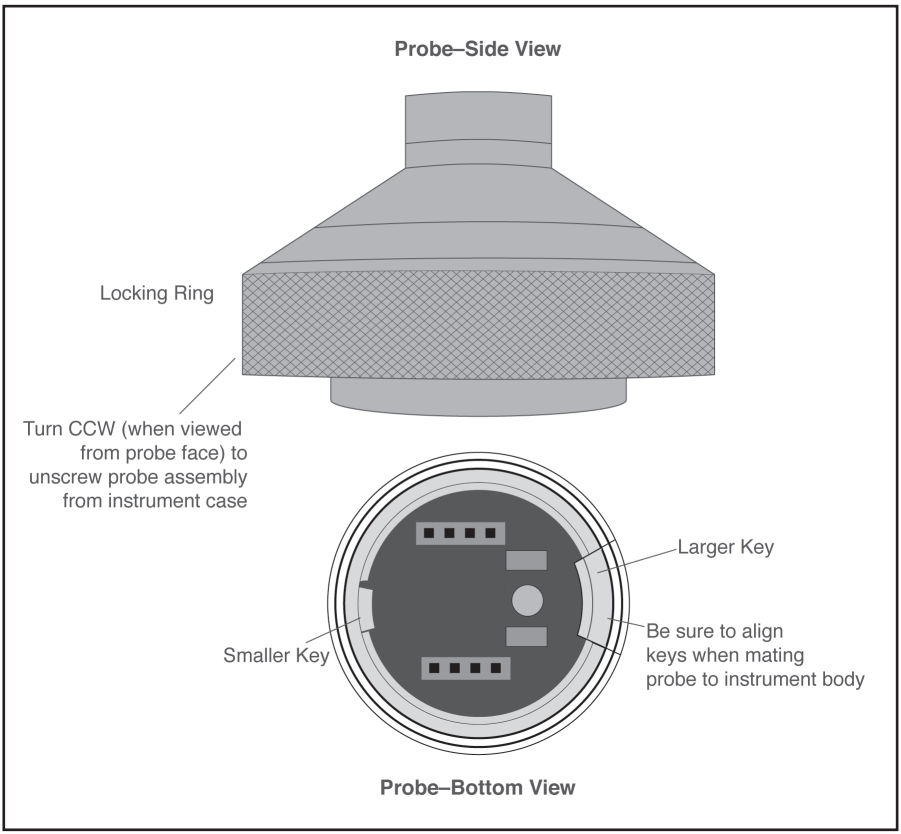


FIGURE 3-3—Probe Replacement

3.7 Disabling Instrument Adjustment Controls

The control lockout feature disables all instrument controls (except Power Off and Display Reversal). To activate the lockout, simultaneously press and hold ⊕ and ⊖ for longer than three seconds until the word “SAFE” appears on the display screen. When lockout mode is activated, the instrument calibration, units of measurement, and backlight setting can not be adjusted. This mode is disabled by repeating the simultaneous key press and is indicated when “donE” appears on the display. Note that powering the instrument off and back on does not disable the lockout mode.

3.8 Rotating the Display

The plastic display housing on the top of the PocketMike can be rotated through 180 degree of motion. To rotate the display housing grasp the PocketMike in one hand while gently turning the display housing. Do not attempt to turn the display housing past its limits or damage could result.

Measuring Thickness

Chapter 4

The PocketMIKE measures thickness in units of inches or mm. Read the following notices and instructions before measuring thickness.

NOTE: The instrument is designed to measure materials with surface temperatures of up to 100°C. However, the instrument's internal electronics should not be allowed to reach temperatures above 60°C for extended periods of time. When internal instrument temperature reaches 60°C, the instrument displays the word "Hot." This warning will remain until the instrument's internal temperature drops below 55°C. When internal temperature reaches 85°C, the HOT warning is momentarily displayed, than the instrument is automatically powered off.

NOTE: Before using this instrument, read the "Important Notices" at the beginning of this manual, and *Chapter 6 — Application Considerations,* for important information on test conditions that affect measurement results.

NOTE: ALWAYS calibrate the PocketMIKE before measuring thickness. Refer to sections 3.2 and 3.3 for instructions.

When THK is displayed, the instrument is ready to measure thickness. Follow these steps to measure thickness:

Step 1—Remove dirt, loose material, and couplant residue from the surface of the test piece.

Step 2—Be sure that the instrument has been calibrated to match the sound velocity of material being tested.

Step 3—Place a drop of couplant on the material surface at the measurement point.

Step 4—Position the transducer in steady contact with the surface of the material at the measurement point. When coupling is achieved, ⚌ will be displayed.

Material thickness is displayed in the user-specified measurement unit (inches or millimeters) and resolution as described in section 3.4. When the probe is uncoupled, ⚌ will no longer appear along the edge of the display but the instrument will continue to display the last measured thickness. Refer to Figure 4-1 to interpret display indicators.

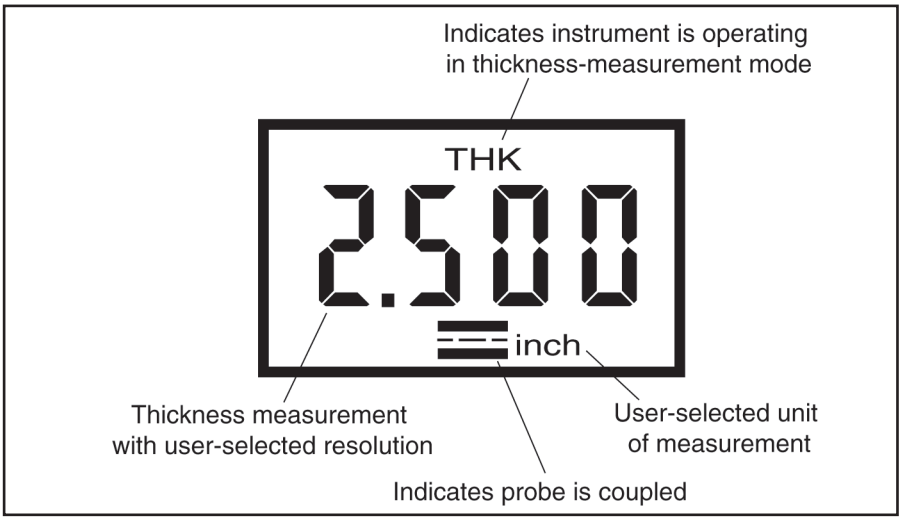


FIGURE 4-1—Thickness Measurement Mode

NOTE: Only couplants approved by GE Inspection Technologies should be used. Other couplants, e.g. oil, may affect the instrument's functionality or cause damages!

Specifications and EC Declaration of Conformity

Chapter 5

5.1 Specifications

Operating Principal	Pulse-Echo
Probe	5 MHz, 0.475 inch (12 mm) Diameter
Probe Zero	Automatic, ON-Block
Instrument Calibration	Known Thickness Known Velocity
Units of Measure	mm or inch
Backlight	Auto/OFF/On
Approximate Measuring Range	0.040" (1mm) to 9.999" (250 mm), Material and Application Dependent
Display Resolution	0.001 inch for < 10.000 inches 0.01 inch for ≥ 10.00 inches 0.01 mm for < 100.00 mm 0.1 mm for ≥ 100.00 mm
Reading Stability	+/- .001 inches
Operating Temperature	-10°C to +50°C (10°F to +120°F)
Storage Temperature	-20°C to +60°C (-4°F to +140°F)
Probe Surface Temperature	-10°C to +100°C (10°F to +212°F) Maximum coupling time 3 sec at 100°C (212°F). One minute cool down.
Power Source	Qty 1, 1.5 VDC, AA Alkaline Battery

Battery Life	Up to 80 hours, with the backlight off, at 22°C (72°F), and with the probe coupled 25% of the time
Instrument Weight	5.2 ounces (150 grams) with battery
Instrument Dimensions	4.00 in (105 mm) x 1.38 in (39 mm) nominal diameter
Environmental	IP67

5.2 EC Declaration of Conformity

GE Inspection Technologies Systems GmbH
Robert-Bosch-Strasse 3
D – 50354 Hürth

We herewith declare in sole responsibility that the product which this declaration refers to, meets the requirements of the following directives:

89/336/EEC (incl. amendments) EEC directive on the electromagnetic compatibility

The conformity with the requirements of the directive 89/336/EEC is proved by meeting the standard specifications:

IEC 61000-6-2:2001 (Immunity to interference for industrial environment)

IEC/CISPR11:1998 + A1:1999 + A2:2002 Class A, Group 2
(Emitted interference for ISM equipment)

Note:

Class-A instruments are instruments suitable for use in all other areas except for the living area and except for areas which are directly connected to a low-voltage supply network (also) feeding residential buildings.

Class-A instruments are provided for the operation in an industrial environment.

The Group 2 comprises all ISM equipment (industrial, scientific, and medical radiofrequency equipment) in which RF energy is intentionally generated and/or used as electromagnetic radiation for the purpose of material treatment, as well as EDM and arc-welding devices.

Application Considerations

Chapter 6

Measuring thickness under certain conditions requires special considerations. In this chapter you will find a summary of special considerations related to the following variables in testing applications:

- Material Consistency in Test Specimen (section 6.1)
- Flaws in the Specimen Being Tested (section 6.2)
- Condition of the Test Specimen's Surface (section 6.3)
- Test Specimens with Curved Surfaces (section 6.4)

6.1 Material Consistency in Test Specimen

Maximum measurement accuracy will be obtained if the work piece and the calibration piece are the same temperature, shape, material, and size.

NOTE: At velocities greater than 6240 m/s the instrument will automatically adjust its gain to improve measurement consistency.

NOTICE

Since sound velocity varies from test piece to work piece, accuracy of measurement depends on consistency of sound velocity. Sound velocity also varies with internal stress, so that heat treatment of the material will also effect accuracy. The following table expresses accuracy variations for some common materials. Actual accuracy may be different.

Aluminum	+/– 2%	Cast Iron	+/– 8%
Steel	+/– 0.5%	Nylon	+/– 10%

NOTE: These specifications are intended only as a general guide.

6.2 Flaws in the Specimen Being Tested

If, during testing, the PocketMIKE suddenly reads a value which is much thinner than the apparent thickness of the part, it may be reading the distance to a flaw in the test piece, rather than the distance to the backwall. If the cause is unclear, further examination of the part with an ultrasonic flaw detection instrument or other suitable GE Inspcetion Technologies method is recommended.

6.3 Condition of the Test Specimen's Surface

A regular pattern on the surface under test, such as machine grooves, may cause a false thickness reading when using a dual element probe. Higher frequency probes are especially sensitive to this condition. The problem can usually be corrected by rotating the probe so that the crosstalk barrier is at a right angle to the grooves.

It is possible for the surface of a test piece to be too rough to permit a good reading. Excess couplant could be trapped between the probe and surface under test, causing a false reading. A very rough surface may prevent coupling altogether (no coupling indicator). This problem can be corrected by grinding the surface until it is smooth enough to permit good coupling.

6.4 Test Specimens with Curved Surfaces

When measuring on curved surfaces, such as tubes or pipes, be sure to keep the probe centered on the part and as stable as possible. As a rule, smaller diameter probes improve coupling and minimize "rocking" on curved parts. In some cases, special probes with contoured faces to match surface curvature may be needed. Practice may be helpful to develop the proper technique.

When using a flat dual probe, position the crosstalk barrier at a right angle to the long axis of the part, as shown in Figure 6-1.

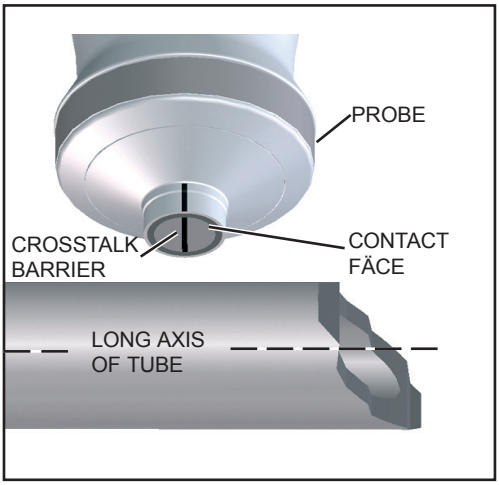


FIGURE 6-1—Crosstalk Barrier Orientation

Troubleshooting Guide

Chapter 7

Should your instrument malfunction, refer to the guidelines that correspond to the problem you're experiencing:

PROBLEM	POTENTIAL SOLUTION
Unit does not turn on.	Replace the battery. Call GE Inspection Technologies application support to review problem.
Unstable measurement	Ensure coupling is indicated. Ensure couplant is used between transducer and test specimen. Ensure test specimen is free of dirt and debris. Test transducer on test block. Call GE Inspection Technologies application support to review problem.
Obvious error in measurement	Ensure proper calibration to the sound velocity of the test specimen. Ensure that correct units (inch or mm) are selected. Ensure coupling indicator is closed. Ensure test specimen is free of dirt and debris. Do not attempt to measure through paint or other coatings.
Cannot obtain coupled reading	Ensure couplant is used between transducer and test specimen. Ensure unit is in thickness measurement mode (THK is displayed). Test transducer on test block. Call GE Inspection Technologies application support to review problem.

Warranty and Repair

Chapter 8

8.1 Warranty

There are no warranties, expressed or implied by either distributor or the manufacturer on new equipment except the manufacturer's warranty against defects in material and workmanship set forth below:

GE Inspection Technologies warrants new instruments manufactured by GE Inspection Technologies and delivered to the original retail purchaser F.O.B. GE Inspection Technologies's factory, to be free from defects in material and workmanship under normal use and service, for a period of two years from delivery of the instrument or unless otherwise stated by GE Inspection Technologies.

GE Inspection Technologies warrants new transducers manufactured by GE Inspection Technologies and delivered to the original retail purchaser F.O.B. GE Inspection Technologies's factory, to be free from defects in material and workmanship under normal use and service, for ninety (90) days from the date of purchase.

These warranties are subject to the following limitations to which the Buyer expressly agrees:

A. GE Inspection Technologies's obligation under this warranty is limited solely to repairing or replacing, at our option, and which, upon examination by GE Inspection Technologies shall be found to its reasonable satisfaction to have been thus defective. THIS REMEDY IS EXPRESSLY SUBSTITUTED FOR ANY AND ALL OTHER REMEDIES POSSIBLE UNDER THE UNIFORM COMMERCIAL CODE, STATE, COMMON OR STATUTORY LAW OR OTHERWISE.

B. The provisions of this warranty SHALL NOT APPLY:

- To any instrument or transducer, which has been subject to misuse, negligence or accident or which has been repaired or altered outside GE Inspection Technologies's factory in any way so as to, in GE Inspection Technologies's sole but reasonable judgment affect its performance and reliability.
- To any instrument or transducer, which has been subjected to an environment, chemistry or temperature that is not compatible with the materials of construction.
- To any parts of an instrument or transducer, which, under normal usage, would not or are not expected to last the warranty period, i.e. "wear" items (i.e. batteries and cables).
- To any instrument or transducer, which have not been subject to proper care and maintenance.
- GE Inspection Technologies shall not be liable for any damages, whether direct or indirect, economic, commercial, incidental, or consequential, and whether arising from GE Inspection Technologies's negligence, breach of contract, product liability, warranty or any other reason.
- To any instruments or transducer not manufactured by GE Inspection Technologies. For equipment furnished, but not manufactured by GE Inspection Technologies, GE Inspection Technologies assigns to the Buyer any warranty and/or claim it may have against the manufacturer or supplier of the equipment.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED INCLUDING ANY IMPLIED OR EXPRESSED WARRANTY OF MERCHANTABILITY, SUITABILITY OR FITNESS FOR A PARTICULAR PURPOSE and GE Inspection Technologies neither assumes nor authorizes another to assume any liability in connection with such equipment, except as provided above.

8.2 Service

GE Inspection Technologies offers a complete Service Department for repair and recertification of our products. You do not need a pre-authorization number to send your GE Inspection Technologies unit in for repair. Simply, provide the following information:

- Company Name
- Contact Name
- Phone Number
- Company Address
- Model Number
- Serial Number
- Accessories
- Description of problem or work required
- Any additional comments

and send it with your unit to:

GE Inspection Technologies, LLC
50 Industrial Park Road
Lewistown, PA 17044
U.S.A.

Phone: +1 (717) 242-0327
Fax.: +1 (717) 242-2606

or:

GE Inspection Technologies Systems GmbH
Robert-Bosch-Straße 3
D – 50354 Hürth
Germany
Phone: +49 (0) 2233 601111
Fax.: +49 (0) 2233 601402

When shipping your unit, please take care to protect it from transit damage. Static sensitive parts must be packaged in anti-static bags, foam, or tubes. All products should be sent back in their original carry cases, or wrapped in bubble wrap or other available packaging material.

GE Inspection Technologies warrants all repairs for a full 90 days.

Appendix

Chapter 9

Typical Sound Velocities in Various Materials (Longitudinal Wave)					
	Inches Per Microsecond	**Meters Per Second**		**Inches Per Microsecond**	**Meters Per Second**
Aluminum	.2500	6300	Nylon	.1000	2500
Brass	.1700	4300	Phenolic	.0560	1400
Cadmium	.1100	2800	Platinum	.1600	4100
Cast Iron	.1800	4600	Plexiglas	.1100	2800
Copper	.1800	4600	Polyethylene	.0700	1800
Epoxy Resin	.1100	2800	Polystyrene	.0930	2400
Glass (Crown)	.2200	5600	Polyurethane	.0700	1800
Glass (Window)	.2700	6800	Porcelain	.2200	5600
Gold	.1300	3300	Rubber (Butyl)	.0730	1900
Inconel	.2200	5600	Rubber (Vulc.)	.0900	2300
Lead	.0850	2200	Silver	.1400	3600
Magnesium	.2300	5800	Steel	.2300	5800
Manganese	.1800	4600	Tin	.1300	3300
Molybdenum	.2500	6300	Titanium	.2400	6100
Monel	.2100	5300	Tungsten	.2100	5300
Neoprene	.0630	1600	Zinc	.1600	4100
Nickel	.2200	5600	Zircaloy 2	.1900	4700

Typical values for the sound velocity of many common materials. Because processing, exact material composition, and temperature affect velocity, these values may not precisely match the velocity in the material being tested.

NOTE: *This information is provided for the convenience of the user. GE Inspection Technologies assumes no responsibility for inaccuracies. Actual velocities depend on exact composition, temperature, and processing of each material.*

Index

H

K

L

M

P

R

S

T

U

V

W