

OPERATION MANUAL

DAKOTA ULTRASONICS MODEL PX-7 PRECISION THICKNESS GAUGE



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DISCLAIMER

Inherent in ultrasonic thickness measurement is the possibility that the instrument will use the second rather than the first echo from the back surface of the material being measured. This may result in a thickness reading that is TWICE what it should be. Responsibility for proper use of the instrument and recognition of this phenomenon rests solely with the user of the instrument.

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INTRODUCTION

The Dakota Ultrasonics model **PX-7** is a precision Ultrasonic Micrometer. Based on the same operating principles as SONAR, the **PX-7** is capable of measuring the thickness of various materials with accuracy as high as ± 0.0001 inches, or ± 0.001 millimeters. The principle advantage of ultrasonic measurement over traditional methods is that ultrasonic measurements can be performed with access to only one side of the material being measured.

This manual is presented in three sections. The first section covers operation of the **PX-7**, and explains the keypad controls and display. The second section provides guidelines in selecting a transducer for a specific application. The last section provides application notes and a table of sound velocity values for various materials.

Dakota Ultrasonics maintains a customer support resource in order to assist users with questions or difficulties not covered in this manual. Customer support may be reached at any of the following:

- Dakota Ultrasonics, 1500 Green Hills Road, #107
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OPERATION

The **PX-7** interacts with the operator through the membrane keypad and the LCD display. The functions of the various keys on the keypad are detailed below, followed by an explanation of the display and its various symbols.

The Keypad



This key is used to turn the **PX-7** on and off. When the tool is turned ON, it will first perform a brief display test by illuminating all of the segments in the display. After one second, the tool will display the internal software version number. After displaying the version number, the display will show "0.0000" (or "0.000" if using metric units), indicating the tool is ready for use.

The **PX-7** is turned OFF by pressing the **ON/OFF** key. The tool has a special memory that retains all of its settings even when the power is off. The tool also features an auto-powerdown mode designed to conserve battery life. If the tool is idle for 5 minutes, it will turn itself off.



The **CAL** key is used to enter and exit the **PX-7**'s calibration mode. This mode is used to adjust the sound-velocity value that the **PX-7** will use when calculating thickness. The tool will either calculate the sound-velocity from a sample of the material being measured, or allow a known velocity value to be entered directly. Refer to page 14 for an explanation of the two **CAL** functions available.



The **IN/MM** key is used to switch back and forth between English and metric units. This key may be used at any time, whether the tool is displaying a thickness (**IN** or **MM**) or a velocity value (**IN/ms** or **M/s**).



The **UP** arrow key has two functions. When the **PX-7** is in calibration mode, this key is used to increase numeric values on the display. An auto-repeat function is built in, so that when the key is held down, numeric values will increment at an increasing rate. When the **PX-7** is in measurement mode, this key is used to select between three different modes of measurement (echo-echo, interface-echo, or auto). Refer to page 14 for an explanation of the calibration procedure and page 13 to review the various measurement modes.



The **SCAN** key switches the **SCAN** measurement mode on and off. Refer to page 17 for an explanation of the **SCAN** measurement mode.



The **DOWN** arrow key has three functions. When the **PX-7** is in the **CAL** mode, this key is used to decrease numeric values on the display. An auto-repeat function is built in, so that when the key is held down, numeric values will decrement at an increasing rate. When the **PX-7** is not in calibration mode, the **DOWN** arrow key switches the display backlight between three available settings. **OFF** will be displayed when the backlight is switched off. **AUTO** will be displayed when the backlight is set to automatic mode, and **ON** will be displayed when the backlight is set to stay on. In the **AUTO** setting, the backlight will illuminate while the **PX-7** is making a measurement and turn off after several seconds to conserve battery life. Finally, if the **DOWN** arrow key is pressed and held down while powering the **PX-7** on, a **LOC** mode will be toggled on/off.



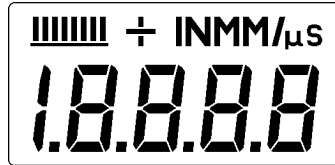
The **ALRM** key has two functions. By holding down the **ALRM** key when powering up the **PX-7**, the audible beeper will be turned on or off accordingly. After the unit has been turned on, pressing the **ALRM** key will toggle the alarm mode to the on/off positions and allow the user to enter a nominal thickness value. Refer to page 18 for details on how to use the alarm feature.



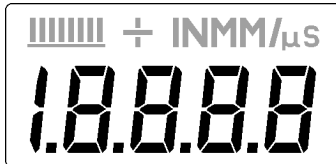
The **DIFF** key is used to enable or disable the Differential mode and allow the user to enter a nominal value as a comparison against actual thickness measurements. Refer to page 19 for a complete explanation of this feature.



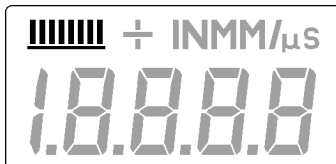
The **SEND** key is used to send the currently displayed thickness measurement to an external storage device via the **PX-7's** RS232 port. Refer to page 20 for an explanation of how to use this feature.



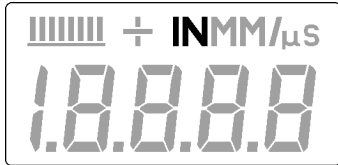
The Display



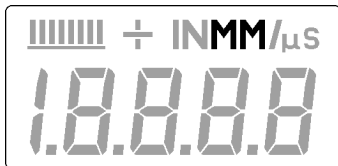
The numeric portion of the display consists of 4 complete digits preceded by a leading "1", and is used to display numeric values, as well as occasional simple words, to indicate the status of various settings. When the **PX-7** is displaying thickness measurements, the display will hold the last value measured, until a new measurement is made. Additionally, when the battery voltage is low, the entire display will begin to flash. When this occurs, the batteries should be replaced.



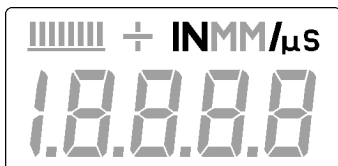
These eight vertical bars form the Stability Indicator. When the **PX-7** is idle, only the left-most bar and the underline will be on. While the gauge is taking a measurement, six or seven of the bars should be on. If fewer than five bars are on, the **PX-7** is having difficulty achieving a stable measurement, and the thickness value displayed will most likely be erroneous.



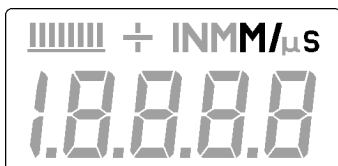
When the **IN** symbol is on, the **PX-7** is displaying a thickness value in inches. The maximum thickness that can be displayed is 1.0000 inches.



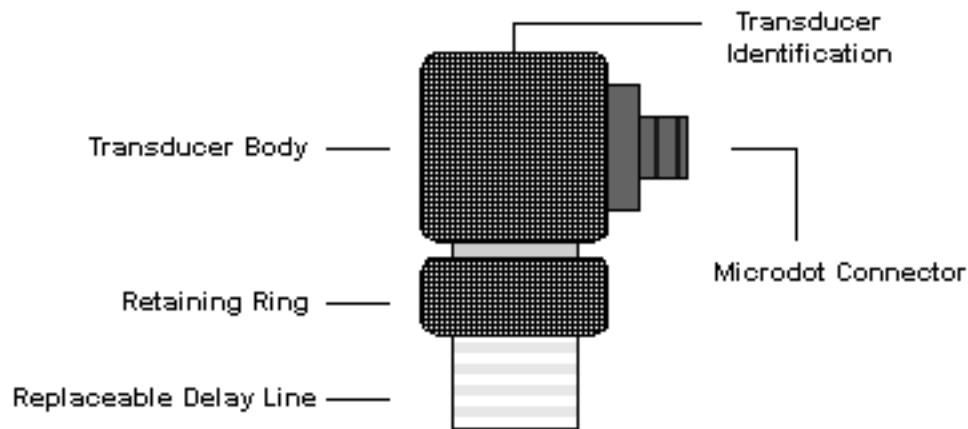
When the **MM** symbol is on, the **PX-7** is displaying a thickness value in millimeters. If the displayed thickness exceeds 20.00 millimeters, the decimal point will shift automatically to the right, allowing values up to 25.40 millimeters to be displayed.



When the **IN** symbol is on, in conjunction with the **μs** symbol, the **PX-7** is displaying a sound-velocity value in **inches-per-microsecond**.



When the **M** symbol is on, in conjunction with the **/s** symbol, the **PX-7** is displaying a sound-velocity value in **meters-per-second**.



The Transducer

The transducer is the "business end" of the *PX-7*. It transmits and receives ultrasonic sound waves that the *PX-7* uses to calculate the thickness of the material being measured. The transducer connects to the *PX-7* via the attached cable, and one coaxial connector.

The transducer must be used correctly in order for the *PX-7* to produce accurate, reliable measurements. Below is a short description of the transducer, followed by instructions for its use.

The diagram above is a side view of a typical single element delay line transducer. This delay line is fastened to the transducer with a retainer ring. **A drop of couplant is applied between the delay line and transducer body.** The transducer body contains one crystal element that is responsible for conducting ultrasonic sound into and back from the material being measured. When the transducer is placed against the material being measured, it is the area directly beneath the delay line that is being measured.

When measuring, press against the top of the transducer with the thumb or index finger to hold the transducer in place. Moderate pressure is sufficient, as it is only necessary to keep the transducer stationary, and the delay line seated flat against the surface of the material being measured.

Making Measurements

In order for the transducer to do its job, there must be no air gaps between the wear-face and the surface of the material being measured. This is accomplished with the use of a "coupling" fluid, commonly called "couplant". This fluid serves to "couple", or transfer, the ultrasonic sound waves from the transducer, into the material, and back again. Before attempting to make a measurement, a small amount of couplant should be applied to the surface of the material being measured. Typically, a single droplet of couplant is sufficient.

After applying couplant, press the transducer (wearface down) firmly against the area to be measured. The Stability Indicator should have six or seven bars darkened, and a number should appear in the display. If the **PX-7** has been set to the correct sound velocity (see page 14), the number in the display will indicate the actual thickness of the material directly beneath the transducer.

If the Stability Indicator has fewer than five bars darkened, or the numbers on the display seem erratic, first check to make sure that there is an adequate film of couplant beneath the transducer, and that the transducer is seated flat against the material. If the condition persists, it may be necessary to select a different transducer (size or frequency) for the material being measured. See page 22 for information on transducer selection.

While the transducer is in contact with the material that is being measured, the **PX-7** will perform four measurements every second, updating its display as it does so. When the transducer is removed from the surface, the display will hold the last measurement made.

IMPORTANT

Occasionally, a small film of couplant will be drawn out between the transducer and the surface as the transducer is removed. When this happens, the **PX-7** may perform a measurement through this couplant film, resulting in a measurement that is larger or smaller than it should be. This phenomenon is obvious when one thickness value is observed while the transducer is in place, and another value is observed after the transducer is removed.

Condition and Preparation of Surfaces

In any ultrasonic measurement scenario, the shape and roughness of the test surface are of paramount importance. Rough, uneven surfaces may limit the penetration of ultrasound through the material, and result in unstable, and therefore unreliable, measurements. The surface being measured should be clean, and free of any small particulate matter, rust, or scale. The presence of such obstructions will prevent the transducer from seating properly against the surface. Often, a wire brush or scraper will be helpful in cleaning surfaces. In more extreme cases, rotary sanders or grinding wheels may be used, though care must be taken to prevent surface gouging, which will inhibit proper transducer coupling.

Extremely rough surfaces, such as the pebble-like finish of some cast iron, will prove most difficult to measure. These kinds of surfaces act on the sound beam like frosted glass on light: the beam becomes diffused and scattered in all directions.

In addition to posing obstacles to measurement, rough surfaces contribute to excessive wear of the transducer, particularly in situations where the transducer is "scrubbed" along the surface.

Selecting Measurement Mode

The PX-7 is equipped with four measurement mode options (echo-echo, interface-echo, auto, or plas). In echo-echo mode, the gauge has the ability to read thin metals down to .006 inches (.15 millimeters). The echo-echo mode also allows the user to measure the thickness of metals that have been previously coated or painted on the surface. This enables the user to determine the thickness of the metal without having to remove the paint. In interface-echo mode, the gauge has the ability to read plastics and thicker materials. The PX-7's auto mode will automatically switch between echo-echo and interface-echo according to the different materials being measured. Finally, the plas mod can be used to measure thin plastics using a special graphite tip. The following section outlines how to switch between measurement modes:

Measurement Modes

- 1) Make sure the **PX-7** is on.
- 2) Press the **UP** arrow key to toggle between measurement modes. The gauge will display **GatE** followed by **I-E**, **E-E**, **Auto**, or **PLAS** depending on which mode the PX-7 was last used in.
- 3) Repeat step 2 until the desired mode has been displayed.

Note: Once the mode has been selected, the user can use the built-in **LOC** feature to prevent additional users from accidentally changing the mode. When the **PX-7** is in **LOC** mode, all features (with the exception of the calibration and units), are locked and cannot be

altered by the user. Press and hold the **DOWN** arrow key while powering up the **PX-7** to toggle the **LOC** feature on/off. Repeat procedure to toggle on/off status.

Calibration

In order for the **PX-7** to make accurate measurements, it must be set to the correct sound-velocity for the material being measured. Different types of material have different inherent sound-velocities. For example, the velocity of sound through steel is about 0.233 inches-per-microsecond, versus that of aluminum, which is about 0.248 inches-per-microsecond. If the tool is not set to the correct sound-velocity, all of the measurements the tool makes will be erroneous by some fixed percentage. The one point calibration is the simplest and most commonly used calibration procedure - optimizing linearity over large ranges. The **PX-7** provides two simple methods for setting the sound-velocity, described in the following pages.

Calibration to a known thickness

NOTE: This procedure requires a sample piece of the specific material to be measured, the exact thickness of which is known, e.g. from having been measured by some other means.

- 1) Make sure the **PX-7** is on.
- 2) Apply couplant to the sample piece.
- 3) Press the transducer against the sample piece, making sure that the transducer sits flat against the surface of the sample. The display should show some (probably incorrect) thickness value, and the Stability Indicator should have nearly all its bars on.
- 4) Having achieved a stable reading, remove the transducer. If the displayed thickness changes from the value shown while the transducer was coupled, repeat step 3.
- 5) Press the **CAL** key. The **IN** (or **MM**) symbol should begin flashing.
- 6) Use the **UP** and **DOWN** arrow keys to adjust the displayed thickness up or down, until it matches the thickness of the sample piece.
- 7) Press the **CAL** key again. The **IN/ms** (or **M/s**) symbols should begin flashing. The **PX-7** is now displaying the sound velocity value it has calculated based on the thickness value that was entered in step 6.
- 8) Press the **CAL** key once more to exit the calibration mode. The **PX-7** is now ready to perform measurements.

Calibration to a known velocity

NOTE: This procedure requires that the operator know the sound-velocity of the material to be measured. A table of common materials and their sound-velocities can be found in **Appendix C**.

- 1) Make sure the **PX-7** is on.
- 2) Press the **CAL** key to enter calibration mode. If the **IN** (or **MM**) symbol is flashing, press the **CAL** key again, so that the **IN/ms** (or **M/s**) symbols are flashing.
- 3) Use the **UP** and **DOWN** arrow keys to adjust the displayed velocity up or down, until it matches the sound-velocity of the material to be measured.
- 4) Press the **CAL** key once more to exit the calibration mode. The **PX-7** is now ready to perform measurements.

NOTE: *At any time during the calibration procedure (IN, MM, IN/ms, or M/s flashing in the display), pressing the **SCAN** key will restore the tool to the factory default sound-velocity for steel (0.233 IN/ μ s).*

To achieve the most accurate measurements possible, it is generally advisable to always calibrate the **PX-7** to a sample piece of known thickness. Material composition (and thus, its sound-velocity) sometimes varies from lot to lot and from manufacturer to manufacturer. Calibration to a sample of known thickness will ensure that the tool is set as closely as possible to the sound velocity of the material to be measured.

PX-7 Modes

Scan Mode

While the **PX-7** excels at making single point measurements, it is sometimes desirable to examine a larger region, searching for the thinnest point. The **PX-7** includes a feature, called Scan Mode, which allows it to do just that.

In normal operation, the **PX-7** performs and displays four measurements every second, which is quite adequate for single measurements. In Scan Mode, however, the tool performs eight measurements every second, but does not display them. While the transducer is in contact with the material being measured, the **PX-7** is keeping track of the lowest measurement it finds. The transducer may be "scrubbed" across a surface, and any brief interruptions in the signal will be ignored. When the transducer loses contact with the surface for more than a second, the **PX-7** will display the smallest measurement it found.

When the **PX-7** is not in calibration mode, press the **SCAN** key to turn Scan Mode on and off. A brief message will appear in the display confirming the operation. While scanning, the display will show a moving series of dashes instead of a thickness value. When the transducer is removed from the material being scanned, the **PX-7** will (after a brief pause) display the smallest measurement it found.

Alarm Mode

The Alarm Mode feature of the PX-7 allows the user to set an audible and visual Hi / Lo parameter when taking measurements. If the measurement falls below or above the Hi / Lo limits, set by the user, a red light will be illuminated on the front panel of the gauge and the beeper sounded. This improves the speed and efficiency of the inspection process by eliminating constant viewing of the actual reading displayed. The following pages outline how to enable and set up this feature:

Using the Beeper

- 1) While the unit is off, press and hold down the **ALRM** key.
- 2) Press **ON/OFF** key to power up the unit.
- 3) Release the **ALRM** key - **BEEP ON** or **BEEP OFF** will be displayed enabling or disabling the beeper.
- 4) Repeat steps 1 through 3 to toggle between **BEEP ON** or **BEEP OFF**.

Alarm Mode

- 1) Press **ON/OFF** key to power up the *PX-7*.
- 2) Press the **ALRM** key. **ALAr OFF**, or **ALAr** followed by a thickness value and flashing **IN** (or **MM**) symbol will be displayed - indicating the alarm mode is enabled.
- 3) Repeat step 2 to toggle between **ALAr OFF** or **ALAr value** and flashing **IN / MM** symbol (On).
- 4) Assuming **ALAr** value flashing **IN** is displayed, use the **UP** and **DOWN** arrow keys to scroll to the desired Lo alarm value.
- 5) Press the **SEND** key to select the Lo value entered. The Hi value will now be displayed. Repeat step 4 select the Hi alarm value.
- 6) The *PX-7* is now ready to perform measurements using the Alarm feature.

Differential Mode

In the Quality Control environment, it is sometimes necessary to know the difference between a nominal (target) thickness value and an actual thickness value. This feature is also included in the PX-7. With the Differential Mode enabled, the PX-7 will display the positive or negative difference from an entered nominal value. The following steps outline the procedure for setting up this feature:

Differential Mode

- 1) Press **ON/OFF** key to power up the *PX-7*.
- 2) Press the **DIFF** key. **DIFF OFF** or **DIFF** followed by a thickness value and flashing **IN** (or **MM**) will be displayed.
- 3) Repeat step 2 to toggle between **DIFF OFF** or **DIFF value** and flashing **IN**.
- 4) Assuming **DIFF value flashing IN** is displayed, use the **UP** and **DOWN** arrow keys to scroll to the desired nominal thickness value.
- 5) Press the **SEND** key once again to select the nominal value entered.
- 6) The *PX-7* is now ready to perform measurements using the Differential feature.

RS232 Serial Port

The *PX-7* is equipped with an RS232 serial port. Using the accessory cable (part# N-306-0010), the *PX-7* has the ability to connect to a computer, or external storage device. The following section outlines the procedure for connecting the *PX-7* to a computer, and how to collect data using any standard communications program:

Connecting To a Computer

- 1) Connect the accessory cable (part# N-306-0010) to the 2 pin jack located on the bottom of the **PX-7**, and the 9 pin connector to a serial port on the computer.
- 2) Start the communications software that will be used to collect the measurements (i.e. Windows 95/98 - HyperTerminal).
- 3) Setup the communications software using the following parameters: **Data Bits - 8, Parity - None, Stop Bits - 1, Baud Rate 1200.**
- 4) Set the communications software **COMM** port to the port number that the **PX-7** is connected.
- 5) After taking a measurement, press the **SEND** key to send the measurement to the computer. The measurement will be displayed on the computer screen.

NOTE: Communications software packages generally have the ability to capture the screen data to a common text file. This text file, containing the measurements, can then be imported into any common spreadsheet program (i.e. Excel, Quattro Pro, Lotus123) for further reporting requirements.

TRANSDUCER SELECTION

The **PX-7** is inherently capable of performing measurements on a wide range of materials, from various metals to glass and plastics. Different types of material, however, will require the use of different transducers. Choosing the correct transducer for a job is critical to being able to easily perform accurate and reliable measurements. The following paragraphs highlight the important properties of transducers, which should be considered when selecting a transducer for a specific job.

Generally speaking, the best transducer for a job is one that sends sufficient ultrasonic energy into the material being measured such that a strong, stable echo is received by the **PX-7**. Several factors affect the strength of ultrasound as it travels. These are outlined below:

- Initial Signal Strength

The stronger a signal is to begin with, the stronger its return echo will be. Initial signal strength is largely a factor of the size of the ultrasound emitter in the transducer. A large emitting area will send more energy into the material being measured than a small emitting area. Thus, a so-called "1/4-inch" transducer will emit a stronger signal than a "1/8-inch" transducer.

- Absorption and Scattering

As ultrasound travels through any material, it is partly absorbed. If the material through which the sound travels has any grain structure, the sound waves will experience scattering. Both of these effects reduce the strength of the waves, and thus, the **PX-7**'s ability to detect the returning echo.

Higher frequency ultrasound is absorbed and scattered more than ultrasound of a lower frequency. While it may seem that using a lower frequency transducer might be better in every instance, low frequencies are less directional than high frequencies.

- Geometry of the Transducer

The physical constraints of the measuring environment sometimes determine a transducer's suitability for a given job. Some transducers may simply be too large to be used in tightly confined areas. Also, the surface area available for contacting with the transducer may be limited, requiring the use of a transducer with a small cone tipped delay line. Measuring on a curved surface, may require the use of a transducer with a matching curved wearface.

- Temperature of the Material

When it is necessary to measure on surfaces that are exceedingly hot, special delay lines may be necessary. Additionally, care must be taken when performing a "Calibration to Known Thickness" with a high temperature application. See **Appendix B** for more information on measuring materials with a high temperatures.

Selection of the proper transducer is often a matter of tradeoffs between various characteristics. It may be necessary to experiment with a variety of transducers in order to find one that works well for a given job. Dakota Ultrasonics can provide assistance in choosing a transducer, and offers a broad selection of transducers for evaluation in specialized applications.

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APPENDIX A

Product Specifications

Physical

Weight: 10 ounces(with batteries).

Size: 2.5W x 4.5 H x 1.24 D inches
(63.5W x 114.3 H x 31.5 D mm).

Operating Temperature: -20 to 120 °F (-30 to 50 °C)

Case: Extruded aluminum body / nickel plated aluminum end caps.

Keypad

Sealed membrane, resistant to water and petroleum products.

Power Source

Two “AA” size, 1.5 volt alkaline or 1.2 volt NiCad cells. 150 hours typical operating time on alkaline, 100 hours on NiCad.

Display

Liquid-Crystal-Display, 4.5 digits, 0.500 inch high numerals. LED backlight.

Measuring

Range: 0.0060 to 1.0000 inches (0.15 to 25.40 millimeters) -Steel

Resolution: 0.0001 inch (0.001 millimeter)

Accuracy: ± 0.0001 inch (0.001 millimeter), depends on material and conditions

Sound Velocity Range: 0.0492 to 0.3937 in/ μ s (1250 to 10000m/s)

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APPENDIX B

Application Notes

- **Measuring tubing**

When measuring a piece of tubing for wall thickness, it may prove beneficial to have multiple delay lines with different radiuses for different tubing diameters. The delay lines can be easily radiused by placing a piece of emery cloth around the tubing and moving the transducer back and forth until a radius has formed on the tip of the delay line.

- **Measuring hot surfaces**

The velocity of sound through a substance is dependant upon its temperature. As materials heat up, the velocity of sound through them decreases. In most applications with surface temperatures less than about 200°F (100°C), no special procedures must be observed. At temperatures above this point, the change in sound velocity of the material being measured starts to have a noticeable effect upon ultrasonic measurement.

At such elevated temperatures, it is recommended that the user perform a **calibration** procedure (refer to page 14) on a sample piece of known thickness, which is at or near the temperature of the material to be measured. This will allow the **PX-7** to correctly calculate the velocity of sound through the hot material.

When performing measurements on hot surfaces, it may also be necessary to use a specially constructed high-temperature delay line. It is recommended that the probe be left in contact with the surface for as short

a time as needed to acquire a stable measurement. While the transducer is in contact with a hot surface, it will begin to heat up, and through thermal expansion and other effects, may begin to adversely affect the accuracy of measurements.

- **Measuring laminated materials**

Laminated materials are unique in that their density (and therefore sound-velocity) may vary considerably from one piece to another. Some laminated materials may even exhibit noticeable changes in sound-velocity across a single surface. The only way to reliably measure such materials is by performing a calibration procedure on a sample piece of known thickness. Ideally, this sample material should be a part of the same piece being measured, or at least from the same lamination batch. By calibrating to each test piece individually, the effects of variation of sound-velocity will be minimized.

An additional important consideration when measuring laminates, is that any included air gaps or pockets will cause an early reflection of the ultrasound beam. This effect will be noticed as a sudden decrease in thickness in an otherwise regular surface. While this may impede accurate measurement of total material thickness, it does provide the user with positive indication of air gaps in the laminate.

APPENDIX C

Sound Velocities of some Common Materials

Material	in/us	sound velocity	m/s
Aluminum	0.250		6350
Bismuth	0.086		2184
Brass	0.173		4394
Cadmium	0.109		2769
Cast Iron	0.180 (apprx)		4572
Constantan	0.206		5232
Copper	0.184		4674
Epoxy resin	0.100 (apprx)		2540
German silver	0.187		4750
Glass, crown	0.223		5664
Glass, flint	0.168		4267
Gold	0.128		3251
Ice	0.157		3988
Iron	0.232		5893
Lead	0.085		2159
Magnesium	0.228		5791
Mercury	0.057		1448
Nickel	0.222		5639
Nylon	0.102 (apprx)		2591
Paraffin	0.087		2210
Platinum	0.156		3962
Plexiglass	0.106		2692
Polystyrene	0.092		2337
Porcelain	0.230 (apprx)		5842
PVC	0.094		2388
Quartz glass	0.222		5639
Rubber, vulcanized	0.091		2311
Silver	0.142		3607
Steel, common	0.233		5918
Steel, stainless	0.223		5664
Stellite	0.275 (apprx)		6985
Teflon	0.056		1422
Tin	0.131		3327
Titanium	0.240		6096
Tungsten	0.210		5334
Zinc	0.166		4216
Water	0.058		1473

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WARRANTY INFORMATION

· Warranty Statement ·

Dakota Ultrasonics warrants the PX-7 against defects in materials and workmanship for a period of five years from receipt by the end user. Additionally, Dakota Ultrasonics warrants transducers and accessories against such defects for a period of 90 days from receipt by the end user. If Dakota Ultrasonics receives notice of such defects during the warranty period, Dakota Ultrasonics will either, at its option, repair or replace products that prove to be defective.

Should Dakota Ultrasonics be unable to repair or replace the product within a reasonable amount of time, the customer's alternative exclusive remedy shall be refund of the purchase price upon return of the product.

· Exclusions ·

The above warranty shall not apply to defects resulting from: improper or inadequate maintenance by the customer; unauthorized modification or misuse; or operation outside the environmental specifications for the product.

Dakota Ultrasonics makes no other warranty, either express or implied, with respect to this product. Dakota Ultrasonics specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. Some states or provinces do not allow limitations on the duration of an implied warranty, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited to the five-year duration of this written warranty.

This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state or province to province.

· Obtaining Service During Warranty Period ·

If your hardware should fail during the warranty period, contact Dakota Ultrasonics and arrange for servicing of the product. Retain proof of purchase in order to obtain warranty service.

For products that require servicing, Dakota Ultrasonics may use one of the following methods:

- Repair the product
- Replace the product with a re-manufactured unit
- Replace the product with a product of equal or greater performance
- Refund the purchase price.

· After the Warranty Period ·

If your hardware should fail after the warranty period, contact Dakota Ultrasonics for details of the services available, and to arrange for non-warranty service.

MATERIAL SAFETY DATA SHEET

N/A = not applicable or not available

(To comply with 29 CFR 1910.1200)

SECTION 1 – PRODUCT IDENTIFICATION

Product Name: **SOUNDSAFE®**
Generic Name: Ultrasonic Couplant
Manufacturer: Sonotech, Inc.
774 Marine Dr., Bellingham, WA 98225
(360) 671-9121

NFPA Hazardous Materials
Identification System (est)
Health.....0
Flammability.....0
Reactivity.....0

SECTION 2 – HAZARDOUS INGREDIENTS

This material does not contain any ingredients having known health hazards in concentrations greater than 1%.

This material does not contain any known or suspected carcinogens.

SECTION 3 – PHYSICAL DATA (nominal)

Boiling Point: >220°F pH: 7.35 – 7.9
Freezing Point: <20°F Acoustic Imp.: 1.726x10⁶
Vapor Pressure: N/A Vapor Density: N/A
Evaporation Rate: N/A Specific Gravity: >1.02
Solubility in Water: complete
Appearance and Odor: water white, opaque gel;
bland odor

SECTION 4 – FIRE AND EXPLOSION HAZARD DATA

Flash Point: none
Upper Exposure Limit: none
Lower Exposure Limit: none
Special Fire Fighting Procedures: N/A
Extinguishing media: N/A
Unusual Fire and Explosion Hazards: none

SECTION 5 – REACTIVITY DATA

Stability: Stable
Conditions to Avoid: none
Incompatibility (Materials to Avoid): none known
Hazardous Polymerization: will not occur
Hazardous Decomposition or Byproducts: none known

SECTION 6 – HEALTH HAZARD AND FIRST AID DATA

Routes of Entry:¹
Skin: not likely Ingestion: not normally
Eyes: not normally Inhalation: no
Effects of Overexposure: *Acute:* May cause temporary
eye irritation
Chronic: none expected

First Aid Procedures:
Skin: Remove with water if desired.
Eyes: Flush with water for 15 minutes.
Ingestion: For large quantities, induce vomiting and
call a physician.
Inhalation: N/A

SECTION 7 – STORAGE AND HANDLING INFORMATION

Precautions to be taken in handling and storage: Store
between 20°F and 120°F. Spills are slippery and should
be cleaned up immediately.
Steps to be taken in case material is released or spilled:
Pick up excess for disposal. Clean with water.
Waste disposal method: Dispose of in accordance with
federal, state, and local regulations.

SECTION 8 – CONTROL MEASURES

Respiratory Protection: not required
Ventilation: not required
Protective Gloves: on individuals demonstrating
sensitivity to SOUNDSAFE®
Eye Protection: as required by working conditions
Other Protective Equipment: not required

¹SOUNDSAFE® contains only food grade and cosmetic grade ingredients.

SONOTECH, INC.

774 Marine Dr., Bellingham, WA 98225
Telephone: (360) 671-9121

Toll Free: 1-800-458-4254

Fax: (360) 671-9024