# OPERATION MANUAL

## NDT-715 ULTRASONIC THICKNESS GAUGE

Rev. B, July 2007



NDT INTERNATIONAL, INC.

**711 S. Creek Road**
**West Chester, PA 19382-8013 USA**
www.ndtint.com E-mail: ndtint@ndtint.com

NDT **INTERNATIONAL, INC.**

711 S. Creek Road,
West Chester, Pennsylvania, 19382-8013 USA
Tel (610) 793-1700 Fax (610) 793-1702

E-Mail: ndtint@ndtint.com

Internet: http://www.ndtint.com

# CONTENT



## 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.

# INTRODUCTION

The NDT International model **NDT-715** is a precision ultrasonic micrometer that is based on the same operating principles as SONAR. The **NDT-715** is capable of measuring the thickness of various materials with accuracy as high as ± 0.001 inches, or ± 0.01 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 **NDT-715**, 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.

NDT International, Inc. 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:

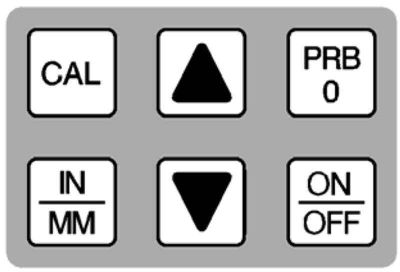
NDT **INTERNATIONAL, INC.,**
711 S. Creek Road
West Chester, PA 19382-8013 USA
Telephone: (610) 793-1700
Facsimile: (610) 793-1702
E-Mail: ndtint@ndtint.com
Internet: http://www.ndtint.com

3

blank page

# OPERATION

The **NDT-715** 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 **NDT-715** 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 "0.000" (or "0.00" if using metric units), indicating the tool is ready for use.

The **NDT-715** 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.

**PRB**
**0**

The **PRB-0** key is used to "zero" the **NDT-715** in much the same way that a mechanical micrometer is zeroed. If the tool is not zeroed correctly, all of the measurements that the tool makes may be in error by some fixed value. Refer to page 13 for an explanation of this important procedure.

---

**CAL**

The **CAL** key is used to enter and exit the **NDT-715**'s calibration mode. This mode is used to adjust the sound-velocity value that the **NDT-715** 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.

---

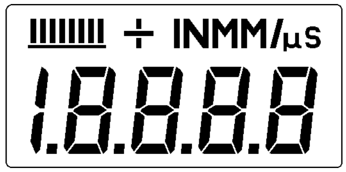
**IN**
**MM**

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/μs** or **M/s**).

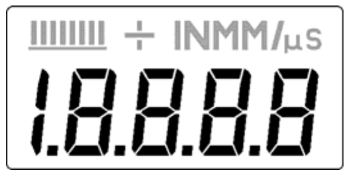

The **UP** arrow key has two functions.  When the **NDT-715** is in calibration mode, this key is used to increase numeric values on the display.  An auto-repeat function is built in, so that when the key is held down, numeric values will increment at an increasing rate.  When the **NDT-715** is not in calibration mode, the **UP** arrow key switches the **SCAN** measurement mode on and off.  Refer to page 18 for an explanation of the **SCAN** measurement mode.

---

The **DOWN** arrow key also has two functions.  When the **NDT-715** 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 **NDT-715** 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 when the **NDT-715** is actually making a measurement.

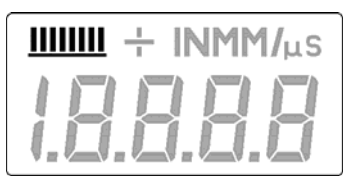



## The Display

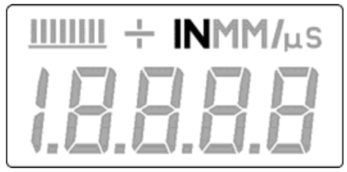



The numeric portion of the display consists of 4 complete digits preceded by a leading "1", and is used to display numeric values, as well as occasional simple words, to indicate the status of various settings. When the **NDT-715** is displaying thickness measurements, the display will hold the last 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.

---

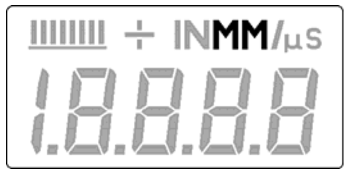



These eight vertical bars form the Stability Indicator. When the **NDT-715** is idle, only the left-most bar and the underline will be on. When the tool is making a measurement, six or seven of the bars should be on. If fewer than five bars are on, the **NDT-715** is having difficulty achieving a stable measurement, and the thickness value displayed will most likely be erroneous.



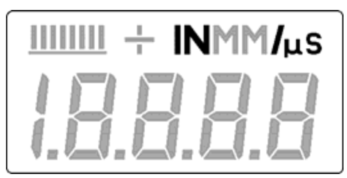

When the **IN** symbol is on, the **NDT-715** is displaying a thickness value in inches.  The maximum thickness that can be displayed is 19.999 inches.

---



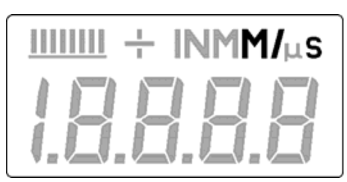

When the **MM** symbol is on, the **NDT-715** is displaying a thickness value in millimeters.  If the displayed thickness exceeds 199.99 millimeters, the decimal point will shift automatically to the right, allowing values up to 1999.9 millimeters to be displayed.

---




When the **IN** symbol is on, in conjunction with the **/µs** symbol, the **NDT-715** is displaying a sound-velocity value in **inches-per-microsecond.**

---




When the **M** symbol is on, in conjunction with the **/s** symbol, the **NDT-715** is displaying a sound-velocity value in **meters-per-second**.

## The Transducer

The transducer is the "business end" of the **NDT-715**. It transmits and receives the ultrasonic sound waves which the **NDT-715** uses to calculate the thickness of the material being measured. The transducer connects to the **NDT-715** via the attached cable, and two coaxial connectors. When using transducers manufactured by NDT International, Inc., the orientation of the dual coaxial connectors is not critical: either plug may be fitted to either socket in the **NDT-715**.

The transducer must be used correctly in order for the **NDT-715** to produce accurate, reliable measurements. Below is a short description of the transducer, followed by instructions for its use.

This is a bottom view of a typical transducer. The two semicircles of the wearface are visible, as is the barrier separating them. One of the semicircles is responsible for conducting ultrasonic sound into the material being measured, and the other semicircle is responsible for conducting the echoed sound back into the transducer. When the transducer is placed against the material being measured, it is the area directly beneath the center of the wearface that is being measured.

This is a top view of a typical transducer. Press against the top 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 wearface 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 transmit, 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 **NDT-715** has been properly "zeroed" (see page 13) and 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 19 for information on transducer selection.

While the transducer is in contact with the material being measured, the **NDT-715** 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 **NDT-715** 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 irons, 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. Transducers should be inspected on a regular basis, for signs of uneven wear of the wearface. If the wearface is worn on one side more than another, the sound beam penetrating the test material may no longer be perpendicular to the material surface. In this case, it will be difficult to exactly locate tiny irregularities in the material being measured, as the focus of the soundbeam no longer lies directly beneath the transducer.

# Probe Zero

Setting the Zero Point of the **NDT-715** is important for the same reason that setting the zero on a mechanical micrometer is important. If the tool is not "zeroed" correctly, all of the measurements the tool makes will be in error by some fixed number. When the **NDT-715** is "zeroed", this fixed error value is measured and automatically corrected for in all subsequent measurements. The **NDT-715** may be "zeroed" by performing the following procedure:

## Performing a Probe-Zero

1) Make sure the **NDT-715** is on.
2) Plug the transducer into the **NDT-715**. Make sure that the connectors are fully engaged. Check that the wearface of the transducer is clean and free of any debris.
3) On the top of the **NDT-715**, above the display, is the metal battery compartment cap also used as the probe-disc. Apply a single drop of ultrasonic couplant to the face of this disc.
4) Press the transducer against the probe-disc, making sure that the transducer sits flat against the surface of the probe-disc. The display should show some thickness value, and the Stability Indicator should have nearly all its bars illuminated.
5) While the transducer is firmly coupled to the probe-disc, press the **PRB-0** key on the keypad. The **NDT-715** will display "Prb0" while it is calculating its zero point. It will then display a value of about 0.415” ±0.005” (the calculated thickness of the probe-disc).
6) Remove the transducer from the probe-disc.

At this point, the **NDT-715** has successfully calculated it's internal error factor, and will compensate for this value in any subsequent measurements. When performing a "probe-zero", the **NDT-715** will always use the sound-velocity value of the built-in probe-disc, even if some other velocity value has been entered for making actual measurements. Though the **NDT-715** will remember the last "probe-zero" performed, it is generally a good idea to perform a "probe-zero" whenever the tool is turned on, as well as any time a different transducer is used. This will ensure that the instrument is always correctly zeroed.

## Calibration

In order for the **NDT-715** 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 <u>large</u> ranges. The **two point** calibration allows for greater accuracy over <u>small</u> ranges by calculating the probe zero and velocity. The **NDT-715** provides three 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 **NDT-715** is on.
2) Perform a Probe-Zero (refer to page 13)
3) Apply couplant to the sample piece.
4) 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.
5) Having achieved a stable reading, remove the transducer. If the displayed thickness changes from the value shown while the transducer was coupled, repeat step 4.
6) Press the **CAL** key. The **IN** (or **MM**) symbol should begin flashing.
7) Use the **UP** and **DOWN** arrow keys to adjust the displayed thickness up or down, until it matches the thickness of the sample piece.
8) Press the **CAL** key again. The **IN/µs** (or **M/s**) symbols should begin flashing. The **NDT-715** is now displaying the sound velocity value it has calculated based on the thickness value that was entered in step 7.
9) Press the **CAL** key once more to exit the calibration mode. The **NDT-715** 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 **NDT-715** 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/µs** (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 **NDT-715** is now ready to perform measurements.

NOTE: *At any time during the calibration procedure (***IN**, **MM**, **IN/µs**, *or* **M/s** *flashing in the display), pressing the* **PRB-0** *key will restore the tool to the factory default sound-velocity for steel* (0.233 IN/µs).

To achieve the most accurate measurements possible, it is generally advisable to always calibrate the **NDT-715** 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.

## Two Point Calibration

NOTE: This procedure requires that the operator has two known thickness points on the test piece that are representative of the range to be measured (preferably the minimum and maximum).

1) Make sure the **NDT-715** is on.
2) Perform a Probe-Zero (refer to page 13)
3) Apply couplant to the sample piece.
4) Press the transducer against the thinnest 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.
5) Having achieved a stable reading, remove the transducer. If the displayed thickness changes from the value shown while the transducer was coupled, repeat step 4.
6) Press the **CAL** key. The **IN** (or **MM**) symbol should begin flashing.
7) Use the **UP** and **DOWN** arrow keys to adjust the displayed thickness up or down, until it matches the thickness of the sample piece.
8) Press the **Probe** key. The display will flash **1OF2** (for 1 of 2) **Repeat steps 3 through 7** on the thicker sample. The **NDT-715** will now display the sound velocity value it has calculated based on the thickness values that were entered in step 7.
9) The **NDT-715** is now ready to perform measurements.


## Scan Mode

While the **NDT-715** excels at making single point measurements, it is sometimes desirable to examine a larger region, searching for the thinnest point.  The **NDT-715** includes a feature, called Scan Mode, which allows it to do just that.

In normal operation, the **NDT-715** performs and displays four measurements every second, which is quite adequate for single measurements.  In Scan Mode, however, the tool performs sixteen measurements every second, but does not display them.  While the transducer is in contact with the material being measured, the **NDT-715** 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 **NDT-715** will display the smallest measurement it found.

When the **NDT-715** is not in calibration mode, press the **UP** arrow 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 **NDT-715** will (after a brief pause) display the smallest measurement it found.

# TRANSDUCER SELECTION

The **NDT-715** 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 **NDT-715**. Several factors affect the strength of ultrasound as it travels. These are outlined below:

- <u>Initial Signal Strength</u>

  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 "1/2-inch" transducer will emit a stronger signal than a "1/4-inch" transducer.

- <u>Absorption and Scattering</u>

  As ultrasound travels through any material, it is partly absorbed. If the material through which it travels has any grain structure, the sound waves will also experience scattering. Both of these effects reduce the strength of the waves, and thus, the **NDT-715**'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. Thus, a higher frequency transducer would be a better choice for detecting the exact location of small pits or flaws in the material being measured.

- <u>Geometry of the Transducer</u>

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 wearface. Measuring on a curved surface, such as an engine cylinder wall, may require the use of a transducer with a matching curved wearface.

- <u>Temperature of the Material</u>

When it is necessary to measure on surfaces that are exceedingly hot, high temperature transducers must be used. These transducers are built using special materials and techniques that allow them to withstand high temperatures without damage. Additionally, care must be taken when performing a "Probe-Zero" or "Calibration to Known Thickness" with a high temperature transducer. See **Appendix B** for more information on measuring materials with a high temperature transducer.

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. NDT International, Inc. can provide assistance in choosing a transducer, and offers a broad selection of transducers for evaluation in specialized applications.

# RESET TO DEFAULT SETTINGS

To reset the NDT-715 Gauge to the original default settings follow these steps.

1) Turn gauge OFF.
2) Turn gauge ON.
3) Wait for gauge to run setup.
4) Press CAL.
5) Press PROB 0.

Connect the Probe to the gauge and perform the normal Probe Zero function as instructed on page 13. Put a drop of couplant on the probe-disc (battery compartment cap). Firmly place the probe on the disc and press PROB 0. The gauge will calculate the zero point and should then display a value of around 0.415”. Once it does this you are reading to take measurements.

# APPENDIX A

## Product Specifications

### Physical

Weight:  10 ounces

Size:  2.5 W x 4.75 H x 1.25 D inches
(63.5 W x 120.7 H x 31.8 D mm)

Operating Temperature:  -20 to 120 °F (-20 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.  200 hours typical operating time on alkaline, 120 hours on NiCad.

### Display

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

### Measuring

Range:  0.025 to 19.999 inches (0.63 to 499.99 millimeters)

Resolution:  0.001 inch (0.01 millimeter)

Accuracy:  ±0.001 inch (0.01 millimeter), depends on material and conditions

Sound Velocity Range: 0.0492 to 0.3930 in/µs (1250 to 10000m/s)

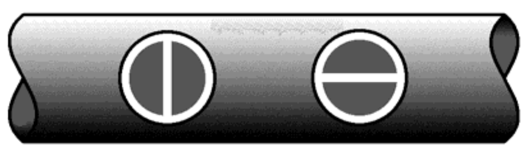
blank page

# APPENDIX B

## Application Notes

- **Measuring Pipe and Tubing**

When measuring a piece of pipe to determine the thickness of the pipe wall, orientation of the transducers is important. If the diameter of the pipe is larger than approximately 4 inches, measurements should be made with the transducer oriented so that the gap in the wearface is perpendicular (at right angle) to the long axis of the pipe. For smaller pipe diameters, two measurements should be performed, one with the wearface gap perpendicular, another with the gap parallel to the long axis of the pipe. The smaller of the two displayed values should then be taken as the thickness at that point.



Perpendicular Parallel

- **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 11) on a sample piece of known thickness, which is at or near the temperature of the material to be measured. This will allow the **NDT-715** 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 transducer. These transducers are built using materials which can withstand high temperatures. Even so, 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 itself, and through thermal expansion and other effects, may begin to adversely affect the accuracy of measurements.

## High Temperature Thickness Measurement Procedure

- Grind excessively rough or corroded surfaces smooth to provide proper coupling.
- Measure the temperature of test surface.
- Select appropriate couplant and transducer for the application.
- Perform a probe zero according to the gauge manual.
- Apply couplant to probe face and then couple to the test surface. DO NOT APPLY TO THE HOT TEST MATERIAL FIRST.
- Use only light transducer contact pressure to achieve proper coupling.
- Look for the measurement value to be displayed within 1-2 seconds.

- Gently rock the probe, if necessary, to get a displayed value.
  DO NOT INCREASE CONTACT PRESSURE OR REMAIN IN CONTACT FOR MORE THAN 5 SECONDS TO AVOID DAMAGING THE PROBE.
- Uncouple the probe and immerse in cool water or air cool until the probe returns to ambient temperature.
- Wipe remaining used couplant from probe before applying new couplant for the next measurement.

WARNING!

INTERNAL PROBE TEMPERATURES ABOVE 300°F (150°C) CAN DAMAGE THE PROBE RESULTING IN EXCESSIVE RINGING, LOSS OF SENSITIVITY OR TOTAL PROBE FAILURE.

- **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.

blank page

# APPENDIX C

## Sound Velocities of some Common Materials

| Material | Sound Velocity inch/micro sec | meter/sec |
|---|---|---|
| Aluminum | 0.250 | 6350 |
| Bismuth | 0.086 | 2184 |
| Brass | 0.173 | 4394 |
| Cadmium | 0.109 | 2769 |
| Cast Iron | 0.180 (apprx) | 4572 |
| 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 |
| 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 |

# APPENDIX D

Part Number

## Optional Accessories

Transducers

| | |
|---|---|
| T-001-2000 | Small Diameter: 0.19" Dia. x 5.0 MHz Dual on 4 foot long top exit cable. Range of 0.040" to 6.000", 1.00 to 150.00mm; good to +200F (+93C) |
| T-101-2000 | Small Diameter: 0.19" Dia. x 5.0 MHz Dual on 4 foot long side exit cable. Range of 0.040" to 6.000", 1.00 to 150.00mm; good to +200F (+93C) |
| T-101-2700 | Small Diameter: High Damped for thru-paint measurement, 0.19" Dia. x 5.0 MHz Dual on 4 foot long side exit cable. Range of 0.040" to 6.000", 1.00 to 150.00mm |
| T-102-2000 | Standard with NDT-715 Gauge: 0.25" Dia. x 5.0 MHz Dual on 4 foot long side exit cable Range of 0.040" to 8.000", 1.00 to 199.99mm; good to +200F (+93C) |
| T-102-2700 | High Damped for thru-paint measurement: 0.25" Dia. x 5.0 MHz Dual on 4 foot long side exit cable. Range: 0.040" to 8.000", 1.00 to 199.99mm; +200F (+93C) |
| T-102-3300 | High Resolution: 0.25" Dia. x 7.5 MHz Dual on side exit 4 foot long cable Range: 0.025" to 2.000", 0.63 to 50.00mm, +200F (+93C) |
| T-102-1000 | High Power, Extended Range: 0.25" Dia. x 2.25 MHz Dual on side exit 4 foot long cable. Range: 0.080" to 12.000", 5.00 to 199.99mm, +200F (+93C) |
| T-104-1000 | High Power, Extended Range: 0.50" Dia. x 2.25 MHz Dual on side exit 4 foot long cable. Range: 0.200" to 12.000", 5.00 to 199.99mm, +200F (+93C) |
| T-042-2000 | High Temperature: good up to +650F Max (+340C); 0.25" Dia. x 5.0 MHz Dual, 4" long straight housing, top exit 4 ft. lg. cable, Range: 0.080" to 6.000", 2.00 to 150.00mm |
| T-212-2001 | High Temperature: good up to +900F Max (+480C); 0.25" Dia. x 5.0 MHz Dual in 4" long straight housing, top exit 4 ft. lg. cable, Range: 0.080" to 6.000", 2.00 to 150.00mm |
| T-042-2700 | High Temperature, High Damped for thru-paint measurement: good to +650F Max (+340C) 0.25" Dia. x 5.0 MHz Dual. in 4" long straight housing, top exit 4 ft. long cable. Range: 0.080" to 6.000", 2.00 to 150.00mm |
| | Many others are available to meet your applications |

Calibration Blocks (with NIST Traceable Certs)

| | |
|---|---|
| 4SB | 4-Step, nickel plated steel, 0.250" to 1.000", in .250" steps |
| 5SB | 5-Step, nickel plated steel, 0.100" to 0.500", in .100" steps |
| 10SB | 10-Step, nickel plated steel, 0.1" to 1.0" in 0.100" steps |
| 4SM | 4-Step, nickel plated steel, 6.25mm to 25.0mm, in 6.25mm steps |
| 5SM | 5-Step, nickel plated steel, 2.5mm to 12.5mm, in 2.5mm steps |
| 8SM | 8-Step, nickel plated steel, 1.00 to 8.00mm 0.500", in 1.00mm steps |
| 10SM20 | 10-Step, nickel plated steel, 2.0mm to 20.0mm, in 2.00mm steps |
| 10SM25 | 10-Step, nickel plated steel, 2.50mm to 25.0mm, in 2.50mm steps |

Ultrasonic Couplant

| | |
|---|---|
| UTGL4C | Case of 1 dozen, 4 oz squeeze bottles, ULTRAGEL-II (-10 to +210F, +100C) |
| UTGL12C | Case of 1 dozen, 12 oz squeeze bottles, ULTRAGEL-II |
| UTGL1G | Gallon plastic cubitainer, ULTRAGEL-II |
| UTGL5G | 5 Gallon plastic cubitainer, ULTRAGEL-II |
| SONO600 | 4 oz tube, high temperature Gel couplant (up to +600F, +315 C) |
| SONO900 | 4 oz tube, high temperature Paste (+600 to +900F, +315 to +480C) |

Other Accessories

| | |
|---|---|
| F-000-7001 | Bell Shaped Spring Loaded Probe Holder (V-Block) for small diameter objects |
| F-112-0005 | Nylon Instrument Case with Neck and Wrist Straps (715, MX-5, MMX-6, PX-7 gauges) |
| F-149-0001 | Nylon Instrument Case with Neck and Wrist Straps (815, MMX-7, PVX, CMX gauges) |
| 700-CB | Padded Nylon Carry Bag with Shoulder Strap and Outside Pocket |
| A-100-6002 | Hard Shell, Foam-Lined Carry Case for 705, 710, 715, MMX-6 or PX-7 Gauges |
| A-100-6003 | Hard Shell, Foam-Lined Carry Case for 705, 710, 715, MMX-6 or PX-7 Gauges |

# WARRANTY INFORMATION

## • Warranty Statement •

NDT International, Inc. warrants the NDT-715 against defects in materials and workmanship for a period of two years from receipt by the end user. Additionally, NDT International, Inc. warrants transducers and accessories against such defects for a period of 90 days from receipt by the end user. If NDT International, Inc. receives notice of such defects during the warranty period, NDT International, Inc. will either, at its option, repair or replace products that prove to be defective.

Should NDT International, Inc. 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.

NDT International, Inc. makes no other warranty, either express or implied, with respect to this product. NDT International, Inc. 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 NDT International, Inc. and arrange for servicing of the product. Retain proof of purchase in order to obtain warranty service.

For products that require servicing, NDT International, Inc. 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 NDT International, Inc. for details of the services available, and to arrange for non-warranty service.

# OPERATOR'S NOTES: