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TI-45N Ultrasonic Wall Thickness Gauge

ABQINDUSTRIAL
PRECISION. RELIABILITY. QUALITY.

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TI-45N Operating Instruction Guide

OI503-45N

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1.0 Introduction

The CHECK•LINE® TI-45N Thickness Gauge measures the wall thickness of metals, glass, ceramics and many rigid plastics. This gauge uses the "pulse-echo" principle of ultrasonic testing where a short ultrasonic signal is transmitted from the probe. The signal travels through the measurement sample until it is reflected back towards the probe from the back side of the material. The elapsed time for this complete cycle is measured and converted into an accurate thickness reading.

The gauge can be used to measure the extent of corrosion on the opposite, inaccessible side of the wall by using the "Subtractive Method." When the thickness of the original wall is known, subtracting the thickness reading obtained from the TI-45N gauge will determine the extent of corrosion at the point of probe placement. If the original wall thickness is not known, test readings should be made along a grid of equally-spaced points to obtain a profile of thickness readings. The smallest thickness reading will locate the area of greatest corrosion.

The gauge is supplied from the factory set for an acoustic velocity of 5930 m/sec to measure steel. The acoustic velocity is easily changed to accurately measure materials other than steel. Refer to section 6.3 Changing Acoustic Velocity and section 6.1 the Acoustic Velocity Selection Table. The TI-45N gauge measures thickness in either Inch (factory default) or mm units. To change units of measure, refer to section 4.1.

The TI-45N is supplied as a complete kit, including the gauge with wrist-strap, probe and cable assembly, a 2-ounce bottle of coupling fluid (couplant) and a AA battery — all supplied in a fitted, hard-plastic carrying case.

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Warranty

ELECTROMATIC Equipment Co., Inc. (ELECTROMATIC) warrants to the original purchaser that this product is of merchantable quality and confirms in kind and quality with the descriptions and specifications thereof. Product failure or malfunction arising out of any defect in workmanship or material in the product existing at the time of delivery thereof which manifests itself within one year from the sale of such product, shall be remedied by repair or replacement of such product, at ELECTROMATIC's option, except where unauthorized repair, disassembly, tampering, abuse or misapplication has taken place, as determined by ELECTROMATIC. All returns for warranty or non-warranty repairs and/or replacement must be authorized by ELECTROMATIC, in advance, with all repacking and shipping expenses to the address below to be borne by the purchaser.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE OR APPLICATION. ELECTROMATIC SHALL NOT BE RESPONSIBLE NOR LIABLE FOR ANY CONSEQUENTIAL DAMAGE, OF ANY KIND OR NATURE, RESULTING FROM THE USE OF SUPPLIED EQUIPMENT, WHETHER SUCH DAMAGE OCCURS OR IS DISCOVERED BEFORE, UPON OR AFTER REPLACEMENT OR REPAIR, AND WHETHER OR NOT SUCH DAMAGE IS CAUSED BY MANUFACTURER'S OR SUPPLIER'S NEGLIGENCE WITHIN ONE YEAR FROM INVOICE DATE.

Some State jurisdictions or States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. The duration of any implied warranty, including, without limitation, fitness for any particular purpose and merchantability with respect to this product, is limited to the duration of the foregoing warranty. Some states do not allow limitations on how long an implied warranty lasts but, not withstanding, this warranty, in the absence of such limitations, shall extend for one year from the date of invoice.

Appendix

The TI-45N Thickness Gauge is supplied from the factory set for an acoustic velocity of 5930 m/sec for the measurement of steel. To measure the thickness of any other material, the acoustic velocity must be changed. When checking the built-in calibration sample, the gauge will display the "Equivalent Value" listed in the Table in section 6.4, instead of 0.197" (or *5.0 mm*)

ACOUSTIC VELOCITY SELECTION TABLE

	Material Type	Acoustic Velocity (meters/sec)	Equivalent Value Of Calibration Disc **(Inch)**	Equivalent Value Of Calibration Disc Disc **(mm)**
◆	Aluminum	6260	.208	5.3
◆	Acrylic (Plexiglass)	2700	.090	2.3
◆	Cast Iron	4400-5000	.148 - .168	3.8 - 4.3
◆	Ceramics	10000	.332	8.4
◆	Copper	4700	.156	3.9
	Duralumin (17S)	6320	.211	5.3
	Ebonite	2500	.083	2.1
◆	Glass	5570	.185	4.7
	Nickel	6040	.201	5.1
◆	Polyethylene (Soft)	1900	.063	1.6
	Polyvinyl Chloride (PVC)	2300-2500	.077-.083	1.9 - 2.1
	Quartz (X cut)	5720	.191	4.9
◆	Stainless Steel (SUS304)	5790	.193	4.9
	Stainless Steel (SUS403)	6100	.205	5.2
◆	Stainless Steel (SUS410)	7390	.246	6.2
◆	Steel	5930	.197	5.0
	Tin	3320	.110	2.8
◆	Zinc (Zn)	4170	.139	3.5

◆ Denotes one of the 10 preset values in Mode C.

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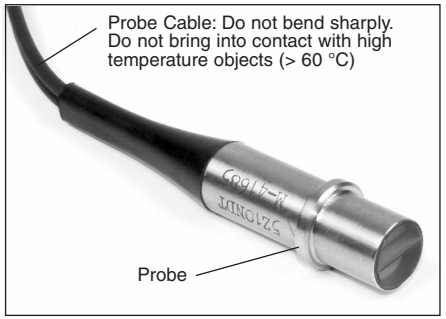
2.0 Precautions

1. The probe surface is fabricated from acrylic resin and care should be taken to insure that it is not scratched by sliding over rough surfaces. The probe should be placed down for measurements and lifted vertically when complete. Do not slide over rough surfaces.
2. Do not use this gauge where material temperatures exceed 140 °F *(60 °C)* as the probe will be damaged. Use the CHECK•LINE Model TI-25H High Temperature Thickness Gauge for these applications.
3. Keep the gauge free of dust (especially metal powders, carbon, etc.) as they will damage the PC Board. Use a damp cloth to clean the gauge after use. DO NOT USE CHEMICAL SOLVENTS OF ANY KIND.

3.0 Description of Gauge

3.1 Gauge

3.2 Probe Assembly



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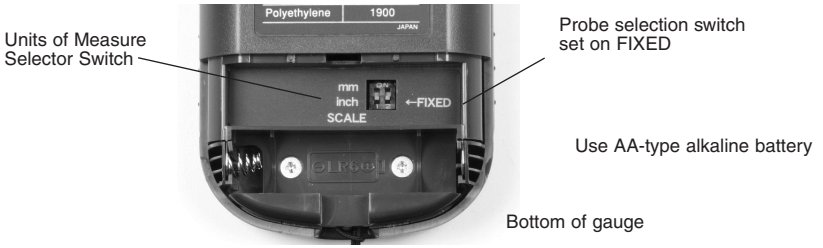
9.0 Specifications

Range (steel)	Flat plate 1.00 to 199.99*mm* Pipe 30 in. diameter and 1.50 in. thickness or more
Accuracy *(mm)*	±0.02
Errors *(mm)*	1.00 to 99.9 ±0.05 100.00 to 199.99 ±2% / rdg
Probe (standard)	5Z10NDT-M
Probe Cable	HF coaxial cable: 1.5 D-QEVX2C, 1.0m Connector: FFS00250CTCE31
Object Material	Iron, steel, aluminum, any other metal, hard plastics, glass and ceramics
Sonic Velocity Adjustable Range	1,000 – 12,000 m/s (10 predefined sonic velocities stored in meter
Display	Digital LCD display with backlight
Display Resolution	0.01*mm* (1.00*mm* to 199.9*mm*)
Display Frequency	Approx. 3 times / sec
Digits	4-1/2 (max 19999) the upper digit displays 1 only
Start-up Time	Approx 2 Sec.
Power Supply	1 AA-type alkaline battery, 1.5 V
Operating Time	>30 hours continuous operation Usage: 2 sec. measurement followed by 10 sec standby
Test Panel for Zero Adjustment	5.00 mm thickness for steel (sonic velocity 5930 m/s) come standard with gauge
Weight	Meter: approx 150 g. Probe: Approx. 50 g
Dimensions	69 (W), 144 (L), 30 (H) mm
Operating Temperature	-5 °C to 55 °C
Storage Temperature	-10 °C to 55 °C
Warranty	Meter: 1 year. Probe: 90 days

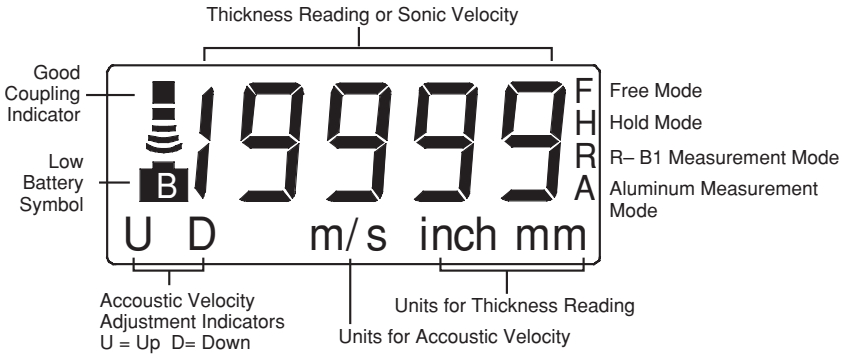
Description of Problem	Possible Cause	Action To Be Taken
Fluxuating readings	Defective probe	Return to manufacturer
Fluxuating readings while measuring aluminum	Aluminum measurement is being taken in standard mode	Switch to aluminum mode
No reading or wildly fluxuating reading while measuring resin	Measurement is being taken in S to B_1 mode	Switch to R to B_1 mode
Flashing coupling signal and/or reading is displayed while the measurement is in standby 	Probe or meter failure or deterioration	Return to manufacturer for service
Sonic velocity reading cannot be modified (fixed to 5930 m/s)	• Effect of external noise • Meter failure	• Change use location • Return to manufacturer for service
Measurement of Test Plate does not show 0.197" *(5.00mm)*	• Acoustic Velocity not set to 5930 (steel)	• Change velocity to 5930 5930 µs. (Refer to section 5.0)

3.3. Complete Kit

3.4 Battery Compartment



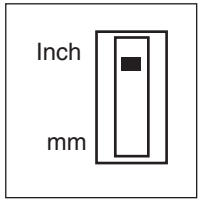
3.5 LCD Display



4.0 Getting Started

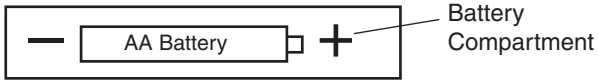
4.1 Setting Units Of Measure

Remove the Battery Cover on the back side of the gauge by pressing it down with your thumb and sliding it in the direction indicated by the arrow. The Units Selector Switch is located in the Battery Compartment. Slide the switch to either the **Inch** (up) or ***mm*** (down) position as desired. **Inch is the factory default unit of measure.**



4.2 Installing The Battery

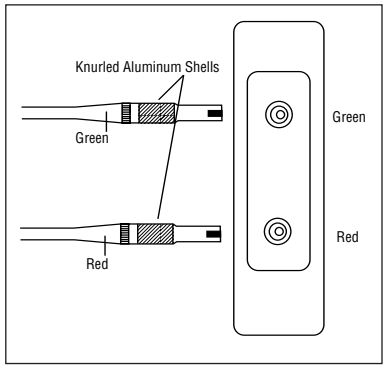
Remove the Battery Cover on the back side of the gauge by pressing it down with your thumb and sliding it in the direction indicated by the arrow. Place one (1) AA-size battery (1.5 Volt) into the battery compartment in the orientation shown on the sketch. Replace the Battery Cover.



Correct Battery Orientation

4.3 Connecting The Probe

Grasp the knurled aluminum shell of the green colored connector on the probe cable. Insert connector into the upper receptacle marked "R" (Receive). Insert the red connector into the receptacle marked T" (Transmit). Refer to illustration at right.



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8.0 Trouble-Shooting Guide

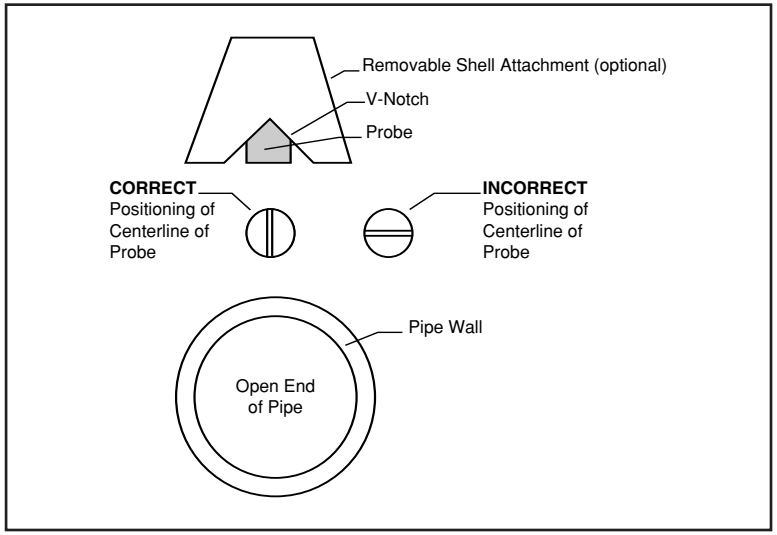
Description of Problem	Possible Cause	Action To Be Taken
Gauge will not power up	Battery voltage may be too low	Replace with new AA battery
Gauge will not power up even though battery has been replaced	• New battery may be too weak	• Check battery voltage (should be ≈1.5 Volt)
	• Back-up battery (lithium) could be too weak	• Return gauge for a new lithium battery
Good Coupling Indicator flashes on/off	• Probe or cable could be defective	• Clean probe & surface and retry measurement
	• Foreign substance may be trapped between probe and sample	• Return to manufacturer for inspection/repair
Good Coupling Indicator not shown	• Insufficient couplant fluid	• Add more couplant
	• Paint or coating is too thick or voids and/or corrosion lies under paint	• Grind off paint and/or corrosion
"....." is displayed when (ZERO) key is pressed	Probe could be degraded or defective	Return to manufacturer for inspection or repair
Displayed thickness value is unstable	Acrylic probe face is deteriorated	Carefully sand face of probe using #500 paper
Can't obtain measurement on small dia. pipe	Pipe diameter (OD) may be less than 1" *(25 mm)*	Consult factory
Coupling indicator does not appear while measurement is being taken 	• Insufficient amount of couplant	• Apply additional couplant
	• Test material surface is too rough	• Grind/polish measuring surface to 50-100-s smoothness
	• Test material bottom surface is too rough	• Change measurement point
	• Too much ultrasonic attenuation due to material composition	• Change measurement point
	• Test material thickness is outside the proper measuring range	• Change measurement point
Fluxuating readings	Defective probe	Return to manufacturer

7.3 Measurement Of Pipes Or Cylindrical Objects

When using a TI-45N Gauge to measure the wall thickness of pipes it is highly recommended that the **optional** spring-loaded shell attachment be used. It is supplied with a v-notch at the bottom of the shell attachment which greatly helps maintain a stable right-angle probe position during measurement on cylindrical surfaces.

Pipes with outer diameters less than 1 inch *(25 m*m) cannot be measured.

The orientation of the probe is important when measuring wall thickness of pipes. The centerline of the probe face (separating the two sections) should be arranged so that it is parallel to the length of the pipe as illustrated below.



4.4 Turning The Power ON

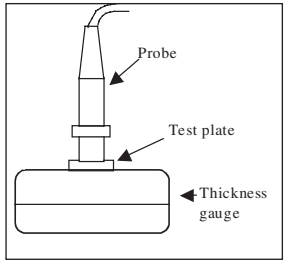
After connecting the probe as described in section 4.4, turn on the power by pressing the (POW) key. The current acoustic velocity setting will be momentarily displayed prior to entering the Measurement Mode (Mode H). The display should then read 0.000 inch (or *0.00 mm*).

If the Good Coupling Indicator is flashing on and off, the red transmit connector of the probe is not connected properly.

4.5 Turning The Power OFF

The Power will turn off automatically after three (3) minutes of non-use. To manually turn off the power, press & hold the (POW) key for 3 sec., then release.

4.6 Zero Adjustment



This operation adjusts the zero point of the probe. Zero adjustment data is stored in the instrument. It is recommended that the zero adjustment data be refreshed once a day, preferably before starting the day's work.

1. Apply couplant on the test plate surface and place the probe on it.
2. Make sure the probe is in good contact with the test plate surface and press the (ZERO) switch.
3. The zero adjustment procedure takes place and the display reads 0.197" or 5.00 mm when the process has been successfully completed.

NOTE: When the sonic velocity is set to a value other than 5390 m/s, the display reads 0.197" or 5.00 momentarily when the (ZERO) switch is pressed. Zero adjustment is nonetheless proceeding correctly.

If the material to be tested is significantly larger or smaller than 0.197" or 5.00mm, and the (ZERO) switch is pressed, the display will read ---- and the zero adjustment process becomes invalid. In this case, the zero adjustment should be made on a sample of known thickness of the test material itself.

4.7 Using Couplant Fluid

Apply couplant fluid to the measuring surface before measurement. The couplant eliminates air between the probe and test surface, promoting the transmission of the ultrasonic pulse.

NOTE: Never use organic solvents, including thinners and alcohols. The surface must be cleaned of couplant after measurement.

5.0 Quick Start Instructions - Steel Thickness

These Quick Start procedures are intended for those applications where the thickness of steel is to be measured.

If a material other than steel will be measured, the acoustic velocity must be adjusted to the appropriate value. In this case refer to Changing Acoustic Velocity Settings in section 6.3

1. Turn the power on by pressing the (POW) key.

2. Check the calibration by placing a drop of coupling on the built-in calibration disc on the front face of the gauge.

3. Grasp the probe and place it on the calibration disc.

4. The display should show a reading of 0.197 Inch ±0.001" or *5.00 mm* ±0.01 *mm*, along with the Good Coupling Indicator located in the upper left side of the LCD display. The indicator will remain on the display while the probe is in contact with the sample.

5. If the gauge shows any other value press the (ZERO) key while the probe remains in contact with the calibration disc. The reading should then be adjusted to read correctly. The gauge is now ready to perform thickness readings on steel samples.

6. Place a small amount of coupling fluid on the steel surface to be measured and proceed as indicated in step 3 above.

7. The gauge will display the thickness of the steel wall along with the Good Coupling Indicator. The Indicator will remain on the display while the probe is in contact with the sample. If the Indicator is not displayed, then the measurement was not successful and should be repeated.

7.1 Notes On Measurements

1. The following surface conditions can prevent accurate measurements. (Refer to section 7.2 Preparing The Surface For Measurement.)
   • More than 0.012" (12 mils or 300 microns) of paint or other coating
   • Flaking or loosely adhered coatings
   • Rough or heavily-pitted surface
2. If the Good Coupling Indicator is not shown on the display when the probe is in contact with the sample or if it flashes on and off, the following possibilities could exist:
   • Some foreign substance (other than coupling fluid) could be present between the probe and the sample (i.e. dust, sand, dirt, etc.)
   • Extent of corrosion is too heavy
   • A problem exists in the receiving (green) side of the cable or connector
3. If two materials are press-fitted or laminated together, the gauge will only read the thickness of the sample that the probe contacts.
4. Pipes with outer diameters less than 1 Inch *(25 mm)* cannot be measured. Specify Model TI-25.
5. Measurement of materials at or above 140 °F (*60 °C*) will damage the probe and should be avoided.

7.2 Preparing The Surface For Measurement

The TI-45N Gauge can be used to measure thickness over existing paint or coatings as long as the coating is in good condition, is well adhered to the surface and does not exceed 0.012" (12 mils or 300 microns) in thickness. Please note that the paint or coating thickness will be included in the overall wall thickness measurement.

If the surface to be measured is rusty, heavily pitted or corroded, it will have to be prepared using a wire brush, grinder, file or sandpaper. Additionally, if the surface is still rough after preparation, use of a more viscous couplant fluid (i.e. water-based K-Y Jelly) will help obtain a good acoustic coupling. K-Y Jelly is also a good choice when measuring on vertical surfaces or on the underside as it will help adhere the probe to the measurement surface while also acting as a coupling agent.

7.0 Taking Measurements

After setting the gauge for the correct acoustic velocity for the material to be measured or retaining the factory preset value of 5930 m/sec for measurement of steel, the gauge is ready to take measurements.

A coupling fluid must be used between the probe and the sample to obtain measurements. A two (2) ounce bottle is supplied with the gauge. We highly suggest using this water soluble couplant. Long-term use of petroleum-based couplants (grease, oil, etc.), salt water or chemical solvents will eventually damage the probe. Additional bottles of coupling fluid are available from the gauge supplier.

1. Turn the power on by pressing the (POW) key.
2. Place a small amount of coupling fluid on the calibration disc located on the face of the instrument.
3. Grasp the probe by the holding the spring-loaded centering shell and place it on the calibration disc. Press the shell down until it contacts the surface.
4. Confirm that the calibration disc measures 0.197" (± 0.001") or *5.0 mm* (± *0.01mm*) or the "Equivalent Value" as found in the Acoustic Velocity Selection Table for non-steel materials.
5. Place a small amount of coupling fluid on the surface to be measured, press probe onto the surface and proceed as indicated in step 3 above.

The gauge will display the thickness of the material or wall along with the Good Coupling Indicator. The Indicator will remain on the display while the probe is in contact with the sample.

If the Good Coupling Indicator is not displayed, then the measurement was not successful and should be repeated. If this problem persists then the surface may not be in acceptable condition for measurement. Refer to Preparing The Surface For Measurement, section 7.2.

Notes

a. When the probe is removed from the sample after a measurement, the last reading will be stored.

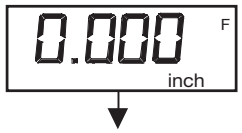
b. The gauge will power off automatically after 3 minutes of non-use. To manually turn off the power, press and hold the (POW) key for 3 or more seconds and then release.

c. Refer to Trouble-shooting Guide, section 8.0 if any problems occur.

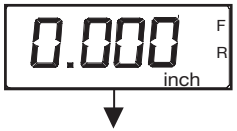
6.0 Overview of Modes

The TI-45N has several modes which are used for operation and velocity adjustment as described below. Each time the MODE key is pressed, the gauge will toggle from one mode to the next as shown in the sequence below:

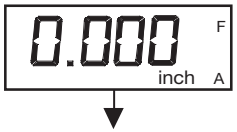
1. Turn gauge on, last velocity setting is shown momentarily, followed by



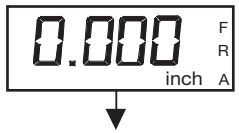
2. Press MODE key. Resin Mode **(Do Not Use)**



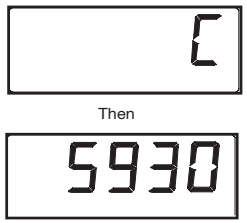
3. Press MODE key. Aluminum Mode. This mode is used for measuring aluminum and other fine metals (titanium, etc.). THIS MODE SHOULD NOT BE USED FOR STEEL. To set for aluminum see procedure below



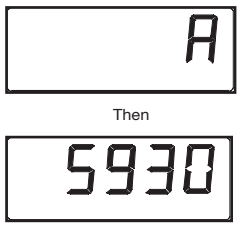
4. Press MODE key. Resin/Aluminum Mode (**Do Not Use)**



5. Press MODE key . Display will read C then 5930. This is the Coarse Adjustment Mode that has preset Acoustic velocities for other materials. Pushing up and down arrows will set other velocities.



6. Press MODE key. Display will read A then 5930. This is the Fine Adjustment Mode. It should be used for adjusting a velocity by single numbers. (Press and hold up or down arrows for rapid movement of numbers.)



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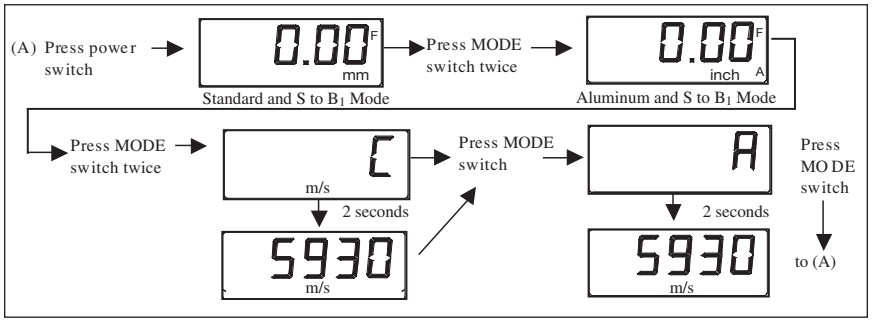
6.7 Changing Modes

Flow of mode selection:

	S to B_1 measurement method
Standard Measurement	Thickness value Ex.: 5.00 mm F/ H appears on the extreme right in Free / Hold mode, respectively.
Aluminum Measurement	Thickness value followed by A Ex.: 5.00 mm_A F/H appears on the extreme right in Free/Hold mode, respectively.

TI-45N provides two measurement modes depending upon the nature of the test material (Standard and Aluminum mode), which can be easily switched by MODE switch operation:



Pressing and holding the MODE switch for longer than two seconds always toggles back and forth between the Free and Hold modes.

Free mode is the correct choice for almost all applications. Select the Hold mode when readings fluxuate and stable measurement cannot be obtained.

6.5 Setup Of Gauge When Acoustic Velocity Is Unknown

In applications where the type of material is not known or the material type is not listed in the Acoustic Velocity Selection Table the following steps can be performed to set the gauge to measure accurately.

1. Measure a sample of the material using a micrometer, caliper or similar measuring device.
2. Turn the power on by pressing the (POW) key.
3. Place a small amount of couplant fluid on the sample and place the probe on the sample.
4. After a thickness value is shown on the LCD display along with the Good Coupling Indicator, remove the probe from the sample.
5. Use the ∩ and ∪ keys to increase or decrease the displayed value until it equals the known thickness of the sample as measured in Step 1. When the ∩ key is pressed the "UP" indicator will be show on the LCD display. The "LOW" indicator will be shown for the ∪ key.
6. The acoustic velocity setting will be automatically adjusted to the correct value for this material after Step 5 is completed.
7. Change modes to either Mode C or Mode A to display the current acoustic velocity, as described in section 6.4. Write this value down so it can be re-entered without having to repeat the above procedures should you need to change the acoustic velocity to another setting.

6.6 Changing Acoustic Velocity Settings

After determining the required acoustic velocity for the material to be measured, the acoustic velocity must be adjusted by:

- Selecting one of the ten (10) preset values [Mode C]
- Adjusting the velocity to the desired setting [Mode A, Fine Adjustment]

METHODS FOR CHANGING ACOUSTIC VELOCITY SETTINGS			
MODE C	Select one from a list of 10 Preset Values	Use ∩ or ∪ keys to index thru selections	Last Setting ➔1900 ➔2700 ➔ ➔ 4170 ➔ 4700 ➔ 5570 ➔ 5790 ➔ 5930 ➔ 6260 ➔7390 ➔10000
MODE A	Fine Adjustment to desired value	Use ∩ or ∪ keys to increase or decrease value	Any acoustic value can be set from 1000 to 12000 m/sec

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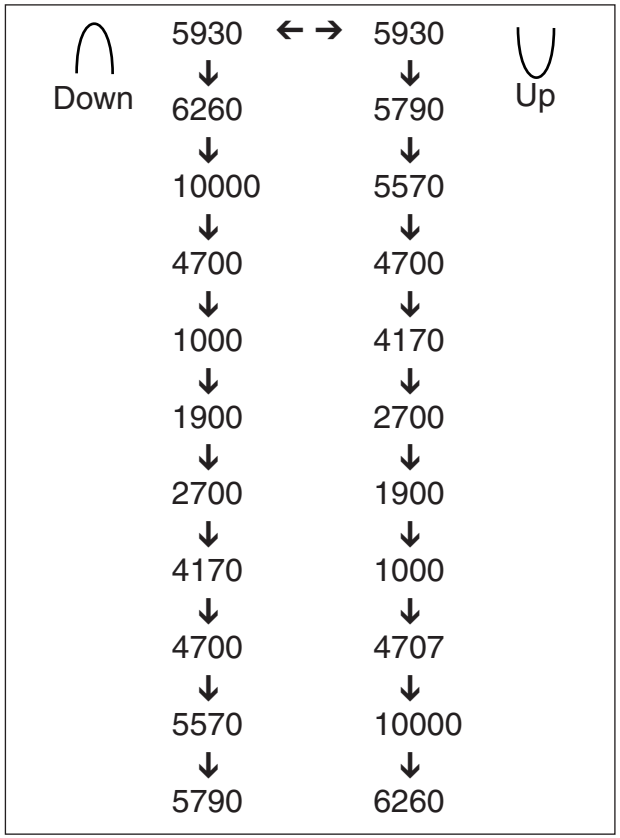
7. Press MODE key. Returns to this Measurement mode.

6.1 Acoustic Velocity Modes

C = Preset
A = Adjust to any velocity

6.2 How to change Acoustic Velocity

1. Press MODE key 4 times until C followed by 5930 is shown.
2 Press ∩ and ∪ keys to toggle to preset velocities.



3. Press MODE key 5 times until A then 5930 is shown. This mode will allow any Acoustic velocity to be set. See section 7.3 for procedure for setting gauge to a material that is not a preset material or is not listed in the Acoustic Velocity Chart.

6.3 Setup For Measuring Thickness Of Materials Other Than Steel

The TI-45N Thickness Gauge is supplied from the factory set for an acoustic velocity of 5930 m/sec for the measurement of Steel. To measure the thickness of any other material, the acoustic velocity must be changed. When checking the built-in calibration disc, the gauge should display the "Equivalent Value" listed in the Table in section 6.4, instead of 0.197" or *5.0 mm* for steel.

To determine the proper acoustic velocity for measurement of the non-steel material, refer to the Acoustic Velocity Selection Table in section 6.4. After determining the proper acoustic velocity, the gauge must be changed to this new value as described in section 6.6 *Changing The Acoustic Velocity Settings*.

If you do not know the type of material to be measured or the material type is not listed in the Acoustic Velocity Selection Table, refer to section 6.5, S*etup Of Gauge When Acoustic Velocity is Unknown.*

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6.4 Acoustic Velocity Selection Table

	ACOUSTIC VELOCITY SELECTION TABLE			
	Material Type	Acoustic Velocity (meters/sec)	Equivalent Value Of Calibration Disc **(Inch)**	Equivalent Value Of Calibration Disc Disc **(mm)**
◆	Aluminum	6260	.208	5.3
◆	Acrylic (Plexiglass)	2700	.090	2.3
◆	Cast Iron	4400-5000	.148 - .168	3.8 - 4.3
◆	Ceramics	10000	.332	8.4
◆	Copper	4700	.156	3.9
	Duralumin (17S)	6320	.211	5.3
	Ebonite	2500	.083	2.1
◆	Glass	5570	.185	4.7
	Nickel	6040	.201	5.1
◆	Polyethylene (Soft)	1900	.063	1.6
	Polyvinyl Chloride (PVC)	2300-2500	.077-.083	1.9 - 2.1
	Quartz (X cut)	5720	.191	4.9
◆	Stainless Steel (SUS304)	5790	.193	4.9
	Stainless Steel (SUS403)	6100	.205	5.2
◆	Stainless Steel (SUS410)	7390	.246	6.2
◆	Steel	5930	.197	5.0
	Tin	3320	.110	2.8
◆	Zinc (Zn)	4170	.139	3.5

◆ Denotes one of the 10 preset values in Mode C.