INNOVATEST®
Advanced Materials Testing Solutions

MANUAL
TT-700

Ultrasonic Thickness Gauge

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CONTENT

1. INTRODUCTION

1.1 SCOPE OF APPLICATIONS

TT-700 Ultrasonic Thickness Gauge, measuring with ultrasonic wave, is applicable for measuring the thickness of any material in which ultrasonic wave can be transmitted and reflected back from the other face.
The gauge can provide quick and accurate measurement to various work pieces such as sheets of board and processing parts. Another important application of the gauge is to monitor various pipes and pressure vessels in production equipment, and monitor the thinning degree during using. It can be widely used in petroleum, chemical, metallurgy, shipping, aerospace, aviation and other fields.

1.2 PRIMARY THEORY

The primary theory of measuring thickness with ultrasonic wave is similar to that of measuring thickness with optical wave. The ultrasonic wave emitted from the probe reaches the object and transmits in it. When the ultrasonic wave reaches the bounding surface of the material, it is reflected back to the probe. The thickness of the material can be determined by accurately measuring the time of the ultrasonic wave transmitting in it.

1.3 CONFIGURATION AND NAME OF PARTS

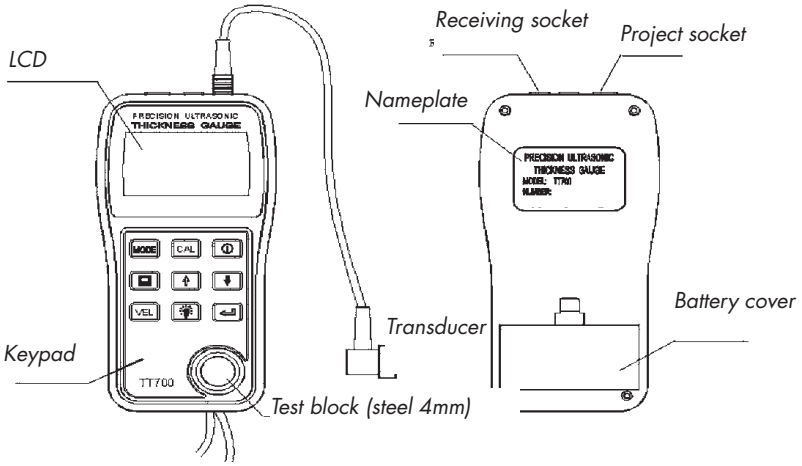
1.3.1 Configuration

- Main unit 1
- Transducer 15 MHz 1
- Couplant 1
- Protection jacket 1

1.3.2 Optional accessories

- Communication cable
- Software
- Transducer 20MHz
- Printer TA-230
- Standard test block

1.3.3 Appearance

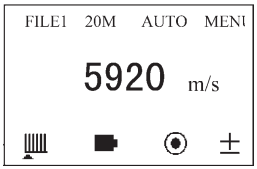


Keyboard:

- ⏻ Power on/off
- MODE Function selector
- 🖫 Memory
- VEL Sound velocity
- ↵ 2-point calibration; to be used together with function keys.
- ↑ Adjusting sound velocity and thickness; key for moving menu cursor
- ↓ Adjusting sound velocity and thickness; key for moving menu cursor
- 🔆 Backlight
- CAL Calibration key of thickness and sound velocity

Display symbols:

- FILE1 Number of saved files
- 20M Frequency of transducers
- AUTO Measuring mode
- MENU Menu
- Coupling indicator
- Battery indicator
- Probe type
- ± Differential mode indicator
- Alarming indicator



2. SPECIFICATIONS

-	Measuring range:	Depending on transducer and material 0.15mm~20.0mm 15MHz transducer 0.15mm~20.0mm 20MHz transducer
-	Display resolution:	0.001mm or 0.01mm
-	Material velocity range:	1000m/s~9999m/s (0.039~0.394in/μs)
-	Environment temperature:	0~40°C
-	Power supply:	2pcs. 1.5V AA batteries
-	Power consumption:	Working current <30mA (3V without back light)
-	Dimensions:	152mm x 74mm x 35mm
-	Weight:	220g

3. OPERATION

3.1 PREPARATION FOR MEASUREMENT

1. Insert the transducer plug into the receiving socket on the main unit,
2. Press ① to turn on the instrument, and the display is shown as follows:

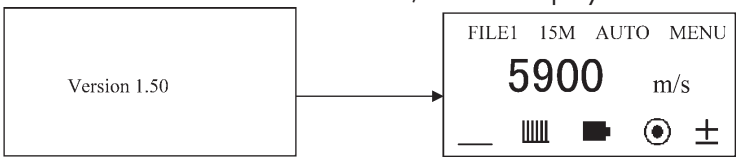


Figure 3 *Figure 4*

Note:
see as figure 4

- FILE1: Current file number (5 files in total)
- 20M: Selection of probe transducer(15M,20M selectable)
- AUTO: Measuring mode (I-E,E-E,AUTO selectable)
- MENU: Parameters and function setting
- Coupling indicator
- Battery indicator(it recommends replace battery when "▭"occurs
- Probe type
- ± Differential mode
- Alarming mode

3. Setting transducer frequency
   Press MODE to move the cursor to the position as shown in the following figure. Press ENTER to change the setting.

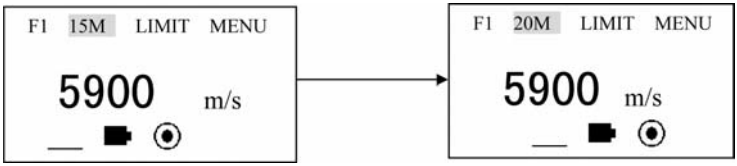


Figure 5 *Figure 6*

It will display the frequency of the transducer, 15M or 20M.

Note:
The frequency setting should comply with the probe frequency, otherwise, it will influence the accuracy of the measurement.

4. The setting of measuring mode
Press the MODE key to move the cursor to the position as shown in the following figures, press ↵ to change between the different measuring modes(see figure 7 and figure 8) Each pressing of ↵ will change between, AUTO I-E or E-E. Use I-E measuring mode to measure thick test pieces but it is easily influence by coupling status. Using the E-E measuring mode, the measuring result will be accuracy and stable, but its upper limit is confined. When you select Auto mode, the instrument will select I-E or E-E automatically. Usually, do not use I-E mode when the measurement can be completed using E-E mode.

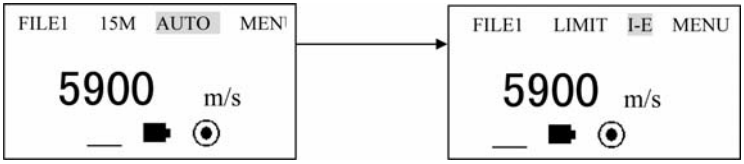


Figure 7 *Figure 8*

3.2 ADJUSTING MATERIAL VELOCITY SETTING

Press VEL to go into the material velocity mode, it will display the current material velocity. The material velocity will change to the next velocity preset every time you press the VEL key, the instrument can store 5 velocities. To change the current material velocity value, use the ↑ or ↓ key till you reach the desired value.

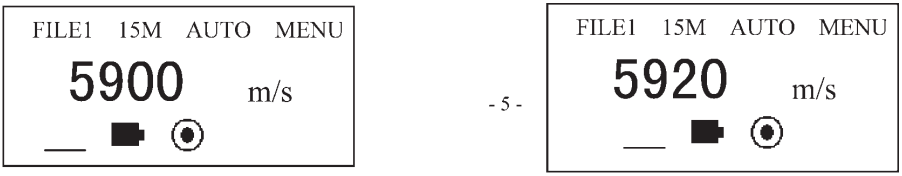


Figure 9 *Figure 10*

Note:
Because of high accuracy, minor changes of the material velocity will influence the measuring results, especially for thick test pieces.

Inputting accurate sound velocity is important factor for accurate measurement. If the sound velocity of test material is uncertain, user can use a known thickness test piece to measure the material sound velocity (see 3.4)

3.3 MEASUREMENT OF THICKNESS

Firstly, set the correct material velocity. Apply coupling agent to measuring area, couple the probe with the material to be measured. The screen will display the thickness of material to be measured. The coupling indicator bar will display current couple state. After you remove the probe, the thickness value will be maintained, while the coupling indicator will disappear.

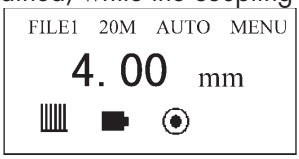


Figure 11
The probe is coupled with the material to be measured

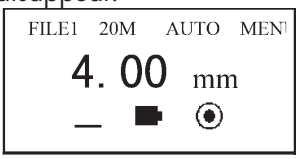


Figure 12
After removing the probe

Note:
when the probe is coupled with the material to be measured, the instrument will display the coupling indicator bar; if the indicator flashes or doesn't appear, it means that the coupling is not so good.

3.4 MEASUREMENT OF MATERIAL SOUND VELOCITY

The material sound velocity can be measured using a test-piece with given thickness. First, measure the test-piece with caliper or micrometer. Couple the probe to the test-piece with given thickness till it displays a value. Remove the probe and adjust the displayed reading to the actual thickness with ↑ or ↓ key. Press VEL the instrument will display the material sound velocity. For measuring material sound velocity please select a test piece with sufficient thickness. The min. thickness is 4.0mm. When measuring the material sound velocity, please disable the min. capturing function.

For example:
To measure the sound velocity of a material with a thickness of 10.0mm, the procedure is:

a. Measure the test-piece with any material sound velocity setting, after the thickness reading is displayed, press CAL key, the thickness value will freeze, then remove the transducer.

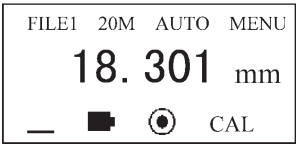


Figure 13

b. Use ↑ or ↓ key to adjust the displayed value to 10.00mm, as shown in the following figure:

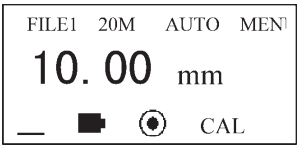


Figure 14

c. Press VEL to display the material sound velocity to be measured, as shown in the following figure:

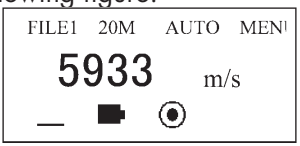


Figure 15

3.5 SINGLE POINT CALIBRATION

First, test material sound velocity by using a known thickness test-piece. Coupling the transducer with test-piece until the screen displays a stable thickness. Press the CAL key, the thickness value will freeze, take away the transducer and press the ↑ or ↓ key to adjust the measured reading to the real thickness value. Press "CAL" to finish the calibration.If users want to delete the calibrated value press ↑ and ↓ for one time. During adjusting the thickness value, press CAL to delete the calibrated data.Single point calibration will only function in I-E measuring mode. Differential mode should be disabled during single point calibration.

For example
To calibrate a 10mm test piece by using single point calibration, the procedure is:

d. Test the material sound velocity by using E-E mode, then measure the thickness by using I-E mode, press CAL to freeze the thickness value and remove transducer, as in figure 16.

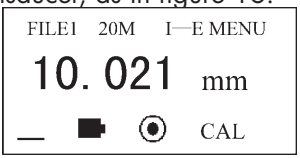


Figure 16

e. Press the ↑ or ↓ key to adjust the displayed value to 10.00 mm see figure 17

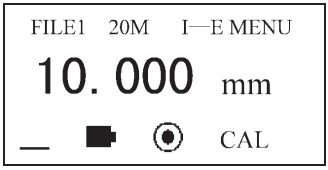


Figure 17

f. Press CAL to finish single point calibration, as in figure 18

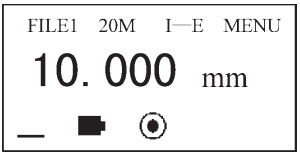


Figure 18

Note:
1. Single point calibration is only suitable for I-E mode.
2. Calibration setting are erased after the instrument is switched off.

3.6 SETTING ALARMING FUNCTION

TT-700 will alarm if the measurement is out of limit. When the measurement is lower than the alarming low limit or higher than the alarming high limit, the buzzer will alarm. The alarm limit is set as follows:

a. Press MODE , move the cursor to MENU, as figure 19.

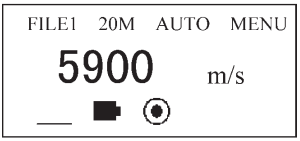


Figure 19

b. Press ↵ to enter main menu, as figure 20.

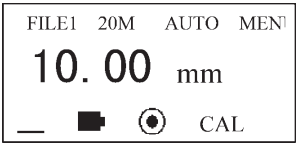


Figure 20

c. Use the ↑ or ↓ key to select system setting, press ↵ to enter.

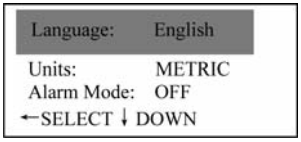


Figure 21

d. Use the ↓ or ↑ key to select Alarm Mode , Press ↵ to enter the low limit setting.

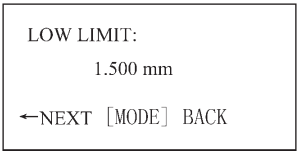


Figure 22

e. Use the ↓ or ↑ key to change the low limit value. After it is finished, press ↵ to save the low limit value. If there is no need setting the high limit, press MODE to return.

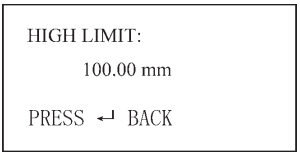


Figure 23

f. Use the ↓ or ↑ key to change the high limit. After it is finished, press ↵ to return.

g. Press MODE to exit. The 🔔 symbol will be displayed in the screen.

If the user wants to disable the alarming function, select “Alarm Mode Off”

3.7 SETTING DIFFERENTIAL MODE

The procedure of setting differential mode is as follows:
a. Press MODE, move cursor to "MENU", as figure 19.
b. Press ↵ to enter main menu, as figure 20.
c. Use the ↓ or ↑ key to select system setting , press ↵ to enter as figure 21.
d. Use the ↓ or ↑ key to select "Diff Mode" press ↵ to select, as figure 24.

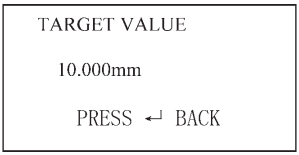


Figure 24

e. Use the ↓ or ↑ key to set the desired value. Press ↵ to confirm.
f. Press MODE to return.

± indicator will be displayed if the differential mode is switched on.
When readings are higher than the target value, the differential indicator will display +, when the measured value is lower than the target value, the differential indicator will display -.
To disable differential mode, select "Diff Mode off" in figure 21

3.8 SETTING LANGUAGE

Chinese and English are selectable. The setting procedure is as follows:
a. Press MODE, move cursor to MENU, as figure 19.
b. Press ↵ to enter main menu, as figure 20.
c. Use Move cursor ↑ or ↓ to select "System setup", press ↵ to confirm.
d. Use the ↑ or ↓ key to move to "Language". Press ↵ to change between Chinese or English (as figure 25 and figure 26).
e. Press MODE to return.

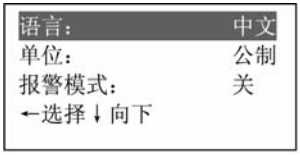


Figure 25

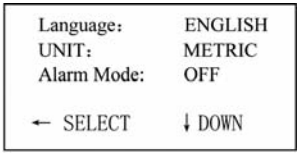


Figure 26

3.9 SETTING MEASURING UNIT

TT-700 has two measuring units metric and imperial, the procedure for setting is :

a. Press MODE, move cursor to "MENU", as shown in the figure 19.
b. Press ↵ to enter the main menu, as shown in the figure 20.
c. Move cursor ↑ or ↓ to select "System setup", press ↵ to confirm.
d. Press the ↑ or ↓ key to select "UNIT", press ↵ to change between metric and imperial.
e. Press MODE to return.

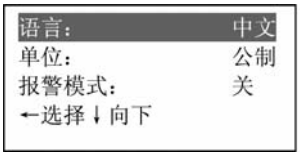


Figure 27

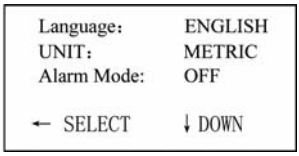


Figure 28

3.10 SETTING DISPLAY RESOLUTION

TT-700 has two display resolution (0.01mm and 0.001mm), the procedure for setting is :

a. Press MODE, move cursor to "MENU", as shown in the figure 19
b. Press ↵ to enter main menu, as shown in the figure 20
c. Move cursor ↑ or ↓ to select "System setup", press ↵ to confirm.
d. Press the ↑ or ↓ key to select "Resolution", press ↵ to change betweenHIGH (0.001mm) and LOW (0.01mm).
e. Press MODE to return.

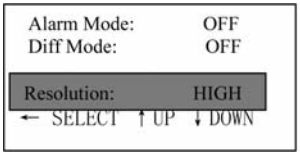


Figure 29

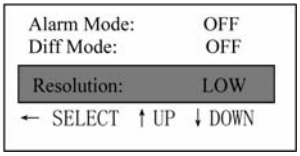


Figure 30

3.11 DATA STORAGE, VIEW AND DELETE

The instrument divides the memory into 5 files. Each file can save 100 measurement values. Before saving data, please set file number first. After you select the correct file No., you can save the measurement value directly by pressing the 🖫 key.

3.11.1 Logging readings into memory

a. Use MODE to move cursor to the position shown in the following figure:

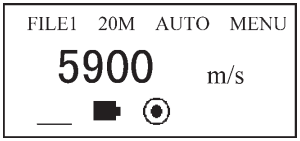


Figure 31

b. Press ↵ to change between F1-F5. After setting file No., you can save the measured values into the file every time after you finished the measurement by pressing 🖫

3.11.2 Reviewing stored thickness readings

a. Press MODE to move the cursor to the position shown in the figure 31
b. Press ↵ to change between F1-F5 and select file to be viewed.
c. Press 🖫 to check the contents of memory.

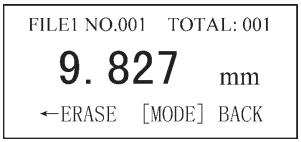


Figure 32

Note :
FILE1 is the current file; NO. is the serial number of the saved data displayed at present; Total is the total number of data saved in the file.
You can check all data saved by pressing ↑ or ↓.

3.11.3 Clearing single readings, Clear file, Clear all data

When reviewing the stored readings, press ↵ to erase the saved value currently displayed.
Erasing memory files :

a. Press MODE to move cursor to MENU, as figure 19
b. Press ↵ to enter main menu.
c. Use the ↓ or ↑ key to select "Function Setup", press ↵ to enter. As shown in figure 33.

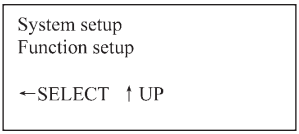


Figure 33

d. Press ↵ to enter, press ↓ or ↑ to move the cursor to "Erase file" (As shown in figure 34).

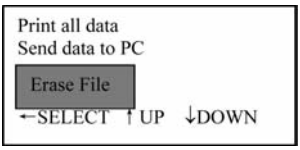


Figure 34

e. Press ↵ to erase the current selected file, then press ↵ to confirm. Press MODE to return.

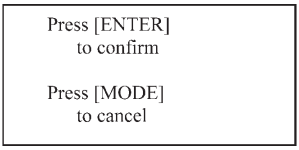


Figure 35

f. Press the ↓ or ↑ key to move cursor to "Erase all data". As shown in the figure 36.

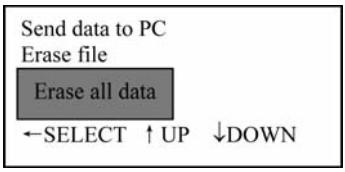


Figure 36

g. Press ↵ to erase all files, then press ↵ to confirm delete all data. Press MODE to return.

3.12 ADJUSTING DISPLAY BRIGHTNESS

a. Press MODE to select MENU, as that shown in the figure 19.
b. Press ↵ to get into menu, as shown in the figure 20.
c. Move cursor ↑ or ↓ to select "Function setup", press ↵, as shown in the figure 33.
d. Move cursor ↑ or ↓ and select "Set brightness", as shown in the figure 37.

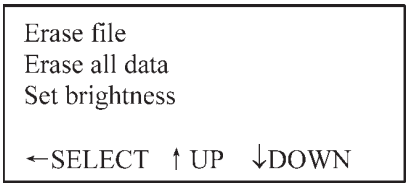


Figure 37

e. Press ↵ to enter brightness setting menu, as shown in the figure 38.

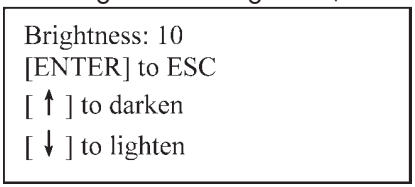


Figure 38

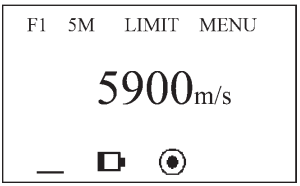
f. Press ↑ or ↓ to adjust the display brightness, press ↵ to return.

3.13 BACKLIGHT

Back-light can ☼ be switch on and off anytime, by pressing the key.

3.14 LOW VOLTAGE INDICATION

The gauge will monitor the battery voltage and give indications. When the battery symbol displayed as follows, it indicates that battery voltage is low, please replace the battery in time.



3.15 SWITCH THE INSTRUMENT OFF

The TT-700 will switch off automatically when no operation is carried out during 2min. By pressing ⏻ the instrument will switch off manually.

3.16 PRINTING

Connect TT-700 with a printer by communication cable, print measured results through menu selection. The operations are as following:

Before operate printing, the serial interface should be switched on, the procedure is as following:

a. Press MODE, move cursor to menu, as shown in the figure 19
b. Press ↵ to enter main menu, as shown in the figure 20.
c. Use ↑ or ↓ to select "system setup", press ↵ to enter, as shown in the figure 21.
d. Use ↑ or ↓ to select the "COMM set", press ↵ to change between ON or OFF, as shown in the figure 40.
e. Press MODE to return.

The procedure of setting printing function is as follows:

f. Press MODE to select MENU, as that shown in the figure 19.
g. Press ↵ to enter into main menu, as shown in the figure 20.
h. Use ↑ or ↓ to move cursor to "Function setup", press ↵, as shown in the figure 33.
i. Use ↑ or ↓ to move cursor to "Print file", see as figure 41.

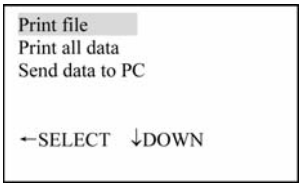


Figure 41

j. Press ↵ to confirm printing current file. When the printing is completed, the buzzer will give out sound, the display will return to MENU state. The display for printing is as shown in figure 42:

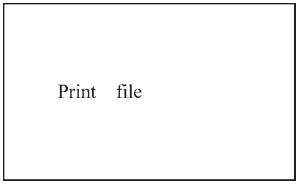
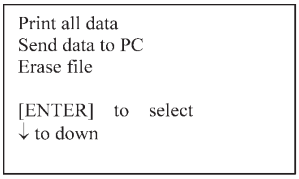
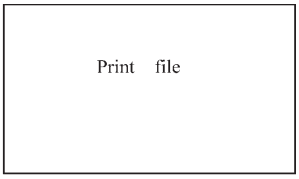


Figure 42

k. Use ↑ or ↓ to move the cursor to Print all data, press Enter confirm Print all data. When the printing is completed, the buzzer will give out sound, the display will return to MENU state. The display for printing is as shown in the figure 43 and figure 44:





3.17 COMMUNICATION WITH PC

The communication setting is as follows:
Baud rate: 9600
Initial bit: 1
Data Bit: 8
Stop bit: 1
Check: no

Note:
If there is need to communicating with PC, the serial port should be in open status, the procedure is set as follows.

a. Press MODE to move cursor to MENU
b. Press ↵ to enter main menu, as shown in figure 20.
c. Use ↑ or ↓ to select "Function setup", press ↵ to enter.
d. Use ↑ or ↓ to move cursor to "Send data to PC", see as figure 45.

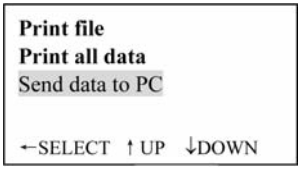


Figure 45

e. Press ↵ to confirm sending data, the screen displays:
Send data to PC, when complere the buzzer will alarm. The instrument will return to menu status, as shown in the figure 46.

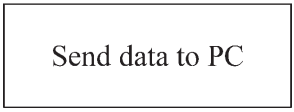


Figure 46

3.18 DISTINGUISH PROBE TYPE

There are two ways of distinguish probe types:
1. Plug in the probe when the instrument is off, then switch on the gauge, it will distinguishprobe type and display the corresponding probe type indicator.
2. When the gauge is on and you want to change the probe, after plug a new probe, press ↵, it will display the probe type and display the corresponding probe type.

4. MEASURING TECHNOLOGY

4.1 CLEANING SURFACE

Before measuring, please clean any dust, dirt and rust on the object, and remove any cover such as paint, etc. on it.

4.2 IMPROVING REQUIREMENT ON ROUGHNESS

Too rough surface will cause error in measurement. Before measuring, please smooth the surface of object by grinding, polishing or filing, etc. or use coupling agent with high viscosity for that.

4.3 ROUGH MACHINED SURFACE

The regular fine slots on rough machined (by such machines as lathe or planer) surface will also cause error in measurement. The way for compensating that is the same as that in 5.2. In addition, by so adjusting the included angle between the probe's crosstalk interlayer plate (the metallic layer passing through the center of probe bottom) and the fine slots of the object that the interlayer plate is perpendicular or parallel to the fine slots, and by taking the min. value of the readouts as the measured thickness, one can also get better results.

4.4 MEASURING CYLINDRICAL SURFACE

When measuring cylindrical material, such as pipes, oil tubes, etc., it is very important to select properly the included angle between the probe's crosstalk interlayer plate and the axial line of the material to be measured. Briefly to say, first couple the probe with the material to be measured, make the probe's crosstalk interlayer plate be perpendicular or parallel to the axial line of the object, shake the probe vertically along the axial line of the object, the readouts displayed on screen will change regularly. Select the min. readout from displayed ones as the accurate thickness of the object.

The standard for selecting the included angle between the probe's crosstalk interlayer plate and the axial line of the object is depending on the curvature of it. For a pipe with large diameter, the probe's crosstalk interlayer plate should be perpendicular to the axial line of the object; for a pipe with small diameter, one can measure with the probe's crosstalk interlayer plate being both parallel and perpendicular to the axial line of the object, and take the min. readout as the thickness.

4.5 UN-PARALLEL SURFACE

To get a satisfactory ultrasonic response, the other surface of the object must be parallel to or co-axial with the surface to be measured, otherwise, it will cause measuring error or even no display.

4.6 INFLUENCE OF MATERIAL'S TEMPERATURE

Both the thickness and transmitting speed of ultrasonic wave are influenced by temperature.If it has a high requirement on the measuring accuracy, one can use comparison method by test pieces, i.e., use a test piece with same material to measure under same temperature, and get temperature compensation coefficient, and use this coefficient to correct the actual measurement of the object.

4.7 MATERIAL WITH LARGE ATTENUATION

For some material such as fiber, with porous and coarse particles, they will cause large scatter and energy attenuation in ultrasonic wave, which will cause abnormal readouts even no display (generally, the abnormal readout is less than actual thickness). In this situation, this kind of material doesn't apply to be measured with this instrument.

4.8 REFERENCE TEST PIECE

When making accurate measuring for different materials under different conditions, the more the standard test piece is near to the material to be measured, the more accurate the measurement is. The ideal reference test pieces should be a group of test pieces with different thickness made of materials to be measured, the test pieces can provide calibrating factors for the instrument (such as the microstructure of the material, heat-treating condition, direction of particles, surface roughness, etc.). To meet the highest requirement on measuring accuracy, a set of reference test pieces will be critical.

Under most situations, one can get satisfactory measuring accuracy with only one reference test piece, which should have same material and similar thickness with the object. Take an even object, measure it by using a micrometer, then it can be used as a test piece.
For thin material, when its thickness is near to the low limit of the probe's measuring range, one can use test piece to determine the accurate low limit. Never measure a material with a thickness lower than the low limit. If the thickness range can be estimated, the thickness for the test piece should select the high limit.

When the object is thick, especially for alloy with complex internal structure, please select a test piece similar to the object from a group of test pieces, thus to can have idea of calibration.
For most casting and forging, their internal structures have some direction. In different direction, the sound velocity will have some change. To solve the problem, the test piece should have an internal structure with same direction as that of the object, and the transmitting direction of sound wave in it should also be same as that for the object.

Under certain circumstances, look up the speed-of-sound table for given materials can replace reference test pieces. But this is approximately to substitute some test pieces. Under some situations, the value in the speed-of-sound table will have some difference from the actual measured values, this is due to difference in the material's physical and chemical characteristics. This way is usually used for measuring low-carbon steel, and can only be taken as a rough measurement.
TT-700 can measure sound velocity. So users can measure the sound velocity first, and then measure the work piece with the measured speed.

4.9 SEVERAL MEASURING METHODS

a. Single measuring way: measurement at one point.
b. Double measuring way: measure with probe at one point twice. During the two measurements, the probe's crosstalk interlayer plate should be placed in perpendicular direction, and take the min. readout as the accurate thickness of the material.
c. Multi-point measuring way: make several measurements in a range, and take the min. readout as the thickness of the material.

4.10 CHANGING PROBE

The weariness of the probe's interlayer plate will influence the measurement. Please replace probe when the following situation happens.
1. When measuring different thickness, it always displays the same value.
2. When plugging the probe, it has echo indication or measured value display without measuring.

4.11 MEASURING CASTING

It has specialty for measuring casting. The crystal particles for castings are coarse, the structures are not dense enough, plus that they are in gross state, which makes difficulty in measuring their thickness.

First of all, due to coarse crystal particles and not-so-dense structure, it will cause large attenuation in sound energy. The attenuation is due to material's scatter and absorption of sound energy. The attenuation degree is closely relative with the size of crystal particle and ultrasonic frequency. Under the same frequency, the attenuation will increase with the crystal diameter, but it has a high limit, when it reaches to this limit, if the crystal diameter increases, the attenuation will tend to be a fixed value. For attenuation under different frequencies, it will increase as the frequency.

Secondly, due to coarse crystal particle and if coarse out-phase structure exists, it will cause abnormal reflection, i.e. the grass-shaped echo or tree-shaped echo, so that the measuring will have error reading, and cause wrong judgment.

Thirdly, as the crystal particle is coarse, the anisotropy in flexibility in metal's crystallizing direction will be obvious, which results in difference in sound velocities in different directions, and the max. difference can even be up to 5.5%. What's more, the compactness in different positions of the work piece is different, which will also cause difference in sound velocity. All of these will produce inaccuracy in measurement. Therefore, one must be very careful in measuring castings.

During measuring castings, please pay attention to the following points:

1. When measuring casting with unmachined surface, please use engin oil, consistent grease and water glass as coupling agent.
2. Calibrate the sound velocity for the object with a standard test piece having the same material and measuring direction as that for the object to be measured.
3. If necessary, take 2-point calibration.

5. PREVENTING ERRORS IN MEASUREMENT

5.1 ULTRA-THIN MATERIAL

For any ultrasonic thickness-gauge, when the thickness of object is less than the low limit of the probe, it will cause measurement error. When necessary, measure the min. limit thickness by comparing with the test pieces.

When measuring ultra-thin object, sometimes error called “double refraction” may occur, its result is that the displayed readout is twice of the actual thickness. Another error result is called “pulse envelop, cyclic leap”, its result is that the measured value is larger than the actual thickness. To prevent these kinds of errors, please repeat the measurement to check the results.

5.2 RUST, CORROSION AND PIT

The rust and pit on the other surface of the object will cause irregular change in readouts. In extreme situation, it will even cause no readout. It is very difficult to find small rust. When one finds a pit or is in doubt, he should be very careful in that area. In such situation, one can orient the probe’s crosstalk interlayer plate in different directions to have multiple measurements.

5.3 ERROR IN IDENTIFYING MATERIAL

When calibrates the instrument with one material, and then uses it to measure another material, error will occur. Please be careful in selecting correct sound velocity.

5.4 WEARINESS OF PROBE

The surface of the probe is allyl resin, after long time of usage, its roughness will increase, and the sensitivity will drop. If the user can be sure that this is the reason for error, he can grind the surface with sand paper or oilstone to make it smooth and has good parallelism. If it is still not stable, the probe must be replaced.

5.5 OVERLAPPED MATERIAL AND COMPOUND MATERIAL

It is impossible to measure uncoupled overlapped material, because the ultrasonic wave can't pass an uncoupled space. Since the ultrasonic wave can't transmit in compound material in even speed, it is not applicable to use ultrasonic thickness-gauge to measure overlapped material and compound material.

5.6 INFLUENCE OF OXIDATION LAYER AT METAL'S SURFACE

Some metals can produce dense oxidation layer on its surface, such as aluminum, etc. The layer is closely contacted with the substrate, and it has no obvious interface, but the ultrasonic wave has different transmitting speed in these two materials, which will cause error. In addition, different thickness in oxidation layer will cause different error. Please be careful in this. One can make a reference piece from a batch of objects by measuring with micron micrometer or caliper, and use it to calibrate the instrument.

5.7 ABNORMAL READOUT OF THICKNESS

The operator should be able to identify abnormal readout. Generally, the rust, corrosion, pit and internal defect of the object will cause abnormal readout. For the solution for that, please refer to chapter 4 and 5.

5.8 UTILIZATION AND SELECTION OF COUPLING AGENT

The coupling agent is for transmitting high-frequency energy between the probe and the object. If the type of agent is wrong, or the utilization is wrong, it will cause error or flashing coupling indicator, and it will be impossible to measure. The coupling agent should be used in proper amount and be coated evenly.
It is very important to select proper coupling agent. When it is used on a smooth surface, you'd better use an agent with low viscosity (such as coupling agent provided along with the instrument and light engine oil, etc.). When it is used on a coarse object surface, or vertical surface and top surface, one can use agent with high viscosity (such as glycerin grease, consistent grease and lubricating grease, etc.).
Various coupling agents with different components are available everywhere.

6. ATTENTION

6.1 CLEANING THE TEST PIECE

Since the test pieces supplied along with the instrument will be coated with coupling agent when being used for inspection, so please prevent it from rust. After the measurement, the test pieces should be cleaned. When the weather is hot, never stick any sweat on the pieces. If the pieces are not to be used for a long time, please paint them with some oil to prevent rust. When one wants to use them again, first clean them, then he can have normal operation.

6.2 CLEANING THE INSTRUMENT'S CASE

Alcohol, diluents will corrode the case, especially the LCD of the instrument. Therefore, when you clean the instrument, you can do that just with some clean water and clean it slightly.

6.3 PROTECTING THE PROBE

The surface of the probe is allyl resin, which is very sensitive to the heavy scratch from the coarse surface. Therefore, during operation, Please press it lightly. When measuring coarse surface, please minimize scratch on the working surface of the probe.
When measuring under normal temperature, the temperature of the surface to be measured should not be more than 60°C, otherwise the probe can't be used.
The oil and dirt will age and break the probe line, so please remove dirt on the cable after operation.

6.4 REPLACING BATTERIES

When indication for low voltage occurs, please replace batteries on time :
a. Turn off the instrument
b. Open the battery chamber
c. Take out the batteries, put in new ones. Please note the polarity.

If the instrument will not be used for a long time, please take out the batteries to avoid leakage, and corrosion in the battery chamber and pole piece.

6.5 ABSOLUTELY AVOID COLLISION AND MOISTURE

7. MAINTENANCE

If the following problems occur,
please contact the Maintenance Department of INNOVATEST Europe BV

a. The component of the instrument is damaged and it is impossible to measure.
b. The LCD is abnormal.
c. During normal operation, the error is too large.
d. The keyboard doesn't function or is in disorder.

8. NON WARRANTY PARTS

1. LCD
2. Battery
3. Probe
4. Test block
5. Covers / Keypad
6. Couplant

APPENDIX

Sound velocity for different materials

Material	Sound velocity (m/s)	(inch/µs)
Aluminum	6320	0.250
Zinc	4170	0.170
Silver	3600	0.140
Gold	3240	0.130
Tin	3320	0.130
Steel	5900	0.240
Brass	4430	0.180
Copper	4700	0.190
SUS	5970	0.240
Plexiglas	2730	0.110
Gray Cast	4600	0.180
Porcelain	5600	0.220
Glass (quartz)	5570	0.220

EC-DECLARATION OF CONFORMITY

This certifies that the following designated product
TT-700 (Portable ultrasonic thickness gauge)
complies with the essential protection requirements of
Council Directive 89/336/EWG approximation of the laws of the
Member States relating to electromagnetic companies.

This declaration applies to all specimens manufactured
in accordance with the manufacturing drawings
which form part of this declaration.

Assessment of compliance of the product with the requirements relating
to the compatibility was based on the following standards:
EN55022, EN60555-2, EN60555-3, EN50082-1

This declaration is the responsibility of the manufacturer/importer:

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