

Ultrasonic Thickness Gauge TT300

Instruction Manual



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1 Introduction

1.1 Scope of applications

TT300 Series Ultrasonic Thickness Gauge(including basic typeTT310, high-temp typeTT320, cast iron typeTT340), 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

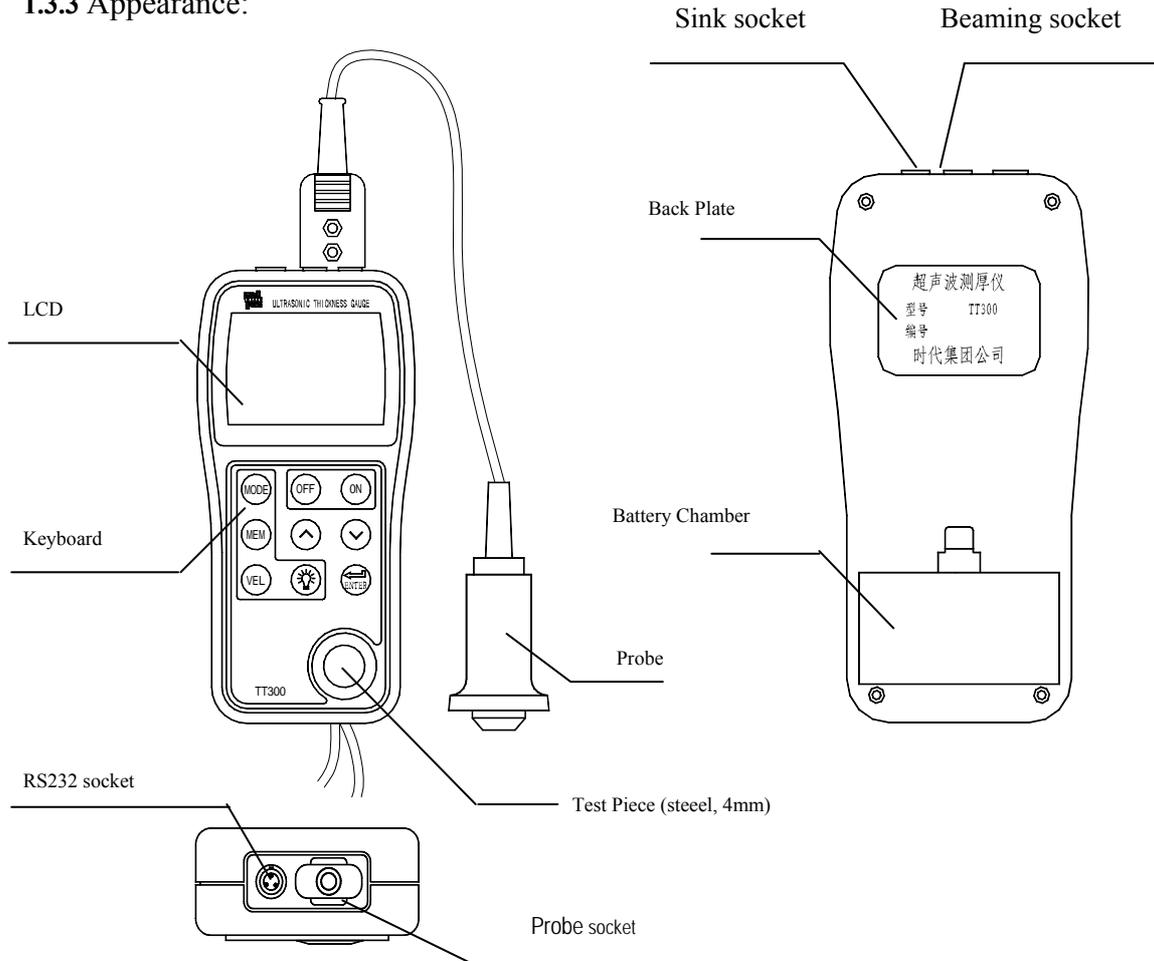
1.3.1 Configuration

Main unit	1
Transducer 5 MHz	1
Transducer 5 MHz (ZW5P)	1 (just for TT320)
Transducer 2 MHz(TSTU32)	1 (just for TT340)
Couplant	1
Protection jacket for TT300	1
AA battery	2
Screwdriver	1

1.3.2 Optional accessories:

Communication cable	(just for TT300)
Communication software	(just for TT300)
Transducer 2MHz	
Transducer 10MHz	(just for TT300)
Printer TA220S	(just for TT300)
Standard test block	

1.3.3 Appearance:

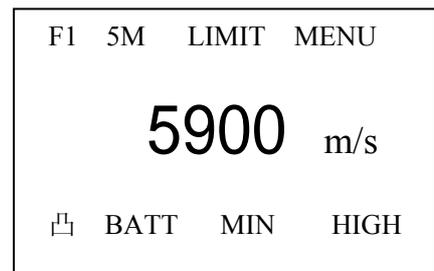


Keyboard:

- ON — Power on
- OFF — power off
- MODE — function selector
- MEM — memory
- VEL — sound velocity
- ENTER — 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
- ☼ -- Display backlight control

Display symbols:

- Fx — number of saved files
- 5M — frequency of probe
- LIMIT — using thickness limits
- MENU — menu
- ☼ — coupling indicator
- BATT — low battery indicator
- MIN — min. capture mode
- HIGH (LOW) — indicator for gain



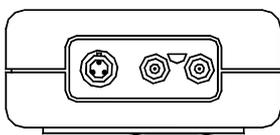
2 Specifications

- ✧ Measuring range: depending on probe and material
0.75mm~300.0mm (0.03inch~11.8 inch)
- ✧ Display resolution: 0.01mm or 0.1mm (lower than 100.0mm)
0.1mm (more than 99.99mm)
- ✧ Lower limit for steel pipes:
5MHz probe: $\Phi 20\text{mm} \times 3.0\text{mm}$ ($\Phi 0.8 \times 0.12$ inch)
10MHz probe: $\Phi 20\text{mm} \times 3.0\text{mm}$ ($\Phi 0.6 \times 0.08$ inch)
- ✧ Material velocity range: 1000m/s~9999m/s (0.039~0.394in/ μs)
- ✧ environment temperature: 0~40°C
- ✧ Power supply: 2pcs. 1.5V AA dry batteries
- ✧ Power consumption: working current <20mA (3V without back light)
- ✧ Dimensions: 152mm×74mm×35mm
- ✧ Weight: 370g

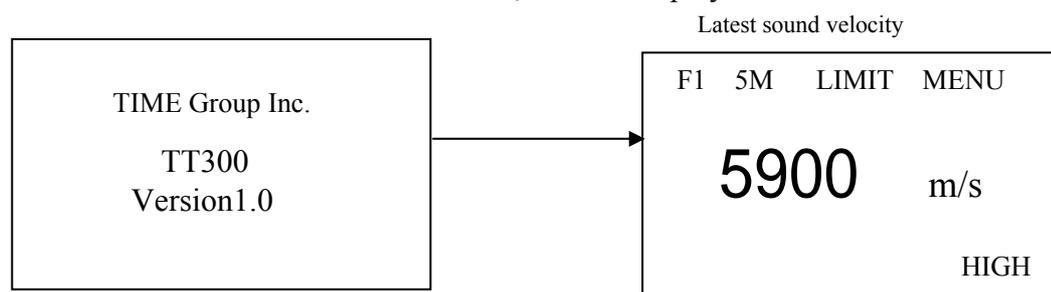
3 Operation

3.1 Preparation for measurement

- 3.1.1 Insert the probe plug into the socket for the probe on the main unit,
Attention: the red plug should be in the .beaming socket.

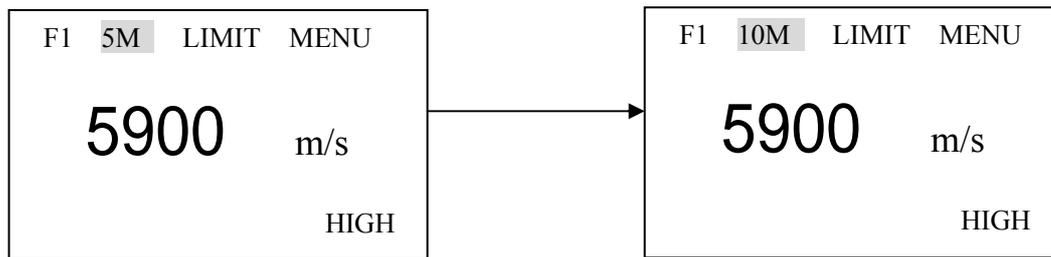


- 3.1.2 Press ON to turn on the instrument, and the display is as follows:



3.2 Setting probe frequency

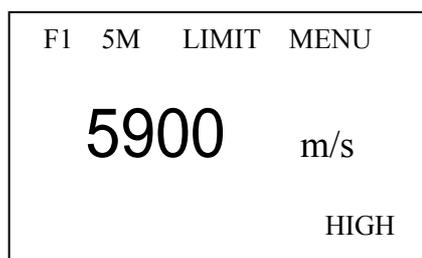
Press MODE to move the cursor to the position as that shown in the following figure. Press ENTER to change the setting.



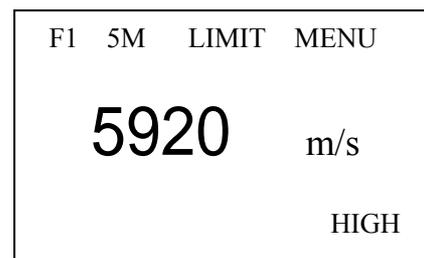
Each time you press ENTER, it will display in sequence the probe frequency to be set 2M (2MHz), 5M(5MHz) or 10M(10MHz).

3.3 Adjusting sound velocity

If the current display is thickness, by pressing VEL, you can come into speed-of-sound state, and it will display content in current speed-of-sound memory unit. The speed-of-sound memory unit will change once every time when you press the VEL key, it can display 5 speeds of sound alternatively. If you hope to change the contents in the current speed-of-sound unit, you can adjust that with \wedge or \vee till reach the desired value, and then you can save the value.



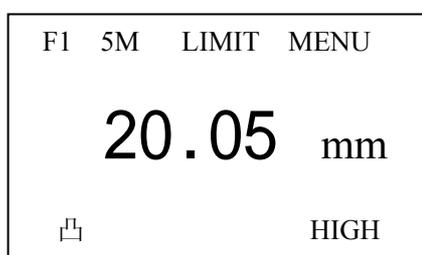
Press VEL to enter sound-velocity state



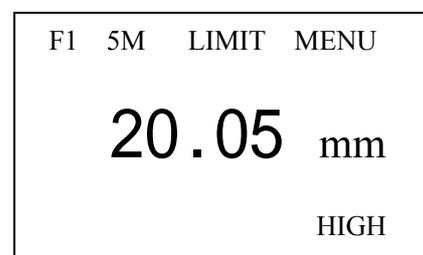
Value after adjusting with \wedge or \vee

3.4 Measurement of thickness

First, set the sound velocity, then coat the coupling agent at the place to be measured, couple the probe with the material to be measured, now you can begin the measurement. The screen will display the thickness of material to be measured. After you remove the probe, the thickness value will be maintained, while the coupling indicator will disappear.



Material to be measured



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

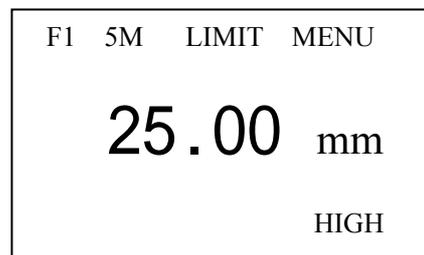
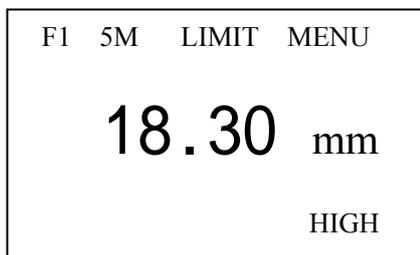
3.5 Measurement of sound velocity

The sound velocity of a material can be measured using a test piece with given

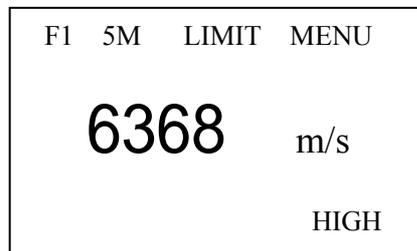
thickness. First, measure the test piece with caliper or micron micrometer and read the thickness accurately. Couple the probe with the test piece with given thickness till it displays a value, remove the probe, then adjust the display to the actual thickness with \wedge or \vee , press VEL, now it will display the sound velocity to be measured. Save the value into current speed-of-sound memory unit. For measuring sound velocity, one must select a test piece with adequate thickness, and the recommended min. wall thickness is 20.0mm. When measuring the sound velocity, please turn off the min. capturing function.

For example: To measure the sound velocity of a material with a thickness of 25.0mm, the procedure is:

- a. Measure with any sound velocity a thickness, as that shown in the following figure;
- b. Use \wedge or \vee to adjust the displayed value to 25.00mm, as that shown in the following figure:



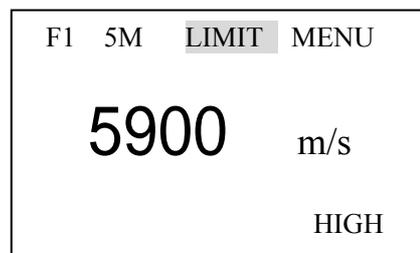
- c. Press VEL to display the sound velocity to be measured, shown as that in the following figure:



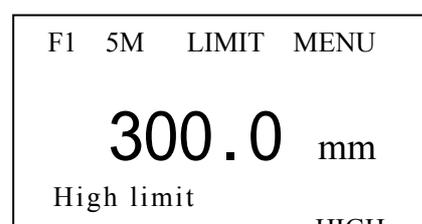
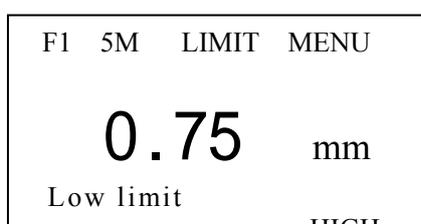
3.6 Setting thickness limits(just for TT300)

TT300 will alarm if the measurement is out of limits. When the measurement is lower than the alarming low limit or higher than the high limit, the buzzer will alarm. The alarming limit is set as follows:

- 1) Press MODE, move cursor to LIMIT:



- 2) Press Enter display the low and high limit of previous setting (as shown in the figure), use \wedge or \vee to set the new low or high limit.



Setting low limit

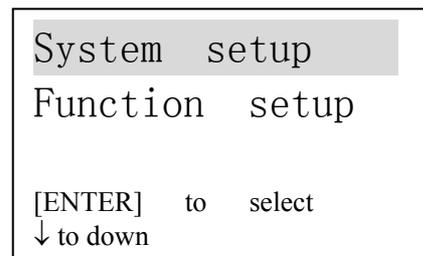
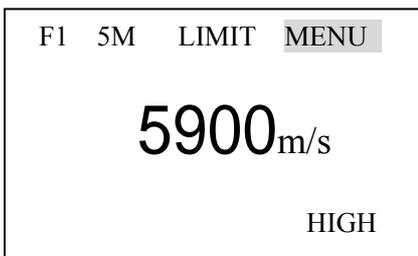
Setting high limit

3) To exit the Limit Setting, press VEL, MODE, or start to measure.

3.7 Setting receiving gain

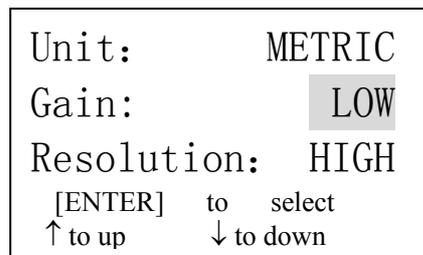
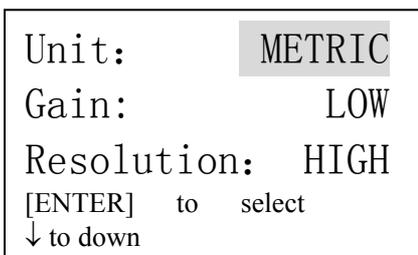
TT300 has two receiving gains, LOW and HIGH. The LOW is mainly used for measuring coarse material with high scatter and small sound absorption, such as cast aluminum, cast copper and other metallic parts. The setting procedures are:

- 1) Press MODE, move cursor to MENU, as shown in the figure:
- 2) Press Enter enter the main menu, move cursor with ^ or v to System setup.



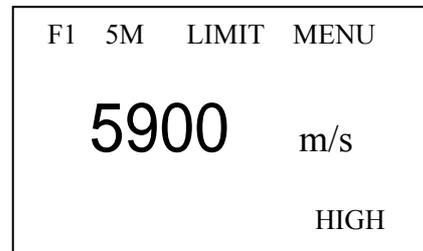
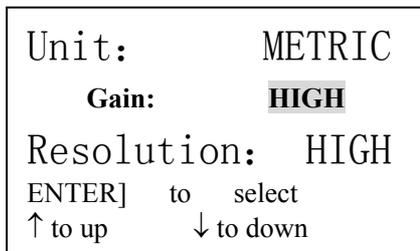
3) Press ENTER and enter System setup menu:

4) Press ^ or v to move the cursor to Gain setting:



5) Use Enter select LOW or HIGH:

6) Use VEL to exit.



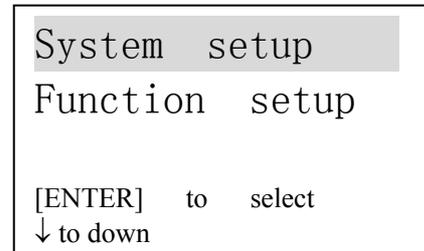
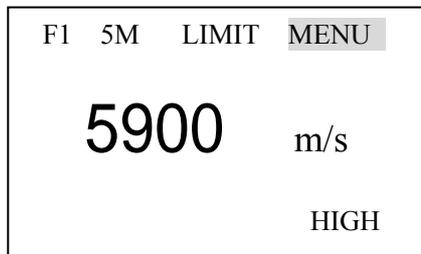
7) Press MODE, you can return to the menu of higher level.

If you want to carry out measurement during above-mentioned setting, you can come into measuring at any time.

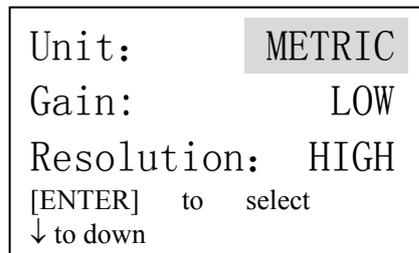
3.8 Setting measurement units and display resolution

TT300 has two display resolutions—0.1mm and 0.01mm, and two measurement units—metric and Imperial, one can select that with menu. The procedure for setting is:

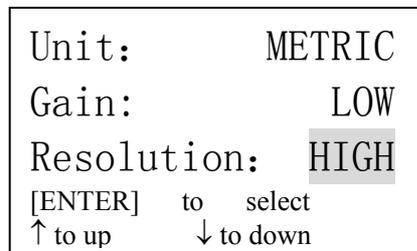
- 1) Press MODE, move cursor to MENU, as shown in the figure:
- 2) Press Enter enter the main menu, move cursor with ^ or v to System setup.



- 3) Press Enter enter System setup menu, press Enter display METRIC and IMPERIAL :



- 4) Press ^ or v to select Resolution, press Enter display HIGH (0.01mm) and LOW (0.1mm):

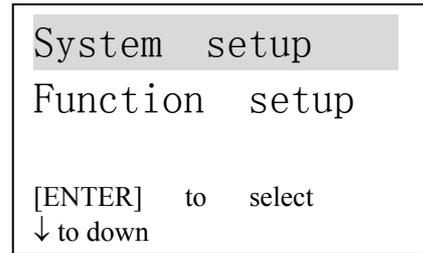
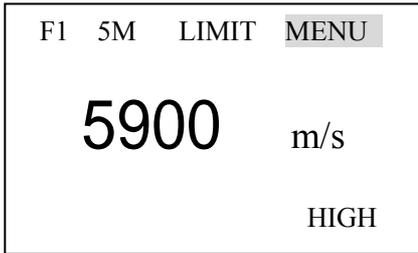


- 5) Press MODE to back to upper menu. To exit, press VEL or carry out measurement.

3.9 Minimum capture measurement

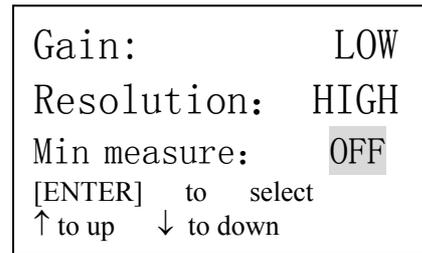
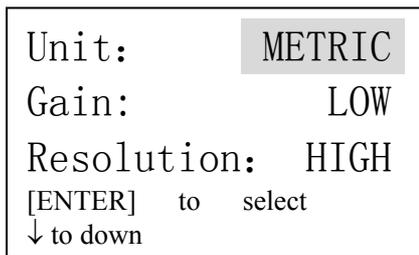
To capture min. measurement is to trap the minimum value in a group of measured values. When the probe couples with the work piece, it will display actual measurement, when the probe is taken away, it will display the min. value of measurement carried out a moment ago, and the MIN indicator for the minimum value will flash several seconds. If you continue the measurement when the MIN is flashing, the former measurements will continue to take part in the min. value capturing. If you carry out measurement after MIN indicator stops flashing, the min. value capturing will begin from then on. The setting of min. measurement capturing is as follows:

- 1) Press MODE to select MENU, as t shown in the figure:
- 2) Press Enter select System setup.



3) Press Enter enter System setup:

4) Press ^ or v to select Min capture:



5) Press Enter display ON (Min. capture function is on) and OFF (Min. capture function is off) alternatively. When the Min. capture function is on, if one exits the setting, it will have MIN indication on the screen. One can exit the setting by pressing VEL or carrying out one measurement.

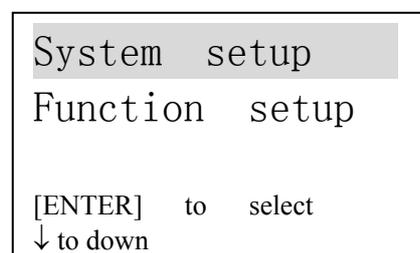
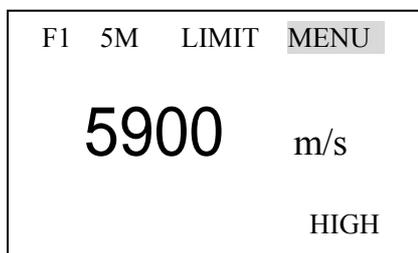
3.10 2-Point Calibration:

Select two standard samples of the same material with workpiece to be measured, among which, one has a thickness equal to or slightly higher than the tested piece, and the thickness of another test piece is slightly lower than the tested piece. Before carrying out 2-point calibration, please turn off Min. Capture function, perform the **Erase CAL data** function in the menu **Function setup**, and cancel the former calibration record. then turn on the 2-point calibration. Steps are as following:

1. Setting function for 2-point calibration:

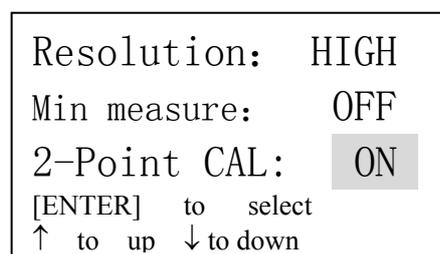
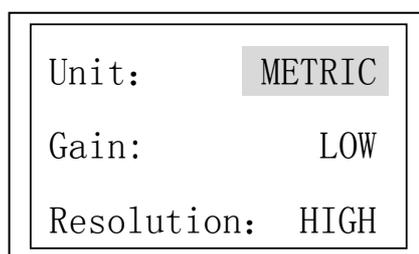
1) Press MODE to select MENU, as shown in the figure:

2) Press Enter to enter into main menu, use ^ or v to select System setup.



3) Press Enter to enter System setup:

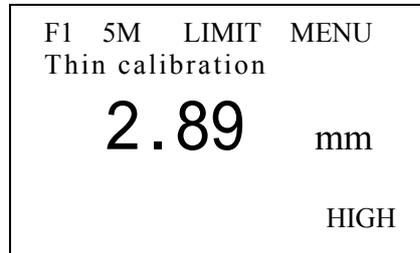
4) Press ^ or v to select 2-Point CAL:



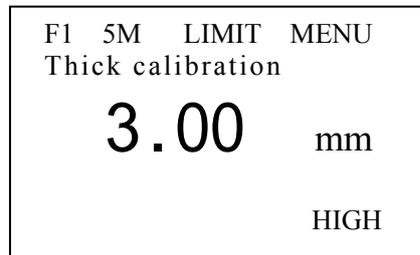
- 5) Press Enter display ON (2-point CAL is on) and OFF (2-point CAL is off) alternatively.
- 6) One can exit with VEL or by carrying out one measurement. Of the 2-Point CAL is set to be ON, one can carry out 2-point calibration at any time during measurement.

2. Operation of calibration:

- 1) Press ENTER under thickness-measuring state to enter into 2-Point CAL, the screen will prompt to calibrate the thinner piece, it displays as following:



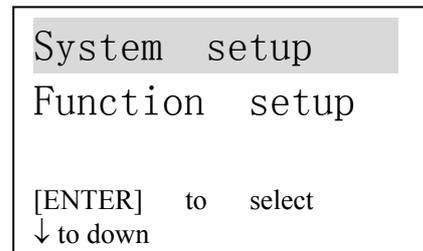
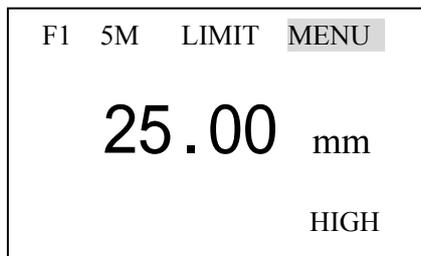
- 2) Measure the thinner standard test piece, use ^ or v to adjust the measurement to standard value. Press ENTER, the screen prompts to measure the thicker piece, the display is as follows:



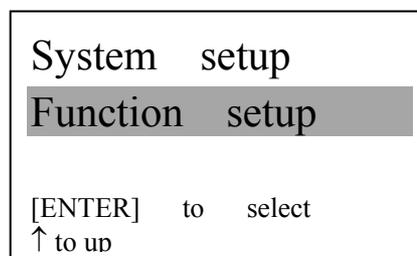
- 3) Measure the thicker standard test piece, use ^ or v to adjust the measurement to standard value. Press ENTER, the calibration operation is finished.

3.11 Adjusting Display Brightness

- 1) Press MODE to select MENU, as that shown in the following figure:
- 2) Press Enter to enter into main menu:



- 1) Press v to move the cursor to Function setup, the display is as follows:



- 2) Press Enter to enter into Function setup, use ^ or v to move cursor to Set brightness:

```

Erase all data
Erase CAL data
Set brightness
[ENTER] to select
↑ to up

```

3) Press Enter select “Set brightness”:

```

      Brightness: 04
[ENTER] to Esc
[ ↑ ] to darken
[ ↓ ] to lighten

```

4) Use ^ or v to adjust the display brightness, and exit setup by using **ENTER**

3.12 Backlight

By pressing key at any time, one can switch ON and OFF back light.

3.13 Low voltage indication

If BATT indicator occurs on the screen, it means the battery voltage is low, please change batteries on time.

```

F1 5M  LIMIT  MENU
      5900m/s
      BATT  MIN  HIGH

```

3.14 Turning off

For TT300, one can turn off it in automatic and manual way. If one carries out no operation in 2min, the instrument will turn off automatically; by pressing OFF, one can turn off the instrument manually.

3.15 Printing

Connect TT300 with a TIME micro printer from by the communication cable, print measured results through menu selection. The operations are:



1) Press MODE to select MENU, as that shown in the figure:

2) Press Enter to enter into main menu, use ^ or v to move cursor to Function setup:

```

F1 5M  LIMIT  MENU
      25.0mm
      HIGH

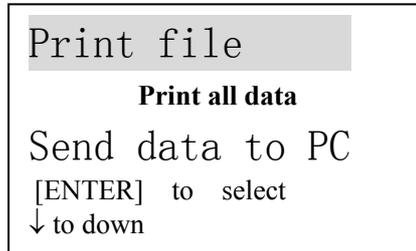
```

```

      System setup
Function setup
[ENTER] to select
↑ to up

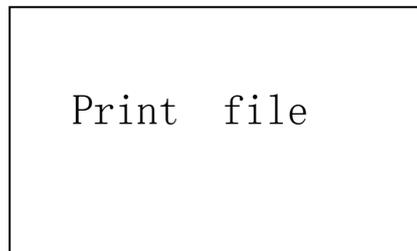
```

3) Press Enter enter into Function setup



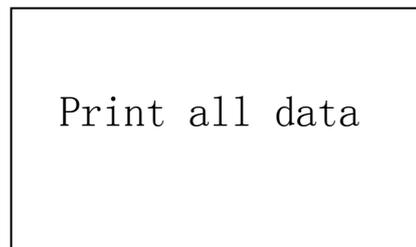
Print file
Print all data
Send data to PC
[ENTER] to select
↓ to down

4) Press Enter confirm Print 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 follows:



Print file

5) Use ^ or v 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 follows:



Print all data

3.16 Communication with PC(just for TT300)

The communication protocol is as follows:

Baud rate: can be set to be 9600, 4800, 2400, 1200

Bit: 8

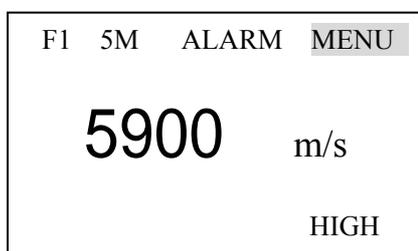
Stop bit: 1

Check: no

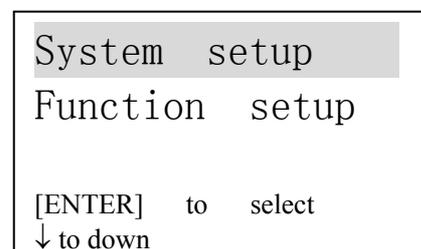
The baud rate is set as follows:

1) Press MODE to select MENU, as that shown in the figure:

2) Press ENTER to enter into main menu, use ^ or v to move cursor to Function setup:



F1 5M ALARM MENU
5900 m/s
HIGH



System setup
Function setup
[ENTER] to select
↓ to down

3) Press Enter to enter into Function setup

```
Unit:      METRIC
Gain:      LOW
Resolution: HIGH
[ENTER] to select
↓ to down
```

4) Press ^ or v to select Baud Rate:

```
2-Point CAL: ON
Comm set: simplex
Baud Rate: 9600
[ENTER] to select
↑ to up ↓ to down
```

5) Press Enter display 9600, 4800, 2400, and 1200 alternatively.

6) Press VEL or have a measurement to exit setup.

Connect the TT300 with PC by using the communication cable, one can send measured results through menu selection. The operations for that are:

1) Press MODE to select MENU, as that shown in the figure:

```
F1 5M ALARM MENU
25.0mm
HIGH
```

2) Press Enter enter into main menu, use ^ or v to move cursor to Function setup:

```
System setup
Function setup
[ENTER] to select
↑ to up
```

3) Press Enter to enter into Function setup, use ^ or v to move cursor to Send data to PC:

```
Print file
Print all data
Send data to PC
[ENTER] to select
↑ to up ↓ to down
```

4) Press Enter confirm Send data, the screen will display: Send data to PC. When the sending is completed, the buzzer will give out sound, and the display will return to MENU state, and the display for that is:

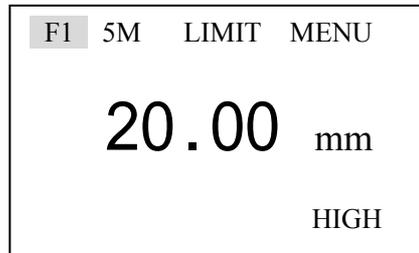
```
Send data to PC
```

4 Data logger operation (just for TT300)

4.1 Logging readings into memory

The instrument divides the memory unit into 5 files. Each can save 100 measurement values. Before saving data, Please set file number first. If you select the current file No., you can save the measurement directly by pressing MEM. The procedures for setting file No. are:

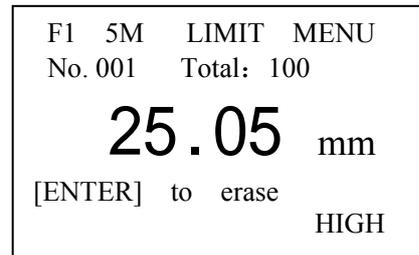
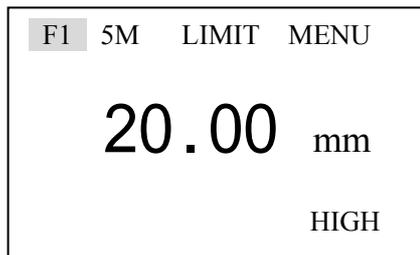
1) Use MODE to move the cursor to the position shown in the following figure:



2) Press ENTER, by pressing F1~F5 to display file No.s cyclically. You can exit by pressing VEL or conducting one measurement. After setting file No., you can save the measured values into the file every time after you finished the measurement by pressing MEM.

4.2 Reviewing stored thickness readings

- 1) Use MODE to move the cursor to the position shown in the following figure: 2) Pressing MEM to check the contents of memory.



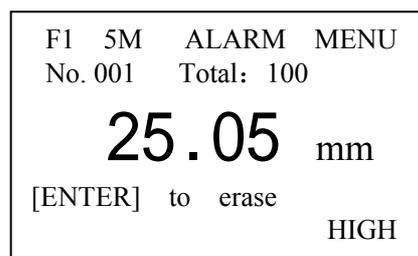
Note: **No.** is the serial number of the saved data displayed at present; **Total** is the total number of data saved in the file.

3) You can check all data saved by pressing ^ or v

4.3 Clearing readings

Under the state of Reviewing stored readings, press Enter to erase a saved value currently displayed. The procedure is:

1) Enter state of Reviewing stored thickness readings:



2) Press Enter to erase the current value, it will display the next value saved:

```

F1 5M ALARM MENU
No. 001 Total: 099

24.99 mm

[ENTER] to erase
HIGH

```

4.4 Clearing selected files or Clearing entire memory

- 1) Press MODE to select MENU, as shown in the following figure:
- 2) Press ENTER to enter into main menu, use ^ or v to select System setup.

```

F1 5M LIMIT MENU

25.05 mm

HIGH

```

```

System setup
Function setup

[ENTER] to select
↓ to down

```

- 3) Press v to select Function setup:

- 4) Press ENTER to enter into Function setup:

```

System setup
Function setup

[ENTER] to select
↑ to up

```

```

Print file

Print all data
Send data to PC
[ENTER] to select
↓ to down

```

- 5) move the cursor to "Erase file" by pressing v or ^:

- 6) Press Enter to confirm Erase file, when the erasing is completed, the buzzer will sound, and the display will return to MENU state, and the Erase information displays as following:

```

Erase file1

```

7) Press \vee or \wedge to move the cursor to “Erase all data”:

```
Send data to PC
Erase file
Erase all data
[ENTER] to select
↑ to up   ↓ to down
```

8) Press Enter confirm Erase all data, when the deletion is completed, the buzzer will give out sound, and the display will return to MENU state. The display for Erase is as follows:

```
Erase all data
```

5. Measuring technology

5.1 Cleaning surface

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

5.2 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.

5.3 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.

5.4 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.

5.5 Compound profile

When the material to be measured has compound profile (such as bend of a pipe), one can use the way described in 5.4 to measure. The exception is that one should have two analysis, get two

results when 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.

5.6 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.

5.7 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.

5.8 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.

5.9 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 micron 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.

TT300 can measure sound velocity. Measure the sound velocity first, then measure the workpiece with the measured speed.

5.10 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.

5.11 Selecting probes

Probe	Frequency	Measuring range	Min. area ϕ	Application
5P ϕ 10	5MHz	1.2mm~225.0mm (steel)	12mm	General Straight probe
5P ϕ 10/90°				General bent probe
TSTU32	2 MHz	5.0mm~300.0mm (steel) <40.0mm (cast iron HT200)	22mm	High penetration probe
DA312	10 MHz	0.75mm~25.0mm (steel)	7.6mm	For thin work piece
DA303	2 MHz	5.0mm~300.0mm (steel)	16.2mm	General applications

5.12 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.

5.13 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 judgement.

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 workpiece 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 engine 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.

6 Preventing errors in measurement

6.1 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.

6.2 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.

6.3 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.

6.4 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.

6.5 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.

6.6 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.

6.7 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.

6.8 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.

7. Attention

7.1 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.

7.2 Cleaning the Instrument's Case

Alcohol, diluent 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.

7.3 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.

7.4 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.

7.5 Absolutely avoid collision and moisture.

8. Maintenance

8.1 When the error of measurement is too large, please refer to chapter 6, 7.

8.2 If the following problems occur, please contact the Maintenance Department of Time Group:

- 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.

8.3 Since TT300 is a high-tech product, its maintenance should be conducted by professional trained person. The user should not disassemble and repair it by himself.

9. Non warranty Parts

1. Window, 2. Battery, 3. Probe. 4. Test block. 5. Sheath of gauge. 6. Couplant

Appendix I

Type and capability of apparatus

T E C H N O L O G Y P A R A M E T E R	Type	TT300	TT310	TT320	TT340
	Testing range (steel)(mm)	0.75~300.0	0.8~300.0	5.0~80.0(high-temp.) 1.2~225.0(normal-temp)	1.2~300.0(normal-temp) 5.0~40.0(cast iron)
	Display resolution (mm)	Tested thickness <100: 0.01or0.1 Tested thickness ≥100: 0.1	0.1	0.1	0.1
	Error (H: actual thickness of standard block)	H<10: ±0.05 10≤H≤99.99: ±(0.5%H+0.01) H≥100: ±(1%H+0.01)	±(1%H+0.1)	±(1%H+0.1)	±(1%H+0.1)
	Down limits for pipes	5MHz probe: Φ20×3.0 10MHz probe: Φ15×2.0 Error is less than ±0.1	5MHz probe: Φ20×3.0 10MHz probe: Φ15×2.0 Error is less than ±0.1	5MHz probe: Φ20×3.0 (normal) Error is less than ±0.1	5MHz probe: Φ20×3.0 (normal) Error is less than ±0.1
	Probe frequency setting	√	√	√	√
	Adjusting of sound velocity	√	√	√	√
	Testing of sound velocity	√	√	√	√
	Limits setting	√			
	Setting of receiving gain	√	√	√	√
Switch of metric and inch	√	√	√	√	
Catch of min. testing value	√	√	√	√	
2-point calibration	√	√	√	√	
Memory of thickness value	√				
Review of	√				

	memory				
	Clear memory	√			
	Adjusting of brightness	√	√	√	√
	Backlight	√	√	√	√
	Low-battery indicator	√	√	√	√
	Communication	√			
	printer	√			

√: means the apparatus has this function.

Appendix II

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