

MiniTest 440

Technical Reference and Operating Manual

Advancing with Technology

ElektroPhysik

VERSION: 3.03

Subject to change without notice

ElektroPhysik Dr. Steingroever GmbH & Co. KG
Pasteurstr.15
50735 Köln
Deutschland

Tel: +49 221 75204-0

Fax: +49 221 75204-67

Web: www.elektrophysik.com

Mail: info@elektrophysik.com

Disclaimer

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

Contents

1	General description.....	E-1
2	Technical specification.....	E-1
3	Measuring principle.....	E-2
4	Complete set, spare parts and contents.....	E-2
	【4.1】 Complete set	E-2
	【4.2】 Display	E-4
	【4.3】 Keypad	E-5
5	Preparation before measurement.....	E-6
	【5.1】 Preparation of the instrument.....	E-6
	【5.2】 Selection of the Probe	E-6
	【5.3】 Treatment of the measured surface	E-7
6	Function operation.....	E-8
	【6.1】 Switch on	E-8
	【6.2】 Measurement.....	E-8
	【6.3】 Calibration	E-9
	【6.3.1】 Auto calibration	E-9
	【6.3.2】 Velocity measurement.....	E-11
	【6.4】 Menu display and operations	E-12
	【6.4.1】 Measuring mode.....	E-13
	【6.4.2】 Sound velocity of the instrument	E-14
	【6.4.3】 Database.....	E-16
	【6.4.4】 Measurement Unit.....	E-16
	【6.4.5】 Gain setting	E-18
	【6.4.6】 Switch off mode	E-19
	【6.4.7】 Contrast.....	E-19
	【6.4.8】 Language.....	E-19
	【6.4.9】 Gauge data	E-19
	【6.4.10】 Probe calibration	E-16
	【6.4.11】 Total reset.....	E-20
	【6.5】 Data.....	E-20

Contents

【6.6】 Data storage	E-20
7 Measuring technology	E-21
【7.1】 Measuring methods.....	E-21
【7.2】 Pipeline measurement method	E-21
8 Maintenance and precautions	E-22
【8.1】 Power check.....	E-22
【8.2】 Precautions.....	E-22
[[8.2.1]] General precautions.....	E-22
[[8.2.2]] Precaution during the measuring.....	E-22
9 Standard delivery	E-23
Appendix	E-24

1 General description

Ultrasonic thickness gauge adopts micro-processor technology and the ultrasonic measuring principle. It is used to measure the thickness or sound velocity of metals and various other materials.

Before usage, please read the operation manual carefully to get to know about the functions of the instrument and master the operations.

2 Technical specification

Display screen: 128×64 LCD dot matrix LCD display (with backlight)

Display digital: 4 digital

Measuring range: 0.65mm~500.0mm (Steel)

Display accuracy: 0.1mm (When the measured value is bigger than 100mm) ;
0.01mm (When the measured value is less than 100mm)

Accuracy: 0.65mm~9.99mm $\pm 0.04\text{mm}$
10.00mm~99.99mm $\pm (0.1\%H+0.04)\text{mm}$
100.0mm~500.0mm $\pm 0.3\%H$

Sound velocity: 1000m/s~9999m/s

Data storage: 10 files including 5000 data

Measurement frequency: 2 times/sec in normal mode
10 times/sec in scan mode

Zero calibration: Auto

Auto switch off: 2 minutes, 5 minutes or shut down manually.

Power: 2 AA batteries, work 64 hours continuously.

Environment: Operating temperature: $-20^{\circ}\text{C}\sim 50^{\circ}\text{C}$
Storage temperature: $-25^{\circ}\text{C}\sim 60^{\circ}\text{C}$

Dimensions: 130mm (L) ×73mm (W) ×24mm (H)

Weight: 190g (Without battery)

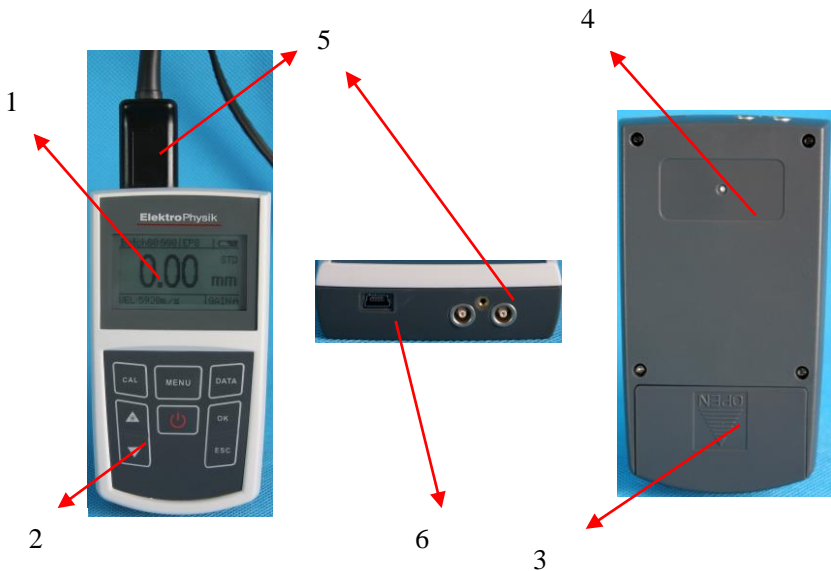
Optional Probes: U5.0, U7.5, U10.0, U5HT, U2.0, U5.0E.

3 Measuring principle

The ultrasonic wave emitted from the probe transmitted through the coupling agents and reach the measured work-piece. One part of then is reflected on the work-piece surface and the probe receive the reflected echo. By accurately measuring the ultrasonic travel time, the thickness will be getting and displayed in figures.

4 Complete set, spare parts and contents

【4.1】 Complete set

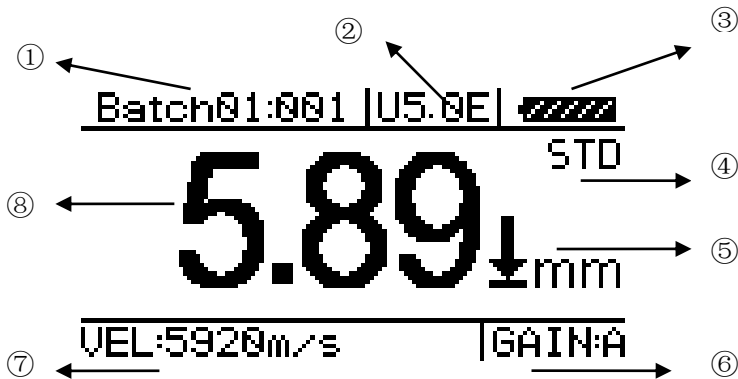





- ① Screen
- ② Keypad
- ③ Battery compartment (back cover)

Display

- ④ Nameplate(back cover)
- ⑤ Probe socket (identify pin)
- ⑥ USB interface







【4.2】 Display



- ① The measured data file groups and the storage data in each file group.
- ② Probe type
- ③  Full battery  Flat battery indicator
- ④ Measuring mode
- ⑤  Measurement icon and measuring unit
- ⑥ The current selected gain method of the amplifier
- ⑦ The current selected sound velocity
- ⑧ The current measured data

【4.3】 Keypad



- ①  **Power ON/OFF.**
Press this key to switch on or switch off the instrument.
- ②  **Menu key.**
Press this key to go to the operation menu.
- ③  **Up and down key.**
Achieve switch among the menu options in the menu operation.
Press the up key to switch on or off the backlight.
- ④  **OK/ESC key.**
In menu operation, press “OK” to confirm, and “ESC” to exit.
In Measurement state, press “OK” to save the current data.
- ⑤  **Shortcut key of calibration**
Auto calibration, second calibration and sound velocity measurement are available.
- ⑥  **Shortcut key Data**
Press this key to read the stored date.

Note: For the operation of each function key, it will give detailed instruction in the function operation below.

5 Preparation before measurement

【5.1】 Preparation of the instrument

For the newly purchased instrument, please check the instrument and its accessory according to the standard delivery table in chapter 9. If you find it is not the same as the table listed, please contact the manufacture in time. If the instrument is damaged, please do not use it and contact the manufacture as soon as possible.

【5.2】 Selection of the Probe

Type	Frequency	Measuring range	Temperature
U5.0E	5.0MHz	E-E 3.0~25mm P-E 1.0~200mm	<60°C
U5.0	5.0MHz	0.8mm~300mm	<60°C
U5HT	5.0MHz	3.0mm~100mm	<350°C
U7.5	7.5MHz	0.65mm~50mm	<60°C
U10.0	10.0MHz	0.65mm~20mm	<60°C
U2.0	2.0MHz	2.0mm~500mm	<60°C

Users can select the suitable probe according to the thickness of the work-piece to be measured.

U5.0E: The probe can measure the thickness of work-piece through pass the coating under the E-E mode; and it can be used as the normal probe under the P-E mode.

U5.0: The probe is used common in many measurements, for example when the measuring surface is flat or with huge curvature, or the thickness of the work-piece to be measured is large than 50mm.

U5HT: Mainly used in the thickness measurement when the temperature is less than 350°C

U7.5: Mainly used in the measurement of thin wall thickness and small

Function

curvature surface.

U10.0: Mainly used in the measurement of thin wall thickness and small curvature surface.

U2.0: Mainly used in the measurement of coarse particles such as cast iron.

【5.3】 Treatment of the measured surface

When the surface to be measured is too rough or rusty heavily, please perform the treatment according to the following methods:

1. Clean the measured surface by grinding, polishing or filing, etc. or use coupling agent with high viscosity for that.
2. Use coupling agents on the work-piece surface to be measured.
3. Take multiple measurements around the same testing point.

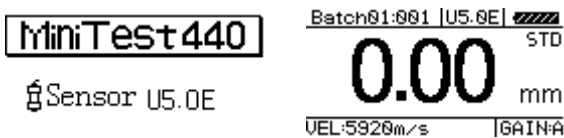
6 Function operation

【6.1】 Switch on

Select the correct probe and insert it into the probe socket and then press



to switch on the instrument, the following screen displays:



If you did not insert the probe before switching on the instrument, the screen will prompt you than “Please insert the probe”. At this moment insert the probe into the socket and waiting to go to the measuring status.

Note: Please use the standard provided probe, otherwise the instrument will does not work normally and displaying “Error”.

【6.2】 Measurement

There are two ways to access to measurement status, which are:

1. Insert the standard probe and switch on the instrument to go to the measuring status.
2. During menu operation, press “**ESC**” to return back to the measuring status.

Note: From measuring screen, press “OK” to save the current measured value.

【6.3】 Calibration


It will cause error during the primary stage of usage and operating, this caused by the following three aspects:

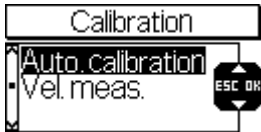
1. The probe itself or the temperature variation
2. System error caused by the match of the instrument and the probe.
3. Calculation error caused by the sound velocity set in the instrument is different from that of the actual material. In order to eliminate the possible error, the instrument provides three solutions to resolve it.

Press  key, and then press  or  to select the options.

[[6.3.1]] Auto calibration

Using different probe, wear out probe and the environment temperature will all cause measurement error, for these factors, the “Auto calibration” function is available.

1. Press  key, screen displays as following ,



2. Select “Auto Calibration”, Press “OK” key.


Note: During calibration, ensure the clean of the probe surface because the attached coupling agents and other dirt will influence the calibration accuracy. When the measuring temperature changes greatly, it is recommended to use this function to make sure the measurement is accuracy.

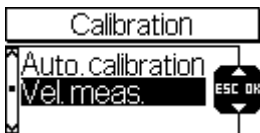
[[6.3.2]] Velocity measurement

Because the work-piece is made from various materials and even the same material with different content and processing technology, the sound velocity will changed. And this change will cause the measuring error. If the error is not enough to influence the measuring accuracy, it can be neglected. Otherwise it is necessary to get the accurate sound velocity of the work-piece to be measured. In this case, the function of velocity measurement can be used, the usage is as follows:

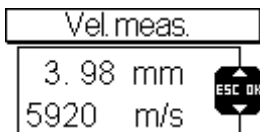
Velocity



1. Select or preset the sound velocity almost that of the material.
2. Select a measured sample whose thickness is nearly the same as the work-piece to be measured and measure the actual thickness A by other measuring methods (For example, Caliper).
3. Use the Minitest 440 to measure the sample and get a thickness B.

4. Press  key, screen displays as following






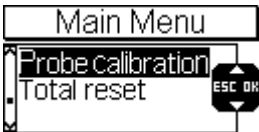
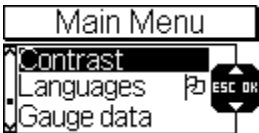
5. Select "Vel. Meas.", press "OK" key. Screen displays as following:



6. Press  or  key to adjust the sound velocity and make the measured thickness value B is almost or the same with the thickness value A. Press "OK" key to confirm.
7. Re-measure the sample's thickness and recheck the deviation between the measured value and the actual value. If the two values are the same, that sound velocity is the accurate value of the materials.
8. This new velocity will be stored in "Menu-Velocity-Vel. Custom".

【6.4】 Menu display and operations

Press  to enter the menu screen and press  or  to select the options.



Press “**OK**” to go to the selected option item.


Press “**ESC**” to exit and go to measuring status.

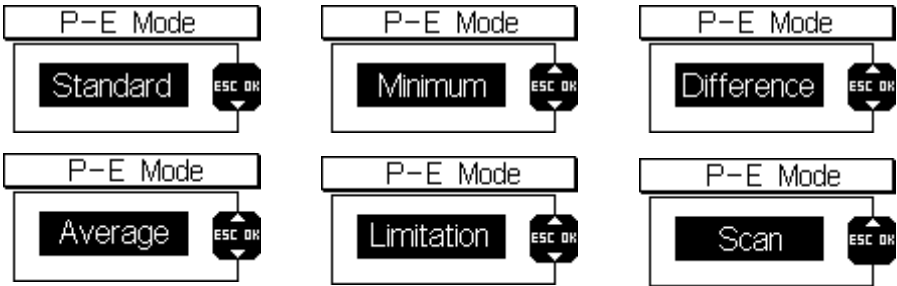
【6.4.1】 Measurement

There are two kinds of measuring modes provided, P-E mode and E-E mode. When the P-E mode is selected, all probes are available. When E-E mode is selected, the probe U5.0E is available only for measuring the thickness through pass the coating.

《6.4.1.1》 P-E mode

Under the P-E mode, there are five measuring modes provided, users can select different measuring modes according to their requirements and measuring environments.

Press  key, select “measurement”, the instrument displays:



1. Standard: display the current value, satisfied with the normal measuring needs.

2. Minimum: Among one measurement, display the minimum value of the current measured point. It is suitable for testing the curvature surface or needs to get the minimum value which is widely used in the thickness measurement of pipeline.

Note: it is not recommended to use this function when measuring cast iron or alloy materials.

3. Difference: display the accurate differential value between the measured value and reference value set by the users, suitable for quality check to identifying the qualified products whose thickness is in the admissible error.

4. Limitation: set the upper and lower limit, when the measured thickness exceeds the preset limit, it will display and give alarm. This measurement mode is more widely used than differential mode.

5. Scan: This mode is recommended to measure the high temperature work-piece


《6.4.1.2》 E-E mode

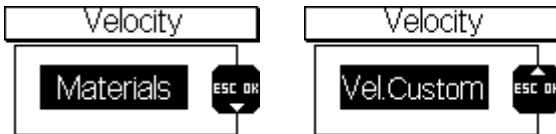
The Echo-to-Echo option allows you to make measurements between two consecutive back wall echoes. Therefore, a good usage of the Echo-to-Echo option is for measuring through coatings to measure only the true metal thickness.



Note: The probe U5.0E is available for this function only.

[[6.4.2] Sound velocity

Sound velocity plays an important role in measurement. Different material is of different sound velocity. When the sound velocity is incorrect, it will cause wrong measured results. There are two ways to select the material's sound velocity, which are “Materials selection” and “velocity custom”.

1. Press  key, select “Velocity”, the screen will display as follows:

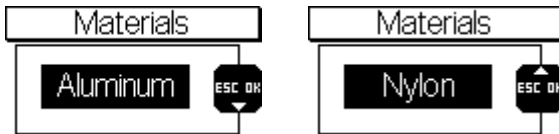


2. Press  or  to select the options. Press “**OK**” to confirm.

《6.4.2.1》 Materials selection

If the material and its sound velocity are known, users can select a sound velocity which is almost that of the standard material. The “material options” gives the sound velocity of 9 different materials which can be select by yourself.

Note: the 9 values are just the theriotic values, if users want to get accurt measuremnts , please refer to the sound velictiy function and get he more accurate sound velocity.



The 9 materials are: aluminum, titanium, steel, stainless steel, glass, copper, brass, polystyrene and nylon.

《6.4.2.2》 Velocity Custom

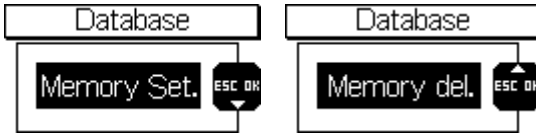
When the sound velocity of 9 materials is not satisfied with the requirements of the users, there is a sound velocity tabe which give the sound velocity of various materials in the appendix. Use this table to set the correct sound velocity.



Note: For more accurate measurements, please refer to 《6.3.2》 the function of sound velocity measuring to get more accurate sound velocity.


[[6.4.3] Database

The instrument provides 10 file groups storage space. 500 group data can be stored in each file group, so the total storage space is 5000 groups data. In each group data concludes following contents, such as the measured data, probe type, sound velocity and the selected measuring mode. In the database, users can set or delete any file in the 10 file groups.



《6.4.3.1》 Memory setting

In this function, users can select a file name 01-10 according to your actual needs. Once the file is selected, it will become the current file which used to save the measured data.

1. Press  key, select “Database”- Memory set”.

2. Select the file name, press “OK” to confirm.

The figure below shows the file is selected but there is no data in it.




The figure below shows the file is selected and there are storage data in it.

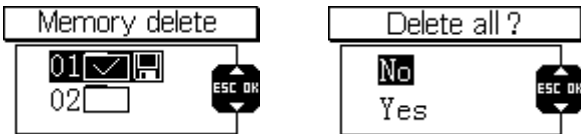


Note: If some file is selected and has storage data in it, but the users change the probe or measuring mode and want to save measured data to the file again, the instruments will prompt users to select another file. The set file is not available.

《6.4.3.2》 Memory delete

When the users confirm to delete the used file, this function can be used to manage the files.


1. Press  key, select “Database”- Memory del”.
2. Select the file you want to delete and press “OK” to confirm.

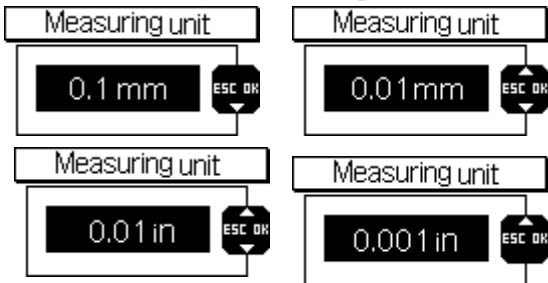


Note: When delete some files, all storage measured data in the file will be deleted. So users should confirm the invalid data before deleting files or backup the files in your PC.

【6.4.4】 Measurement Unit

Users can select the displayed accuracy and the measuring unit. When selecting the high accuracy, the workpiece surface to be measured should be smooth, for the purpose of get a accurate value.

1. Press  key, select “Measuring unit”
2. Select the unit you want and press “OK” to confirm.



Note: when probe U5HT ad U2.0 is selected, it is recommended to use 0.1 mm and 0.01in.

[[6.4.5]] Gain setting

In the user's measuring environment, both different materials and the same material with different status will have different effects on the accurate and stable measuring. So for different measured objects and different measuring environment, users should adjust the work status of the instrument to meet more measurements.


There are four different gain modes: Auto, Low, medium and high.

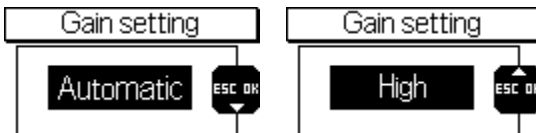
Auto: Match different probe and meets almost the measuring requirements.

Low: Suitable for high scattering and small attenuation materials

Medium: Suitable for many measurements.

High: Suitable for high attenuation materials.

1. Press  key, select “Gain setting”
2. Select option, press “OK” to confirm. The default set is “AUTO”.



[[6.4.6]] Switch off mode

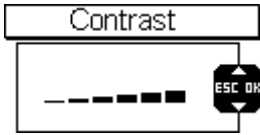
The instrument provides three ways to control the power:

1. Without operation in **2** minutes, the instruments will switch off automatically.
2. Without operations in **5** minutes, the instrument will switch off automatically.
3. Auto switch off is unavailable.

Note: When select “Disable”, users should switch off the instrument power manually to save power.

[[6.4.7]] Contrast

There are six contrast levels to meet the measuring requirements.



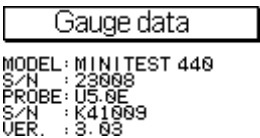
[[6.4.8]] Language

There are only two languages can be selected, which are Germany and English. Other languages will be added in future.



[[6.4.9]] Gauge data

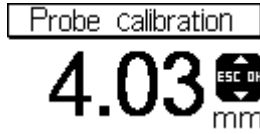
In this function, users can inquiry the instrument's data:



[[6.4.10]] Probe calibration

For the measuring error caused by the probe replacement and other factors and it can not eliminated by using the “Auto calibration” function. (Please make sure that the error is not caused by the incorrect sound velocity setting), at that moment by the function of “second calibration”, the error will eliminated according to the system error. The steps are as follows:

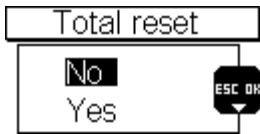
1. Adjust the sound velocity at 5920 m/s
2. Measure the thickness of the standard delivered test block. The measured value should be 4.00mm \pm 0.01mm. If the measured value is not that, the usage of “Probe calibration” can eliminate the error.



3. Adjust the measured value and make it meets the above requirements.

【6.4.11】 Total reset

During the usage, when users can not ensure why the problems comes out and with some questions on setting, this function can be used to make the parameters to reset the factory status to eliminate any abnormal because of the parameters setting.



【6.5】 Data

This function provides the data processing of the stored data of the instrument. There are two ways of data processing for the previously stored data.

1. Read data: select the file and the stored data will be read directly in the instrument screen.
2. Data transmission: transfer the stored data to the PC via USB interface.

Note: For the detailed operation instruction of transferring the data to PC via USB, please refer to the files in the provided CD.

【6.6】 Data storage

When the storage file is set, users can save the measuring data to the file, the detailed procedure is as follows:

1. Make sure the measurement is correct.
2. Press “**OK**”, the measured data will be saved automatically.

Note: The process is available when the measurement icon disappeared

7 Measuring technology

【7.1】 Measuring methods

The instrument provides many measuring methods.

1. Single point measuring method: use the probe to measure any point of the work-piece to be measured and the displayed value is the thickness.
2. Two point measuring method: Perform two measurements on the same point of the measured surface, in the second measurement, splitting plane of the probe should be 90 degree, take the minimum as the thickness value
3. Multiple point measurement method: perform several measurements in a circle about 30mm in diameter and take the minimum value as the thickness value.
4. Continuous measurement methods: apply the single point measurement method, and take measurements continuously along the designated route, the intervals should be less than 5mm, and take the minimum value as the work-piece's thickness.

【7.2】 Pipeline measurement method

During the measurement, make the probe's crosstalk interlayer plate be perpendicular or parallel to the axial line of the pipeline. For a pipeline with larger diameter, the probe's crosstalk interlayer plate should be perpendicular to the axial line of the pipeline, but for pipeline with small diameter, users should perform measurements making the crosstalk being both parallel and perpendicular to the axial line of the pipeline and take the minimum readout as the thickness value.

8 Maintenance and precautions

【8.1】 Power check

When the power is low, the low battery indicator will appear, at this moment users should replace the battery in time, or it will affect the measuring accuracy. The backlight can not be switched on for a long time, because it is a big consumer of electricity.

Note: if the instrument did not used for a long time, please take out of the battery to avoid leakage to damage the instrument.

【8.2】 Precautions

【8.2.1】 General precautions

The instrument should avoid strong vibration, do not let it in an excessively humid environment, plug in or out the probe should hold the jacket to avoid the core wire of the probe damaged.

【8.2.2】 Precaution during the measuring

1. During the measurement, only the measuring icon appears and displayed stable, it can be regarded as a good measurement.
2. If there are large quantity coupling agents attached on the measured surface, when taking away the probe, it will cause error, so when the measurement is completed, please move the probe away from the measured surface quickly.
3. If the probe wears out, it will cause the displayed value unstable, please replace the probe.

9 Standard delivery

Main unit	1 set
Probe (U5.0E)	1 piece
Coupling agent	1 bottle
Instrument case	1 piece
Certificate	1 piece
Instruction manual	1 piece
AA battery	2 pieces
CD disk	1 piece
USB cable	1 piece

Appendix:

All velocities are approximations

Sound velocity measurement chart

Material	Sound Velocity	
	Inch/ μ S	M/s
Air	0.013	330
Aluminum	0.250	6300
Alumina Oxide	0.390	9900
Beryllium	0.510	12900
Boron Carbide	0.430	11000
Brass	0.170	4300
Cadmium	0.110	2800
Copper	0.180	4700
Glass(crown)	0.210	5300
Glycerin	0.075	1900
Gold	0.130	3200
Ice	0.160	4000
Inconel	0.220	5700
Iron	0.230	5900
Iron (cast)	0.180	4600
Lead	0.085	2200
Magnesium	0.230	5800
Mercury	0.057	1400
Molybdenum	0.250	6300
Monel	0.210	5400
Neoprene	0.063	1600
Nickel	0.220	5600
Nylon, 6.6	0.100	2600
Oil (SAE 30)	0.067	1700
Platinum	0.130	3300
Plexiglas	0.110	1700

Appendix

Polythylene	0.070	1900
Polystyrene	0.0930	2400
Polyurethane	0.0700	1900
Quartz	0.230	5800
Rubber, Butyl	0.070	1800
Silver	0.140	3600
Steel, Mild	0.233	5920
Steel, Stainless	0.228	5800
Teflon	0.060	1400
Tin	0.130	3300
Titanium	0.240	6100
Tungsten	0.200	5200
Uranium	0.130	3400
Water	0.584	1480
Zinc	0.170	4200

Note: All the sound velocity listed above and for reference only.