SNDWAY®

SW-6510S

User's Manual

ULTRASONIC THICKNESS GAUGE

User Instruction

Please read this instruction intently before your first utilization.

1. The instrument is not allowed to disassemble or repair in any ways.It is forbidden to do any illegal modification or performance change for laser emitter. Please keep it out of reach of children and avoid being used by any irrelevant personnel.
2. Due to electromagnetic radiation interference to other equipment and devices, please don`t use the device in the plane or around medical equipment and don`t use it in an inflammable, explosive environment.
3. Discarded batteries or devices shall not be processed just like household garbage, please handle them in line with related laws and regulations.
4. If the company's products beyond the warranty period are faulty, they can be handed over to the company to repair the product, and the maintenance fee will be charged according to the company's regulations.
5. The company cannot provide warranty for any damage to the product caused by the user's own disassembly and assembly of the company's products, improper transportation, storage, or failure to operate according to the product manual, as well as unauthorized alteration of the warranty card without proof of purchase.
6. If there is any quality problem with the instrument, or if you have any questions about the use of the instrument, please contact the local distributor or manufacturer in time, and we will solve it for you as soon as possible.

1 Packing List

No.	Names	Quantity	Remark
Standard Configuration			
1	User Manual	1PC	
2	The Meter	1PC	
3	Standard Probe(5mhz Φ10)	1PC	
4	Coupling Agent	1PC	
5	Portable Package	1PC	
6	USB Cable	1PC	

2 Overview

This instrument is an intelligent ultrasonic thickness gauge. It adopts the latest high-performance, low-power microprocessor technology. Based on the principle of ultrasonic measurement, it can measure the thickness of metals and other materials, and can measure the sound speed of materials. It can monitor various pipes and pressure vessels in production equipment, monitor their thinning degree after being corroded during use, and can also accurately measure various plates and various processed parts. This instrument can be widely used in petroleum, chemical industry, metallurgy, shipbuilding, aviation, aerospace and other fields.

2.1 Working principle

The thickness measurement of this ultrasonic thickness gauge is that the ultrasonic pulse generated by the probe passes through the couplant to reach the measured object, part of the ultrasonic signal is reflected by the bottom surface of the object, and the probe receives the echo reflected by the bottom surface of the measured object, and accurately calculates the ultrasonic wave round-trip time, and calculate the thickness value according to the following formula, and then display the calculation result.

In the formula:
H- Thickness; v- Sound speed in material;
t - The propagation time of the ultrasonic wave in the test piece back and forth once.

$$H = \frac{v \times t}{2}$$

2.2 Product Features

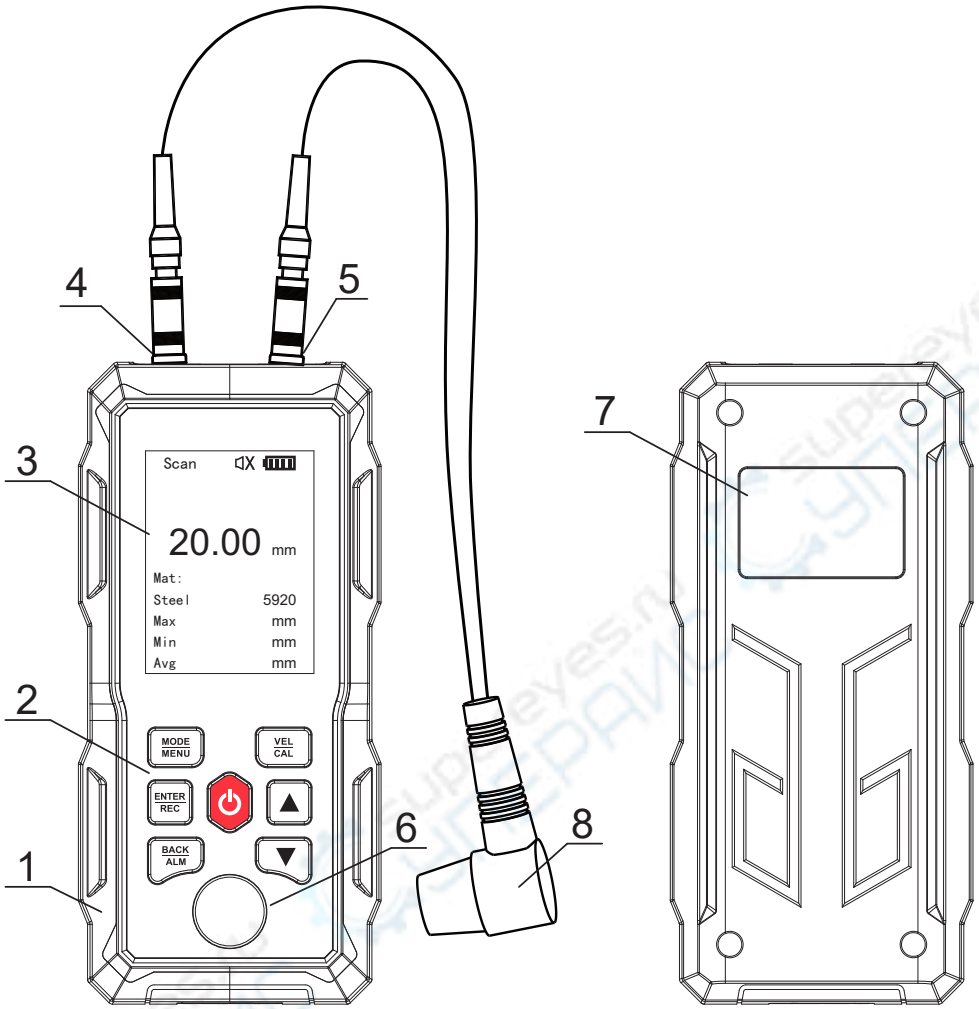
A. 2.4 inch black and white dot matrix screen
B. Chinese/English display interface
C. Built-in 2000mAh lithium battery
D. DC 5V/1A charging Type-C interface
E. 300 stored data

2.3 Technical Parameter

ITEMS	SW-6510S
Display	2.4 inch black and white dot matrix screen
Language	Chinese / English
Measuring Range	1.00~300.00mm(the steel)
Sound Velocity	(1000~9999) m/s
Unit	0.1mm / 0.01mm / 0.01in
Accuracy	H<10mm, ±0.1mm; H≥10mm, ±(1%H+0.1)mm H is the thickness of the object
Lower limit of pipe measurement	Φ20*3mm(steel)
Storage capacity	300 sets, each set including current material, Velocity of Sound, Unit, Measuring Value, the MAX value, the MIN value and Average Value
Main Functions	Single Measurement, Continuous Measurement, Alarm Measurement, Sound Velocity Measurement, Calibration
Battery	Built-in 3.7V 2000mAh Li-ion battery
Charging specification	DC5V 1A Type-C interface
Battery life (fully charged)	About 16 hours
Working Temperature & Humidity	0°C~40°C, 10%RH~80%RH
Storage Temperature & Humidity	-10°C~+50°C, 10%RH~70%RH
Dimension	140x66x28.5mm

Note: 1) The standard probe of the instrument cannot use oily couplant, otherwise the probe will be damaged! After using the probe, wipe off any residual couplant on the probe to prolong the life of the probe.
2) Please try to avoid using it in an oily environment. If it is unavoidable, try to reduce the contact time with oily substances as much as possible, and after use, dry the probe surface with oil-absorbing paper.

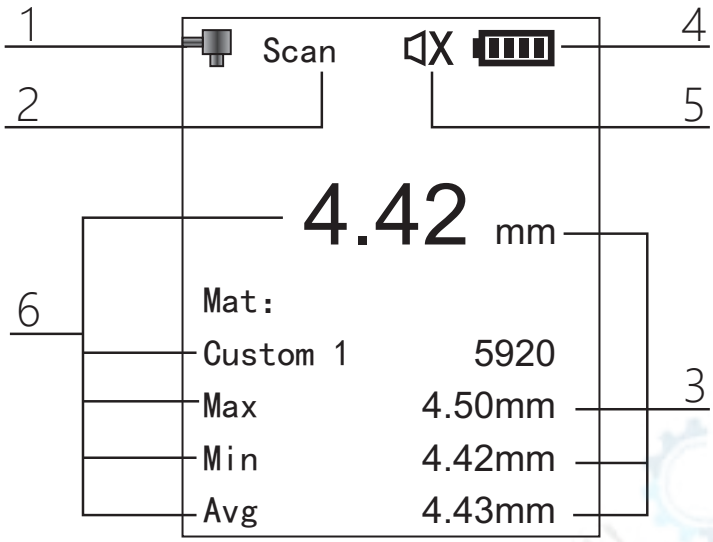
3 Structure and appearance



1. Housing 2. Buttons 3. Display
4. Transmitter socket 5. Receiver socket
6. Thickness calibration block 7. Nameplate
8. Ultrasonic thickness probe (probe for short)

3.1 Main Display Interface

After the instrument is turned on, it will automatically enter the main display interface, as shown in the following figure:



1) Coupling state: the coupling state between the probe and the workpiece to be measured
2) Measurement mode: display the current measurement mode
3) Unit system: mm (in metric system), or in (in imperial system)
4) Battery power: Display of remaining battery power
5) Sound indication: alarm sound switch display
6) Information display: display thickness measurement value, measurement material, sound speed, maximum, minimum, average;

4 Charging and maintenance of lithium battery

The product is powered by a built-in 3.7V 2000mAh lithium battery, which is not removable. When the product cannot be turned on or the battery is empty after turning on, please charge it in time. Please use a DC5V, more than 1A charging adapter to charge the product, and the charging port is Type-C. While charging, the battery symbol scrolls to display. When fully charged, the battery symbol becomes full.

Note: When not in use for a long time, fully charge the product first, and recharge it every six months to avoid battery damage.

5 The general measurement process of the instrument

A. Prepare the tested workpiece, refer to "6.1 Surface Treatment of Measured Workpiece".
B. Insert the probe into the instrument and turn it on.
C. Instrument calibration. Refer to "7.5 Instrument Calibration".
D. Inversely measure the speed of sound. The sound speed of the workpiece is uncertain, and the sound speed must be measured back to obtain the correct sound speed of the workpiece. Refer to "7.6 Reverse Measurement of Sound Velocity".
E. Measure the thickness. Use the inversely measured sound velocity value to measure the thickness of the workpiece of the same material.

6 Preparation before measurement

6.1 Surface treatment of the workpiece to be tested

If the surface of the object to be measured is rough or severely corroded, please use the following methods:

- Use couplant on the surface of the measured object;
- Use rust remover, wire brush or sandpaper to treat the surface of the measured object
- Multiple measurements around the same point

7 Instrument use

7.1 Turning the instrument on and off

Power on: Insert the probe into the instrument, short press the key to power on.
Power off: long press the key to power off.
Automatic shutdown: the instrument will automatically shut down if there is no operation, and the default time is 5 minutes. Users can change the automatic shutdown time, refer to "7.18 Shutdown Settings".

Forced shutdown: long press the power button for more than 10 seconds to force shutdown.

7.2 single measurement

Apply the couplant evenly to the tested area, tightly couple the probe to the surface of the tested material, and the screen will display the thickness of the tested area. When the probe and the material to be tested are well coupled, the screen will display the coupling mark . If the coupling mark flashes or there is no coupling mark, it means that the coupling is not good and needs to be added with couplant. When the probe is removed, the coupling symbol disappears and the thickness value remains.

Figure 1. Add couplant.

Figure 2. Smear the couplant evenly, and tightly couple the probe to the surface of the material to be tested.

7.3 Continuous measurement

Apply the couplant evenly to the measured area, then couple the probe to the workpiece and move it along the surface of the workpiece. The instrument will display the current value, maximum value, minimum value and average value of the measurement in real time.

7.4 Alarm measurement

The user can monitor the material with poor quality through the alarm function. Press and hold BACK ALM to turn the alarm on or off. The displayed on the screen means to open the alarm measurement, and the displayed on the screen means to close the alarm measurement.

For example:
Alarm setting: Standard value: 4.00mm
Tolerance limit: ±0.1mm (Refer to "7.19 Alarm Setting" for alarm setting) When the measured thickness is less than 3.90mm or greater than 4.10mm, the instrument will continuously issue a

"Beep beep beep" alarm sound, at this time, the thickness of the object is detected to be unqualified. After the alarm, the user can press any key to exit the alarm, or continue to measure.

7.5 Instrument calibration

Note: Probe calibration should be performed every time the probe is replaced, the ambient temperature changes greatly, or the measurement deviates.

When the instrument is used for the first time or has not been used for a long time, please calibrate it first. Calibration must use the calibration thickness block provided by the manufacturer. After calibration, the material automatically becomes steel, and the speed of sound becomes 5920m/s (0.233in/us).

The calibration operation is as follows:

1) Press and hold VEL CAL to enter the calibration mode, and the screen displays "Please measure the calibration thickness block" .
2) Referring to Figure 1 and Figure 2 in "7.2 Single Measurement", apply the couplant evenly to the surface of the standard thickness block on the case, and press the probe on the couplant to make it in close and uniform contact with the surface of the thickness block ; (Note: Do not apply the couplant too thick, otherwise the instrument will record the thickness of the couplant, resulting in a calibration error).
3) After the measured value is stable, press ENTER REC again to save the calibration data. (Note: Before pressing ENTER REC , the displayed value may not be 4mm. Please press ENTER REC again when the value is stable. After calibration, the displayed value should be within the range of 4±0.04mm, otherwise re-calibrate).

7.6 Measure sound speed in reverse

Different materials have different speed of sound, the materials listed in "Appendix A" material and speed of sound are for reference only.
The function is used to determine the sound velocity of the workpiece material.

The steps to measure the speed of sound are as follows:

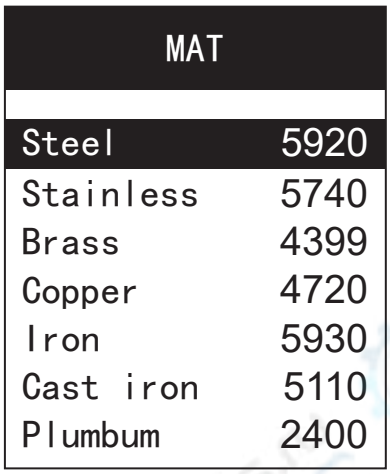
1) Calibrate the instrument first.
2) Use a caliper to measure the thickness of the workpiece once.
3) Use the instrument to measure the thickness of the workpiece once.
4) Press ▲ ▼ to adjust the thickness value of the instrument, and adjust it to the same value as that of the caliper.
5) Press ENTER REC to calculate the sound speed of the workpiece material.
6) At this time, the correct sound velocity value is obtained, and the correct thickness value can be obtained by measuring the same material with this sound velocity value.

Note: The thickness can be adjusted within a range of ±20mm (±0.79in) (custom materials can be adjusted by ±250mm (±9.84in)), the maximum limit is 300mm, and the minimum limit is 1mm. If the user misoperation, the sound speed value can be restored through "7.7 Sound Speed Selection".

7.7 Selection of sound speed

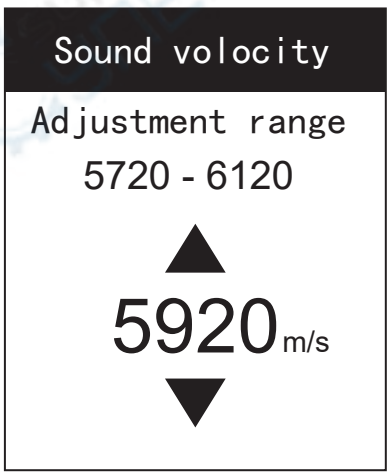
The user can select the speed of sound according to the material. When the current unit is mm, the unit of sound speed is m/s, and when the unit is in, the unit of sound speed is in/us. In the display state of the main interface, short press VEL CAL to enter the material selection. The instrument provides 3 kinds of custom materials. If the user does not know which material to choose, he can choose a custom material, and then determine the sound speed of the material by measuring sound speed in reverse, refer to "7.6 Measure sound speed in reverse.

MATERIAL SELECTION INTERFACE



1) ▲ Up to select the sound velocity of materials
2) ▼ Down to select the sound velocity of materials
3) ENTER REC Confirm the selected material Enter the adjustment of sound speed
4) BACK ALM Return to the main interface

SOUND VELOCITY ADJUSTMENT INTERFACE



1) ▲ Increase the value of sound velocity, long press to speed up adjustment
2) ▼ Decrease the value of sound velocity, long press to speed up adjustment
3) ENTER REC Confirm the speed of sound and return to the main interface
4) BACK ALM Return to material selection

7.8 CLEAR MEASUREMENT RESULT

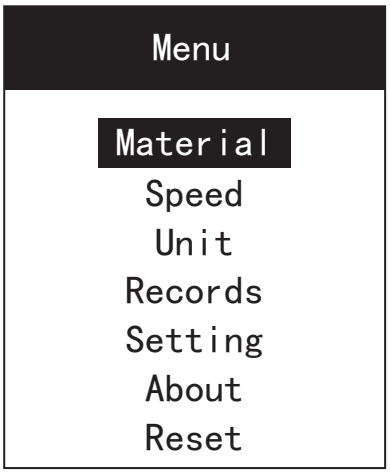
In single measurement and continuous measurement, short press BACK/ALM to clear the current measurement result (including maximum value, minimum value and average value). Continuous measurements do not clear the measurement until the probe is removed.

7.9 Storage function

In single measurement and continuous measurement, long press ENTER/REC to save records, each record includes current measurement value, maximum value, minimum value, average value, and material sound velocity. The instrument can store up to 300 sets of records. For viewing and deleting records, please refer to "7.14 Recording Operation". Results of continuous measurement cannot be saved until the probe is removed. During measurement, measurement results cannot be saved to prevent unstable data from being stored.

7.10 MENU

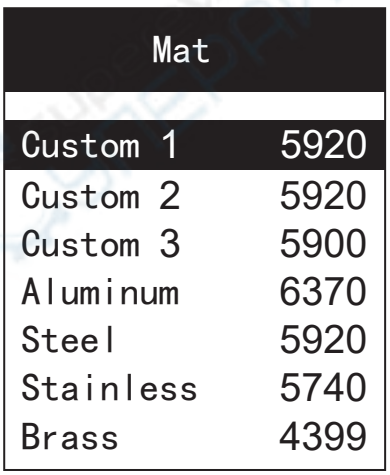
The menu includes: material selection, sound speed adjustment, unit, recording operation, system setting, about, and factory reset. Long press MODE/MENU to enter the menu, the operation is as follows:



1) ▲ Select the previous option
2) ▼ Select the next option
3) ENTER/REC Enter the selected option
4) BACK/ALM Exit the menu and return to the main interface

7.11 MATERIAL SELECTION

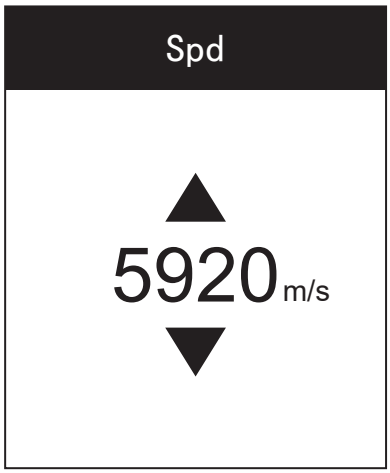
Select Material from the menu.



1) ▲ Up to select material
2) ▼ Down to select material
3) ENTER/REC Confirm the selected material and return to the menu
4) BACK/ALM Return to menu

7.12 THE ADJUSTMENT OF SOUND VELOCITY

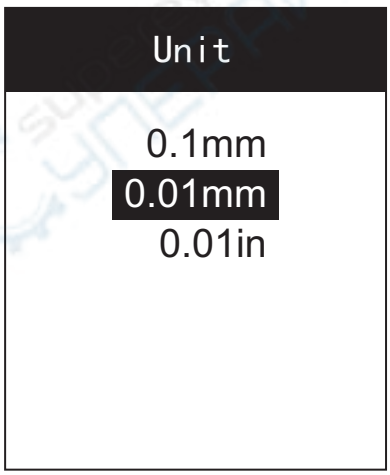
Select **Speed** in the menu to adjust the range of sound speed settings: The default value is ±200m/s (0.008in/us), and the adjustable range of custom materials is: 1000m/s to 9999m/s (0.039in/us to 0.394in/us).



1) ▲ Increase the value of sound velocity, long press to speed up adjustment
2) ▼ Decrease the value of sound velocity,long press to speed up adjustment
3) ENTER REC Save and return to menu
4) BACK ALM Return to menu

7.13 UNIT SETTINGS

Select **Unit** in the menu.



1) ▲ Up to select units
2) ▼ Down to select units
3) ENTER REC Save and return to menu
4) BACK ALM Return to menu

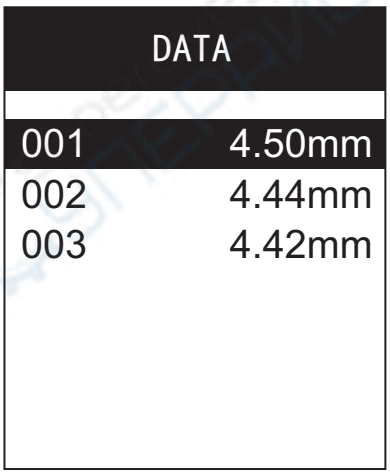
7.14 RECORD

Select Records in the menu. When the instrument has no record, it will prompt "no stored value" and cannot enter the record operation.

1) ▲ Up to choose functions
2) ▼ Down to choose functions
3) ENTER REC Enter the selected functions
4) BACK ALM Return to the menu

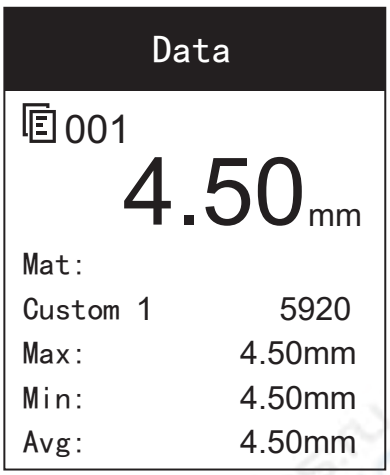
7.14.1 Browse from the first page

Select the "Browse from the first page" function in the record operation interface, the instrument will display the record list from the first page of records, and display the record number and current value of each record.



1) ▲ Page up
2) ▼ Page down
3) ENTER REC Enter the selected page
4) BACK ALM Return to the record interface

View record details: Enter the selected page, press ▲ ▼ to select the record number, and press ENTER REC to view the details (details include record number, current value, maximum value, minimum value, and current value). After viewing details, short press BACK ALM to return to the record list.



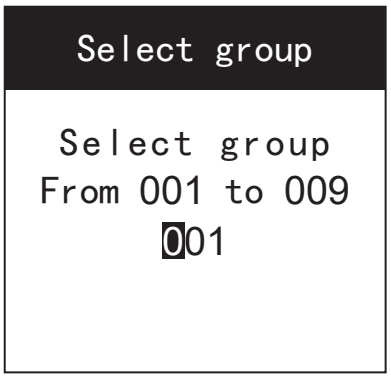
In the record list and record details functions, the user can long press BACK ALM to delete the currently browsed record. Short press ▲ ▼ to view the previous or next record details.

7.14.2 Browse from the last page

Select the "Browse from the last page" function in the record operation interface, the instrument will display the record list from the last page of records, and display the record number and current value of each record. Please refer to 7.14.1. for the operation.

7.14.3 Browse from selected groups

In the record operation interface, select the "Browse from selected group" function, the user selects the record to be browsed, the instrument displays the record list from the page where the record is located, and displays the record number and current value of each record.



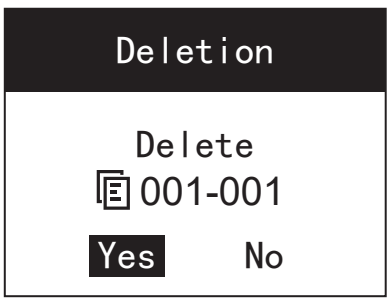
1) ▲ ▼ Adjust the record number
2) ENTER REC Confirm the number of digits currently modified (hundreds/tens/units of record number), When the units digit is confirmed, enter the selected record number
3) BACK ALM Return to the record operation interface

7.14.4 Deleted selected groups

In the record operation interface, select the "Delete Selected Group" function, and the user can select the record to be deleted.

1) ▲ ▼ Adjust the record number
2) ENTER REC Confirm the number of digits currently modified (Hundreds digit of start record/end record/tens/units), when the unit of the record is terminated, enter the deletion prompt
3) BACK ALM Return to the record operation interface

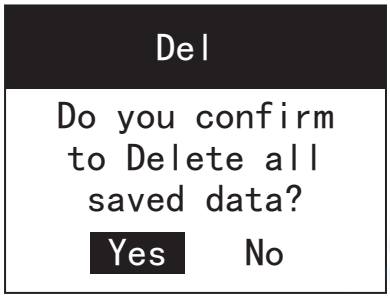
Deletion prompt: In this interface, the user can confirm whether to delete. Use ▲ ▼ to select "Yes/No", select Yes, press ENTER REC to delete; select No, press ENTER REC to return to the interface to delete the selected group. Press BACK ALM to directly return to the delete selected group interface.



It will take a while to delete the record, and the instrument will prompt that it is being deleted.

7.14.5 Delete all records

Select the "Delete All" function in the record operation interface, the user can choose to delete all records. Use ▲ ▼ to select "Yes/No", select Yes, press ENTER REC to delete all records; select No, press ENTER REC to return to the record operation interface. Press BACK ALM to directly return to the record operation interface.



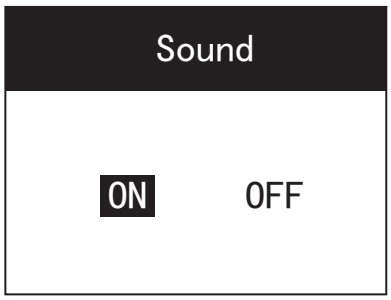
7.15 system settings

Select Setting in the menu.

1) ▲ Up to select functions
2) ▼ Down to select the function
3) ENTER REC Enter the selected function
4) BACK ALM Return to menu

7.16 Sound Settings

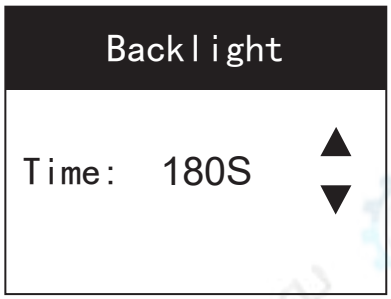
In the system settings interface, select the Sound function, the sound settings interface.



1) ▲ ▼ Select sound on/off
2) ENTER REC Save and return to menu
3) BACK ALM Return to system settings

7.17 Backlight time

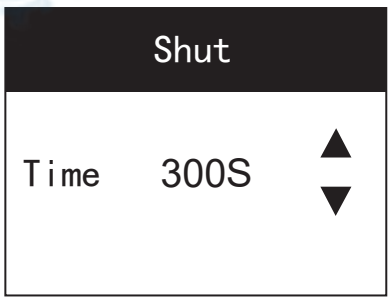
Select the "Backlight Setting" function in the system setting interface to adjust the backlight time.



1) ▼ Increase backlight time
2) ▲ Reduce backlight time
3) ENTER REC Confirm the backlight time and return to system settings
4) BACK ALM Return to system settings

7.18 shutdown time

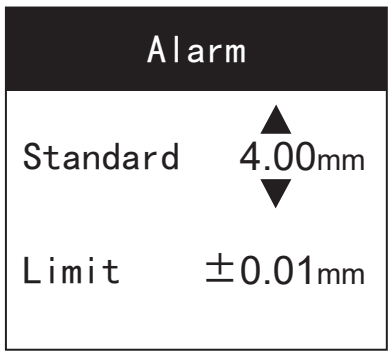
In the system settings interface, select the Shut function



1) ▼ Increase shutdown time
2) ▲ Reduce shutdown time
3) ENTER REC Confirm the shutdown time
4) BACK ALM Return to system settings

7.19 Alarm settings

Select the Alarm function in the system setting interface to adjust the standard value first.
And press ENTER/REC to adjust the tolerance limit. Long press ▼ ▲ to increase the adjustment range



1) ▼ Increase standard value / increase tolerance limit
2) ▲ Reduce standard value / reduce tolerance limit
3) ENTER/REC Confirm standard value/confirm tolerance limit and return to system setting
4) BACK/ALM Return to system settings

7.20 Language settings

Select the "Language Settings" function in the system settings interface.

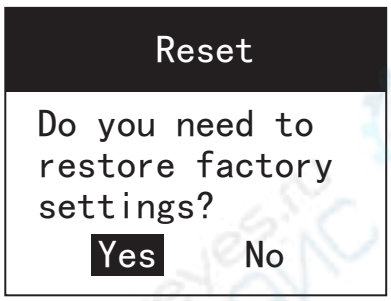
1) ▼ Up to select functions
2) ▲ Down to select functions
3) ENTER/REC Save and return
4) BACK/ALM Return to system settings

7.21 About the device

Select About in the settings menu and press BACK ALM to return to the menu. The content will be updated in the future, please take the actual situation as the standard and will not be updated here.

7.22 Reset

Select Reset in the setting menu, the user can restore the factory settings through this function.



1) ▲ ▼ select yes/no
2) ENTER REC Select yes to restore factory settings, select no to return to the menu
3) BACK ALM Return to menu.

8 Measurement method

8.1 Measurement method

- Single-point measurement method: Use the probe to measure any point on the measured object, and the displayed value is the thickness value.
- Two-point measurement method: The probe is used for secondary measurement at the same point of the measured

object. In the secondary measurement, the dividing plane of the probe is 90°, and the smaller value is the thickness value.

- Multi-point measurement method: make multiple measurements in a circle with a diameter of about 30mm, and take the minimum value as the thickness value.
- Continuous measurement method: Use single-point measurement method to measure continuously along the specified line, the interval is not less than 5mm, and the minimum value is taken as the thickness of the measured objects.

8.2 Pipe wall measurement

During measurement, the dividing surface of the probe can be measured along the axis of the pipe or perpendicular to the axis of the pipe. If the pipe diameter is long, the measurement should be made in the direction of the vertical axis. If the pipe diameter is short, it should be measured in two directions, and the minimum value is taken as the thickness value.

9.Maintenance and precautions

9.1 General precautions

- The instrument and probe should avoid strong vibration;
- Avoid placing the instrument in an environment that is too humid;
- When inserting and unplugging the probe, you should hold the movable jacket and force it along the axis. Do not rotate the probe to avoid damage to the probe cable core.
- The adhesion of oil and dust will cause the probe wire to gradually age and break. The dirt on the cable should be removed after use.

9.2 Precautions during measurement

- When measuring, it is a good measurement only when the coupling icon appears and is stable;
- If there is a lot of couplant on the surface of the object to be measured, when the probe leaves the surface of the object to be measured, the couplant will cause error.
  Therefore, when the measurement is over, the probe should be quickly removed from the surface of the object to be measured.
- The surface of the probe is made of acrylic resin, which is very sensitive to the scratching of the rough surface, so it should be pressed lightly during use. When measuring the rough surface, try to reduce the scratching of the probe on the surface.
- During measurement at normal temperature, the surface of the measured object should not exceed 60°C, otherwise the probe cannot be used again.
- If the probe is worn out, the displayed value will be unstable, and the probe should be replaced at this time.

9.3 Clean the calibration block

Since couplant needs to be applied when calibrating the instrument with the calibration test block, please pay attention to the rust prevention of the test block. Wipe the calibration block clean after use. Do not make it get sweaty when the temperature is high. If it is not used for a long time, a little grease should be applied to the surface of the random test block to prevent rust. When it is used again, after the grease is wiped off, it can work normally.

9.4 Clean the case

Alcohol, diluent, etc. have a corrosive effect on the case, especially the window, so when cleaning, just wipe it gently with a damp cloth.

9.5 Maintenance

When the instrument has abnormal phenomena (such as the instrument is damaged and cannot be measured; the liquid crystal display is abnormal; the error is too large during normal use; the keyboard operation fails or is confused, etc.), please do not disassemble or adjust any fixed assembly parts, please contact the after-sales service, handed it over to the maintenance department of our company to implement the warranty regulations.

Appendix A Materials sound velocity

Attention:All of sound velocity is approximate value, just for reference.

	material	sound velocity	
		in/μs	m/s
custom 1	User define 1	0.233	5920
custom 2	User define 2	0.233	5920
custom 3	User define 3	0.233	5920
Aluminum	Aluminum	0.250	6340~6400
Steel	common	0.233	5920
Steel	stainless	0.226	5740
Brass	Brass	0.173	4399
Copper	Copper	0.186	4720
Iron	Iron	0.233	5930
Cast iron	Cast iron	0.173~0.229	4400~5820
Lead	Lead	0.094	2400
Nylon	Nylon	0.105	2680
Silver	Silver	0.142	3607
Gold	Gold	0.128	3251
Zinc	Zinc	0.164	4170
Titanium	Titanium	0.236	5990
Tin	Tin	0.117	2960
Acrylic resin	Acrylic resin	0.109	2760
Epoxy resin	Epoxy resin	0.100	2540
Ice	Ice	0.157	3988
Nicke	Nicke	0.222	5639
Plexiglass	Plexiglass	0.106	2692
Porcelain	Porcelain	0.230	5842
PVC	PVC	0.094	2388
Quartz glass	Quartz glass	0.222	5639
Rubber	Rubber,vulcanized	0.091	2311

Appendix B Common Problems and Solutions in Ultrasonic Thickness Measurement

B.1 Influence of Surface Condition on Measurement Results

B.1.1 Surface covering

Before measurement, all dust, dirt and rust on the surface of the object to be measured should be removed, and paint and other coverings should be removed.

B.1.2 Rough surface

A surface that is too rough can cause measurement errors or even no readings from the instrument. The surface of the material to be tested should be as smooth as possible before measurement, and can be made smooth by grinding, throwing, filing, etc. High viscosity couplants can also be used.

B.1.3 Rough finished surface

Regular fine grooves caused by rough machined surfaces (such as lathes or planers) can also cause measurement errors and are treated in the same way. In addition, adjust the angle between the ultrasonic probe's crosstalk spacer plate (thin metal layer passing through the center of the bottom surface of the probe) and the fine groove of the material to be measured, so that the spacer plate and the fine groove are perpendicular or parallel to each other, and take the minimum value of the readings. As a measurement of thickness, better results can be achieved.

B.1.4 Cylindrical surfaces

When measuring cylindrical materials, such as pipes, oil drums, etc., it is very important to select the correct angle between the probe crosstalk barrier and the axis of the material to be measured. Simply speaking, couple the probe with the material to be tested, the probe crosstalk barrier plate is parallel or perpendicular to the axis of the material to be tested, slowly shake the probe perpendicular to the axis of the material to be

tested, the reading on the screen will change regularly, Select the lowest value of the readings as the measured thickness of the material. According to the curvature of the material, select the correct direction of the angle between the probe crosstalk barrier plate and the axis of the material to be tested. For pipes with larger diameters, select the probe crosstalk barrier plate perpendicular to the axis of the pipe; for pipes with smaller diameters, select two measurement methods, parallel and perpendicular to the axis of the pipe, and take the minimum value of the readings as the measurement thickness.

B.1.5 Composite shape

When measuring materials with composite shapes (such as pipe elbows), the method described above can be used, the difference is that a second measurement is required, and the two values of the probe crosstalk barrier plate perpendicular to the axis and parallel to the axis are read respectively, the smaller of which is taken as the thickness measurement of the material at the measurement point.

B.1.6 Non-parallel surfaces

In order to obtain a stable and reliable thickness measurement value, the other surface of the measured material must be parallel or coaxial with the measured surface, otherwise it will cause a large measurement error or no reading display at all.

B.2 Influence of temperature on measurement results

The thickness of the material and the propagation speed of ultrasonic waves in the material are affected by temperature. When the measurement accuracy is high, the test block comparison method can be used, that is, the test block of the same material and approximate thickness is used for measurement under the same temperature conditions, and the temperature compensation coefficient is obtained, and this coefficient is used to correct the measured value of the workpiece.

B.3 Influence of material attenuation on measurement results

For some materials such as fibers, porous, coarse crystals, etc., they will cause a lot of scattering and energy attenuation of ultrasonic waves, so that the instrument may have abnormal readings or even no readings (usually abnormal readings are smaller than the actual thickness). In this case, the material is not suitable for thickness measurement with this thickness gauge.

B.4 Use of reference blocks

Accurate measurement of different materials under different conditions, the closer the material of the calibration block is to the material to be tested, the more accurate the measurement will be. The ideal reference test block would be a set of test blocks of different thicknesses of the material being tested that provide the instrument to compensate for correction factors (such as material microstructure, heat treatment conditions, particle orientation, surface roughness, etc.). A set of reference blocks will be important in order to meet the requirements for maximum accuracy measurements.

In most cases, satisfactory measurement accuracy can be obtained using only one reference block, which should be of the same material and similar thickness as the material being tested. Take a uniform material to be tested and measure it with a micrometer and then it can be used as a test block.

For thin materials, when its thickness is close to the lower limit of the probe's measurement, a test block can be used to determine the exact lower limit. Do not measure material below the minimum thickness. If a thickness range can be estimated, then the thickness of the test block shall be selected as the upper limit. When the material to be tested is thick, especially alloys with complex internal structures, a test block that is close to the material to be tested should be selected in a set of test blocks to facilitate mastering the calibration.

The internal structure of most forgings and castings is directional. In different directions, there will be a small change in the speed of sound. To solve this problem, the test block should have an internal structure in the same direction as the material to be tested, and the sound waves in the test block. The direction of propagation should also be the same as in the material being tested. In some cases, the sound velocity table of known materials can be substituted for the reference test block, but this is only an approximate replacement for some reference test blocks. In some cases, the value in the sound velocity table is different from the actual measurement. This is because the material The physical and chemical conditions are different. This method is often used to measure mild steel, but only as a rough measure. This thickness gauge has the function of measuring the speed of sound, so it can first measure the speed of sound, and then measure the workpiece at this speed of sound.

B.5 Casting Measurements

Casting measurement has its particularity. The grain of the casting material is relatively coarse, the structure is not dense enough, and the measurement is often performed in a rough state, so the measurement encounters greater difficulties. The first is that the coarseness of the grains and the insufficiency of the structure cause a great attenuation of the sound energy. The attenuation is caused by the scattering and absorption of the sound energy by the material. The degree of attenuation is closely related to the grain size and ultrasonic frequency. At the same frequency, the attenuation increases with the increase of the grain diameter, but there is a maximum point. Beyond this point, the grain diameter increases and the attenuation basically tends to be higher. to a fixed value. For probes of different frequencies, the attenuation increases with increasing frequency. Secondly, when the grains are coarse and there is a coarse heterophase structure in the casting, the ultrasonic signal will be abnormally reflected, and a grass-like echo or a tree-like

echo will be generated, which will cause an incorrect reading in the thickness measurement result and cause a misjudgment.

In addition, with the coarsening of the grains, the anisotropy in the crystallographic direction of the metal becomes more pronounced, resulting in differences in the speed of sound in different directions, and the maximum difference can even reach 5.5%. Moreover, the density of the tissue at different positions in the workpiece is also inconsistent, which will also cause differences in the speed of sound. These factors will cause inaccurate measurement results. Therefore, special care should be taken when measuring castings.

When measuring castings, pay attention to:

- When measuring castings with rough surfaces, a couplant with a higher viscosity must be used.
- It is recommended to use the same material as the object to be tested and a test block with the same measurement direction as the object to be tested to calibrate the sound velocity of the material.

B.6 Methods to reduce measurement errors

B.6.1 Ultra-thin materials

Using any ultrasonic thickness gauge, when the thickness of the material to be tested falls below the lower limit of the probe, it will cause measurement errors. If necessary, the minimum limit thickness can be measured by the test block comparison method.

When measuring ultra-thin materials, an erroneous result called "double refraction" sometimes occurs, which occurs when the displayed reading is twice the actual thickness; another erroneous result is called "pulse envelope, cyclic "Jump", its phenomenon is that the measured value is greater than the actual thickness, in order to prevent such errors, the measurement should be repeated when measuring critical thin materials.

B.6.2 Rust spots, corrosion pits, etc.

Rust spots and pits on the other surface of the tested material (small rust spots are sometimes difficult to find), etc., will cause irregular changes in readings, and even no readings in extreme cases. When a pit is found or suspect, the measurement of this area must be very careful, and the probe crosstalk barrier can be positioned at different angles to make multiple tests.

B.6.3 Material identification errors

When the instrument is calibrated with one material and then used to measure another material, erroneous results will occur, and care should be taken to select the correct speed of sound.

B.6.4 Wear of the probe

The surface of the probe is made of acrylic resin. Long-term use will increase the roughness and reduce the sensitivity of the probe. If the probe is severely worn and results in a large error in the measurement results, a small amount of sandpaper or oilstone can be used to polish the probe surface to make it smooth and ensure parallelism. If the measured value is still unstable, the probe needs to be replaced.

B.6.5 Multilayer materials, composite materials

It is not possible to measure multi-layer materials with loosely bonded surfaces, because ultrasonic waves cannot penetrate uncoupled surfaces. Because ultrasonic waves cannot propagate at a uniform speed in composite materials, instruments that use the principle of ultrasonic reflection to measure thickness are not suitable for measuring multi-layer materials and composite materials.

B.6.6 Influence of oxide layer on metal surface

Some metals may have a denser oxide layer on their surface, such as aluminum, etc. This layer of oxide layer is closely combined with the substrate, and there is no obvious interface, but the propagation speed of ultrasonic waves in these two substances is different, so it will cause measurement error, and the size of the error is also different for the thickness of the oxide layer. Please pay attention to this situation when using it. You can choose a sample block from the same batch of tested materials, measure its thickness with a micrometer or caliper, and use this sample block to calibrate the instrument.

B.6.7 Abnormal thickness readings

The operator should have the ability to identify abnormal readings, usually rust spots, corrosion pits, and internal defects in the tested material will cause abnormal readings. For solutions, refer to the relevant chapters of this manual.

B.6.8 Selection and use of couplant

The couplant is used as a carrier of ultrasonic signal propagation between the probe and the material to be measured. If the type of couplant or use method is improper, it may cause a large error, or the coupling mark will flicker, and the measured value will not be stable. The coupling agent should be used in an appropriate amount and applied evenly. It is important to choose the right type of couplant. When used on smooth material surfaces, low viscosity couplants (such as randomly configured couplants) can be used; when used on rough material surfaces, or vertical surfaces and top surfaces, higher viscosity couplants are required.

Dongguan Sndway Electronic Co.,Ltd.

Add: Sndway Science & Technology Industrial Park, 58 Tuanjie Road, Humen 523930, Dongguan, China

Services Hotline: 400-125-6969 Tel: 0769-85265688

Fax: 0769-85116652 Url: www.sndway.com