SMART SENSOR®

Model：AR850

Ultrasonic Thickness Gauge
Instruction Manual

Over warranty period, any repairing / maintenance will charge the fee on the buyer in standard rate by local distributor.
The standard rate is not including the accessories which not packing in standard package(For example, abnormity transducer, lengthen lead-wire, special software) .
   We disclaims any liability due to: transportation damages; incorrect use or operation; manipulation, alterations or repair attempts; without warranty card, invioce.

7.2. Non-warranty list
LCD, battery, probe, sample block, plastic case, coupling agent

8. Table of sound velocity

Sound velocities of common materials

Material	Velocity(m/s)	Material	Velocity(m/s)
Aluminum	6320	Acetate resin	2670
Zinc	4170	Phosphor bronze	3530
Silver	3600	Turpentine	4430
Glod	3240	Glass	5440
Tin	3230	Incoloy alloy	5720
Iron/Steel	5900	Magnesium	6310
Brass	4640	Monel alloy	6020
Copper	4700	Nickle	5630
SUS	5790	Steel 4330（mild）	5850
Acrylic resin	2730	Steel 330	5660
Water（20℃）	1480	Titanium	6070
Glycerinl	1920	Zirconium	4650
soluble glass	2350	Nylon	2620

Table of Contents

1.Introduction

Smart sensor AR850 ultrasonic thickness gauge is an intelligent hand-hold product, which adopts ultrasonic measuring principle, and is controlled by micro processor, provides quick and precise measurement of thickness for most of industrial material. This unit is widely used in various precise measurement for different hardware / parts in industrial realm; one of its important application is to monitor the level of thickness-decreasing during operation of various and pressure container. Diffusely applied in manufacture fields, metal processing, and commercial inspection. The material that conduct and reflect constant sonic velocity, this product is to be applicable to used.

1. 1 Scope of application

This unit is suitable for measuring materials that are good ultrasonic conductor such as metal, plastic, ceramic, glass etc., as long as the measured part in two parallel surfaces for measurement of thickness. This unit is not suitable for cast iron due to its big crystalloid composition.

1.2 How it work

This unit is comprised of transimtting circuit, receiving circuit, Hi-frequency oscillator, counter, central unit processor, keypad, and moniter etc., adopting ultrasonic pulse reflect principle. Similar to light-wave measure principal, the sonic pulse occurs from the unit travels through the material being measured till reach the interface and reflects back to determine the thickness of the target material.
See the diagram below:
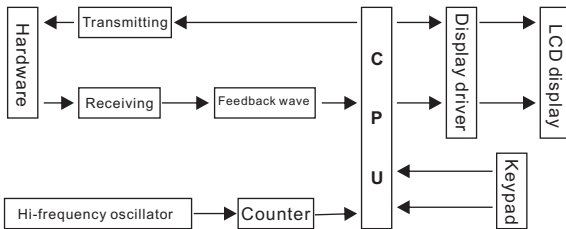
6.3 Cleaning the cabinet
Do not use solvent/alcohol for cleaning which erode the cabinet & LCD window, brush and sweep only with a moist cotton cloth.

6.4 Cleaning the sample block
Because of coupling agent should be put on the sample block during calibration, after use the sample block should be cleaned for preventing rust. In higher temperature environment, be sure protect the block form the droplet of water. If the gauge is not use for a long period, please apply some antirust on the sample block.

6.5 Avoid shocking/impact. Do not store the unit in high humidity enviroment.

6.6 When the tolerance is over than stated in this manual, please refer to the 3, 4, 5 chapter, in this manual.

6.7 Please contact us or our distributor if the following occurs:
A. Component being destroyed, no readout and enable to measure.
B. Abnormal LCD display.
C. The tolerance is too big in proper operation.
D. Malfunction of keypad.

6.8 This gauge is a advanced technology product, the repairing only by technician authorized by us, do not try any alterations or repair attempts.

7．Notice

7.1. Warranty and warranty policy

Please fill the warranty card with your cachet/chop after purchasing this products, the warranty period for repaired is 12 months form the date of original purchase. During warranty period, product must be returned with the invoice(copy) and warranty card to our customer service department. The product will not be warranted which without the warranty card.

micrometer/caliber.

5.8 Abnormal reading

A seasoned operator should be capable to distinguish the abnormal reading, practically result from rusting, erosive recess surface / incorrect calibrate sample block/ the inner flaw of material.

5.9 Choose and using coupling agent

Coupling agent serves the high frequency ultrasonic wave transmitting between the transducer to the hardware. Choose incorrect agent or wrong operation man cause error or poor coupling which lead to failure of measuring. The coupling agent should be used in proper way, typically, a single droplet of agent is sufficient.

It is important to use proper coupling agent, low viscosity agent(the provided agent / machining oil) is suitable for smooth surface. For rough / veritcal / aluminum surface, high viscosity agent like glycerin and lubrication grease is applicable. All kinds of coupling agent is available in local market, you can buy it form local distributor as well.

6. Maintain

6.1 Battery replacement

When low battery icon is showed, please replace the batteries.
A. Press ON/OFF to turn off.
B. Open the battery door properly.
C. Replace the low power batteries by new batteries in correct polarity. When the gauge is not use for long period, please take out the batteries.
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6.2 Protection of transducer

Because the wear face of transducer is propylene material which easy to be scratched. During taking measurement on rough material, please using the transducer in gentle motion. The temperature of the hardware should not over 60℃, otherwise it will cause damage on the transducer. Adhering oil, dust on the wear face will speed up aging of transducer and lead to rupture. Clean the lead-wire & transducer after use.

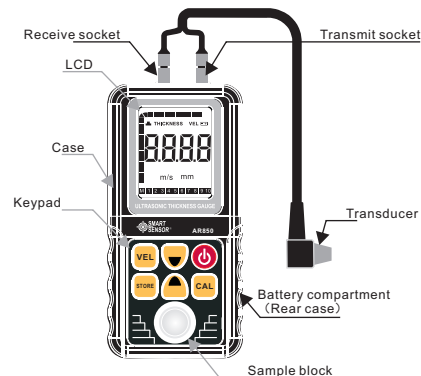## 1.3 Standard packing & Parts description

1. Standard packing:
   Main unit-1PCS Transducer-2 PCS(Φ10mm 5MHz ,Φ10mm 2.5MHz)
   Coupling agent-1PCS（50ml）
   4mmSample block-1PCS
2. Parts description

Receive socket
Transmit socket
LCD
Case
Keypad
Transducer
Battery compartment（Rear case）
Sample block

3. LCD diagram：

- ⌷⊞ ---- Low battery indicator
- ▚ ---- Coupling indicator
- m/s ---- Sound velocity unit
- mm   ---- Thickness unit
- VEL ---- Sound velocity indicator
- THICKNESS ---- Thickness indicator
- Ⓜ ---- Store / recall indicator
- 1 -- 10 ---- Stored unit indicator
- ■ ---- Calibration indicator

LCD display
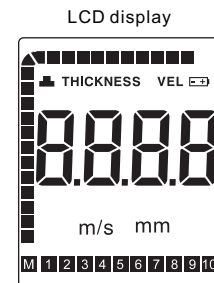
4. Keypad diagram
  ON/OFF -- ON/OFF key
  CAL -- Calibration key
  VEL -- Sound velocity key
  STORE -- Measurement
              data stored key
  CAL+ON/OFF --Backlight active keys
  ▲ --Sound velocity, thickness,
thickness unit adjust/recall key
  ▼ --Sound velocity, thickness,
thickness unit adjust/recall key

Keypad

1.4 Specification
Display: 4-digital LCD display
Minimum display unit: 0.1 mm
Working frequency: 5MHz
Measuring range: 1.2 to 225.0mm (steel)
Minimum limit for tube measuring: Φ20*3mm (steel)
Accuracy: +/- (1%H+0.1)mm,H denotes the measured thickness.
Sound velocity range: 1000 to 9999 m/s
Measuring sound velocity with a given thickness: measuring range:
1000 to 9999 m/s. When the given thickness over 20mm, the accuracy
is +/-5%; when the given thickness less than 20mm, the
accuracy is +/-1mm/H*100%.
Operation temperature: 0℃ to 40℃
Power supply: 3*1.5V AAA alkaline batteries
Operation current: Normal operation current≤50mA
                    With Backlight turn on current≤120mA
                    Stand-by current: ≤20uA
Size: 70.0*145.5*28mm

1.5 Features
 ● Auto calibration to assure the accuracy.
 ● Auto linear compensation: this advanced software program enha
nces the precision by correcting the non-linear accuracy of transducer.

Take care for measurement while measuring the known rusting spot/
suspicious area. or using sound insulation boardcelotex to locates the
spot in different testing angles.

5.3 Identify different velocity with vary material
   A fault reading would obtains, when measuring the hardware with the
velocity calibrated by prior material. So a correct velocity should be ad-
opted. The fault reading may also result form the difference between
the actual velocity with the calibrated value.

5.4 Abrasion fo the transducer
Because the transducer is made of propylene, long period use will cause
the surface of transducer became more rough which will decline the sen-
sitivity lead to the wrong reading. Please polish the surface with sand
paper or whetstone to assure the smoothness and parallel. If the reading
still unsteady, the transducer should be replaced with new one.

5.5 "CAL" function
   "CAL"(calibration) is used to calibrate the unit with the standard block
on the panel, do press this key for calibration with other materials or the
wrong measuring will take place.

5.6 Multilayer / composite material
It is impossible to read out the thickness of the uncoupled multilayer for
the ultrasonic wave can not go through the uncoupled space. Further
more, the sonic wave cannot travel in the composite material at an even
speed, so ultrasonic reflect principle cannot be applied for measuring
the multilayer/composite material.

5.7 Influence from the oxidized surface
   For some metals, such as aluminum a layer of oxide being generated
on their surface. The oxidized layer combined with the substrate tightly,
but the sonic wave travel within 2 different material which will lead to
error reading, the more oxidized layer the reading will be more tolerant.
Please calibrated the unit with the sample block that pick up along the
hardware to be measured, and obtain the thick of sample block by using

In most situations, using one referring block will get a satisfying measurement. This referring block must be the same material with same thickness as the parts to be tested. The referring block should be read out the thickness by micrometer.

When measuring thin material which thickness close to the minimum limit range of this unit, please use a referring block to define exact limit of this material(1.2mm for steel material). Do not measuring the material that the thickness under the minimum limit.

When material is a complex alloy in a large size. A block that has a similar thickness with the material should be selected for calibration.

For most hardware by forging / casting, they have different inner structure, so that the sound velocity slight different. To reach the exact reading, the referring block has similar structure as the hardware.

In comment measurement, you check the sound velocity on the table stated on this manual instead of taking calibration for the referring block. However, this table just for reference, sometimes the sound velocity will be different cause by different physical / chemical factors. The sound velocity of mild steel is adopted on the reference table.

This gauge with the function to measure the sound velocity, so the velocity can be obtained before thickness measurement, and then proceed with measurement of thickness.

5. Precautions for accuracy

5.1 For very thin material

Any ultrasonic thickness gauge, when the thickness of the material to be measured is less than the minimum limit the fault reading will occurs. Using sample block compare method to get a minimum limit of this material.

In measuring the thin material, an error may happen that the reading is two times as the actual dimension. Another error which display the reading much more bigger than the actual. To prevent the wrong reading by double check out the minimum limit in the thin material.

5.2 For stained, rusting surface

The stained/rusting surface on the contra side will occurs the ruleless wrong readings. Sometimes a small stained spot is hard to find out.

● Use ▲ and ▼ keys to make a quick adjustment for the sound velocity /thickness,and a quick recall to the stored data.
● Coupling status indication: Observing the coupling icon to learn if the coupling is accomplished or not.
● 10 thickness measurement storage and recall function is available, which facilitates the height work or working in wild area.
● Sound velocity measurement: With a given thickness by a sample hardware to measure the sound velocity, which avoid the further conversion or consultation of the table.
● 12 sound velocity for different material
● Low battery indication
● Auto power off mode designed to conserve battery power.
● More than 10000 times long lift keys.
● Manual power off: Press the " ⏻ " button to turn it off

2. Operation instruction

2.1 Operation area condition: this unit can measure hardware all that areas is equal to or bigger than the transducer's area. To measure the slim parts axially that is not vertical to the surface, the area shall not be too small, otherwise the error measure may happen.

2.2 Curved surface condition: When the material is curved surface like boiler wall or tubing, the curvature radius must be more than or equal to 10 mm, and the wall thickness must be more than or equal to 3 mm. This requirements is referring in steel material, as for the curve surface of other materials measuring requirements we still can not provide exact data, we highly appreciate if you feedback us and share with your precious experience.

2.3 Roughness condition: This gauge wildly applies upon the rough hardware/material, for most cases, our provided transducer can make exact measurement. However, if the roughness is too big due to the rust etc. the error measure may happen, in such case, please try to minimize the roughness or select the 2.5MHz transducer. If the transducer is worn out, please re-purchase on the local distributor.

2.4 Working temperature condition

Material thickness and sound velocity will change along with tempera-ture. In normal measurement, environment temperature impact can be ignored.

The transducer is made of propylene material, considering the protec-tion of the transducer and its precision we recommend that the surface temperature of the hardware/workpiece should not over 60℃, otherwise the transducer can not put into use.

Operation temperature: 0~40℃

Relative humidity: <90%RH

Hardware/workpiece/material temperature: <60℃

Do not apply in violent vibration / erosive material.

Avoid impact and humidity.

3. Operation procedure:

3.1 Before measurement

(1) Connect the transducer with the main unit, press ON/OFF to turn on, LCD display full screen for 0.5 second with backlight,then vertical bar is displayed twice circularly, meanwhile the main display area show 0000 to 9999 progressively.After that, LCD display the last applied sound velocity with registered memory unit, indicating the gauge is ready for use.
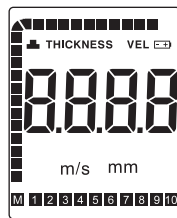
Full screen
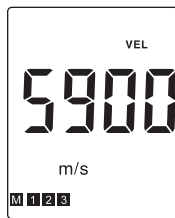
Last applied sound velocity
& registered unit

(2) Sound velocity selected & adjustment

Press "VEL" to enter sound velocity interface, press "VEL" again, you can select reserved velocity data by pressing " ▲ " or " ▼ " with the word "VEL" blinking on LCD ; If you need to adjust sound velocity data,

The standard of selecting the angle between the crosstalk segregating board of the transducer and axis of the measured part is up to material curvature. For bigger pipe diameters, choose vertical orientation between the crosstalk segregating board of the transducer and axis of the measured pipe, and for the smaller ones, two measurement should be performed, one with the axis of pipe perpendicular, another is parallel, and the smaller of two displayed values should then be taken as the thickness at that point.

4.5 Complex shape material

For complex shape material measurement, please refer to the 4.4, the smaller of the two reading should then be taken as the thickness.

4.6 Non-parallel surface

To get a satisfying ultrasonic response, the surface must have its one measuring side parallel with another, otherwise will obtain wrong result.

4.7 Influence of the material temperature

The size & sound velocity of material will change with the temperature, when the precision is critical, please make measurement in 2 samples of the material under the same temperature to determine the proper reading resulting from the temperature. When taking measurement for steel parts in high temperature, this method may be adopted to obtain the correct reading.

4.8 High acoustic reduction material

For materials in fiber, poriferous or big granular, acoustic dispersion will cause the energy attenuation that may result in abnormal readings (practically the reading less than the actual thickness), in this case, the material is not suitable for the gauge.

4.9 Reference sample block

For calibration for the gauge, a given thickness or sound velocity of the material is very import. Calibration needs at lest one referring stan-dard sample block. This gauge is provided with a 4.0mm sample block on the front cabinet, please see for calibration operations.

In different material & situation, only one sample block may not satisfy every calibration. The more similar sample block, the more exact reading obtained. Ideally, referring block is a group of different thickness and same material, by calibrating to the referring block, the effect of var-iation of sound velocity will be minimized. To get the most exact measure, a set of referring block is very important.

3.7 Low battery indication

When icon ⊟ flashes, please replace the batteries for further measurement.

3.8 LCD back light & Automatic power off

Before turn on the gauge, hold pressing " CAL ", and press ON/OFF button to turn on, the back light will active, every operation will turn on the back light for 7 seconds until press ON/OFF to turn off the unit.

If no any operation for 2 minutes, the gauge will turn off automaticly and the back light function will be cancelled.

4. Measurement Tips

4.1 Cleaning surface

Before measuring, the dust, dirt, rusting and grease etc that adheres on the hardware/workpiece must be removed off and cleaned.

4.2 Decreasing the roughness of surface

Too rough surface may result in measure error/ fault reading. Please try to make the surface smooth by milling, polishing, filling or using high viscosity coupling agent.

4.3 Rough machining surface

The regular tiny texture/slots resulting from rough machining process may cause error, and the compensation method is the same as in 4.2, adjusting the angle between the crosstalk segregating board of the transducer (a metal membrane crossing the detector bottom centre) and linear texture/slots (parallel or vertically) may also get a better result.

4.4 Measuring the surface of cylindrical parts

When measuring the material of cylindrical parts, like pipe 、oil tub etc, it is critical to select the angle between the crosstalk segregating board of the transducer and axis of the measured material. In simple terms, couple the transducer and measured material, keep the crosstalk segregating board of the transducer and axis of the measured material parallel or vertical, wave the transducer slowly and perpendicularly along the axis of the measured part. The reading on the screen will be changed orderly, select the smallest one as the exact thickness.

press "VEL" once more, the "VEL" and "m/s" will keep blinking, indentifying the unit is on adjusting status. Then, increase or decrease the sound velocity to the data you want by pressing "▲" and "▼",and this data will be automatically stored into current sound velocity memory unit. After that, press " VEL" to confirm new sound velocity, and the icons of "VEL" and "m/s" stop blinking.
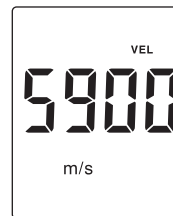

Velocity adjustment   Velocity revision

3.2 Calibration

A calibration should be made for every replacement of transducer or batteries, this operation is sufficiently important to assure the measuring precision. If necessary,this step should be repeated. Pressing "CAL" for 2 seconds, LCD displays "CAL", indicating that the unit is on calibration status, vertical bar displayed circularly on the left of LCD. put few provided coupling agent on the stan-dard sample block to couple the transducer and the sample block. Until the LCD display 4.0mm indicating the calibration is completed. After calibration, sound velocity will back to your selected value, and ready to measurement.
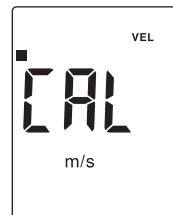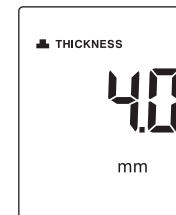
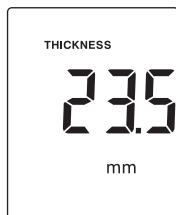

Calibration statu   Calibration accomplished

3.3 Thickness measurement

Put the coupling agent on the area to be measured to couple the transducer with the hardware/workpiece, LCD will display the thickness reading.

Notes: 🔧 icon on the screen indicates a well coupling, if the icon flashes or not shows that means a poor coupling. After remove the transducer, the reading will be hold.
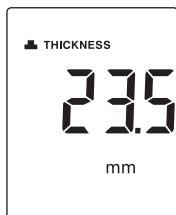
THICKNESS **23.5** mm	THICKNESS **23.5** mm
In a well coupling measurement	Measurement accomplished

3.4 Sound velocity measurement

With a given thickness to read out sound velocity of material: Obtains the thickness of material by using vernier caliper / micrometer, then couple the transducer with that sample material until a reading displays on the LCD, remove the transducer and press ▼ or ▲ to adjust the reading match the thickness by caliper/mirometer, then press VEL to display the sound velocity and save in current velocity memory unit.
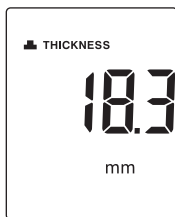
| THICKNESS **18.3** mm	THICKNESS **25.0** mm	VEL **6368** m/s
Measuring the thickness	Adjusting actual thickness	Velocity read out
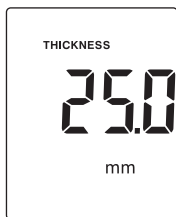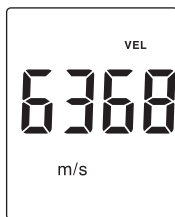
3.5 Data storage

(1) Keep pressing "STORE" for 2 seconds to enter save thickness data mode, LCD display THICKNESS, mm, Ⓜ icon with first memory unit. If the first memory unit is not being registered, so LCD will display 0.0.

(2) Press ▲ or ▼ to select your desired memory unit (1-10).

(3) After picked up the memory unit, it will begin to work. While measuring, the memory unit NO will flash and the new measurement will be renew the memory unit, when the measurement completed, the last reading will be stored in the selected memory unit automatically with the memory unit NO stop blinking.
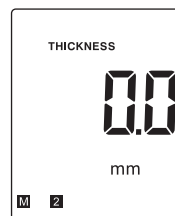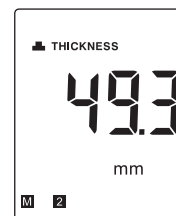
THICKNESS **0.0** mm Ⓜ ②	THICKNESS **49.3** mm Ⓜ ②	THICKNESS **49.3** mm Ⓜ ②
Select memory unit	Taking measurement & saving data	Measurement & storage accomplished

3.6 Review the saved data

Press "CAL", the memory unit NO and stored data displayed. You can review the saved data in 1-10 units by pressing " ▼ " and " ▲ " and they are read-only. Press "STORE" will back to measurement mode.

THICKNESS **45.2** mm Ⓜ ③
Review saved data