Ultrasonic Thickness Gauge

User Manual

Preface

Dear users:

Thank you for your purchase of our Ultrasonic Thickness Gauge (it is called Gauge),the Gauge is portable device. It is small in size, light in weight and easy to catch with. Before using the Gauge you must read this User's Manual carefully, which could help you use this device correctly and we hope that it could open up to your satisfaction.

The Hardness Tester confirm to the following specifications:

Calibration procedures of Ultrasonic Thickness Gauge, JJF 1126-2004

Verification regulation of Ultrasonic Thickness Gauge, JJG 403-1986

CONTENTS

1. Overview

The thickness gauge is a digital ultrasonic thickness gauge. Based on the same operating principles as SONAR, it is capable of measuring the thickness of various materials with accuracy as high as 0.01 millimeters, or 0.001inches. It is suitable for a variety of metallic and non-metallic materials.

1.1. Main technical parameters

- **Measuring range:** 0.75-300mm(steel)
- **Displaying accuracy:** 0.01mm
- **Measuring error:**1 mm～10 mm :±0.04mm 10mm～200mm :(±0.4%H+0.1)mm
- **Measurement period:** 4 times per second
- **Measurement frequency:** 5MHZ, 2MHz,7MHz
- **Ultrasonic velocity:** 1000-9999m/s
- **Display:** FSTN digital LCD with cold back light
- **Zero adjustment:** auto returning to zero when you press the key after the probe is put on the specimen
- **Linear correction:** auto linear correction by the MCU programs(V Path auto-compensation)
- **Alarm function:** setting the measurement limit and alarming for the results beyond the limit
- **Working voltage:** 1.5V x3 AAA
- **Working Time:** about 50 hours (with backlight off)
- **Data Memory:** 500 readings

- **Power off:** Auto power off if not working for 2 minutes, and the power key is also available
- **Display contents:** thickness value, coupling state, power state, CAL calibration state, sound velocity
- **Shape size:** 155mm X 68mmX27mm
- **Whole weight:** 230g

1.2. Main functional parameters:

- Able to measure the ultrasonic velocity in turn if the thickness value is known in order to improve the measurement precision.
- Able to preset the upper limit and the lower limit for the thickness, alarm when the value is beyond the limit.
- Coupling state indicating in the display.
- With LED backlight of display, easily used in dark environment.

1.3. Measuring Principle

The digital ultrasonic thickness gauge determines the thickness of a part or structure by accurately measuring in the time required for a short ultrasonic pulse generated by a transducer to travel through the thickness of the material, reflect from the back or inside surface, and be returned to the transducer. The measured two-way transit time is divided by two to account for the down-and-back travel path, and then multiplied by the velocity of sound in the material. The result is expressed in the well-known relationship:

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

Where：H—Thickness of the test piece.

v—Sound Velocity in the material; t—The measured round-trip transit time.

2. Structure Feature

2.1. Main body

Fig 1 Appearance of the thickness gauge

2.2. Keypad

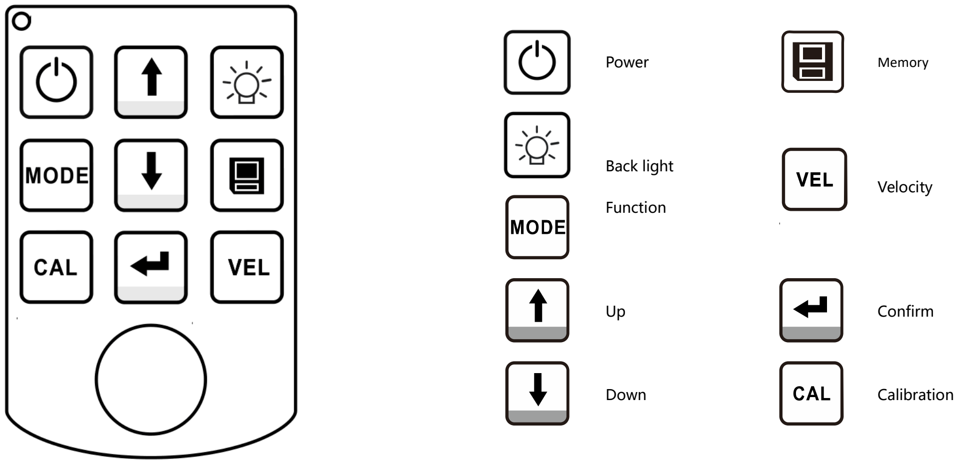


Fig 2 keypad definition

3. Preparation

3.1. Transducer Selection

The gauge is inherently capable of performing measurements on a wide range of materials, from various metals to glass and plastics. Different types of material, however, will require the use of different transducers. Choosing the correct transducer for a job is critical to being able to easily perform accurate and reliable measurement. The following paragraphs highlight the important properties of transducers, which should be considered when selecting a transducer for a specific job.

Generally speaking, the best transducer for a job is one that sends sufficient ultrasonic energy into the material being measured so that a strong, stable echo is received by the gauge. Several factors affect the strength of ultrasound as it travels. These are outlined below:

Initial Signal Strength. The stronger a signal is to begin with, the stronger its return echo will be. Initial signal strength is largely a factor of the size of the ultrasound emitter in the transducer. A large emitting area will send more energy into the material being measured than a small emitting area. Thus, a so-called "1/2 inch" transducer will emit a stronger signal than a "1/4 inch" transducer.

Absorption and Scattering. As ultrasound travels through any material, it is partly absorbed. If the material through which the sound travels has any grain structure, the sound waves will experience scattering. Both of these effects reduce the strength of the waves, and thus, the gauge's ability to detect the returning echo. Higher frequency ultrasound is absorbed and scattered more than ultrasound of a lower frequency. While It may seem that using a lower frequency transducer might be better in every instance, low frequencies are less directional than high frequencies. Thus, a higher frequency transducer would be a better choice for detecting the exact location of small pits or flaws in the material being measured.

Geometry of the transducer. The physical constraints of the measuring environment sometimes determine a transducer's suitability for a given job. Some transducers may simply be too large to be used in tightly confined areas. Also, the surface area available for contacting with the transducer may be limited, requiring the use of a transducer with a small wearface. Measuring on a curved surface, such as an engine cylinder wall, may require the use of a transducer with a matching curved wearface.

Temperature of the material. When it is necessary to measure on surfaces that are exceedingly hot, high temperature transducers must be used. These transducers are built by using special materials and techniques that allow them to withstand high temperatures without damage. Additionally, care must be taken when performing a "Probe-Zero" or "Calibration to Known Thickness" with a high temperature transducer.

Selection of the proper transducer is often a matter of tradeoffs between various characteristics. It may be necessary to experiment with a variety of transducers in order to find one that works well for a given job. The transducer is the "business end" of the instrument. It transmits and receives ultrasonic sound waves that the instrument uses to calculate the thickness of the material being measured. The transducer connects to the instrument via the attached cable, and two coaxial connectors. When using transducers, the orientation of the dual coaxial connectors is not critical: either plug may be fitted to either socket in the instrument.

The transducer must be used correctly in order for the instrument to produce accurate, reliable measurements. Below is a short description of the transducer, followed byinstructions for its use.

Left figure is a bottom view of a typical transducer. The two semicircles of the wearface are visible, as is the barrier separating them. One of the semicircles is responsible for conducting ultrasonic sound into the material being measured, and the other semicircle is responsible for conducting the echoed sound back into the transducer. When the transducer is placed against the material being measured, it is the area directly beneath the center of the wearface that is being measured.

Right figure is a top view of a typical transducer. Press against the top with the thumb or index finger to hold the transducer in place. Moderate pressure is sufficient, as it is only necessary to keep the transducer stationary, and the wearface seated flat against the surface of the material being measured.

Table 3-1 Transducer Selection

Model	Freq MHZ	Diam. mm	Measuring Range	Description
2P20	2.5	20	3.0mm～300.0mm （In Steel）40mm (in Gray Cast Iron HT200)	For thick, highly attenuating, or highly scattering materials
5P8	5	8	1.2mm～200.0mm（In Steel）	Normal Measurement
5P10	5	10	1.0mm～230.0mm（In Steel）	Normal Measurement
7P6	7	6	0.75mm～80.0mm （In Steel）	For thin pipe wall or small curvature pipe wall measurement

H3M	3	12	3～200mm（In Steel）	For high temperature (lower than 300°C) measurement.

3.2. Condition and Preparation of Surfaces

In any ultrasonic measurement scenario, the shape and roughness of the test surface are of paramount importance. Rough, uneven surfaces may limit the penetration of ultrasound through the material, and result in unstable , and therefore unreliable measurements. The surface being measured should be clean, and free of any small particulate matter, rust, or scale. The presence of such obstructions will prevent the transducer from seating properly against the surface. Often, a wire brush or scraper will be helpful in cleaning surfaces. In more extreme cases, rotary sanders or grinding wheels may be used, though care must be taken to prevent surface gouging, which will inhibit proper transducer coupling.

Extremely rough surfaces, such as the pebble-like finish of some cast iron, will prove most difficult to measure. These kinds of surfaces act on the sound beam like frosted glass on light, the beam becomes diffused and scattered in all directions.

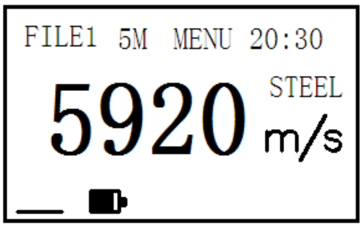
In addition to posing obstacles to measurement, rough surfaces contribute to excessive wear of the transducer, particularly in situations where the transducer is "scrubbed" along the surface. Transducers should be inspected on a regular basis, for signs of uneven wear of the wearface. If the wearface is worn on one side more than another, the sound beam penetrating the test material may no longer be perpendicular to the material surface. In this case, it will be difficult to exactly locate tiny irregularities in the material being measured, as the focus of the sound beam no longer lies directly beneath the transducer.

4. Operation in details

4.1. Power On/Off

1) Insert the plug of the probe into the socket of probe on the tester.

2) 2) Keep pressing the key  until the LED screen shows as below:



It is turned off by pressing the key when it is on. Thetool has a special memory that retains all of its settings evenwhen the power is off.

FILE1: File selection(5 files in total)

5M : Probe selection（4 kinds of probe in total:10M，5M，2M，H2M)

MENU: Menu selection

20：30 ： System time

： Sign of coupling

： Battery information（When it is ,the battery should be changed）

： Sign of alarm mode

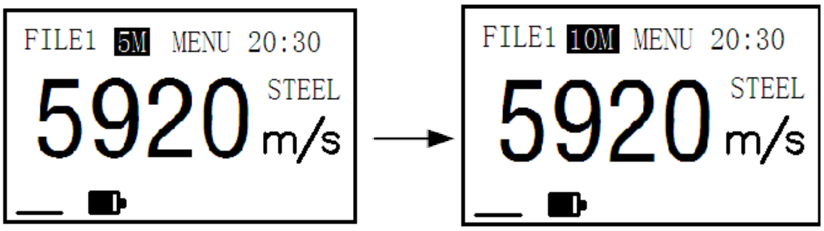
4.2. Transducer Set

The model of the transducer should be pre-set to the instrument before measuring operation. This enables the user to select the transducer type among supported transducers according to frequency and diameter depending on application requirements. Use the following steps to select your transducer model：

1) On the measurement screen, press the key MODE multiple times to activate the 【Transducer model】tab.

2) Use the key to switch to the desired transducer model (7M,5M,2M,H3M).

3) Press the key to exit.

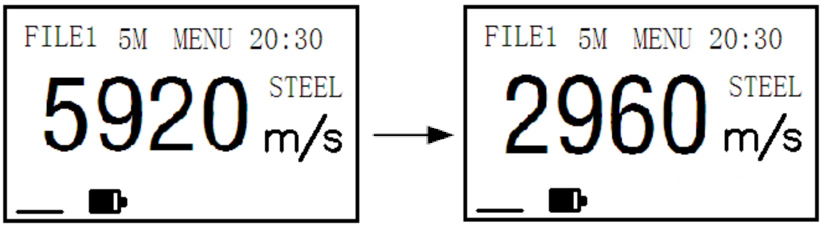


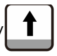
4.3. Sound velocity setting

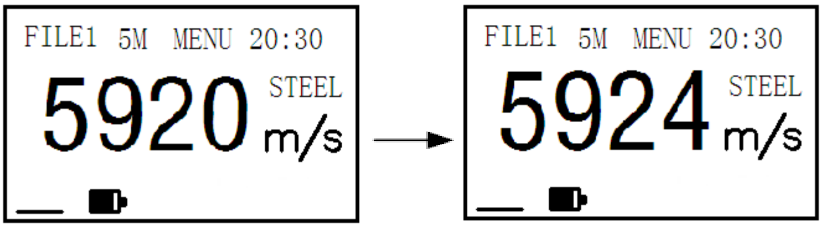
In order for the gauge to make accurate measurements, it must be set to the correct sound velocity for the material being measured. Different types of material have different inherent sound velocities. If the gauge is not set to the correct sound velocity, all of the measurements the gauge makes will be erroneous by some fixed percentage.

Use the following steps to select your transducer model:

1) On the measurement screen, Press the VEL key to switch among the preset commonly using velocities. (If the screen shows thickness reading, please press VEL to turn it to sound velocity first.)



2) Use the key  and the key  to adjust the sound velocity value up or down, until it matches the sound velocity of the material to be measured.



Note: If the sound velocity of sample measured is unknown, you could use the same material sample whose thickness is known to measure sound velocity by the method in chapter "4.5 Calibration to a known velocity". In addition, sound velocity varies with temperature, so you need update the sound velocity when the temperature changes.

4.4. Zero calibration

The key CAL is used to "zero" the instrument in much the same way that a mechanical micrometer is zeroed. If the gauge is not zeroed correctly, all the measurements that the gauge makes may be in error by some fixed value. When the instrument is "zeroed", this fixed error value is measured and automatically corrected for all subsequent measurements. The instrument may be "zeroed" by performing the following procedure.

1) Plug the transducer into the instrument. Make sure that the connectors are fully engaged. Check that the wearface of the transducer is clean and free of any debris.

2) Change the model of the transducer set in the instrument to the model currently using.

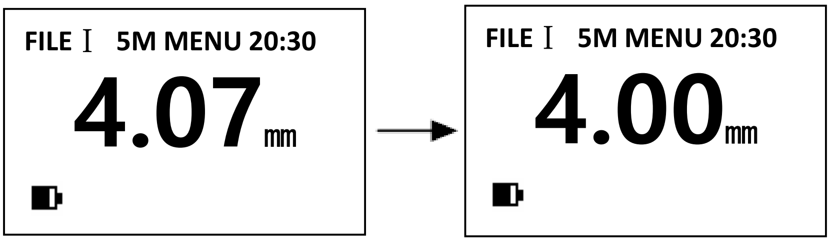
3) Set sound velocity to 5920m/s, which is sound velocity of steel, i.e. sound velocity of the probe zero disc.

4) Apply a single droplet of ultrasonic couplant to the face of the metal probe-disc.

5) Press the transducer against the probe disc, making sure that the transducer sits flat against the surface.

6) While the transducer is firmly coupled to the probe disc, the thickness reading of the probe zero disc shows on the screen (for example,4.07mm).

7) Press key CAL to set the value on screen to standard value4.00mm.



4.5. Thickness measurement

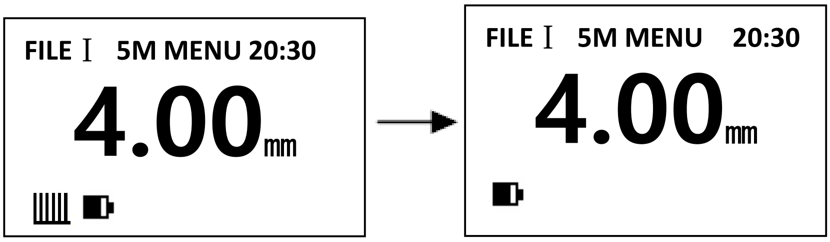
When the tool is displaying thickness measurements, the display will hold the last value measured, until a new measurement is made.

In order for the transducer to do its job, there must be no air gaps between the wear-face and the surface of the material being measured. This is accomplished with the use of a "coupling" fluid, commonly called "couplant". This fluid serves to "couple", or transfer, the ultrasonic waves from the transducer, into the material, and back again. Before attempting to make a measurement, a small amount of couplant should be applied to the surface of the material being measured. Typically, a single droplet of couplant is sufficient.

After applying couplant, press the transducer (wearface down) firmly against the area to be measured. The coupling status indicator should appear (if the bar in coupling status indicator is less than 5, the coupling effect is not good), and a number should appear in the display. If the instrument has been properly "zeroed" and set to the correct sound velocity, the number in the display will indicate the actual thickness of the material directly beneath the transducer.

If the coupling status indicator does not appear, or the numbers on the display seem erratic, firstly check to make sure that there is an adequate film of couplant beneath the transducer, and that the transducer is seated flat against the material. If the condition persists, it may be necessary to select a different transducer (size or frequency) for the material being measured.

While the transducer is in contact with the material that is being measured, the instrument will perform four measurements every second, updating its display as it does so. Remove the transducer from the surface, and the display will hold the last measurement made, just as below:



Note: *Occasionally, a small film of couplant will be drawn out between the transducer and the surface as the transducer is removed. When this happens, the gauge may perform a measurement through this couplant film, resulting in a measurement that is larger or smaller than it should be. This phenomenon is obvious when one thickness value is observed while the transducer is in place, and another values observed after the transducer is removed. In addition, measurements through very thick paint or* *coatings may result in the paint or coating being measured rather than the actual material intended. The responsibility for proper use of the instrument, and recognition of these types of phenomenon, rest solely with the user of the instrument.*

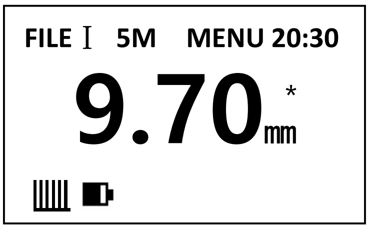
4.6. Calibration to a known velocity

Note: This procedure requires that the operator knows the sound velocity of the material to be measured. A table of common materials and their sound velocities can be found in Appendix A of this manual.

For example, if you want to get the sound velocity of test block whose thickness is10.00mm, you should operate as following.

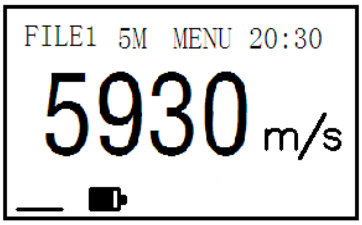
1) Make measurement of the test block whose thickness is known (10.00mm) according to chapter "4.5Thickness measurement" correctly.

2) After the thickness value shows on the screen, press key  and remove the transducer from the surface, the display will hold the last measurement made. At the same time, sign * shows on the right of the screen as below, which means the result is frozen.



3) Press the key  and the key  to change the value to the exact value 10.00mm.

4) Press key VEL , the sound velocity of the material measured will show and it is saved as one of the commonly using velocities at the same time.



4.7. System setup

The items including "Gain", "Alarm mode", " Language" , "Units " and "Beep" can be set in 【System setup】menu interface. The following shows details about Alarm mode setting, Difference mode setting and 2-point CAL set Language setting, Units setting and Resolution setting refer to scan mode setting.

4.7.1. Alarm mode setting (Limit Setting)

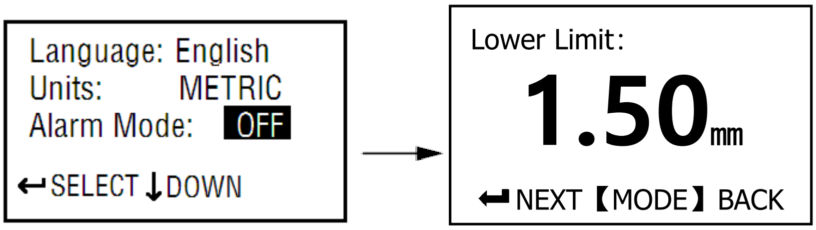
The Thickness Gauge will alarm when the measured value is beyond measurement range. The buzzer will ring if the measured value reaches pre-set lows or pre-set highs.

The Limit Set feature of the gauge allows the user to set an audible and visual parameter when taking measurements. If a measurement is beyond the limit range, set by the user, the beeper will sound, if enabled. This improves the speed and efficiency of the inspection process by eliminating constant viewing of the actual reading displayed. The following section outlines how to enable and set up this feature:

a. Press the key MODE multiple times to activate the【MENU】tab.

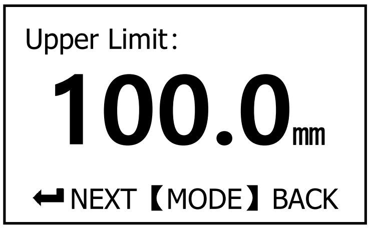
b. Press key ⏎ to enter "system setup" interface menu.

c. Press the key ↑ and the key ↓ to move the cursor to "Alarm Mode: OFF", then press ⏎ to turn on the alarm mode and enter menu" LOW LIMIT" as below: (if you don't want to use alarm mode, you can also turn it off) .



Press the key ↑ and ↓ to change lower limit.

d. Press key ↵ to enter menu "HIGH LIMIT" to set high limit (if it is not need to set high limit press key MODE to exit) as below.



Press the key ↑ and ↓ to change up limit.

e. Press key MODE to confirm setting and return to main interface.

If alarm mode is turned on, mark shows on the screen.

4.7.2. Other items in system setup

Setup steps:

a. Enter “system setup” menu according to chapter “4.7.1”.

b. Press the key and to move the cursor to corresponding item, and press the key to select the proper option.

4.8. Function setup

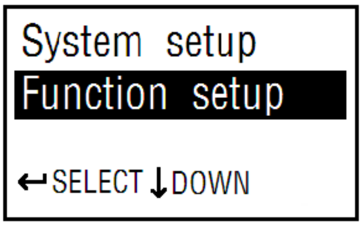
The following items including “Set System time”, “Set Standby time”, “Set Contrast”, “Load default”, “Version info”, “Ease the file ”and “Ease all files” can be set in 【Function setup】menu interface. The following gives details about “System time set”, please refer to “System time set” to set other items.

4.8.1. System time set

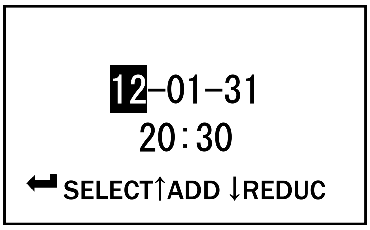
a. On measurement screen, press the key MODE multiple times to activate the【MENU】tab.

b. Press key to enter the main menu.

c. Press the key and to move the cursor to “Function setup” and then press to enter it.



d. Press the key ↑ and ↓ to move the cursor to "Set system time" and then press key ↵ to enter system time set interface as below:



e. Press key ↵ to move the cursor and press the key ↑ and ↓ to add or reduce the number.

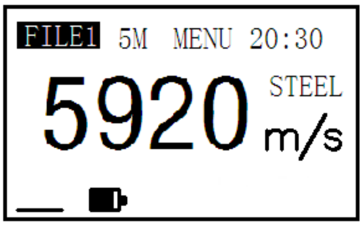
f. Press key MODE to confirm and exit.

4.8.2. Memory Management

There are 5 files (FILE1-FILE5) that can be used to store the measurement values inside the gauge. At most 100 records can be stored to each file. The following procedures outline this process:

(1)Store a reading

a. On measurement screen, press the key MODE multiple times to activate the【FILE name】tag as below:



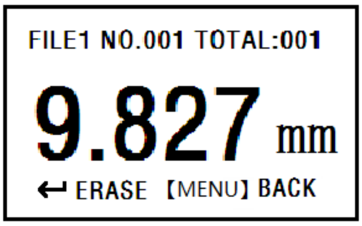
b. Use the key ↵ to select the desired file to save the data.

c. After a new measurement reading appears, long press the key to save the measurement value to current file.

(2) View stored readings

a. Press key MODE to activate the【FILE name】tab and press key ↵ to select the desired file to view the data,

b. Press key to view the data saved as below,



c. Press key and to view all data saved,

d. Press key MODE to exit.

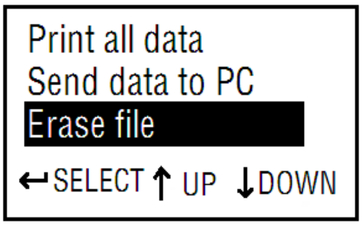
(3)Delete data

Press key when you are viewing data saved to delete that data and the next data will show on the screen.

4.8.3. Erase selected file

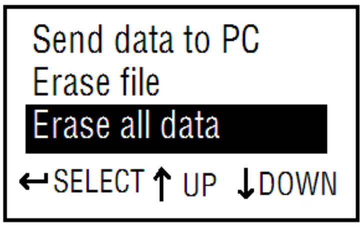
a. Select "Erase file" sub-menu according to section "4.8.1".

b. Press key to delete the current selected file, and press key MODE to exit the sub menu. Then press key to delete the current selected file.



4.8.4. Erase all the files

Refer to section "4.8.3".



4.8.5. Auto power off

The instrument features an auto power off function designed to conserve battery life. If the tool is idle for 2 minutes, it will turn itself off. While the voltage of the battery is too low this function will also work. Set standby time following the instruction of section 4.8.1.

4.8.6. Version Information

Select "Version Info" sub-menu according to section "4.8.1", and press key to view the version information of the firmware.

4.8.7. Load default

"Load default" function will recover the factory setting, which can fix the wrong setup of the gauge. Select "Load default" sub-menu according to section "4.8.1", and press key to recover the factory setting.

5. Servicing

When the hardness tester appears some other abnormal phenomena, please do not dismantle or adjust any fixedly assembled parts. Fill in and present the warranty card to us. The warranty service can be carried on.

6. Transport and Storage

1) Keep it away from vibration, strong magnetic field, corrosive medium, dumpiness and dust. The storage of the thickness gauge should be in ordinary temperature.

2) With original packing, transport is allowed on the third grade highway.

Appendix A

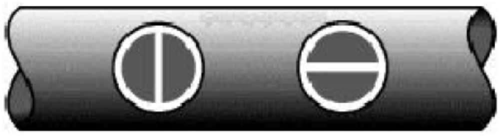
The sound velocity of different material

Material	Sound velocity（m/s)
Aluminum	6320
Zinc	4170
silver	3600
Gold	3240
Tin	3320
Steel	5920
Brass	4430
Copper	4700
SUS	5970
Acrylics acid resin	2730
Water（20°C)	1480
glycerol	1920
sodium silicate	2350

Appendix B Applications Notes

Measuring pipe and tubing

When measuring a piece of pipe to determine the thickness of the pipe wall, orientation of the transducers is important. If the diameter of the pipe is larger than approximately 4 inches, measurements should be made with the transducer oriented so that the gap in the wearface is perpendicular (at right angle) to the long axis of the pipe. For smaller pipe diameters, two measurements should be performed, one with the wearface gap perpendicular, another with the gap parallel to the long axis of the pipe. The smaller of the two displayed values should then be taken as the thickness at that point.



Perpendicular Parallel

Measuring hot surfaces

The velocity of sound through a substance is dependent upon its temperature. As materials heat up, the velocity of sound through them decreases. In most applications with surface temperatures less than about 100 ℃ , no special procedures must be observed. At temperatures above this point, the change in sound velocity of the material being measured starts to have a noticeable effect upon ultrasonic measurement. At such elevated temperatures, it is recommended that the user perform a calibration procedureon a sample piece of known thickness, which is at or near the temperature of the material to be measured. This will allow the gauge to correctly calculate the velocity of sound through the hot material.

When performing measurements on hot surfaces, it may also be necessary to use a specially constructed high-temperature transducer. These transducers are built using materials which can withstand high temperatures. Even so, it is recommended that the probe be left in contact with the surface for as short a time as needed to acquire as table measurement. While the transducer is in contact with a hot surface, it will begin to heat up, and through the rmalexpansion and other effects, may begin to adversely affect the accuracy of measurements.

Measuring laminated materials

Laminated materials are unique in that their density (and therefore sound-velocity) may vary considerably from one piece to another. Some laminated materials may even

Exhibit noticeable changes in sound-velocity across a single surface. The only way to reliably measure such materials is by performing a calibration procedure on a sample piece of known thickness. Ideally, this sample material should be apart of the same piece being measured, or at least from the same lamination batch. By calibrating to each test piece individually, the effects of variation of sound-velocity will be minimized.

An additional important consideration when measuring laminates, is that any included air gaps or pockets will cause an early reflection of the ultrasound beam. This effect will be noticed as a sudden decrease in thickness in an otherwise regular surface. While this may impede accurate measurement of total material thickness, it does provide the user with positive indication of air gaps in the laminate.

Suitability of materials

Ultrasonic thickness measurements rely on passing a sound wave through the material being measured. Not all materials are good at transmitting sound. Ultrasonic thickness measurement is practical in a wide variety of materials including metals, plastics, and glass. Materials that are difficult include some cast materials, concrete, wood, fiberglass, and some rubber.

Couplants

All ultrasonic applications require some medium to couple the sound from the transducer to the test piece. Typically a high viscosity liquid is used as the medium. The sound used in ultrasonic thickness measurement does not travel through air efficiently.

A wide variety of couplant materials may be used in ultrasonic gauging. Propylene glycol is suitable for most applications. In difficult applications where maximum transfer

of sound energy is required, glycerin is recommended. However, on some metals glycerin can promote corrosion by means of water absorption and thus may be **undesirable**. Other suitable couplants for measurements at normal temperatures may include water, various oils and greases, gels, and silicone fluids. Measurements at elevated temperatures will require specially formulated high temperature couplants.

Users Notice

1.Pleasefill out the warranty registration card seriously and seal your Company Chop after you get the instrument. Then mail the copies of the warranty registration card and the invoice to our user service center or you can relegate that to the seller when buying the instrument.

2. If it go wrong for quality matter within a year after you buy our instruments, please take your warranty registration card and invoice to our repair station nearby for repairing, changing or returning. If you can't show the warranty registration card and the invoice we would calculate the warrantyperiod since the instruments are produced, and the warrantyperiodis one year.

3. If it is out of the warrantyperiod, the repair stations are response for after service and repairing and charge according to the rules of our company.

4. You need to pay for additional configuration, such as the and the software.

5.If transportation, installation, faulty operation problem, lead to the equipment's part damage. The damages caused by transportation, installation, faulty operation, non-professional maintenance are out of warranty service. If you alter the warranty registration car or there is no invoice, we wouldn't provide free repair