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Instruction Manual
Multi Mode
Ultrasonic Thickness Gauge

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SAUTER TO-EE

Version 1.0
12/2018
GB

PROFESSIONAL MEASURING

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GB

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Version 1.0 12/2018

Instruction Manual Ultrasonic Thickness Gauge

Thank you for buying this SAUTER Multimode Material Thickness Gauge. We hope you are pleased with your high quality instrument and with its big functional range. If you have any queries, wishes or helpful suggestions, do not hesitate to call our service number.

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1 Overview

The model TO-EE is a multi-mode ultrasonic thickness gauge. Based on the same operating principles as SONAR, the instrument is capable of measuring the thickness of various materials with accuracy as high as 0.1/0.01 millimeters.
The multi-mode feature of the gauge allows the user to toggle between pulse-echo mode (flaw and pit detection), and echo-echo mode (eliminating paint or coating thickness).

1.1 Product Specifications

1) Multi-mode: Pulse-Echo mode (P-E mode) and Echo-Echo mode (E-E mode). In Echo-Echo mode, it can test the wall thickness eliminating paint or coating thickness.
2) Wide measuring range：Pulse-Echo mode: (0.65～600)mm (in Steel, depending on the probe). Echo-Echo mode: (3～60)mm
3) V-Path correction to compensate the nonlinearity of the probe
4) Color TFT display (320×240 TFT LCD) with adjustable backlight, allow the user to work at worksites with low visibility.
5) Non-volatile memory can store 100 groups of tested thicknesses. One hundred records max for each group.
6) Two AA size alkaline batteries as the power source. Continuous operating period of no less than 100 hours (default brightness setting). Display Standby and Auto Power Off functions to save power.
7) With the internal Bluetooth module, it can be connected to PC or other mobile devices wirelessly.
8) USB 1.1 communication port. Online transfer of the measured data to PC via USB.

1.2 Measuring Principle

The ultrasonic thickness gauge determines the thickness of a part or structure by accurately measuring 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.

1.3 Specifications

Multi-mode: Pulse-Echo mode and Echo-Echo mode.
Capable of performing measurements on a wide range of material, including metals, plastic, ceramics, composites, epoxies, glass and other ultrasonic wave well-conductive materials.
Special transducer models are available for special application, including for coarse grain material and high temperature applications.

Probe-Zero function, Sound-Velocity-Calibration function

Two-Point Calibration function

Three working modes: normal mode, scan mode and diff mode

Coupling status indicator showing the coupling status

Units: Metric and Imperial unit selectable

Battery information indicates the rest capacity of the battery
Auto sleep and auto power off function to conserve battery life

USB1.1 communication port
Bluetooth support

Size: 130mm×70mm×32mm

Weight: 295g

1.4 Transducer: Technical parameters

Table 1.1 Transducer Technical Parameters

Model	Freq MHz	Φ mm	Measuring Range	Lower limit	Description
N02	2.5	14	3.0mm～300.0mm（In Steel）40mm (in Gray Cast Iron HT200)	20mm	for thick, highly attenuating, or highly scattering materials
N05	5	10	1mm～600.0mm（In Steel）	Φ20mm×3.0mm	Normal Measurement
N05 /90°	5	10	1mm～600.0mm（In Steel）	Φ20mm×3.0mm	Normal Measurement
N07	7	6	0.65mm～200.0mm（In Steel）	Φ15mm×2.0mm	For thin pipe wall or small curvature pipe wall measurement

HT5	5	12	1～600mm (In Steel)	30mm	For high temperature (lower than 300℃) measurement.
P5EE	5	10	P-E: 2~600mm E-E: 3~60mm	Φ20mm×3.0mm	Normal Measurement and trough-coating thickness testing

1.5 Configuration

Table 1.2 Instrument Configurations

	No	Item	Qty.	Note
Standard configuration	1	Main body	1	
	2	Probe P5EE(5MHz)	1	
	3	Couplant	1	
	4	Instrument Case	1	
	5	Operating manual	1	
	6	Alkaline battery	2	AA size
	7	USB Cable	1	
Optional Configuration	8	Probe N02 (2.5MHz)		
	9	Probe N05/90°(5MHz)		See Table1.1
	10	Probe N05 (5MHz)		
	11	Probe N07(7MHz)		
	12	Probe HT5(5MHz)		

1.6 Operating Conditions

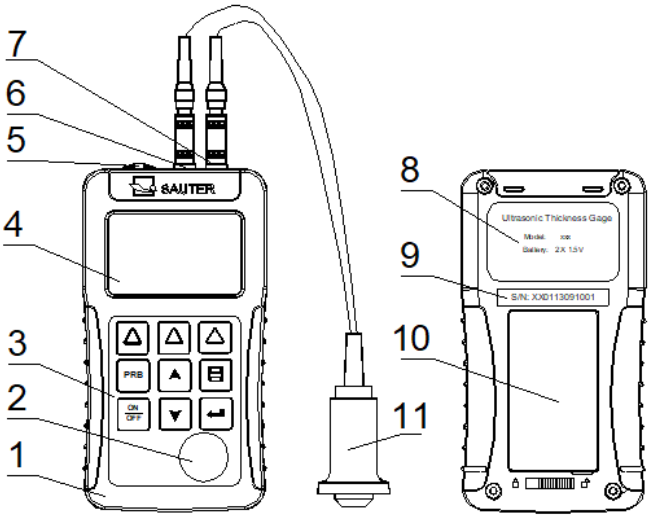
Operating Temperature: 0℃～＋50℃;

Storage Temperature：-20℃～＋70℃

Relative Humidity: ≤80%

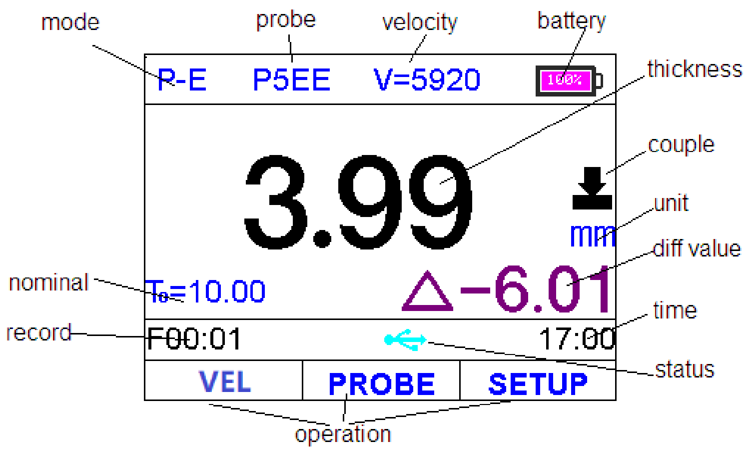
In the environment of usage vibrations, strong magnetic field, corrosive medium and heavy dust should be avoided.

2 Keypad & Screen



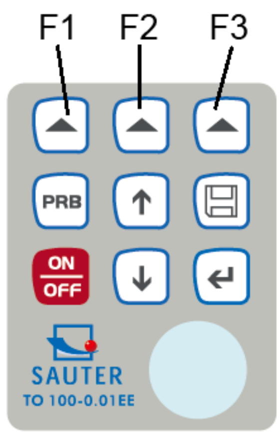
1 The main body
2 Probe zero disc
3 Keypad
4 TFT display
5 USB interface
6 Pulser socket
7 Receive socket
8 Label
9 Serial number
10 Battery cover
11 Probe

2.1 Main Screen



Mode: "E-E" indicating the gauge works in Echo-Echo mode; "P–E" indicating it works in Pulse-Echo mode;
Probe: Probe selection
Velocity: Sound velocity
Battery: Indicating the rest capacity of the battery.
Thickness: Last test result
Unit: Unit system: mm or inch
Diff value: Test result when working in diff mode.
Time: System time
Status: USB communication status
Operation: Indicate the information about the ongoing operation;
Record: Shows selected data group and record count.
Couple: Indicates the coupling status
Nominal thickness: the nominal thickness of the test piece

2.2 Keypad Definitions

The instrument is designed to give the user quick access to all of the instrument's functions. Its easy-to-use menu system allows any function to be accessed with several key presses. ▲ Function keys to select accordingly the function on the screen. In the following sections of this manual, they are referred to as F1, F2 and F3 from left to right.			
ON OFF	Turn the instrument on/off , or Cancel	PRB	Probe-Zero operation
💾	Save test result	↵	Confirm/Enter
↑	Plus or scroll up	↓	Minus or scroll down

3 Test 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 an application is much important to perform easily accurate and reliable measurements. The following paragraphs highlight the important properties of transducers, which should be considered when selecting a transducer for a specific application.
Generally speaking, the best transducer for an application is one that sends sufficient ultrasonic energy into the material being measured in the way that a strong, stable echo is received by the gauge. Several factors affect the strength of ultrasound as it travels. These are outlined below:
<u>Initial Signal Strength</u>: 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.
<u>Absorption and Scattering</u>: 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.
<u>Geometry of the transducer</u>: 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 bearing face. Measuring on a curved surface, such as an engine cylinder wall, may require the use of a transducer with a matching curved bearing face.
<u>Temperature of the material</u>: When it is necessary to measure on surfaces that are exceedingly hot, high temperature transducers must be used. These transducers are built using special materials and techniques that allow them to withstand high temperatures without damage. Additionally, care must be taken when performing a “Sensor-Zeroing” 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 application.
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 by instructions for its use.

Left figure is a bottom view of a typical transducer. The two semicircles of the bearing face 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 bearing face 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 bearing face seated flat against the surface of the material being measured.

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 bearing face. If the bearing face 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

4.1 Power Supply

Two AA size alkaline batteries are needed as the power supply. The battery compartment is situated at the instrument back. The cover is fastened with two screws. To insert the batteries:

- Loosen the two screws of the battery cover.
- Lift the cover off upward.
- Insert the batteries into the battery compartment.
- Close the battery compartment and fasten the screws.
- Turn on the instrument to make sure the battery is installed correctly and firmly.

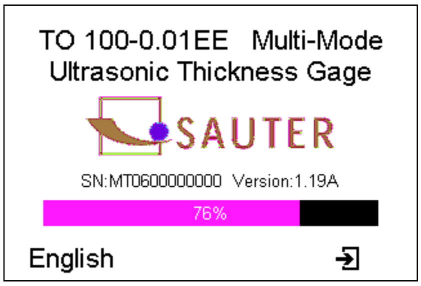
4.2 Connection of the Probe

To prepare the instrument for operation, you have to connect a probe to it. The instrument is available with the Lemo socket connectors.

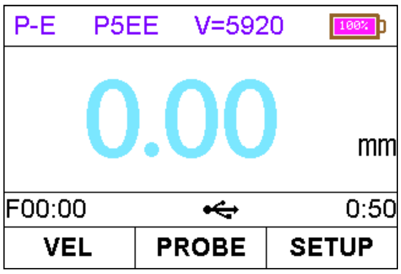
When connecting a probe to the instrument, it's not only important that the physical connection be properly made. It's also important that the instrument is properly configured to work with the installed probe.

4.3 Starting the instrument (Power ON)

To start the instrument, press down ON OFF until display activates. While the device is booting a splash screen, the serial number of the unit, the installed software version, the date and time of the system appear on the display.
The start display of the instrument apears as the figure shown below:



Press F1 key to change to a different language.
Press F3 key to skip the booting check process and enter the measurement mode immediately.
The instrument carries out a self-check and then switches over to the measurement mode automatically if there is no further key operation.
The instrument is now ready for the first measurement.



The instrument will automatically reload last settings. It has a special memory that retains all of its settings even when the power is off.

To shut off the instrument, keep pressing down key until shutting down message appears.

The gauge also has auto power off function to save battery capacity. If there is no operation during a specified period of time (setting as the Auto Poweroff delay), the gauge will be powered off automatically.

Note: The instrument will shut off automatically if the battery capacity level is too low.

4.4 Configuration of the Standby Settings

To save battery power, the device supports the following power states:

Run state – The main unit is running at full frequency

Standby state – After 5 seconds (default setting) the brightness of the LCD display is tuned to a low level and the CPU is running at reduced frequency. This has no effects on the data or the memories. Pressing any key or performing a measurement sets the unit back to run state and the brightness is tuned back.

Power off state – After 2 minutes (default setting) the instrument changes from standby state to power off state. The main unit and the display is switched off and consumes almost no energy. Pressing any key will stop the unit entering power off state while it prompts out “Idle Timeout!” and return back to run state.

The change from run state to standby state is controlled by Display standby delay setting. The time delay can be configured by the user in the Display Standby Delay dialog box. The main unit can be reset to run state by any user activity while in standby state.

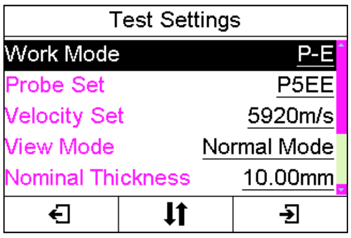
5 Operation

5.1 Setting the Work Mode

Often times users and inspectors in the field are faced with coated materials such as pipes and tanks. Typically inspectors will need to remove the paint or coating prior to measuring, or allow for some fixed amount of error introduced by the paint or coating thickness and velocity.

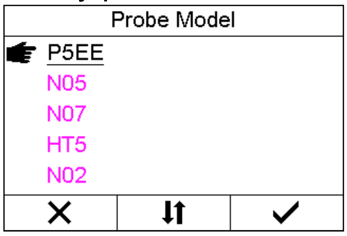
The error can be eliminated with this gauge by using a special Echo-Echo mode to perform measurements for applications such as this. The gauge gives you this feature in a simple way eliminating the need to remove the paint or coating.

To switch between P-E mode and E-E mode, press in the Test Settings dialog.



5.2 Probe selection

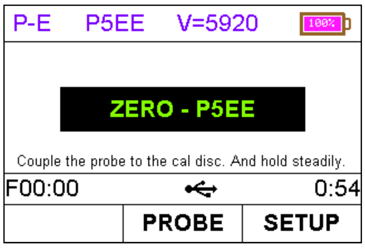
Be sure to set the right probe model to the instrument. Otherwise, erroneous measurements will be possible. In the Probe Model dialog, Use the key and the key to scroll to the probe model currently being used.
Finally press or F3 to confirm the selection. Or press to cancel and exit.



5.3 Perform "Probe Zero"

The key 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) Press the key to activate the probe zero mode, as figure below.
3) Apply a single droplet of ultrasonic couplant to the face of the metal probe-disc.



4) Press the transducer against the probe disc, making sure that the transducer sits flat against the surface.
5) When the progress bar shows complete, remove the transducer from the probe disc. If necessary, repeat this procedure for times.
6) At this point, the instrument has successfully calculated its internal error factor, and will compensate for this value in any subsequent measurements. When performing a "probe zero", the instrument will always use the sound velocity value of the built-

in probe-disc, even if some other velocity value has been entered for making actual measurements. Though the instrument will remember the last “probe zero” performed, it is generally a good idea to perform a “probe zero” whenever the gauge is turned on, as well as any time a different transducer is used. This will ensure that the instrument is always correctly zeroed.

Press PRB while in probe zero mode will stop the probe zero operation and return to the measurement mode.

5.4 Sound Velocity Calibration

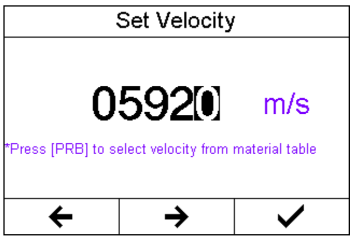
In order for the gauge to make accurate measurements, it must be set to the correct sound velocity for the material being measured. Different types of material have different inherent sound velocities. If the gauge is not set to the correct sound velocity, all of the measurements the gauge makes will be erroneous by some fixed percentage. The **One-Point** calibration is the simplest and most commonly used calibration procedure optimizing linearity over large ranges. The **Two-point** calibration allows for greater accuracy over small ranges by calculating the probe zero and velocity.

Note: **One** and **Two** point calibrations must be performed on material with the paint or coating removed. Failure to remove the paint or coating prior to calibration will result in a multi material velocity calculation that may be different from the actual material velocity intended to be measured.

5.4.1 Calibration to a known velocity

Note: This procedure requires a sample piece of the specific material to be measured, the exact thickness of which is known, e.g. from having been measured by some other means.
A table of common materials and their sound velocities can be found in Appendix A of this manual.

In the Set Velocity dialog, press F1/F2 and ↑/↓ keys to adjust the velocity value up or down, until it matches the sound velocity of the material to be measured.

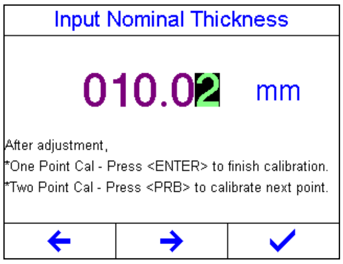


You can also press the PRB key to select among the preset commonly using velocities.

5.4.2 Calibration to a known thickness

Note: This procedure requires a sample piece of the specific material to be measured, the exact thickness of which is known, e.g. from having been measured by some other means.

1) Perform a Probe-Zero on the standard 4.00 mm disc.
2) Apply couplant to the sample piece.
3) Press the transducer against the sample piece, making sure that the transducer sits flat against the surface of the sample. The display should show some thickness value, and the coupling status indicator should appear steadily.
4) Having achieved a stable reading, remove the transducer. If the displayed thickness changes from the value shown while the transducer was coupled, repeat step 3.
5) Press the key to enter the “Input Nominal Thickness” dialog. See figure below.



6) Press F1/F2 and to input the thickness value, until it matches the thickness of the sample piece.
7) Press /F3 to confirm the input. The gauge exits from the input dialog and return to the measurement mode. It is now displaying the sound velocity value it has calculated, based on the thickness value that was input.

The gauge is now ready to perform measurements.

5.4.3 Two Point Calibration

Note: This procedure requires that the operator has two known thickness points on the test piece that are representative of the range to be measured.

1) Probe-Zero has to be performed first on the standard plate of the instrument.
2) Apply couplant to the sample piece.
3) Press the transducer against the sample piece, at the first/second calibration point, making sure that the transducer sits flat against the surface of the sample. The display should show some (probably incorrect) thickness value, and the coupling status indicator should appear steadily.
4) Having achieved a stable reading, remove the transducer. If the displayed thickness changes from the value shown while the transducer was coupled, repeat step 3.
5) Press the key to enter the “Input Nominal Thickness” dialog. See right figure.
6) Press F1/F2 and to input the thickness value, until it matches the thickness of the sample piece. Then press to calibrate the second point, see the following

figure below:

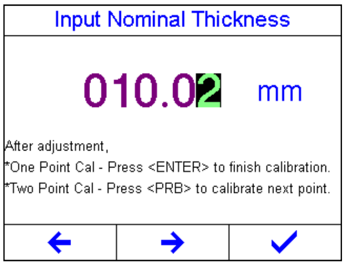
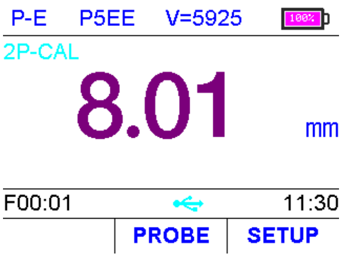


Figure below: Testing the second point during Two Point Calibration.



7) Repeat Step 2 to Step 6 on the second calibration point.
8) Finally press the /F3 to complete Two Point Calibration procedure. The gauge is now ready to perform measurements within this range.

5.5 Performing Measurements

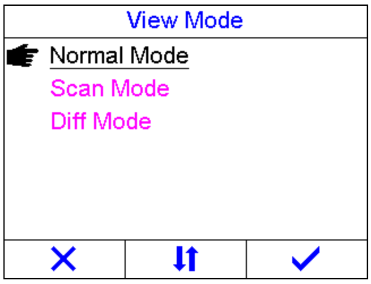
When the instrument is displaying thickness measurements, the display will hold the last value measured, until a new measurement is made.
In order for the transducer to do its job, there must be no air gaps between the wear-face and the surface of the material being measured. This is accomplished with the use of a “coupling” fluid, commonly called “couplant”. This fluid serves to “couple”, or transfer, the ultrasonic sound 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 (bearing face down) firmly against the area to be measured. The coupling status indicator should appear, and a digit 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, not stable, 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.

When the transducer is removed from the surface, the display will hold the last measurement made.

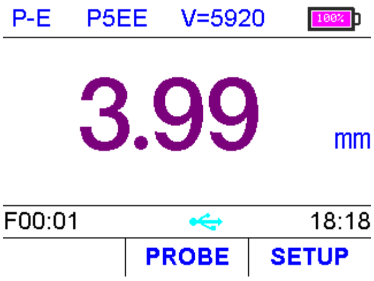
Note: Occasionally, a small film of couplant will be drawn out between the transducer and the surface as the transducer is removed. When this happens, the gauge may perform a measurement through this couplant film, resulting in a measurement that is larger or smaller than it should be. This phenomenon is obvious when one thickness value is observed while the transducer is in place, and another value is 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, rests solely with the user of the instrument.

5.6 View Mode Setting

Three view modes can be selected to show the measured value: Normal Mode, Scan Mode and Diff Mode.

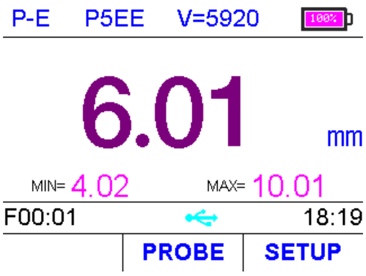


Normal Mode. As shown in right figure, it shows the last test thickness value.

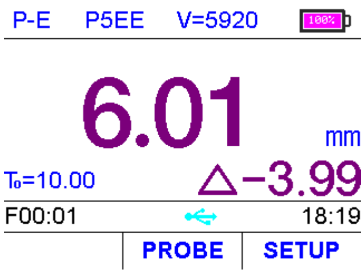


Scan Mode. Besides the last test thickness value, it also shows the minimum thickness value and the maximum thickness during the test.

Press ON/OFF will reset the minimum and maximum value.



Diff Mode. Shows both the last test thickness value and the differential thickness value (between the absolute thickness value and the nominal thickness value)



While the gauge excels at making single point measurements, it is sometimes desirable to examine a larger region, searching for the thinnest point. The gauge includes a feature, called Scan Mode, which allows it to do just that.

In normal mode, the gauge performs and displays ten measurements every second, which is quite adequate for single measurements. In Scan Mode, however, the gauge performs over ten measurements every second, and displays the readings while scanning. While the transducer is in contact with the material being measured, the gauge is keeping track of the minimum and maximum measurement it finds. The transducer may be "scrubbed" across a surface, and any brief interruptions in the signal will be ignored.

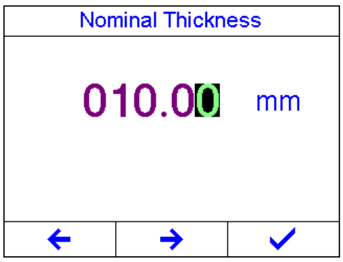
5.7 Normal Thickness Setting

In Differential measurement mode, it needs to set the nominal thickness value of the test piece. The setting method is as below:

Press F1/F2 key to move the highlight cursor; Press arrow keys to increase/decrease the values.

Press or F3 key to confirm the setting.

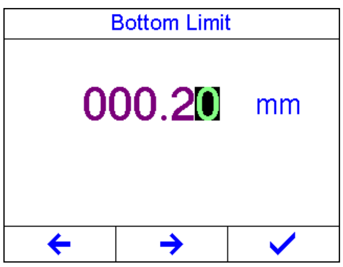
Press key to cancel the change and exit.



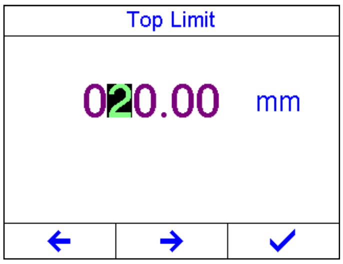
5.8 Limit Setting

For the gauge, test results beyond the limits will be displayed with red color to alarm the user. To change the limit setting,

Press F1/F2 key to move the highlight cursor; Press arrow keys to increase/decrease the values.



Press or F3 key to confirm the setting. Press key to cancel the change and exit



5.9 Changing Resolution

The gauge has selectable display resolution, which is 0.1mm and 0.01mm.

When the resolution is set to 0.01mm, the tested piece surface should be smooth to get accurate test result. When measuring rough surface or coarse grained materials, it is suggested to use low resolution.

5.10 Memory Management

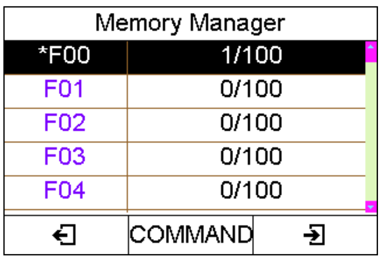
5.10.1 Store a Record

By simply pressing the key after a new measurement reading appears, the measured thickness value will be saved to current selected data group. It is added as the last record of the group.

5.10.2 View the Recorded Items

This function provides the user with the ability to view the records in a desired data group previously saved in memory. Following is the steps:
Activate the Memory Manager dialog as right figure.

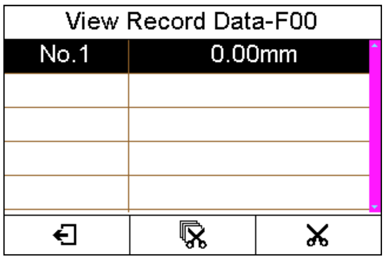
Press to move the cursor; Press or F3 key to open the View Record Data dialog, see next figure.



Press to move the cursor to the desired record.
Press F3 to delete the focused record.

Press F2 to clear all the records of this group.

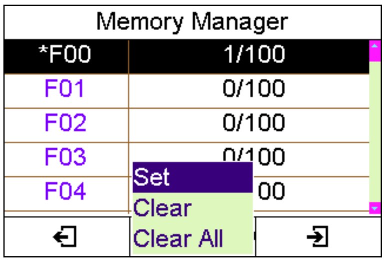
Press /F1 to exit.



5.10.3 Select as current Data Group

There are 100 data groups (F00 ~ F99) inside the gauge that can be used to store the measurement values. At most 100 records (thickness values) can be stored to each group. You can change the destination data group to store the measured values as following.

Activate the Memory Manager dialog. Press to focus on the desired data group. Press F2 to prompt out the commands list. Then select the command “Set” and press to confirm.

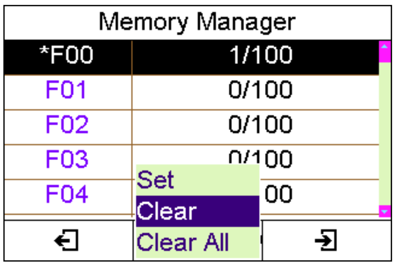


After finished the above steps, the new selected data group will be set as current data group to store the new coming testing results.

5.10.4 Clear a Data Group

The user may require the contents of an entire data group be completely cleared of all measurements. This would allow the user to start a new list of measurements starting at storage location No.00. The procedure is outlined in the following steps.
Activate the Memory Manager dialog.

Press to focus on the desired data group. Press F2 to prompt out the commands list. Then select the command “Clear” and press to confirm.



If the “Clear All” command is selected and confirmed, all the data groups of the gauge will be cleared.
Note: Once cleared, the data is not able to be recovered!

5.11 Key Sound Setting

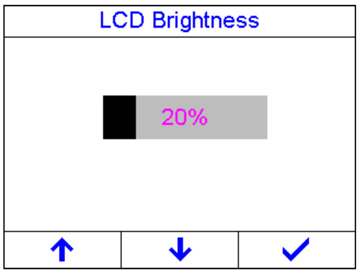
Key sound can be configured to on or off. When the key sound is set to on, the buzzer inside the main unit would make a short audible alarm while press the key each time.

5.12 Warn Sound Setting

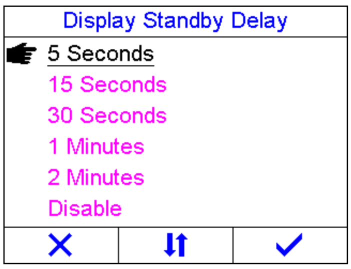
Warning sound can be configured to on or off. If the warning sound is set to on, the buzzer inside the main unit would make a long audible alarm when a new measured value appears. When the main unit gives out some operation warnings it will also give a alarm sound if the setting is on.

5.13 LCD Brightness Setting

The different brightness of the LCD will affect battery standby time and continuously working time.
The setting can be changed by scrolling with F1 (increase) and F2 (decrease) keys, or by pressing arrow keys.
Press or F3 key to confirm the setting.
Press key to cancel the change and close the dialog box.



The instrument consumes less current in lower brightness and consequently increases the operating time.
Note: For saving power, lower down the LCD brightness in good light environment.
See right figure of Display Standby Delay dialog box for the items of the settings.
Press arrow keys or F2 key to select the desired item.
Selecting “Disable” item will forbid the main unit switching into standby state.



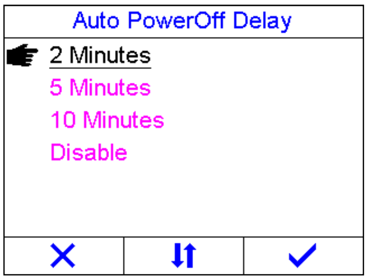
The main unit goes into standby state after a period of time as selected. Carry out a test or press any key to reactivate the main unit from standby state.

5.14 Display Standby Setting

Standby state lower down the LCD brightness and puts the CPU in a power conserving mode. The change from run state to standby state is controlled by the setting of the Display standby delay.

5.15 Auto Poweroff Setting

The change from standby state to power off state is controlled by the setting of automatic shutdown delay.
The time delay can be configured by the user in the auto shutdown delay dialog box.
Press arrow keys or F2 key to select the desired item.
Selecting “Disable” item will forbid the main unit switching automatically into power off state.

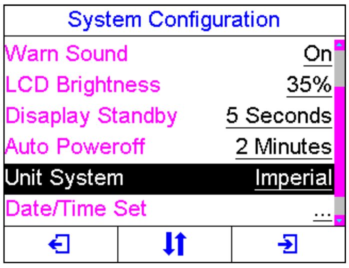


Note: If the voltage of the battery is too low, the LCD screen will show “Battery Exhausted!”, then power off automatically.

5.16 Changing the Unit System

The instrument supports both metric and imperial unit systems.

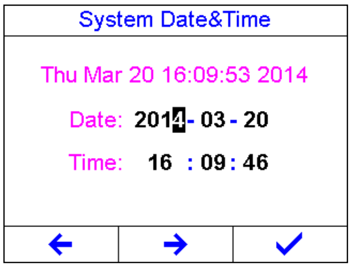
In the System Configuration dialog, press ↵ on the Unit System item to switch back and forth between imperial and metric unit system.



5.17 Date and Time setting

For a correct documentation you should always make sure that you are using the correct date and time setting. Open the system time dialog to set date and time of the instrument system.
The format for date: Year-Month-Date
The format for time: Hour–Minute- Second
Use F1 and F2 keys to move the cursor. Use arrow keys to increase/decrease the values;

Press /F3 key to confirm the setting. Press key to cancel the setting change and close the dialog box.



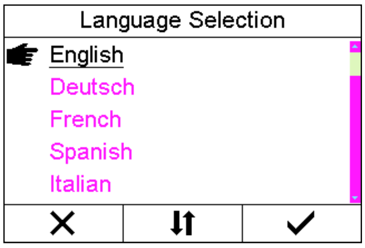
Once set, the internal clock of the instrument will maintain the current date and time.

5.18 Language Setting

Operating language of the gauge can be selected.
Use the arrow keys and F2 key to select the operating language.

Press or F3 key to confirm the selection.

Press key to cancel the change and close the dialog box.

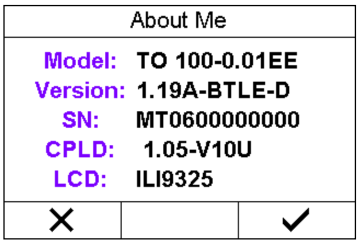


Note: User can also change the operating language on the booting screen during startup.

5.19 Product Information

Information concerning the instrument model, the software version and the serial number of the main unit are displayed in windows as figure below.

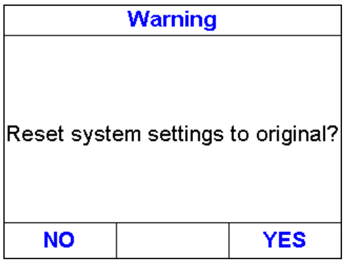
Press , , F1 or F3 key to close the dialog box.



5.20 Reset System

In case the instrument can no longer be operated, or you need to make a basic initialization (factory setting), you can reset the instrument to original.
The instrument can be reset by the System Reset function. All the stored data inside the main unit and user calibration will be cleared during system reset. And the instrument settings will be reset to default.
To reset the instrument:
- Activate the System Reset function. Then you will see right dialog.

-Press or F3 key to confirm the reset operation. Or press F1 key to cancel the reset operation.



NOTE: *The effects of resetting the instrument may not be reversed. No key action should be performed during resetting process.*

5.21 USB Communication

The instrument is equipped with a USB port on upper left of the instrument. The PC can be connected with the instrument via the USB cable.

- Insert the mini-USB end of the USB cable into the USB socket on the upside of main body.
- Insert the other end into the USB port of the computer.

6 Measuring Technologies

6.1 Measuring Method

Single point measuring method: Put the probe to any point in the workpiece, the instrument will show the probe located place thickness.
Two point measuring method: Using the probe to measure two times in the same point of the test piece, in two measurements, the probe parting plane keeps 90º, the smaller value should be the thickness of this point.
Multi-point measurement method: Taking times testing in an approximately 30 mm diameter circular around, the minimum value is the thickness value of the tested piece.
Continuous measurement method: using single point measurement to take continuous measurement along the specified path with less than 5mm intervals, the minimum value is the thickness value of the tested piece.

6.2 Wall Measurement

During measuring, the probe parting plane can be along with the tube axis or vertical to the tube axis. If meeting larger tube diameters, you should measure at the vertical axis. And when the tube diameter is smaller, you should measure in both directions and the minimum value is thickness value.

7 Servicing

When the tester appears some other abnormal phenomena, please do not dismantle or adjust any fixed assembled parts. Just contact us by e-mail or phone and the follow-up for a (warranty) service can be initiated.

8 Transport and Storage

Keep it away from vibration, strong magnetic field, corrosive medium, dumpiness and dust. Storage in ordinary temperature.
With original packing, transport is allowed on the third grade highway.

8.1 Appendix A Sound Velocities

Material	Sound Velocity	
	in/µs	m/s
Aluminum	0.250	6340-6400
Steel, common	0.233	5920
Steel, stainless	0.226	5740
Brass	0.173	4399
Copper	0.186	4720
Iron	0.233	5930
Cast Iron	0.173-0.229	4400－5820
Lead	0.094	2400
Nylon	0.105	2680
Silver	0.142	3607
Gold	0.128	3251
Zinc	0.164	4170
Titanium	0.236	5990
Tin	0.117	2960
Epoxy resin	0.100	2540
Ice	0.157	3988
Nickel	0.222	5639
Plexiglass	0.106	2692
Polystyrene	0.092	2337
Porcelain	0.230	5842
PVC	0.094	2388
Quartz glass	0.222	5639
Rubber, vulcanized	0.091	2311
Teflon	0.056	1422
Water	0.058	1473

8.2 Appendix B: Applications Notes

Measuring pipes and tubes
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 bearing face is perpendicular (at right angle) to the long axis of the pipe. For smaller pipe diameters, two measurements should be performed, one with the bearing

face 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 dependant 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 procedure on 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 a stable measurement. While the transducer is in contact with a hot surface, it will begin to heat up, and through thermal expansion 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 a part 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.

Measuring through paint & coatings

Measuring through paints and coatings are also unique, in that the velocity of the paint/ coating will be significantly different form the actual material being measured. A perfect example of this would be a mild steel pipe with approximately 0.6mm of coating on the surface. Where the velocity of the pipe is 5920m/s, and the velocity of the paint is

2300m/s. If the user is calibrated for mild steel pipe and measures through both materials, the actual coating thickness will appear to be 2.5 times thicker than it actually is, as a result of the differences in velocity. This error can be eliminated by using a special echo-echo mode to perform measurements for applications such as these. In echo-echo mode, the paint/ coating thickness will be eliminated entirely and the steel will be the only material measured.

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

Annotation:
To have a look at the CE Declaration of Conformity, please click onto the following link:
https://www.kern-sohn.com/shop/de/DOWNLOADS/