Sauter GmbH
Ziegelei 1
D-72336 Balingen
E-Mail: info@sauter.eu

Tel: +49-[0]7433- 9933-199
Fax: +49-[0]7433-9933-149
Internet: www.sauter.eu

Instruction Manual
Digital Ultrasonic Thickness Gauge

SAUTER TU-US

Version 1.4
09/2017
GB

PROFESSIONAL MEASURING

TU_US-BA-e-1714

GB

SAUTER TU-US

Version 1.4 09/2017

Instruction Manual

Digital Ultrasonic Thickness Gauge

Thank you for buying a digital SAUTER 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.

Table of contents:

1 Overview

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

1.1 Product Specifications

Display: 128x64 dot matrix LCD with EL backlight

Measuring range: 0.75 to 300mm (in steel)
- TU 80-0.01, TU 230-0.01 US, as well as TU 300-0.01 are measuring continuously with a resolution of 0.01

Sound velocity range: 1000 to 9999m/s

Resolution: 0.1/0.01mm (selectable)

Accuracy: ± (0.5% thickness +0.04) mm, depending on materials and conditions

Units: Metric/ Imperial units selectable

- Four measurements readings per second at single point measurement and ten per second at Scan Mode.
- Memory up to 20 files (up to 99 values for each file) of stored values

- Upper and lower limits can be pre-set. It will alarm automatically if the Measurement result exceeds the limit.

- Case: Extruded aluminium body suitable for use under poor working conditions

Power supply: 2x AA, 1.5V alkaline batteries
Typical operating time: about 100 hours (EL backlight off)

Transfer to PC: USB 2.0

Dimensions: 132 x 76.2 mm

Weight: 345g

1.2 Main functions

- Capable of performing measurements on a wide range of materials including metals, plastic, ceramics, epoxies, glass and other ultrasonic wave well- conductive materials.
- Four transducer models are available for special applications included coarse grain material and high temperature applications.
- Zero adjustment function
- Sound velocity calibration function
- Two- point calibration function
- Two measurement modes: Single point mode
  Scan mode
- Coupling status indicator showing the coupling status
- Battery indication indicates the rest capacity of the battery
- “Auto sleep” and “Auto power off” function to conserve battery’s life

1.3 Measuring principle

The digital ultrasonic thickness gauge determines the thickness of a part or a structure by accurately measuring
The time required for a short ultrasonic pulse generated by a transducer to travel through the thickness of the material, to 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 following 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

1.4 Configuration

	No.	Item	Quan-tity	Note
Standard Configuration	1	Main body	1	
	2	Transducer	1	ATU-US10 90°
	3	Couplant	1	
	4	Instrument Case	1	
	5	Operating Manual	1	
	6	Screwdriver	1	
	7	Alkaline battery	2	AA size
Optional Con-fig-uration	8	Transducer: ATU-US01		See Table3-1
	9	Transducer: ATU-US02		
	10	Transducer: ATB-US02		
	11	DataPro for Thickness Gauge	1	For use on the PC
	12	Communication Cable	1	

1.5 Operation conditions

- Temperature: -10°C up to +60°C
- Storage temperature: -30°C up to 70°C
- Relative humidity: ≤ 90%

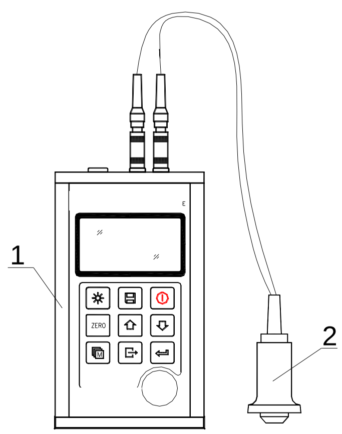
In the surrounding environment any kind of vibrations should be avoided, as well as magnetic fields, corrosive medium and heavy dust.

2 Structure feature

2.1 Instrument appearance

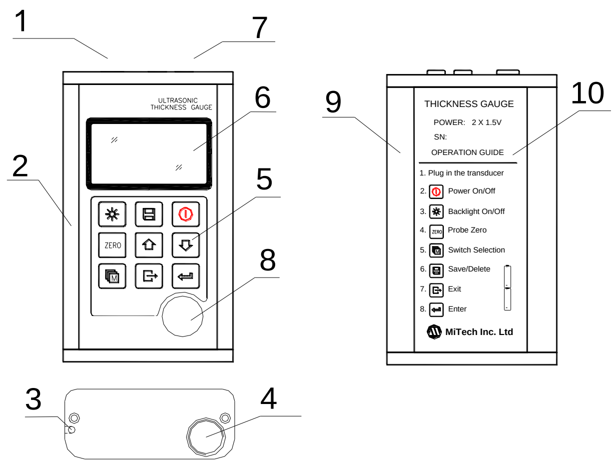
1 Main body

2 Transducer (ultrasonic measurement head)

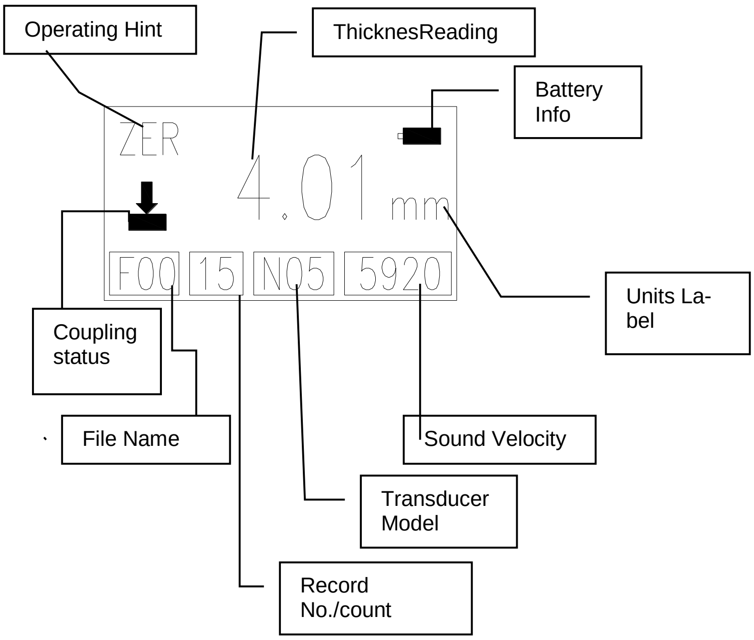


2.2 Parts of the main body

1 Communication Socket
2 Aluminium case
3 Belt hole
4 Battery cover
5 Keypad
6 LCD Display
7 Socket of transducer (no polarity)
8 Control plate (inbuilt)
9 Aluminium case
10 Labels



2.3 Measurement screen



Battery Information:
Displays the information of the rest capacity of battery

Coupling status:
Indicates the coupling status. While measurements are performed, this symbol should be on. If it isn’t, the instrument is having difficulties in achieving a stable measurement and the thickness value displayed will most likely be erroneous.

Operating hint: Shows hints of current operation
FIL: File selection
MEM: Memory data viewing
PRB: Transducer set
VEL: Change velocity
CAL: Velocity calibration
DPC: Dual point calibration state
ZER: Probe zero state

SCA: Indicates that the current thickness measurement
Mode is Scan mode, not Single point mode.

File name: current file name is shown

Record No./ Count: The current record number is indicated while this item is highlighted or the total record counts while it isn't highlighted.

Transducer Model: Current transducer model setting in the instrument

- ATU-US01: N02
- ATB-US06: N05
- ATU-US02: N07
- ATB-US02: HT5

Sound velocity: Current sound velocity setting
Thickness reading: The present Single time measured value is displayed. ↑ means that the upper measuring limit is exceeded. ↓ means that the value is lower than bottom measuring limit.

Units label: If the **mm** symbol is on, the instrument is displaying the thickness value in millimetres and the sound velocity in **m/s.**
If the **in** symbol is on, the instrument is displaying the thickness value in inches and the sound velocity in **inch/us.**

3 Keypad definitions

	Turn the instrument on and off		Exit from current selection
	Turn on/off the EL backlight		Enter
ZERO	Probe Zero operation		Plus or scroll up
M	Switch selection among items		Minus or scroll down
	Data Save or Data Delete		

4 Preparation

4.1 Transducer Selection

With this instrument it is possible to measure a wide range of different materials, started from various metals to glass and plastics. These different types of material require the usage of different transducers. Choosing the correct transducer is the most important thing to perform accurate and reliable measurements. Generally speaking, the best transducer for an operation is the one that sends sufficient ultrasonic energy into the material to be measured in the way that a strong, stable echo is to be received in the instrument. There are several factors that affect the strength of the traveling ultra-sound.

They are described as followed:

Initial signal strength: The stronger a signal is at the beginning, the stronger its echo will return. Initial signal strength is mainly 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 one. Thus, a so-called “1/2 inch” transducer will emit a stronger signal than a “1/4 inch” transducer.

Absorption and scattering: As the ultrasound travels through a material, it is partly absorbed. If the material has got any grain structure, the sound waves will start scat-tering. Both of these effects reduce the strength of the waves and thus the instrument’s ability to detect the returning echo. Ultrasound of higher frequency is absorbed and scattered more than ultrasound of lower frequency.

While it may seem that using a lower frequency transducer is better in every instance, it should be mentioned that low frequencies are less directional than higher ones. Thus, a higher frequency transducer is a better choice for detecting the exact location of small pits or flaws in the material to be measured.

Geometry of the transducer:

The physical constraints of the environment sometimes determine a transducer’s suit-ability for an operation. Some transducers are simply too large to be used in a confined area. If the available surface area for contacting with the transducer is limited, the us-age of a transducer with a small surface is required.

Measurements on a curved surface, in example an engine cylinder wall, will require a transducer with an adapted surface.

Temperature of the material: If exceedingly hot surfaces are to be measured, high temperature transducers must be used. These transducers are built with special ma-terials and techniques that allow them to withstand high temperatures without being damaged. Additionally, care must be taken if a “Zero adjustment” or a “Calibration to known thickness” is being performed with a high temperature transducer.

The selection of a proper transducer is often a matter of tradeoffs between various characteristics. Sometimes it is necessary to experience with a variety of transducers in order to find the one that works well for a special operation.

The transducer is the “business end” of the instrument.

It transmits and receives ultrasonic sound waves which the instrument uses to calcu-late the thickness of the material being measured. The transducer is connected to the instrument via the attached cable and two coaxial connectors. The transducer has to be installed correctly to get reliable measurement results. Each plug must be fit into the adequate socket in the instrument.

Below there are shown two photos and a short description of the instruction use of a transducer.

The upper figure is a bottom view of a typical transducer. The two semicircles are visibly separated in the middle of the surface. One of the semicircles is conducting the echoed sound back into the transducer. When the transducer is placed against the material being measured, this is the area directly beneath the centre of the measured surface.
The below figure is a top view of a typical transducer.
It is pressed against the top with the thumb or the index finger to hold the transducer in place. Only moderate pressure is sufficient to keep it stationary. Its surface must be placed flat against the surface of the material.

Table 3-1 Transducer selection

Model	Freq MHz	Diameter mm	Measurement range	Lower limit	Description
ATU-US01	2	22	3.0mm～300.0mm(in steel) 40mm(grey Cast iron HT200)	20	For thick, highly attenuating or highly scattering materials
ATU-US09	5	10	1.2mm～230.0mm (in steel)	Φ20mm× 3.0mm	normal measurement
ATU-US10 /90°	5	10	1.2mm～230.0mm(in steel)	Φ20mm× 3.0mm	normal measurement
ATU-US02	7	6	0.75mm～80.0mm (in steel)	Φ15mm× 2.0mm	For thin pipe wall or small bent pipe wall
ATB-US02	5	14	3～200mm (in steel)	30	For high temperature (lower than 300°C) measurement

4.2 Conditions and preparation of surfaces

At any kind of ultrasonic measurement, the shape and roughness of the surface being tested are of paramount importance. Rough and uneven surfaces may limit the penetration of the ultrasound through the material resulted by an unstable and therefore unreliable measurement.

The surface being measured should be clean and free of any small particulate matter, rust or scale. The transducer must be placed on a flat and even surface. To get it clean it might be helpful to use a wire brush or a scraper. In more extreme cases, rotary sanders or grinding wheels may be used. Care must be taken to prevent surface gouging which inhibits a proper transducer coupling.
Extremely rough surfaces such as the pebble-like finish of cast iron will be measured quite complicated. These kinds of surfaces comport to the sound beam like frosted glass on light: the beam becomes diffused and scattered in all directions.
In addition to this, rough surfaces account for an excessive wear of the transducer, especially when it is “scrubbed” along the surface. Transducers should be inspected time by time if there are any signs of abrasion.
If the transducer is worn off on one side more than on the other, the sound beam penetrating the test material may no longer be perpendicular to the surface of the material. In this case, it is difficult to exactly locate tiny irregularities in the material, as the focus of the sound beam no longer lies directly beneath the transducer.

5 Operation

5.1 Power on/ off

The instrument is turned on by pressing the key.
If the instrument is initially turned on, the model type, the manufacturer information and the serial number will be displayed before entering the main measurement screen. It is turned off by pressing the key.
The instrument has got a special memory where all settings are stored even if it was powered off.

5.2 Transducer Set

The model of the transducer should be preset to the instrument before measurements are to be started. This enables the user to select the transducer type among supported transducers according to frequency and diameter depending on application requirements. The following steps are to be used to select the applicable transducer model:
1) On the measurement screen, the key has to be pressed multiple times to activate the 【Transducer model】tab.
2) The and the key have to be pressed to switch to the desired transducer model.
3) The key has to be pressed to exit. The transducer model set can also be changed by menu operation. For this, please refer to chapter 5.

5.3 Zero adjustment

The key is used to „zero“ the instrument. It is just the same way as a mechanical micrometer is zeroed. If the instrument isn't zeroed correctly, all the measurements taken may be in error by an initially incorrect value. When the instrument is zeroed, this fixed error value is measured and automatically corrected for all subsequent measurements.

The instrument is “zeroed” as follows:

1) The instrument has to be powered on and the Two-point calibration function is OFF. The Zero adjustment is disabled in Two-point calibration mode.

2) The transducer had to be plugged in and it has to be made sure that the connectors are fully engaged. The surface of the transducer has to be checked: it has to be clean and free of any debris.

3) The model of the transducer set in the instrument has to be changed to the model currently used.

4) A single droplet of ultrasonic couplant is to be applied to the metallic control plate.

5) The transducer has to be pressed flat against the surface of the control plate.

6) While the transducer is firmly coupled to the control plate, the key has to be pressed. The instrument will display “ZER” on the operating hint area while it is calculating its Zero point.

7) After “ZER” disappears, the transducer has to be removed from the control plate.

At this point, the instrument has successfully calculated its internal error factor and will compensate for this value in all following measurements.

When performing a “Zero adjustment”, the instrument will always use the sound velocity value of the in-built control plate, even if any other velocity value has been entered for making actual measurements.

Though the last “Zero adjustment” will be stored it is generally recommended to perform a “Zero adjustment” whenever the instrument is turned on as well as, if a different transducer is used. This way it is ensured that the instrument has been zeroed correctly.

The key has to be pressed and the Zero adjustment is terminated. The instrument returns to the measurement mode.

5.4 Sound velocity

In order to performing accurate measurements, the instrument must be set to the correct sound velocity of the material being measured. Different types of material have got different inherent sound velocities. If the instrument isn't set to the correct sound velocity, all the measurements will be deficient 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 has got higher accuracy over small ranges by calculating the Zero adjustment and sound velocity.

Note: One- and **Two-point** calibrations should only be performed on material where the paint or the coating is removed; if not, it will result in a multi material velocity calculation which is surely deviating from the actual velocity of the material intended to be measured.

5.4.1 Calibration to a known thickness

Note: This procedure requires a sample piece of the material which is going to be measured, its exact material thickness, which has to been measured by any means before.

1) A Zero adjustment has to be performed.
2) A couplant has to be applied to the sample piece.
3) The transducer has to be pressed against the sample piece, making sure that the transducer is placed flat on it.
The display should show a thickness value and the coupling status indicator should appear.
4) As soon as a stable reading has been achieved, the transducer has to be removed. If the displayed thickness
Is different from the value shown while the transducer was coupled, step 3 has to be repeated.
5)The and the key has to be used to adjust the displayed thickness up or down until the thickness of the sample piece is matched.
6) The key has to be pressed and the sound velocity value, which has been calculated before based on the thickness value that was entered, is displayed.
7) The key hast to be pressed to exit the calibration mode. Now, measurements can be performed.

5.4.2 Calibration to a known velocity

This procedure requires that the sound velocity of the material being measured, is known. A table of the most common materials and their sound velocities can be found in Appendix A of this manual.

1. The key has to be pressed multiple times to tab to the sound velocity item.
2. The key has to be pressed to switch among the preset commonly used velocities. The preset sound velocity value can be overwritten, if essential, up or down with the keys and until the sound velocity of the material to be measured is matched. This value may be above or below the preset sound velocity for a special material (see table in Appendix A).
3. The key has to be pressed to exit from the calibration mode. The instrument is now ready to perform measurements.

Another method to set the instrument with a known sound velocity is as follows:

1) The submenu item 【Test Set】 —>【Velocity Set】has to be highlighted and the key has to be pressed to enter the sound velocity set screen.

2) The ⏎ key has to be pressed multiple times to tab to the numeric digit to be changed. The ⇧ / ⇩ keys have to be used to increase/ decrease numeric values on the display until the sound velocity of the material being measured is matched. An auto repeat function is built in, so that when the key is held down, numeric values will increment/ decrement at an increasing rate.
3) The ⏎ key has to be pressed to confirm or the ⇨ key hast to be pressed to cancel the calibration.
To achieve the most accurate measurement results, it is generally advisable to calibrate the instrument to a sample piece of known thickness. The composition of materials (and thus, its sound velocity) sometimes varies from lot to lot and from manufacturer to manufacturer.
Calibration to a sample of known thickness ensures that the instrument is set as closely as possible to the sound velocity of the material being measured.

5.5 How to perform measurements

The instrument always stored the last measured value until a new measurement is made. In order for the transducer working in the right way there may not be any gaps between the contact area of the sensor and the surface of the material being measured. This is accomplished with the 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.
Therefore a small amount of couplant should be applied onto the surface of the material, before measurements are performed. Typically, a single droplet is sufficient.
After the couplant is applied, the transducer has to be pressed firmly against the area being measured. The coupling status indicator should appear on the display as well as a digit number. If the instrument has been “zeroed”
properly and if it has been set to the correct sound velocity, the actual thickness of the material directly beneath the transducer will be indicated as a number in the display.
If the coupling status indicator doesn’t appear or if it isn’t stable or if the numbers on the display doesn’t seem to be correct, it has to be checked whether there is an adequate film of couplant beneath the transducer and whether the transducer is placed flat onto the material.
If conditions persist, sometimes it is necessary to select a different transducer (size or frequency) for the material intended to be measured.
While the transducer is in contact with the material, the instrument will perform four measurements every second, updating its display as it does so.
If the transducer is removed, the display will hold the last measurement performed.
Note: Occasionally a small film of couplant will be drawn out between the transducer and the surface, as the transducer is removed. If this happens, the instrument may perform a measurement through this couplant film, resulting in an erroneously measurement. This is comprehensible because one thickness value is observed while the transducer is in place and the other value is observed after the transducer is removed.

In addition, measurements performed through very thick paint or coatings may result in the paint or coating being measured rather than the material intended.
The responsibility for a proper use of the instrument, as well as the recognition of these types of phenomenon solely depends on the user of this instrument.

5.6 Two-point Calibration

This procedure requires that the testing person has got two known thickness points on the test pieces which are representative of the range being measured.
1) On the 【Test Set】—>【2-Point Cal】submenu item the key has to be pressed to switch ON the Two-point mode. Then the menu has to be left to get to the measurement screen of the instrument. The string "DPC" will appear on the operation hint area of the main measurement screen.
2) The key has to be pressed to start the calibration procedure. The string "NO1" will appear on the operating hint area, indicating measuring the first point.
3) A small amount of couplant has to be applied to the sample piece.
4) The transducer has to be pressed against the sample piece at the first / second calibration point. It has to be made sure that the transducer is placed flat on the surface of the sample. Now the display should show any (probably incorrect) thickness value and the coupling status indicator should appear steadily.
5) As soon as a stable measurement is achieved, the transducer is to be removed. If the displayed thickness distinguishes from the value shown while the transducer was coupled, step 4 is to be repeated.
6) The and the key are to be used to adjust the material thickness up and down until it matches the material thickness of the sample piece.
7) The key has to be pressed to confirm. The hint will change to "NO2" indicating to be ready to measure the second calibration point.
8) Steps 3 to 7 are to be repeated. The hint will change back to "DPC".
The instrument is now ready to perform measurements within its range.

5.7 Scan mode

While the instrument excels in making single point measurements, it is sometimes necessary to examine a larger region, searching for the thinnest point. This instrument includes a feature, called SCAN- Mode, which allows to do just that.
During normal operation, it performs and displays four measurements every second which is adequate for single measurements. In SCAN- Mode, however, the instrument performs ten measurements every second and displays the readings while scanning. While the transducer is in contact with the material to be measured, it is always keeping track to finding the lowest measurements. The transducer may be "scrubbed" across the surface, any brief interruptions of the signal will be ignored. If it loses contact with the surface for more than two seconds, the instrument will display the smallest measurement it found.

On the 【Test Set】 —>【Work mode】menu item the key has to be pressed to toggle between single point mode and scan mode.

5.8 Limit set

With the Limit set feature the user is able to set an audible and visual parameter while taking measurements.
If a measurement is beyond the limit range, set by the user, the beeper will sound, if enabled. With this, the speed and efficiency of the inspection process is improved by elimination of constant viewing of the actual reading displayed. In the section below it is described how to set up this feature:
1) On the 【Test Set】 —>【Tolerance Limit 】menu item the key has to be pressed to activate the limit set screen.
2) The key, the and key are to be used to change the bottom limit and the upper limit value to the desired values.
3) The key has to be pressed to confirm the change and to return to the previous screen, or the key has to be pressed to cancel the change.
If the measurement range is exceeded, the user will be reminded to re-set. If the bottom limit is larger than the upper limit, the values will be exchanged automatically.

5.9 Changing resolution

The instrument has got a selectable display resolution, which is 0.1 and 0.01mm.
On the 【Test Set】 —>【Resolution】menu item the key has to be pressed to switch between “high” and “low”.

5.10 Unit scale

On the 【Test Set】 —>【Unit 】menu item the key has to be pressed to switch back and forth between imperial and metric units.

5.11 Memory management

5.11.1 Storing a reading

There are 100 files (F00-F99) which can be used to store the measurement values inside the instrument. At most 100 records can be stored in each file.

The following steps outline how to do this:

1) The key has to be pressed to activate the 【File Name】item on the main measurement screen.

2) The and key are to be used to select the desired file to save the data.

3) After a new measurement reading appears, the key has to be pressed to save the measurement value to the current file. If the 【Auto Save 】function is activated, the measurement value will be automatically saved to the current file after a new measurement operation.

5.11.2 Viewing a stored reading

The key has to be pressed multiple times until the 【file name 】area on the measurement screen is highlighted. The and key are to be used to change the record number.

	delete the marked file
PRB	delet all files
oder	select the file to store
	escape the menu

*F00	4/100
F01	0/100
F02	0/100
F03	0/100
F04	0/100
F05	0/100

Press the key until **{**Record Count**}** is shown at the display. The and key are to be used to change the record count.

	delete the highlited measurement value
PRB	delete all measurement values
oder	escape the manu

No.1	12.00mm
No.2	18.95mm
No.3	23.94mm
No.4	29.95mm

5.12 System Set

The key has to be pressed on the 【System set】 menu item and enter this submenu from the main menu.

1) When 【Auto save】 is set to <On>, the measured data are automatically stored to the current file.

2) When 【Key sound】 is set to <On>, the buzzer will make a short hoot every time if any key is pressed.

3) When 【Warn sound】 is set to <On>, if the measured value exceeds the limit, the buzzer will make a long hoot.

4) LCD Brightness Set: The key has to be pressed on the 【System set】 —> 【LCD Brightness】 menu item to enter the LCD Brightness screen. has to be pressed to enhance , and to weaken the brightness.

The key has to be pressed to confirm the modification, or the key has to be pressed to cancel it

5.13 System information

This System information function will display the information about the main body and the firm ware. The version will change with the firmware.

5.14 EL Backlight

With the background light, it is convenient to work in even dark condition. The key has to be pressed to switch on or off the background light any moment it is needed after having powered on the instrument.

As the EL light will consume much power it only has to be turned on if necessary.

5.15 Auto Power OFF

Here you can set the Auto power off function. You are able to choose between 2 minutes, 5 minutes and 10 minutes.

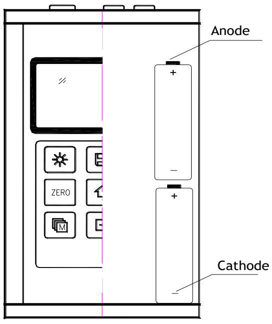
5.16 System Reset

The key has to be pressed while powering on the instrument: factory defaults will be restored. All the memory data will be cleared during system reset. The only time this might be helpful is if the parameter in the instrument was somehow corrupted.

5.17 Battery information

Two AA size alkaline batteries are needed as power source. After several hours' usage of the pre-set batteries, the battery symbol on the screen will be shown as .

If battery capacity runs out, the battery symbol will be shown and it will begin to flash. In this case, the batteries should be replaced.
If the instrument isn't used for a longer period, the batteries have to be removed.



Procedure:
1 Power Off the instrument
2 Take off the cover of the battery and take out the two batteries
3 Insert the new batteries into the instrument two batteries
4 Re-plug the battery cover
5 Power on the instrument to check.

5.18 Connection to PC

This instrument is equipped with a USB port. Using the accessory cable, the instrument has got the ability to connect to a PC or an external storage device.
Measurement data stored in the memory can be transferred to the PC through the USB port. For detailed information of the communication software and its usage, refer to the software manual.

6 Menu operation

Both, pre-setting system parameters and the additional function are verified by menu operation. On the measurement screen, the key has to be pressed to get into the main menu.

6.1 Enter the main menu

To enter the main menu, the key has to be pressed to activate the menu items tab while being on the measurement screen. To turn back to the previous screen, the key has to be pressed again.

6.2 Enter the Sub menu

The key has to be pressed to enter the submenu screen while the submenu item is selected.

6.3 Change the parameter

The key has to be pressed to change the value of a parameter while the item is selected on the parameter set screen.

6.4 Numeric digit input

The key has to be pressed multiple times to tab to the numeric digit to be changed; the numeric values on the display can be decreased/ increased with the and key until the desired value is matched.

6.5 Save and exit

The key has to be pressed to confirm the modification and to return back to the previous screen.

6.6 Cancel and exit

The key has to be pressed to cancel the change and return back to the previous screen.

7 Servicing

If there should appear some abnormal phenomena to the instrument, please do not dismantle or adjust any fixed assembly parts on your own. Instead of this, the present warranty card has to be filled out and the instrument has to be sent to us. The warranty service can be carried on.

8 Transport and Storage

The instrument has to be kept away from vibration, strong magnetic fields, corrosive medium, dumpiness or dust. It has to be stored in ordinary temperature.

Appendix A Sound velocities

Material	Sound Velocity	
	In/us	m/s
Aluminum	0.250	6340-6400
Herkömml. Stahl	0.233	5920
Rostfreier Edelstahl	0.226	5740
Messing	0.173	4399
Kupfer	0.186	4720
Eisen	0.233	5930
Gusseisen	0.173-0.229	4400—5820
Blei	0.094	2400
Nylon	0.105	2680
Silber	0.142	3607
Gold	0.128	3251
Zink	0.164	4170
Titan	0.236	5990
Blech	0.117	2960
Epoxidharz	0.100	2540
Eis	0.157	3988
Nickel	0.222	5639
Plexiglas	0.106	2692
Styropor	0.092	2337
Porzellan	0.230	5842
PVC	0.094	2388
Quarzglas	0.222	5639
Gummi	0.091	2311
Teflon	0.056	1422
Wasser	0.058	1473

Appendix B Application Notes
Measuring pipe and tubing

When a piece of pipe is measured to determine the thickness of the pipe wall, the orientation of the transducer is of importance. If the diameter of the pipe is larger than approximately 4 inches, measurement should be performed with the transducer orientated in the way that the gap in the surface of the sensor is perpendicular (at right angle) to the long axis of the pipe.
For smaller pipe diameters, two measurements should be performed, one with the surface gap of the sensor perpendicular, another with the gap parallelto the long axis of the pipe. The smaller one of the displayed values should be taken as the thickness of that point.

Measuring hot surfaces

The sound velocity through a substance is dependent on its temperature. As materials heat up, the velocity of sound through them decreases. In most applications with surface temperatures of less than 100°C, no special procedures must be observed. At temperatures above that point, the change in sound velocity of the material being measured starts having a noticeable effect upon ultrasonic measurement. At such elevated temperatures it is recommended to first performing a calibration on a sample piece of known thickness, which is at or near the temperature of the material being measured. This will allow the instrument to correctly calculate the sound velocity 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 of materials which can withstand high temperatures.
It is also recommended that the sensor has to be left in contact with the surface for a short time in order to aquire a stable measurement. While the transducer is in contact with the hot surface, it will be heated up and with termal expansion and other effects, the accuracy of measurement may adversely be affected.

Measuring laminated materials

Laminated materials are unique because of their density (and therefore sound velocity) may considerably vary from one piece to another. Some laminated materials may even exhibit noticeable changes in sound velocity across a single surface. The only way to a reliable measurement is to perform a calibration 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. The effects of variation of sound velocity will be minimized by calibrating each test piece individually.
An additional important consideration is , that any included air gaps or air pockets will cause an early reflection of the ultrasound beam. This will be noticed as a sudden decrease in thickness in an otherwise regular surface. While this may impede accurate measurement of the total material thickness, it does positively indicate any air gaps in the laminate.

Suitability of materials

Ultrasonic thickness measurement relies on passing a sound wave through the material being measured. Not all materials are suited to transmitting sound. Ultrasonic thickness measurement is practically found in a wide variety of materials including metals, plastic and glass.
Materials which are difficult include some cast materials, concrete, wood, fibreglass and some rubber.

Coupling medium

Every ultrasonic application requires some medium to couple the sound from the transducer to the tested material. Typically, a high viscosity liquid is used as the medium. The sound used in ultrasonic thickness measurement doesn’t travel through air efficiently.

A wide variety of coupling mediums may be used. Propylene glycol is suitable for mostly all applications. In difficult applications, where a maximum transfer of sound energy is required, glycerine is recommended. However, on some metals glycerine may promote corrosion by means of water absorption, which is undesirable.

Other suitable coupling medium 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 coupling medium.

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 being in standard pulse-echo mode.

This may result in a thickness reading that is TWICE what it should be.

The responsibility of a proper use of the instrument and the recognition of these types of phenomenon solely rest with the user of the instrument.