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Instruction Manual Ultrasonic Material Thickness Gauge

SAUTER TN-Gold

Version 2.0
04/2020
GB

PROFESSIONAL MEASURING

TN_Gold-BA-e-2020

GB

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V. 2.0 04/2020

Instruction Manual Ultrasonic Material Thickness Gauge

Congratulations on the purchase of an ultrasonic gold tester from SAUTER. We hope you will enjoy your quality tester with its wide range of functions. Please do not hesitate to contact us if you have any questions, requests or suggestions.

Table of contents:

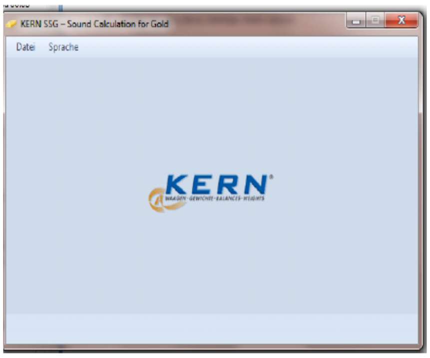
1. Main function of the KERN SSG software for the gold tester

With the help of this software, the individual ultrasonic speed of your test piece can be conveniently determined.
Pieces of gold, such as coins or bars, may not be made of pure gold, with a sound velocity of 3240 meters per second (m/s). In many cases, copper or other components in small amounts are part of the gold piece. This is usually necessary for a higher strength of the body and must be taken into account for the authenticity check.
These mixture components (or alloys) can be taken from the gold piece's exposé or can be requested from the manufacturer or the smelting or refining plant.

1.1 Opening the software

- Extract from KERNSSG.zip
- Open KERNSSG.exe

1.2 Starting the procedure



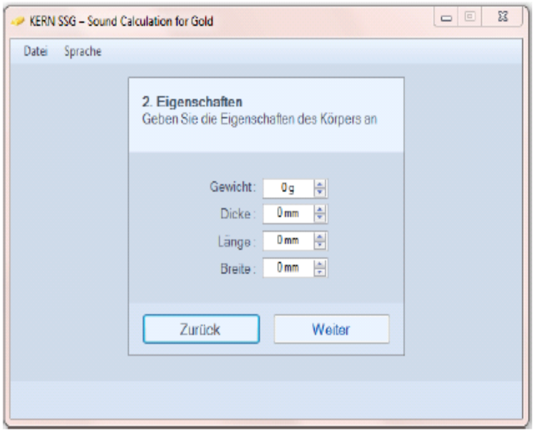
Click on File and select New in the menu

1.3 Choice of external shape

Choice between gold bars or coins

1.4 Weight and dimensions

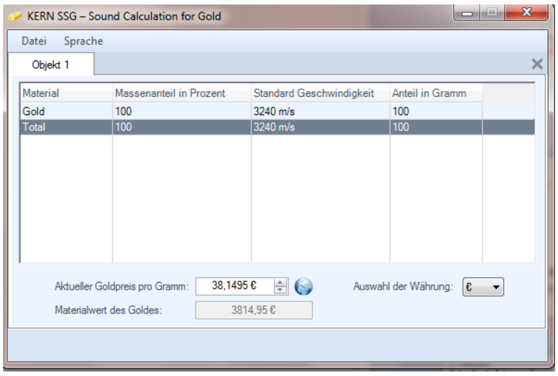
Enter the weight of your test piece and the outer dimensions.
To determine the weight, we recommend a suitable precision balance. You can find this at www.kern-sohn.com .
To determine the dimensions, it is recommended to use a caliper gauge or outside micrometer. When determining the thickness of coins, please pay attention to the point at which you are measuring. In this context, depressions and elevations caused by the minting process must be taken into account.
* Determine the size dimensions with caliper gauge
* Read the result in millimetres



2. Determination of the safety level

Each measurement is subject to uncertainty or has a tolerance. A tolerance of, for example, 5% corresponds to a safety level of 95% and indicates the value by which the measurement result may fluctuate. Since the method used here compares two measurements, a generous tolerance selection is recommended.
A safety level of 95 % is therefore provided for from the factory side. This can be overwritten.

3. Basic view alloy



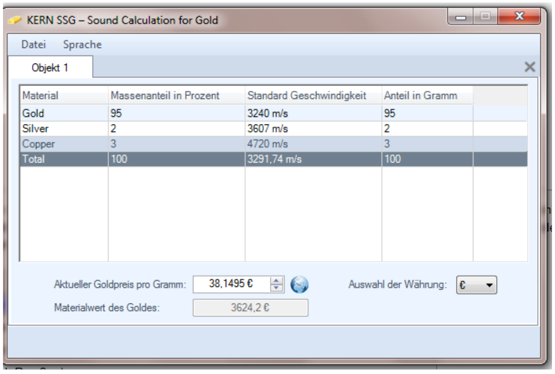
In order to give the material the stability customary in use, coins are made as gold alloys. This means that other materials besides gold have been added during the production process. Silver and copper are particularly popular for this.

The exact alloy of the gold piece can be taken from the exposé, which is usually enclosed. Alternatively, the refinery or mint that produced the gold piece can provide information about it.

The alloy of the gold piece to be tested must be entered in this window.

In the row "New component" the first alloy component - after gold - is to be inserted via the drop-down selection field. In addition, the percentage of the alloy must be entered. The software now automatically inserts the respective mass fraction in grams.

After entering all components, the software outputs the ultrasonic speed to be used.



This calculated ultrasonic speed must now be entered into the SAUTER TN-US ultrasonic measuring device.

4. Transfer of the sound velocity into the measuring instrument

The device must be switched on for this. After the ZERO calibration, the value is entered by pressing the CAL button twice (m/s flashes in the display). The last used sound velocity is displayed. With the arrow keys ▲ and ▼ the speed of sound can be increased or decreased. Enter the calculated speed of sound here. By pressing the CAL key again, this entry is accepted.

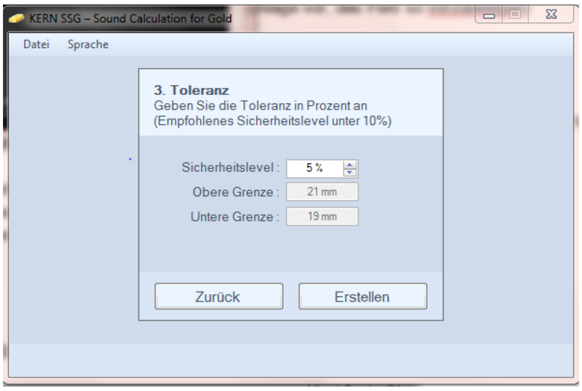
5. Measurement of the gold piece to be tested with the ultrasonic measuring device

A small amount of coupling agent (ATB-US 03, to be ordered separately) is applied to one side of the test object. The transducer is now pressed slightly onto this coupling gel. If the connection is correct, the display shows

┻	This symbol indicates the coupling
Value (mm)	This number represents the measured thickness of the test piece

6. Evaluation of the measurement result

The measured result of the ultrasonic measuring device must be within the tolerance range.



If the measurement result is above or below the tolerance range, it is recommended that a comparative measurement be made at another point on the gold piece, or on the other two opposite side faces (for bars).

If there are still deviations that are outside the tolerance range, there is now a suspicion of a wrong core.

7. Alternative measurement methods

As a traditional measuring method for determining the authenticity of gold pieces, density determination in liquid is recommended.

For this purpose, we offer attractive density determination solutions in the laboratory balance section at www.kern-sohn.com.

8. TN-US Series Manual

8.1 General overview

The model TN-US is a digital ultrasonic material thickness gauge. It is based on the same operating principles as SONAR. With the TN-US the material thickness of various materials can be measured with an accuracy of up to 0.1mm or 0.01 mm. It can be used for a variety of metallic and non-metallic, homogeneous materials.

8.2 Technical data

	TN Gold 80
Dispaly	4.5 inch LCD display with backlight

Measuring range	0.75~80mm
Sound speed	1000~9999m/s
Resolution	0.01mm
Measurement uncertainty	±0.5% ± 0.04mm
Memory	of up to 20 files (up to 99 measured values per file) with stored measured values
Power supply	2x 1,5V AA batteries
Communication	RS-232
Ambient temperature	-20°C - 60°C
max. air humidity	≤ 90%
Dimensions	150x74x32mm
Weight	245g

8.3 General functions

A wide range of materials can be measured, including metals, plastics, ceramics, composites, epoxy, glass and other ultrasonic wave conductive materials.

For special applications, certain models of sounders are available, especially for coarse-grained materials and high-temperature applications.

- Zero setting and sound velocity calibration function.
- Two-point calibration function
- two working methods: single point mode and ultrasound image mode (scan mode)
- Coupling status display shows the coupling status.
- The battery information shows the remaining capacity of the battery.
- "Auto Sleep" and " Auto Power off" function to conserve battery power.
- Software ATU-04 and AFI-0.1 for TN xxx0.01 US available on request to transfer memory data to the PC

8.4 Measuring principle

The Ultrasonic Digital Material Thickness Gauge measures the thickness of a part or structure by accurately measuring the time taken for a short ultrasonic pulse to pass through the thickness of a material, controlled by a transducer, then reflected from the back or inner surface and returned to the transducer.

This measured two-way transmission time is divided by 2 (representing the outward and return paths), and then multiplied by the sound velocity of the corresponding material. The result is calculated with the following

Expressed by formula

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

H = Material thickness of the test object

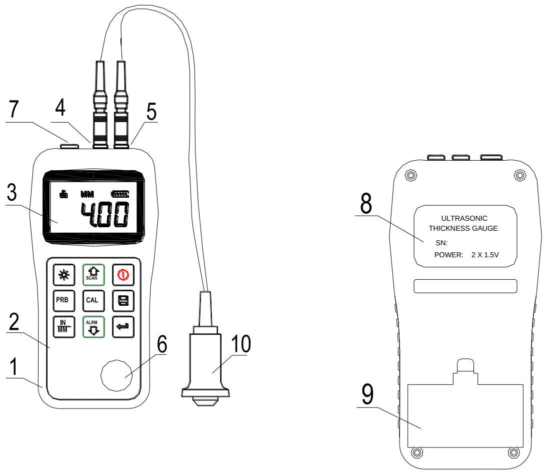
v = sound velocity of the corresponding material

t = the measured transit time for the sound

8.5 Equipment

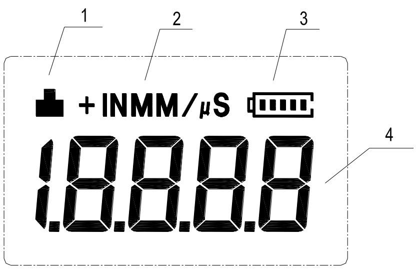
	No.	Designation	Quantity	Note
Standard Equipment	1	Main body	1	
	2	Sounder	1	Depending on model
	3	Coupling means	1	
	4	Transport case	1	
	5	Operating instructions	1	
	6	Alkaline battery	2	size AA
Optional Additional-Equipment un	7	Sound generator: ATU-US 01	1	
	8	Sound generator: ATU-US 02	1	
	9	Sound generator: ATB-US 02	1	
	10	Sound generator: ATU-US10 right angle	1	
	11	Sound generator: ATU-US09	1	
	12	Sound generator: ATB-US01	1	
	13 14 15	Data Pro Software ATU-04 Plug-In Software AFI-1.0 USB comm. cable FL-A01	1 1 1	for PC, only for models TN xxx 0.01US
	16	Coupling gel ATB-US03	1	

9. Design features



1 The main unit (display unit)
2 Keypad
3 LCD display
4 Pulse encoder socket
5 Radiation receiver socket
6 Zero plate
7 PC connection socket
8 Label (on the back)
9 Battery cover
10 US measuring probe

9.1 Digital display



1. <u>Coupling status:</u> displays the coupling status;

This symbol must appear while measurements are being taken. If this is not the case, the instrument has problems obtaining stable measurements and it is very likely that deviations will occur.

2. <u>Unit:</u> mm or inch for the material thickness m/s or in/µ s for the speed of sound
3. <u>Battery indicator:</u> shows the remaining capacity of the batteries
4. <u>Information on the display:</u> The determined material thickness value and the speed of sound can be read off and indicates the current operation.

9.2 Description of the control panel

	On/off go to	CAL	Calibration Sound velocity
	Background- lighting fixture On/ Off		Enter key
ZERO	Button for Zero adjustment	SCAN	Plus; US mode: On/ Off
IN MM	Button for Changing the Units	ALRM	Minus; Beep mode: On/ Off
	Save data o. delete		

10. Preparation for commissioning

10.1 Selection of the sound generator

With this instrument a wide range of materials can be measured, from various metals to glass and plastics. For these different types of materials, different sounders, i.e. US measuring heads, are required. The correct transducer is crucial for a reliable measurement result. The following sections explain the important characteristics of the transducers and what should be considered when selecting a transducer for a specific work object. Generally speaking, the best transducer for a workobject should send sufficient ultrasonic energy into the material to be measured so that a strong, stable echo arrives at the instrument. Certain factors influence the strength of the ultrasound as it is transmitted.

These can be read in the following:

The initial signal strength:

The stronger a signal is from the beginning, the stronger the returning echo will be. The initial signal strength is mainly a factor of the size of the ultrasonic emitter in the transducer. A strong emitting surface will emit more energy into the material than a weak one. Consequently, a so-called "1/2 inch" US probe will emit a stronger signal than a "1/4 inch" US probe.

Absorption and dispersion:

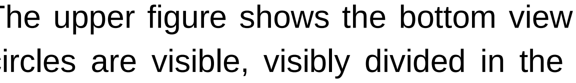
When the ultrasound passes through any material, it is partially absorbed. In materials with a granular structure, the sound waves scatter. Both of these influences reduce the strength of the sound waves and thus the ability of the device to detect or record the returning echo. Sound waves with higher frequencies are more "swallowed" than those with lower frequencies.

So it might seem, it would be better to use a low frequency probe in any case, but these are less alignable (bundled) than those with high frequencies. Consequently, a high-frequency transducer would be the better choice for detecting small depressions or impurities in the material.

Geometry of the sound generator:
The physical limits of the measurement environment sometimes determine the suitability of the sound generator for a particular test object. Some sounders are simply too large to be used in a fixed environment. If the available surface for contact with the sound generator is limited, a sound generator with a small contact area is required. If one measures a curved surface, for example a
drive cylinder wall, the contact surface of the sound generator must also be adapted to this.
Temperature of the material:
If measurements are made on unusually hot surfaces, high-temperature sounders are used. These are built in such a way that they can be used under high temperatures without suffering damage, for special materials and techniques. In addition, care must be taken when performing a "zero calibration" or "calibration with known material thickness" using a high temperature transducer.

The selection of a suitable sound generator is often a compromise between different influences and characteristics. Sometimes it is necessary to select several
to try out sounders until the most suitable one for the test object is found.
The sound generator is the "end piece " of the measuring instrument.
It transmits and receives ultrasonic waves, which the device uses to measure the thickness of the material to be examined. The transducer is connected to the gauge by an adapter cable and two coaxial connectors. When sounders are used, plugging in the connectors is simple: either the plug fits into the socket or into the instrument itself. The transducer must be used correctly to obtain accurate, reliable measurement results.

The following is a brief description of one of these, followed by instructions for use.



The upper figure shows the bottom view of a typical sound generator. The two half circles are visible, visibly divided in the middle. One of the semicircles directs the ultrasound into the material to be measured and the other directs the echo back to the transducer. When the transducer is placed on the material to be measured, it is located directly below the center of the area whose thickness is to be measured.
The picture to the right shows the top view of a sound generator.
It is pressed with the thumb or index finger from above on the sound generator to keep it exactly placed. Only moderate pressure is required, as its surface only needs to be positioned flat on the material to be measured.

Model	Freq MHZ	Ø mm	Measuring range	Lower limit	Description
ATU-US01	2,5	14	3.0mm～300.0mm（Stahl） 40mm (grey cast iron HT200)	20	For thick, highly damping or highly scattering materials
ATU-US09	5	10	1.2mm～230.0mm (steel)	Φ20mm×3.0mm	Normal measurement
ATU-US10	5	10	1.2mm～230.0mm（Stahl）	Φ20mm×3.0mm	Normal measurement,90°angle
ATU-US02	7	6	0.75mm～80.0mm（Stahl）	Φ15mm×2.0mm	For thin or slightly bent tube material
ATB-US01	5	6	0.75mm～80.0mm (steel)	Φ15mm×2.0mm	For thin material
ATB-US02	5	12	3～200mm (steel)	30	For high temperature measurements (up to 300°C)

10.2 Conditions and preparations for surfaces

For any kind of ultrasonic measurement, the condition and roughness of the surface to be measured is of utmost importance. Rough, uneven surfaces can
restrict the penetration of the ultrasonic waves through the material, resulting in unstable, incorrect measurement results
The surface to be measured should be clean and free of any substances, rust or verdigris. If this is the case, the sound generator cannot be cleaned
can be placed on the surface. A wire brush or scraper is often helpful to clean the surface. In extreme cases, belt sanders or the like can be used. However, it is important to avoid gouging the surface, which prevents the sound generator from being placed cleanly.
Extremely rough surfaces like siliceous cast iron are very difficult to measure. These types of surfaces behave like when light shines on frosted glass, the beam is scattered and sent in all directions.
In addition, rough surfaces contribute to considerable wear of the sounders, especially in situations where they are "scrubbed" over the surface.
They should therefore be checked at a certain distance, especially at the first signs of unevenness on the contact surface. If it is worn down more on one side than the other, the sound waves can no longer penetrate vertically through the material surface of the test object. In this case, small irregularities in the material are difficult to measure because the sound beam is no longer exactly below the sound source.

11. Mode of operation

11.1 Switching on and off

The device is switched on and off by the on/off button.
In the device there is a special memory in which all measurements are stored, even after switching off.

11.2 Sound generator setting (zero setting)

The key is used to zero the device. This is done almost like with a mechanical precision measuring instrument (micrometer).
If this is not done correctly, all measurements performed may be incorrect.
When the instrument is zeroed, the specified error value is measured and automatically corrected for all subsequent measurements.
The procedure is as follows:

1. 1Plug in the sound generator (US probe) and check the connections of the plugs. The contact surface of the transducer must be clean.
2. Press the key to activate the zero setting mode.
3. The key and the key are pressed to display the currently used sound generator model. Of course, no mistake should be made here, as this is crucial for the measuring accuracy.
4. A drop of coupling agent is now applied to the metal zero plate.
5. The US probe is carefully pressed onto the zero plate and should lie flat on this surface, the value 4mm will now appear as the zero plate is 4mm thick and the instrument will now be calibrated to this value.
6. Now the US measuring probe is lifted off the zero plate. The instrument has now recognized the initial error factor and will use this to adjust all subsequent measurements. When zeroing, the instrument will always use the sound velocity of the built-in zero plate, even if other values have been previously entered to make current measurements. Although the last zero setting is stored in memory, it is recommended that it be repeated each time the instrument is switched on, even if a different transducer is used. This will ensure that the instrument is always set correctly. Pressing the key cancels the current zero setting. The instrument returns to the measuring mode.

11.3 Sound velocity

In order to be able to make exact measurements, this must be adjusted to the speed of sound of the corresponding material. Different materials have different sound velocities.
If this is not done, all measurements will be faulty by a certain percentage.
One-point calibration is the most common way to optimize linearity over a long range.
Two-point calibration allows higher accuracy at a shorter range by calculating the zero setting and the speed of sound.
Note: For **one-point and two-point calibrations,** paint or coating must be removed in advance. If this is not done, the calibration result will consist of a kind of "multi-

material sound velocity" and will certainly not be the same as that of the actual material to be measured.

11.3.1 Calibration with known material thickness

Note: This procedure requires a sample of the material to be measured, the exact material thickness of which, e.g. on any
species was measured before.

1. The zero setting is made.
2. The sample material is provided with coupling gel.
3. The US measuring head is pressed onto the piece of material. A material thickness value can now be read on the display and the coupling symbol appears.
4. As soon as a stable reading value is reached, the US measuring head is lifted off again. If the thickness of the material just detected changes from the value that existed during coupling, step 3) must be repeated.
5. The key CAL is pressed and thus the calibration mode is activated. The MM (or IN) symbol should start flashing.
6. With the and SCAN keys you ALRM can now adjust the required material thickness (that of the material pattern).
7. The key CAL is pressed again and the M/S (or IN/ µS) should start flashing. The display will now show the sound velocity value previously calculated based on the material thickness.
8. To exit the calibration mode, press the key to CAL return to the measuring mode. From now on measurements can be made.

11.3.2 Calibration at known sound velocity

Note: For this procedure the sound velocity of the material to be measured must be known. A table of the most common materials can be found in Appendix A of this manual.

1. Press the key to CAL activate the calibration mode. The MM (or IN) symbol should start flashing.
2. Press this button repeatedly so that the M/S (or IN/ µS) symbol also flashes.
3. Use the and SCAN keys to ALRM adjust the sound velocity value up or down until it corresponds to the sound velocity of the material to be measured. It is also possible to use the key to switch between the preset, generally used velocities of sound.
4. To exit the calibration mode, CAL press the key. From now on measurements can be made.

In order to obtain the most accurate measurement result possible, it is generally recommended to calibrate the measuring instrument with a material sample of known material thickness.

The material composition itself (and thus the speed of sound) often varies from one manufacturer to another. Calibration with a material sample of known thickness ensures that the instrument is adjusted as accurately as possible to the material to be measured.

11.3.3 Two-point calibration

This procedure assumes that the user has two known material thickness points of the test material and that these are representative for the measuring range.

1. The zero setting is made
2. Coupling agent is applied to the material sample.
3. The US measuring probe is placed on it (at the first or second calibration point) and the correct position of the US measuring head on the material sample is checked. The display should now show a measured value and the coupling symbol should appear.
4. As soon as a stable measured value is reached, the sound generator is lifted off. If the reading differs from that when the transducer was coupled, step 3 must be repeated.
5. The key CAL is pressed and the M/S (or IN/ µS) should start flashing.
6. The and SCAN keys ALRM can now be used to correct the required material thickness on the display until it matches that of the material pattern.
7. The key ZERO is pressed and the display shows 1OF2. The steps 3. to 6. are now repeated for the second calibration point.
8. The CAL key is pressed so that the M/S (or IN/ µS) starts to flash. The instrument now displays the sound velocity value that it has calculated based on the material thickness value entered in step 6).
9. Press the key CAL again to exit the calibration mode. You can now start measuring in the preprogrammed measuring range.

11.4 Measurements are made

The meter always stores the last measured value until a new value is added.
For the sound generator to function properly, there must be no air bridges between its contact surface and the surface of the material to be measured. This is achieved with the ultrasonic gel, the "coupling agent". This liquid "couples" or transmits the ultrasonic waves from the transducer into the material and back again. Before the measurement, a little coupling agent should therefore be applied to the material surface to be measured. Even a single drop is sufficient.
Then the US measuring probe is carefully pressed firmly onto the material surface. The coupling symbol and a number appear in the display. If the instrument is "cleanly adjusted" and the correct sound velocity
has been determined, the number in the display shows the current material thickness, measured directly under the sound generator.
If the coupling indicator does not appear or the number on the display is questionable, first check that there is sufficient coupling agent at the point under the US probe and that it has been placed flat on the material. Sometimes it is necessary to try a different transducer for the material in question (diameter or frequency).
While the US measuring probe is in contact with the material to be measured, four measurements are taken per second. When it is lifted from the surface, the display shows the last measurement.

Note: Sometimes a thin film of the coupling agent is drawn between the US probe and the material surface when the probe is
is lifted off. In this case it is possible that a measurement is made through this film, which then turns out to be larger or smaller than it should be. This is obvious because if one measurement is taken while the US probe is still in place and the other when it has just been lifted off. In addition, when materials with thick paint or coating are used, they are measured instead rather than the intended material. Ultimately, the responsibility for the clean use of the gauge in connection with detecting these phenomena is withheld from the user.

11.4.1 Changing the individual sound velocities

Annex A lists the individual sound velocities used for the measurement of different materials.

If the speed of sound is to be changed, proceed as follows:

1. The CAL button is pressed twice until the M/S symbol starts to flash.
2. Then press the SCAN or ALARM button to change the speed of sound.
3. Now press the Cal- button to save the changes.

11.5 The ultrasound image mode (scan mode)

While the TN-US instrument excels in single point measurements, it is sometimes desirable to examine a larger area to search for the thinnest point. This instrument has a scan mode feature that allows you to do just that.

In normal operation, four measurements are taken per second, which is very appropriate for single measurements. In scan mode this is ten measurements per second and the readings are shown on the display. While the transducer is in contact with the material to be measured, the instrument automatically searches for the smallest reading. The transducer can be "scrubbed" over the surface, because short interruptions of the signal are ignored. In the case of interruptions lasting longer than two seconds, the smallest measured value found is displayed. If the transducer is lifted, the smallest measured value found is also displayed.

When the scan mode is switched off, the single point measuring mode is automatically switched on.

The scan mode can be switched off as follows:

The key [SCAN] is pressed to switch it on or off. The current state of the scan mode appears on the screen.

11.6 Change the resolution

The device TN xxx-0.01US has two selectable screen resolutions, 0.1mm and 0.01mm.

This option is not available for TN xxx-0.1US series devices. It is limited here to 0.1mm. If the key is pressed [IN/MM] after switching on, the resolution can be selected between "high" (high) and "low" (low).

11.7 Changing the units

Starting from the measuring mode, the unit can be changed by pressing [IN/MM] the key and selecting between mm (metric) and inch (English).

11.8 Storage management

11.8.1 Saving a meter reading

The measured values can be stored in the device with 20 files (F00-F19). For each file there are at least 100 registers (material thickness values) that can be stored. If the key [SAVE] is pressed after a new reading is displayed, the measured material thickness is stored in the current, running file. If you want to change the file in which the measured values are stored, proceed as follows:

1. Press the key to activate the data collection function and to read the current file name and the total number of all data records in the file.
2. Use the and keys to set the desired file as the current one.
3. This program can be exited at any time with the key.

11.8.2 Delete the contents of a specific file

It is also possible to completely delete the contents of a file, which allows the user to create a new list of measurements in memory location L00. The procedure is as follows:

1. Press the key to activate the data collection function and to read the current file name and the total number of all data records in the file.
2. With the and key you can scroll back and forth in the file until the corresponding file is found.
3. At the desired file, press the button and the contents will be deleted automatically. The display shows the "-DEL" symbol.
4. This program can be exited at any time with the key and the measuring mode can be returned to.

11.8.3 Entering/deleting stored data records

This function allows the user to enter or delete a data record in a desired, previously saved file.

The following steps have to be taken:

1. Press the key to activate the data collection function and to read the current file name and the total number of all data records in the file.
2. Use the and keys to highlight the desired file.
3. Press the key to open the desired file and the display shows the current data set (e.g. L012) and its contents.
4. Use the and keys to select the desired data record.
5. Press the key at the desired position. It is now automatically deleted and the display shows "-DEL".
6. This program can be exited at any time with the key and the measuring mode can be returned to.

11.9 "Beep" mode

If the "Beep" mode is activated under **((**On**))**, a short "honk" can be heard each time the key is pressed, each time a measurement is taken and if the measured value exceeds the tolerance limit.

This option can be switched on and off with the key and the symbol is visible on the display.

11.10 EL Backlight

This allows it to be used in a dark environment. The button is used to activate and deactivate the background light as soon as the meter is turned on.

As the EL light consumes a lot of electricity, it should only be switched on when needed.

11.11 Battery information

Two AA alkaline batteries are required as energy source. After several hours of use, the display will show the symbol ▭. The larger the black portion in the symbol, the fuller the battery is. When the battery capacity is exhausted, the following symbol appears ▭ and starts flashing. The batteries should now be replaced.
When changing the polarity must be observed.
If the device is not used for a longer period of time, the batteries should be removed.

11.12 Automatic switch-off

The device has an automatic switch-off function to save the batteries. If no button is pressed for more than 5 seconds, the unit switches off automatically.
It also switches off when there is insufficient battery voltage and the battery is almost exhausted.

11.13 Basic setting of the system (Reset)

The key ZERO is pressed during power-up to restore the factory settings. All memory data is also deleted. This procedure can be helpful if the parameter in the meter has become unusable.

11.14 Connection to PC

At the end of the measuring activity or at the end of the day, it may be desirable to transfer the data to a PC using one of the two software programs. The PC transfer is **only** possible **with the models TN xxx-0.01 US** and not with the model TN xxx-0.1US. The device TN xxx-0.01US is equipped with the standard adapter connection RS-232. With the optionally available cable the connection to the PC or external storage devices is possible. The measurement data stored in the instrument memory can be transferred via this cable through the RS-232 access.

12. Maintenance

If you experience any unusual problems with your US thickness gauge, please do not repair, replace or disassemble it at your own risk. Please contact SAUTER GmbH immediately and send the device to us. We will then carry out the maintenance as quickly as possible.

13. Transport and storage

1. The measuring instrument must not be exposed to vibrations, strong magnetic fields, decomposing media or dust and must not be subjected to rough handling.

It should be kept at normal temperature.

14. Sound velocities

Material	Sound velocity	
	In/us	m/s
Aluminum	0.250	6340-6400
Conventional. Steel	0.233	5920
Stainless steel	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
Sheet metal	0.117	2960
Epoxy	0.109	2760
Resin	0.100	2540
Ice	0.157	3988
Nickel	0.222	5639
Plexiglas	0.106	2692
Styrofoam	0.092	2337
Porcelain	0.230	5842
PVC	0.094	2388
Quartz glass	0.222	5639
Rubber	0.091	2311
Teflon	0.056	1422
Water	0.058	1473

15. Comments on application

15.1 The measurement of tubes and hose material

If a piece of pipe is measured to determine the thickness of the pipe wall, the positioning of the transducer is important. If the diameter of the pipe is greater than 4 inches, the position of the transducer on the pipe should be such that the incision on the contact surface is perpendicular to the long axis of the pipe.
For smaller pipe diameters, two measurements should be taken at the same location, one with the incision on the contact surface perpendicular to the long axis and the other parallel to it. The smaller of these two measurements is then taken as the exact measurement of this point.

Perpendicular Parallel

15.2 Measuring hot surfaces

The velocity of sound through a particular material depends on its temperature. With increasing temperature, the speed of sound decreases. For most applications with a surface temperature of less than 100°C no further precautions need to be taken. At temperatures above this, the change in the speed of sound through the material to be measured begins to have a noticeable effect on the ultrasonic measurement.
At such high temperatures, it is recommended to first calibrate with a material sample of known material thickness, which corresponds exactly or approximately to the temperature of the material to be measured. This allows the instrument to calculate the exact sound velocity through the hot material.
For measurements on hot surfaces it may also be necessary to use a "high temperature sound generator". These are specially designed for use at high temperatures, especially since contact with the material surface should be maintained for a short period of time for stable measurement.
While the sound generator is in direct contact with the hot surface, it heats up. Thermal expansion and other effects can have a negative impact on the measuring accuracy.

15.3 Measuring coated materials

Coated materials are special because their density (and therefore the speed of sound) can vary considerably from one piece to another.
Even through a single surface, noticeable differences in the speed of sound can be detected. The only way to obtain an accurate measurement result is to first perform a calibration on a material sample of known thickness. Ideally, this should be from the same piece as the material to be measured, at least from the same production series. With the help of the "pre-calibration" the deviations are reduced to a minimum.
An additional important factor when measuring coated materials is that any trapped air gap causes premature reflection of the ultrasonic beam. This is noticeable in a sudden decrease of the material thickness. While on the one hand this prevents the exact

measurement of the total material thickness, on the other hand the user is positively alerted to air gaps in the coating.

15.4 Material suitability

Ultrasonic material thickness measurements are based on the fact that a sound is sent through the material to be measured. Not all materials are suitable for this. Ultrasonic measurement can be applied practically to a wide range of materials including metals, plastics and glass. Difficult materials include some cast materials, concrete, wood, fiberglass and some rubber.

15.5 Coupling means

All ultrasonic applications require a medium to transmit the sound from the transducer to the test material. Typically this is a very viscous substance.
The ultrasound cannot be efficiently transmitted through air.
A variety of coupling means is used. For most applications propylene glycol should be used. Glycerine is recommended for difficult applications, as maximum sound transmission strength is required. However, glycerine can cause corrosion due to water absorption in some metals.
Other coupling agents for measurements at normal temperatures may include water, various oils or greases, gels and silicone fluids. High temperature measurements require special high temperature coupling agents.
A characteristic of ultrasonic measurement is that the instrument uses the second rather than the first echo from the rear surface of the material to be measured when in standard pulse-echo mode. This results in a reading that is **twice** as large as it should be.

The responsibility for the appropriate use of the measuring instrument and the detection of these phenomena lies exclusively with the user himself.

Note:
To view the CE declaration, please click on the following link:
https://www.kern-sohn.com/shop/de/DOWNLOADS/