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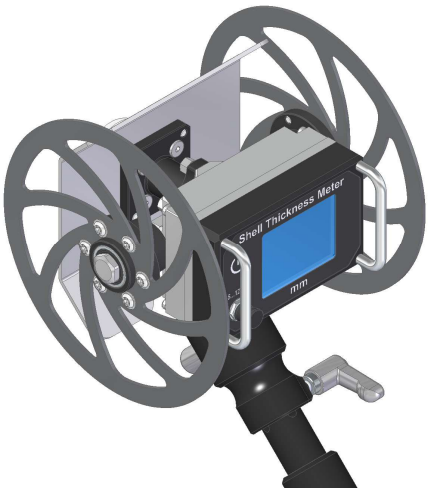
User Manual (Draft Version)
Version January 20, 2026

Shell Thickness Meter

Portable device with data streaming via Bluetooth to a Windows PC



1 INTRODUCTION

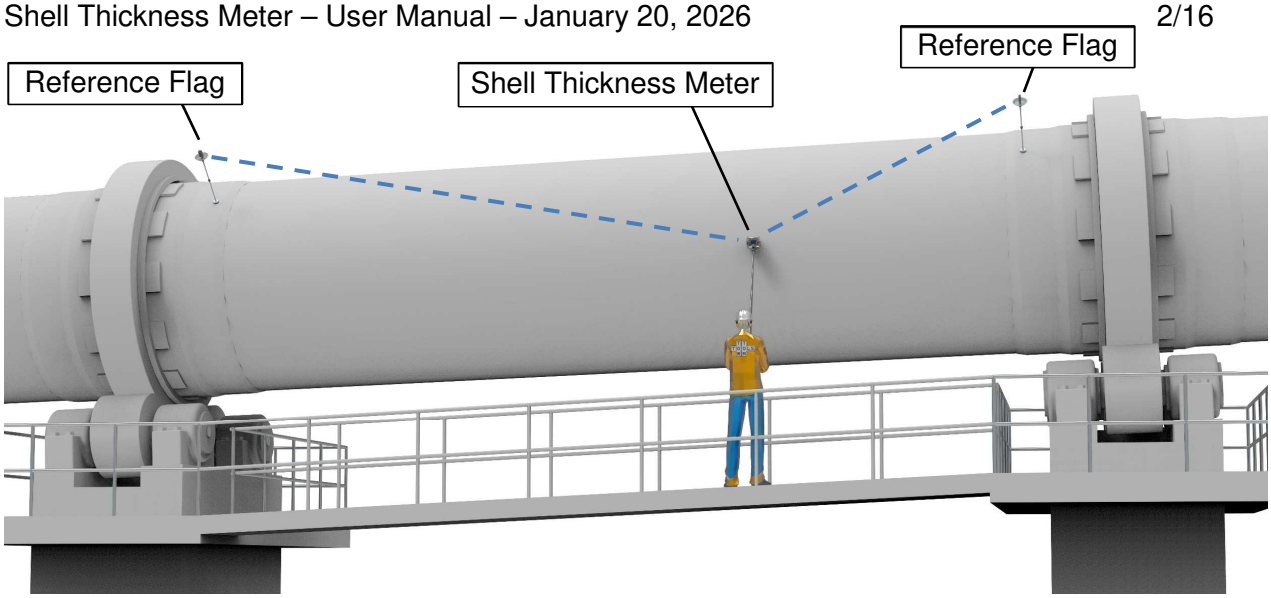
The Shell Thickness Meter is a portable device to measure the thickness of the steel shell on rotary kilns or dryers during normal operation. In modern kilns is the usage of alternative fuels and raw materials a common practice. The high chlorine and sulfur content of these materials often penetrate the refractory bricks, reach the inner surface of the kiln shell and lead to fast progressing corrosion. When the shell thickness gets reduced, the stresses will increase, which leads to dangerous fatigue cracks. Therefore, it is important to detect possible corrosion at an early state to take counter measures. The most effective and economical way to protect the shell is by adding a thin (0.6…08mm) sacrificial stainless-steel sheet between the kiln shell and the refractory bricks. To find out, if the remaining shell thickness is still sufficient to hold the weight of the kiln, use the TomTom-Tools Kiln Calculator.

Measuring Principle

The Shell Thickness Meter is held with a telescopic pole to the kiln shell and rolling with two wheels on it. To measure the shell thickness, it uses the electromagnetic acoustic transducer (EMAT) technology. The sensor head does not need to touch the kiln shell and there is no couplant gel required as it is the case for traditional (UT) ultrasonic sensors. EMAT works by using magnetic fields and electrical currents to generate ultrasonic sound waves directly within the material, which then travel through it. At the inner surface of the kiln shell, the sound waves get reflected and travel back to the outer surface. The process is reciprocal, as the returning sound waves induce currents in the coil, allowing the EMAT to also receive the signals. By measuring the time delay between sending a sound pulse and receiving its echo, the material thickness is calculated.
The measured thickness values are displayed on the screen on the Shell Thickness Meter and also transferred via Bluetooth to a PC for further processing and visualization.

Position Tracking

For efficient data collection and correct allocation of the measured points, the Shell Thickness Meter is equipped with a position tracking system, based on ultra-wide band (UWB). Two UWB Reference Flags are included in the tool kit and can get attached to the kiln shell during the measurement to provide the information for the position tracking.



2 FEATURES:

The Shell Thickness Meter comes as a tool kit to measure the shell thickness of rotary kilns and dryers during normal operation (thickness range 5...130mm, precision +/-1mm, Measurement rate 10Hz). It is made to be used at elevated temperature. Depending the exposure time, it is possible to measure rotary kilns with temperature up to 400°C.
In combination with the Windows software, the Measurement Studio, it allows to establish a 3D shell thickness model of the whole kiln within only a few minutes.
The tool kit contains the following components:
Shell Thickness Meter, based on EMAT (electromagnetic acoustic transducer) technology. It is equipped with wheels to run on the kiln shell, it is battery powered and has a graphic display, a Bluetooth interface and an UWB (ultra-wide band) module for position tracking
2 pieces of Reference Flags with UWB module for position tracking, including heat resistant magnets, heat shields and extension rods, to be attached to the rotating kiln.
Transport Case Peli 1507 (43x36x24cm) with foam cushioning, including Bluetooth adapter, battery charger (with country adapters), USB cable to Power Jack (Barrel 5.5x2.5) and user manual
Telescopic Pole made of high strength carbon fiber tubes.
, including protective tube casing

3 SAFETY

Rotary kilns and dryers, where this system typically is used, are huge rotating equipment with many pinch points and hot surfaces which can cause serious injuries. Therefore, only specialized and trained personnel shall work close to these machines. For installation, follow strictly the local safety rules given by the respective plant / factory / local authorities and discuss the application with the safety engineer in charge.
The tools provided by TomTom-Tools Ltd. have proven their functionality in various applications; nevertheless TomTom-Tools Ltd. does not take any responsibility for the application on site regarding safety or machine damage. The plant is responsible for the safety, according to the local law, in a way that nobody can be hurt or injured. The application and safety instructions below are guidelines and not exhausted which include the experience from previous applications. They might need to be adapted to the local circumstances and safety requirements.

Caution:

Magnetic Fields and Forces:
Be aware of the strong magnet field on the magnet surface.
Keep the tool away from people with pace makers or any other sensitive item as credit cards or magnetic data carrier.
Do not put fingers between the magnets and magnetic surface. There is the risk for clamping or pinching, due to the strong magnetic force.

Falling:
The tool might fall off the attached surface, if it is not properly attached.
Dust, dirt, corrosion, roughness or high surface temperature (>330°C) increase the risk.
Do not stand in the area and keep it clear, where the tool might fall down

Helmet:
Wear a proper helmet while using the measurement tool.

Hot Surface:
After the measurement, the magnets of the Reference Flags might be very hot. Hold them on the extension rod but not on the magnet.
The EMAT probe of the Shell Thickness Meter might also get hot. Do not touch it. Let the tools cool down before stowage. Otherwise, the transport case may get damaged.

Gloves:
Wear proper gloves, which prevent burning the hands.
Especially for attaching, removing, handling and cleaning the tool, when it is hot.

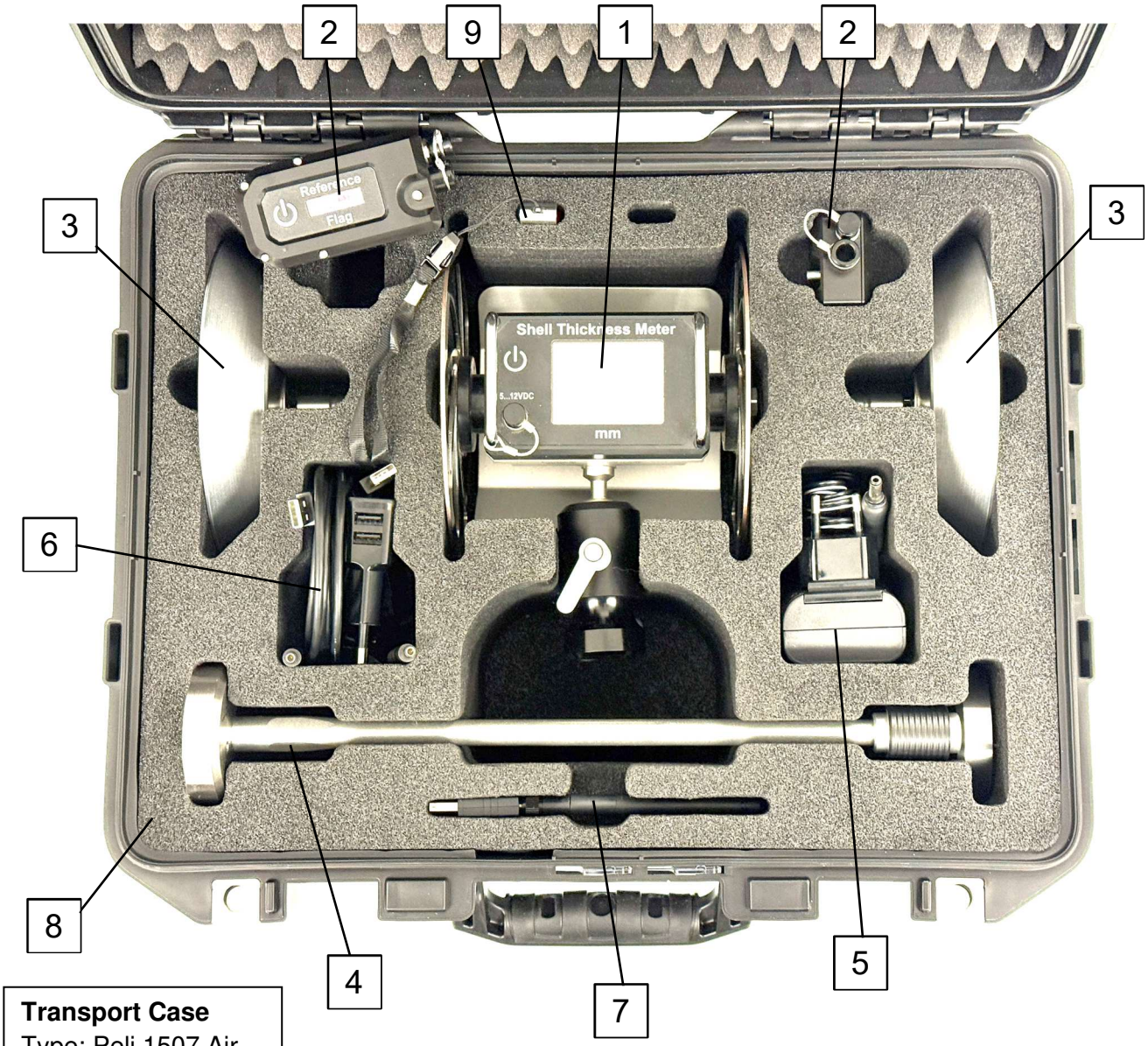
Radio Waves:
Be aware of the radio waves (Bluetooth and UWB) which are emitted from the tool as well from the Bluetooth adapter on the computer.
Do not keep the tool unnecessary in operation; switch it off, after usage.

TABLE OF CONTENT

4 Tool Kit includes:

1. Shell Thickness Meter
2. 2 Reference Flags with UWB transmitter for position tracking
3. 2 Heat shields for Reference Flags
4. 2 magnetic poles with 2 extensions for Reference Flags
5. Battery charger with country adapter (100…240VAC)
6. 2 Adapter cables USB to Power Jack (Barrel 5.5x2.5) 1m
7. Long-Range Bluetooth USB adapter (ZEXMTE)
8. Transport case Peli 1507 Air (black) with foam padding
9. Software (TomTom-Tools Measurement Studio) and manual on USB flash drive

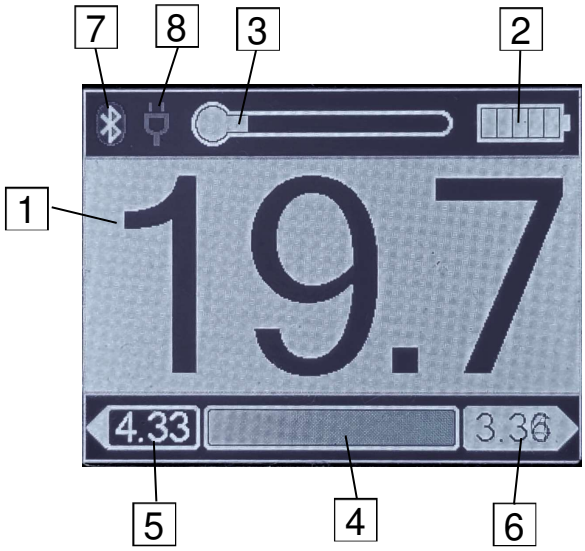
Telescopic pole, retracted 1.2m, expanded 4.62m, including protective tube case



Transport Case
Type: Peli 1507 Air
43x36x24cm
Weight total: 6 kg

5 SHELL THICKNESS METER

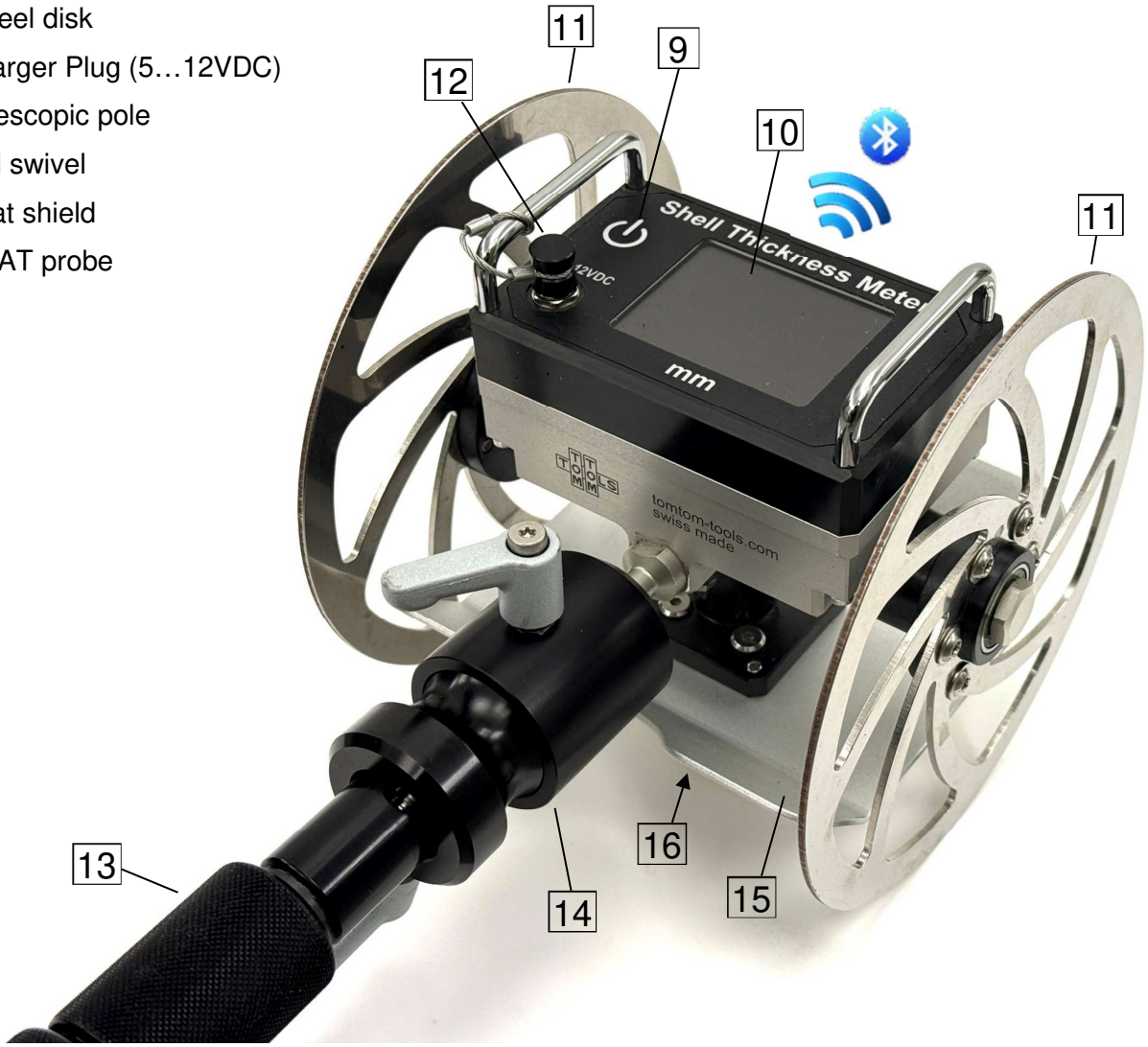
5.1 Display:



1. Measured shell thickness [mm]
2. Battery status
3. Temperature indicator
4. Signal strength indicator
5. Distance to Reference Flag “black” [m]
6. Distance to Reference Flag “white” [m]
7. Bluetooth connection indicator
8. Charger indicator

5.2 Main Components

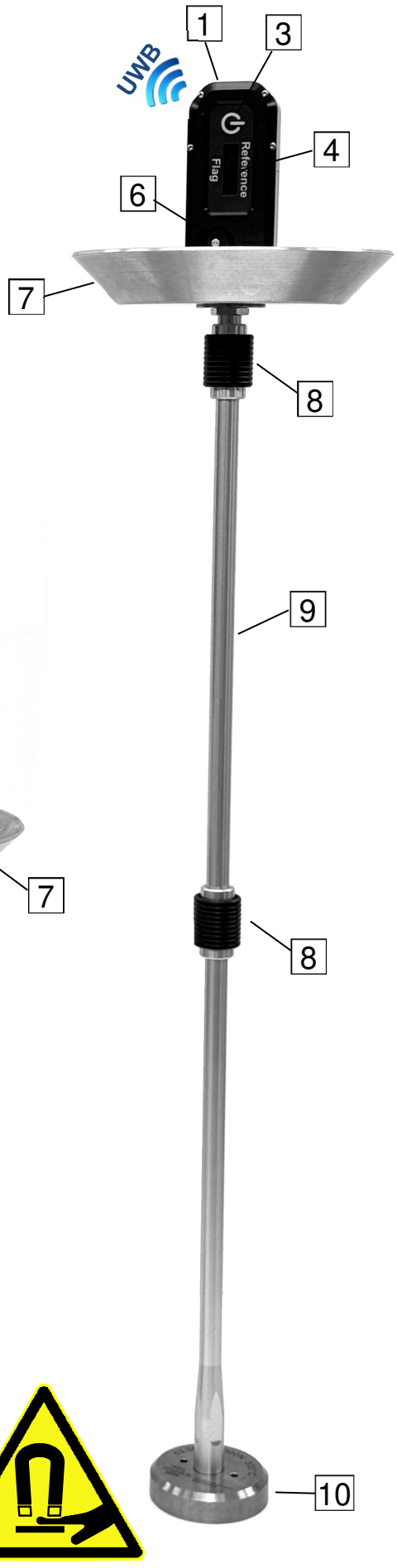
9. ON/OFF Button
10. Graphic display
11. Wheel disk
12. Charger Plug (5…12VDC)
13. Telescopic pole
14. Ball swivel
15. Heat shield
16. EMAT probe



6 REFERENCE FLAGS

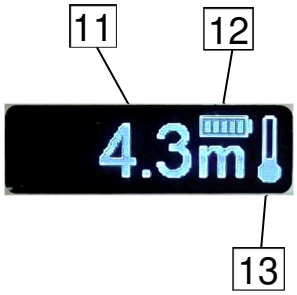
6.1 Main Components:

1. Reference Flag “black”
2. Reference Flag “white”
3. ON/OFF button
4. OLED display
5. Charger Plug (5…12VDC)
6. Lock button
7. Heat shield
8. Quick connector
9. Extension rod (optional)
10. Heat resistant high strength magnet



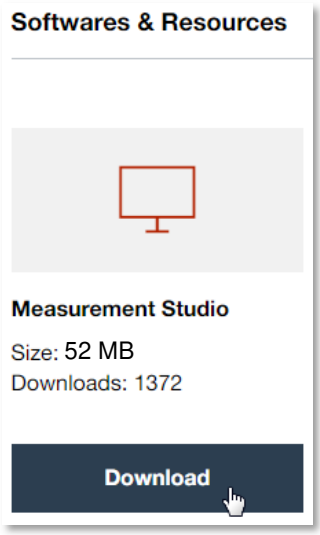
6.2 Display

11. Position value (preset) [m]
12. Battery status
13. Temperature indicator



7 Software:

7.1 Software Installation:



The software (**TomTom-Tools Measurement Studio**), which is used for the Shell Thickness Meter and for all others of our portable tools, comes along with the tool kit on an USB memory stick.
Nevertheless, it is recommended to **install the software from** www.tomtom-tools.com , where always the latest version is available.
During any start of the Measurement Studio, it is checking for updates if the computer is connected to the internet. In case of available upgrades, the user gets asked if they should be downloaded and installed.
Please keep your PC up to date.

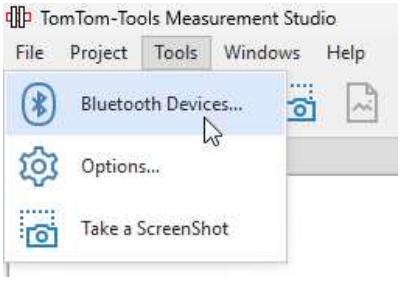
8 Start the Tool:

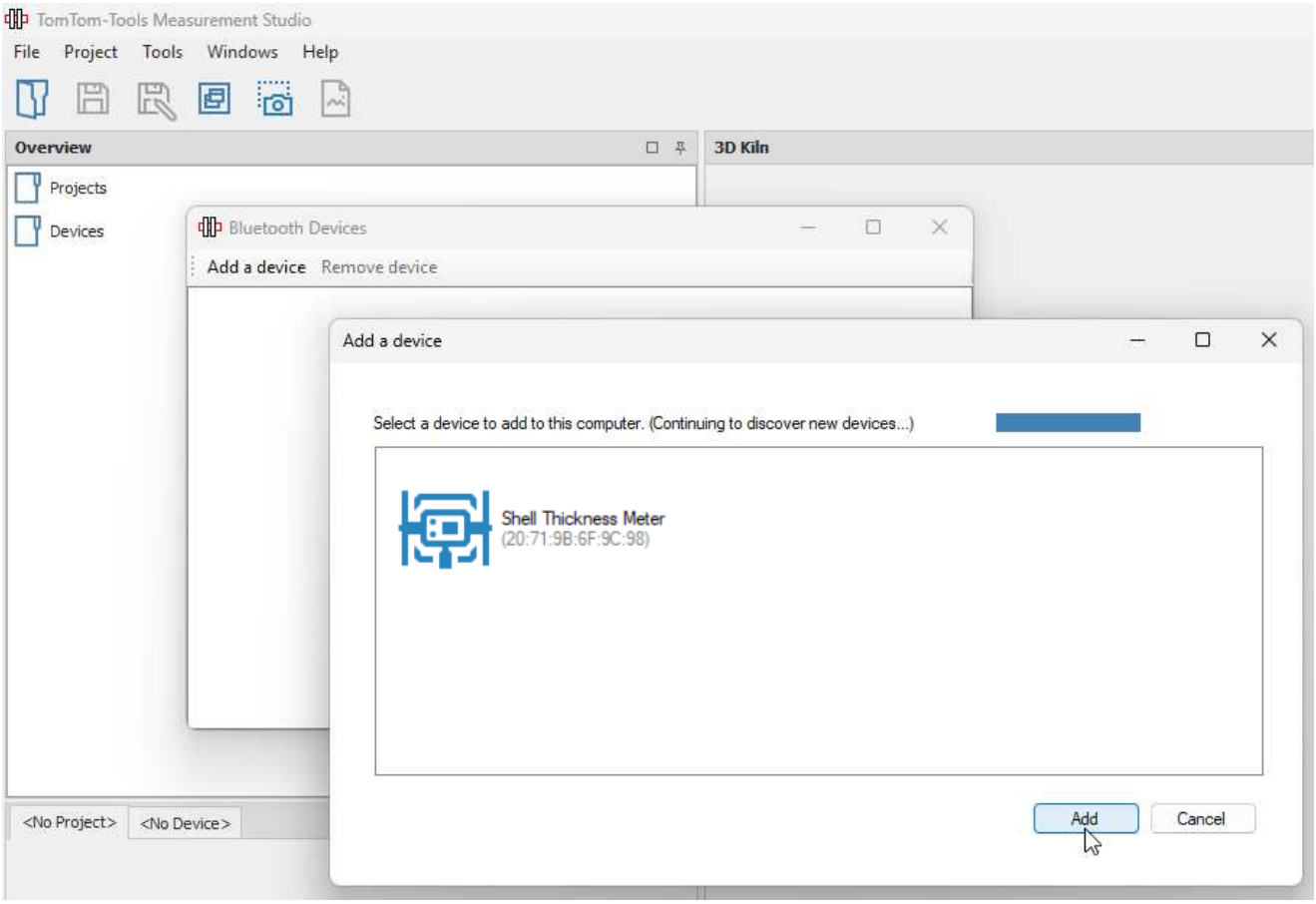
8.1 Connect Shell Thickness Meters with Laptop

To connect a tool for the first time it has to be paired with the computer.
To do so, follow this sequence:

- Start the Measurement Studio
- Make sure a Bluetooth connection is activated on the PC
- Start the Shell Thickness Meter by pushing the on/off button
- On the PC, click on “Tools / Bluetooth Devices / Add a device”
- Wait until the tool got found
  Note: Depending on the search speed of the computer,
  it might take up to 30 seconds
- Select the device, which has to be connected; (here the Shell Thickness Meter) and click “OK”
- Switch on the second Thrust Load Meter and connect it the same way

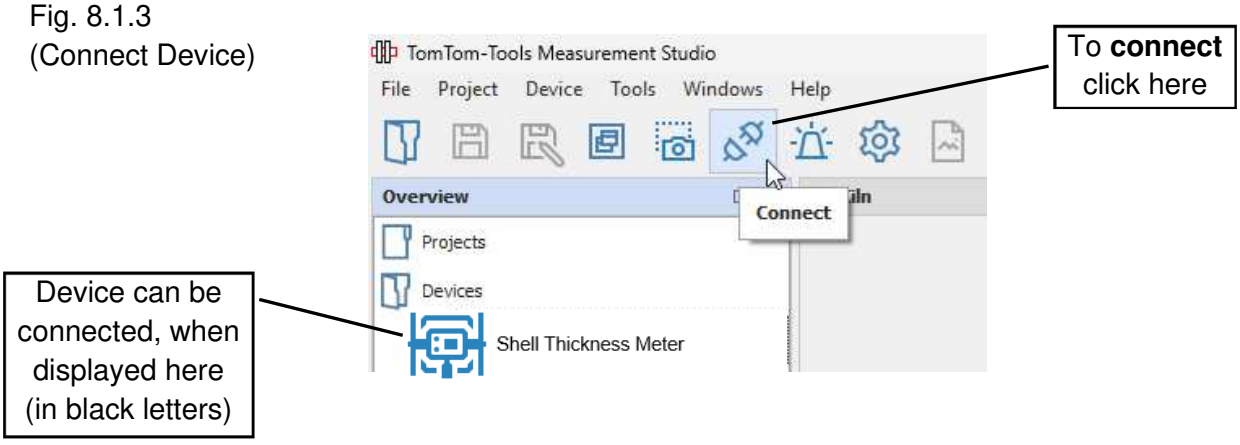
Fig. 8.1.1 (Add Device)





The Shell Thickness Meter gets added to the Device List
To connect it, click on the “Connect” Button

Fig. 8.1.3
(Connect Device)



8.2 Bluetooth Adapter (optional)

To use the Shell Thickness Meter, the inbuilt Bluetooth of a normal Laptop PC is usually strong enough to establish a reliable connection, because only short distances are required. If the PC in use is not equipped with a Bluetooth connection, the Long-Range Bluetooth adapter (ZEXMTE), which comes along with the tool kit, can be used.

Note:

- To force the PC to connect via the Long-Range Bluetooth Adapter, the integrated Bluetooth needs to be disabled in the Device Manager as shown below.
  The Bluetooth Adapter communicates **only with the generic Windows Bluetooth Stack**. If there is another Bluetooth software installed (e.g. Intel, Toshiba, Widcomm, ThinkPad,…), **deactivate it.**

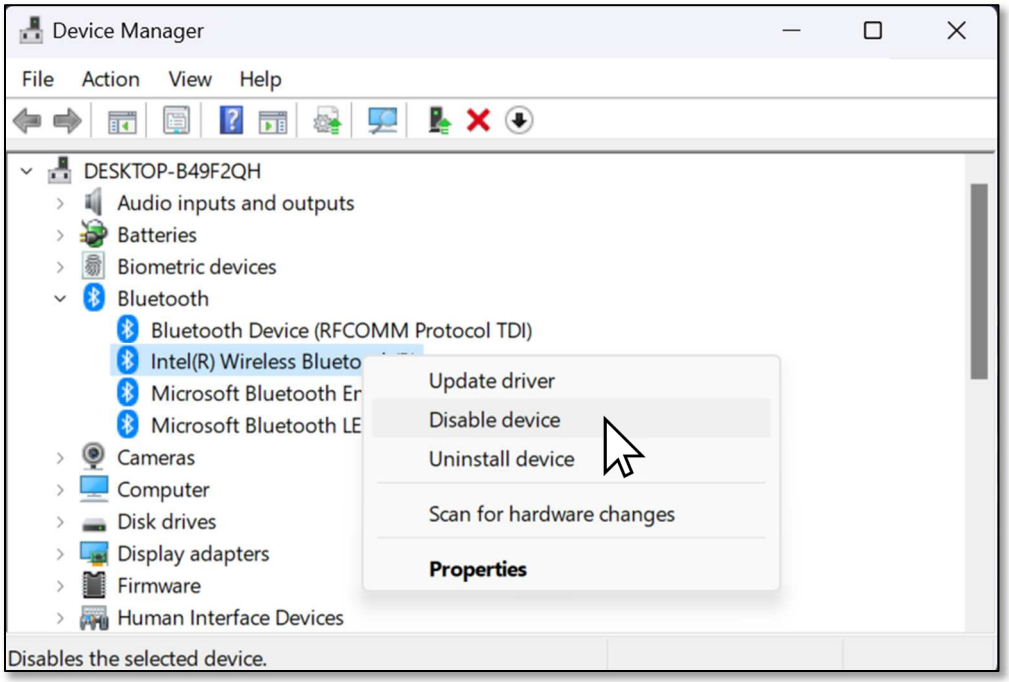
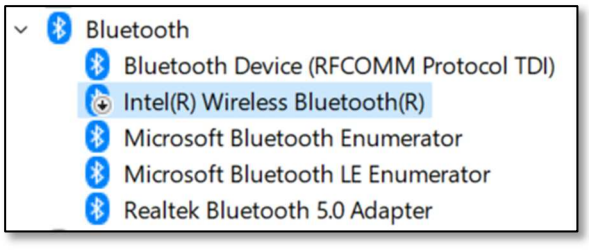


Fig.8.2.1
Device Manager

- Then plug the Bluetooth adapter ZEXMTE or Sena UD100.
  Windows will recognize the new hardware
  and automatically install the suitable Windows drivers

- The Device Manager will show the following:
  - Generic Bluetooth Radio
  - Microsoft Bluetooth Enumerator
  - the not required Bluetooth is down
    (indicated by the small arrow at the Bluetooth icon)

Fig.8.2.2 Device Manager
(USB Bluetooth correctly working)

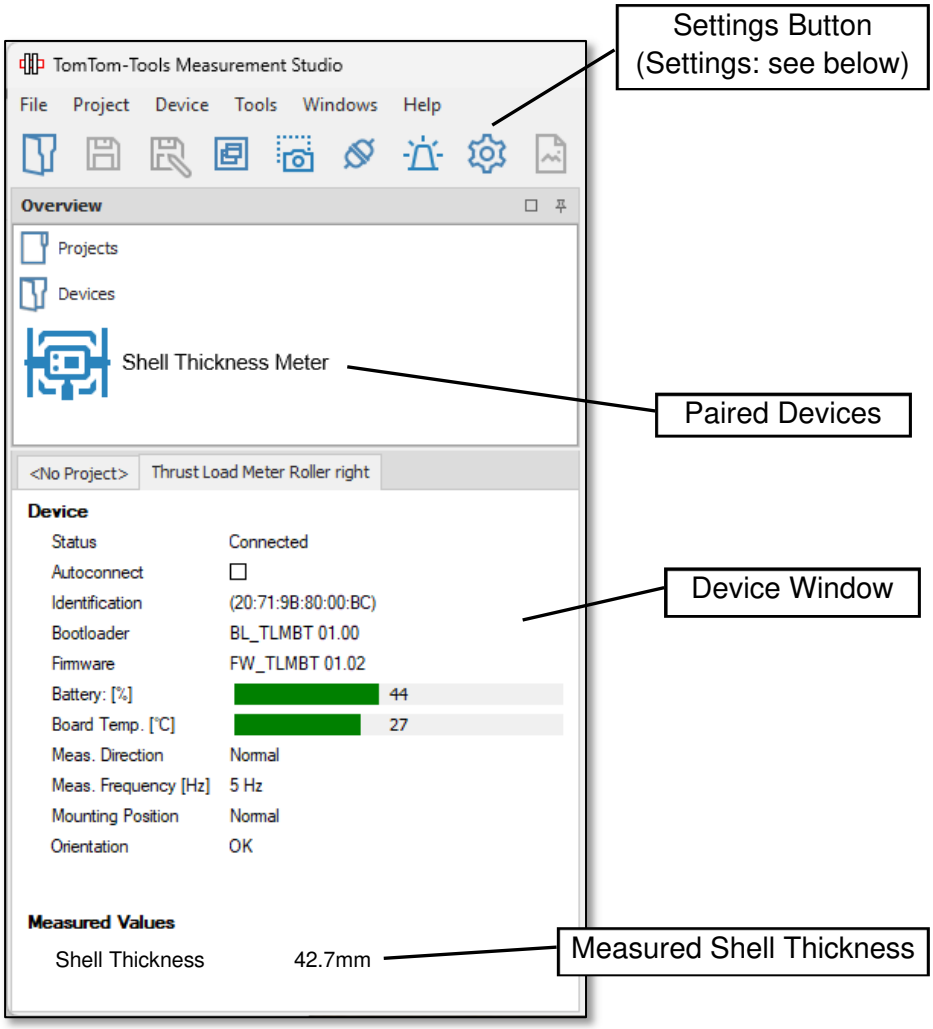


ZEXMTE Bluetooth Adapter Specifications:

- Bluetooth 5.1 and EDR Class 1 (dual mode)
- USB-A 3.0
- Frequency Range: 2.402 ~ 2.480GHz
- Antenna: RP-SMA

8.3 Device Window

Fig.9.3.1



8.4 Calibrate the Reference Flags

The Reference Flags communicate with the Shell Thickness Meter via UWB radio to measure the distance between them. It might be that the distance needs calibration. To check if the readings are right, hold the Reference Flag next to the Shell Thickness Meter, then it should show 0m. If not, push the calibration button in the device window on the PC screen.

9 Measurements

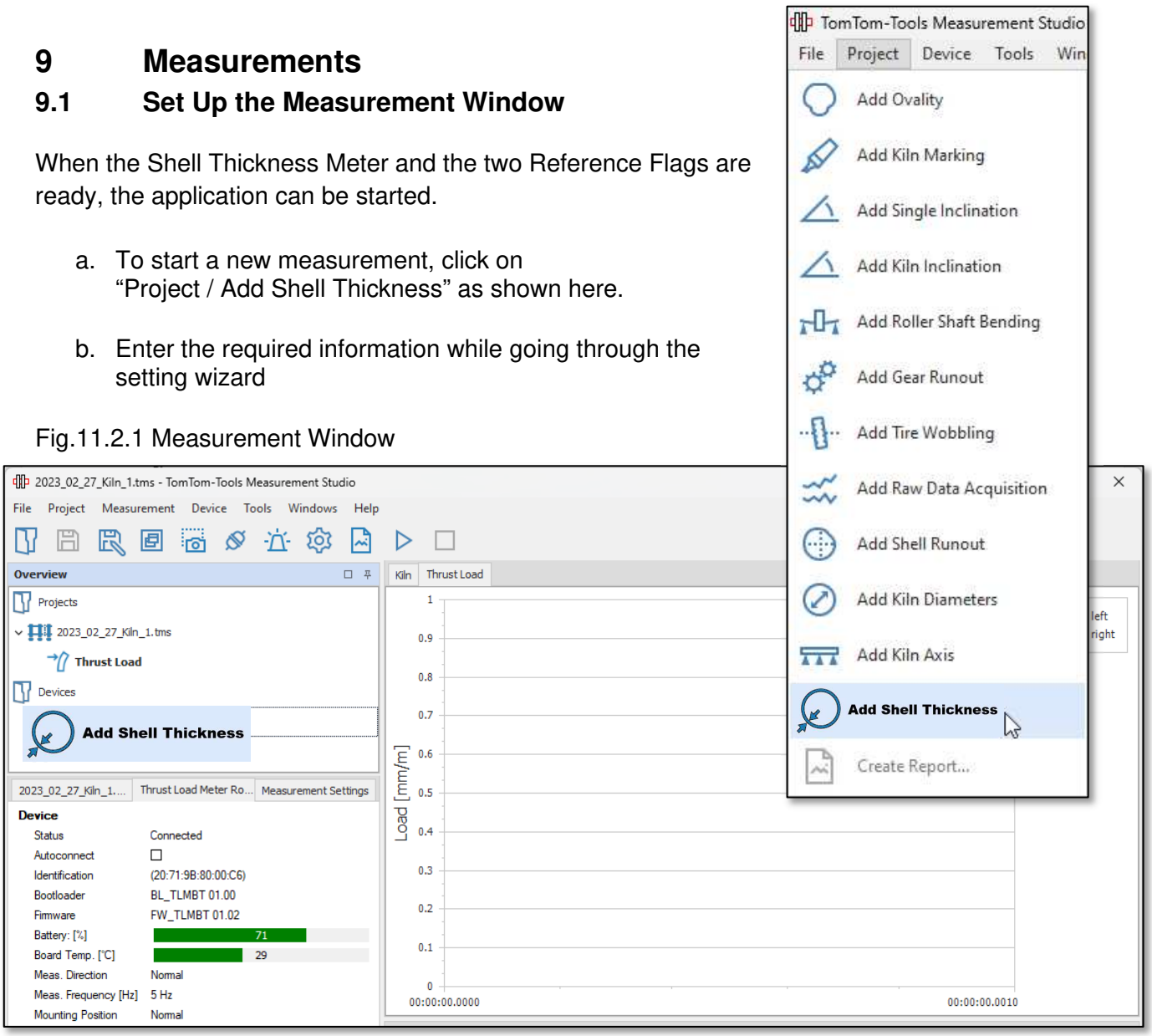
9.1 Set Up the Measurement Window

When the Shell Thickness Meter and the two Reference Flags are ready, the application can be started.

a. To start a new measurement, click on “Project / Add Shell Thickness” as shown here.

b. Enter the required information while going through the setting wizard

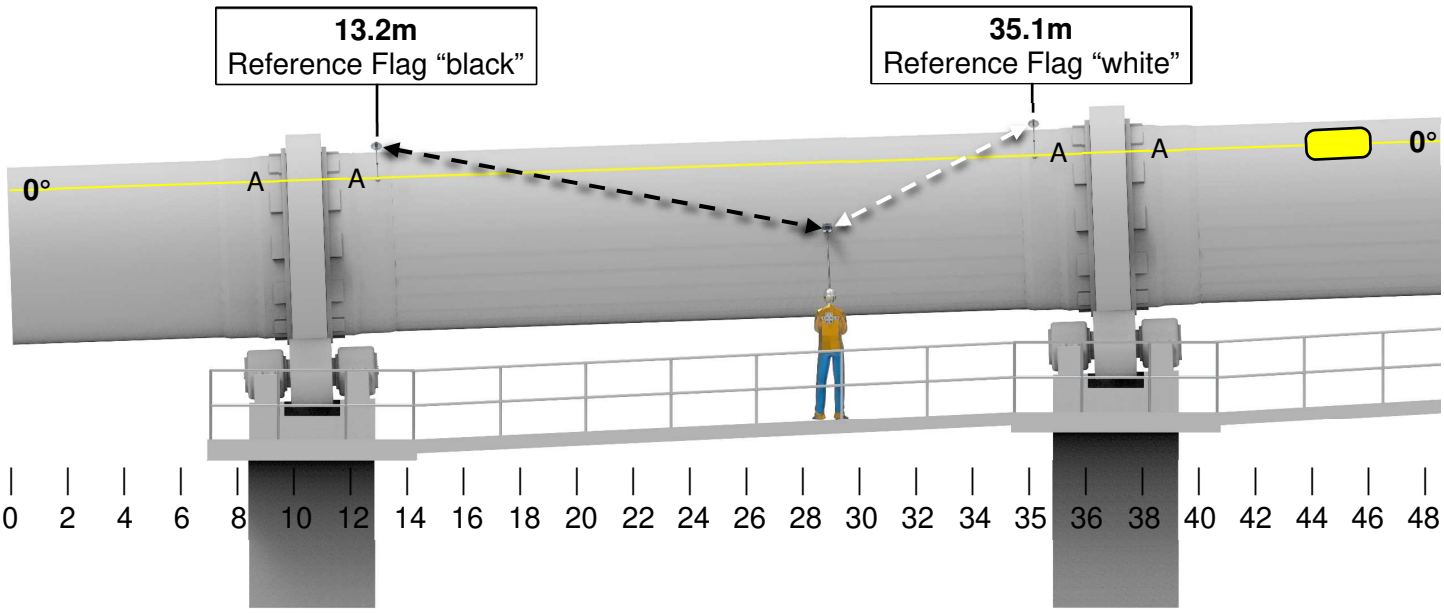
Fig.11.2.1 Measurement Window



9.2 Reference Flags Position

The Reference Flags are used to track the position of the Shell Thickness Meter. They are considered as temporary installed fixpoints, attached to the rotating kiln shell. The reference flags get typically located in the area of a kiln pier, where it is safe and easy to attach them to the kiln shell. Make sure that the way of the flags is free of any interference.
When the shell temperature is at the higher side, it is recommended to extend the magnetic base, to get more distance to the reference flags to avoid overheating. Attach the reference flags in line with the 0° position of rotation. 0° is the same as the A-position for Ovality measurements, it is usually in line with the manhole.

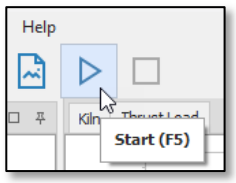
When the Reference Flags are placed to the kiln shell and circling around the kiln, the meter position of them needs to be entered to the Measurement Studio.



9.3 Position Tracking

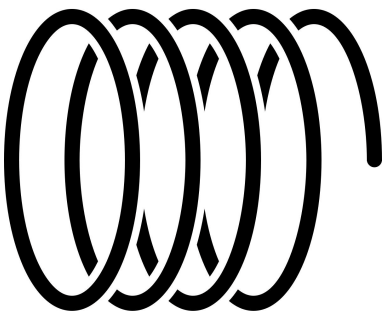
As soon as the Reference Flags are in range of the Shell Thickness Meter, the distance between them is measured and displayed in the screen. The Measurement Studio is able to calculate the meter position and the angular position of the Shell Thickness Meter by using the distances to the two Reference Flags. When the 0° line is passing the Shell Thickness Meter, the distances to the Reference Flags reach their minimum and with that the software knows that a new turn has started.

9.4 Start the Measurement

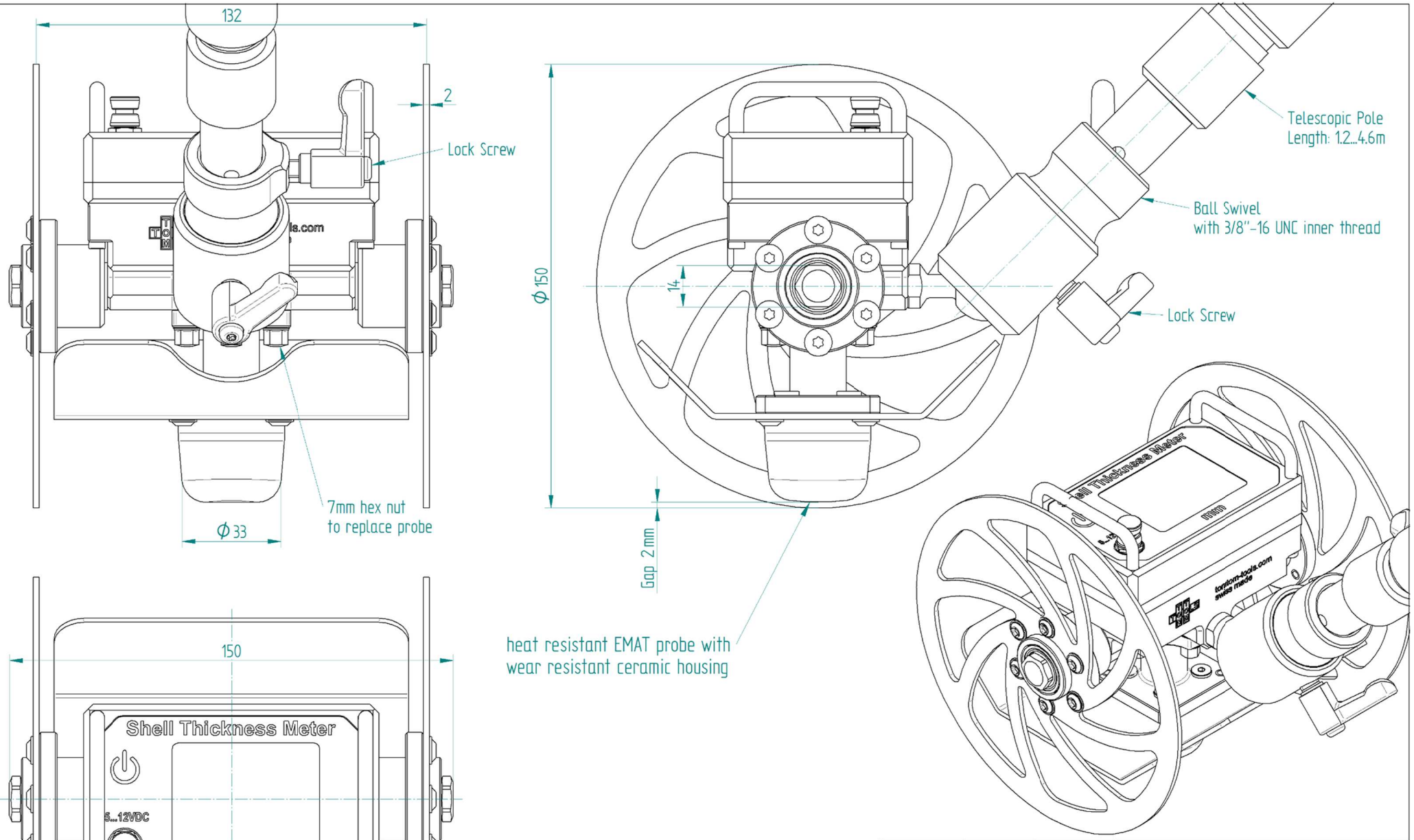


Click on the Start Button or F5 to start the measurement.
10 thickness and position values are recorded per second and displayed on the PC in a 3D model.

The thickness can be measured, for example, at each meter position for a full turn.
But the most efficient way is to walk along the kiln while measuring. The values will not be received as single slices, but as a helix along the kiln length. The measured resolution depends on how much the tool is moved per kiln turn.




Shell Thickness Meter
31.0
mm



	NAME	DATE
DRAWN	thoma	06/23/24

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www.tomtom-tools.com

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS ± 0.1 mm ANGLES ± 0.1°
TYPICAL EDGE CHAMFER 0.3x45°

Shell Thickness Meter

TITLE
measuring range 5...130mm

SIZE	DWG NO	REV
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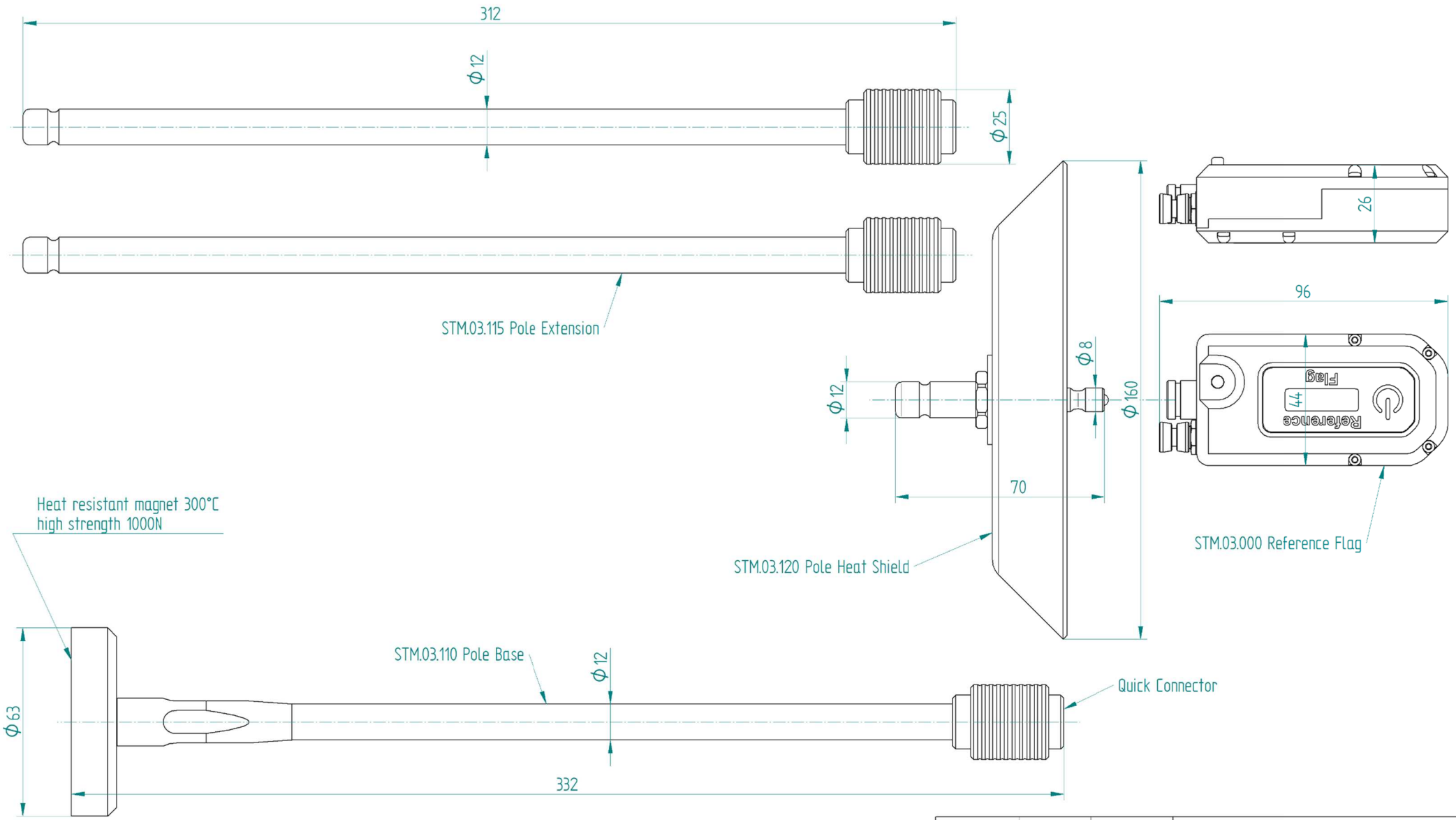

	NAME	DATE
DRAWN	thoma	01/20/26

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8905 Arni / Switzerland
www.tomtom-tools.com

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS ± 0.1 mm ANGLES ± 0.1°
TYPICAL EDGE CHAMFER 0.3x45°

Reference Flag (Set)

TITLE
for Shell Thickness Meter

SIZE	DWG NO	REV
A3	STM.03.000	

FILE NAME: STM.03.000 Reference Flag 2.dft

SCALE:	WEIGHT:	SHEET 1 OF 1