MFE INSPECTION SOLUTIONS

MFE PulsePro

Pulse Eddy Current Testing Instrument
Operating Manual

Edition instructions

(V5.0 June, 2024, edition)

Dear Customer:

You are welcome to use our products and equipment. We hope that our products can provide more convenience for your work and become a good assistant in your work.

Please read this user manual carefully and follow the instructions in the manual.

If you have any questions during use, please feel free to call. Our service hotline will always provide you with the best service.

When you receive the product, please carefully check the product against the shipping list. Products and accessories are subject to the shipping list.

If the contents of the instruction manual are subject to change, please refer to the latest version without prior notice. We apologize for any inconvenience caused.

Copyright Notice

- Please pay attention to the full power during use, when the power is low (<5%, it will flash to indicate power shortage), the excited energy will be low. It should be charged before starting up. Try to charge the battery when it is turned off. During charging, power interference and functional conflicts are introduced, the instrument automatically prohibits calibration and detection operations, and can only look back at historical data.
- Avoid running high-power strong electromagnetic interference sources (welding, motors, etc.) around, otherwise it may interfere with the instrument and cause unstable detection data, or even abnormal operation.
- The contact temperature of the bottom surface of the probe should be ≤100℃, and it is forbidden to directly contact the high temperature bare tube to prevent scalding.
- The calibration point can be selected anywhere on the inspected component, but try to select a good area with low corrosion probability and thin coating, such as the upper half of the pipe and the side of the elbow.
- The materials of the calibration point and the detection point must be the same, and the operating conditions such as operating temperature and coating thickness should also be as close as possible. If a major change occurs, user need to recalibrate. The elbow part and the straight pipe section generally need to be calibrated and tested separately due to different materials and processing techniques.
- Welding will cause the material parameters to change, so the detection result will change when the probe passes through the weld area.
- When using a distance encoder, user must press the probe slightly to make it fit well on the surface of the inspected member to ensure that the encoder wheel does not slip and lose steps.
- After use, remember to turn off the power of the main unit to avoid damage caused by over-discharge of the battery, do not store it for a long time. If it is not used for a long time, please charge and maintain it regularly (about once every 1.5 months, every charge for 5~6h).
- When transporting, remove the probe and other components and place it in the special shockproof box slot, and place the cable in suitable position.
- When not in use, please place it in the indoor/car interior, store the ambient temperature -20℃~+60℃, relative humidity ≤85%, ventilation, non-corrosive gases.

Contents

Product Overview: Introduction & Functional Features

1. Brief Introduction

The equipment can be used for in-service inspection of metal pipe wall thickness outside the cladding layer, it instead of traditional sinusoidal current incentives to pulse current, pulse magnetic field outside the conductor, the conductor in the pulsed eddy current sensor, by measuring the attenuation process of pulsed eddy current electromagnetic field, to assess the degree of corrosion of pipe wall thickness compared with the traditional NDT methods of corrosion, without removing pipe outsourcing cladding on the inspection equipment without stopping, can significantly improve the detection efficiency, and reduce the test cost.

2. Functional Features

- 2.1 There are shortcut keys and LCD screen on the probe, which can display the working status and detection data in real time, and the work efficiency is greatly improved without frequent operation of the host during the detection process.
- 2.2 Not sensitive to the shape of defects, it can detect the wall thickness corrosion or other thickness reduction defects of metal members "with cover layer (insulation layer, cooling layer, protective layer, etc.)".
- 2.3 Inspections can be done when the equipment is running (high temperature, low temperature, materials in the equipment etc.)
- 2.4 Materials that was detected: detection of remaining wall thicknesses ferromagnetic metal material such as carbon steel, low alloy steel.
- 2.5 It can also detect the remaining wall thicknesses of stainless steel, aluminum alloy and other non-ferromagnetic metal materials.
- 2.6 Tube plate shape: plate, straight pipe, elbow, tank.
- 2.7 Cladding materials: Non-conductive, non-magnetic materials (asbestos, foam etc.), metal mesh, iron, aluminum and other protective layer.
- 2.8 AC/DC hybrid power supply, built-in rechargeable lithium battery continually working ≥8h.
- 2.9 Fully sealed IP64 anti-dust and anti-splash design, silicone sheath anti-drop and anti-vibration design, more suitable for harsh working conditions.

3. Technical Parameters

3.1 The max thickness of cladding layer:

with stainless steel or aluminum protective layer ≤300mm, with iron protective layer ≤150mm

3.2 The thickness of metal protective layer:

≤1mm

3.3 The max detection of wall thickness:

2～100mm

3.4 Diameter of the pipe:

≥20mm

3.5 Repeated detection accuracy:

2%

3.6 Corrosion defect detection sensitivity:

5% (volume ratio)

3.7 Measuring speed:

15~0.5 time/s (reducing with the increasing measured wall thickness)

3.8 The length of probe cable:

5m, 30m (optional)

3.9 Built-in rechargeable Lithium battery:

continually working more than 8 hours.

3.10 Power adapter/charger:

single-phase AC100~240V/2A 50/60Hz, output DC28V/4.5A

3.11 Size and Weight:

Host: L346×W278×H136.5mm 7.05kg, Type P1/small probe: L106.5×W60.8×H52mm 0.5kg, Type P2/medium probe: L148.5×W73×H92mm 1kg, Type P3/large probe: L188.5×W95×H97.5mm 1.5kg.

3.12 Temperature of the material being tested:

-150～+600°C

3.13 Work environment:

temperature -10～+50°C, humidity ≤85%R.H

4. Working Principle and Structural Characteristics

Figure 4-1 overall structure

The system is mainly composed of host, cable, probe/sensor [small, medium, large size carbon steel, stainless steel probe], power adapter (charger), etc.

Instead of traditional sinusoidal current excitation with pulsed current excitation, a pulsed magnetic field is generated outside the conductor to induce a pulsed eddy current in the conductor, the degree of corrosion of the wall thickness is measured by detecting the attenuation process of the pulsed eddy current electromagnetic field.

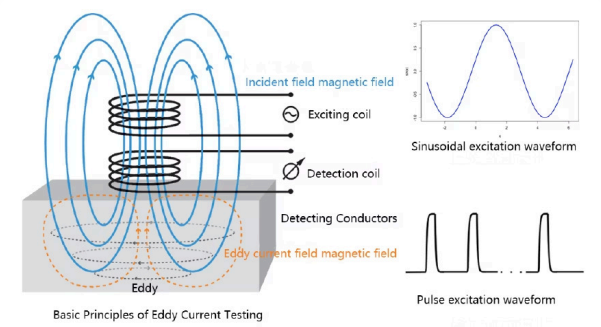
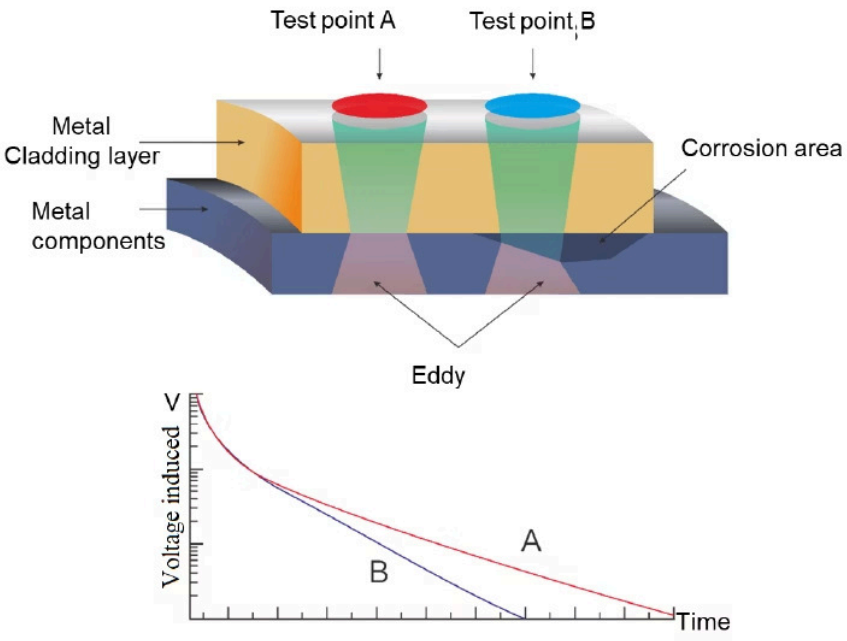


Figure 4-2 Basic principles of eddy current testing

The wall thickness of in-service metal components can be tested outside the cladding layer. When the wall thickness, corrosion or scale deposits of the component under test occur, it will cause changes in parameters such as wall thickness, electrical conductivity, and magnetic permeability, resulting the distribution of the induced pulsed eddy current field changes, and the time-domain induced voltage decay process reflected at both ends of the detection coil will also change: where the corrosion thins, the induced voltage decays faster. By comparing the process of signal attenuation at two detection points, changes in component size and electromagnetic parameters can be detected to assess the degree of corrosion.



(Positions A and B indicate that a probe is tested
at two places, not two channels / probes at the same time)
Figure 4-3 Pulse eddy current corrosion detection signal (schematic)

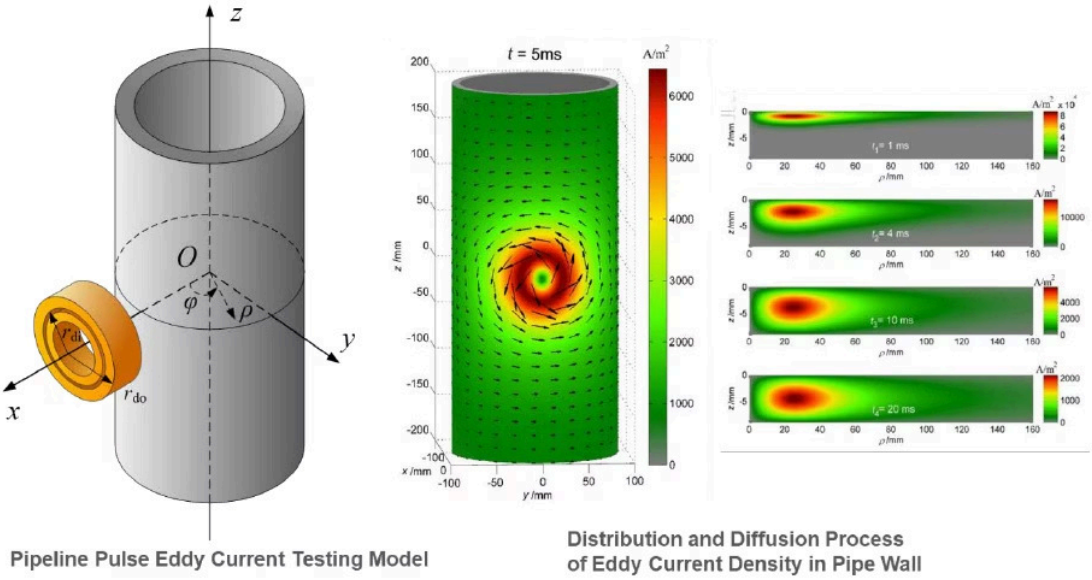


Figure 4-4 Diffusion process of pulse vortex in the tube wall (schematic diagram)

4.1 Probe/Sensor

Figure 4-5 Probe and accessories

- **1) Display screen and buttons:**

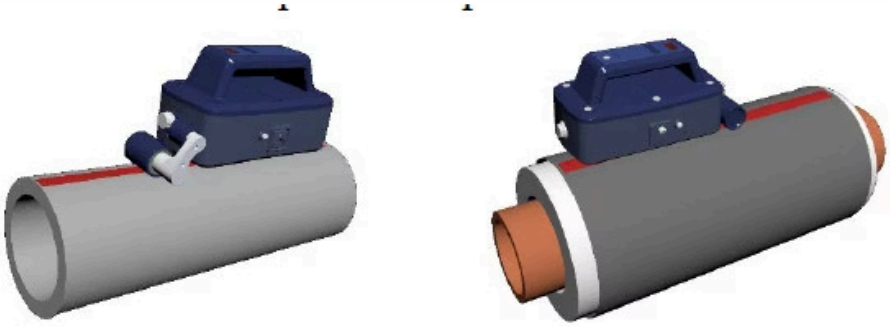
  After the probe is connected to the power supply, the display will show the encoder data, and the cumulative value of the distance meter will change when the encoder is rolled. When the left and right buttons are pressed, K1 or K2 will be displayed. During the inspection, information such as "Run ···" running status, relative percentage of wall thickness, etc. will be displayed to facilitate quick and easy operation by personnel.

- **2) Distance encoder:**

  the encoder is installed in front of the probe / longitudinal axis. There are electronic devices inside the encoder, which must be replaced when the probe is powered off. Align the metal contact of encoder with the metal contact of probe slot and tighten the set screw.

  Attention:

  - (1) An encoder must be installed when the scanning detection method is Position Scan, Position Step, or Position Point, and no position encoder is required when "Point test" and "Time scan". The vacant screw holes should be fitted with "dust-proof screws".
  - (2) There may be foreign objects stuck in the encoder wheel, it is necessary to remove foreign objects so that the encoder wheel can rotate (walk) smoothly, otherwise the distance will not be measured or the error will be too large.
  - (3) When using a distance encoder, it is necessary to press the probe slightly to make it fit well on the surface of the inspected component to ensure that the encoder wheel does not slip out of step.



(a) longitudinal axis of bare tube (b) longitudinal axis with cladding

Figure 4-6 Relationship between the scanning direction and the phase position of the encoder

- **3) Center mark:**

  the electromagnetic pulse energy excited by the probe, the downward propagation space is similar to a circular pile dispersive body. The "center mark" on the probe indicates the central axis of the energy field of the circular pile.

- **4) Probe cable:**

  the two ends of the cable can be interchangeable. There are (red dot) alignment marks on the plug and socket, first insert the mark gently, do not force to insert and remove. In the field and dust environment, pay special attention to prevent dust particles from entering the socket hole core.

- **5) Bare tube probe adapter:**

  When using the "bare tube high resolution probe", insert the "bare tube probe adapter" at one end of the instrument host first, and then access the data line and bare tube high resolution probe.

- **6) Wear-resistant temperature insulation probe boots:**

  When the contact temperature of the bottom of the probe is ≥100°C, the "wear-resistant temperature insulation probe boots" must be put on to prevent burning.

- **7) Extension rod:**

  The detection position that is out of reach of people at height requires the extension rod. ***When using an extension rod, the distance encoder wheel cannot be effectively brought into contact with the detection surface, and the meter positioning cannot be accurately measured. Therefore, it is not recommended to use the distance encoder function.*** Clamp the probe to the top of the extension rod, tighten the fixing screws on both sides of the probe, and connect the probe cable. Loosen the lock to pull the extension rod to a suitable length, and then lock the lock. The operation of the display and keys on the lower part of the extension rod is the same as that on the probe.

4.2 Area of Detection Point

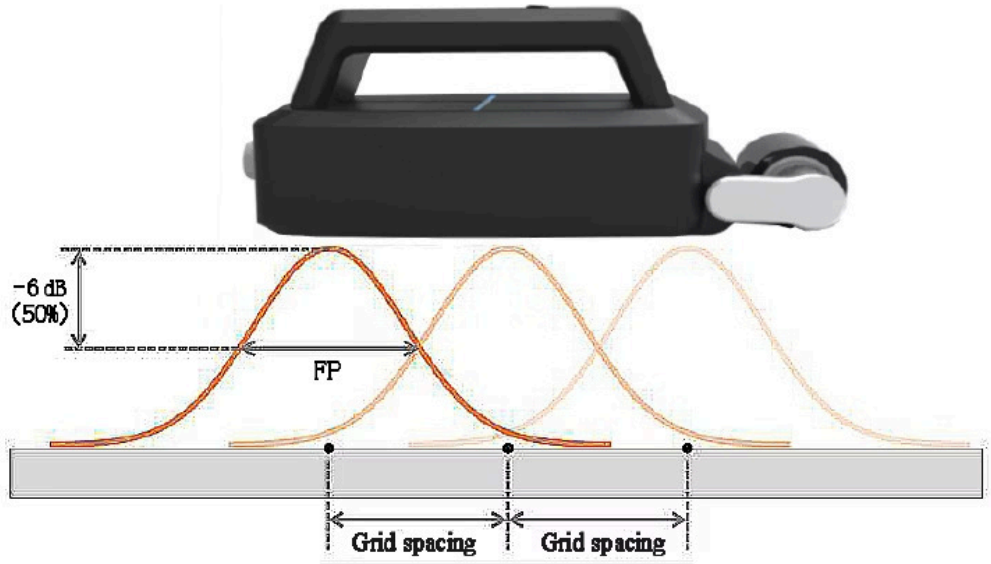


Figure 4-7 Schematic diagram of detection area

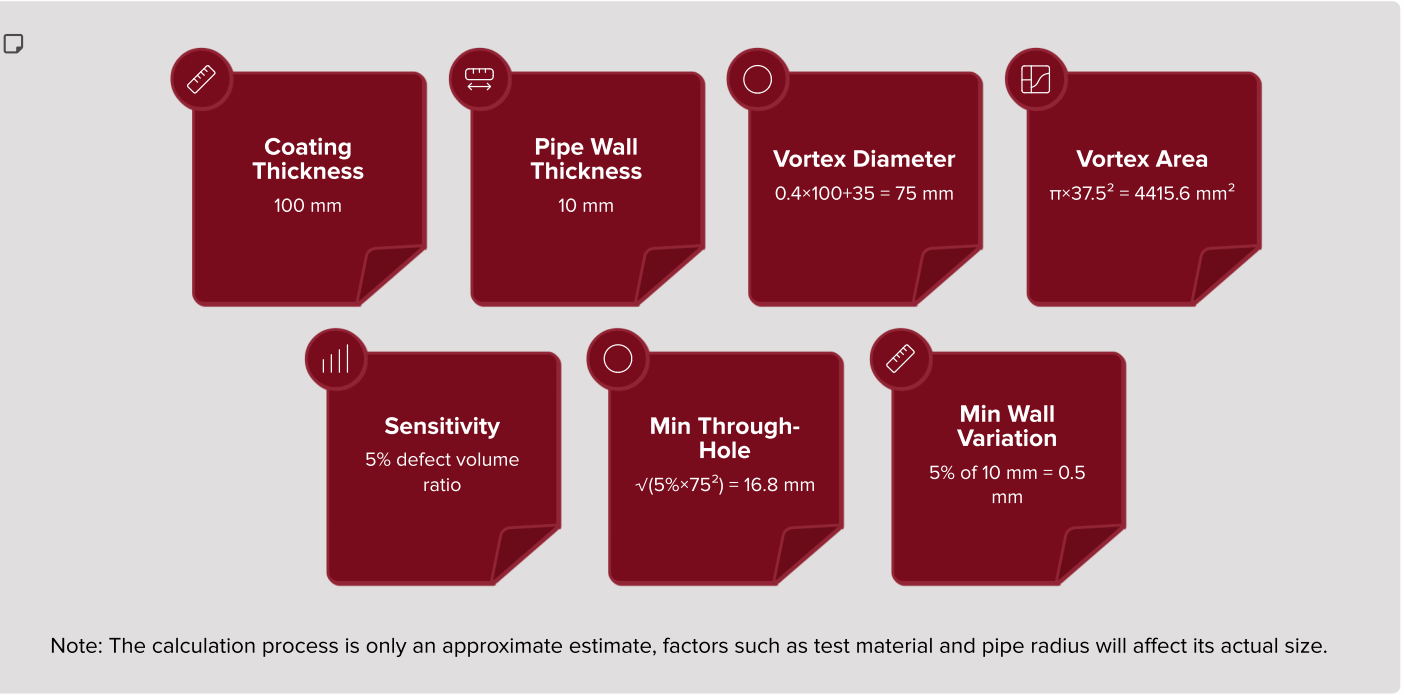
The pulsed eddy current test results reflect the average wall thickness in a range of areas, the diameter formula of the circular area covered by the probe: FP≈0.4×L0+FP0

In the formula:

- FP = the diameter mm of the circular detection area
- L0 = lift-off (coating layer thickness) mm
- FP0 = probe's inherent coverage area (the diameter of the round sole when lift off = 0) mm

Among them, P1 type / small probe FP0 =25, P2 type / medium probe FP0 =35, P3 type / large probe FP0 =45mm.

Example: P2 type / medium probe, detection of 100mm thick carbon steel pipe under the cover of 10mm, the detection area and resolution /smallest defect size are calculated as follows:



Note: The calculation process is only an approximate estimate, factors such as test material and pipe radius will affect its actual size.

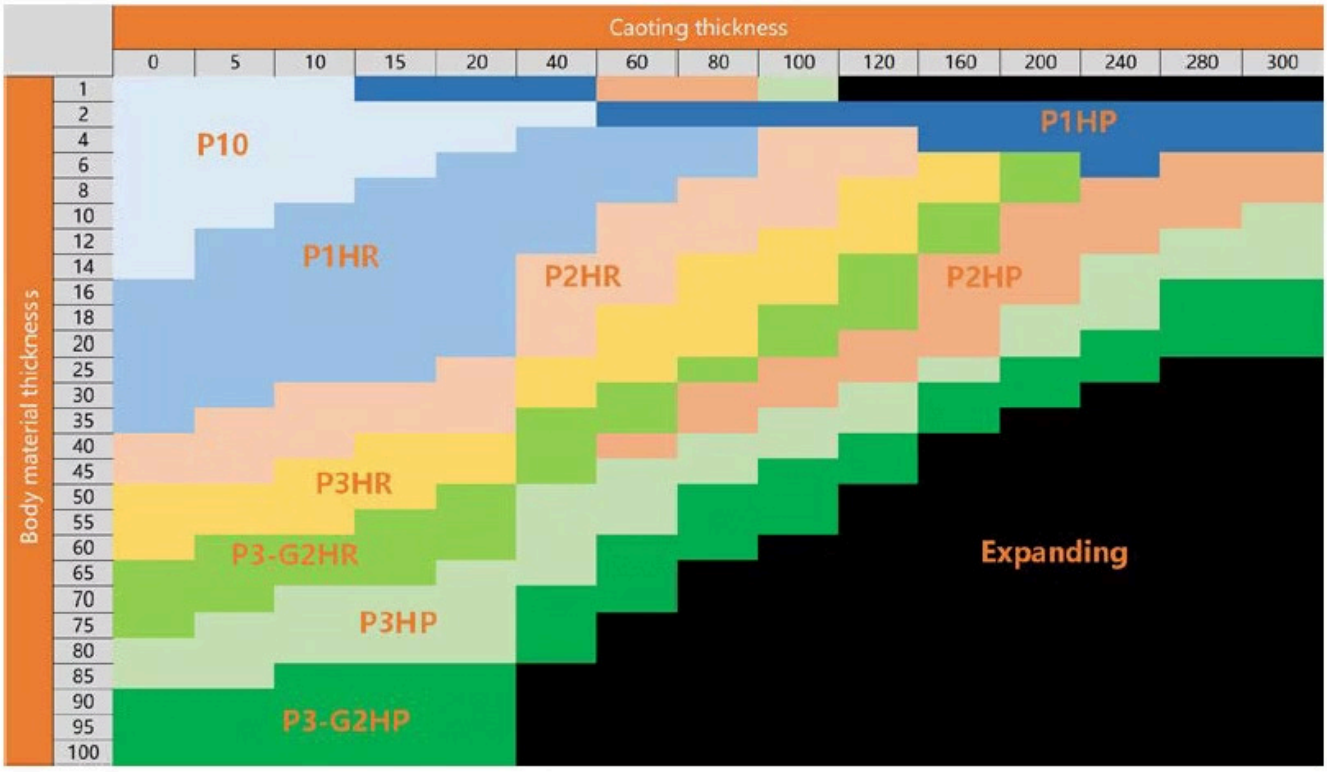
4.3 Probe Capability Selection

C.S (Carbon Steel) probe for carbon steel, S.S (Stainless Steel) probe for stainless steel. P1 type / small probe FP0 = 25, P2 type / medium probe FP0 = 35, P3 type / large probe FP0 = 45mm, large size probe:

The eddy current distribution field is large, the penetration force is strong, and the resolution is slightly lower, which is suitable for components with thick cladding and large wall thickness. Small size probe: small eddy current distribution field, high resolution and slightly weak penetration, suitable for components with no coating or thin coating and small wall thickness. According to the material of the component to be inspected, the thickness of the cover layer, and the wall thickness of the body, refer to the detection capability range of each probe in Table 1, and select a probe of a suitable specification.

Table 1: Detection range of carbon steel C.S probe

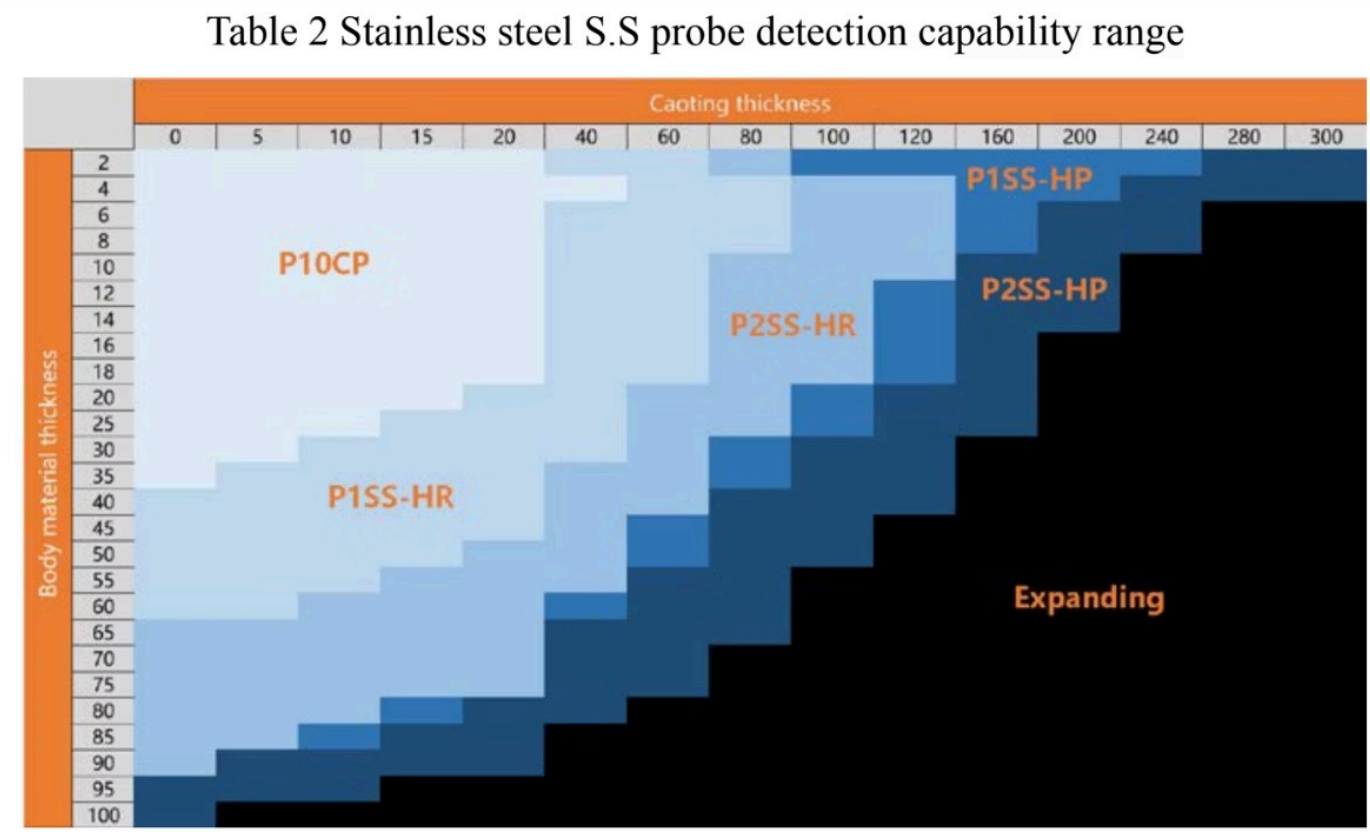
Table 1 Detection range of carbon steel C.S probe



Note:

- ① This table is for reference only, and the actual inspection capability on site shall prevail.
- ② When the composition grades of carbon steel are different, the capacity range will be greatly different.
- ③ This table is drawn according to the flat sample, and it will shrink as the diameter of the component decreases. For example: when the pipe radius is 200mm, the corresponding maximum cover layer thickness is about 2/3 of the value in the table; when the pipe radius is 50mm, the corresponding maximum cover layer thickness is about 1/2 of the value in the table.
- ④ When the protective layer is iron skin, the corresponding maximum cover layer thickness is about 2/3 of the value in the table.

Table 2: Stainless steel S.S probe detection capability range



4.4 (Extended Function) Multi Channel Pulse Eddy Current C-scan Continuous Corrosion Measurement

4.4.1 The "probe ring" integrates multiple probes uniformly distributed along the circumference, which are buckled on the outside of the pipeline cover layer and continuously scanned manually (or electrically) along the longitudinal axis, improving the density and coverage of detection points.

4.4.2 C-scan imaging, automatically analyzing the remaining wall thickness and presenting warning areas.

4.4.3 When selecting the suspected defect area, the remaining wall thickness value will be automatically displayed for further analysis.

4.4.4 Parameters of probe:

- The max thickness of cladding layer: with stainless steel or aluminum protective layer ≤100mm, with iron protective layer ≤80mm
- The max detection of wall thickness: 3～35mm
- Diameter of the pipe: ≥140mm
- The thickness of metal protective layer: ≤1mm
- Repeated detection accuracy: 1%
- Corrosion defect detection sensitivity: 5% (volume ratio)
- Measuring speed: 15~0.5 time/s (reducing with the increasing measured wall thickness)
- The length of probe cable: 5m, 30m (optional)
- Size and Weight: (carbon steel or stainless steel) six-channel array probe: L687.5×W230×H65mm, 8.15kg

Figure 4-8 Overall structure

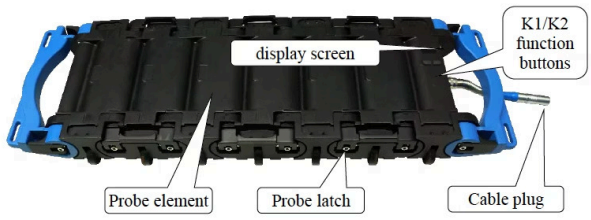


Figure 4-9 Probe structure diagram

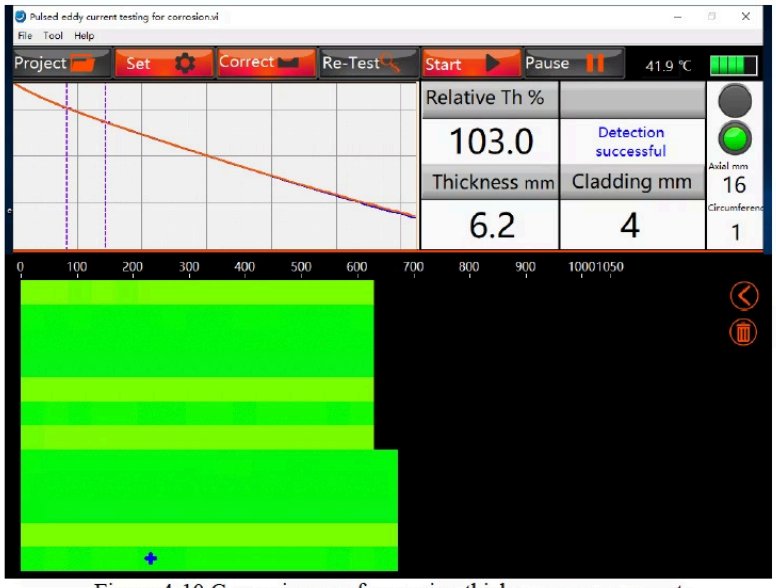


Figure 4-10 C-scan image of corrosion thickness measurement

5. Method of Operation

The "Precautions" on the homepage must be strictly implemented. Before formal use, make sure that the battery is fully charged, each unit component is installed and fixed reliably, and the wiring is completed and correct (see Figure 4-1).

Note: 【XX】represents button, represents reference, ···➝represent next step.

5.1 Main Interface

Click on the left panel of the instrument (its light will be on), wait about 30s, the instrument will start to the system interface first, then automatically enter, and finally enter. If user only boots to the system interface, user can double-click "shortcut PECT-**. exe" to enter the main interface. Click【×】in the upper right corner of the interface to exit.

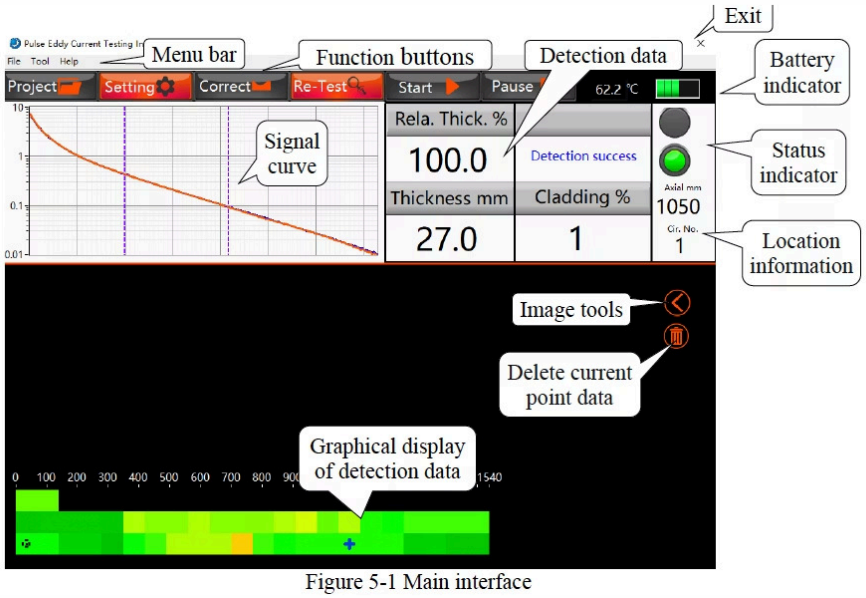


Figure 5-1 Main interface

• **Menu bar:** File: Generate a report, shut down the system; Tools: C scan map, B scan map, Chinese interface, English interface, encoder calibration, delete current point; Help: Operating procedures, probe range, copyright description.

• **Function buttons:** there are six commonly used buttons: Project, Setting, Correct, Re-test, Start, Pause.

• **Battery indicator:** the power indicator of the built-in battery, when the power is low (≤5%), it will flash to indicate that the battery is lack of power, and user need to connect the power adapter to charge. When charging: the indicator light on the adapter is red, turns green after being fully charged, and the power bar on the instrument screen will be dynamically displayed. It takes 4 ~ 5h to fully charge. During charging, the instrument automatically prohibits calibration and detection operations, and can only look back at historical data.

• **Signal curve:** X axis: sampling time, Y axis: signal amplitude, the orange line is the induction curve at the calibration point, and the blue line is the induction curve at the current detection point. The blue line will be below the orange line (wall thickness reduction / negative deviation) or above (wall thickness thickening / positive deviation). The higher the coincidence of the two curves, the smaller the wall thickness change.

5.1 Main Interface (continued)

• **Detection data:**

- Relative th. % = (remaining thickness at current detection point / thickness at calibration point) × 100%
- Thickness = relative thickness × nominal thickness entered in new project (mm)
- Status display = simple analysis prompt of device detection results
- Cladding cha. = change of cladding thickness measured by instrument (the unit is mm when the cladding thickness ≤10mm, and % when the cladding thickness >10mm)

• **Status indicator:** there are two indicators, red and green, indicate the current running status and test result in combination.

Red light on, green light off: Being tested, other operations are queued and suspended.

Red light off, green light on: The test is over, the data value is reliable, and other operations can be responded

Red light on, green light on: The test is over, the data value is suspicious, and other operations can be responded

Red light off, green light off: The test is over, the data value is error, and other operations can be responded

• **Location information:** indicates the longitudinal and circumferential position of the current detection point. It is usually scanned along the longitudinal direction of the inspected component and divided equally into several parts in the circumferential direction.

- **Axial position:** means the distance between the current detection point and the longitudinal axis of the scanning starting point. When an encoder is installed on the probe, the metering information is the accumulated value showing on the encoder, and changes at step intervals (not continuously). When the encoder is not installed on the probe, this value is not the actual distance value, but the "axial step" multiplied by the current point serial number, for reference only.
- **Circumferential number:** indicates the current grid line scanned along the horizontal axis.

• **Image tools:** there are four buttons: **Screenshot, Move, Zoom in, Zoom out.**

• **Graphical display of detection data:**

- **X-axis:** axial detection distance
- **Y-axis:** circumferential equal number of lines, and color indicates the relative thickness change of the detection point.

The darker the color, the more serious the corrosion thinning. User can use the **"Jog dial"** to move the cross cursor (turn left and right to move the cursor back and forth, press the cursor to move up one line, and move to the top line will cyclically move to the bottom line) to view the historical data at the cursor.

5.2 Project Management

In the main interface, click【Project】to enter the project management interface, user can delete, loading, open, and create new test items.

Click on an item in the "Project List", it will automatically load and display the information of the item, click【Open】to load the history detection item and return to the main interface. Click on the corresponding parameter in "Project Information" to modify it.

Click【New】to create a new test project. If a project with the same name already exists, user will be prompted to replace the original project. If you need to load the calibration parameter information of an existing item, click OK, otherwise click Cancel. In the project management interface, light the【Load】button, and then click【New】to modify the project name, wall thickness, probe and other parameters; If the wall thickness, material, probe has changed, it is recommended to re-calibrate after loading; If the original calibration parameters are not loaded, please turn off the【Load】button on the project management interface. Click【Delete】to delete the entire project or project data.

Click【×】in the upper right corner of the interface to exit the project management. If it is a project management interface that pops up automatically after booting, user must【Open】or【New】a test project.

Figure 5-2 Project management

- **Function buttons:**

  There are four buttons: Delete, Loading, Open, New.

- **Project list:**

  List of historical projects. "Project" is a first-level directory, and "Item" is a second-level directory. Click【+】of the tree node to expand, and click【—】to shrink.

5.2 Project Management - Information Parameters (continued)

Information Parameters:

Showing project information and the data can be modified. Click the project name in the "Project list", the information bar will display the information of the currently selected project.

- **Item name:**

  the item is secondary directory, it is recommended to use the same segment of the tested component as a unit to build test items, the project name temporarily supports only English input methods.

- **Geometry:**

  there are pipes, tanks, flat plates three kinds in total.

- **Wall thickness [mm]:**

  this value is used as the calculation coefficient of the subsequent "thickness" result and the initial conditions of the algorithm. It is recommended to use an ultrasonic thickness gauge to measure the actual thickness in a non-corroded area. If the actual thickness value cannot be obtained, the nominal thickness of the component can be entered; if the nominal value is also unknown, an approximate value can be entered.

- **Cladding layer thickness [mm]:**

  the nominal value of the thickness of the coating layer. If the nominal value is unknown, user can enter the approximate value without having to be very accurate.

- **Outer diameter [mm]:**

  the nominal outer diameter of the pipe components, if the nominal value is unknown, user can enter the approximate value without having to be very accurate. This parameter has no effect on tanks and flat components.

- **Body material:**

  carbon steel C.S (contains all magnetic metal materials), stainless steel S.S (contains all non-magnetic metal materials), two kinds of options. A small magnet can be used to quickly determine the material of the body material.

- **Protective layer material:**

  the material of the metal protective layer outside the coating layer, none, aluminum sheet (including stainless steel sheet), iron sheet (white iron sheet, galvanized iron sheet, etc.) are optional. A small magnet can be used to quickly determine the material of the protective layer.

- **Medium temperature[℃]:**

  approximate temperature of the internal medium of the component be detected.

- **Probe selection:**

  P1-C.S、P2-C.S、P3-C.S、P3-C.S-G1、P3-C.S-G2、P10-C.S、P1-S.S、P2-S.S、P10-S.S, etc., see <4.3 Probe capability selection>. Select the type of probe connected to the host, if the selection is wrong, it will prompt that the type does not match during calibration and testing.

5.2 Project Management - Parameters (continued)

- **Axial length [mm]:**

  the approximate longitudinal axial length of the inspected component (pipe), that is, the X axis of

  : The axial inspection distance can also be set and calibrated in <5.3> to modify this parameter.

- **Axial step [mm]:**

  the separation distance during longitudinal axial scanning. The axial length divided by the axial step is the number of grids in the <5.1 Main interface • Graphical display of inspection data> X axis. In the "position trigger" mode, each time the distance encoder accumulates to this step value, it will automatically trigger a detection, and this parameter can also be modified in <5.3 Setting and calibration>.

  Select different probe types, the default value of axial step will be automatically filled in:

  - Probe P1: Default 10mm
  - Probe P2: Default 15mm
  - Probe P3: Default 20mm

- **Circumferential(Circ.) equal number:**

  indicates how many grid lines are scanned along the axial direction, that is, the Y axis of

  : the number of equally divided rows in the circumferential direction, this parameter can also be modified in <5.3 Setting and calibration>.

- **Detection date:**

  the system date is default when the project was established, and it cannot be modified temporarily.

- **Sparse scan/Dense scan:**

  the default mode is "Sparse scan". If suspected corrosion is found in the detection, it can be quickly switched to "Dense scan" for more dense scanning.

5.3 Setting and Calibration

In the main interface, click **Setting** or press the left K1 key and right K2 key of the probe at the same time to enter the setting interface for partial parameter modification and calibration. Click × in the upper right corner of the interface to exit.

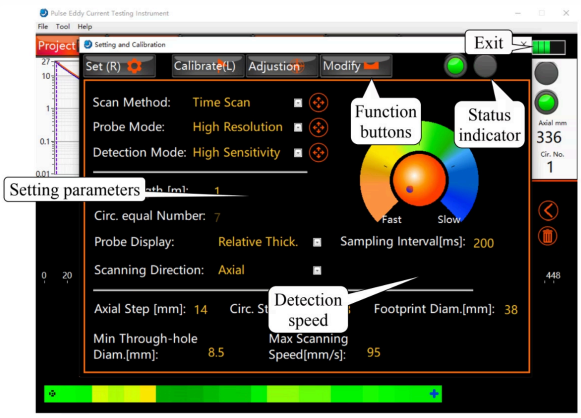


Figure 5-3 Setting and calibration

Action buttons:

Set(R), calibrate(L), adjustion and Modify.

Setting parameters:

Click the value on the right of each parameter to modify it. Click **Setting** to save the modified parameters, or click **Calibration** to automatically save the set parameters. If you click × to exit, it will not be saved.

- **Scan mode:** There are five options: Point test, Time scan, Position scan, Position step, Position point.
  For details, see section 5.6 Test and Retest.
- **Attention:** The distance encoder is required for position scan, and the encoder distance has been calibrated before delivery. The same host equipped with multiple types of probes only needs to calibrate one probe. If the distance error is found to be too large during use, users can calibrate themselves.

Encoder Calibration Process:

Click the menu bar **Tools → Encoder Calibration**:

1. Prepare a ruler, align the probe center axis with the 0mm scale, click the probe left button to start the calibration procedure
2. Push the probe forward (the positive direction can be specified by itself) move the center axis to the 200mm scale, click the probe right button. The message "Encoder calibration success!" is displayed
3. If the encoder calibration fails, please re-enter step (1)

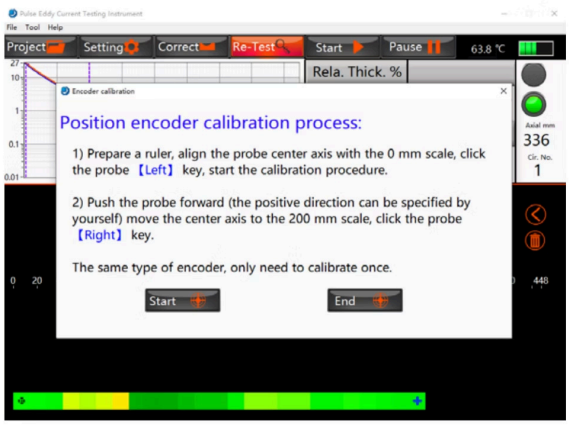


Figure 5-4 encoder calibration

5.3 Setting Parameters (continued)

- **Probe mode:**

  Two options available: **"high resolution (slightly lower penetration)" and "high penetration (slightly lower resolution)"**.

  Priority should be given to using the "high Resolution" mode.

  When the "high resolution" mode calibration is unsuccessful or the detection data jumps significantly when the coverage layer thickness is greater than 120 mm or the workpiece body wall thickness is greater than 30mm, the "high penetration (slightly lower resolution)" mode should be selected.

- **Detection mode:**

  Two types: **"High sensitivity" and "High reliability".** The "High sensitivity" mode is preferred.

  When there is serious interference or iron sheet working condition around, it is recommended to choose "High reliability" mode.

- **Probe display:**

  Relative thickness %, Absolute thickness mm.

- **Axial length:**

  The same as section 5.2 Project management • Information Parameters • Axial length.

- **Circumferential (Circ.) equal number:**

  Same as section 5.2 Project management Items • Information Parameters • Circumferential equal number.

- **Scanning Direction**

  There are two options of longitudinal axis and lateral circumference, which are determined by the scanning direction of the probe along the component (pipe).

- **Axial Step**

  Same as <5.2 Project management project • Information parameter • Axial step size

- **Note**

  Modify the scores such as axial length, axial step, and circumferential direction here. Only the number of table cells in the graphical display can be increased. If the number of table cells is decreased, the automatic setting is invalid.

5.3 Detection Speed

There are five levels adjustable from Fast to Slow. Click on different positions of the fan-shaped color bar, or drag the concave point on the red circle in the middle, and rotate to a suitable angle and then release. Different triggering methods have different adjustment objects:

Scan Mode	Object of Adjustment
Point test, Position step, Position point	Adjust single point detection/sampling duration. The slower speed, the longer single point detection/sampling time, and the higher stability of the detection data.
Time scan	Adjust the interval between tests. The slower speed, the longer interval and sampling time, the higher stability of the detection data, and the slower continuous scanning speed.
Position scan	This parameter is invalid/no effect

Attention: Under the premise of ensuring the stability of the test results, try to use a faster test speed to improve the test efficiency. Generally, the thicker the cladding layer, the weaker the detection signal, and the slower the detection speed; for the bare tube scanning without cladding, the fastest gear can be used.

5.3 Calibration

Similar to the ultrasonic thickness measurement method, the pulse eddy current method needs to calibrate the electromagnetic parameters of the inspected member before detecting the thickness. ***If it is a new inspection project, it must be calibrated before inspection. Calibration is carried out in a good area of the tested component, or on standard test blocks of the same material, similar wall thickness, the same protective skin layer, similar thickness cover layer, and similar operating temperature.***

Calibration Steps:

Place the probe in a good area of the component to be inspected

Click **Calibration** or click the left key K1 of the probe

The status indicator lights red ⚫🔴, and the probe display shows "Run...", indicating that calibration is in progress (takes about 10-30s)

When the indicator lights green ⚫🟢, the probe display shows "ok!", indicating successful calibration

A calibration dialog box will be prompted. After clicking OK, the dialog box will close

Place the probe in the air of the detection environment

Click **Calibration** or click the K2 button on the right side of the probe

Status indicator will be red ⚫🔴, probe displays "Run..." (takes about 1~5 seconds)

When green light is on ⚫🟢, probe displays "OK!", indicating successful calibration

The setting interface will automatically close and return to Main interface, showing the red calibration curve

5.3 Calibration

Important Attention Points

Calibration point selection:

The calibration point can be selected anywhere on the inspected component, but try to select a good area with low corrosion probability and thin coating, such as the upper half of the pipe and the side of the elbow.

Material consistency:

The material of the calibration point and the detection point must be the same, and the operating conditions such as operating temperature and coating thickness should also be as close as possible. If there is a major change, you need to recalibrate. The elbow part and the straight pipe section generally need to be calibrated and tested separately due to different materials and processing techniques.

Probe orientation:

The probe is directional. It is generally recommended that the long side of the probe be placed along the longitudinal axis of the pipeline. If the long side of the probe needs to be placed along horizontal circumferential of the pipeline during the detection process, certain detection errors may be introduced at this time, and it is necessary to re-calibrate with the probe placed horizontally.

Calibration duration:

The calibration process takes more than ten seconds to dozens of seconds. The thicker the thickness, the longer the calibration time. During the calibration process, the probe must not be moved, especially when the protective layer is iron, the probe must be pressed as close as possible to the iron.

5.3 Calibration - Troubleshooting & Verification

Calibration Failure:

After the calibration is completed, if the prompt "Calibration failed" is clicked, you can try the calibration again after clicking OK, or return to the Project management interface, and re-calibrate after creating a new project. If the calibration fails multiple times, it may be that the current component under test is beyond the scope of the probe. You can try another probe after replacing it.

Verification of Calibration Effect:

In order to further verify the calibration effect, after the calibration is completed, the detection can be repeated 3~5 times at the calibration point. If the detection data has a high degree of coincidence (the blue line of the detection signal and the orange line of the calibration signal have a high degree of coincidence), and the fluctuation range is ≤3% (reference value), it means that the calibration effect is good and ready for target area detection. If the test result jumps greatly, the fluctuation range ≥10% (reference value) indicates that the calibration effect is poor, and it needs to be recalibrated, or because the current component being tested exceeds the probe's capability range, the probe must be replaced before attempting the calibration.

Detection Speed Adjustment:

Generally, before the calibration, the detection speed is adjusted. After the calibration is successful, the detection speed is increased as much as possible according to the calibration effect.

Air Calibration:

When calibrating, the probe should be placed in the air as far as possible away from the inspected member.

Bare Tube Exception:

If it is a bare tube scan and the signal is relatively strong, the calibration step can also be skipped after calibration without calibration. After calibration is completed, click × Exit to skip calibration.

5.3 Status Indicator

The status indicator is composed of two indicators, left green and right red, indicating the current running status and calibration result.

Red light on ⚫🔴, green light off	Calibration is in progress. Other operations are automatically prohibited.
Red light off, green light on ⚫🟢	The calibration is successful and the setting interface is automatically exited.
Red light off, green light off ⚫⚫	Calibration failed, user can follow the program prompts for the next step.

5.4 Adjustment (Strong Electromagnetic Interference Noise Suppression)

If the signal is strong after calibration and no indication of waveform fluctuation, this step can be omitted/no adjustment is required (electromagnetic noise suppression). If the signal is weak after calibration and waveform fluctuation is prompted, it indicates that there may be strong electromagnetic interference in the space of the detection area, the probe needs to be adjusted first (electromagnetic noise suppression).

Adjustment Procedure:

Please lift the probe into the air, away from metal components and the instrument host > 1m, and then click the **Adjustment** button to start adjustment.

5.5 Modify (Confidence Interval Modification)

In some complex work environments, if the automatic calibration has failed and the signal curve is good, it can be tried to manually adjust the confidence interval for calibration.

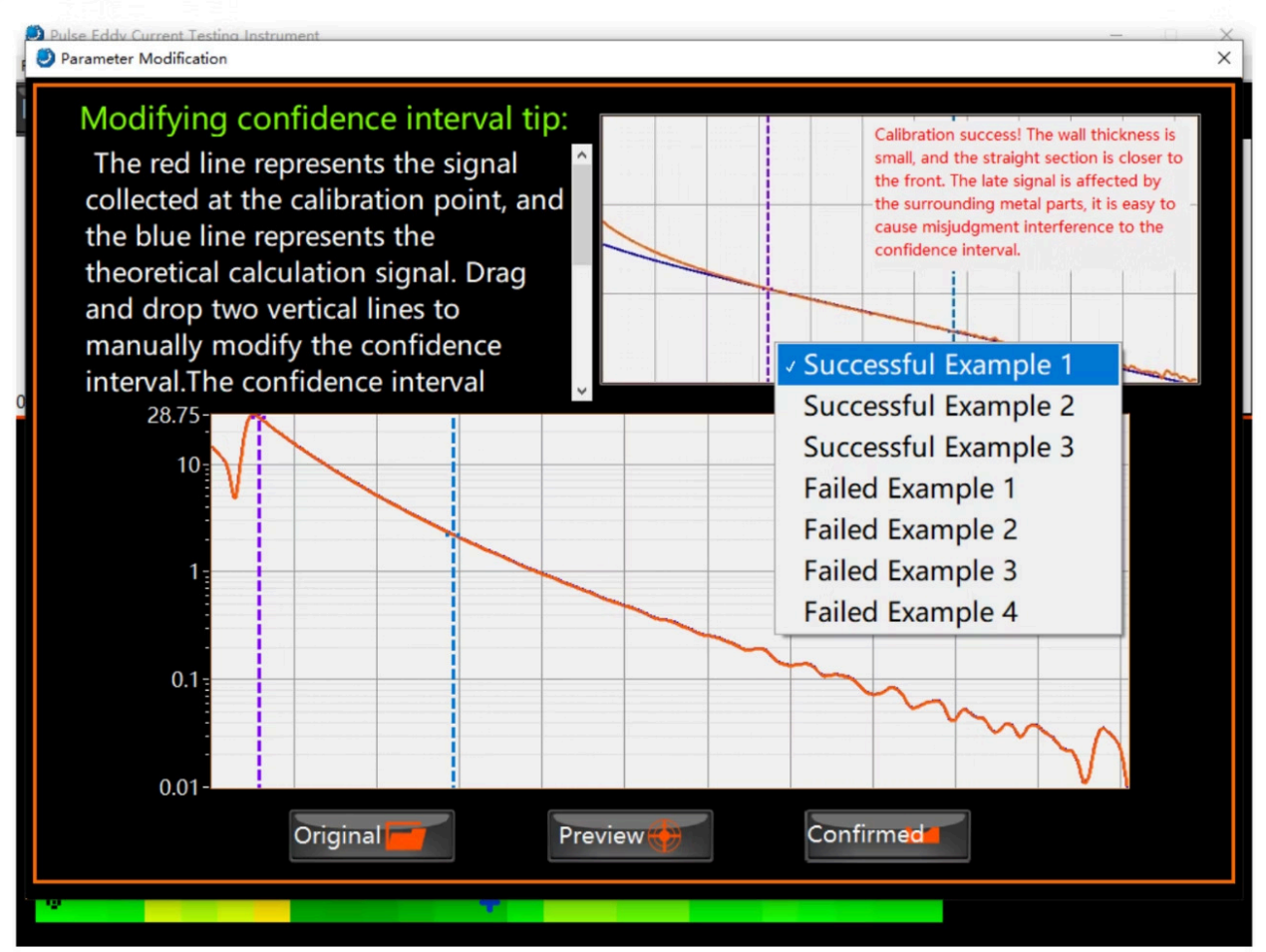


Figure 5-5 Modify (confidence interval modification)

As shown in the picture:

- The **orange line** represents the signal collected at the calibration point
- The **blue line** represents the theoretical calculation signal
- Drag and drop two vertical lines to manually modify the confidence interval

Adjustment Guidelines:

→ The **purple dotted line** is generally dragged to the front end of the straight line segment of the orange and blue solid line fitting curve to ensure the strength of the signal

→ The **blue dotted line** is generally dragged to the back end of the straight line segment of the orange and blue solid line fitting curve to ensure the stability of the signal

→ Do not be in the late end of the signal, because the late signal is affected by the surrounding structural parts and other factors, easy to cause interference and misjudgment of the confidence interval

Action Buttons:

- Click **Correction preview** to see the correction effect
- Click **Original parameter** to return to the parameter before correction

5.6 Detection and Retesting

After the calibration is successful, Click the **Confirm** button and return to Main interface. The operation steps of the five modes are as follows:

Scan Mode Overview:

Point test

Point by point detection, manual keys required to trigger measurement, no position information recorded/no encoder required

Time scan

Automatic continuous scanning at fixed time intervals, position information not recorded/encoder installation not required

Position scan

Distance encoder automatically triggers measurement each time it accumulates to the step value during probe movement

Position step

Step move the probe, cursor moves with probe position, probe stays at detection point for about 0.5s which automatically triggers measurement

Position point

Stepping moving probe, cursor moves with probe position, manual keystroke required to trigger measurement

5.6 Point Test Mode - Detailed Operation

Point by point detection, manual keys are required to trigger the measurement, no position information is recorded/no encoder is required. In the Detection Speed settings, the duration of a single test can be adjusted: when the measurement signal is weak, you can turn the "Measure speed panel" to the right, the measure speed becomes slower/the cumulative sampling time becomes longer/the number of repeated sampling times of a single point can be increased, so that the detection data is more accurate and stable.

Operation Steps:

1. Click the probe left K1 key or **Start** in Main interface to trigger a measurement. The probe displays "Run..." and the main interface red light on ⚫🔴.

2. After the current point detection is completed, the main interface red light is off and the green light is on ⚫🟢, and the probe displays "OK!" and the result of thickness detection. "Err!" indicates that the measurement is abnormal, you need to remeasure or find the cause. Main interface displays: the signal orange line of the calibration point and the signal blue line of the current detection point, the detection result of the current point. The graphical display stores the current thickness value, and the cursor automatically moves forward by 1 grid. When the current line is full, the cursor will automatically change to the next line in the leftmost column, or you can click the probe right K2 key to change the cursor to the next line in the leftmost column.

3. Move the probe to the next test point and repeat steps 1) and 2) until all test points have been tested.

5.6 Time Scan Mode - Detailed Operation

Automatic continuous scanning at fixed time intervals, position information is not recorded/encoder installation is not required. In the Detection Speed settings, the interval between two detections can be adjusted: if the acquisition speed is too fast and there is obvious lag in the data display, the interval can be increased by rotating the "Measuring speed panel" to the right. When detecting stainless steel, the small screen on the probe temporarily does not refresh the detection data in real time.

Operation Steps:

Click the probe left K1 key or **Start** in Main interface to start the time scan. The probe displays "Run...", the probe displays the current thickness detection result in real time, the main interface red light on ⚫🔴.

Click the probe right K2 key or **Pause** in Main interface to pause time scan. The probe displays "Pause", the main interface red light is off and the green light is on ⚫🟢.

Click the probe left K1 key or **Start** again in Main interface to continue scanning. The probe displays "Run...", the probe displays the current thickness detection result in real time, and the main interface red light on ⚫🔴.

Move the probe to the next test point until all test points have been tested. Probe displays "Pause", the main interface red light is off, green light on ⚫🟢.

5.6 Position Scan Mode - Detailed Operation

The distance encoder must be installed first. During the probe movement, the distance encoder automatically triggers a measurement each time it accumulates to the step value. The "Measurement speed panel" is invalid/no effect in this mode. When the protective layer is iron sheet, the surface condition of the coating layer is poor, and the detection signal is weak, this mode is not recommended/"Position step" or "Position point" mode is recommended.

Operation Steps:

Set scan parameters: Scanning direction, Axial length, Axial step size, Circumferential equal number.

Click the probe's right K2 key, or tap the touch screen, or rotate the instrument's shuttle knob to move the cursor to the starting position of the leftmost column, or (but try not to) stop the cursor anywhere in the middle.

Place the probe at the scanning start point of the detected component, the encoder wheel faces the front end, and click the probe left K1 key or **Start** in Main interface to start the position scan. The probe displays "Auto Test", and the main interface red light on ⚫🔴.

The encoder wheels roll against the surface of the component. During the continuous forward movement of the probe, each time the encoder accumulates the (axial) step value, it will automatically trigger a detection, and the probe display will show the current point thickness test results in real time. The observed axis/circumferential coordinates should accumulate toward + and have no - value. When moving to the end of the line, it will automatically pause: the probe displays "Pause", the main interface red light is off, the green light is on ⚫🟢.

Click the probe right K2 key, or click the touch screen, or rotate the shuttle knob of the instrument to move the cursor to the next row in the leftmost column.

Move the probe to the starting point of the next line of scanning. Click the probe left K1 key again or **Start** in Main interface to continue scanning until all test points have been tested.

During the process: You can also click the probe right K2 key or **Pause** in Main interface to pause the continuous scan triggered by the position. Click the probe left K1 key again or **Start** in Main interface to continue scanning.

5.6 Position Step Mode - Detailed Operation

Step move the probe, the cursor moves with the probe position, and the probe stays at the detection point for about 0.5s, which will automatically trigger a measurement. When the measurement signal is weak, you can turn the Detection Speed "Measure speed panel" to the right, the measure speed becomes slower/the cumulative sampling time becomes longer/the number of repeated sampling times of a single point can be increased, so that the detection data is more accurate and stable. Elbow, tee, cladding surface condition is not suitable for continuous push probe occasions, this mode is not recommended/"Position point" mode is recommended.

Operation Steps:

Set scan parameters: Scanning direction, Axial length, Axial step size, Circumferential equal number.

Click the probe left key or **Start** in main interface to enter scanning ready state.

Place the probe in the leftmost column starting position and click the probe left key (or pull the cable encoder) to start position scan.

Step forward push the probe (or pull the cable encoder) cursor to the new detection point, stay about 0.5s, will automatically trigger a measurement.

Move the probe at the set step size and repeat step 4). If the probe does not move, the measurement will not be triggered repeatedly.

Click the probe right key (or quick release cable encoder), wrap the cursor, and re-enter step 3).

Click the **Pause** in main interface, pause the scan to review data or perform other operations.

5.6 Position Step & Position Point Mode - Probe Status Display

The probe displays "Auto Test", indicating that the cursor has moved to the next detection point, stationary probe waiting for trigger measurement.

Probe Display Status:

- **"Run..."** is displayed - indicates acquisition in progress, and the probe should continue to be stationary at this time
- **"OK!"** is displayed - indicates that the current point detection is completed, and the probe can be moved to the next detection point
- **"Err!"** indicates that the measurement is abnormal, you need to remeasure or find the cause

Note: The probe status display occasionally lags, the cursor position on main interface is accurate and reliable.

Important: If an important detection point is missed, the probe can be rolled back and re-measured to make up the detection data.

5.6 Position Point Mode - Detailed Operation

Stepping moving probe, cursor moves with probe position, manual keystroke required to trigger measurement. (Compared with point measurement mode) automatic recording of probe position information, which can be corrected by imaging at a later stage. The distance encoder must be installed first. When the measurement signal is weak, you can turn the Detection Speed "Measure speed panel" to the right, the measure speed becomes slower/the cumulative sampling time becomes longer/the number of repeated sampling times of a single point can be increased, so that the detection data is more accurate and stable.

Operation Steps:

Click the probe left key or **Start** in main interface to enter scanning ready state.

Place the probe in the leftmost column starting position and click the probe left key to start position scan.

Push the probe forward and after the cursor reaches the detection point position, click the probe left key to manually trigger a measurement.

Click the probe right key, wrap the cursor, and re-enter step 2).

Click the **Pause** in main interface, pause the scan to review data or perform other operations.

The probe displays "Auto Test", indicating that the cursor has moved to the next detection point, hold the probe still and click probe left key to trigger measurement. The probe status display occasionally lags, the cursor position on main interface is accurate and reliable.

If an important detection point is missed, the probe can be rolled back and re-measured to make up the detection data.

5.6 Retesting Function

Only the detection of carbon steel components with cladding has retesting function. When (suspected interference from wire and other structural parts in the cladding) the relative change in the detection results is abnormal, place the probe on the workpiece being tested, click the K2 button on the right side of the probe or click the **Retesting** button on the host to perform re-inspection analysis on the detection results. The analysis results are displayed in the "Detection data" in the right corner of the main interface.

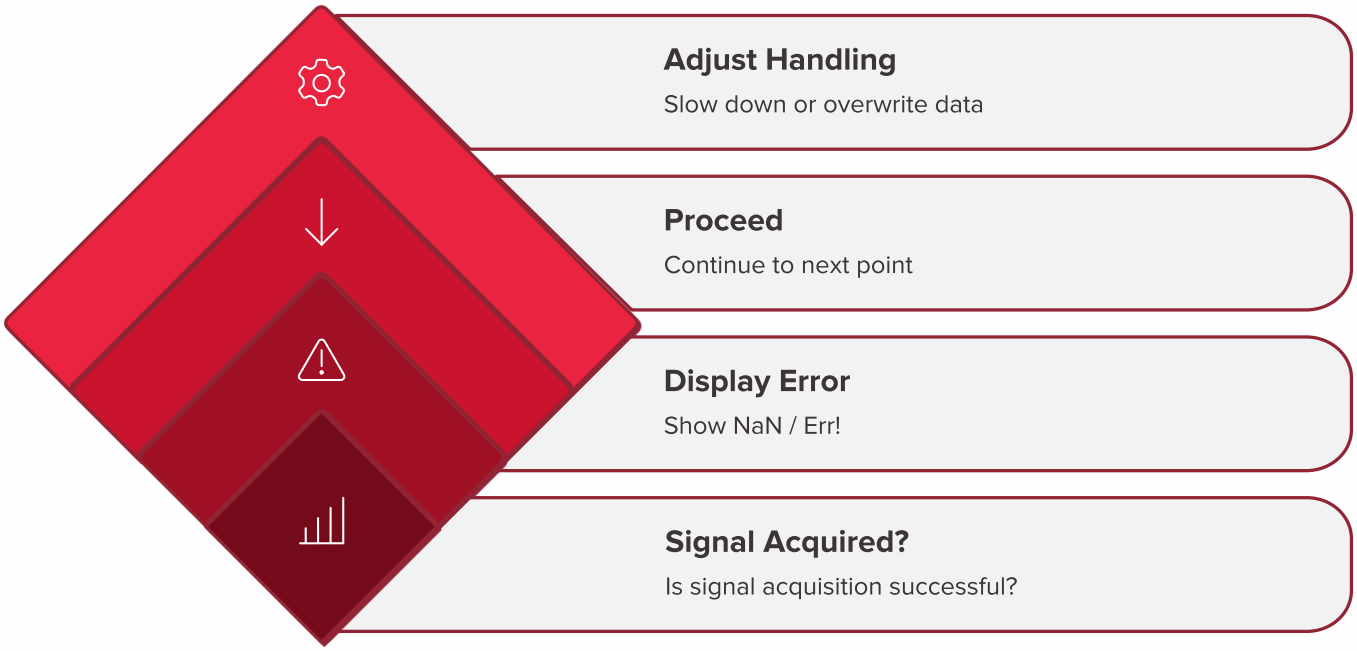
Important Attention Points:

1. In time scan and position scan mode, the program can respond to other operations only in the pause state.
2. Give priority to the "Point test" method. Only under the premise of ensuring the stability and reliability of the detection results, the "Time scan" or "Position scan" mode is selected. Generally, the "Time scan" and "Position scan" mode are only used when the bare tube without a cladding or the cladding is thin.
3. Due to the large attenuation of the electromagnetic signal by the iron sheet, it is recommended to only use the "Point test" method for the working condition with the iron sheet protective layer. During the data acquisition process, the probe can not be moved, and the probe should be pressed as close as possible to the iron sheet.

5.6 Detection - Additional Important Notes

In the two automatic scanning modes of "Time scan" and "Position scan", if the current detection point signal acquisition fails, the detection result is displayed as NaN, the probe displays "Err!", and the cursor jumps to the next detection point. When there are many such leaks, the detection speed and probe moving speed should be appropriately slowed down.

If you move the cursor to a table cell with existing data, when the test is performed again, the original detection data of the table cell will be overwritten.



5.7 Correction

After the detection is completed, in order to further analyze the detection data, you can click **Correction**, as shown in the following figure:

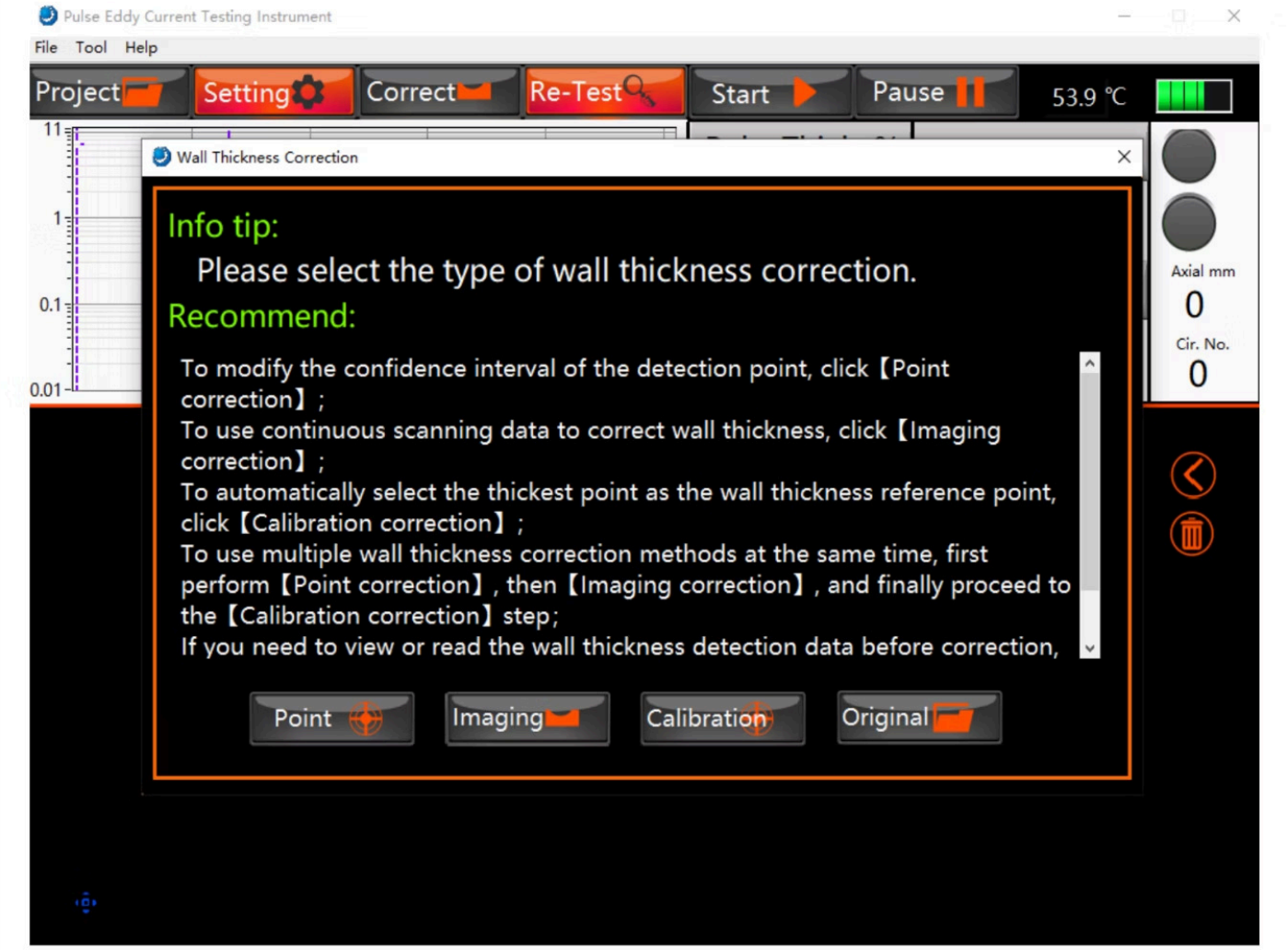


Figure 5-6 Wall thickness correction

Correction Options:

- To modify the confidence interval of the detection point, click **Point correction**
- To use continuous scanning data to correct wall thickness, click **Imaging correction**
- To automatically select the thickest point as the wall thickness reference point, click **Calibration correction**
- To use multiple wall thickness correction methods at the same time, first perform **Single point correction**, then **Imaging correction**, and finally proceed to the **Calibration correction** step
- If you need to view or read the wall thickness detection data before correction, please click **Original data** to close this interface without proceeding and exit the interface directly

C-scan Color Block Diagram - Color to Relative Wall Thickness:

Color	Relative Wall Thickness Value
Deep Red	50%
Red	70%
Yellow	90%
Green	100%
Dark green	130%
Blue	150%

5.8 Data Viewing

After all the tests are completed, you can visually judge the corrosion of the base material thickness in the C-scan and B-scan diagrams in the Graphical display of detection data.

Data Viewing:

Directly click the touch screen in the Graphical display of detection data area, or use the shuttle knob of the instrument (turn left and right to move the cursor forward and backward, press the cursor to move up one line, and move to the top after the line will move to the bottom line cyclically) move the cursor to the color block, you can view the historical data of the detection point (see the signal curve, detection data, positioning information of Main interface for details).

If you want to delete the specified data, you can click **Tool → Delete current point** in Main interface Menu bar.

5.8 Graphic Operations & B-scan View

Graphic Operation:

Click Image Tool to expand the image tool. From left to right, they are: screenshot, drag, zoom in (partial zoom), zoom out (restore to global display), and hide/expand buttons. The screenshot file name is "Project Name-Item name.bmp", and the save path is <D drive \ program installation folder PECT-xxx \ Screenshots and Reports>.

B-scan View:

In Main interface Menu bar, click **Tool → B-scan view** or click **C** in the graphic operation, the main interface becomes the thickness corrosion is displayed in a curve. Scanning B is to remove the blank and error detection points in scanning C, and then splice the detection data in line order. The Y axis represents the remaining thickness%, and the X axis coordinate has no corresponding relationship with the distance information.

Click **Tool → C-scan view** or click **B** in the graphic operation, the main interface returns to C-scan. The C-scan view can more intuitively show the size of the corrosion area.

Figure5-7 B-scan view

5.8 Generate Test Report

Click **File → Generate report** in Main interface Menu bar to automatically generate a test report with the file name "Project Name-Project Name.xlsx" and save it Path .

If you insert a USB flash drive, click **Confirm** to change the saving path to the root directory of the USB flash drive. See the appendix for the sample report. The content can be edited again with EXCEL.

Note: If you click **Generate report** multiple times under the same test item, the report will be overwritten as the latest.

5.9 Exit the Program, Shut Down

There are three ways to exit the program and shut down to a black screen, and the lights on the right panel is light off:

01

Normal Shutdown via Menu

Click **File** in Main interface Menu bar → **Close system**, it will close the detection program and shut down normally.

02

Exit Program then Windows Shutdown

Click × in the upper right corner of Main interface to exit the detection program, and then click (or swipe up) in the lower left corner of the screen → the **Windows start menu** → click **Shut down**

03

Force Shutdown (Emergency Only)

Press ⚫ on the left side panel of the instrument for about 3s to force shutdown. When the work process (some accidental factors may cause) instrument crashes (test program or system no response), only need mandatory shutdown.

⚠ **Warning:** Forced shutdown risks losing current test data!

5.10 Basic Operation Process Steps

1

Preparations

- On-site environmental inspection
- Select the appropriate probe/sensor according to the object to be inspected
- Connect the probe cable

Attention:

When selecting "P10 CP bare tube high resolution probe", insert the "bare tube probe adapter" at one end of the instrument host first, and then connect the data cable and P10 CP bare tube high resolution probe

The contact temperature of the bottom surface of the probe should be ≤100℃. When the contact temperature of the bottom surface of the probe is ≥100℃, the "wear-resistant temperature insulation probe shoe (optional)" must be put on to prevent burning

2

Power On and Battery Check

Click ⚫ on the left panel of the instrument (the upper light is on), wait about 30s, the instrument will start to the system interface first, then automatically enter Main interface, and finally enter Project management. Observe whether the power (the power indicator on the upper right side of the screen) is sufficient. If the power is less than 5%, it will flash to indicate that the battery is underpowered. You need to connect the power adapter (full charge takes 4~5h) to be charged to more than 4 cells (80%), and then unplug the power adapter. During charging, the instrument automatically prohibits calibration and detection operations, and can only look back at historical data

01

Project Setup and Calibration

In Project management (open, modify or create new project, set project information parameters) ➔ Setting parameters ➔ Calibration.

02

Detection

Press the probe at the detection point of the component (the probe bottom contact temperature should be ≤100℃, it is forbidden to directly contact the high temperature bare tube to prevent scalding), press the probe's left K1 key once or **Start** in Main interface. After observing the thickness data is stable ➔ move the probe to the next detection point, and press the left K1 key of the probe again, observing the thickness data is stable ➔ ..... until all the detection points are tested.

03

High Temperature Detection

When the temperature of the detection point is ≥100°C, the probe can be worn with wear-resistant temperature insulation probe boots (optional) to prevent burning.

04

Data Review

Can be done to test the data query, delete, export, etc.

05

Shutdown

After the work is completed, click **File ➔ Close system** in Main interface Menu bar, wait for the instrument to shut down to the black screen, and the lights on the left panel is light off.

06

After Work

Clean the probe, cable and its connector ➔ remove the cable, place the components in the corresponding slot of the special anti-vibration box ➔ count all parts without missing ➔ box lid and fasten.

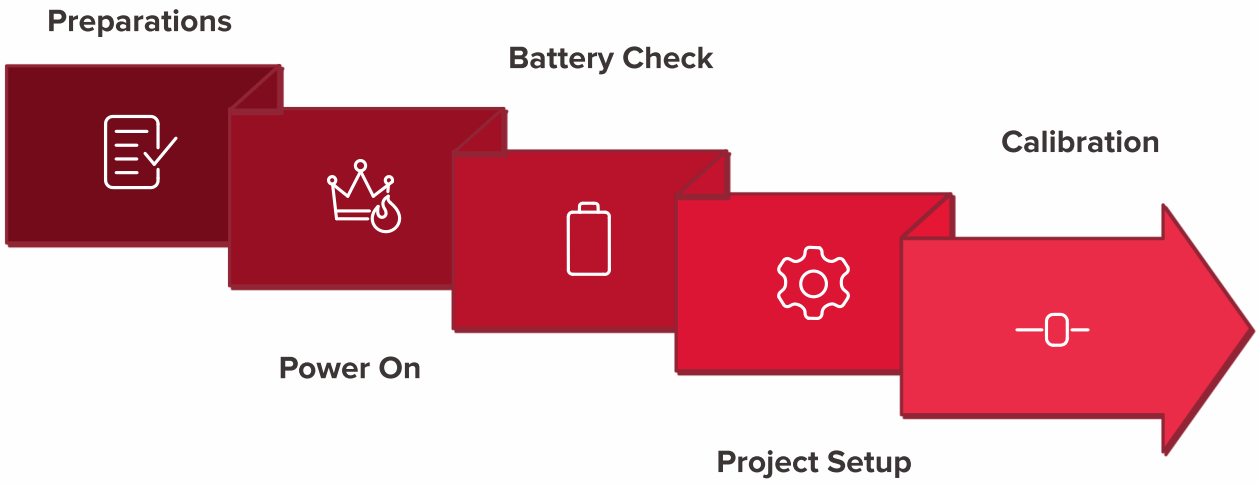
5.10 Important Attention Points

Electromagnetic Interference:

Avoid running high-power strong electromagnetic interference sources (welding, motors, etc.) around, otherwise it may interfere with the instrument and cause unstable test data, or even abnormal operation.

Welding Effects:

Welding will cause the material parameters to change, so the detection results will change when the probe passes through the weld area.



6. Maintenance

Figure 6-1

6.1 The Use and Replacement of the Probe Protection Wear Belt

The front end of the probe will inevitably be worn by the workpiece in the process of use, it is

appropriate to paste protective wear tape. **Please check the wear band at the front of the probe before use, and replace it in time if it is seriously damaged.**

Figure 6-1

Wear-resistant tape replacement steps:

1. Clean the front surface of the probe stains
2. Paste wear-resistant tape - wear-resistant tape for single-sided adhesive mode, tear and paste in the front surface of the probe (Note: the temperature type of wear-resistant tape must match the temperature type of the probe)
3. Excess overhanging edge must be cut off
4. Paste and cut the effect as shown below

6.2 Cable Connections

There are (red dot) alignment marks on the plugs and sockets of the cable. Aim the mark first and then gently insert it. In the field and dust environment, pay special attention to prevent dust particles from entering the socket core.

6.3 Cleaning

When cleaning all parts, it should be wiped with a soft damp cloth. Do not soak or flush directly.

6.4 Battery Replacement

There is a DC24V/12Ah lithium battery embedded in the instrument, it is recommended to replace the battery every 3 years. When the power is sufficient, the power indicator on the upper right side of the instrument screen is near full (95%). After a period of time, the battery power will be reduced and the power display will be reduced; if the power is less than 1 cell (5%), it will flash to indicate lack-power. The battery bar will be displayed dynamically, it takes 4~5h to fully charge.

6.5 Charging

Try to charge the battery when it is turned off. During charging, power interference and functional conflicts will be introduced, the instrument automatically prohibits calibration and detection operations, and can only look back at historical data.

6.6 Battery Maintenance

After use, remember to turn off the power of the host to avoid over-discharge and damage to the battery, do not store it for a long time. If it is not used for a long time, please carry out regular charging maintenance (about once every 1.5 months, 4~5h per charge).

6.7 Transportation:

When transporting, remove the probe and other components and place it in the special shockproof box slot, and place the cable in suitable position.

6.8 Storage:

When not in use, please place it in the indoor/car interior, store the ambient temperature -20℃~+60℃, relative humidity ≤85%, ventilation, non-corrosive gas.

7. Common Fault Analysis and Elimination

During calibration, prompting calibration failure	The basic information such as the material of the main body is incorrectly input, or the component being inspected exceeds the detection capability of the probe	Confirm whether the current working condition is within the detection range of the probe, confirm whether the basic information such as the body material is accurate, and then try the calibration procedure again. If the calibration fails repeatedly, try again after changing the probe.
Fault Phenomenon	Possible Cause Analysis	Solution
The Device does not start when booting, or automatically shuts down after booting	The built-in lithium battery is low on power/low voltage	External single-phase AC100~240V power adapter, first charge after starting work
	Ambient temperature is too low ≤-20℃ or too high ≥60℃	Control the temperature of the test environment within the requirements of the equipment parameters
The battery is not fully charged, or it can be charged quickly but can be used up quickly	Lithium battery is damaged, or cycle life is over	Replace the battery with a new one, it is recommended to replace the battery every 3 years
Screen is too dark or too bright	-	Check the screen brightness adjustment in the window system settings
Test program does not respond to operation	The touch screen is not responding, or a continuous scan triggered by time or position is in progress, or the program freezes	If only the red light is on, user need to wait until the green light is on before operating; If a continuous scan triggered by time or position is in progress, pause the scan before proceeding; If it can respond to the key operation on the probe, but does not respond to the touch screen operation, the test program will be restarted after forced shutdown.
During calibration, it indicates that no signal is detected	The connecting cable and plug connector between the probe and the host are loose or faulty, or the component to be inspected exceeds the detection capability of the probe	Confirm that the cable between the probe and the host is well connected, or recalibrate after replacing other probes.

7. Common Fault Analysis and Elimination (continued)

Fault Phenomenon	Possible Cause Analysis	Solution
During calibration, it indicates that the probe model selection is not accurate	The connected probe model does not match the probe model set in the project management	Check the probe model, refer to section 5.2 Project management • Information parameters • Probe selection, after correctly selecting the probe type connected to the host, re-calibrate.
The test result is unstable, and the data at the same test point jumps greatly	Calibration is unsuccessful or the component under test exceeds the detection range of the probe	Refer to section 4.3 Probe capability selection to confirm whether the current working condition is within the probe detection capability interval, and then re-calibrate.
During continuous scanning, the detection result jumps too much	The probe moves too fast, or the detection speed is set too fast	First confirm that the detection data is stable when the probe is not moving. Refer to section 5.3 • Detection speed to set a slower detection speed and slow down the movement speed appropriately.
Distance measurement error is too large	Distance counter encoder slips out of step	Need to press the probe slightly to make it fit well on the surface of the component to be checked to ensure that the encoder wheel does not slip out of step
Distance measurement does not count meters or the error is too large	Foreign objects may get stuck in the encoder wheel	Remove foreign objects so that the encoder wheel can rotate (walk) smoothly

7. Common Fault Analysis and Elimination (continued)

Fault Phenomenon	Possible Cause Analysis	Solution
The instrument crashes (the test program or system is not responding, the data is disordered, the keys are not responding, and the machine cannot be shut down, etc.)	During the work, some accidental factors may cause: the detection program or the system is unresponsive, the data is disordered, the buttons do not respond, and the shutdown cannot be performed	Press ⚫ on the right side panel of the instrument for about 3s to force shutdown, and restart. ⚠️ **Forced shutdown risks losing current test data!**
Unable to read the test data of the existing project, an error window pops up	Abnormal shutdown during detection may cause damage to the data file of the current detection project	After restarting the program, if the data cannot be read normally, can delete the project data in project management interface
The equipment is not working properly due to other reasons	Whether the plug and connect devices of the equipment are in a loose state	Check and tighten each plug
	The environmental electromagnetic interference is too large, and the interference with the instrument leads to unstable test data and even abnormal operation	Avoid running high-power strong electromagnetic interference sources (welding, motor, etc.) around
	-	See Attention to eliminate possible causes one by one

8. Packing List

1. **Main unit (Containing data cable, charger)**
   1 Set

2. **Carbon steel probe (C.S: smaller, medium, larger, including 5m cable)**
   1 Group

3. **Stainless steel probe (S.S: smaller, medium)**
   1 Group

4. **Wear-resistant temperature-isolation probe boots (smaller, medium, larger)**
   1 Group (optional)

5. **Carbon steel bare tube high-resolution probe (C.S with handle)**
   1 Piece (optional)

6. **Stainless steel bare tube high-resolution probe (S.S with adapter)**
   1 Piece (optional)

7. **Carbon steel six-channel array probe (C.S)**
   1 Piece (optional)

8. **Stainless steel six-channel array probe (S.S)**
   1 Piece (optional)

9. **30m Probe cable 30m**
   1 Piece (optional)

10. **Probe extension lever**
    1 Piece (optional)

11. **Operating manual**
    1 Book

12. **Factory test report**
    1 Copy

13. **Instrument case/bag**
    1 Piece

Appendix A - Sample Detection Report Form (General Table Page)

Pulse Eddy Current Testing Report

Report Information:	
Report number:	TEST-1
Process specification number:	DPECT-17-20230807 (6.8.2-230801)
Executive standards:	GB/T 28705-2012, NB/T 47013.13-2015
Project Details:	
User:	[User Name]
Project:	GD-1
Component type:	Pipe
Material:	carbon steel
Wall thickness:	5.7 mm
Diameter:	80 mm
Coating thickness:	30 mm
Protective skin:	Aluminium
Type pressure:	[Value] Mpa
Temperature:	[Value] °C
Safety regulations:	Rules for the Construction of Pressure Vessels
Surface state:	[Description]
Instrumentation:	
Instrument:	DPECT-17-20230807 (6.8.2-230801)
Probe:	P1-C.Sp
Scanning method:	single-point
Step:	3 mm
Circumferential:	4

Appendix A - Sample Detection Report (continued)

On Site Testing Situation Description:

Example:

1. The total area of the tank/pipeline is ____ square meters, with a total of ____ square meters of testing points per square meter.

2. Carbon steel/stainless steel material, with ____ mm insulation layer, with aluminum/iron sheet inspection, or bare tube inspection without insulation layer.

3. The on-site insulation is in good/poor condition, with/without obvious potholes; There is/is no obvious pipeline vibration, and there is/is no obvious noise; There are high-power electrical equipment such as pumps, welding machines, motors, switchgear, and busbars operating on site, and they are approximately ____ meters away from the detection point. There is/is no identification of ____ Hz electromagnetic interference on site.

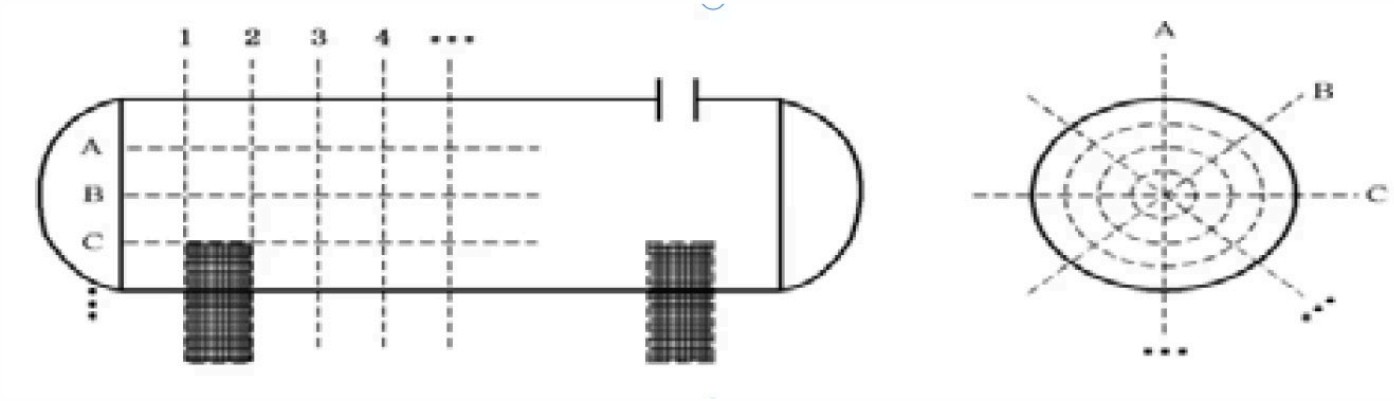
4. No obvious structural components were identified within the insulation layer, or they were iron wires/heat tracing pipes/support frames, etc.

5. The testing of the sample tube test block in the office environment shows ideal/poor working conditions.

Detection Site Schematic Diagram:

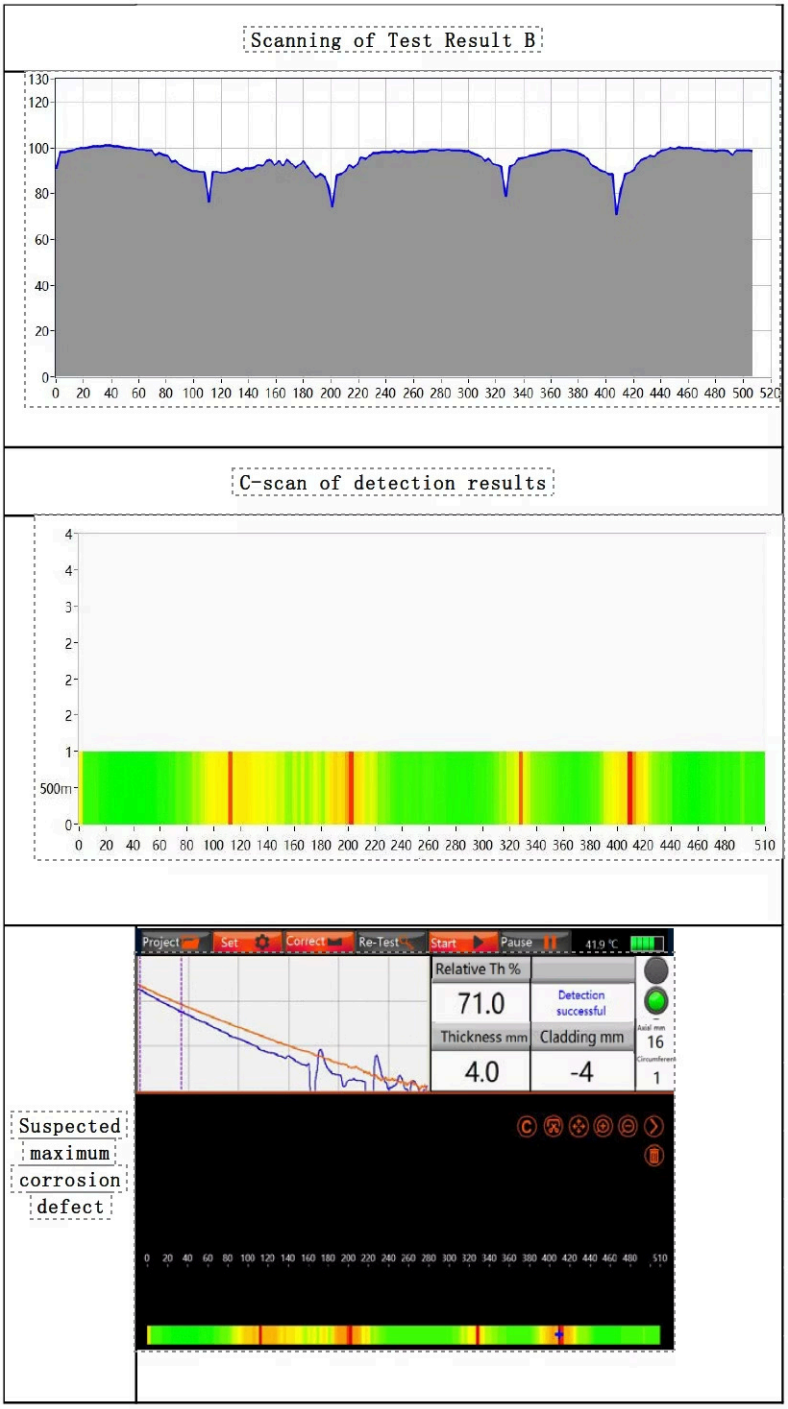
Example:

Scan from right to left along the axial direction, scanning a total of four lines in the circumferential direction.



Appendix A - Sample Detection Report (continued)

Test Conclusion



Example:

01	02	03
At areas suspected of severe corrosion (wall thickness reduction >20%), it is recommended to remove the cladding layer as soon as possible for re-inspection;	It is recommended to regularly monitor the corrosion trend of suspected areas with significant corrosion (wall thickness reduction of 10-20%), and remove the cladding layer for re-inspection during the overhaul period;	It is recommended to remove the cladding layer as much as possible for re-inspection during major repairs in areas suspected of corrosion (with a wall thickness reduction of 5-10%).

Report Signatures:

[Organization Name]	[Name]	2023/8/11	[Name]	2023/8/29

Appendix B - Detection Report Sample Table (Data Page)

Summary of Relative Wall Thickness Testing Data

Circumferential \ Axial (mm)	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320
0	99.3	99.3	98.6	99.8	98.9	99.2	99.2	99.3	98.8	97.7	99.9	99.0	98.6	98.6	97.7	102.7	90.5
1	99.4	100.0	99.0	99.4	97.6	97.9	96.6	94.9	94.8	94.8	95.3	93.3	86.6	72.9	68.9	67.1	65.0
2	99.2	100.7	99.7	99.4	99.3	100.5	99.9	97.6	95.9	95.8	96.8	96.5	96.4	95.5	96.1	88.3	73.0
3	96.5	64.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

340	360	380	400	420	440	460	480	500	520	540	560	580	600	620	640	660	680
81.5	74.0	74.4	76.2	76.3	76.8	75.9	76.1	76.1	75.8	76.6	74.8	74.2	76.2	74.7	74.3	76.7	74.6
64.6	65.0	66.0	68.4	69.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69.3	65.7	65.2	64.9	65.2	66.5	68.2	71.0	99.0	102.9	100.5	99.7	100.1	101.0	100.4	98.5	96.5	97.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0