

# **ISONIC PA AUT**

## **Spiral Scan – Inspection of Tubular Parts**

**Operating Manual and Inspection Procedure**

**Rev 1.00**

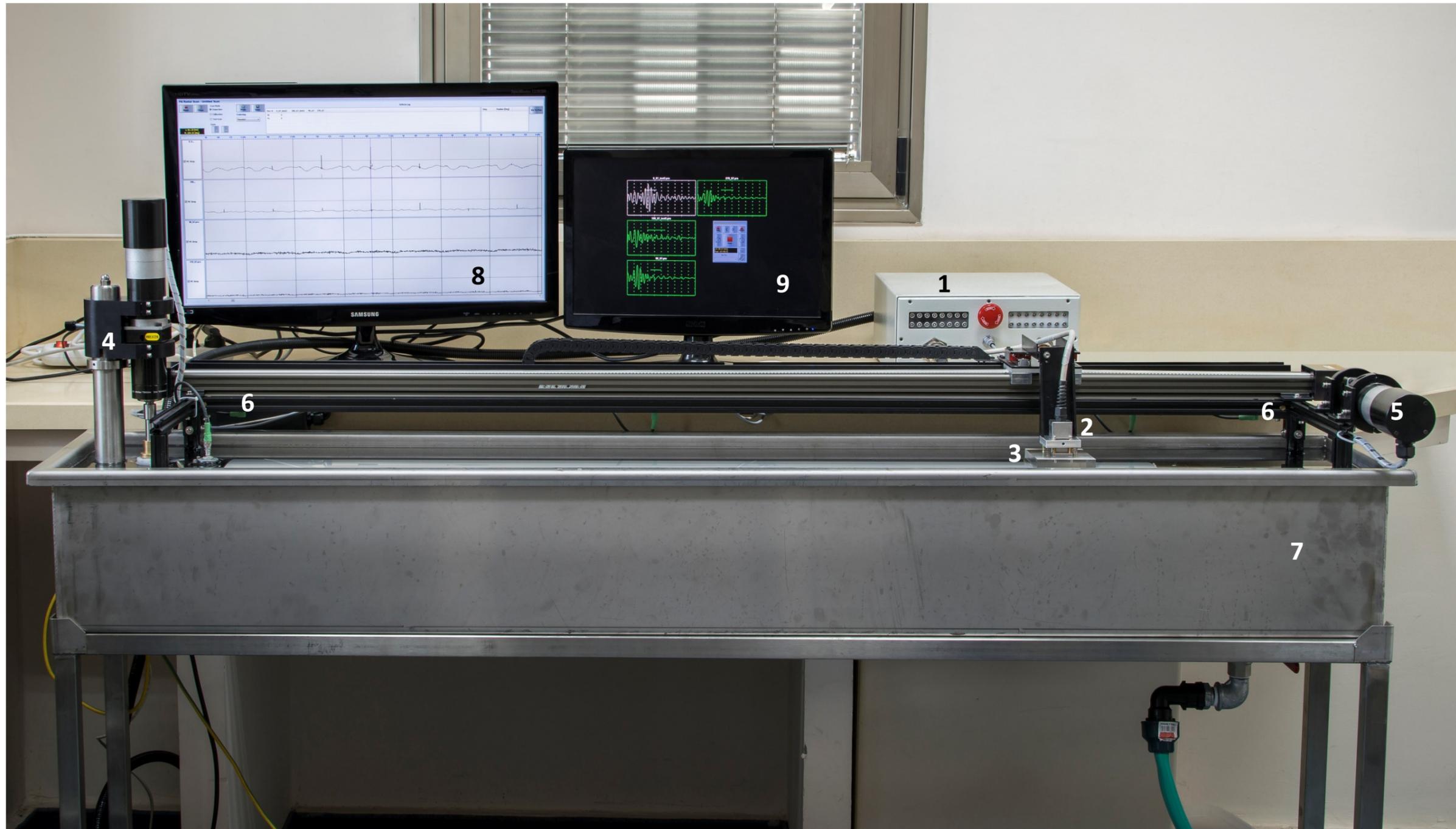
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## General

**ISONIC PA AUT Spiral Scan Inspection Application** was designed on the platform of **ISONIC PA AUT** instrument in order to perform the automatic immersion ultrasonic inspection of tubular parts for the tube wall defects such as variously situated cracks, voids, pitting, and the like

The inspection is performed with use of one 8X8 matrix array probe forming sequence of the beams defined by the corresponding pulsing-receiving cycles in all necessary directions required to detect variously situated cracks and other defects in the wall of the tubular part, which rotates in the immersion tank whilst the probe moves along so the probe motion over the whole OD surface of the part is represented by the spiral trace

## System Components



1 – **ISONIC PA AUT** electronic unit

2 – Matrix Array Probe

3 – Collimator-Delay Line

10 – Control and data acquisition computer (not shown on the photo)

4 – Stepped motor / encoder / gear box for the rotation of the tubular object

5 – Stepped motor / encoder / gear box for the linear motion of the matrix array probe

6 – Frame and fixture of tubular object in the immersion tank

7 – Immersion tank

8 – Main screen

9 – Secondary screen

## Prior to the scanning...

Every part should be inspected visually prior to the scanning: it should be clean and free of metallic particles on the OD and ID surface. If necessary the part should be washed gently

The parts with:

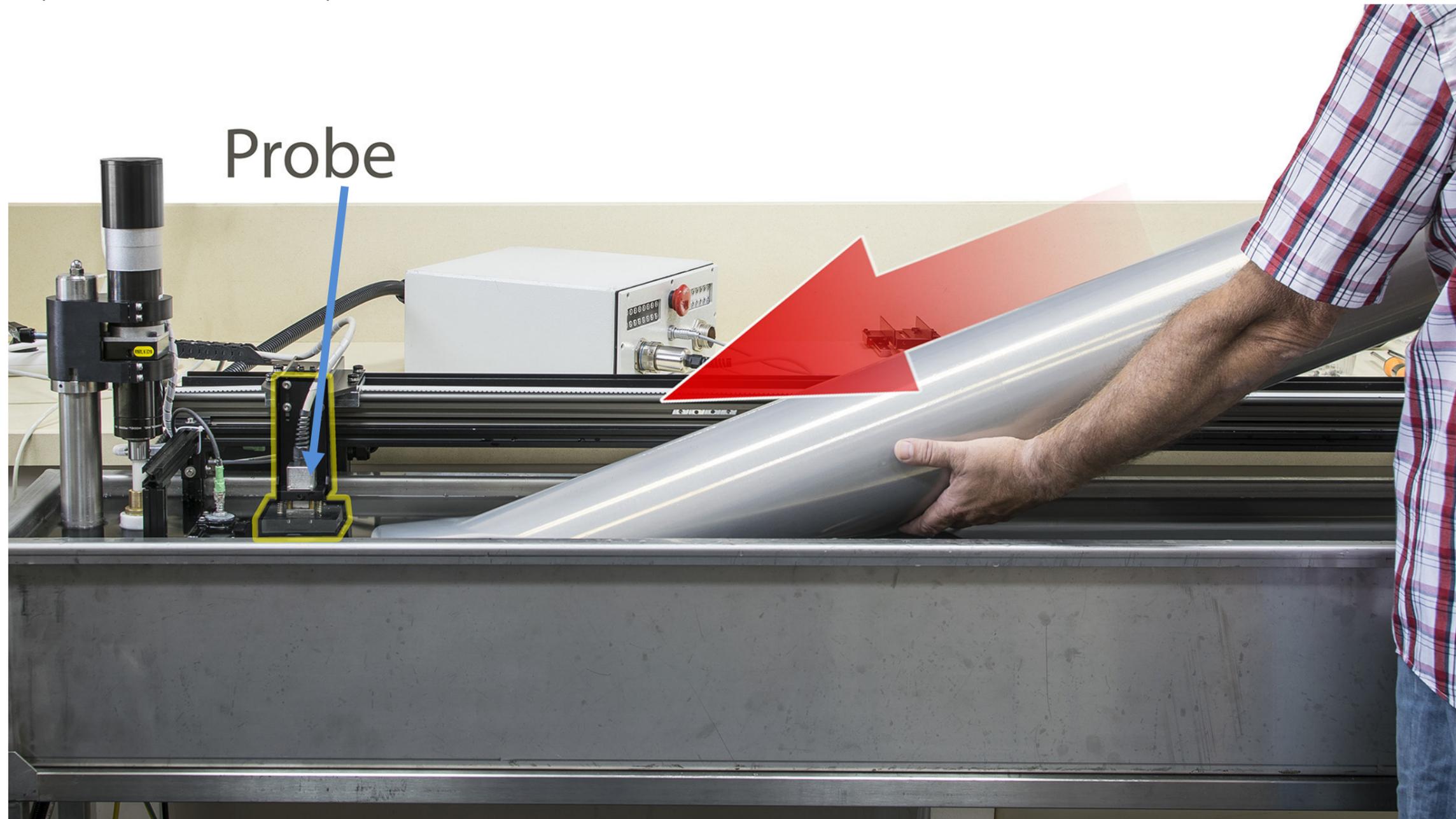
- stickers and other foreign materials (glue, paints) on the ID and OD surfaces
- coarse mechanical damages and deformations

should not be inspected

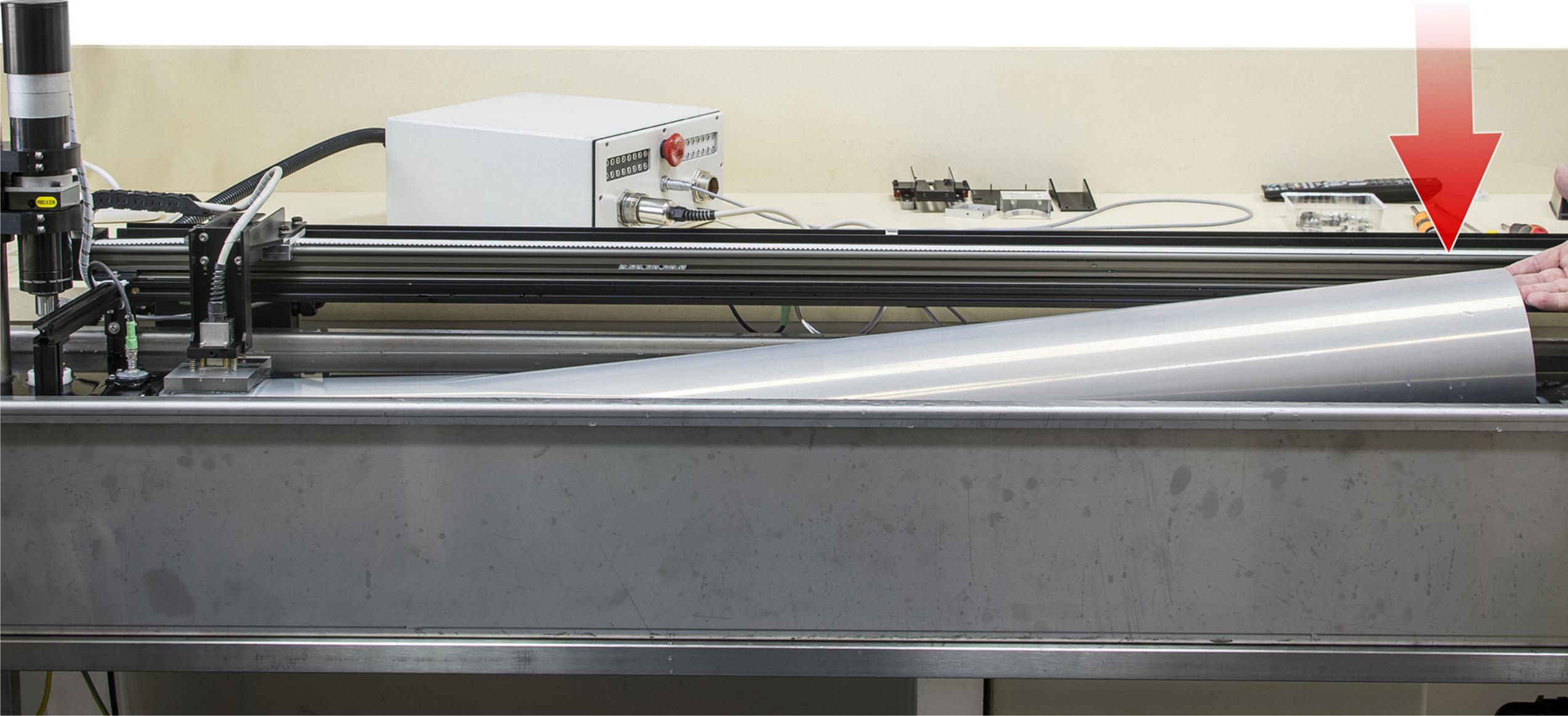
All imperfections found during visual inspection should be documented with noting of their positions on the part

## Inserting tubular part / calibration block into immersion tank before the scanning

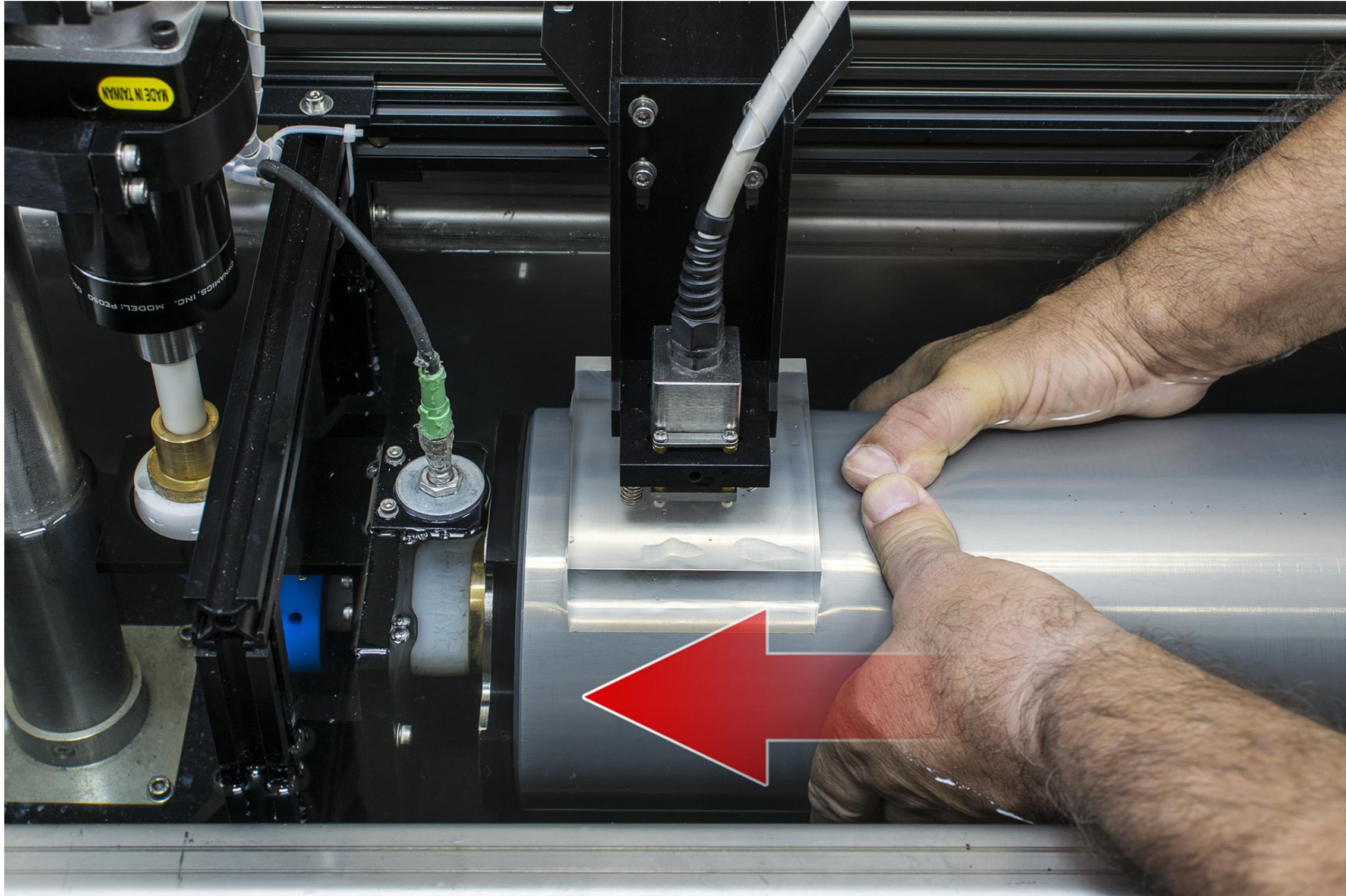
1. Insert the part into the water under the probe's collimator



2. Slowly lay down the part until it is fully submersed and the air bubbles went out from inside



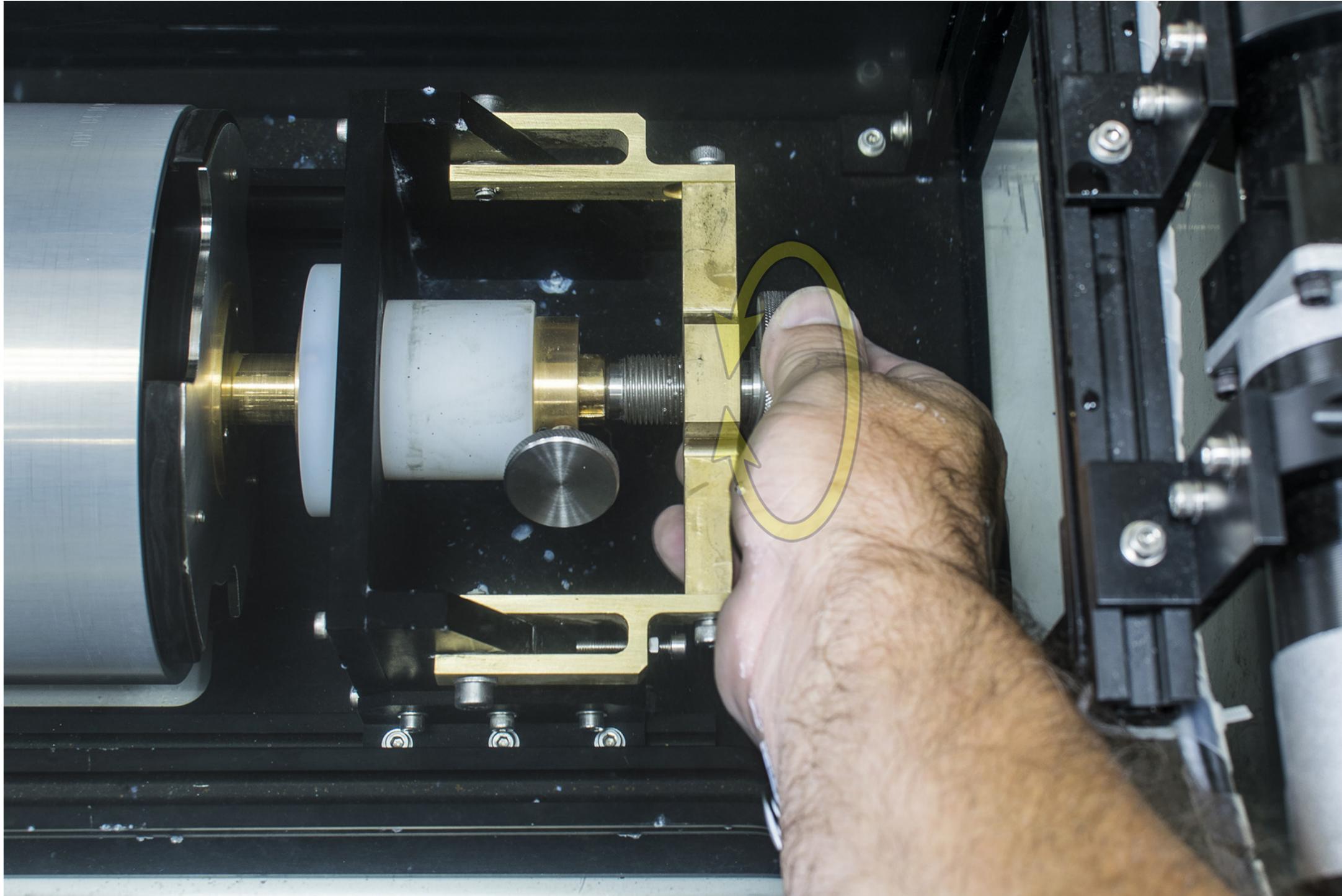
3. At the probe side lift the part slightly upwards and push it towards the conical clamp until it's fully inside



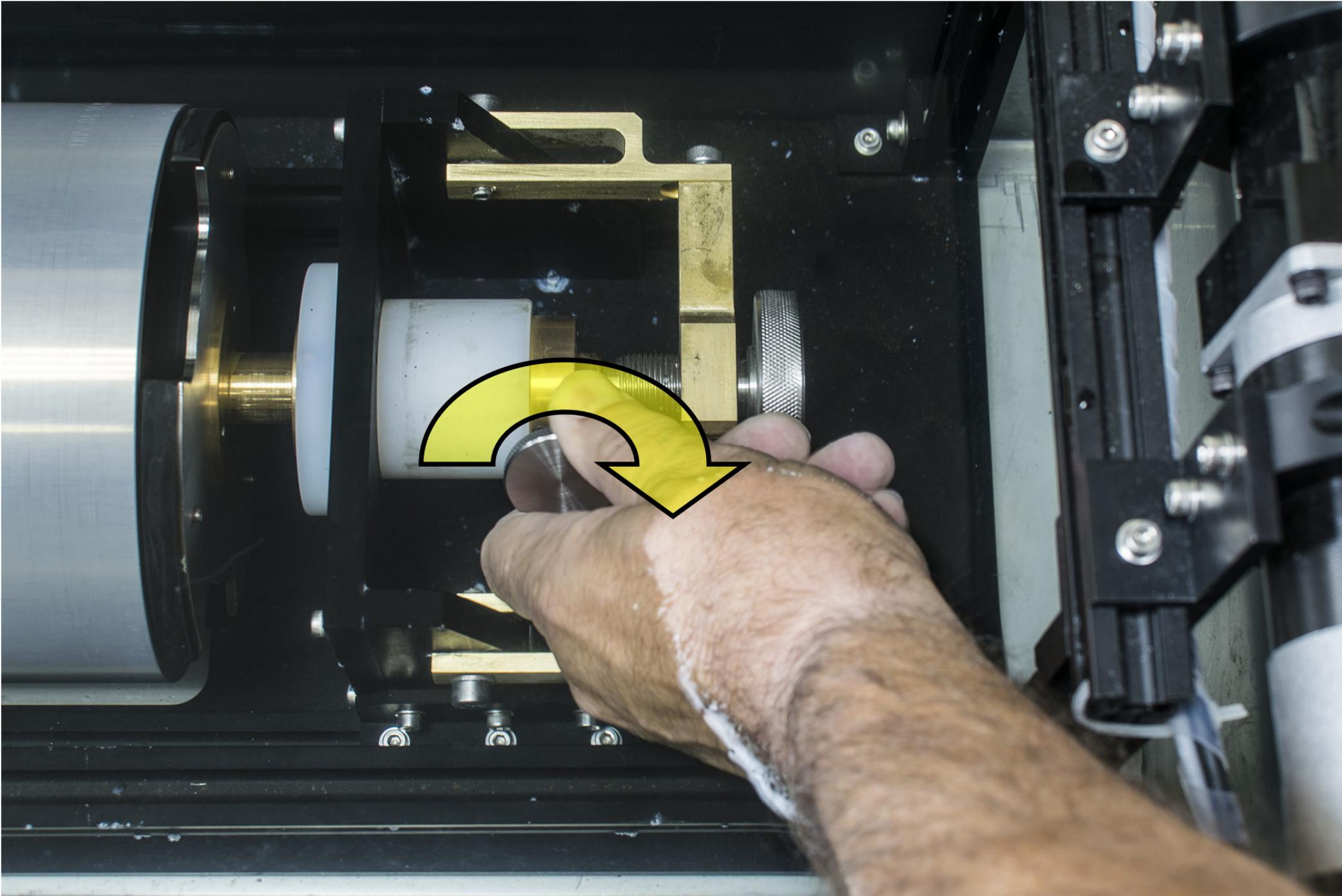
4. At the opposite side proceed in the same manner: lift up the part slightly and slide the conical clamp inside until it is fully inserted



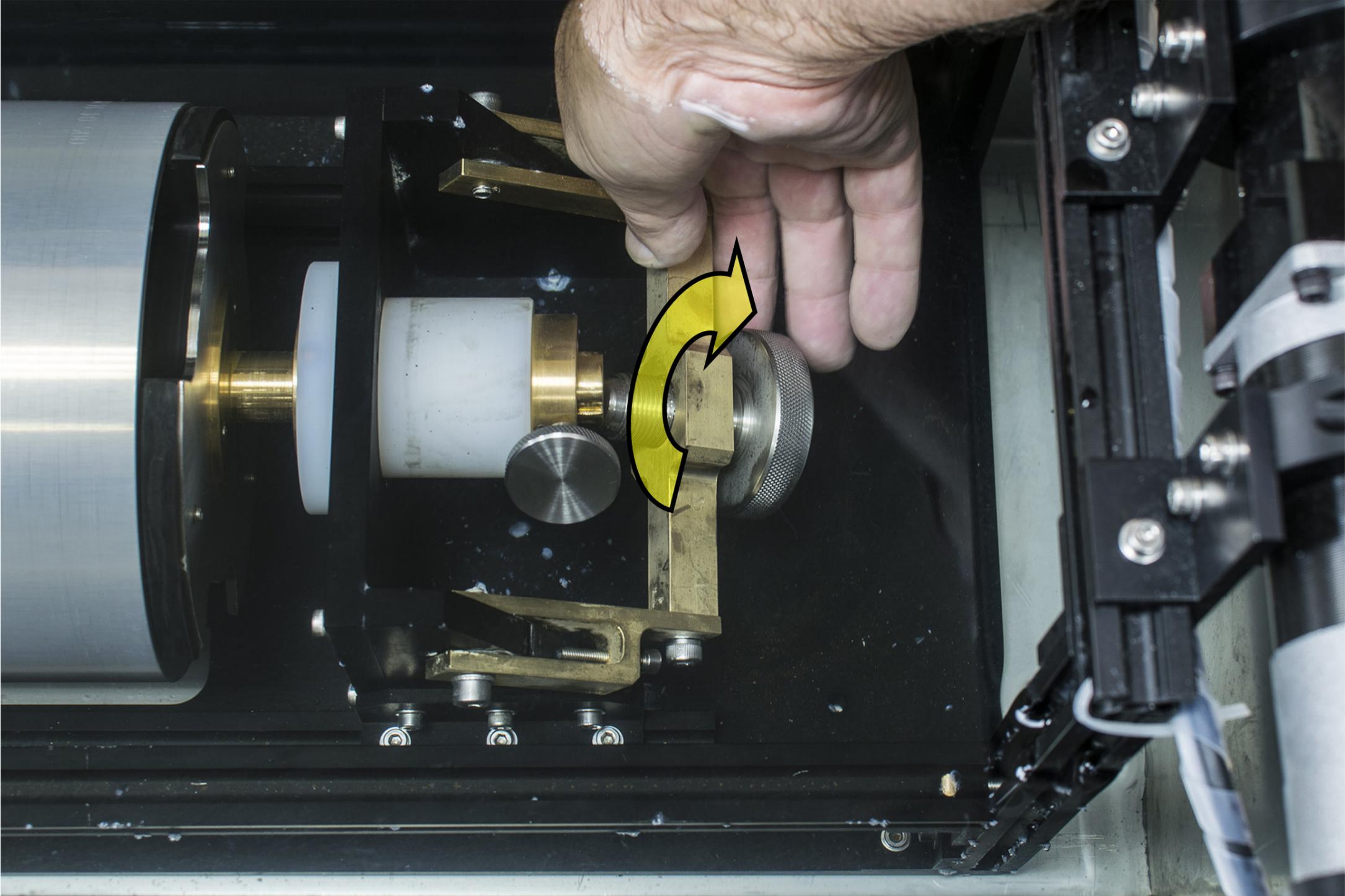
5. Lift up the bracket carrying the large screw knob so that it is aligned with the part's axis then tighten



6. Tighten the small knob on side

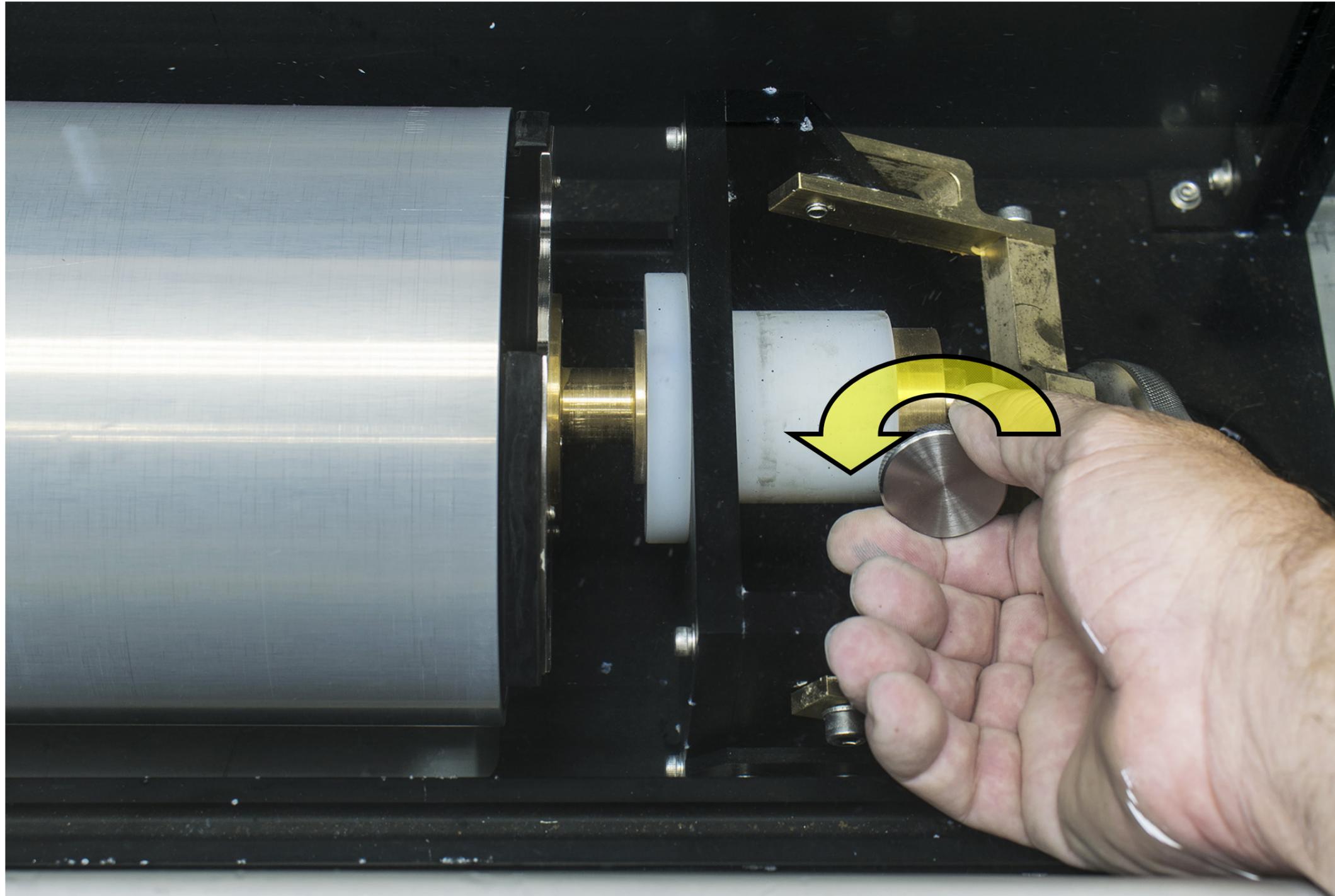


7. Unscrew the large knob and lay the bracket down gently

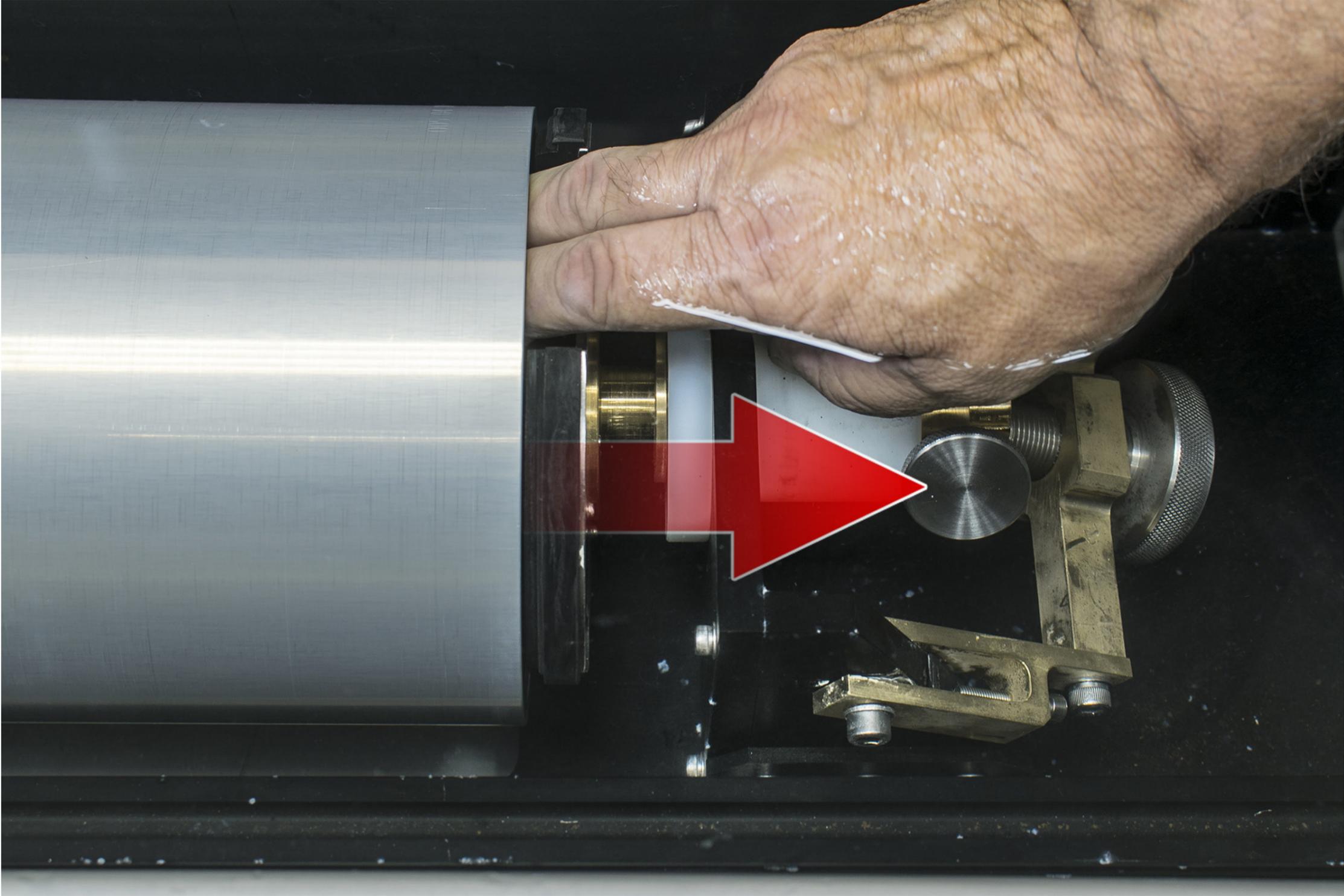


## Removal tubular part / calibration block from the immersion tank after the scanning

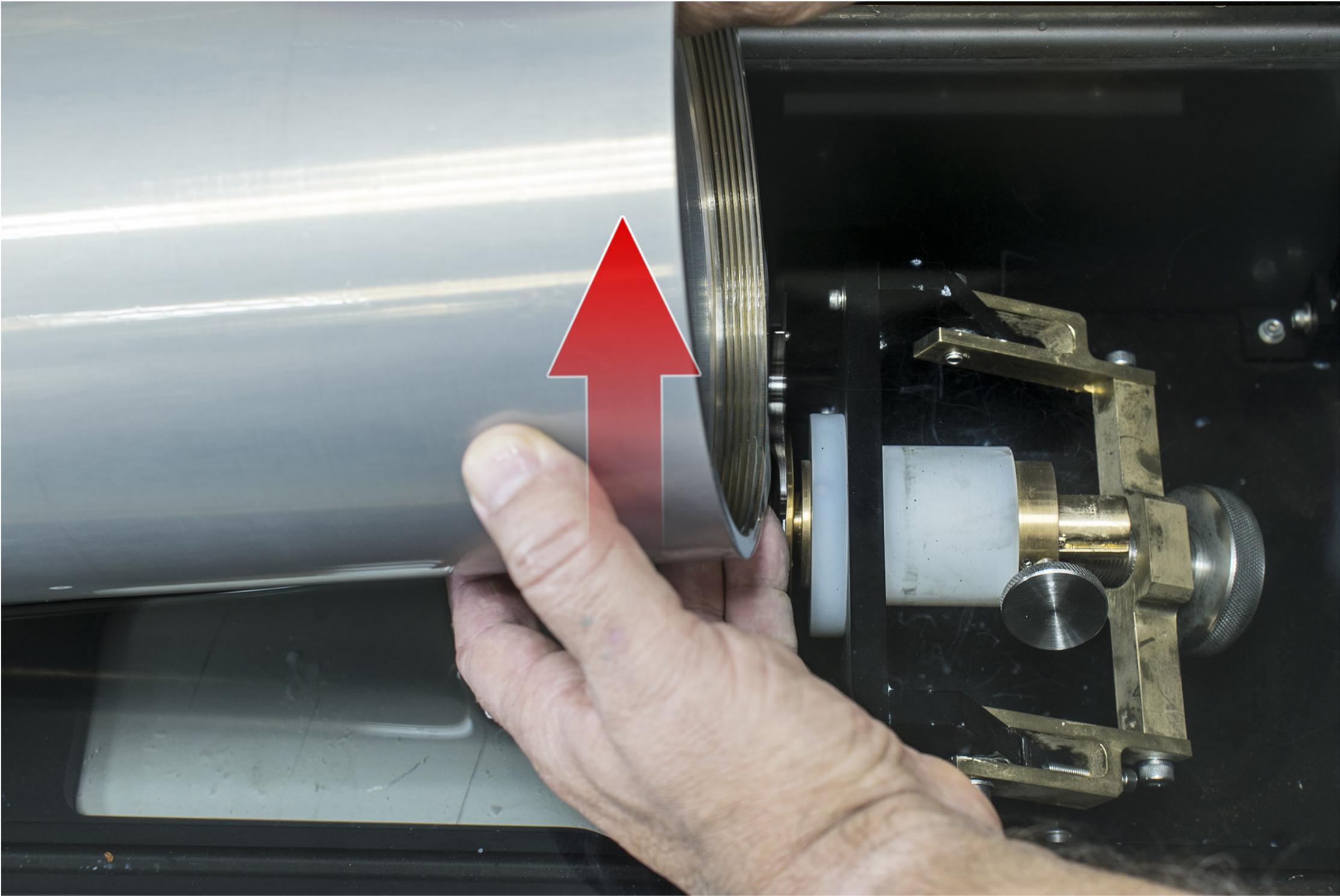
1. Unscrew the small knob on side



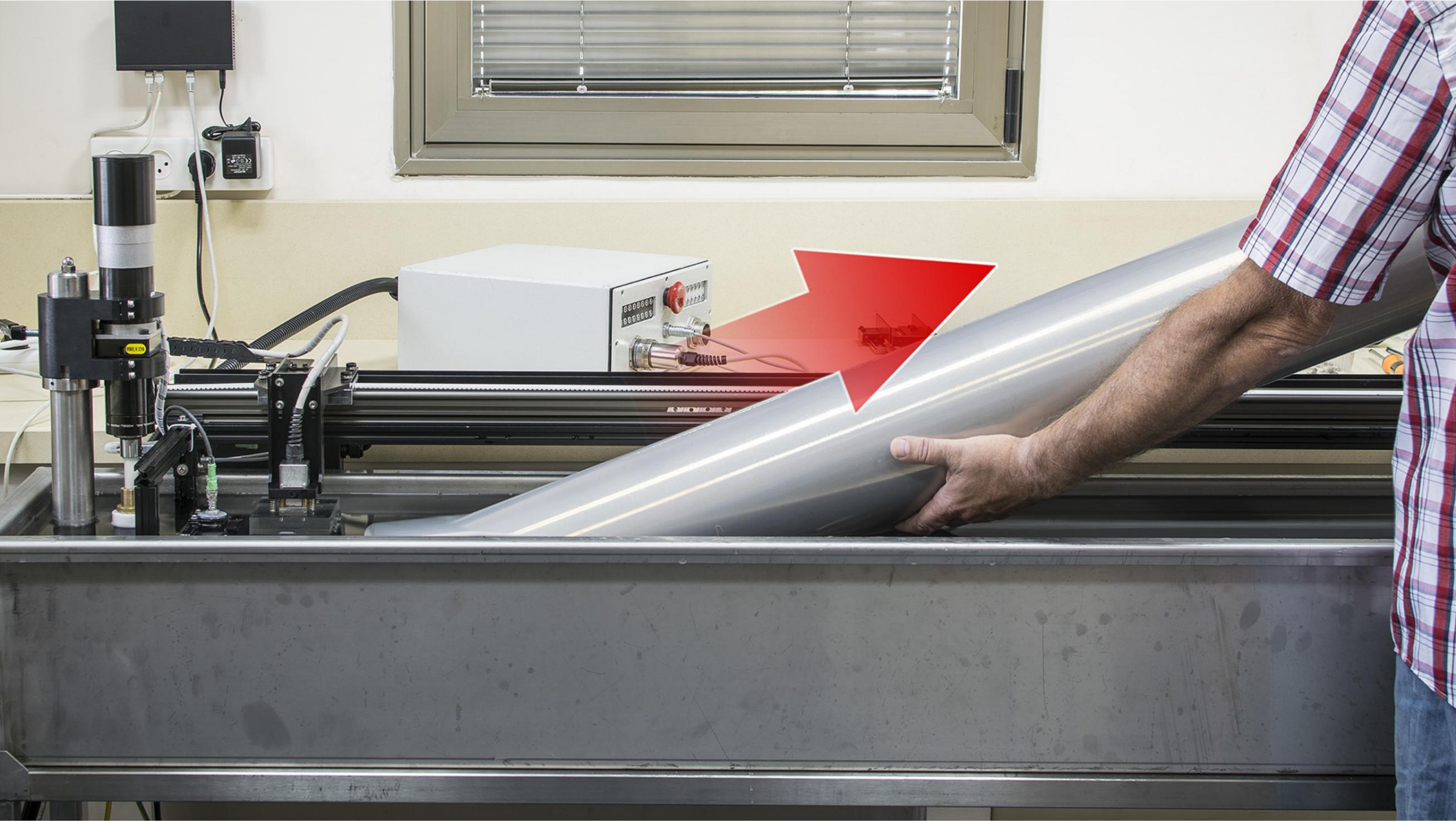
2. Pull out the clamp out gently



3. Lift the part upwards



4. Take out the part gently

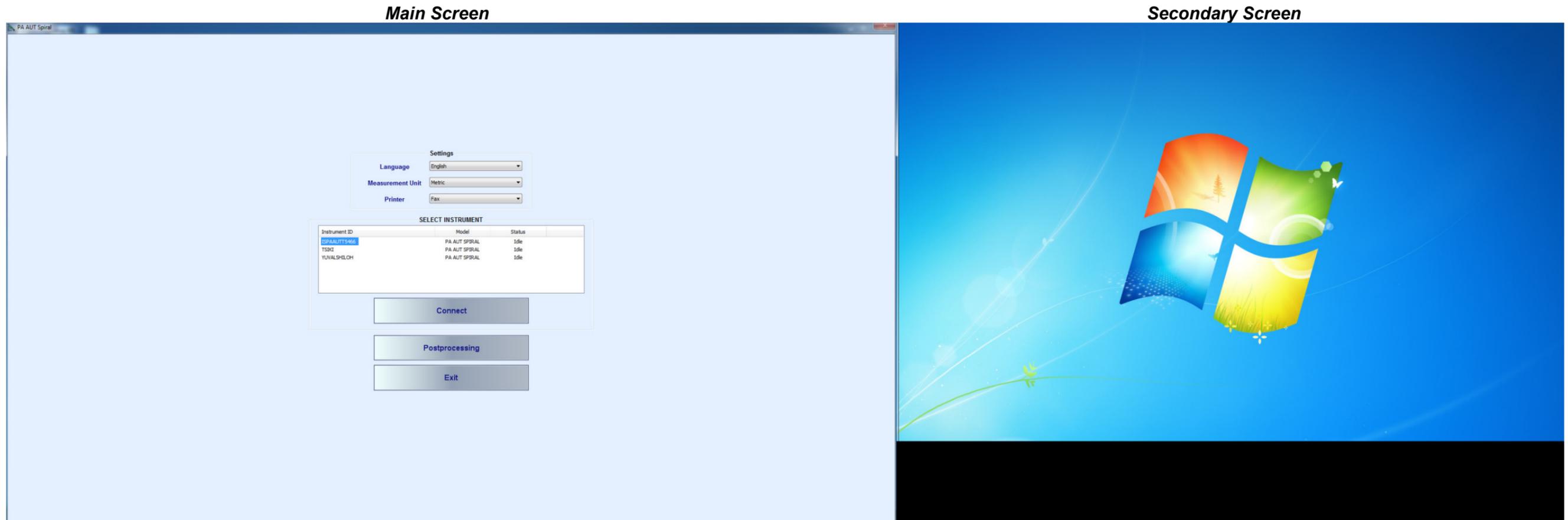


## After the scanning...

Every part should be dried completely after removal from the inspection tank. For that purpose the part should be fixed in the sure vertical position. Upon the part is completely dry it should be packed into the original plastic envelop and fitted into it's original slot in the transport container

# Performing Calibration and Inspection – Operating the System through ISONIC PA AUT Spiral Scan SW

Connect the control computer and **ISONIC PA AUT** instrument to the LAN (Local Area Network) and switch them on. Upon Windows boot up completed in the control computer run **ISONIC PA AUT Spiral Scan** software



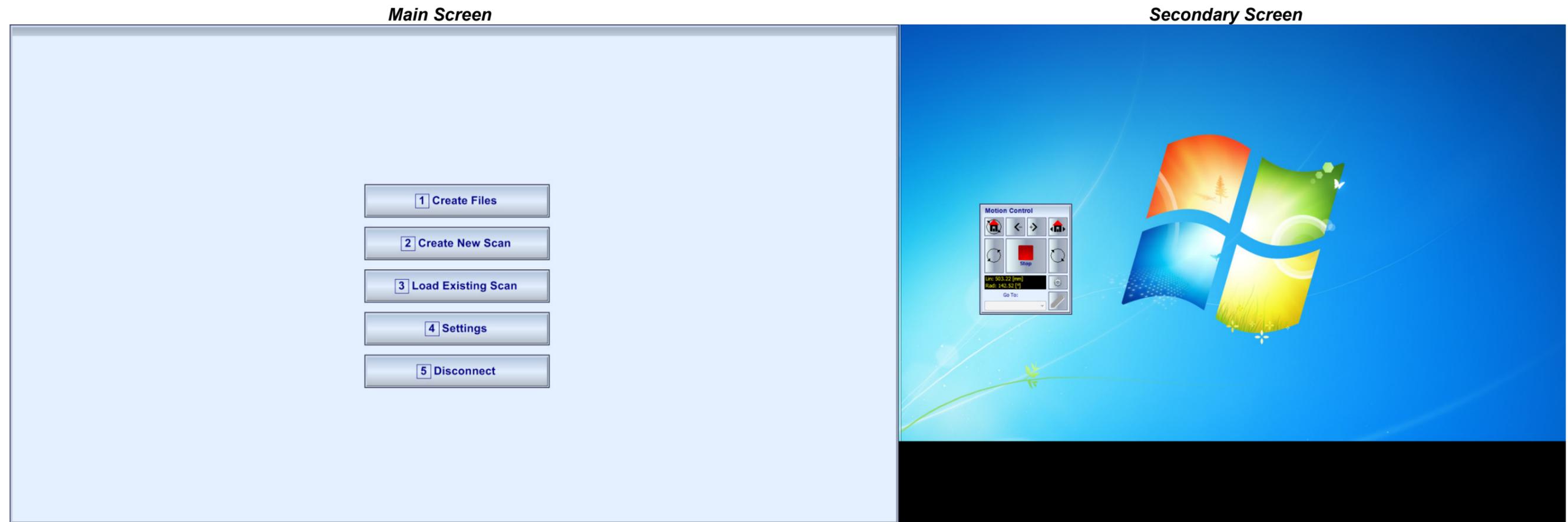
## Connecting to the instrument

To connect control computer to **ISONIC PA AUT** instrument highlight it's name in the list of Idle machines through left mouse click on it and click on the **<Connect>** button then

## Postprocessing

One of the most powerful features of the **ISONIC PA AUT Spiral Scan** is the ability of processing previously saved scans offline. To start click on the **<Postprocessing>** button then select a file to deal with

## Main Menu



The main menu screen is the first one appearing upon connected to the **ISONIC PA AUT** instrument. The **Motion Control** virtual joystick appears as well, it is recommended to move it to the secondary screen using mouse drag-and-drop

### Create Files

Use this option to create the configuration files for the scan. Every configuration file determines one pulsing / receiving cycle (beam, focal law). For further details refer to the "**Probe Select**" and "**Pulser Receiver**" screens

### Create New Scan

A number of focal laws should be implemented in the sequence loop automatically whilst scanning the part. Upon configuration files ready select this mode of operation for composing the **Scan Plan** and continue to the "**Strip Chart**" screen. For further details see the "**Configuration Files Select**" and "**Strip Chart**" screens

### Load Existing Scan

Use this option in order to upload previously saved scan plan from a file and navigate directly to the "**Strip Chart**" screen

## Settings

The miscellaneous settings defining the scanning parameters and speed, encoder resolution, and the like should be provided

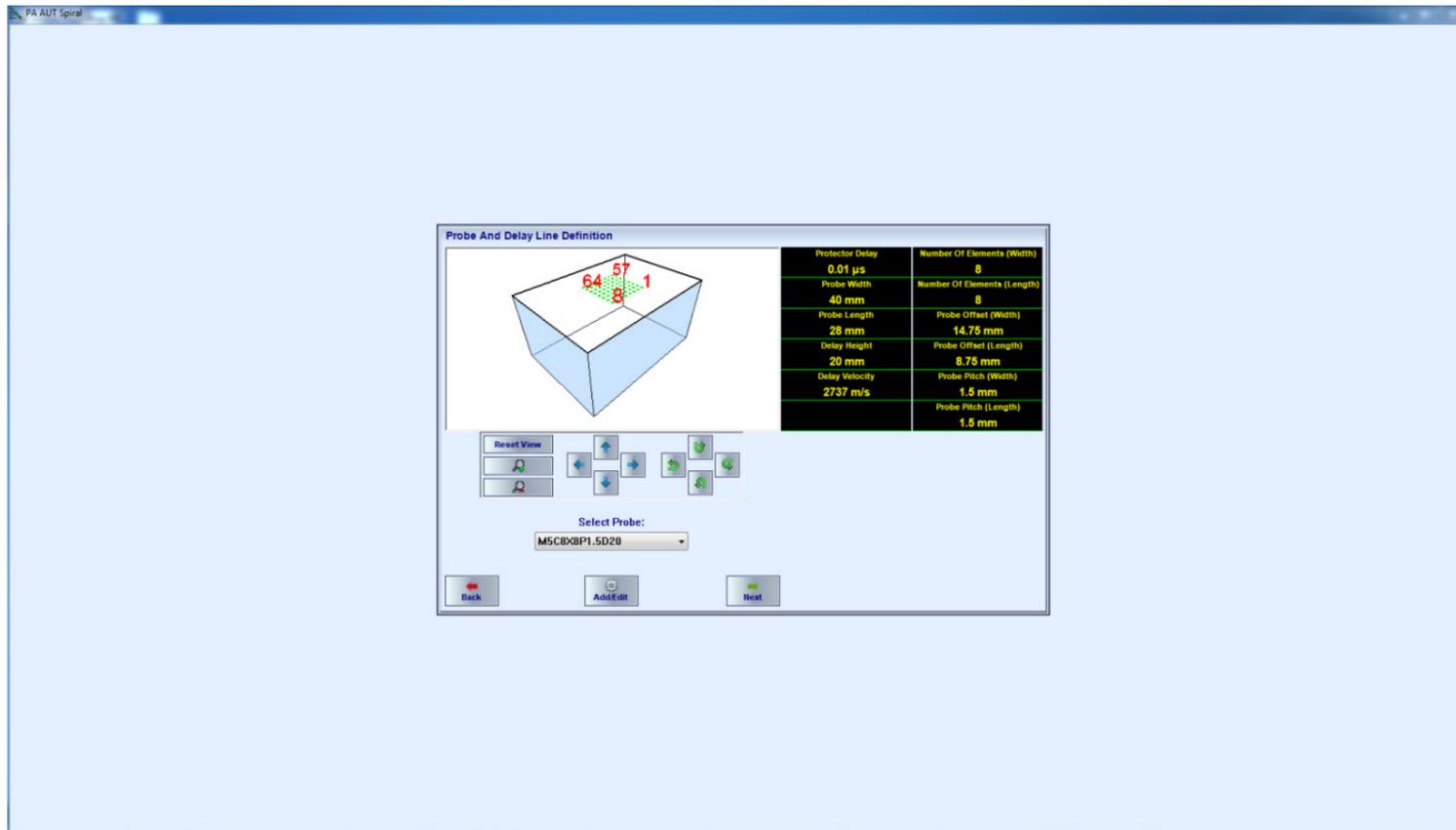
## Motion Control Virtual Joystick

The **Motion Control** virtual joystick is implemented as a "floating" window and is used to control the motion of the probe and tubular object, the buttons

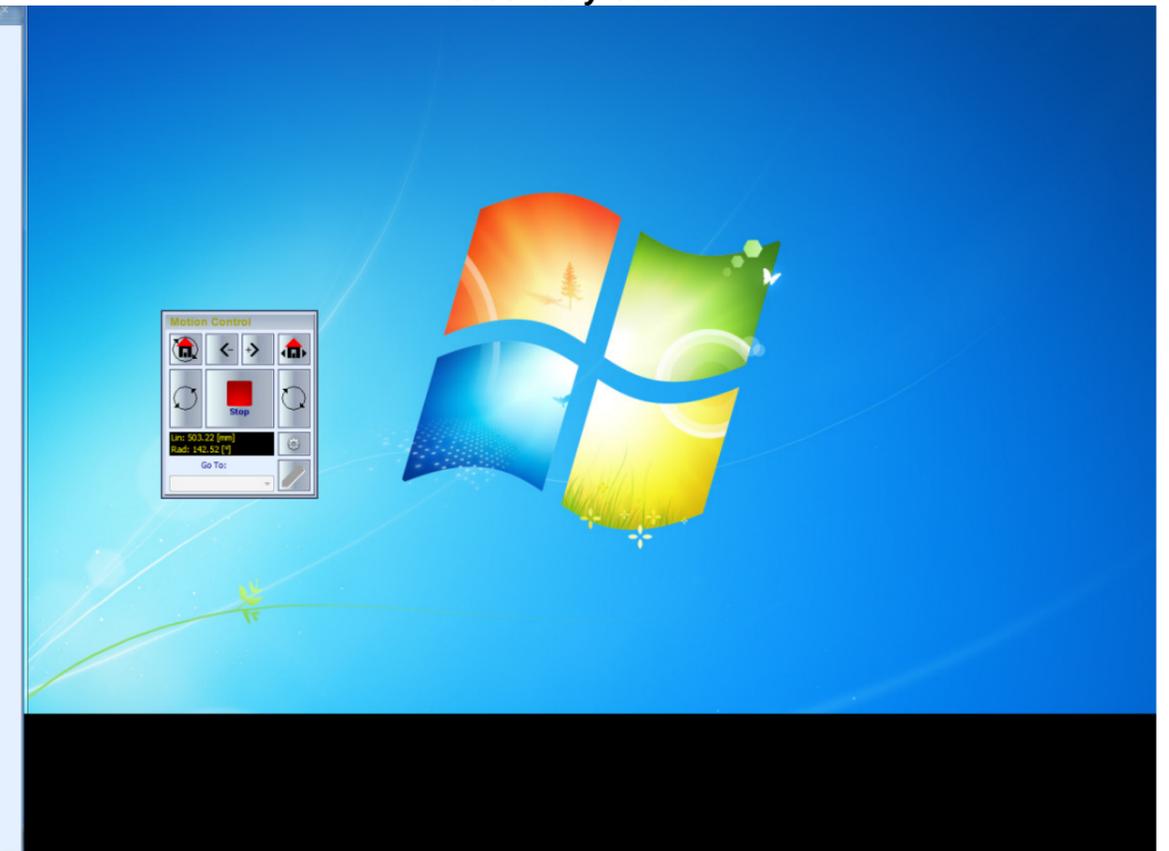
- +> Start linear motion of the probe in the positive direction
- < Start linear motion of the probe in the negative direction
-  Start part rotation counter clockwise direction
-  Start part rotation in clockwise direction
-  Perform linear homing
-  Perform radial homing

# Probe Selection

Main Screen



Secondary Screen



The "**Probe Selection**" screen the probe to be used should be selected among the plurality of recorded in the database

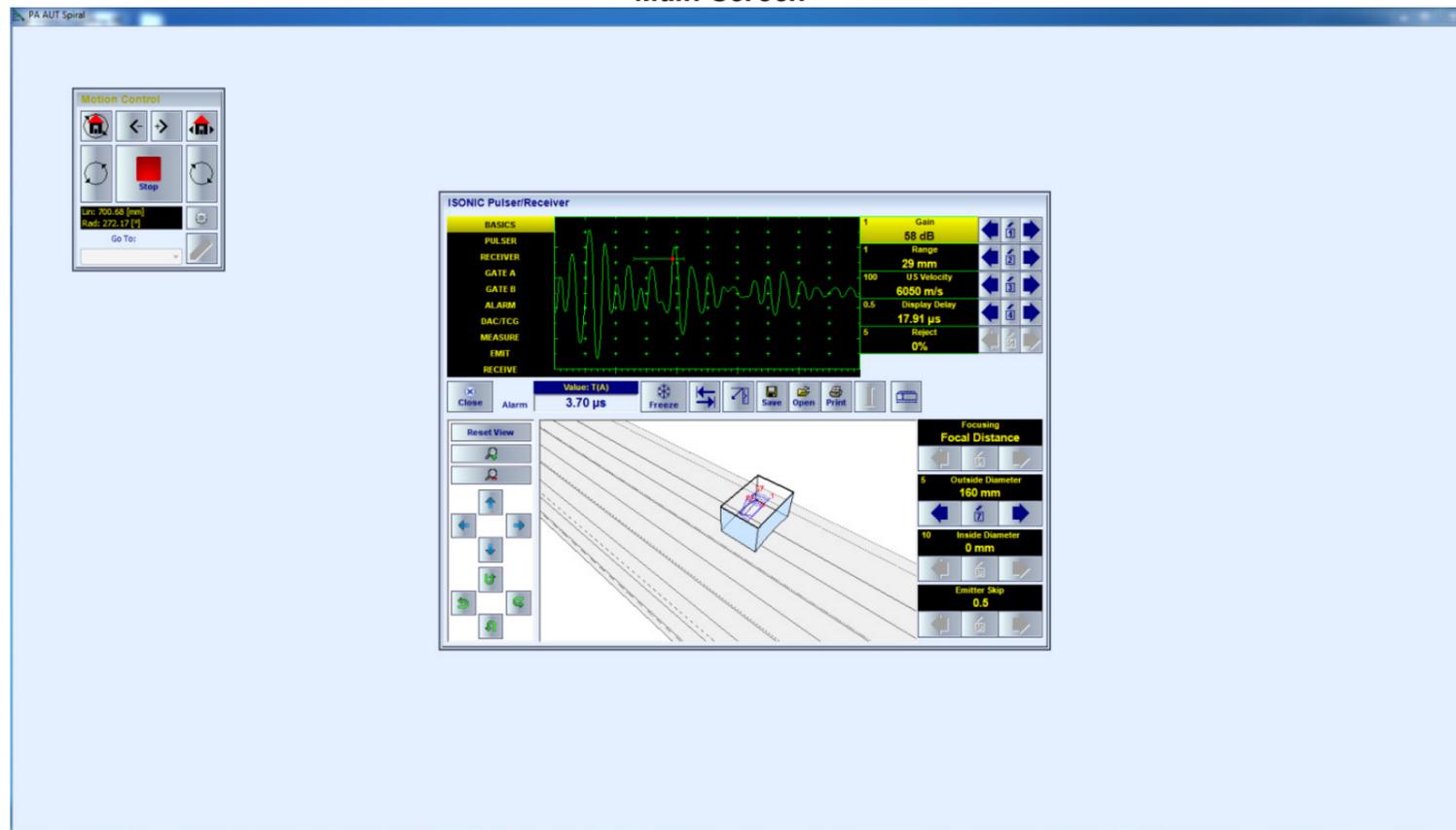
It is also possible to create new or edit the existing probe data upon click on the **<Add/Edit>**

Click on **<Next>** to navigate to the "**Pulser Receiver**" screen

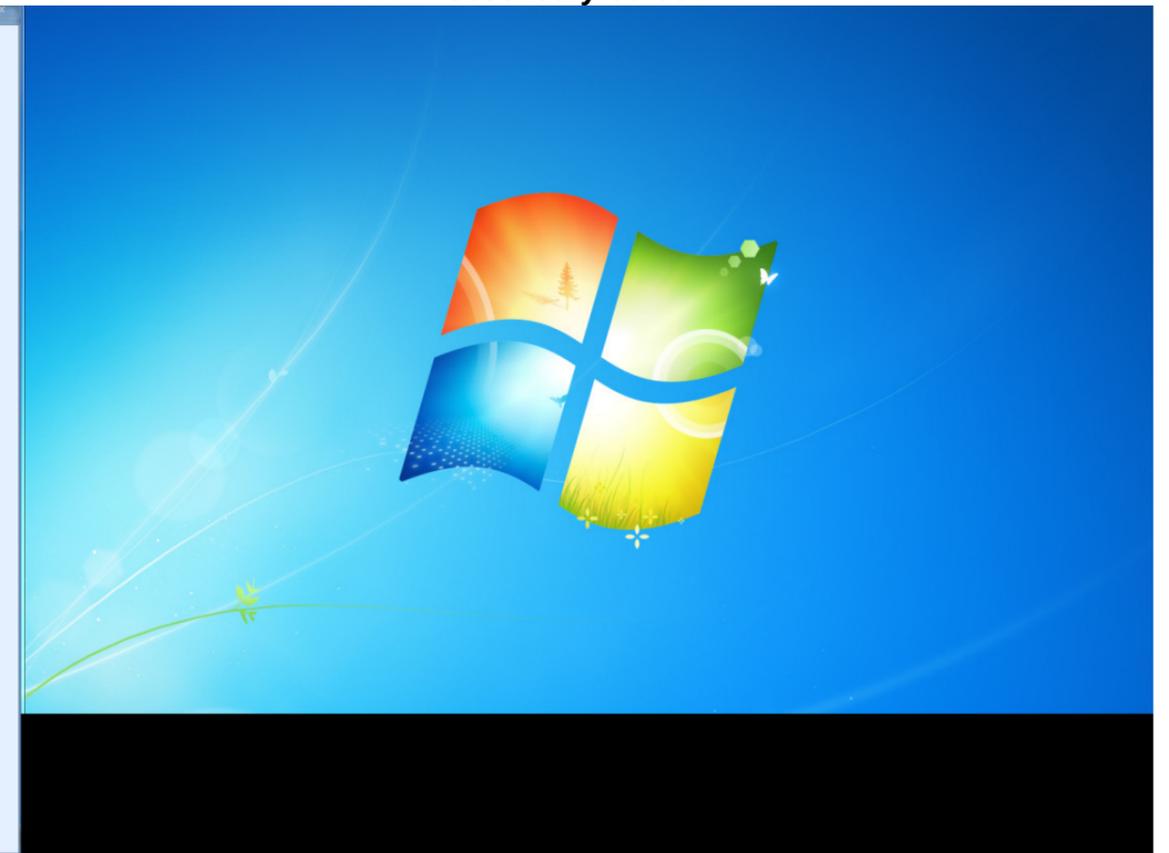
Click **<Back>** to navigate back to the "**Main Menu**" screen

# Pulser Receiver

Main Screen



Secondary Screen



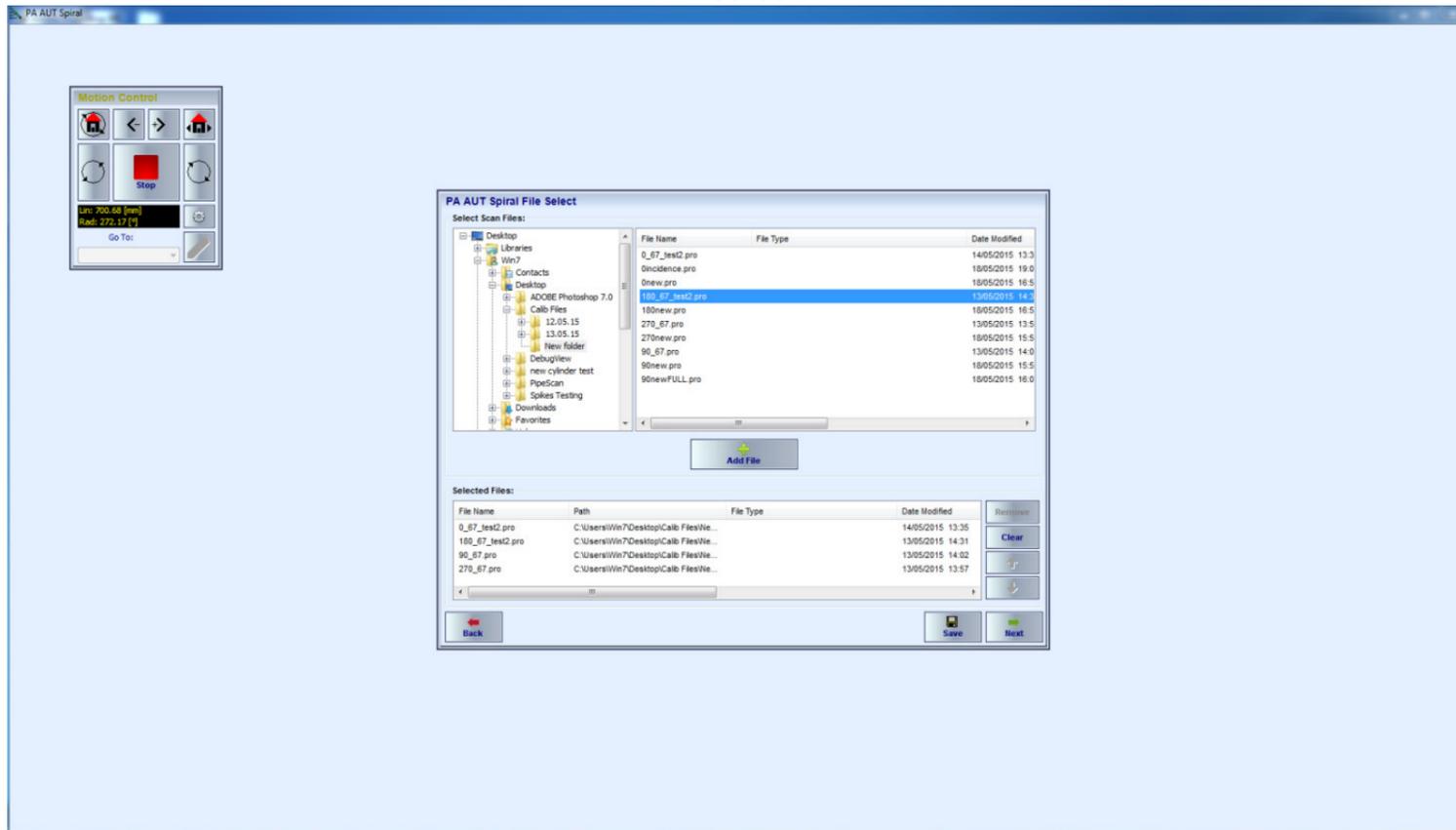
The "**Pulser Receiver**" screen allows calibrating of all ultrasonic parameters such as incidence angle, azimuth and focusing of ultrasonic beam, firing level and gain, gates, and the like. The calibration to be performed on the reference reflectors situated in the calibration block. Each Pulser Receiver calibration set to be stored into a separate configuration file (focal law); the total number of such files (focal laws) is defined by the number of various reflectors to be detected and their position having in mind that each reference reflector should be detected from two opposite sides at least whilst scanning over the calibration block

Clicking the **<Save>** button will open a dialog for saving the configuration file

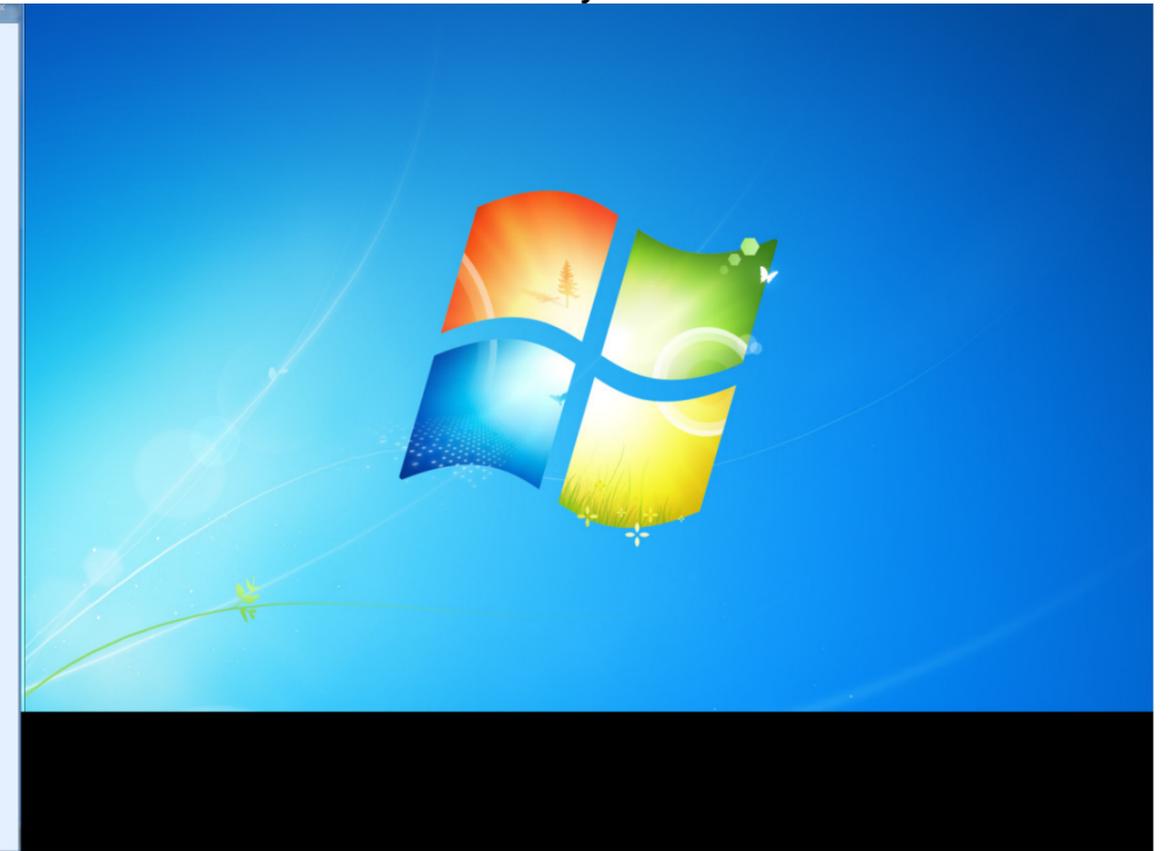
Click **<Close>** to go back to the "**Probe Selection**" screen

# Configuration Files Select

Main Screen



Secondary Screen

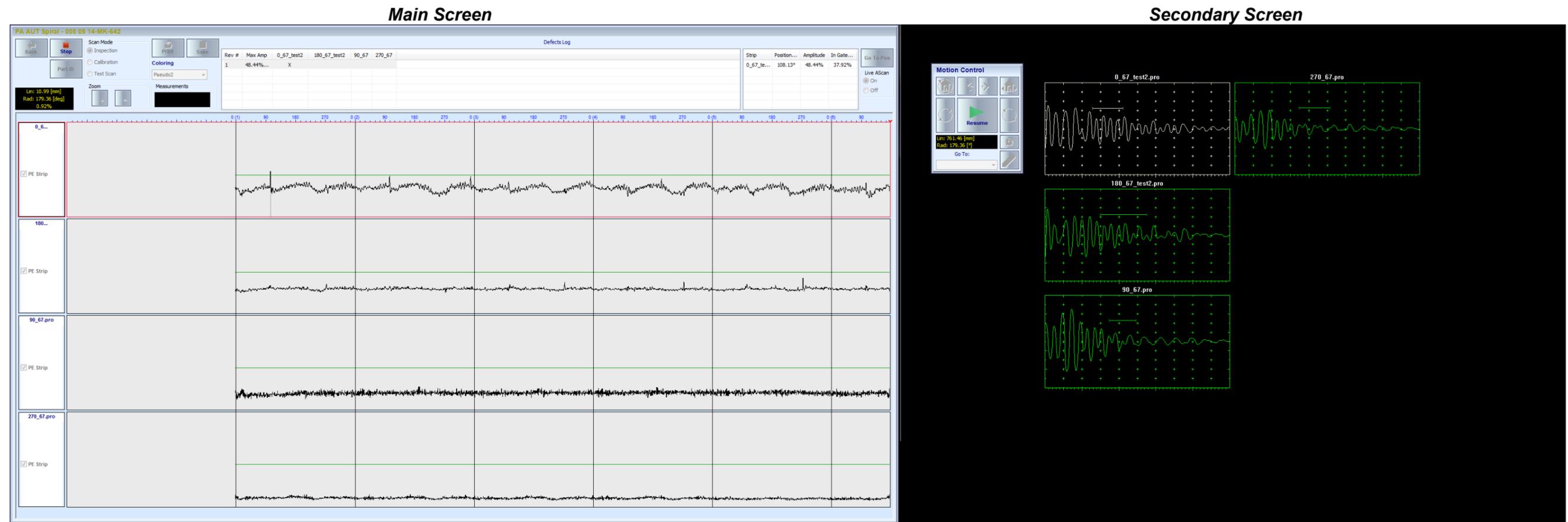


The new *Scan Plan* should be created in this screen from the saved configuration files (focal laws), the configuration files composing the Scan Plan should be uploaded and sorted in the desired order

Click on **<Next>** to navigate to the **"Strip Chart"** screen

Click **<Back>** to navigate back to the **"Main Menu"** screen

# Strip Chart



The "**Strip Chart**" screen represents the records of maximal echo amplitudes within the gate (**PE**: the default mode) captured along the probe trace over the part. Each focal law implemented during the scanning is represented by the corresponding strip: one strip per focal law. On the secondary screen there is a number of real time A-Scans formed (one A-Scan per focal law)

**PE** mode of the strip chart representation is switchable into to the **B-Scan** mode composed of the whole A-Scans. The switch from **PE** to **B-Scan** mode is possible either before or after the scanning at the **Post Scan / Postprocessing** stage thanks to the complete **A-Scan** data capturing is provided

The vertical lines above the strips are drawn for every revolution (360 deg) within the entire scan trace

The bar above the upper strip indicates the angular position inside each revolution

The horizontal line inside the **PE** strip indicates the **Gate Threshold**

## Selecting a strip

Click above the strip frames it in red and highlights the corresponding A-Scan

## Defects log

In the upper section of the "**Strip Chart**" screen there are two tables. The left table displays the data about the revolutions, during which the echo amplitude exceeded the **Gate Threshold** (defect event) through placing "X" symbol in the corresponding cell. The strings of the table correspond to the revolutions whilst the columns correspond to the strips. Clicking on the string in the left table highlights the detailed data about the defect event in the right table (angular position, maximal echo amplitude, and the like)

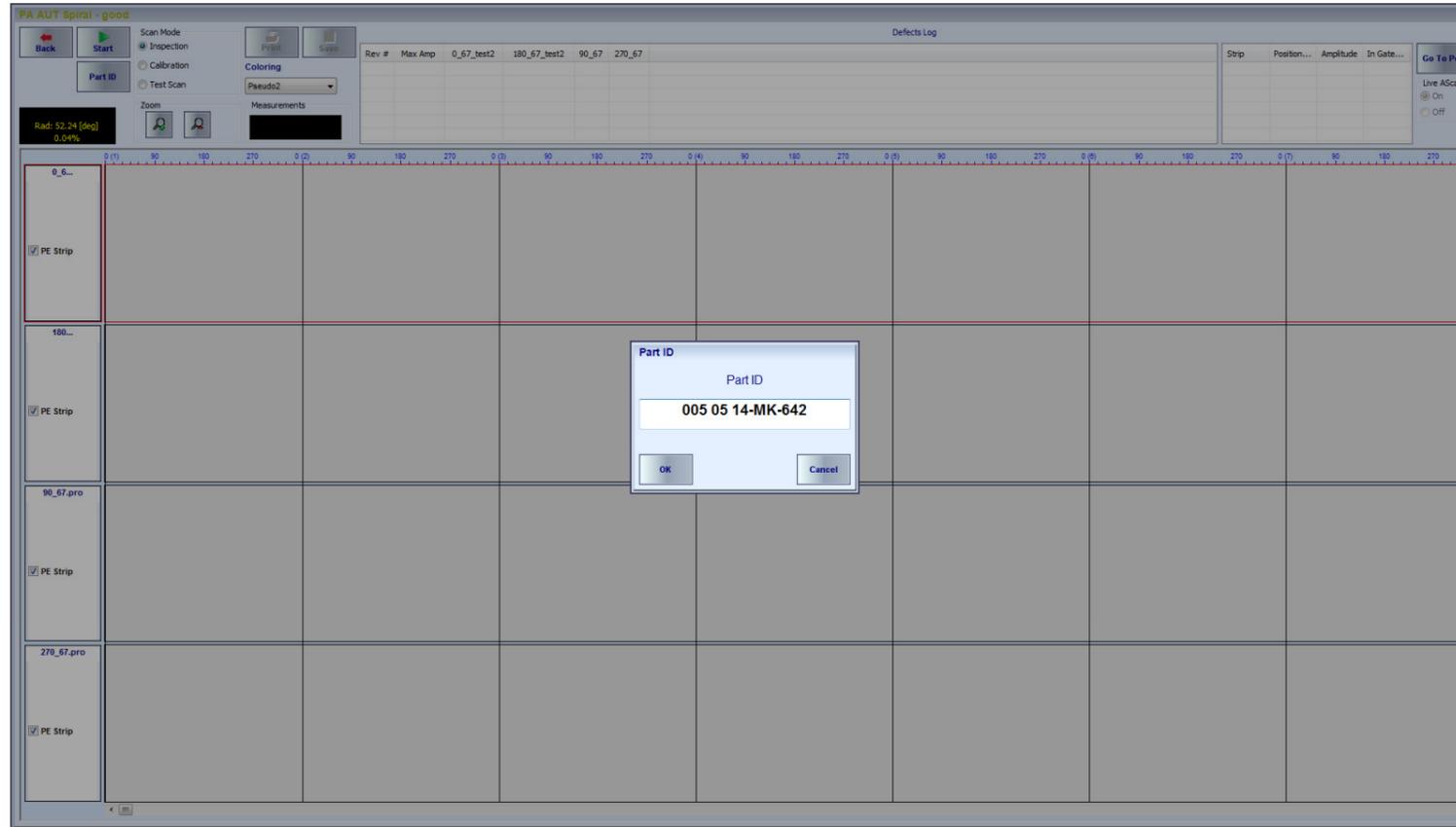
## Position and scanning progress

The data about current position of the probe (linear and radial) and scanning progress is represented in the black rectangle under the **<Part Id>** button

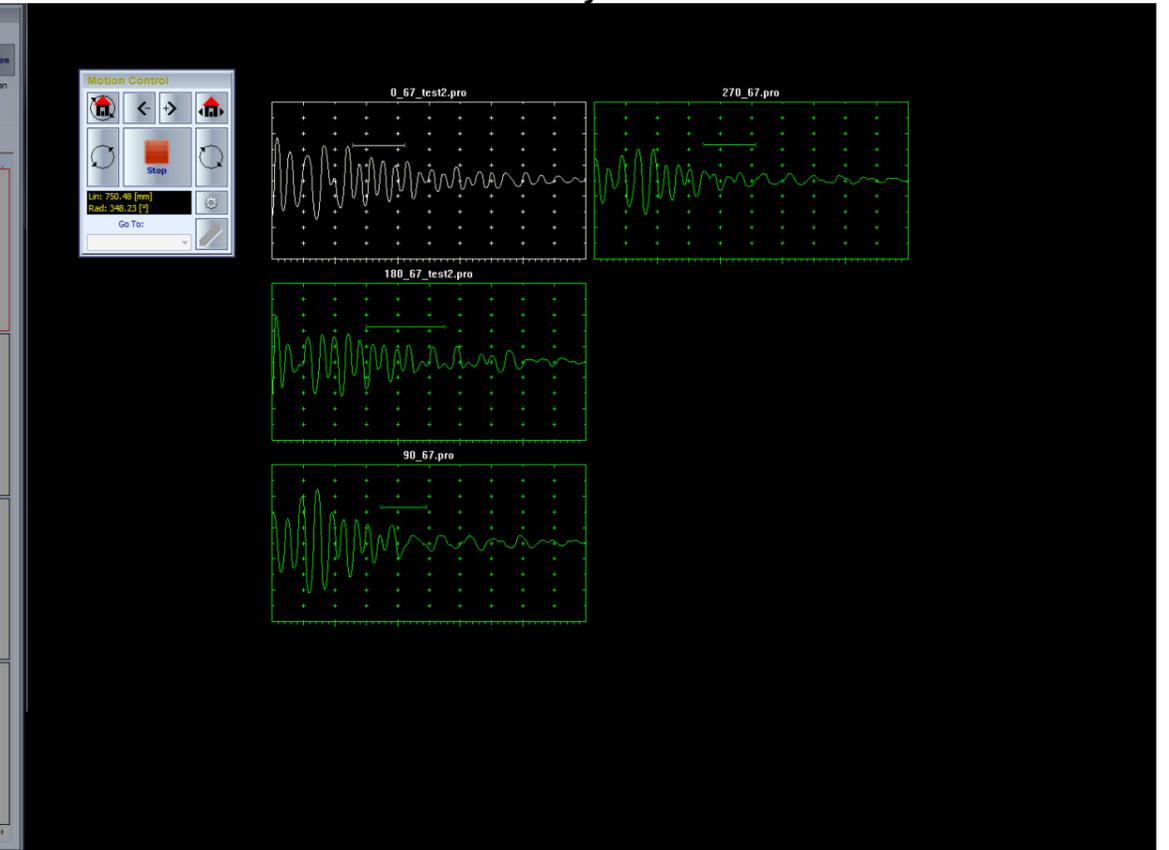
## Scanning Modes

- *Inspection* mode – to be used in cases when saving the inspection data and the ability of retrieving it later for postprocessing is required
- *Calibration* mode – to be used for the calibration scan
- *Test run* mode – to be used in cases of data saving / postprocessing is not required

**Main Screen**



**Secondary Screen**



**Start scanning**

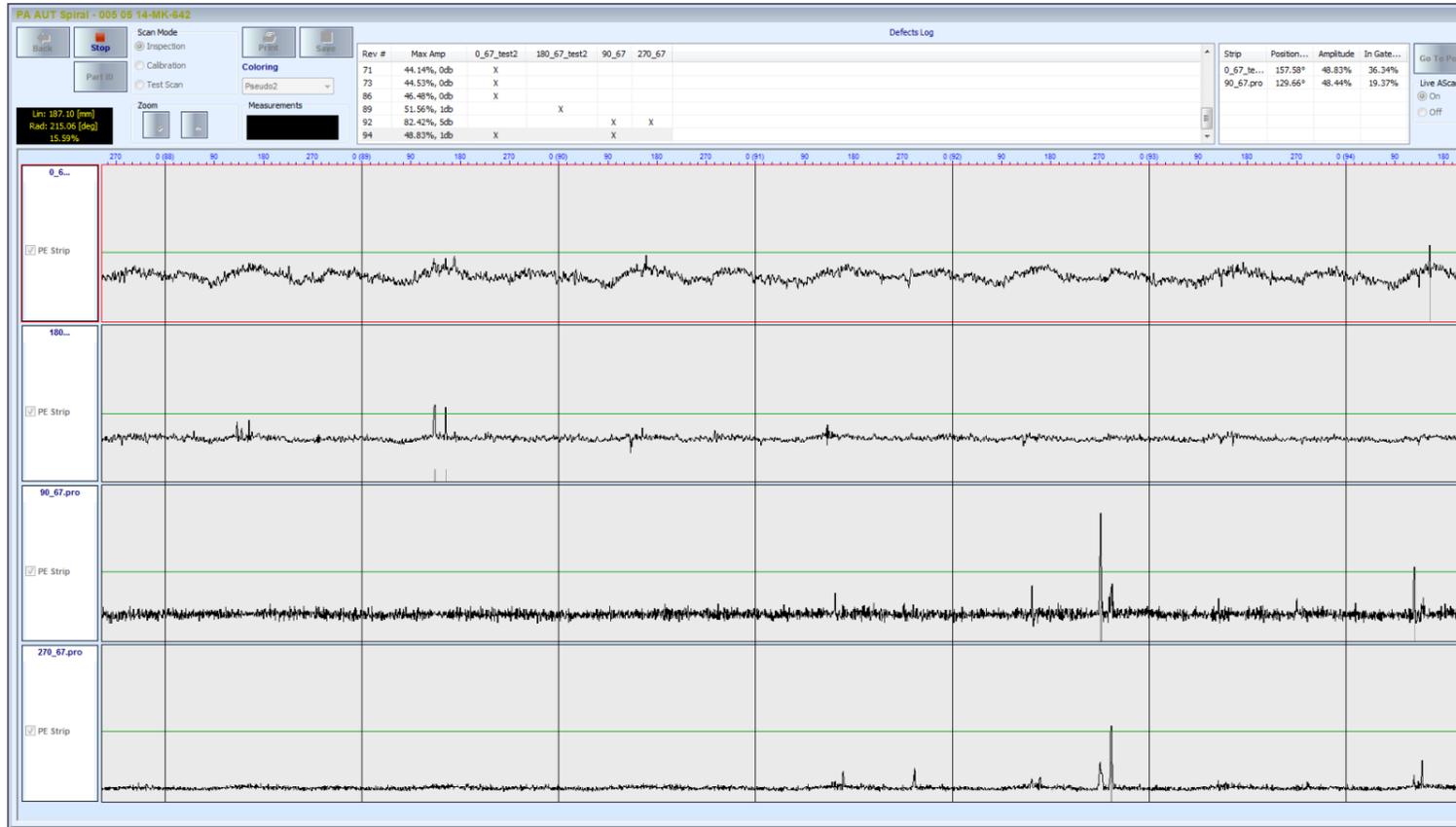
Click on the **<Start>** button intimates the automatic inspection process. At the beginning the scanning a dialog is prompted for entering the Part Id. Upon Part Id is keyed in click on **<OK>** or press **<Enter>** key – this will start the automatic scanning and data recording

It is also possible to pre enter the Part ID through clicking on the **<Part ID>** button

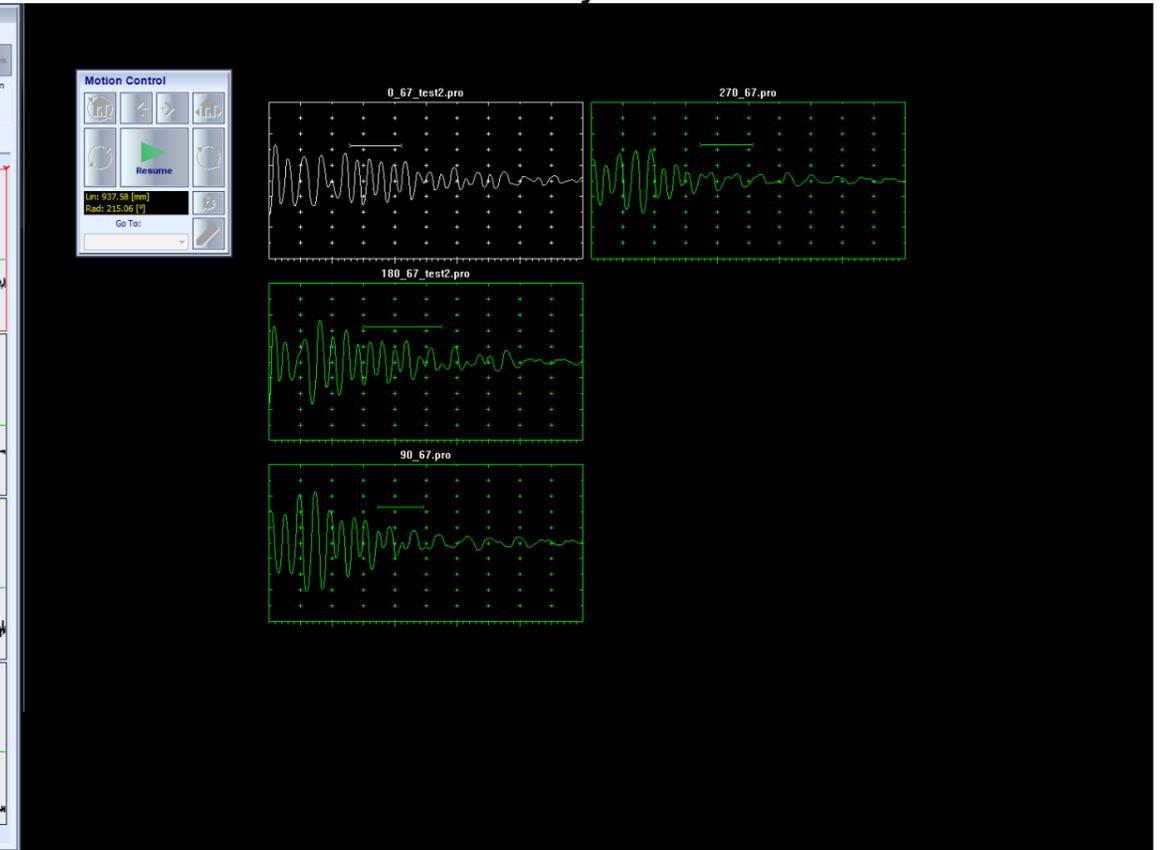
**Auto-Save Scanning Data**

When auto-save option is enabled (see settings section) and scanning mode is settled as **Inspection**, the scanning data will be saved automatically once it is completed or the **<Stop>** button has been clicked on

Main Screen



Secondary Screen



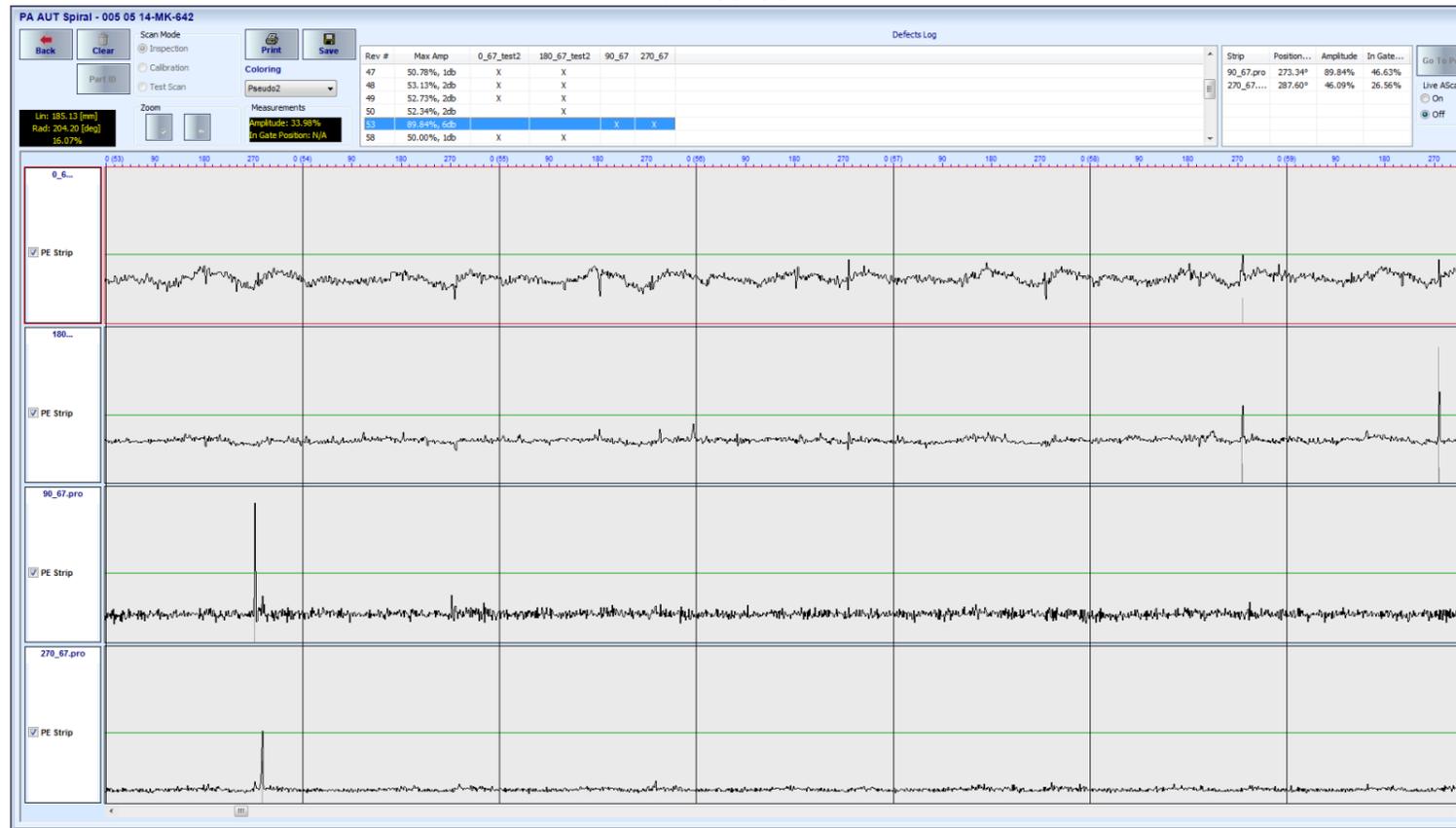
### Motion Control Virtual Joystick

During the scan the **Motion Control** virtual joystick buttons are disabled except the **<Stop>** button. Clicking on the **<Stop>** button interrupts the probe and part motion. The inspection may be continued through click on the **<Resume>** button of the **Motion Control** virtual joystick

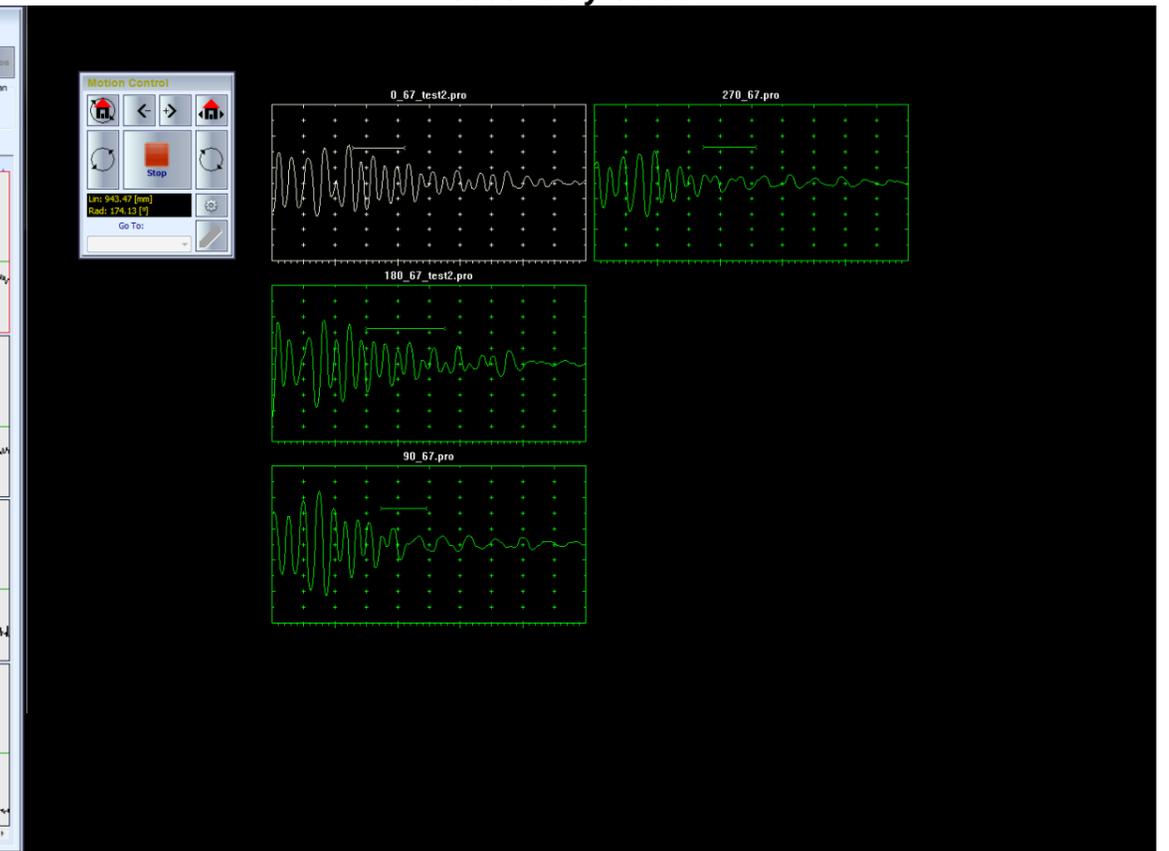
To terminate the scanning click on the **<Stop>** button of the **“Strip Chart”** screen

# Post Scan

Main Screen



Secondary Screen



Upon inspection / calibration scanning completed it is possible to deal with the post scan data analysis including retrieving of the A-Scans through placing the vertical marker over the strip chart

## Defects Log

In the upper section of the **"Strip Chart"** screen there are two tables. The left table displays the data about the revolutions, during which the echo amplitude exceeded the **Gate Threshold** (defect event) through placing "X" in the corresponding cell. The strings of the table correspond to the revolutions whilst the columns correspond to the strips. Clicking on the string in the left table highlights the detailed data about the defect event in the right table (angular position, maximal echo amplitude, and the like). By selecting a revolution line (**Rev #** column) it is highlighted in blue and:

- the defect events particulars table at the right side is filled accordingly
- the strip chart is scrolled to the selected revolution

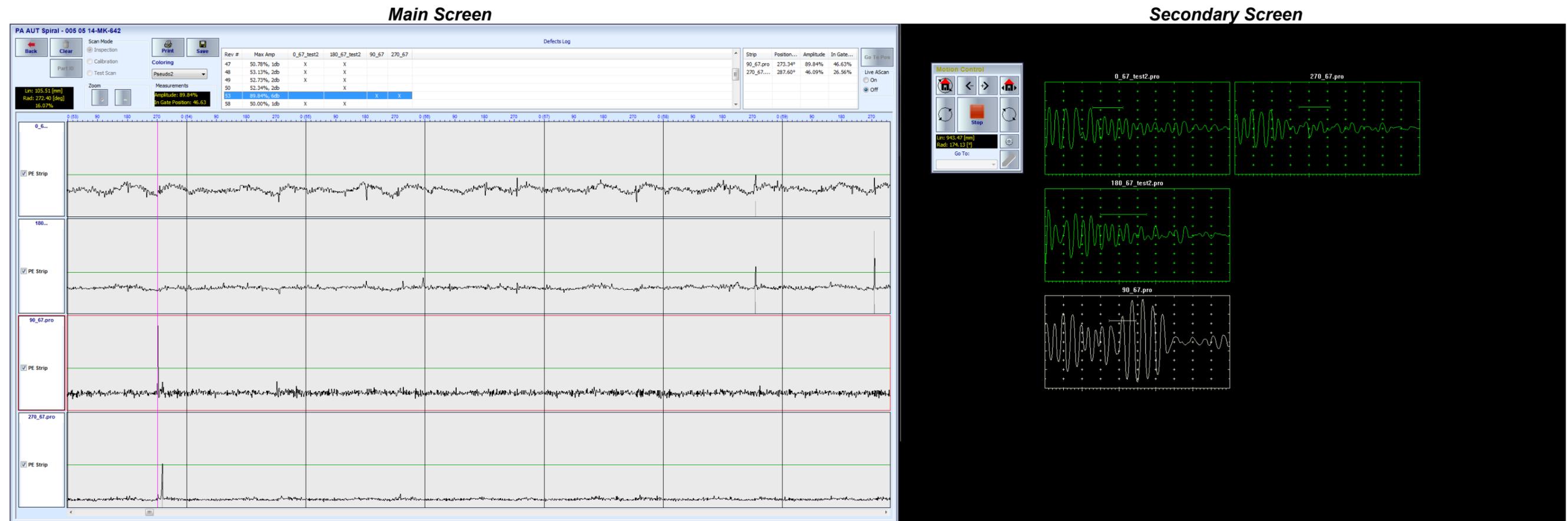
## Go To Position

By selecting a defect event in the particulars table the **<Go To Pos>** button becomes enabled. Click on it results the automatic placement of the probe into the defect event position on the part under test

## Live A-Scan

While in post scan mode it is possible to observe:

- live A-Scans (**On**)
- retrieved A-Scans (**Off**) according to the position of the cursor the mouse pointer over the strip chart



Click **<Clear>** to clear the strip chart data and start a new inspection

Click **<Back>** to return to "Configuration Files Select"

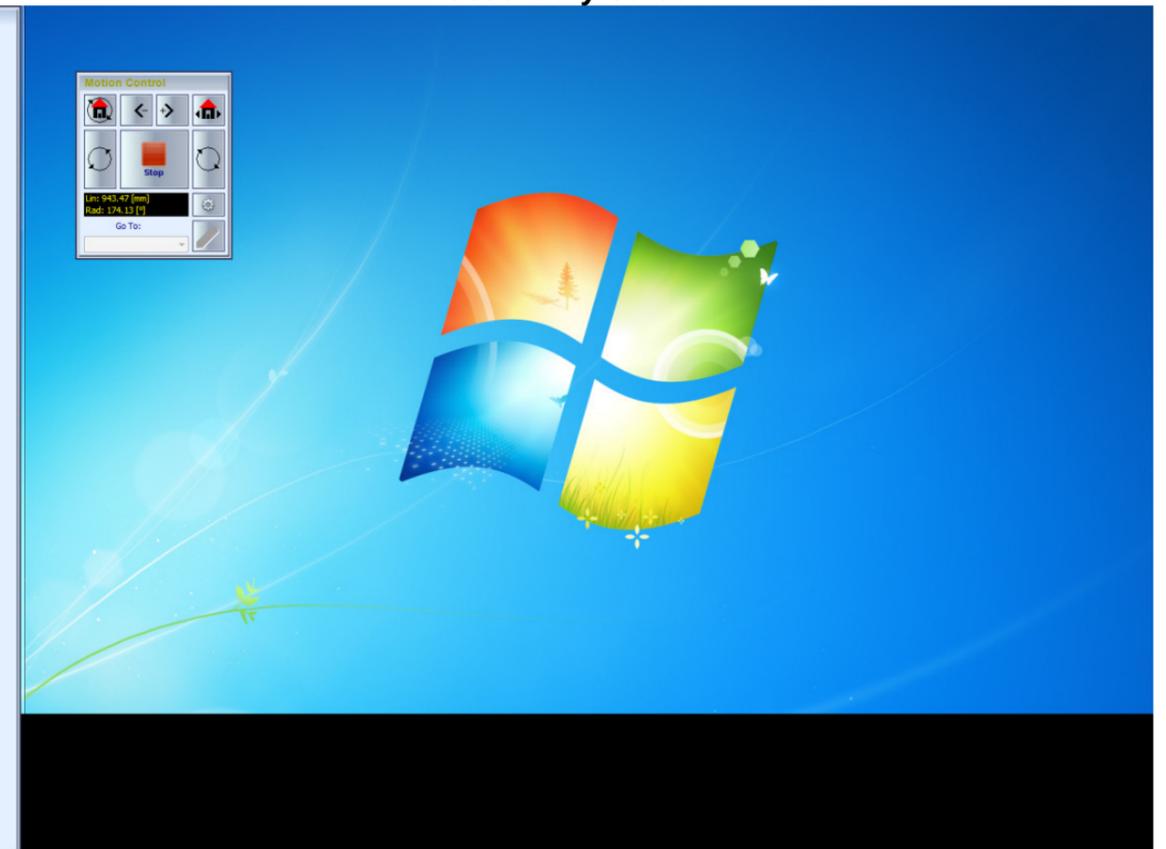
# Settings

The settings section allows controlling the various parameters related to the scanning, data storage, encoding, and the like

*Main Screen*

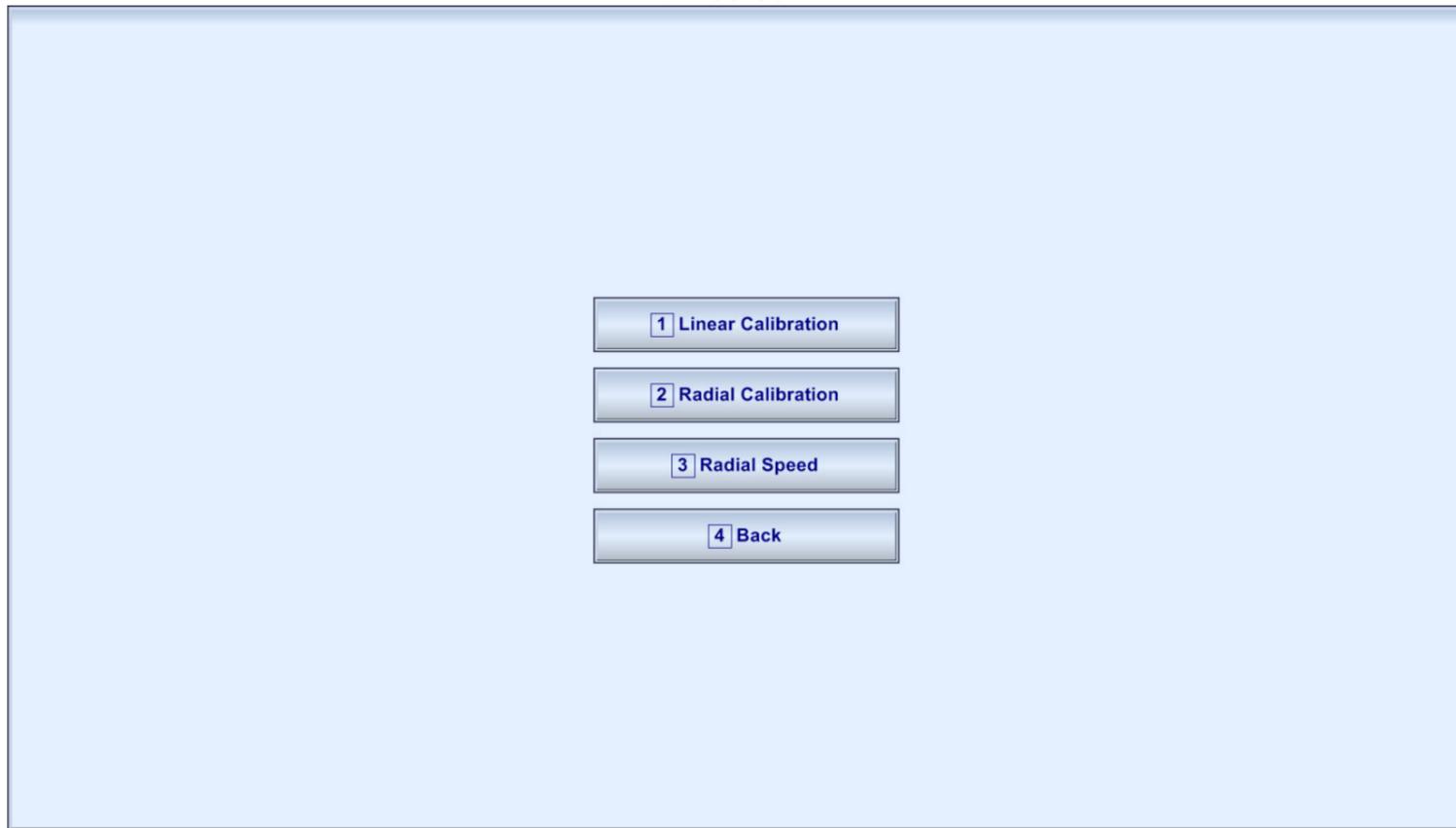


*Secondary Screen*

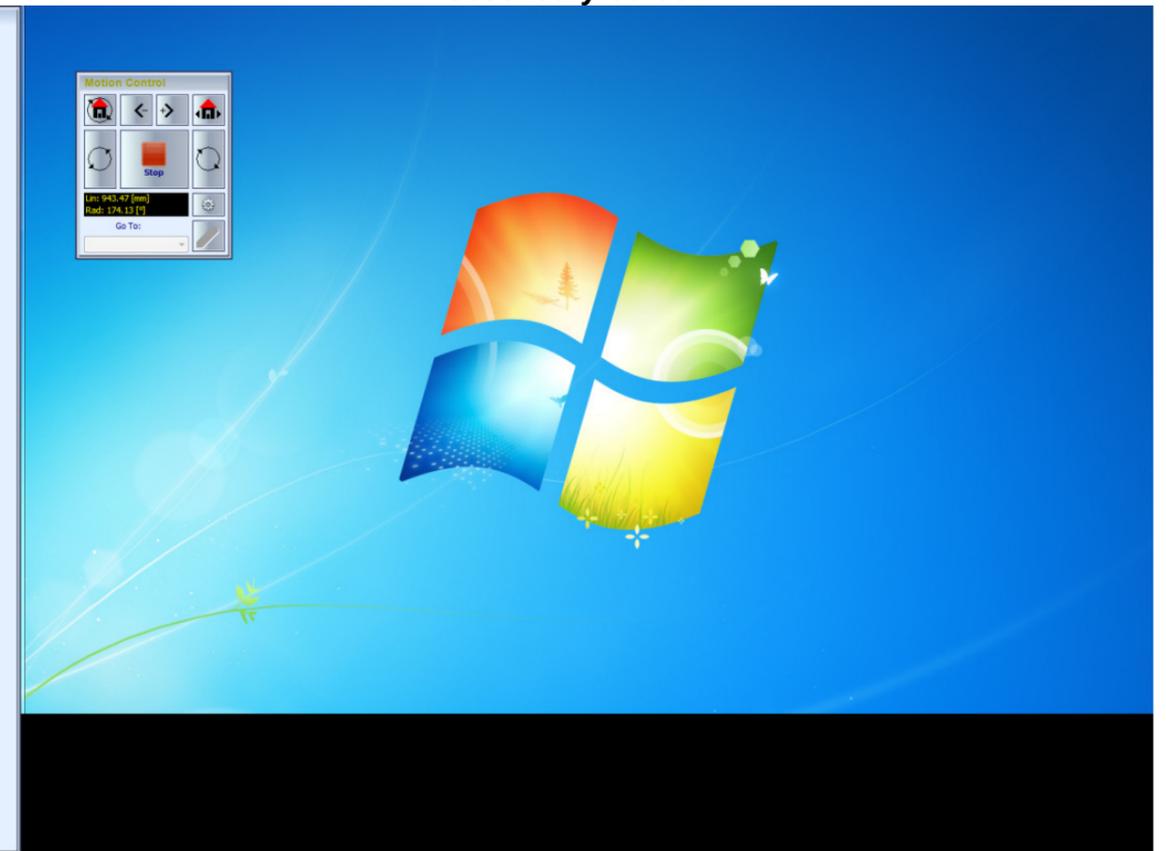


# Motor Settings

Main Screen



Secondary Screen



## Linear Calibration

This procedure is used in order to calibrate the stepped motor / encoder / gear box module providing the linear motion of the matrix array probe and verify the precision of the linear positioning

## Radial Calibration

This procedure is used in order to calibrate the stepped motor / encoder / gear box for the rotation of the tubular object and verify the precision of the radial positioning

## Radial Speed

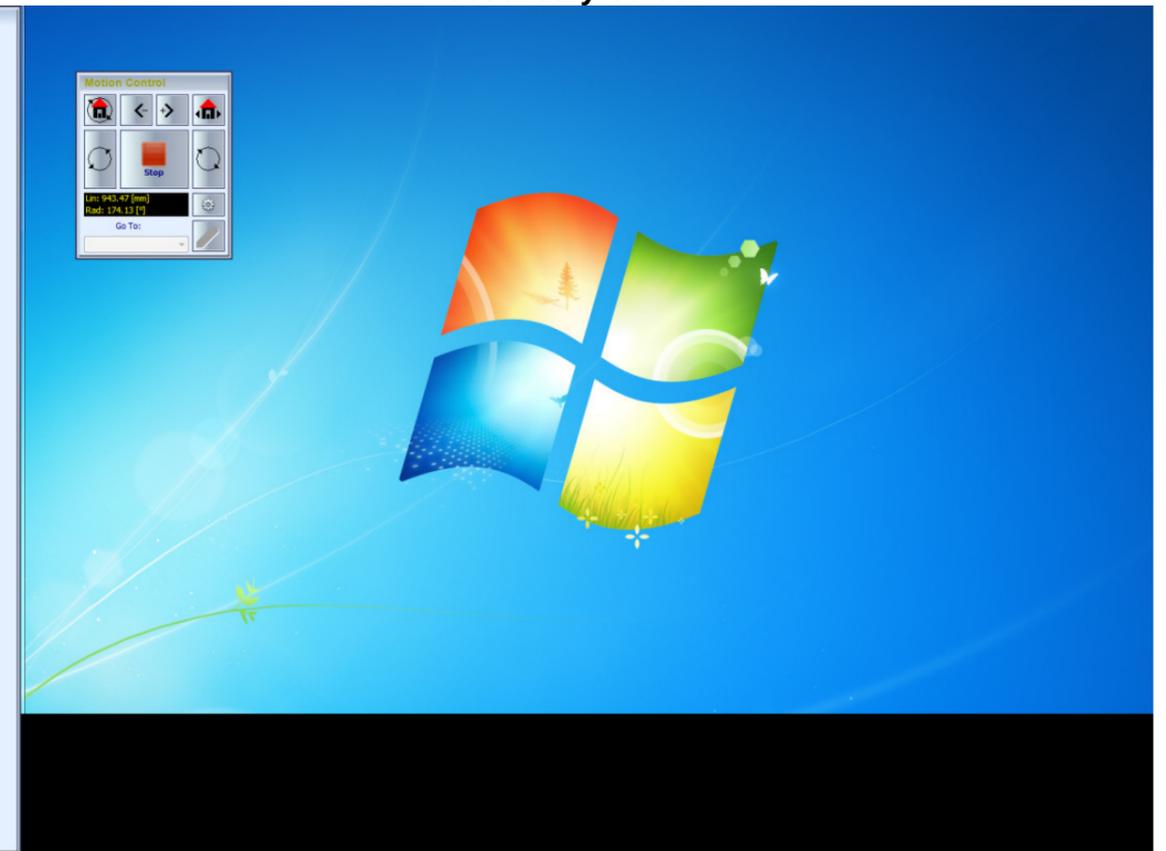
This procedure is used to settle the rotation speed

# Scan Settings

*Main Screen*



*Secondary Screen*



## **Calibration Scan**

Calibration scan settings – the start position and the length of the scanned area on the calibration block

## **Inspection Scan**

Inspection scans settings – the start position and the length of the scanned area on the part under test

## **Spiral**

This procedure is used to settle the spiral index

## **Revolution Encoder Increment**

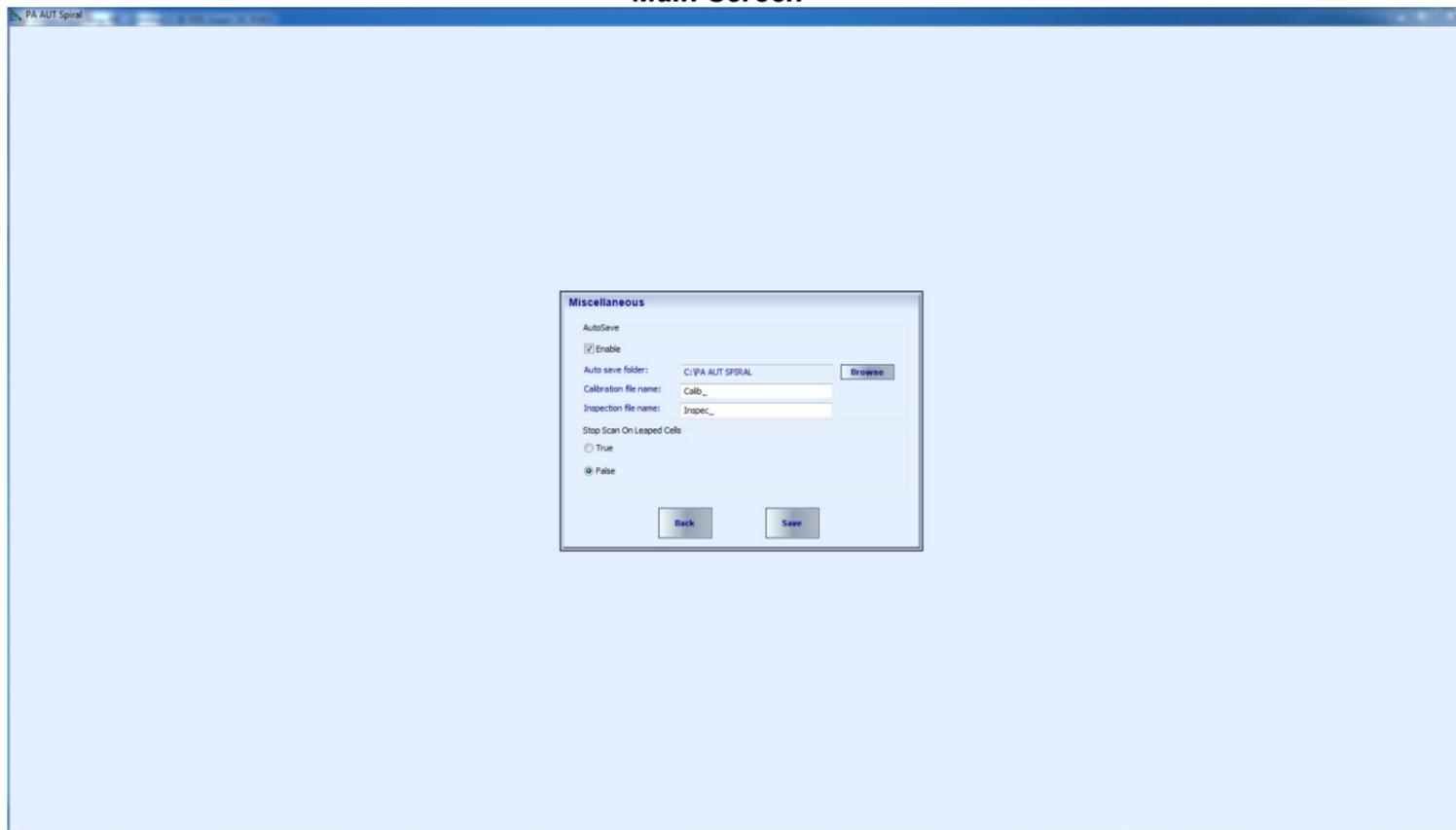
This procedure is used to settle revolution encoder increment determining the quantity of A-Scan cells per revolution

## Miscellaneous

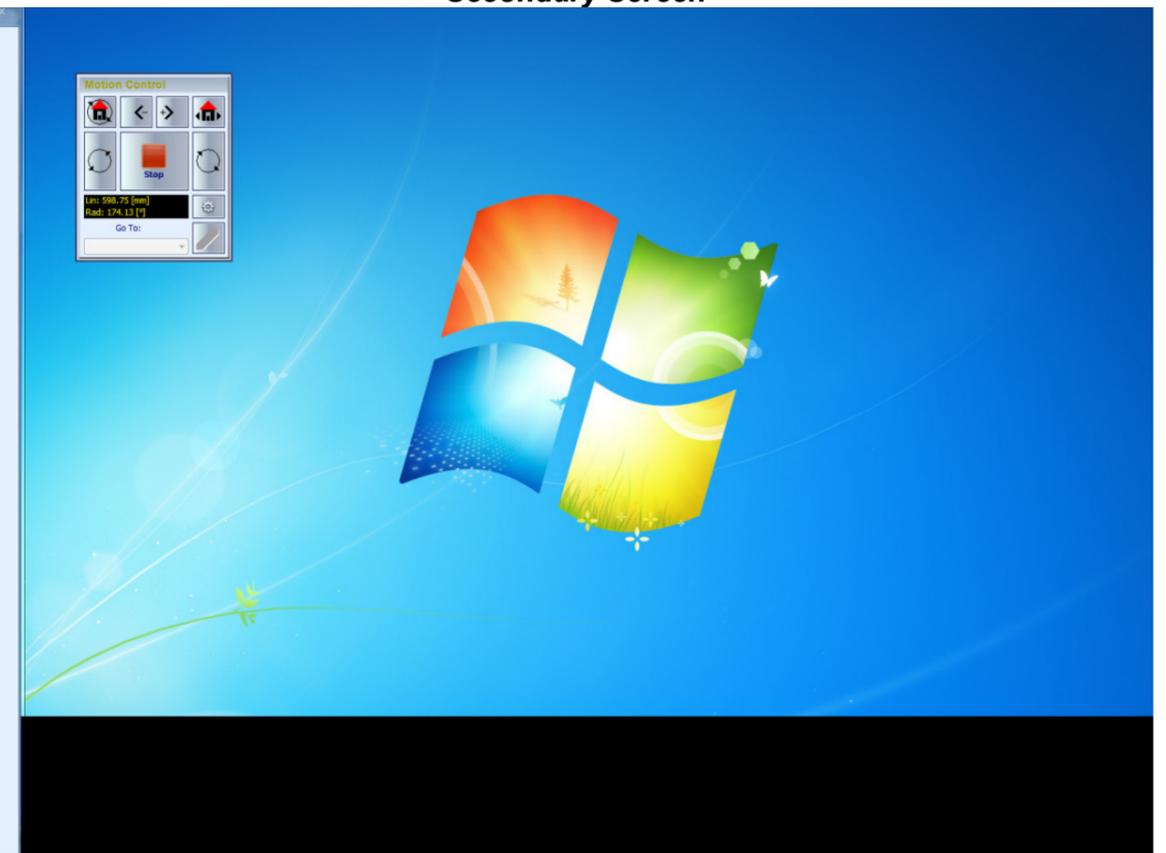
Navigate to the miscellaneous options menu for various setting around the inspection, namely:

- enable / disable the auto save file upon the scanning of the part / calibration block completed
- location for file saving
- prefixes for the file names
- etc

*Main Screen*

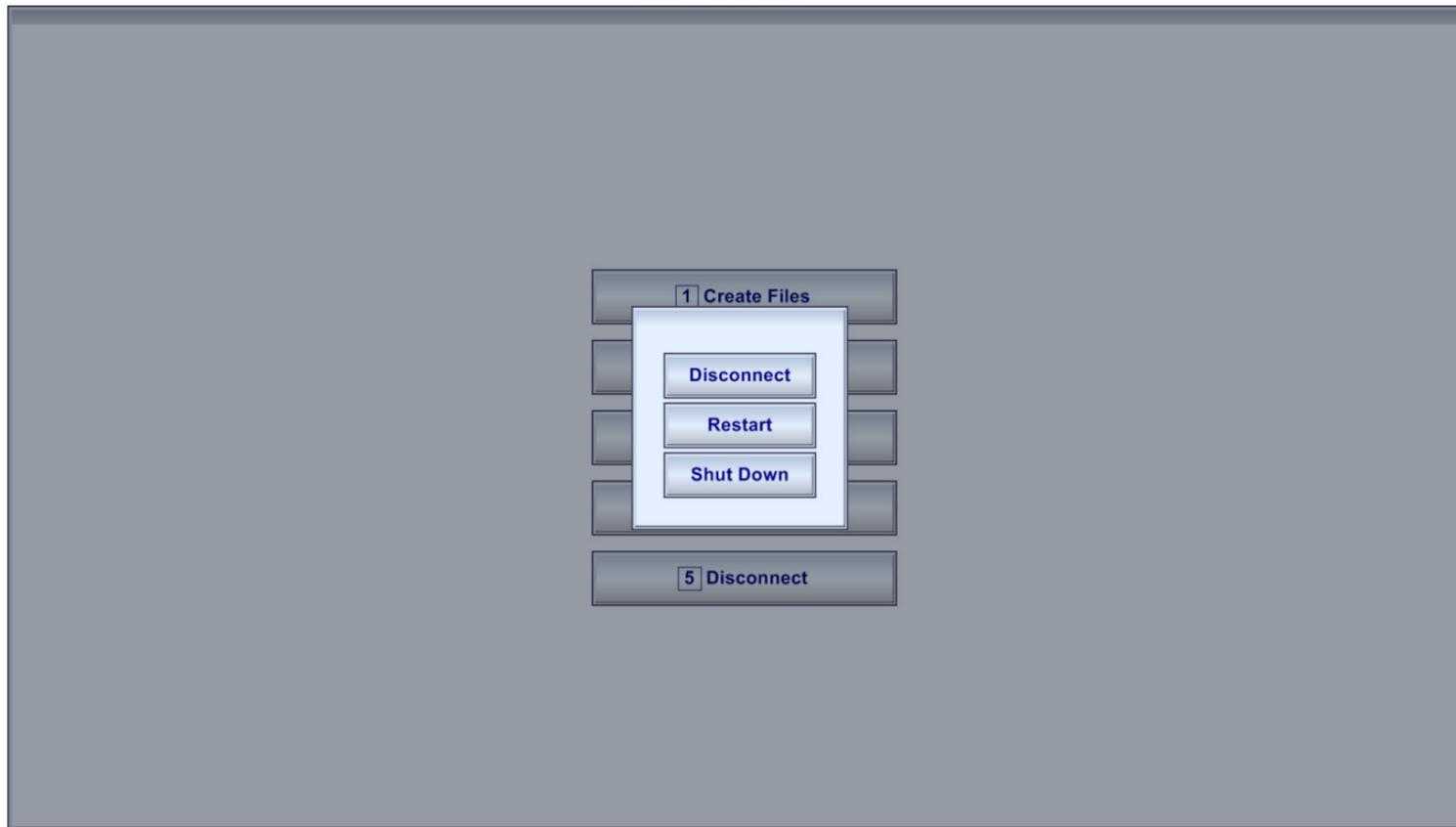


*Secondary Screen*

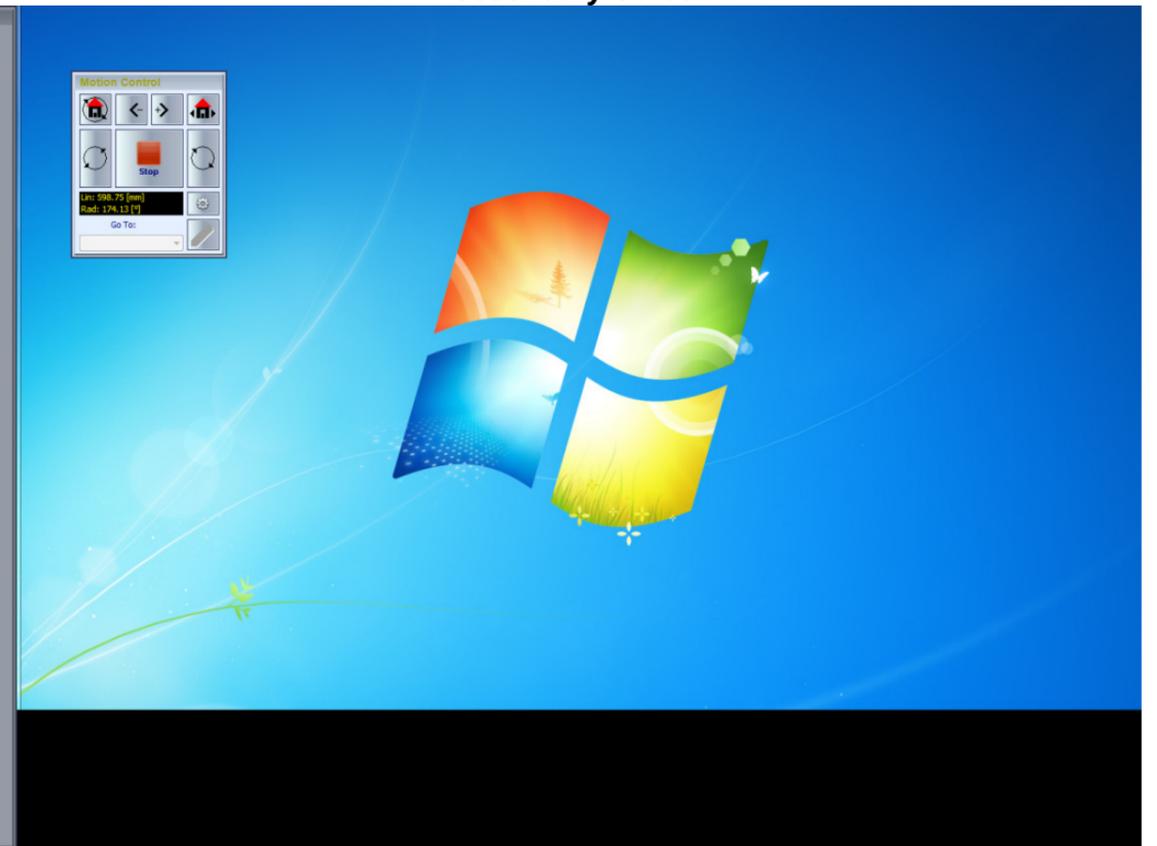


# Disconnect

Main Screen



Secondary Screen



There are 3 ways to disconnect control computer from the **ISONIC PA AUT** instrument:

- Disconnect: **ISONIC PA AUT** instrument becomes Idle upon control computer is disconnected
- Restart: **ISONIC PA AUT** instrument reboots Idle upon control computer is disconnected and becomes Idle upon boot up completed
- Shut Down: **ISONIC PA AUT** instrument shuts down upon the control computer is disconnected

## Reporting the Inspection Results

Each part is accompanied with the inspection results file on the CD

The CD may contain inspection results files for several parts

File name should contain serial number of the part

Every CD should have setup package for the Viewing / Postprocessing of the inspection files

Every CD should also contain the PDF file containing:

- the list of parts, for which the inspection results are situated on the CD
- brief comments on the visual inspection
- GO / NO GO conclusion based on the results of ultrasonic inspection backed by the defect list if found and other comments