Eddyfi Technologies

Beyond current

Getting Started with

REDDY AC AND PROBES USER MANUAL


EDDYFI REDDY
Eddyfi Technologies

Revision History		
Version	**Description**	**Date**
1.0	Original document	April 2019

Contents

INTRODUCTION

This document describes how to use an AC probe (PRBT-ECT-BBAC) with Magnifi® Go 4.5 on a Reddy® AC test instrument.

The following information was generated using the AC probe, but the same principles apply to ECT bobbin probes.

EQUIPMENT

Eddyfi's AC probes are detachable and can be used with a HDPE or a LLDPE cable. These cables include two 4-pin connectors that can be connected on a Reddy AC instrument. An adaptor (PRBT-ADAPT-41xAC) is also available to connect this probe to the 41-pin connector of an Ectane® instrument.

Depending on the manufacturer, air conditioner tubes can have inside and/or outside diameter fins. Dimensional specifications sometimes include the fins, but not always. The most important information for probe selection is the inside diameter of the tube (probe diameter selection) and the root thickness (probe frequency selection).

Because AC probes need to fill an optimal portion inside the tube, their diameters are offered from 11.0 to 23.0mm by steps of 0.2mm. It is recommended to select a probe diameter with a fill factor around 88%. The following formula can be used to calculate the diameter that meets this fill factor:

$$diameter = 2\,x\sqrt{0.88\,x\,(tube\ inside\ diameter/2)^2}$$

Select the standard probe that is closest to the result of the above formula. For instance, with a tube ID of 14.65mm, the formula result is 13.74mm. Therefore, a 13.8mm probe should be selected for optimal fill. When possible, we recommend keeping a lift-off around the probe between 0.3mm and 1mm.

The right probe frequency can be selected based on the following table.

Table 1 - ECT-BBAC probes frequency range selection table

		TUBE WALL THICKNESS (BWG, mm, in)														
	BWG	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	mm	3.4	3.05	2.77	2.41	2.11	1.83	1.65	1.47	1.24	1.07	0.89	0.81	0.71	0.65	0.56
	in	0.135	0.120	0.109	0.095	0.083	0.072	0.065	0.058	0.049	0.042	0.035	0.032	0.028	0.025	0.022
Copper		UF	UF	UF	UF	UF	UF	UF	UF	UF	UF	UF	UF	LF	LF	LF

Table 2 - ECT-ACTX Frequency range

CODE	FREQUENCY IN kHz		
	Min.	Max.	Central
UF	1	10	5
LF	10	100	50

The AC calibration tube used in this document includes the following flaws:

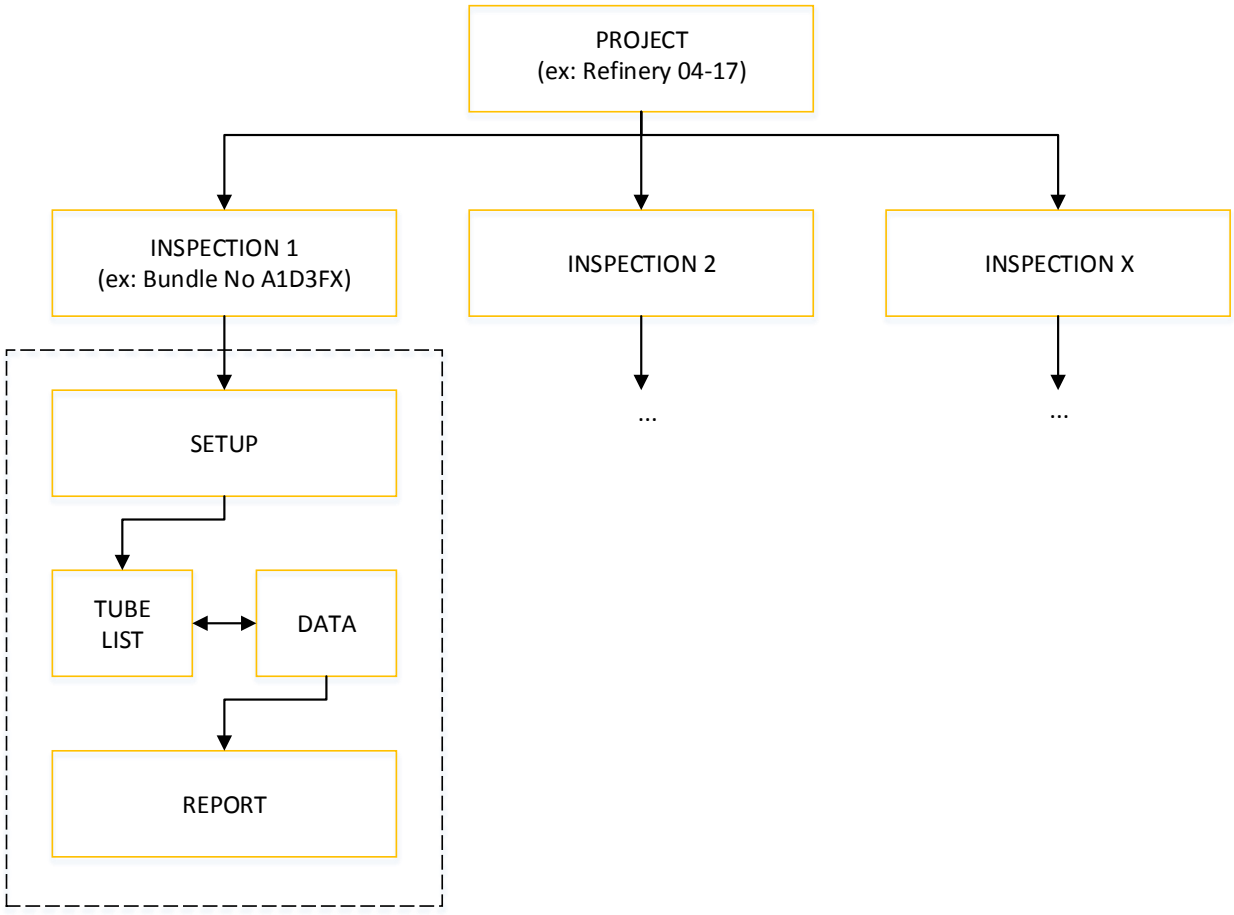
- Internal groove, 10% wall loss
- External groove, 20% wall loss
- Hole, 100% wall loss
- OD Flat Bottom Hole (FBH) at 40%, 60% and 80% depth
- OD 4 x FBH 20% depth

However, other combinations of flaws can be used to calibrate the probe and build sizing curves.

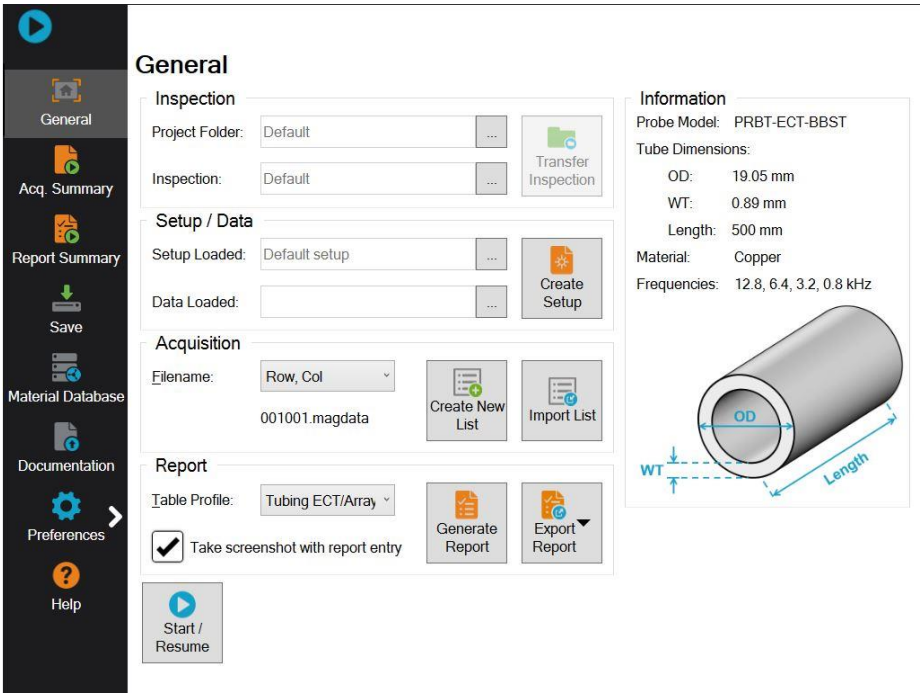
PROJECT AND INSPECTION FILES

In this section, we create a folder structure that manages the saving location of your setup, data and report. This management is operated through the creation of a Project.

Magnifi Go suggests two levels of files. The first level is the Project. It should include different inspections that are related in some way. For instance, it can include all the inspections done at a refinery shutdown and be named Refinery_Shutdown_May_2019. The second level of files is the Inspection folder. Inspection folders are saved in the project file. An inspection folder can include the data specific to the inspection of a tube bundle with a specific technology and could be named Copper_075x0.065_AC, for instance. This inspection folder groups the setup, the tube list, the data files and the Magnifi Go report.

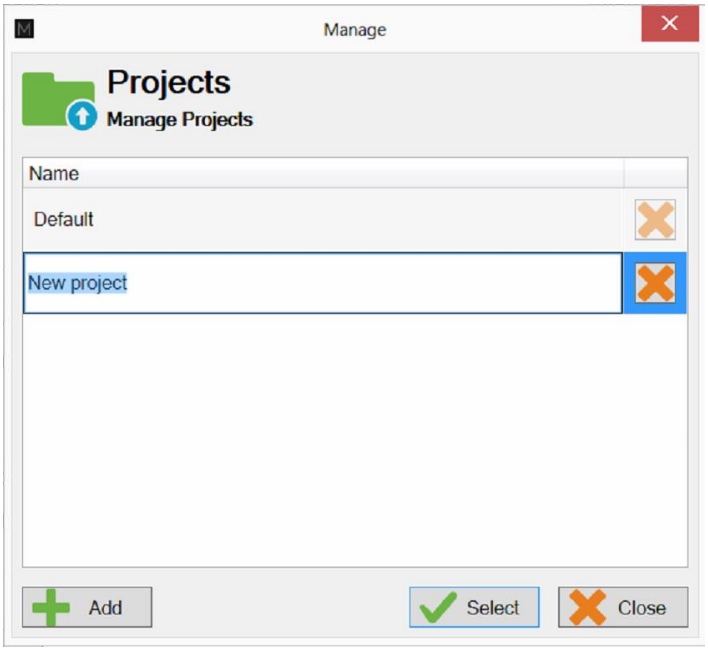


When you open Magnifi Go, the first page displayed is called the backstage.

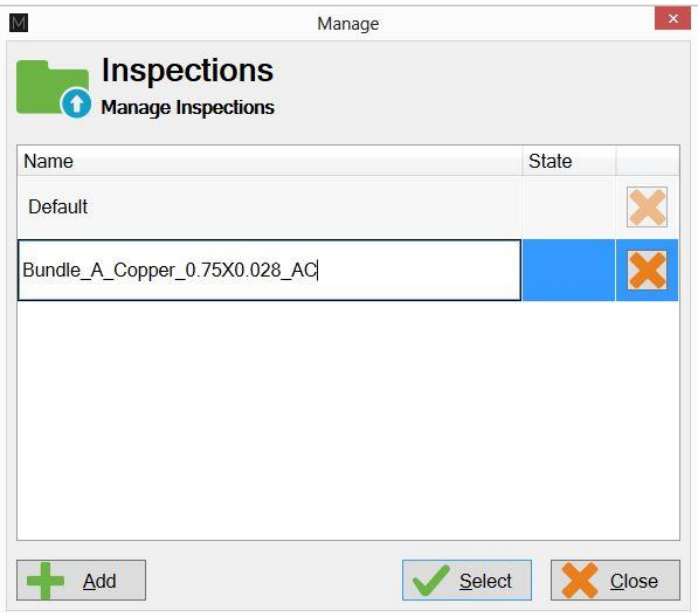


To create or open a project, click the ellipsis next to the project folder textbox in the backstage. You can select an existing project/folder or you can create a new folder.

1. Create a folder by clicking the Add button and enter the chosen name or select an existing folder. The chosen folder is highlighted in blue. Once the correct folder is selected, click the Select button.



2. Click the ellipsis next to the inspection textbox in the backstage, then click Add and enter the name of your inspection.

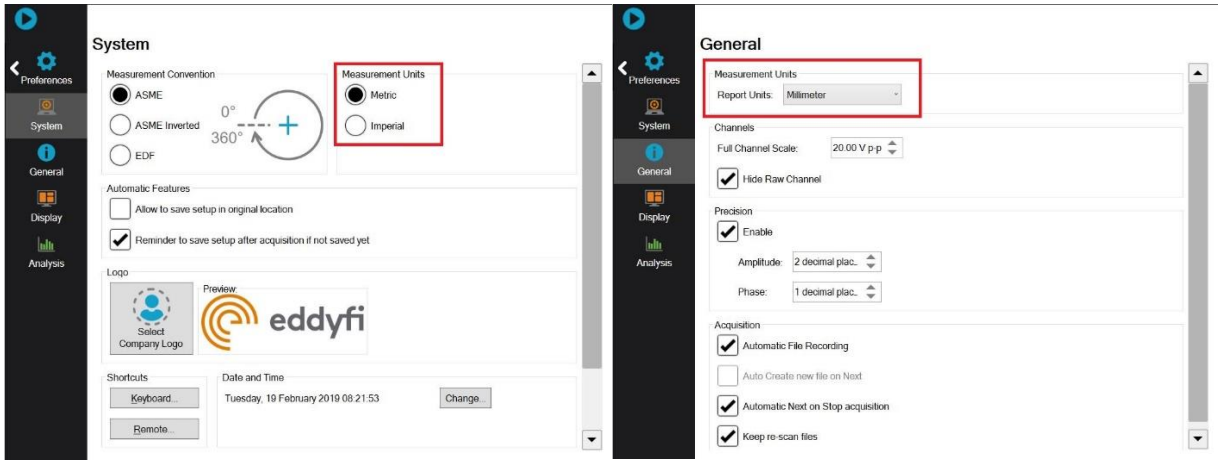


3. Hit Select. This defines the position where the setup(s) and data are saved.

SETUP WIZARD

In this section, we show how to create a setup using the Setup Wizard in Magnifi Go.

Before proceeding, you can change the measurement unit. To do so, click Preferences. In the System tab you can change the measurement units from metric to imperial and vice versa. For the metric units, you can choose meters, centimeters, or milimeters in the General tab. For imperial units, you must use inches. When finished, click Preferences again to return to the General window.

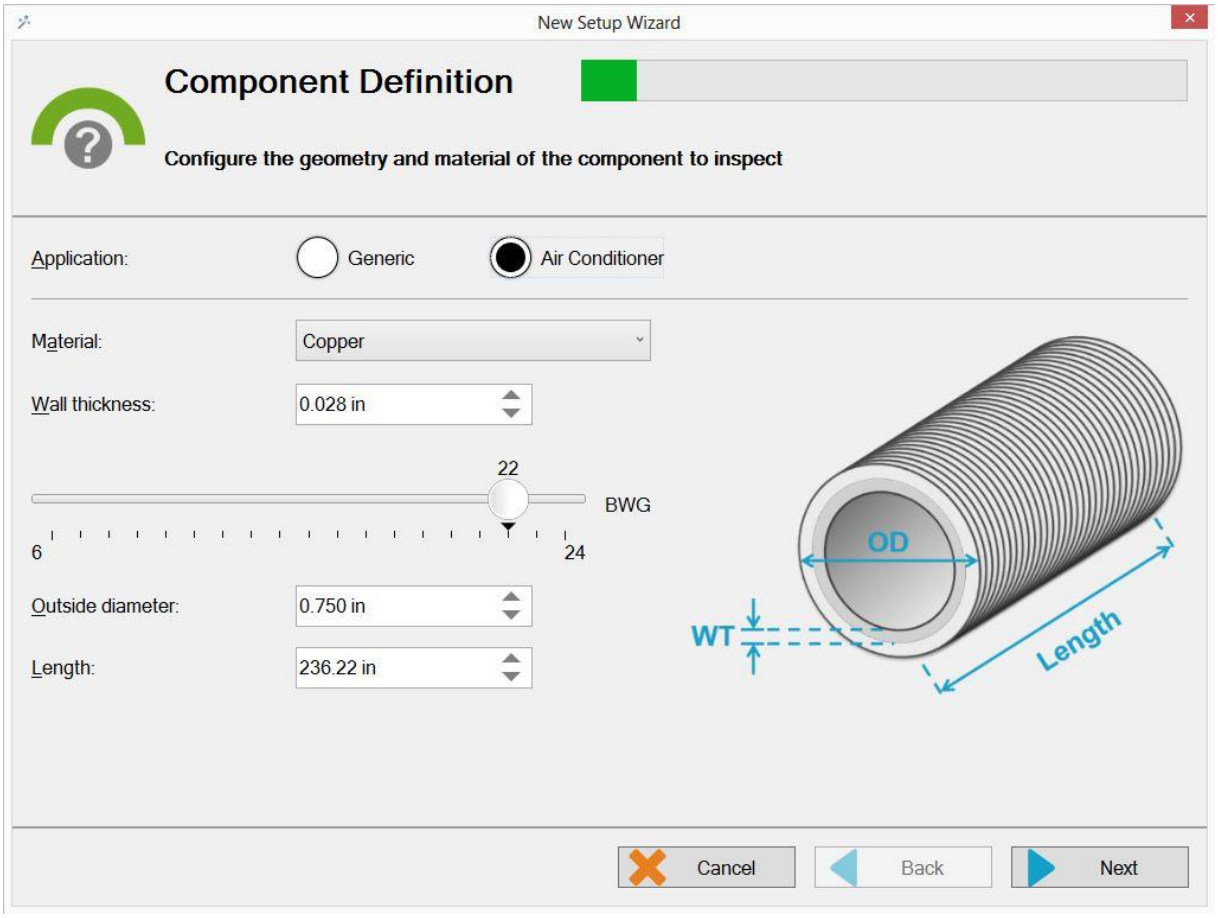


To create a new setup, you can use the Setup Wizard process. Click Create Setup to start the Setup Wizard.

COMPONENT DEFINITION

The first page shown by the Setup Wizard is the Component Definition.

Select the Air Conditioner option, then click the Material field to open a scrolling menu. Select the material of the tube to be inspected.



Adjust the tube wall thickness by entering the value in the Wall thickness field or by moving the slider. Note that the wall thickness value excludes the fins. Enter the tube outside diameter and length.

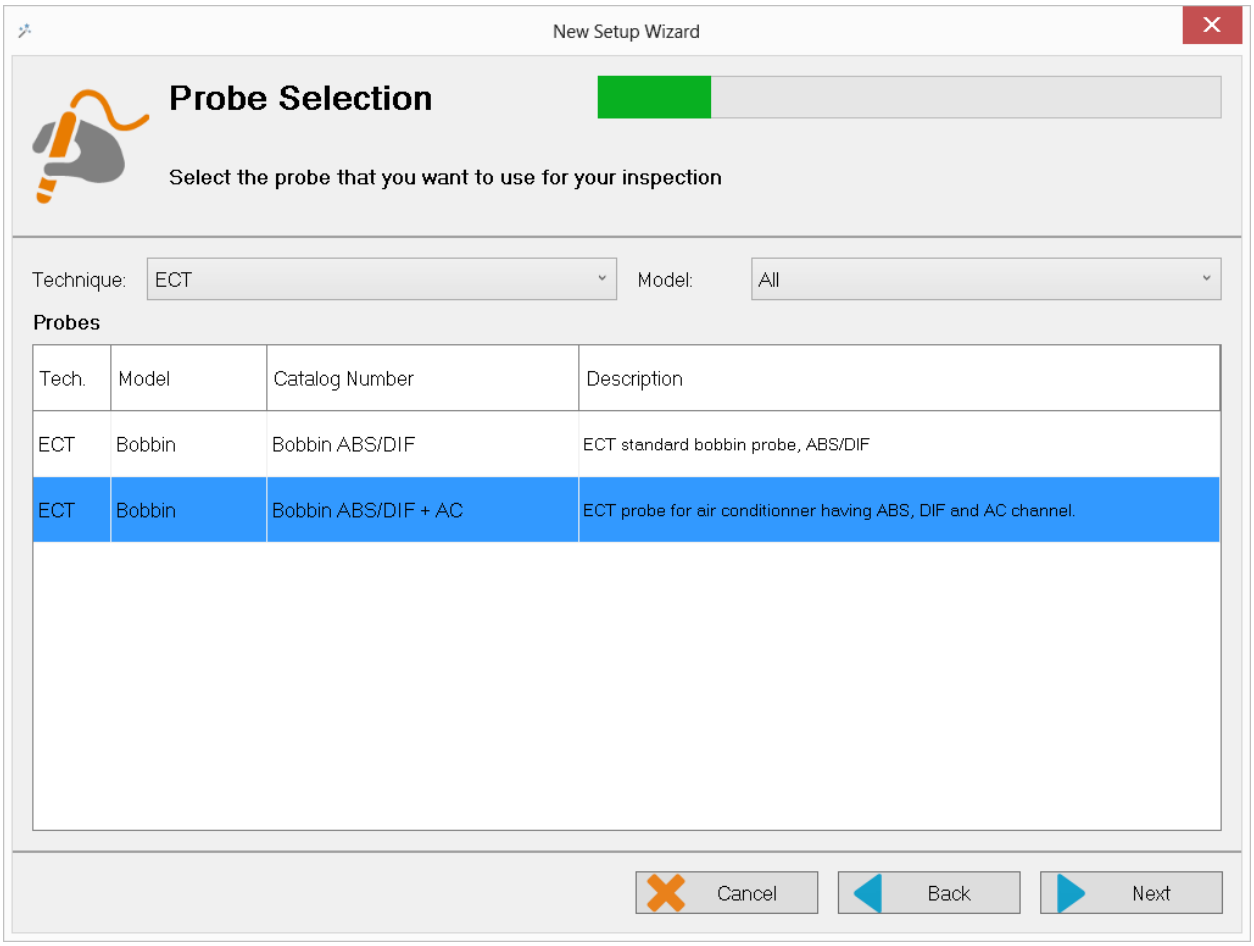
These tube properties help Magnifi Go suggest the optimal scan parameters.

Click Next when everything is set correctly.

PROBE SELECTION

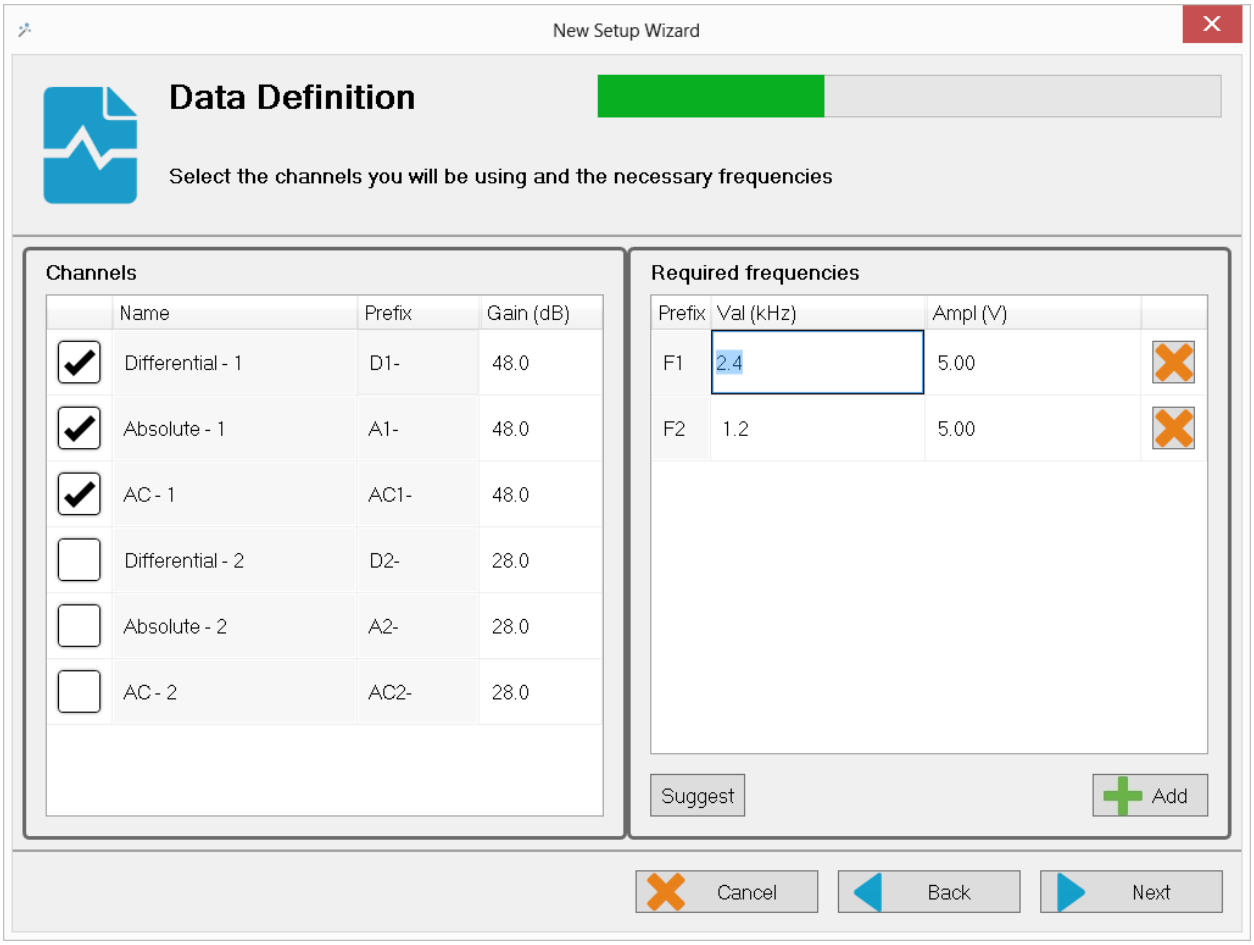
In the Probe Selection window, select the probe you are using for your inspection.

Select Bobbin ABS-DIF + AC probe the Eddyfi's AC probe.



Data Definition

The Data Definition window is used to set the hardware gain, frequency and drive voltage for the Absolute, Differential and AC channels. It is important to set these parameters correctly before acquiring data since they are driven by the instrument and cannot be modified during the analysis.



By default, Magnifi® Go suggests four frequencies theoretically calculated with the parameters previously entered:

Prefix	Frequency
F1	2 x F90
F2	F90
F3	F90/2
F4	F90/8

Frequency and drive voltage can be changed by replacing their values in the Required Frequencies table. Up to four frequencies can be set at the same time. The sum of their amplitude cannot exceed 10V.

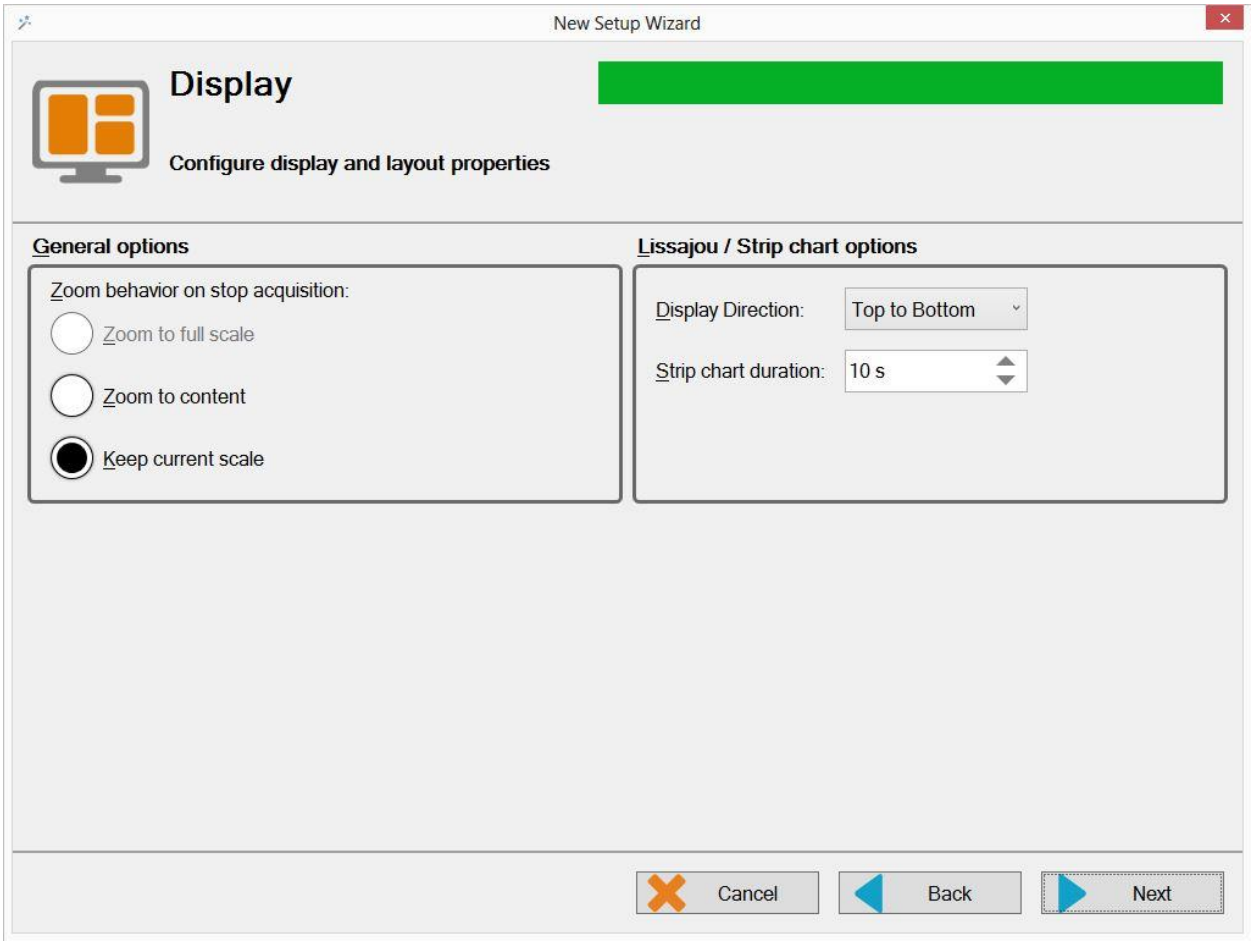
Ensure that the frequencies are within the probe limits found in Table 3. If one of the suggested frequencies is not within the recommended probe frequency range, you can either remove it by clicking the X or update it to the recommended range.

Note that a second set of channels, labeled with "-2", is available for the AC probe. By default, these channels have a lower gain and can be used in land areas to get data where the first set of channels are saturated.

Click Next after the desired parameters are entered.

DISPLAY

The first Display window is used to configure how data displays during and after acquisition.



The display direction is the direction in which data appears on the screen.

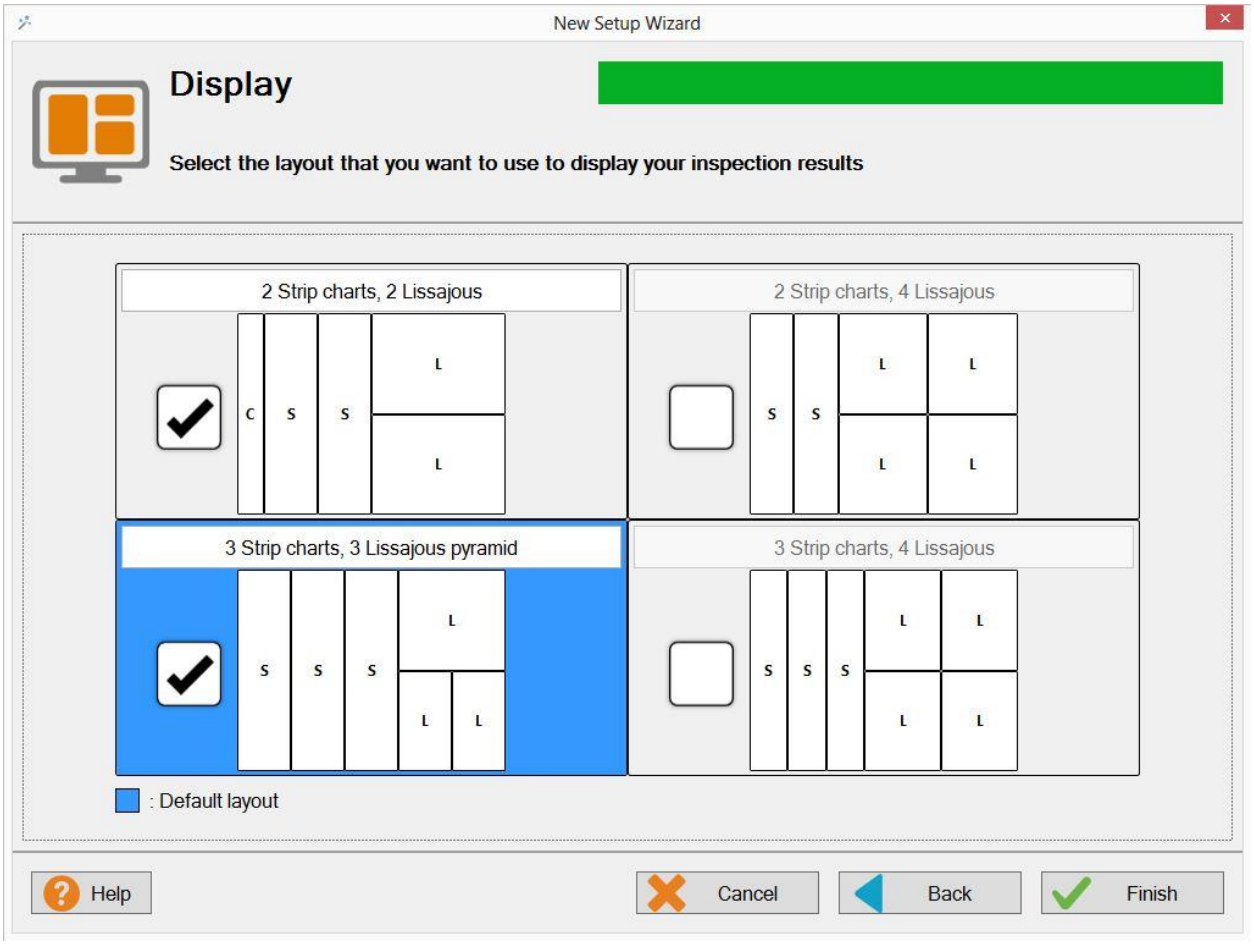
The strip chart duration is the length of a Strip chart window when the data is acquired.

Click Next.

The second Display window is used to set the layouts. Selecting the proposed layouts makes them available in your setup. You can switch from one to another via the layout tab. The "S" stands for Strip chart, "L" for Lissajous and "C" is the defect Code indication zone.

The blue background layout is the one opened by default.

Layouts can be readjusted at any time.



Click Finish to complete the Setup Wizard process.

SETUP MODIFICATIONS

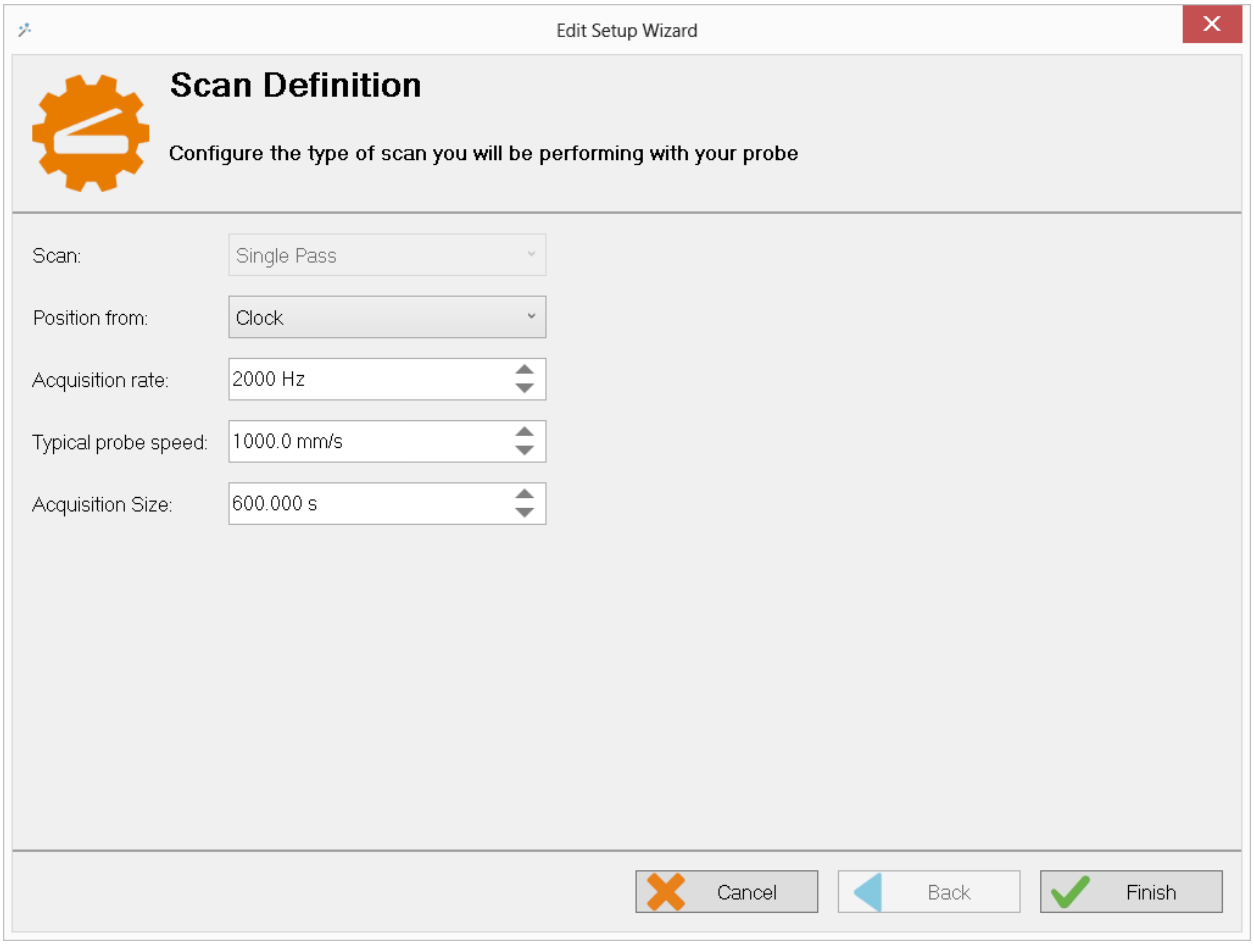
Some parameters or preferences can be modified after the Setup Wizard process. Go to the Setup tab in the Frontstage and click the button associated with the parameter you want to change.

The Comp, Probe, Data and Display buttons opens one for the windows previously described.

Other parameters are available via the Scan, Process, Landmark, Cal Points, Calibration, Sizing and Indication buttons. Change the desired parameter. If applicable, go through the process by clicking Next, and then click the Finish button. This applies the modification to the setup.

SCAN DEFINITION

The Scan Definition window is used to configure the axial position measurement method, the acquisition rate and the typical probe speed.



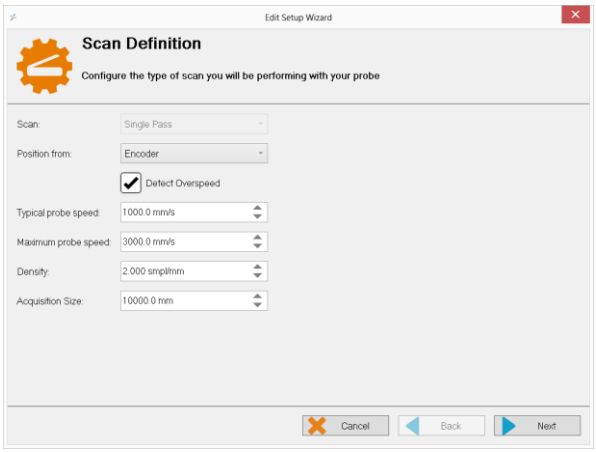
The position along the tube can be defined by using either the system's internal clock or an axial encoder. If you use the internal clock, the default position assumes that the probe is always pulled at the typical probe speed. If the typical probe speed is set to 300mm/s, and the time since the acquisition was started is two seconds, the system will indicate a position of 600mm. Using an encoder gives you the exact position of the probe. Note that the position can also be obtained by using the landmark, but this feature is shown later.

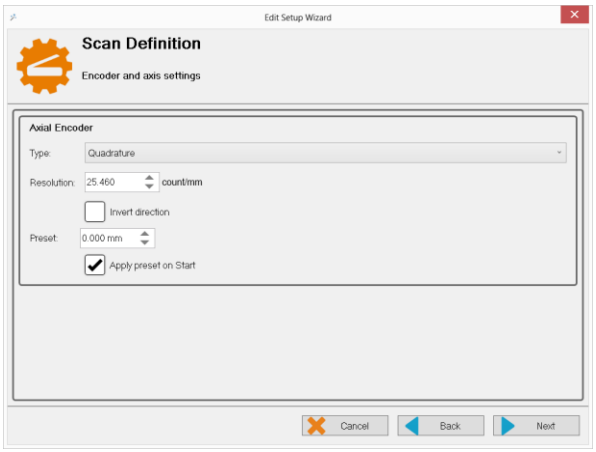
The acquisition rate is the number of acquisition points taken per second. By default, the acquisition rate is set to 2000 Hz for the AC probe, but depending on drive frequency used to inspect, the actual acquisition rate may differ. The system automatically readjusts this value as needed. For standard AC probes, the acquisition rate can always be set to 2000 Hz.

The axial resolution depends on the combination of the acquisition rate and pulling speed. For an acquisition rate of 2000 Hz, the pulling speed needs to be less that 1m/s to have at least two points per millimeter. If the probe is pulled manually, the pulling speed won't be constant.

Therefore, it is recommended to target a lower pulling speed to be able to reach your axial resolution target. Also, typical probe speed should be set as close as possible to the real value. This helps the algorithm that automatically detects landmarks (explained later). The recommended pulling speed for the AC probe is around 1m/s.

If you selected the position from Encoder, different fields appear and a second Scan Definition page becomes available.





On the first page, the Typical Probe Speed, Maximum Probe Speed and the Density need to be entered. The Maximum Probe Speed is the maximum acceptable speed for your probe and the Density is the number of acquired points per millimeter (axial resolution). These values are used to set the acquisition rate and optimize the acquisition processes used by Ectane. Note that if your probe is pulled at a speed exceeding the Maximum Probe Speed, data will be lost.

The second page includes the type of encoder and its resolution. A preset can also be specified if your acquisition doesn't start at 0 mm.

Selecting the Detect Overspeed option highlights the maximum probe speed when pulling too fast.

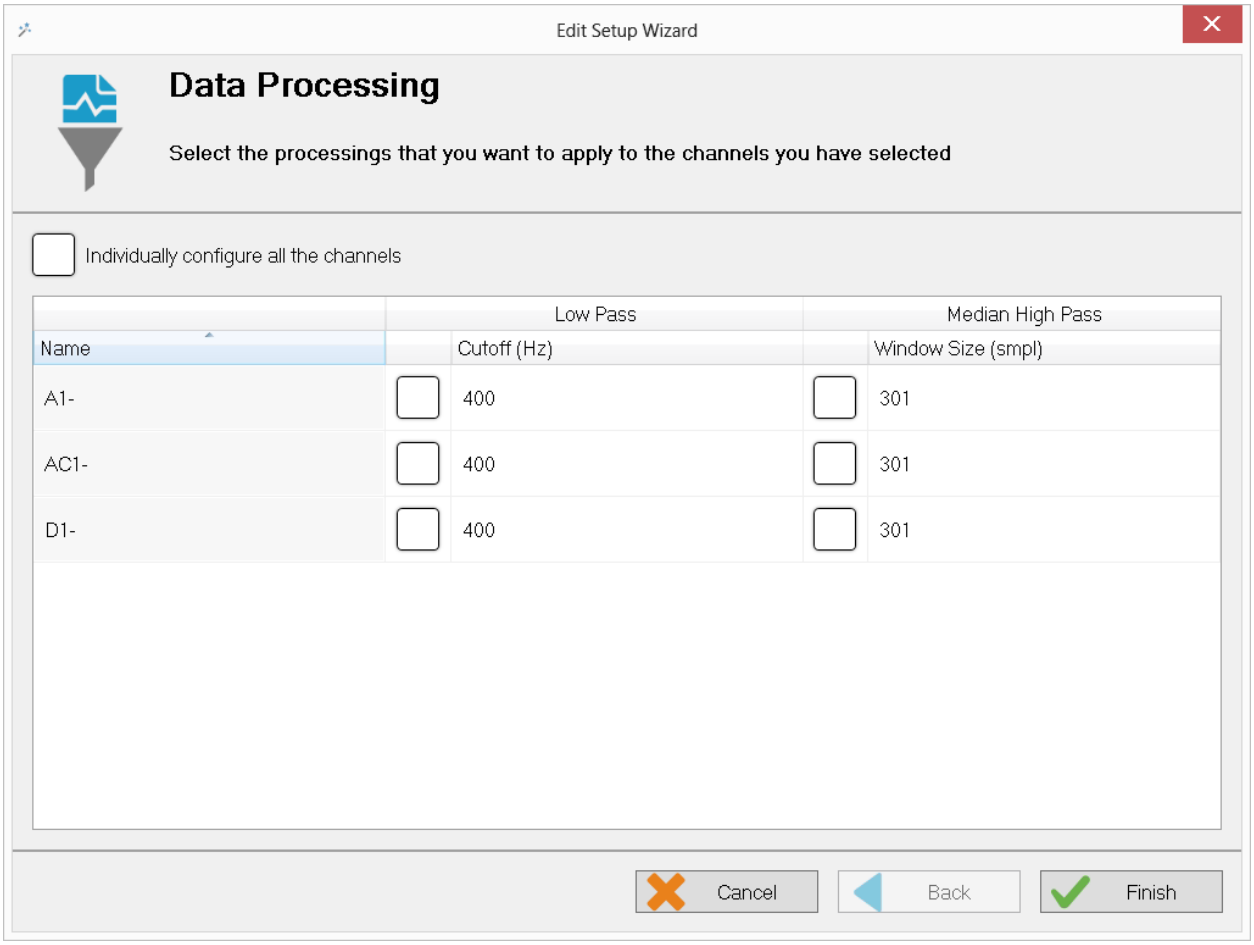
Click Next when you're finished.

DATA PROCESSING

The Data Processing window is used to configure the signal processing to apply to the channels.

You can choose to configure every frequency individually or apply the same filters to every channel with the Individually Configure All The Channels option.

Note that the signal processing is done after data acquisition. Wrong parameter choices for data acquisition can mislead the analysis, but an inappropriate parameter choice can be changed without any problem during data analysis.



The low-pass filter eliminates part of the signal above a certain frequency. As an example, it is useful when the defect signal has lower frequency content than the background noise. In this case, using a filter removes part of the noise without removing defect signals. This may help to analyze the data. However, a cutoff frequency that is too high won't remove much noise, and a too low cutoff frequency filters out defect signals.

The median high-pass filter is used to filter out low frequency noise or drift such as lift-off variations of the probe within the tube, changes in material, geometry or thickness. As a rule-of-thumb, the width of high-pass median filter should be set at least three times of the longest flaw that may be encountered. Data should be examined in its filtered and unfiltered states. It

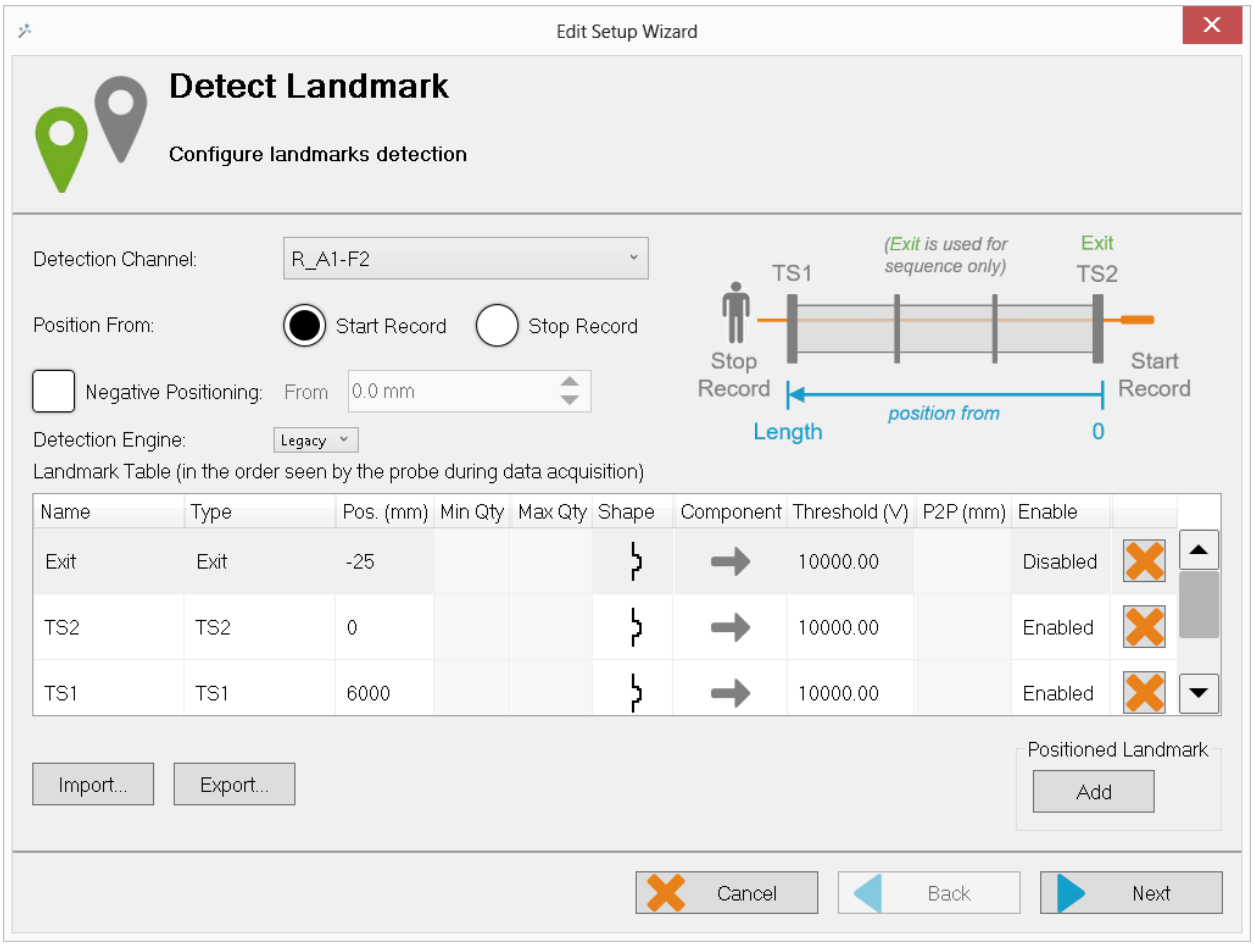
is important to keep in mind that the high-pass median filters can distort phase. More information about median filter for NDT analysis can be found on Eddyfi's blog.

Click Next when you are done.

Detect Landmark

The Detect Landmark window is used for configuring the automatic detection of features such as tube sheets and support plates. Landmarks are not mandatory and don't need to be set to have functional setup. However, they can give relevant information of the axial position in a tube. They can also be used by the software to trigger automatic acquisition sequences.

Three landmarks are created by default. The default channel used to detect these landmarks is the lowest frequency absolute channel. The R_ before the channel stands for Raw. This is the signal of the channel without software filter, rotation or software gain applied.



You can base the position of your landmarks either on the location where you start to record (usually the tube entrance, opposite from the operator position) or by the place you stop recording (usually the operator side).

In the above example, the Exit landmark is detected when the probe exits the tube at its outer end. It can be used to trigger the data recording (explained later). It has a negative position because this event happens before entering the tube. It is enabled only when performing the acquisition. This landmark is not included in the resulting data file and is not available at the subsequent analysis step.

TS2 is the first tube sheet encountered when the probe is pulled. TS1 is the last tube sheet encountered at the end of the acquisition. These two landmark detections are enabled during both the data acquisition and analysis.

The landmark detection can be set manually by describing the shape, component and voltage threshold that triggers the detection. The Shape describes the shape of the signal when the landmark is reached. If a differential signal shape is chosen, the peak-to-peak distance ("P2P") is also needed. Direction is the projection axis (horizontal of vertical) of the Lissajous signal used to trigger the Landmark, and Threshold is the voltage amplitude threshold.

Landmarks can be calibrated on real signals (explained later); in this case, there is no need to change these parameters as they are automatically measured by the software.

It's important to set the landmarks position as accurately as possible. If the position is not accurately set, the software might prevent their automatic detection since it won't be at an expected position.

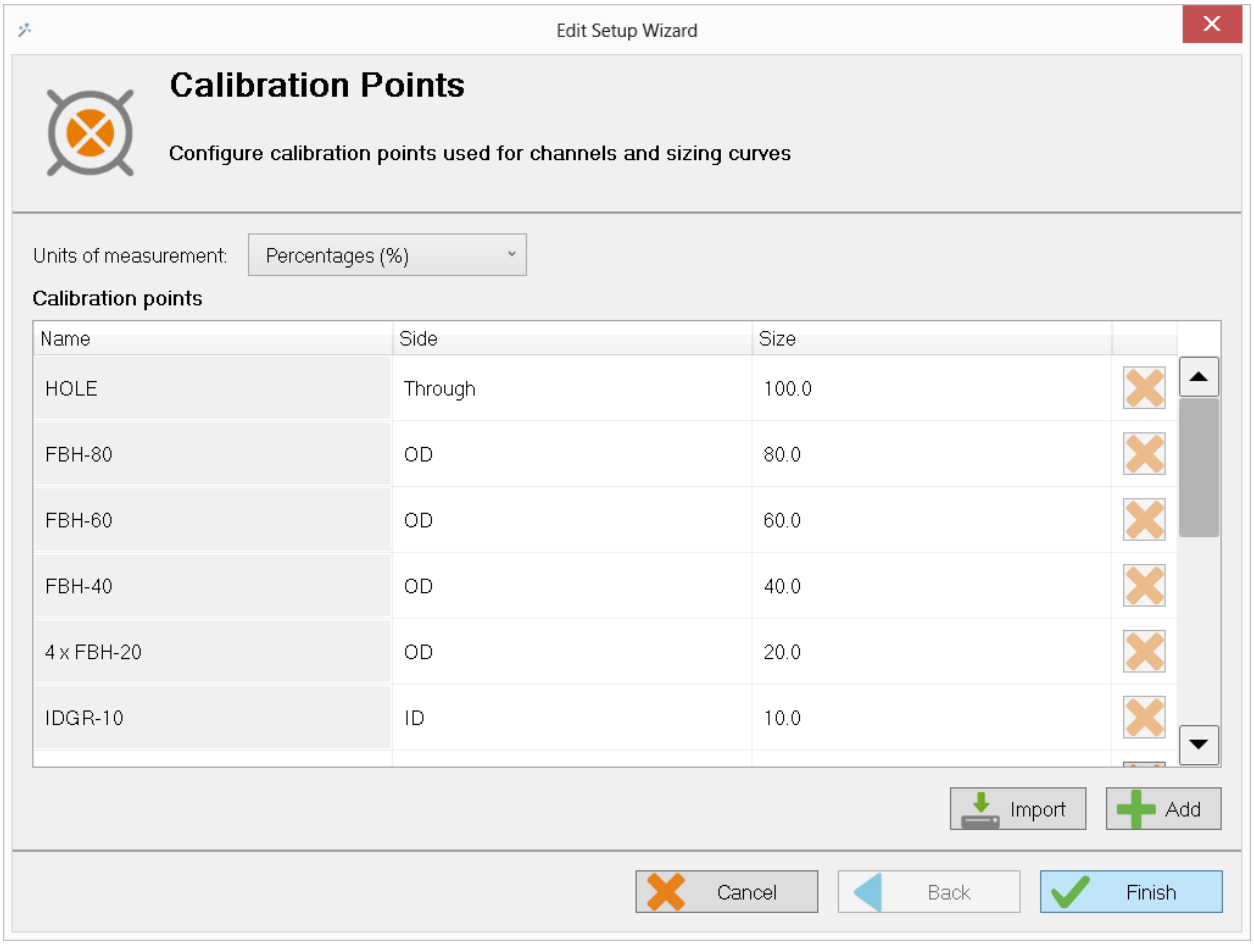
The Type field is a name that associates the calibration point to the landmark. If landmarks share the same Type, they are calibrated at the same time using the same point and process. To associate two landmarks with the same Type, their signal must be the same. If same geometry support plates are present in a bundle, they can share the same Type. In the above example, TS1 and TS2 don't share the same Type because one is triggered when the probe enters the tube and the other is triggered when the probe exits the tube.

Detection Engine drop-down menu can be set to Legacy or Extended. In Legacy mode, all landmarks must be entered with the right position. The system looks for the exact number of landmarks entered at positions close to those entered in the table. With the Extended mode, the system looks for several landmarks between the Qty max and the Qty min. In this mode, the exact number of support plates doesn't need to be constant or known.

CALIBRATION POINTS

The Calibration Points page is used to define the points in your calibration tube. These indications are used later to calibrate your probe and build sizing curves.

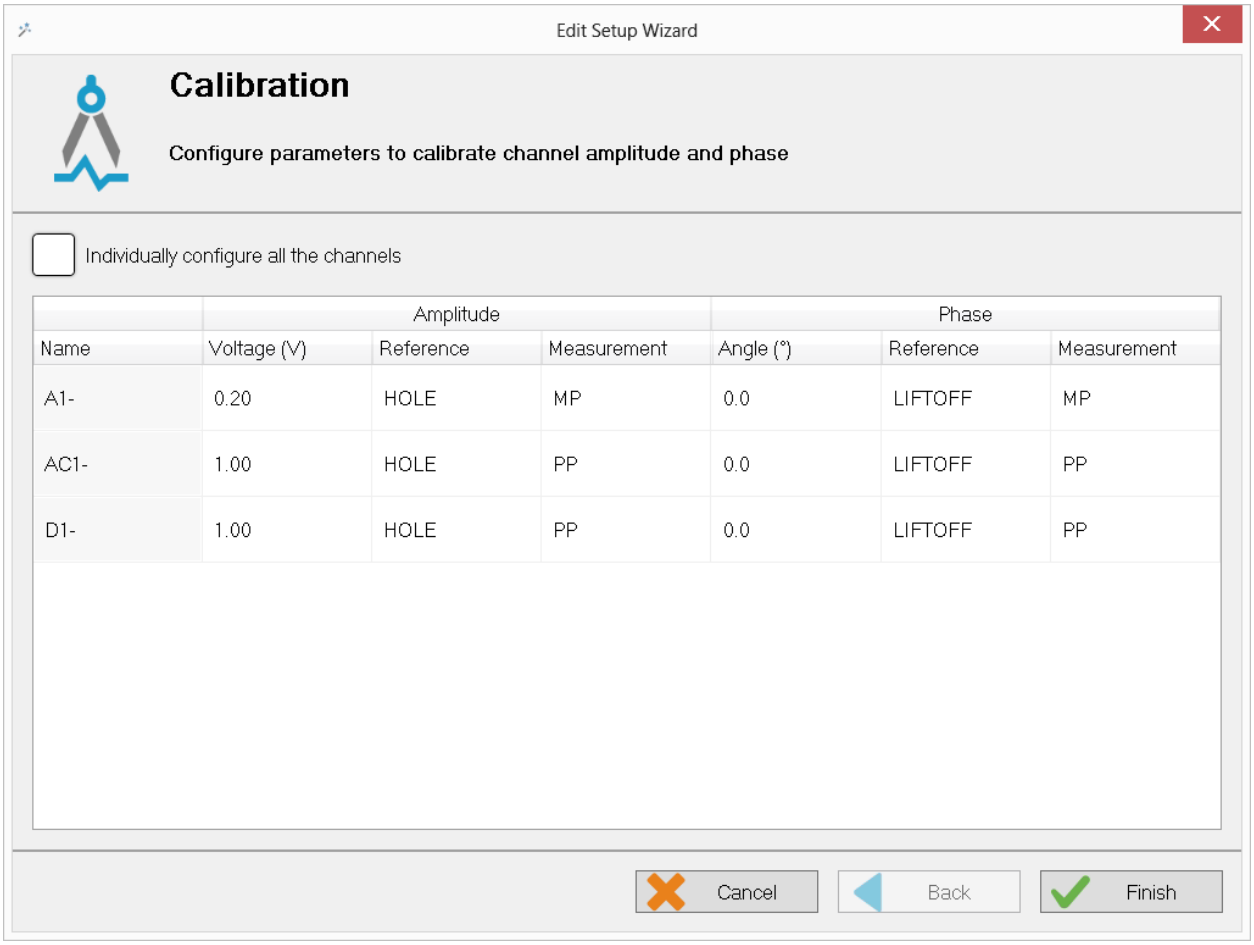
The calibration point units of measurement can be set in percentage or in depth (millimeters or inches).



You can add calibration points by clicking on the Add button. Specify the calibration point name, side and size. The side and size of the flaw is used to position the calibration point on the sizing curve(s).

CALIBRATION

The Calibration page is used to define reference signal(s) that are used to set the amplitude(s) and phase(s) of each channel using the selected measurement method.



By default, calibration is performed on the Hole signal by putting it at 1V on both the absolute and the differential channels, and at 0.2V on the AC channel. The phase is adjusted at 0° on the lift-off signal. However, the calibration can be done differently on each channel type. It can also be done individually for each frequency by selecting the Individually Configure All The Channels option.

When you select the reference signal, the system uses the selected measurement method to apply rotation and gain. Here are short descriptions for the available options:

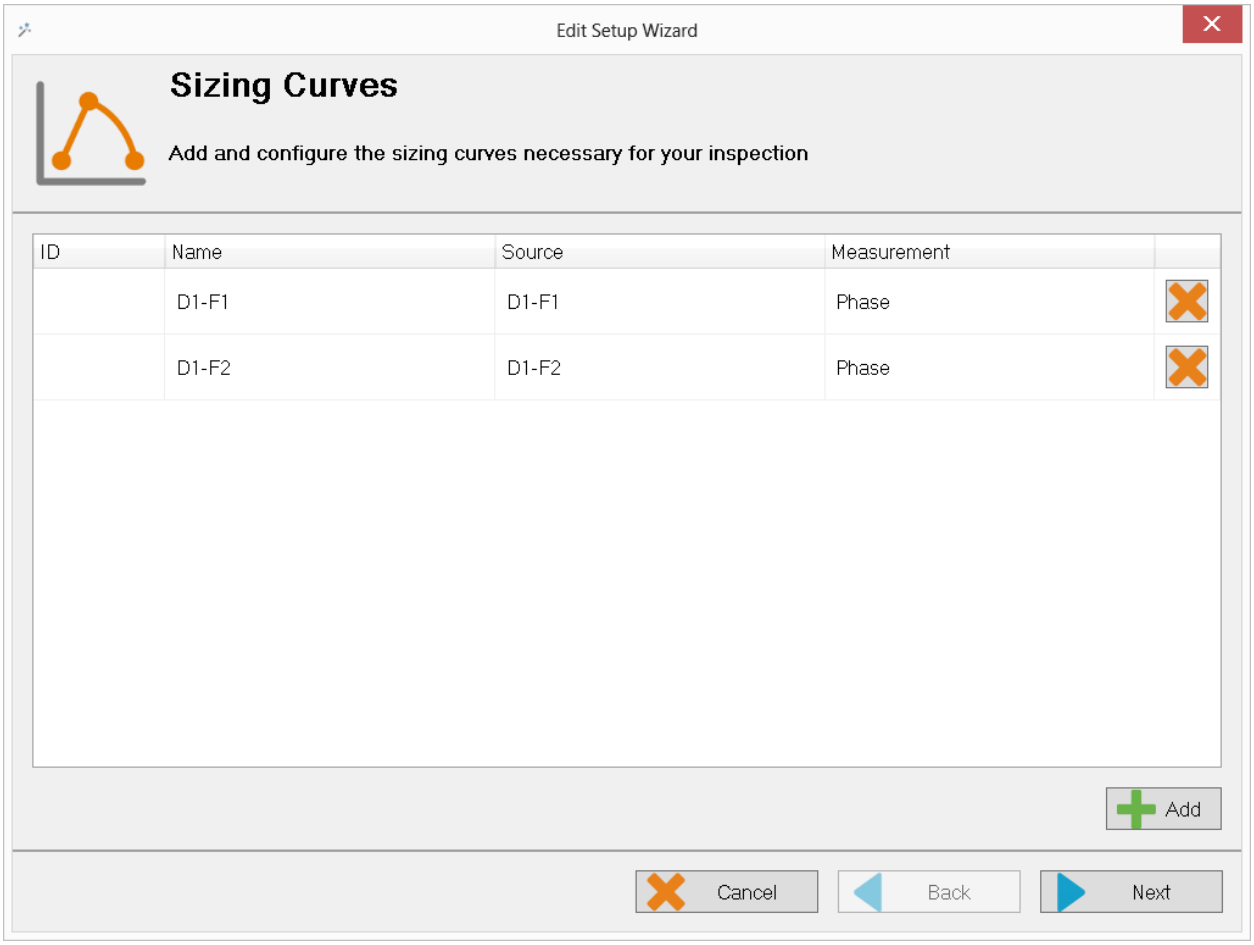
1. **Absolute (A):**
   Uses a straight line from the Lissajous origin to the main cursor position to measure amplitude.
2. **Absolute Horizontal (AH):**
   Only uses the horizontal component, from the Lissajous origin to the main cursor position to measure amplitude.
3. **Absolute Vertical (AV):**
   Only uses the vertical component, from the Lissajous origin to the main cursor position to measure amplitude.
4. **Absolute Peak (AP):**
   Uses a straight line, from the Lissajous origin to the peak value of the data selection, to measure amplitude.
5. **Absolute Peak Horizontal (APH):**
   Only uses the horizontal component, from the Lissajous origin to the peak value of the data selection, to measure amplitude.
6. **Absolute Peak Vertical (APV):**
   Only uses the vertical component, from the Lissajous origin to the peak value of the data selection, to measure amplitude.
7. **Absolute (A):**
   Uses a straight line from the Lissajous origin to the main cursor position to measure amplitude.
8. **Absolute Horizontal (AH):**
   Only uses the horizontal component, from the Lissajous origin to the main cursor position to measure amplitude.
9. **Absolute Vertical (AV):**
   Only uses the vertical component, from the Lissajous origin to the main cursor position to measure amplitude.
10. **Absolute Peak (AP):**
    Uses a straight line, from the Lissajous origin to the peak value of the data selection, to measure amplitude.
11. **Absolute Peak Horizontal (APH):**
    Only uses the horizontal component, from the Lissajous origin to the peak value of the data selection, to measure amplitude.
12. **Absolute Peak Vertical (APV):**
    Only uses the vertical component, from the Lissajous origin to the peak value of the data selection, to measure amplitude.
13. **Average Peak (MP):**
    Takes the distances from points at the extremity of the cursor to the peak of the data selection to build an average vector. Only used and recommended for absolute signals.
14. **Average Peak Horizontal (MPH):**
    Uses the horizontal component of the distance form points at the extremity of the cursor to the peak of the data selection to make an average vector. Used for absolute signals.
15. **Average Peak Vertical (MPV):**
    Uses the vertical component of the distance form points at the extremity of the cursor to the peak of the data selection to make an average vector. Used for absolute signals.

16. **Peak to peak (PP):**
    Uses combination of the vertical and horizontal components to measure the maximum amplitude.
17. **Horizontal (PPH):**
    Only uses the horizontal component to measure the amplitude.
18. **Vertical (PPV):**
    Only uses the vertical component to measure the amplitude.
19. **Peak to peak First Transition (PPF):**
    Uses a combination of vertical and horizontal components of the first transition of the signal to measure maximum amplitude. The first signal transition is from the base of an indication to its peak.

Note that some measurement methods are only available if they are checked in the Analysis tab of the Preferences section in the Backstage.

SIZING CURVES

The first page of this section is the definition of your sizing curves. A curve is built for each line in this table.

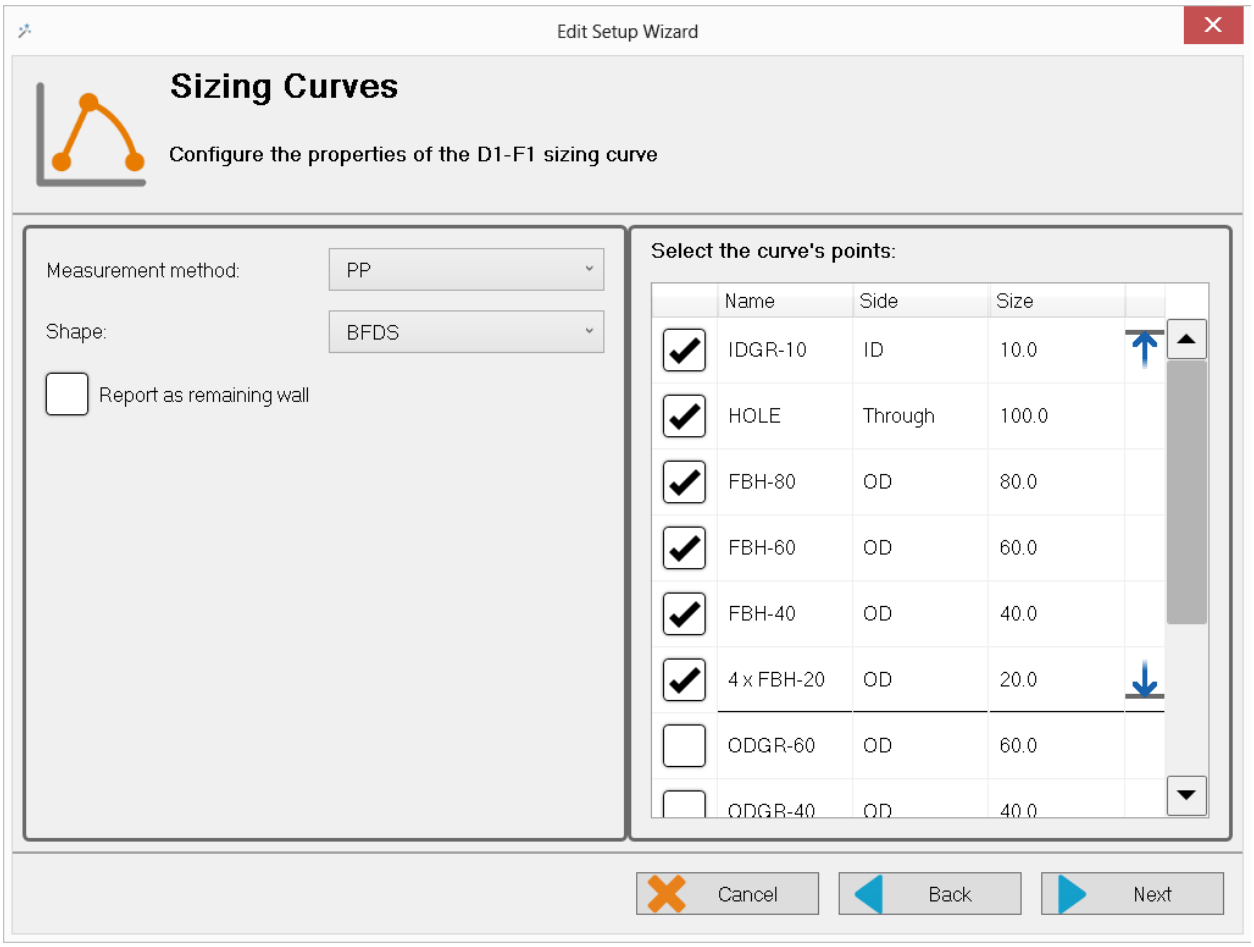


The sizing curve allows you to estimate the size of a defect based on the calibration points' signals (amplitude or phase) obtained with your calibration standard. Magnifi Go provides the interpolated flaw size based on the built sizing curves.

Sizing curve names are customizable. The channel source and measurement type can also be changed. You can add sizing curves by clicking the Add button.

Click Next when you are done.

For every sizing curve created in the last window, a window appears to configure the curve properties. The name of the curve is shown in the upper left corner of the page (D1-F1 in the example below).



The measurement method options are the same as those described in the calibration page section of this document. By default, the option peak to peak is used for the differential channels.

The interpolation method can be selected in the Shape dropdown menu. Here are short descriptions for the available options:

1. **Best Fit (Dual linear) (for phase measurement only):**
   A curve with two linear segments representing ID and OD (or Near and Far) side calibration points in relation to phase.
2. **Best Fit (Dual Slope) (for phase measurement only):**
   A curve with two segments representing ID and OD (or Near and Far) side. The ID section is linear and the OD section is polynomial. The OD side of the curve needs at least three points (including the hole) in order to trace a polynomial curve.
3. **Best Fit (Polynomial) (for phase and amplitude measurements):**
   Best polynomial (degree 2) interpolation within the measured (at least three) calibration points.
4. **Connected Points (for phase and amplitude measurements):**
   Simple point-to-point curve.
5. **Best Fit (Linear) (for phase and amplitude measurements):**
   Best linear interpolation within the measured calibration points.
6. **Best Fit (Dual Polynomial) (for phase and amplitude measurements):**
   Polynomial (degree 2) interpolation with two segments for both ID and OD side of the curve; at least three points are needed.

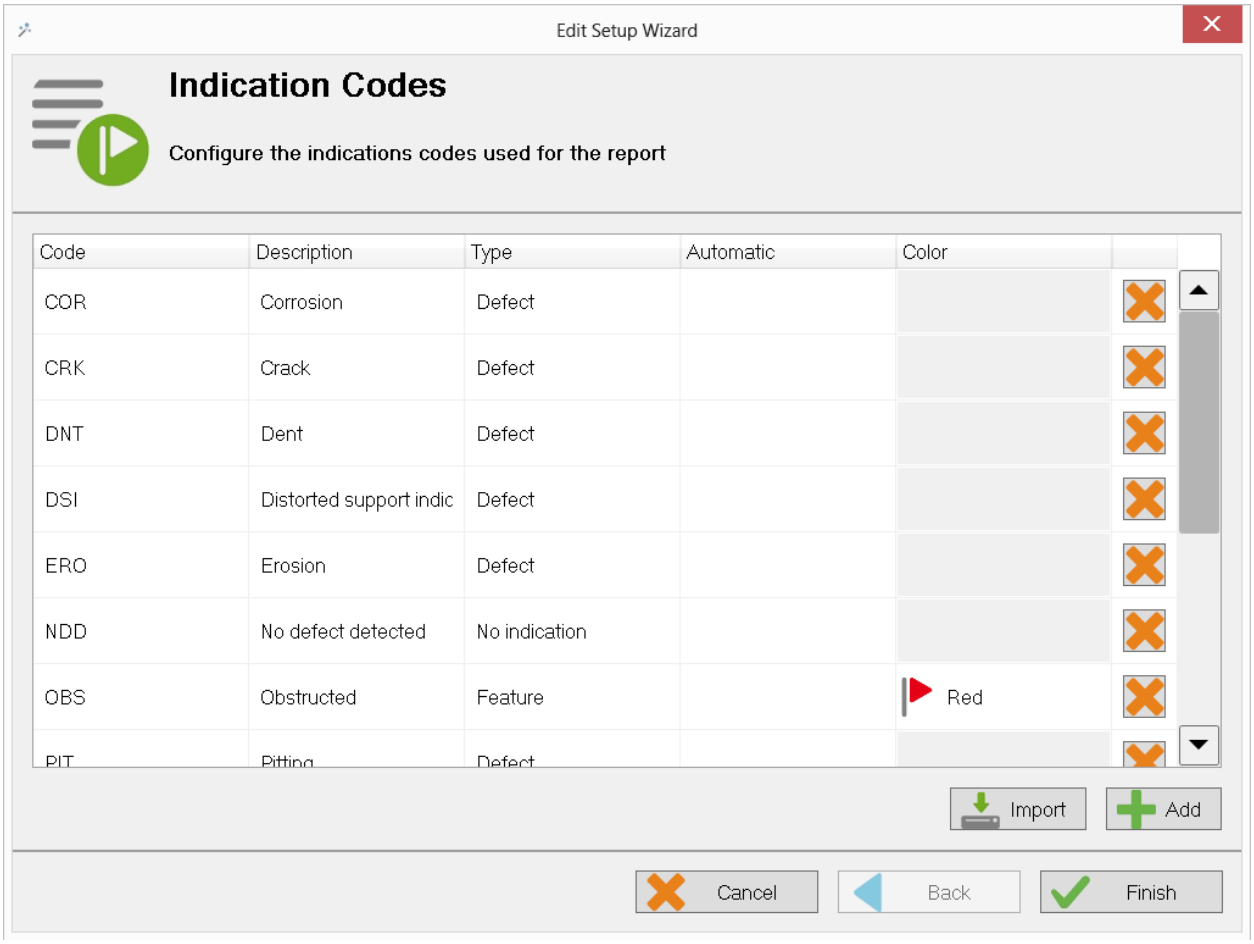
The linear options are mostly used when few data points are available, while the Best Fit (Dual Polynomial) option is a more precise method when your calibration tube has multiple defects.

Once the measurement method and the interpolation curve shape are chosen, you can select the curve points for each sizing curve previously created. The order in which the points appear in the list may influence your sizing curve. Make sure that the measured values of the calibration points are in ascending order in the list. You can set Magnifi Go to show remaining wall instead of defect size by checking the box Report As Remaining Wall Thickness.

INDICATIONS

The Indication Codes page is used to define the entries added to the report when analyzing the data.

When an indication is added, its abbreviation (code) is shown in the code pane next to the data.

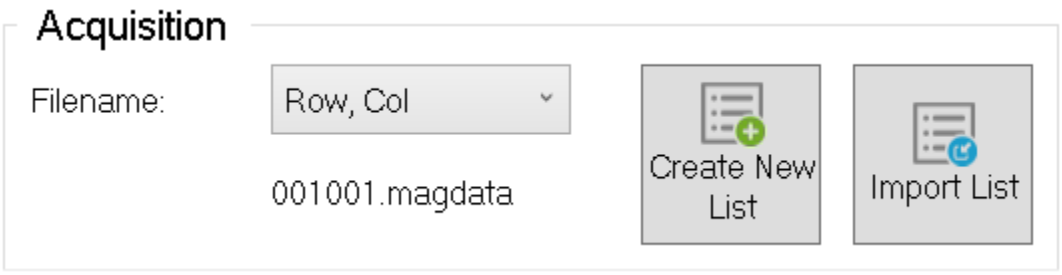


You can modify the default Indications Codes list by changing the parameter in the table. New indications can be defined by clicking the Add button.

TUBE LIST

Magnifi Go saves a file for each inspected tube. The file names are defined by creating the tube list.

This list can be created in the Acquisition section of the General tab in the Backstage.

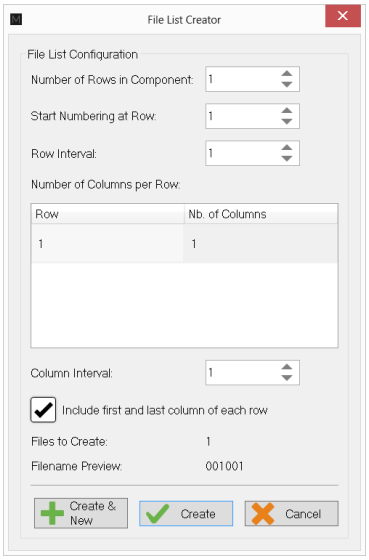


Two options are available to set the filename format:

1. **Row, Col:**
   Row number, Column number. Mostly used for tubing inspections.
2. **Zone, Row, Col:**
   Zone number, Row number, Column number. Mostly used for tubing inspections.

Click the Create New List button. The window display is different depending on the chosen filename format.

For the Row, Col option, enter the number of rows, the starting row number and row interval. Then enter the number of tubes per row in the Nb. of Columns fields of the table. Click Create to generate the list of tube. You can also use the Create & New button to add another set of tube to your list.



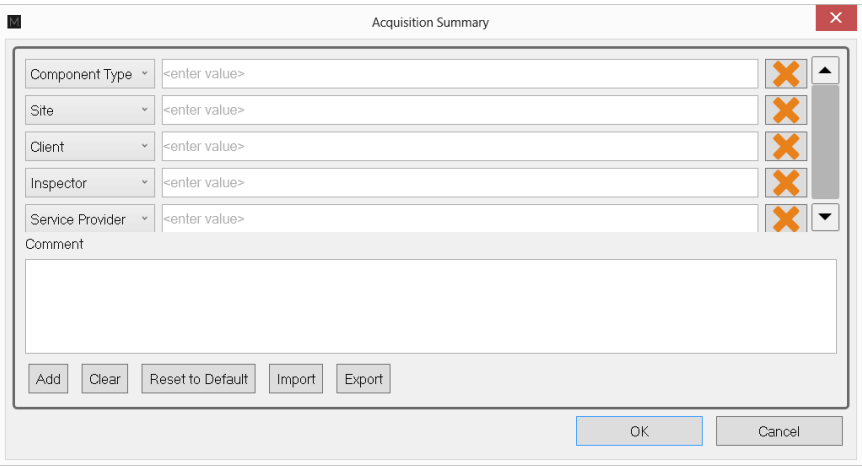
The same principles apply to the Row, Col format.

The tube list can also be imported from another project using the Import List button. The tube list file is found in the Inspection folder. You can also import a list created in the TubePro™ software (available from Eddyfi).

Performing an Acquisition

1. If you are in Backstage, move to Frontstage by clicking the Start/Resume button.

   Note: If you created a new inspection project, the Acquisition Summary window will open. The customizable fields displayed give information on the current inspection and are shown in the Magnifi Go report (described later).

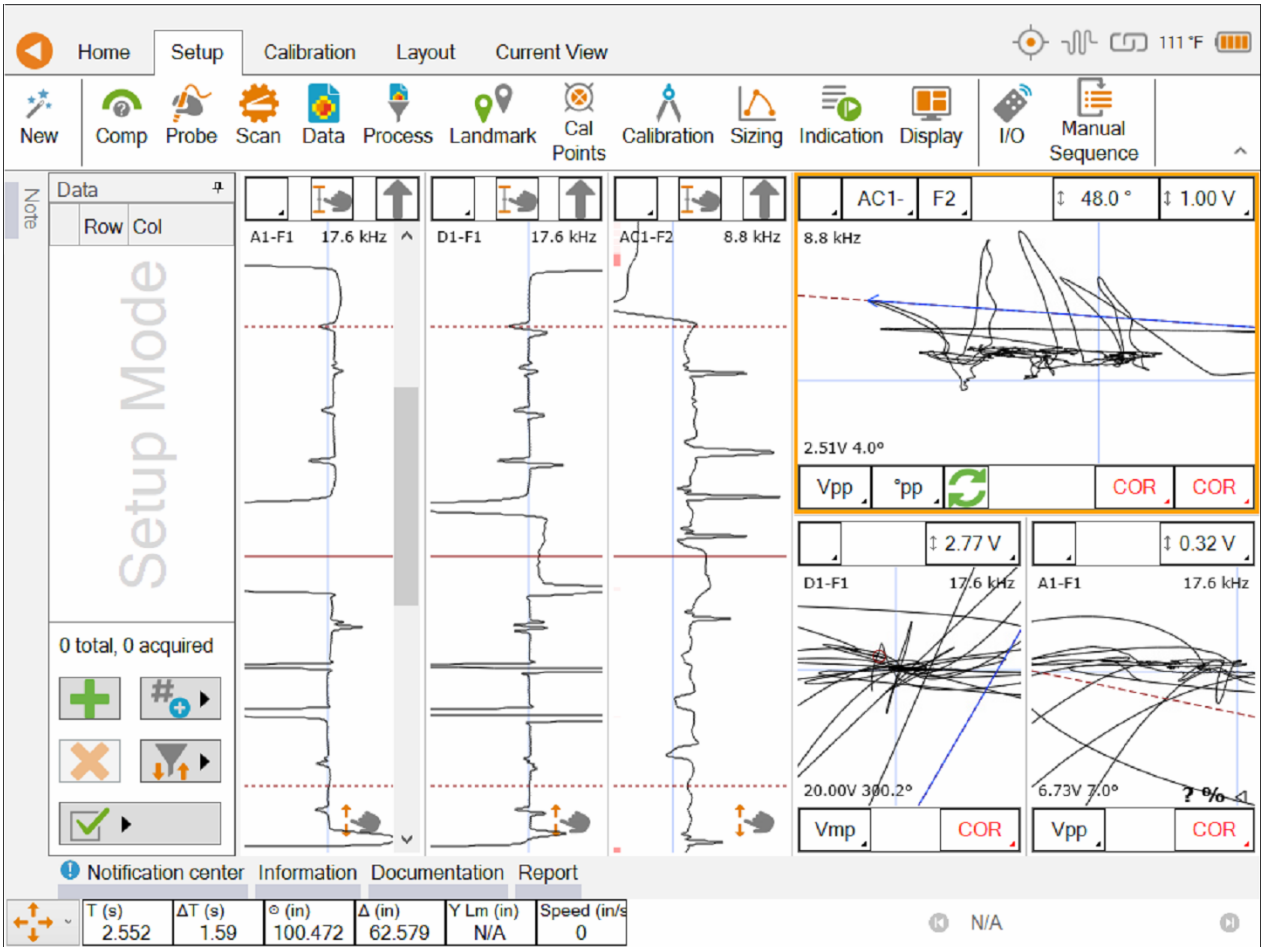


   Two acquisition modes are available in Magnifi Go: The Setup Mode and the Acquisition Mode. The Setup Mode is used to scan your calibration tube and make the necessary adjustments to your setup without saving the data automatically. The acquisition mode is used for inspection. When in this mode, the software automatically saves the acquired data using file names based on the tube list.

2. For the calibration phase, go to Setup Mode by clicking the Setup Mode button in the Home tab. This mode is active when the Setup Mode button is gray.

3. Plug the probe into the two 4-pin connectors on the Reddy AC.
4. Put the probe head in a clear area in your calibration tube and balance the probe by clicking the Null button in the Home tab or the same icon on the instrument.

5. With the probe ***inside*** the tube, start your acquisition by clicking the Acquire button in the Home tab or press the physical Play/Stop button on the Reddy AC.
6. Put the probe head outside the tube at a normal pushing speed.
7. Pull the probe until it is outside the tube.
8. When done, press the Stop button or press the physical Play/Stop button on the Reddy AC.



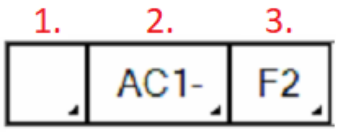
Note that a red zone in the code pane means that at least one of the raw signals is saturated. This is usually the case when your probe is out of the tube.

VISUALIZING THE DATA

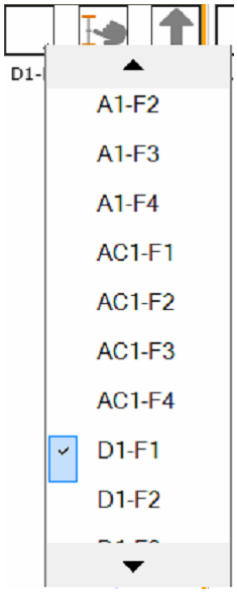
Multiple options are available to select and measure your data. The following describes useful functions:

DISPLAYED CHANNEL

There are three buttons at the upper left corner of the Strip charts and Lissajous windows. These buttons are used for channel selection.



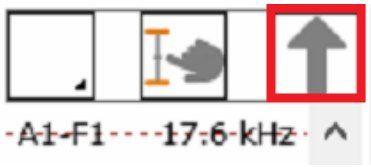
1. Link Strip charts and Lissajous to the same channel. For instance, if a Lissajous and a Strip chart are both set to 1, setting the Lissajous to DI-F1 also sets the associated Strip chart to this channel.
2. Click the corner with the black triangle for the list of available channels. Select the desired channel. Click this button to switch to the channel in the list.



3. Same principle as 1, but for the frequencies only.

Strip Charts Axis Orientation

The Strip charts are a projection of the Lissajous on the vertical or horizontal axis. To switch from one axis to another, click the box showing an arrow at the upper right corner of the Strip chart.



Zooming

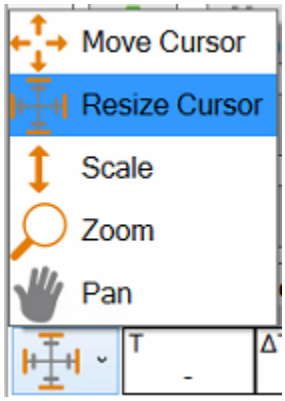
To adjust the zoom of a Strip chart on a Lissajous, pinch/un-pinch the selected window.

Adjusting the Cursor Length

On a Strip chart, the cursor is divided by three lines. The dotted lines represent the limit of your cursor and the full line is the center of what you selected.

Only the selected section of your data is shown in the Lissajous.

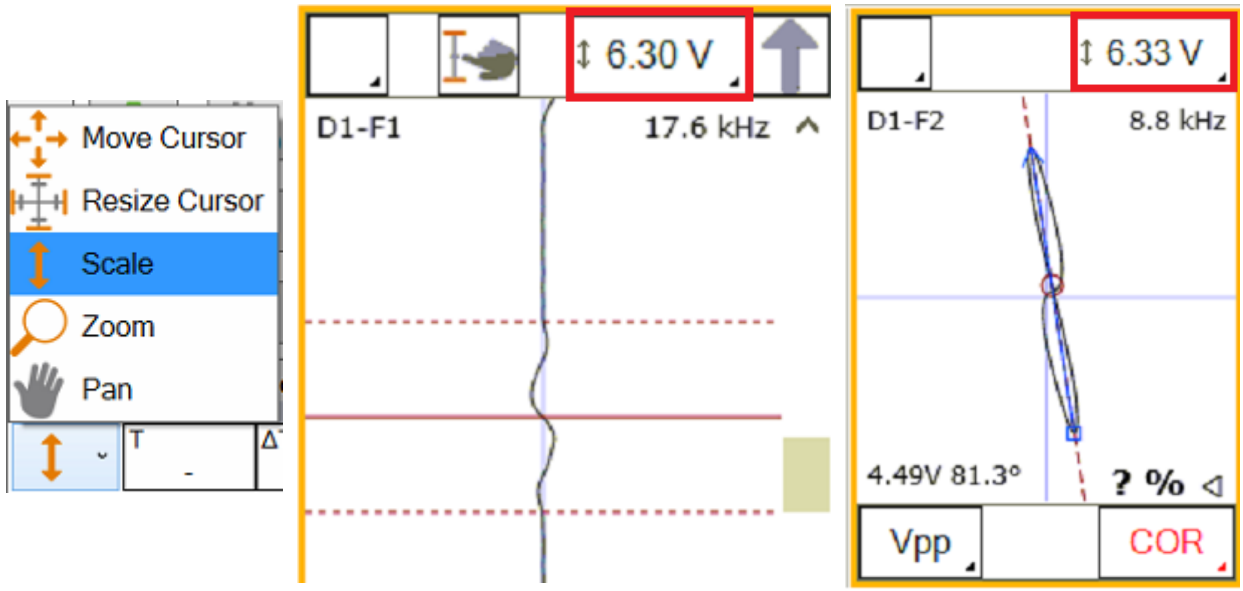
To adjust your cursor length, select the Resize Cursor option and use the up/down arrow buttons on the instrument to resize the dotted lines symmetrically.



Alternatively, you can touch the  button on the desired Strip chart, using your finger to resize the cursor.

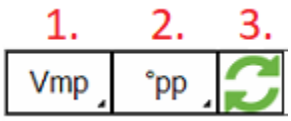
Adjusting the Scale

The scale of a window (Lissajous or Strip chart) can be modified by selecting the Scale option and the up/down arrow buttons to increase or decrease the scale of the selected window.



Measurement Method

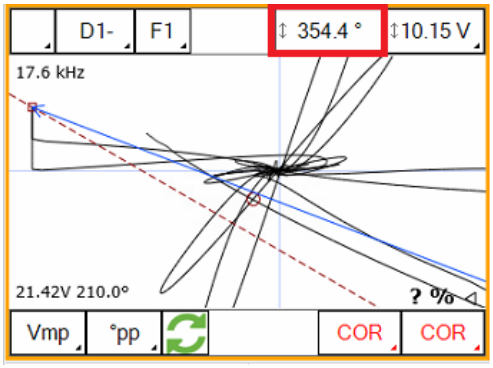
The buttons at the lower left corner of the Lissajous windows are used to select the measurement method. A short description of the measurement methods can be found in the above calibration section of the Setup Wizard.



1. Click the corner with the black triangle for the list of measurement methods for amplitude of the signal. Select the desired method. Right or left click this button to select the following or previous method in the list.
2. Same as 1, but for the phase measurement.
3. Remove 180° from the measured phase. This option can be used if the software doesn't measure the phase with the right orientation.

Lissajous Rotation and Panning

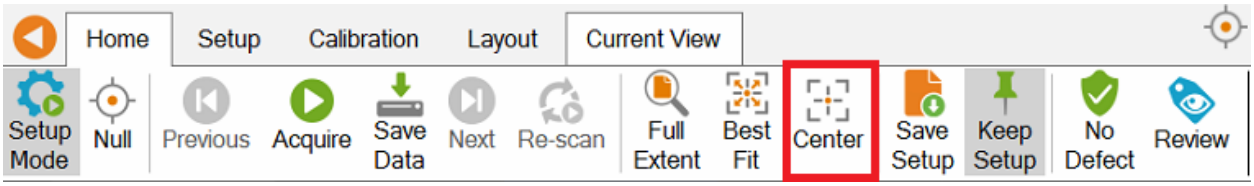
The signal in a Lissajous can be rotated by clicking and holding the orientation button on the Lissajous and dragging up or down on the screen.



Rotating the signal will affect your calibration. If you perform this operation, make sure to recalibrate afterwards.

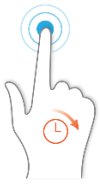
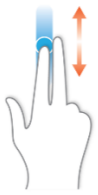
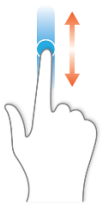
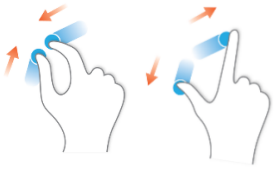
Data Centering

To center data in different windows, put your cursor on the point you want the data to be centered and press on the Center button in the Home tab.



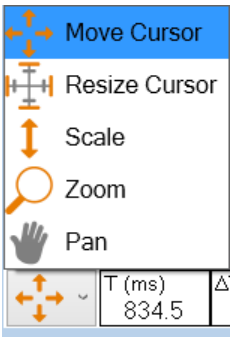
Gestures

Gesture	Representation	View	Effect
Single tap		Strip chart	Move the cursor to the tap location.
		Lissajou	Center the data in the view (effective in both Lissajou and Strip chart).
		View top or bottom box (like the channel box D1-F2, frequency box, etc.)	Switch to next item in the list for that box.

Long tap		View top or bottom box (like the channel box  , frequency box, etc.)	Open the items list for that box.
Two finger scroll		Strip chart	Scroll the data vertically.
One finger scroll		Strip chart	Move the cursor vertically.
		Strip chart, after tapping on the  button.	Resize the cursors until you stop touching screen.
One finger pan		Lissajou	Scroll data in all directions.
Pinch / un-pinch		Strip chart & Lissajou	Zoom/ un-zoom data (vertically for Strip charts, in both directions for Lissajou).

Gesture representations (Gestures Long Press.png, Gestures Pan.png, Gestures Pinch.png, Gestures Scroll.png, Gestures Tap.png, Gestures Two Finger Tap.png, Gestures Unpinch.png) by GRPH3B18, licensed under CC-BY-SA 3.0, available from Wikimedia Commons (https://commons.wikimedia.org/wiki/Category:Multi-touch_gestures).

The Reddy's physical arrow buttons can also be used for finetuning data selection or cursors. Their effects are modified depending on the choice made on the cursor effect button located at the bottom left of the screen. This choice can also be made via the  physical button.



CALIBRATION AND SIZING CURVES

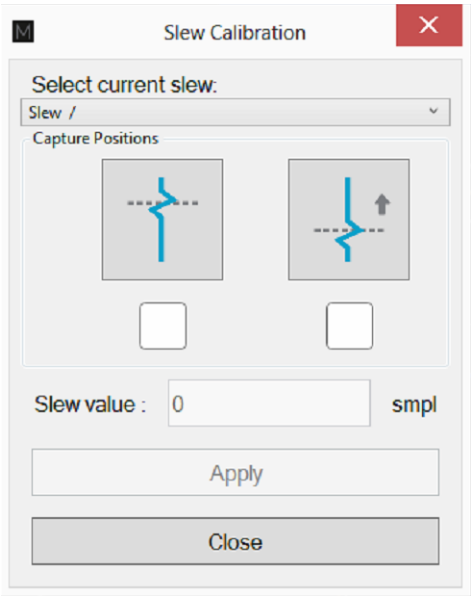
SLEW

The AC probe includes three channels: the absolute, the differential and the AC.

The coils used of the AC channel are not physically located at the same axial position as the bobbins of the absolute and differential channels. Therefore, there is a time delay between these channels. To bring all the signals to the same position, the bobbin channels can be shifted in time to match the AC signal. This process is called Slew in Magnifi Go.

To Slew:

1. Click the Slew button that can be found in the Calibration tab.



2. Place your cursor over a flaw in your AC signal.
3. Click the button on the left in the Slew Calibration window. This sets the reference point where the channels will move.
4. Place your cursor over the same flaw but on the differential or absolute channel.
5. Click the button on the right in the Slew Calibration window.
6. Click Apply.

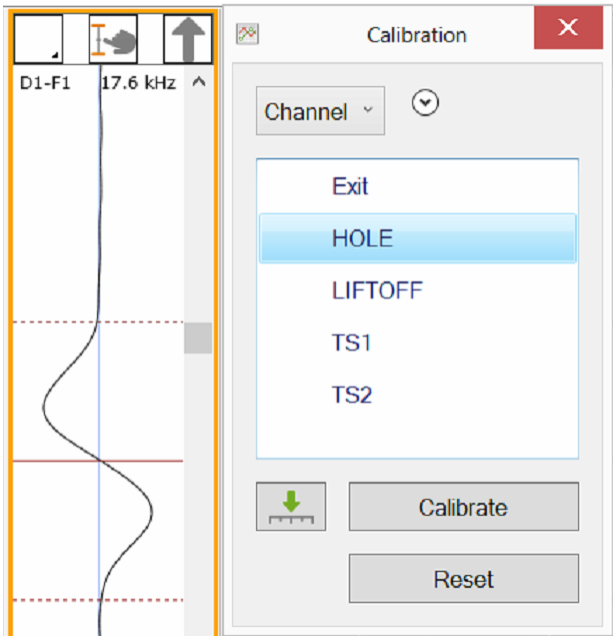
Note that this process will move the channels by a constant number of samples. Therefore, an inconsistent probe pulling speed won't have valid data alignment for the entire scan.

CALIBRATION

The following section describes how to calibrate your probe.

1. Access the Calibration tab and click the System icon.
2. Select Channel in the Calibration window.
3. In the Strip chart, go over the signal to calibrate and adjust the cursors to view the desired signal only.

Note: The system calibrates the signal with the measurement method defined in the calibration part of the setup (accessible in the Setup tab). We recommend reading the data with the same method indicated in the calibration section of the setup. This allows you to see what the system is using to make its calibration. If for some reason the measurement is not taken properly, you may be able to readjust your cursor to have the right measured values.



4. Select the signal name in the list.
5. Click the green arrow button to associate the measured signal to the calibration point.
6. If more than one calibration point is present in the list, redo steps 3, 4 and 5 for all of them.
7. When all your calibration points are selected, click the Calibrate button.

SIZING CURVES

The following section describes how to build sizing curves of the bobbin channels (Absolute and Differential) only.

The AC signal is designed to see circumferential flaws in the tube. It also attenuates the land area signal and allows better detection in these areas. However, the coils used to generate this channel are configured in a way that may lead to different signal shapes for a given flaw. This shape depends on where on the probe circumference the flaw is detected. Sizing curves for this channel are therefore not suggested.

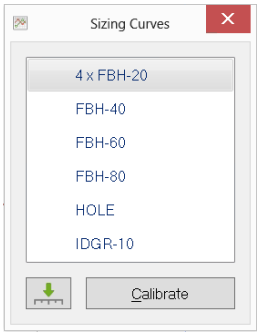
To build your sizing curves:

1. Go to the Calibration tab and click the Sizing Curve button.
2. Select Channel and Sizing Curves in the Calibration window.
3. Go over the signal in your Strip chart and adjust the cursors to only see the desired signal.

Note: The system reads the signal with a measurement method that is defined in the sizing curve part of the setup (accessible in the Sizing tab). We recommend reading the data with the same method as indicated in this section of the setup. This allows you to see what the system is using to build sizing curves. If for some reason the measurement is not taken properly, you may be able to readjust your cursor to have the right measured values.

Also, when points are entered in the sizing curves, the interpolated value is displayed on the Lissajous to show the defect size. To have the correct interpolated value, the measurement method needs to be the same as the one used for the sizing curve. To change the measurement method, click the icons at the bottom left of the Lissajous.

4. Select the signal name in the list.
5. Click the green arrow.
6. Redo the previous steps for all the other indications in the list.
7. Click the Calibrate button.

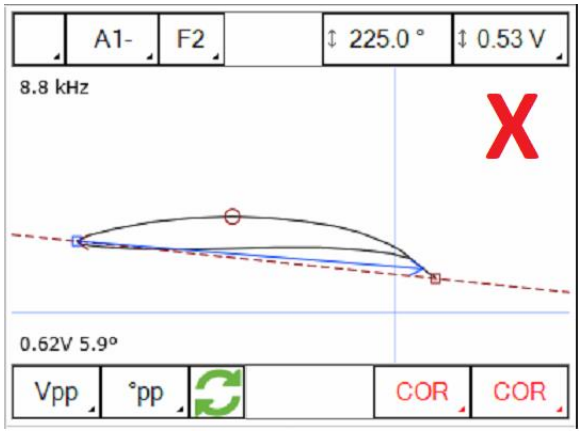


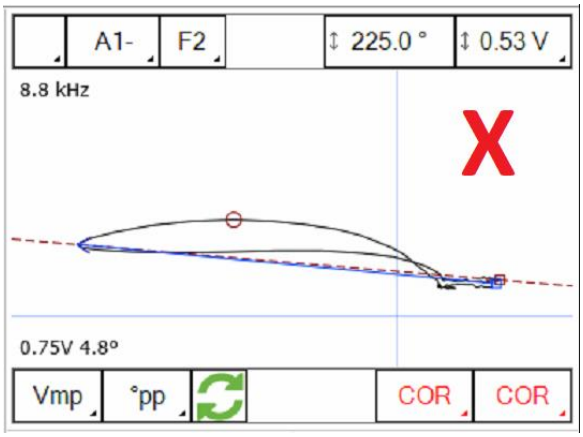
Error messages after creating the phase sizing curves may appear. The main cause for these errors is the measurement direction.

The image below shows two different measurements. On the left you can see the measurement arrow pointing towards the lift-off signal. In this case, the measured phase is rotated 180° from

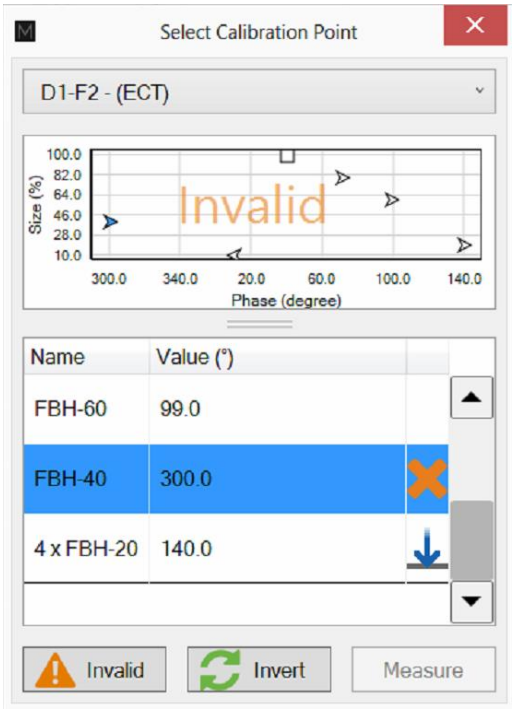
the correct value. When one or more points were measured in the wrong direction, Magnifi Go cannot build the sizing curve and generates an error message. Note that you won't have this issue with an absolute channel if you're using the average peak measurement method.

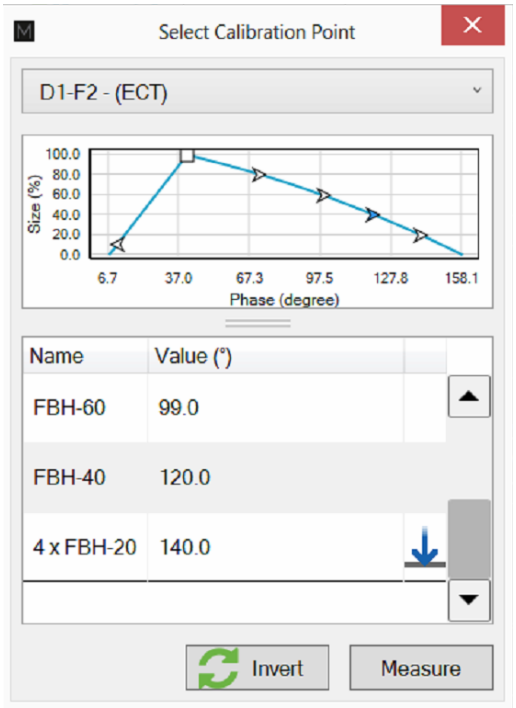
In the image on the right, the arrow points from the lift-off signal to the defect signal, which is correct. However, in this picture, the arrow starts quite far from the middle of the lift-off variation signal that causes an error in the measurement. In this case, we suggest moving the cursors until your measurement is taken from a point near the base of the signal.





To adjust you sizing curves and remove the error messages, go the Calibration tab, and click View Curves.





The sizing curve window appears. Each sizing curve you asked Magnifi to create is listed in the drop-down menu. If an invalid notification is present on the curve, it means that either you haven't entered the sizing points yet or that Magnifi Go failed to create the curve. To adjust the sizing curve manually, enter the value in the table.

In the above example, the entered phase angle for the 40% defect is 300°, but the correct phase angle for the 40% is 120°. The 40% defect has an 180° bias due to wrong measurement direction. In this case, we can simply change the angle value from 300° to 120° in the table to fix the sizing curve.

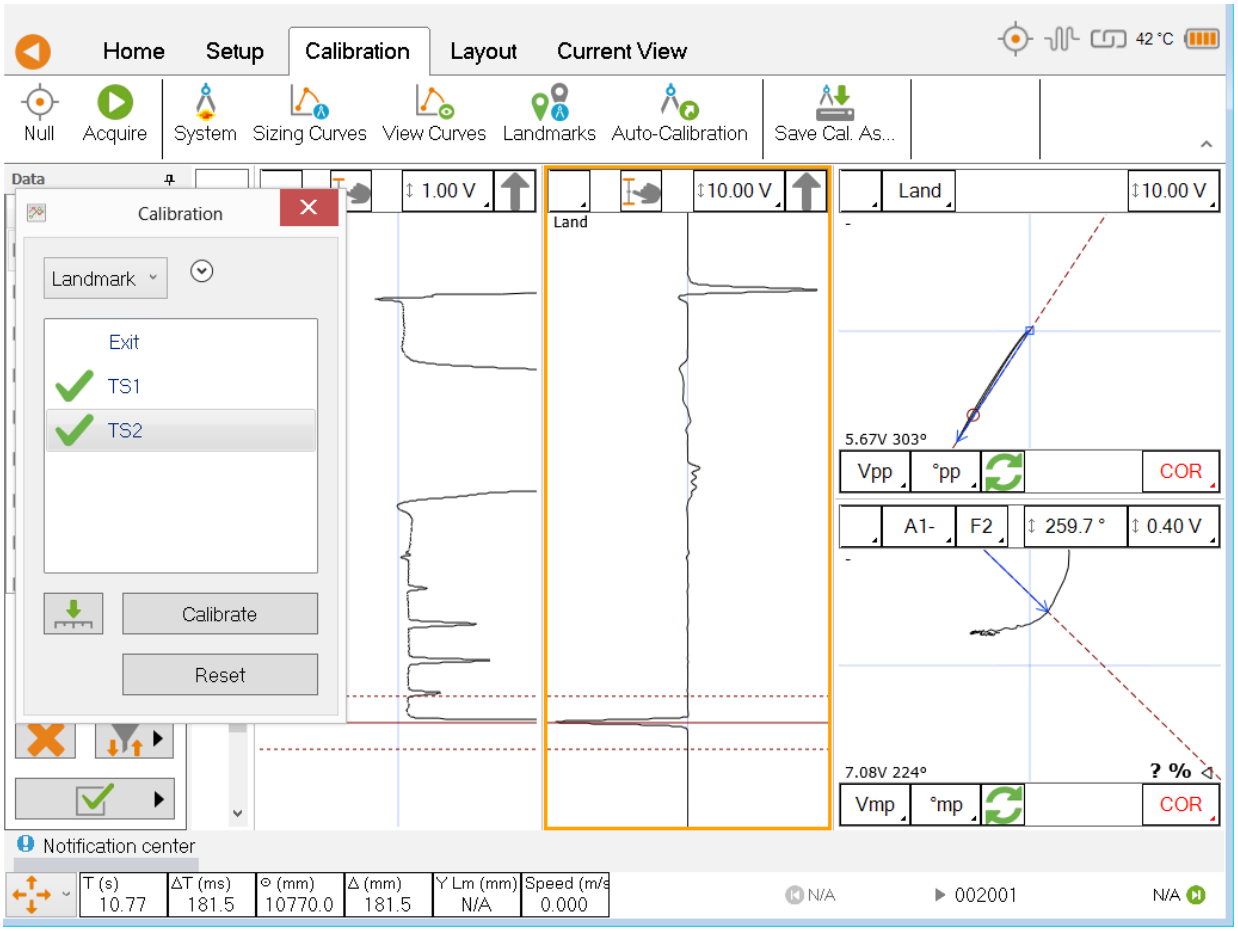
Note: To quickly remove or add an 180° bias to a flaw in your sizing curve, click the Invert button.

To validate the curves, bring the measurement cursor over one of the calibrated flaws in the Lissajous and get an estimate of the depth (shown in the lower right corner). If the flaw size does not appear, it means that you are not in a channel where a sizing curve was set.

LANDMARK

The following section describes how to calibrate your landmarks.

Go to the Calibration tab and click the Landmark icon. Calibrate the landmarks shown in the Landmarks window the same way you calibrated the sizing curve(s) points. You can use the Land channel to do so. The positions of TS1 and TS2 are described in the Landmark window in the Setup tab (TS2 is the far side tubesheet or the first one encountered by the probe while pulling back; TS1 is the near side tubesheet).



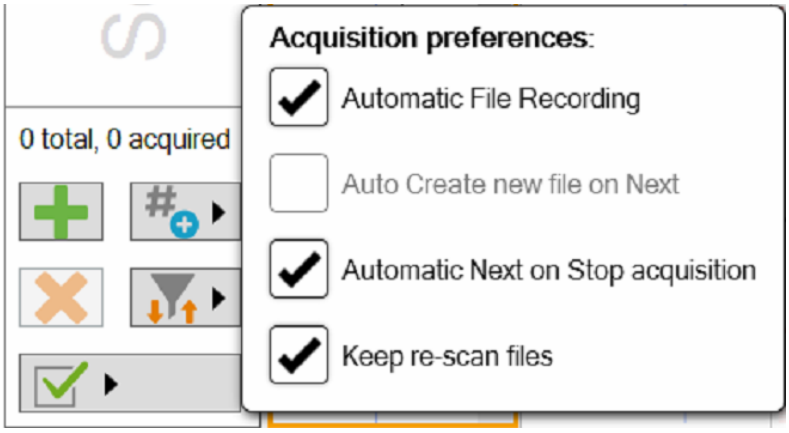
Once the landmarks are calibrated properly the system should recognize them automatically.

Note that in order to calibrate the default Exit landmark, data including the probe exit at the far end of the tube is needed.

INSPECTION

TUBE LIST MANAGEMENT

For each acquisition, Magnifi Go can automatically save a file using the file name defined previously in the Tube List section of this document. Select the Automatic File Recording option found by clicking the Acquisition preferences button in the Data window. This option is selected by default.



The list of tubes is also shown in the Data window.

Tubes are added or removed by using the first line of buttons in this window.

It is common practice to rescan your calibration tube and balance it periodically. You can save this new calibration tube data by adding a new tube in your tube list (e.g. 999 001). Alternatively, you can exit the acquisition mode, scan your tube, and click the Save Cal As... button in the Calibration tab to save your data; then, you can go back to the acquisition mode and continue your inspection, automatically saving the acquired tubes in your bundle.

Once a tube has been scanned, the play icon is replaced by a checkmark icon next to the tube description.

You can rescan a tube by selecting its name in the list and clicking the Rescan button in the Home tab.

A tube name can be changed by right-clicking its name and selecting the Rename option.

STANDARD ACQUISITION

The following section describes how to perform an inspection.

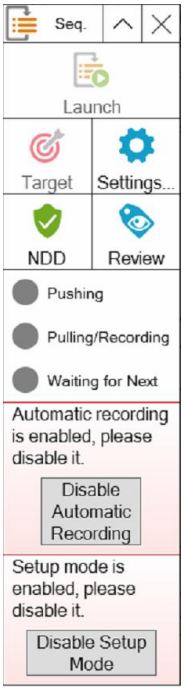
1. Access Acquisition Mode by clicking the Setup Mode button in the Home tab. Acquisition Mode is activated when the Setup Mode button is not gray.
2. Plug the AC probe into the two Reddy AC 4-pin connectors.
3. Put the probe head in a clear area in your standard and balance the probe by clicking the Null button in the Home tab or the physical target button on the Reddy AC.
4. Put the probe head outside the tube and start the acquisition by clicking the Acquire button in the Home tab or press the physical Play/Stop button on the Reddy AC.
5. Pull the calibration tube.
6. When done, press the Stop button or physical Play/Stop button on the Reddy AC.
7. Repeat steps 4,5 and 6 for all tubes requiring inspection in your bundle.

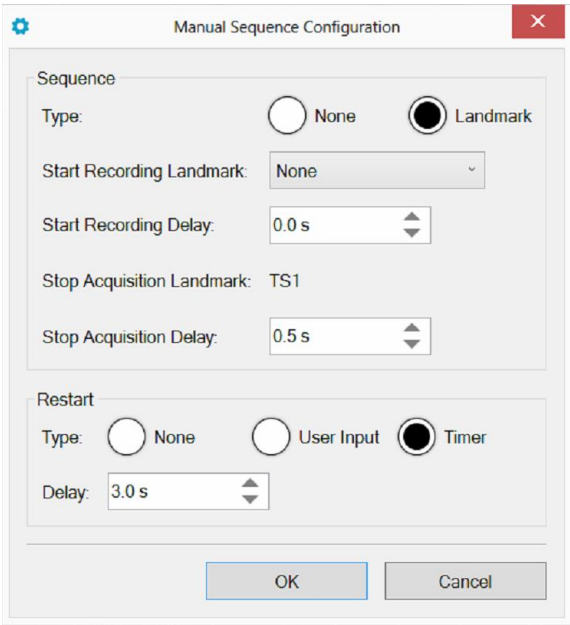
MANUAL SEQUENCE

An inspection can also be done with the manual sequence. This feature is based on landmarks and can trigger the acquisition start/stop and data recording automatically. At least two (2) landmarks are needed to use this feature. These landmarks can be set in the Landmark section in the Setup ribbon.

To set the manual sequence:

1. Click the Manual Sequence button in the Setup tab.
2. If a warning message displays in this window, change the parameters until no warning is shown. The system guides you through the different windows.
3. Click Settings...





4. Select Landmark in the Type section
5. In the drop-down menu choose the Landmark to start the data recording. If you keep the default landmarks, you can select the Exit landmark that triggers when the probe exits the tube when pushed.
6. You can enter a delay to start the acquisition after the first landmark is detected (Start Recording Delay) and a delay to stop the acquisition when the last landmark is detected (Stop Acquisition Delay).
7. Two options are available to restart the acquisition: The user can either push a button or use a timer. Select the desired option in the Restart section.
8. Click OK.

To use the manual sequence:

1. Access the Acquisition Mode by clicking the Setup Mode button in the Home tab. The Acquisition Mode is activated when the Setup Mode button is not gray.
2. Plug the AC probe into the two Reddy AC 4-pin connectors.
3. Put the probe head in a clear area in your standard and balance the probe by clicking the Null button in the Home tab or the physical target button on the Reddy AC.
4. Open the Sequence window by clicking the Manual Sequence button in the Setup tab.
5. Place your probe in the tube requiring inspection and click the Launch button. This starts the data acquisition.
6. Push the probe through the tube. If set correctly, this triggers the landmark that starts data recording.
7. Push the probe until it exits the tube. This triggers the last landmark detection that stops the data recording.

8. Acquisition restart:
    a. If you selected User Input in the settings of the Manual Sequence Configuration, the system waits for the user to enter information on the tube to restart the acquisition. Click NDD or Review. This adds a tag to the inspected tube and restarts the acquisition. Repeat steps 6, 7 and 8a for all the tubes requiring inspection.
    b. If you selected Timer in the settings of the Manual Sequence Configuration, a countdown triggers after the last tube acquisition is taken. The acquisition starts after this timer has elapsed. Repeat steps 6 and 7 for all the other tubes requiring inspection in the bundle.

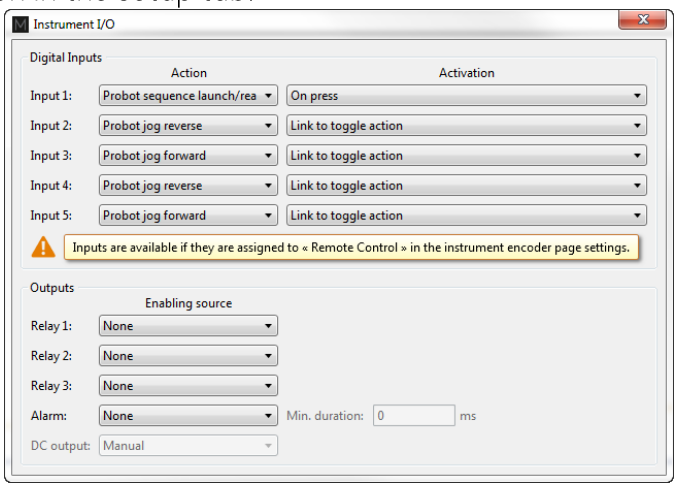
During your inspection, you may encounter some tubes that can't be scanned completely. If this is the case, you won't be able to catch the landmark that triggers the data recording at the end of the tube. In this situation, you can click the Target button in the Sequence window to start the data recording.

FOOTSWITCHES

Footswitches can be used to gain inspection time by quickly triggering functions like start/stop recording or tagging a file for review. They also offer an alternative to manual sequences for bundles where it is not possible to push the probe out of the tubes to trigger the landmark that automatically starts the acquisition.

To set the foot pedals:

1. Plug the Foot pedals cable into the 18-pin connector of the Reddy.
2. Click the I/O button in the Setup tab.

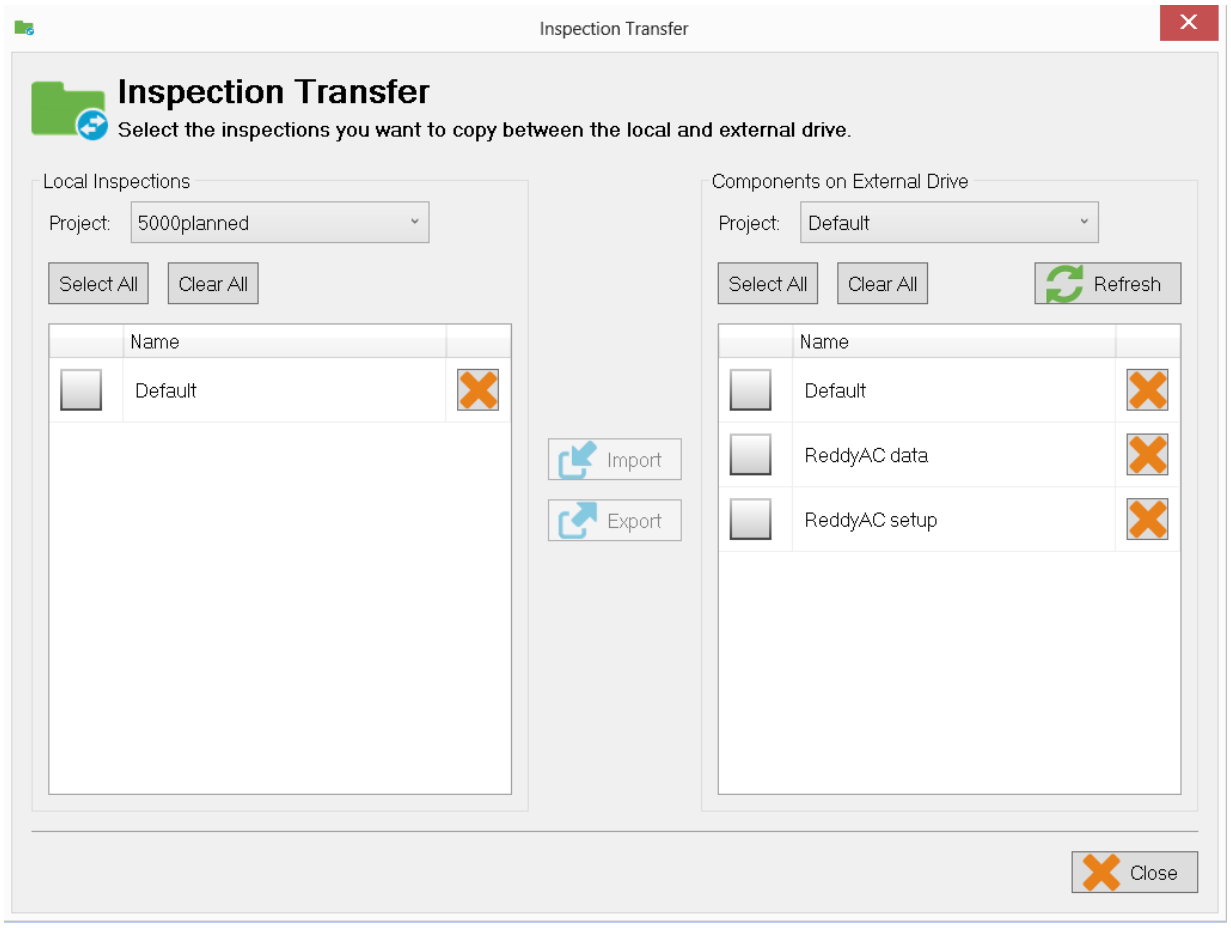


3. Inputs 1 to 4 are linked to the foot pedals 1 to 4 respectively.
4. For each input, select the desired action from the Action drop-down menu.
5. Select the activation mode with the Activation drop-down menu. You can either activate the action by pressing on the foot pedal or by releasing it.

MAGNIFI R

Analyzing data can be done directly on the Reddy AC screen or with a desktop computer using Magnifi R (readback). The latter can be used with larger or multiple screens.

To export your inspection on an USB key with the Reddy AC, click the Transfer Inspection button located in the General tab of the Backstage.



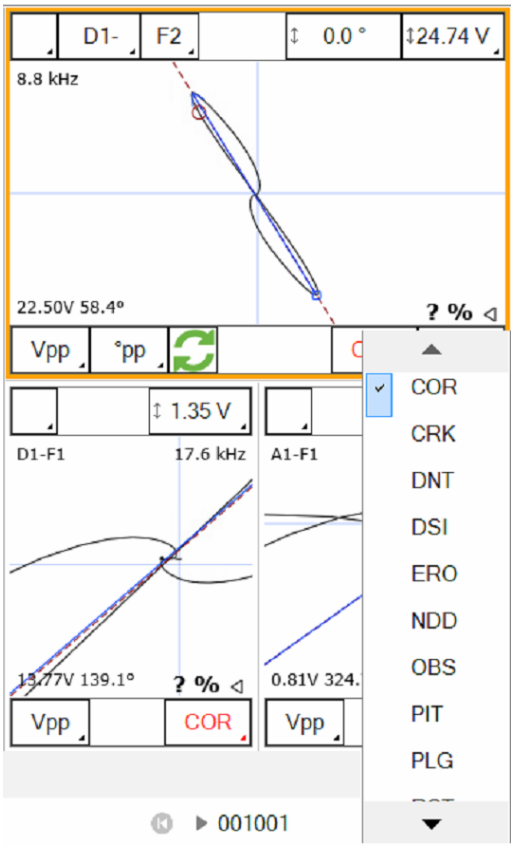
Each Project/Inspection can be exported from the instrument (left) to the USB key (right) or imported from the key to the instrument.

INDICATIONS

The two Indication buttons in the lower corner of the Lissajous windows can be used to add an entry to the report. These two buttons indicate the code associated with the defect being entered. They do the same thing but can be set to different flaw types.

To add an indication to the data:

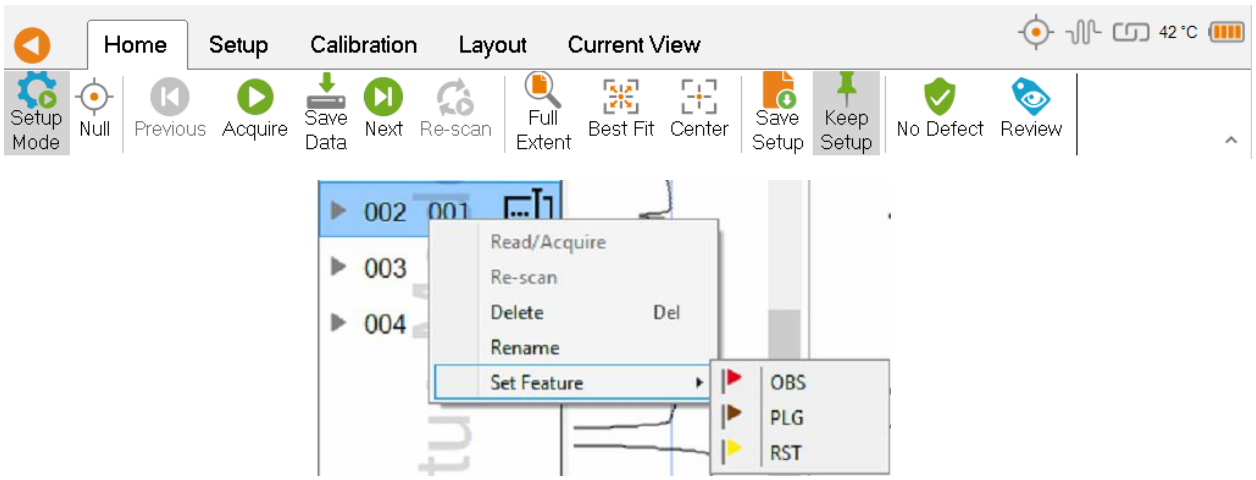
1. Select the defect signal in the Strip chart and adjust the cursor so that the signal in the Lissajous includes only the defect signal.
2. Click the red triangle on the corner of the Indication button to select the type of defect being entered.
3. Click the defect button to add an entry to the report.



Indications can also be added to a tube to indicate, for instance, that it has no flaw or that it is plugged.

To add an indication to a tube:

1. Load the file.
2. Click the No Defect button in the Home tab or right-click the tube and set the feature of the tube.

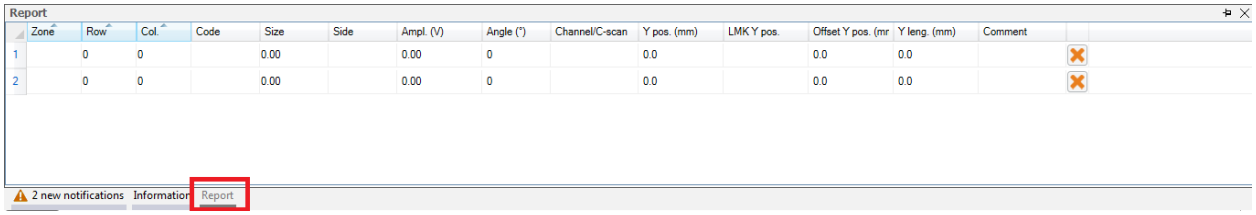


Report Table

To access the list of detects entered:

1. Make sure that the Report option is selected in the Layout tab.

2. Click the Report ribbon at the bottom of the screen to make the list visible.



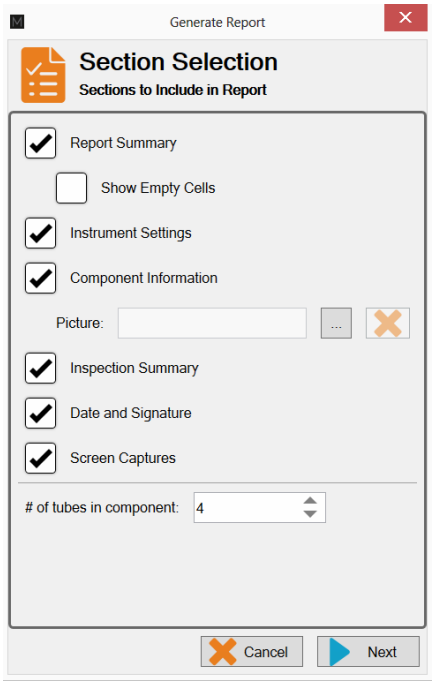
Report entries can be modified by changing the value in the table. You can also delete an entry be clicking the X next to it.

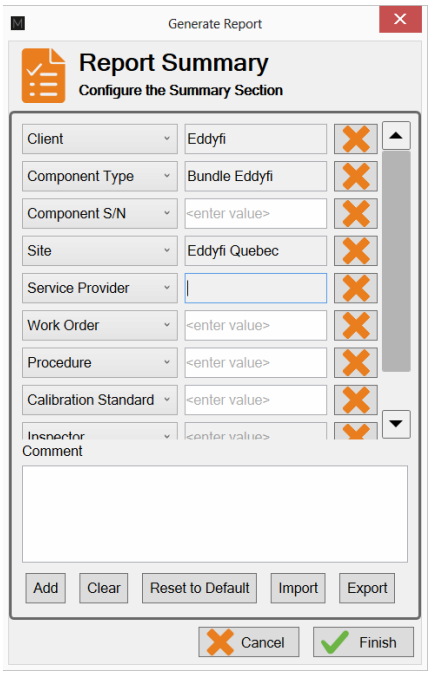
Report Generation

Magnifi Go can automatically generate a full report with the report table.

To generate this report:

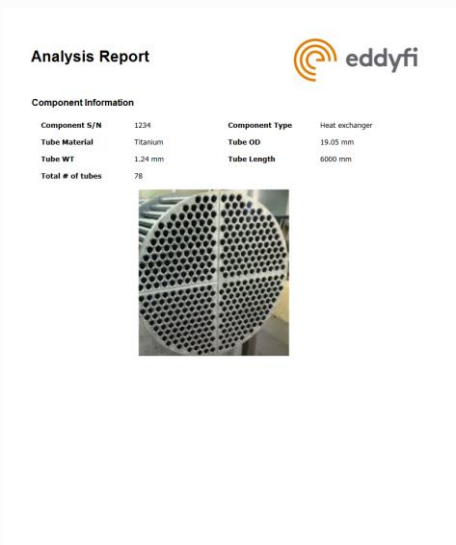
1. Access Backstage by clicking the arrow on the upper left corner of the Frontstage.
2. Click the Generate Report button in the Report section of the General tab.
3. Choose your preferences and enter the required parameters. The # of tubes in component is used to show the percentage of tubes in each category.

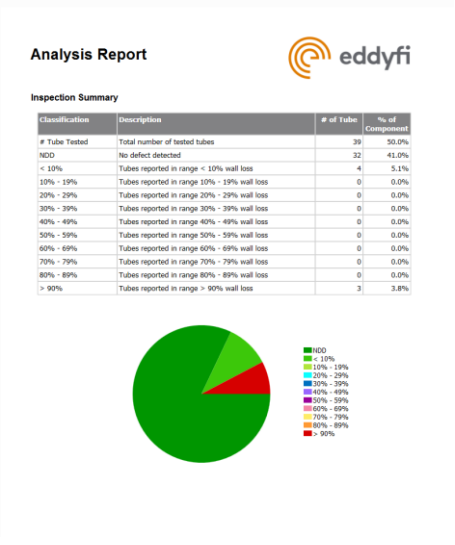


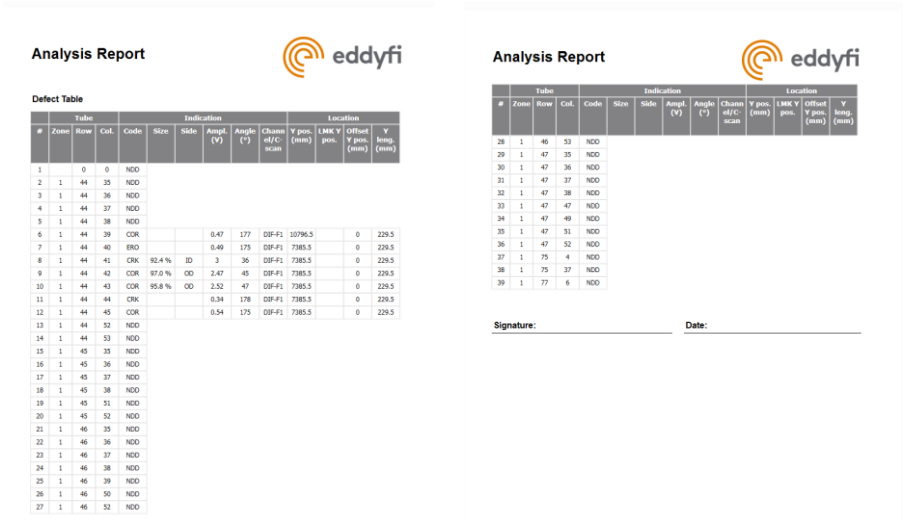


4. Click Finish to generate the report.

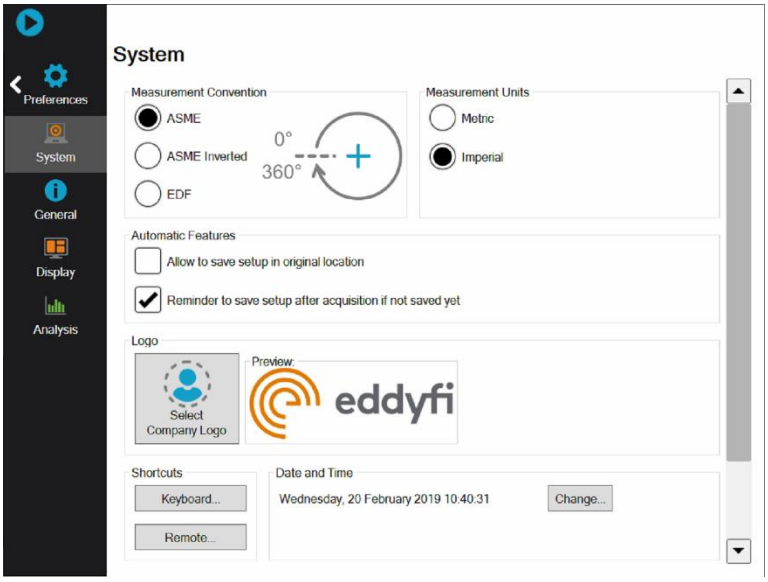
This creates a PDF report that shows information like the list of indications in your bundle and a report summary with a pie chart.







The report logo can be modified by clicking the Select Company Logo in the System tab of Backstage.



The report table file in the Inspection folder can also be imported into other reporting software such as TubePro™.