Eddyfi Technologies

Sharck™ Pencil G2 User Guide

Version: 1.1

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Contents

1. Probe Description

Figure 1 : Sharck Pencil G2 models. Straight (ST) (left), Right Angle (RA) (middle), and Toothbrush (TB) (right).

2. Material compatibility

The User Mat calibration that will be discussed later in this User guide is mainly useful to compensate for permeability changes which may occur during scans, either along a same part being inspected or simply, between alloys having different properties. Permeability changes affect signal amplitude for a given flaw, this is then the reason why there is a need to compensate for it, assuring accurate depth sizing on each individual crack. The Sharck probes were primarily designed for the assessment of surface breaking cracks in carbon steel material and welds. Those can also be used to derivates to a certain extend.

Carbon steels (most of construction steels)

- Reliable detection.
- Reliable depth sizing.

Alloy steels

- Reliable detection
- Possible underestimation of depth sizing (specifically Nickel based one).

Note: A dedicated sizing matrix, hence setup file can be produced for specific alloys providing a sample with EDM notches is made available to Eddyfi.

High strength low alloy (HSLA) steel

- Reliable detection.
- Reliable depth sizing.

Note: Forged steels can be carbon steels, alloy steels or HSLA steels. Same capabilities as mentioned above.

3. Setup

I) Make sure to use Magnifi® 4.3 or Magnifi® GO 1.4 (or a more recent version).

II) Click *Open setup* and select the setup corresponding to the probe in the Default Master List.

III) Connect the pencil probe to the Ectane® 41-pin connector or to the Reddy® 19-pin connector.

IV) For Ectane® only: connect the instrument to Magnifi®.

4. Data Management

This section suggests a convenient way to manage and save automatically large amounts of data files during an inspection. The following steps can be done in advance in Magnifi (or Magnifi GO), before getting to the inspection site.

I) In the backstage of Magnifi, in the *Inspection* menu, select a project folder and an inspection folder  .

II) In the *Acquisition* menu, select the *Prefix* filename option.

III) Click *Create New List*  .

IV) Select the prefix for the data file list, the number of files in the list, the index for the first data file and the index increment between each file. The example below shows an example of data file list based on the following parameters:

Selected parameters:

Prefix:	TECA
Number of elements:	4
Element start number:	10
Element increment:	2

Resulting data file list :

Prefix	Index
TECA	010
TECA	012
TECA	014
TECA	016

V) Click *Create*

VI) In the frontstage, in the *Layout* tab, make sure the *Data* button is checked. The data file list will be displayed on the left side of the screen.

VII) At the bottom of the data file list, click *Acquisition preferences*  , and check the following two options:

i) Automatic file recording

ii) Automatic Next on Stop Acquisition

When an acquisition is stopped, these two options allow to automatically save the data file and select the next one in the list. The user can then start the next acquisition, without any other action required.

VIII) Once the setup parameters and preferences are settled and the probe has been calibrated (see section 4), uncheck *Setup Mode*  in the *Home* tab.

IX) In the data file list, select the first file to be acquired. The inspection can then begin.

A few more information about data management in Magnifi and Magnifi GO:

- The small icon beside each data file indicates its current state:

Icon	Definition
	The data file was acquired and saved, but has not been analyzed yet
	The data file was acquired, saved and analyzed, and it was reported as being defect-free
	The data file was acquired, saved and analyzed, and defects have been reported
	The data file has not been acquired yet (empty file)
	The data file is tagged for further review

  For more information on data analysis, refer to section 8 of this user guide.

- At any time during the inspection, the user can click *Add data*  or *Delete data*  at the bottom of the data file list. Data files added with this button will keep the same prefix, and their index will be incremented by the number selected in the index menu  . To create data files with a new prefix, go back to the backstage and click *Create New List*.

- To re-scan a data file that has already been acquired and saved, right-click the data file (or hold the Reddy's touchscreen) and click *Re-scan*. To choose whether the original data file should be kept or erased, select the corresponding option in *Acquisition preferences*  .

5. Layout

1. Dp-Proc strip chart: Visualisation of axial cracks with material permeability and lift-off compensations.
   ➔ Used to localize axial cracks indications quickly, in combination with Lg strip chart
2. Lg strip chart: Visualisation of axial cracks ends
   ➔ Used to localize axial crack indications quickly, in combination with Dp-Proc strip chart, and size the axial cracks length
3. Dp-Raw Lissajous: Raw impedance signal within the cursor of the strip charts.
   ➔ Used for depth measurement of axial cracks
4. Compensated Depth: Depth measurement of the axial crack, up to 7 mm, with compensation for lift-off and permeability.
5. Length: Length approximation of the axial crack
   ➔ The length approximation is based on the manual scan speed. To be accurate, the scan must be done at exactly 50 mm/s.
6. Lift-off: Local lift-off measurement, up to 4 mm
7. Lg Lissajous: Signal of the Lg channel within the cursors of the strip chart.

Figure 2 : Acquisition and analysis layout

6. Probe calibration

I) Place the probe in the air, away from any metallic surface, then click on Null

II) In the Sharck menu, click *Calibration*

III) Keeping the probe in the air, click on Air reference block

IV) Put the probe in the middle of the aluminum plate supplied for calibration purposes

Note1: Place the probe in the center of the Aluminium plate with the tip flat on the surface

Note2: Ensure the Aluminium plate is placed away from any conductive material prior to performing the calibration.

V) Click on Aluminum

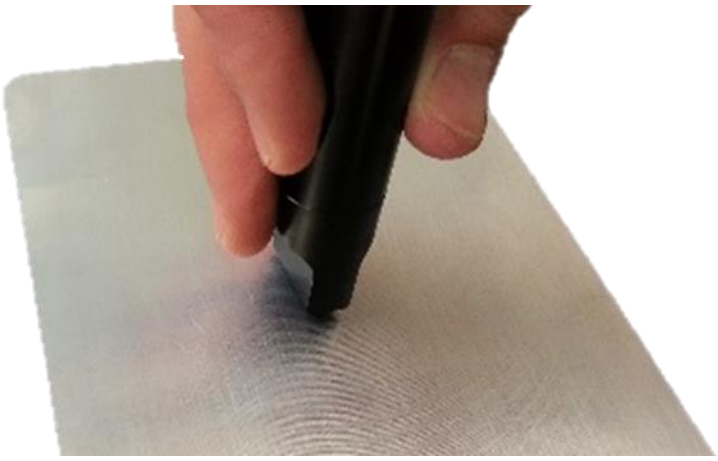

Figure 3: Sharck pencil probe on the aluminum plate

VI) Place the probe on the material to be inspected.

VII) Click on Carbon Steel and move the probe on the material.

Note: During this calibration step, keep the probe flat on the surface, in the HAZ.

VIII) Click on Calibrate.

IX) Close the Sharck calibration window.

7. Acquisition

I) Null the probe in the air.

II) Place the probe on the weld.

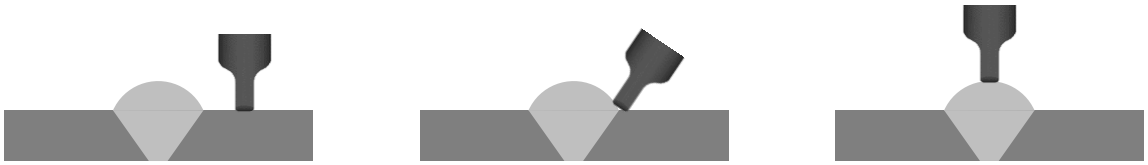

Figure 4 : Probe tip position on the weld. Flat on in the HAZ (left), with an angle on the toe (center), and flat of the top of the weld (right).

III) Start the acquisition.

IV) Scan the weld with the probe so that the long side of the tip of the probe is parallel to the weld, in the direction of the arrow featured on the pencil's casing.

Note: Scanning speed should be approximately 50 mm/sec (2 in/sec)

Note: It is recommended to do two scans on the toe. The first scan with the tip flat on the surface, in the HAZ, leaning on the toe of the weld. The second scan with the tip at mid-angle between the weld and the HAZ.

V) Stop the acquisition

Note1: Always Null the probe before performing an acquisition.

Note2: To detect transverse cracks on the top of the weld turn the probe 90°

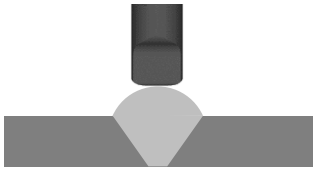

Figure 5 : Probe tip position for the detection of transverse cracks.

8. Analysis

The analysis is performed in three simple steps: user material calibration, detection, and sizing.

8a. User material calibration

To compensate for the magnetic permeability of the inspected material, a "global user material calibration" should always be performed before analyzing data, to help with the detection of defects. A "local user material calibration" will ensure the accuracy of the depth sizing (see section 0).

I) For a global calibration, open the strip chart cursor as large as possible in the middle of the Dp-Proc strip chart. To compensate properly, it is very important that the signal within the cursors contains more data from clean material than from apparent defects or lift-off.

II) In the Sharck menu, click the UserMaterial button.

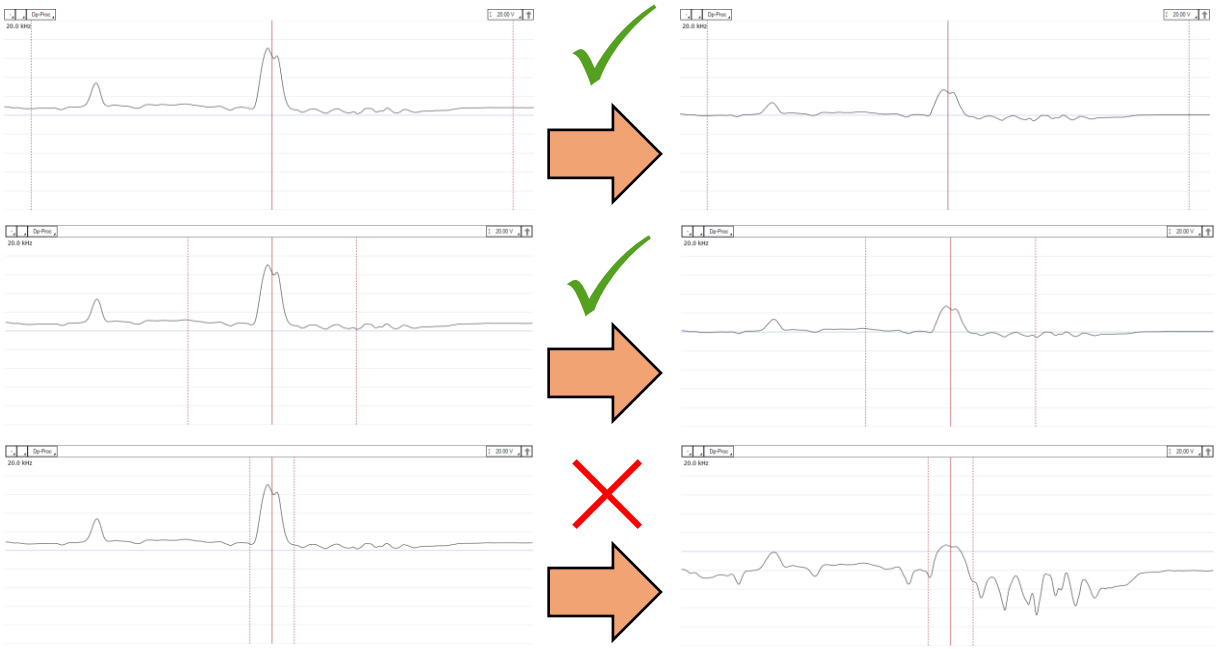

Figure 6 : Top: Good user material calibration, with the C-scan cursor widely opened; Middle: Good user material calibration, cursor contains only one specific crack, but opened wide enough (at least three times the length of the crack) providing a local averaging; Bottom: Bad user material calibration, cursor too closed around the crack signal. The user material is not well measured because there is not enough safe material information in it, averaging mostly calculated on the crack signal.

8b. Detection of axial cracks

The detection of axial cracks is made using both the Dp-Proc and the Lg strip charts. The Dp-Proc strip chart shows the depth of the crack, while the Lg strip chart shows its beginning and end. To be certain that an axial crack is present, it must meet these criteria:

- Positive peak in the Dp-Proc strip chart.
- Negative and positive peaks in the Lg strip chart. Note that the negative peak is always to the left of the positive peak. If the positive peak is to the left of the negative peak, it is not an axial crack (can be linked to a transverse crack or a geometrical indication).
- Correlation between the two strip charts : The negative and positive peaks in the Lg strip chart must be at the beginning and end of the positive peak in the Dp-Proc strip chart

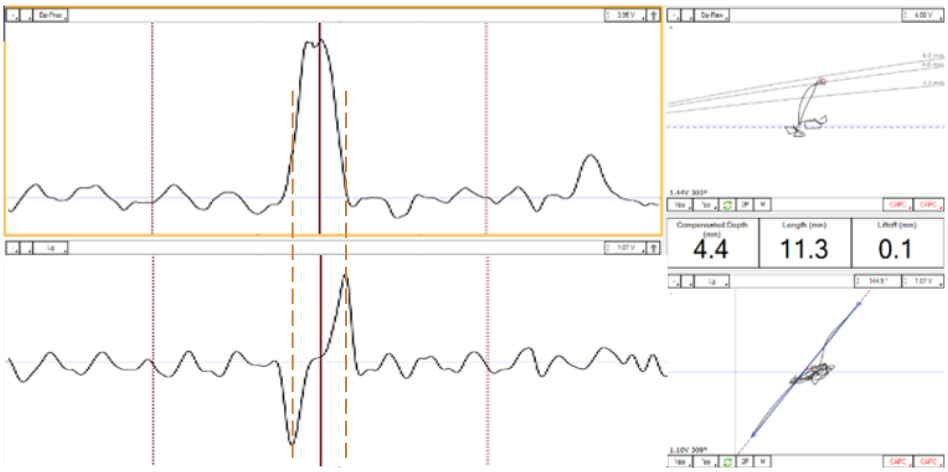

Figure 7: Detection of axial cracks. The ends of the crack are correlated on both strip charts.

8c. Depth sizing and reporting of axial cracks

Sizing information

During the analysis of a data file, the sizing of axials cracks is shown between the two Lissajous. This information is updated in real time as the cursor is moved in the strip charts.

Compensated Depth (mm)	Length (mm)	Liftoff (mm)
4.4	11.3	0.1

Figure 8 : Example of sizing information displayed in the infodields. In this example, the compensated depth of the crack is 4.4 mm, the length is 11.3 mm and the lift-off is 0.1 mm.

Local user material calibration

To improve the depth sizing of an axial crack, it is recommended to perform a local user material adjustement (on or close to the indication) before reporting it.

I) Click on the crack in the Dp-Proc or Lg strip chart to center the cursors on the crack.

II) Open the cursors to at about three times the length of the defect.

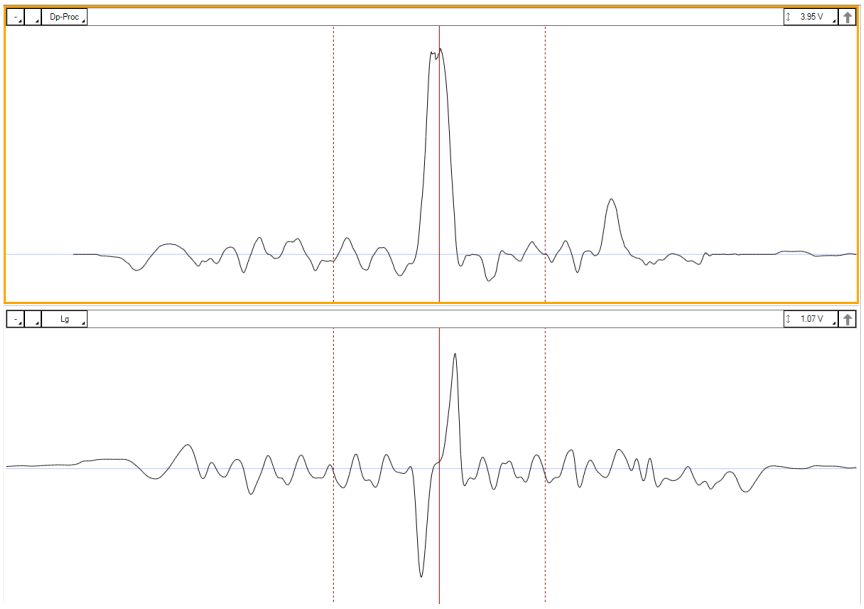

Figure 9 : Position and size of the cursors on a potential axial crack

III) Verify that the user material calibration has been done properly around the defect.

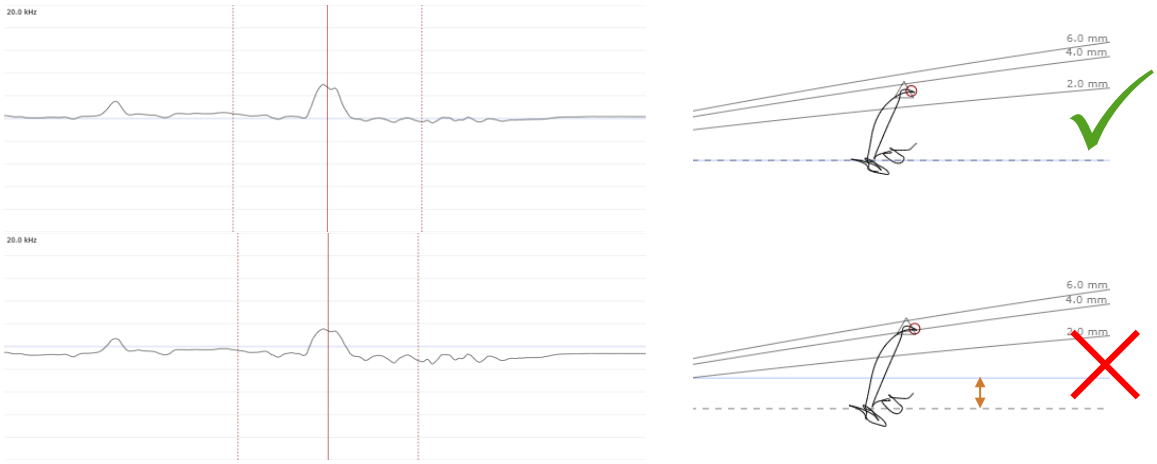

Figure 10 : Good vs bad user material calibration. On the top (good calibration), the dashed line in the Lissajous is near the horizontal null mark line. On the right (bad calibration), the dashed line in the Lissajous is far from the horizontal null mark line.

IV) If the user material calibration is not correct, perform a local material calibration by clicking the UserMaterial button without moving the cursors.

Precision sizing and entry report

I) Click on one of the indication buttons in the lower right corner of the Lissajous ("CAPC" written in red in Figure 11). This will open the TECA Tune Calculations window (Figure 12)

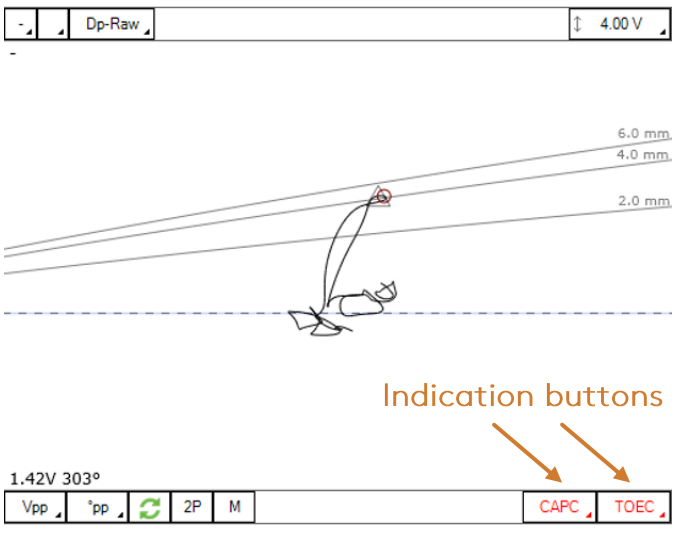

Figure 11: Indication buttons in the Lissajous window

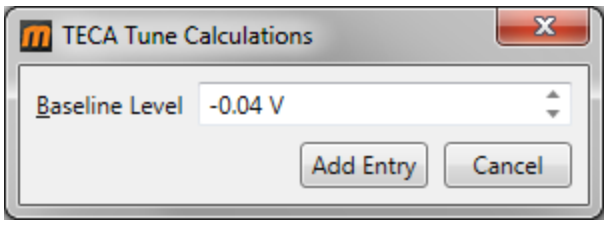

Figure 12: TECA Tune Calculations window

II) In most cases, the automatic process will give the optimized results, so no adjustment is needed in the TECA Tune Calculations windows. However, in the rare cases that the automatic process is not optimal, this window gives the user the choice to adjust some parameters, making sure the sizing is accurate. If the baseline seems incorrect on the Lissajous, the user can manually adjusts it. This can occurs if there is a lot of background noise or if there is a rapid change of material properties near the crack or if the cursors are set too tight around the crack signal.

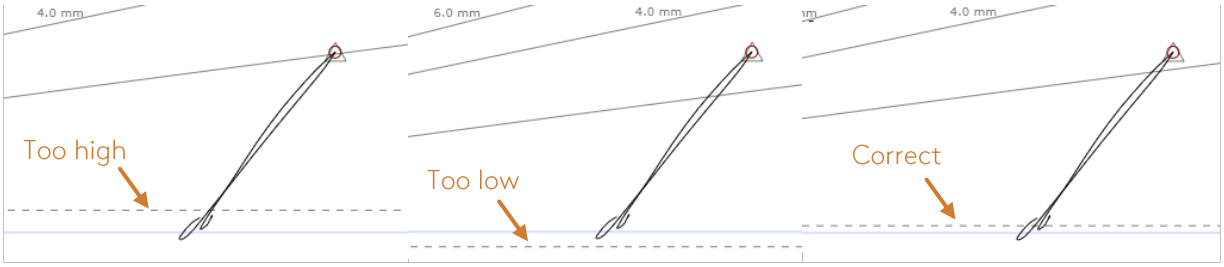

Figure 13 : The baseline level (dashed line). It can be too high (left), too low (middle), or spot on (right).

III) Click on "Add Entry" to add the analyzed indication in the report or click on "Cancel" to close the TECA Tune Calculations windows without adding indication to the report.

Note1: If a datafile contains no defect indication, you can click 

Note2: To add or remove indication codes, go to Setup → Indication.

9. Maintenance

If the component to be inspected is abrasive or rough, it is recommended to protect the probe with a tape (polyolefin, Teflon or other non-conductive abrasion resistant material). However, **make sure to remove the tape before a full calibration** (section 6)