Eddyfi Technologies
Beyond current

CAPTURE V4.0
PA WELD ASSISTED ANALYSIS USER MANUAL

NEW FEATURES DESCRIPTION

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Summary

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II. License activation

III. Configuration & set-up

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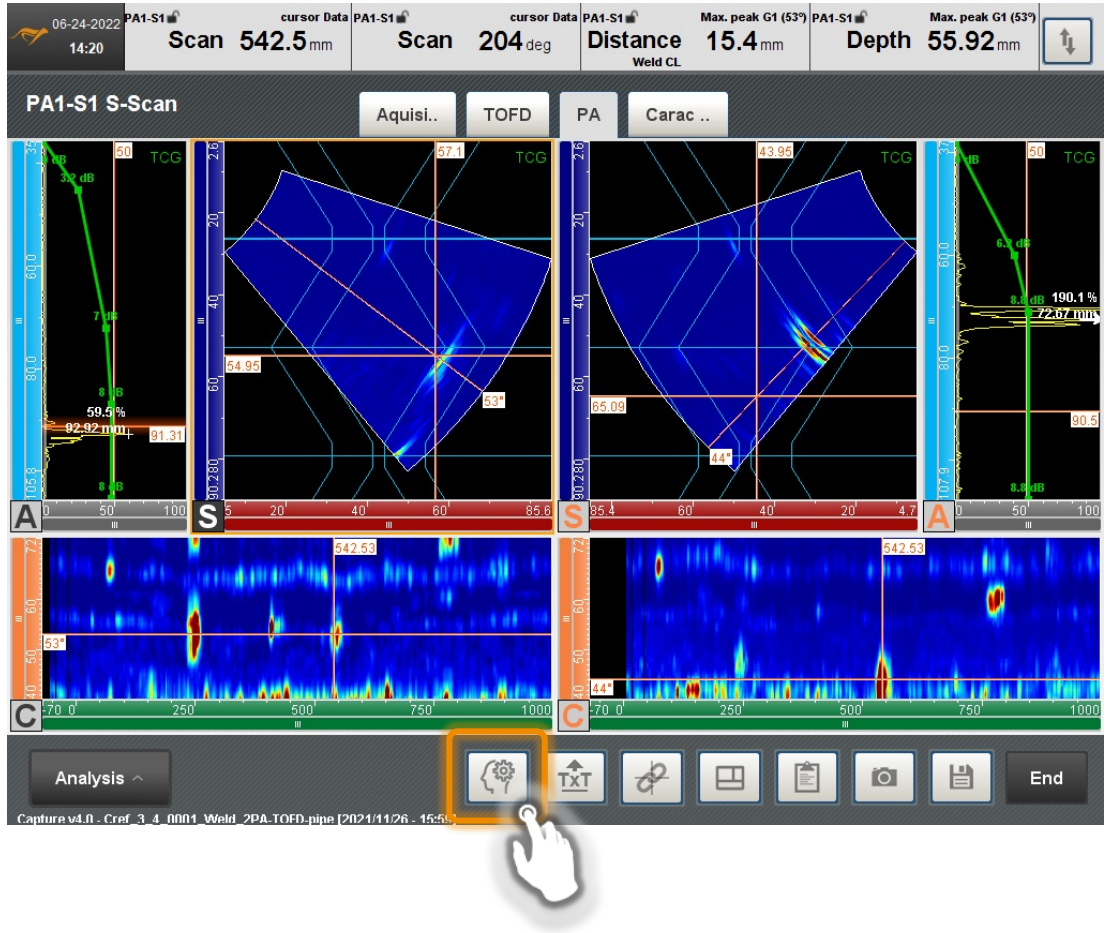
VI. Indication table management

Assisted analysis quick start

Quick start #1

ASSISTED ANALYSIS (1/6)

Capture 4.0 offers an assisted analysis module dedicated to butt weld inspection with PAUT. The aim of this feature is to increase analysis productivity by providing automatic detection, filtering and classification of indications.



When assisted analysis can be used

The button appears only if these following requirements are met:

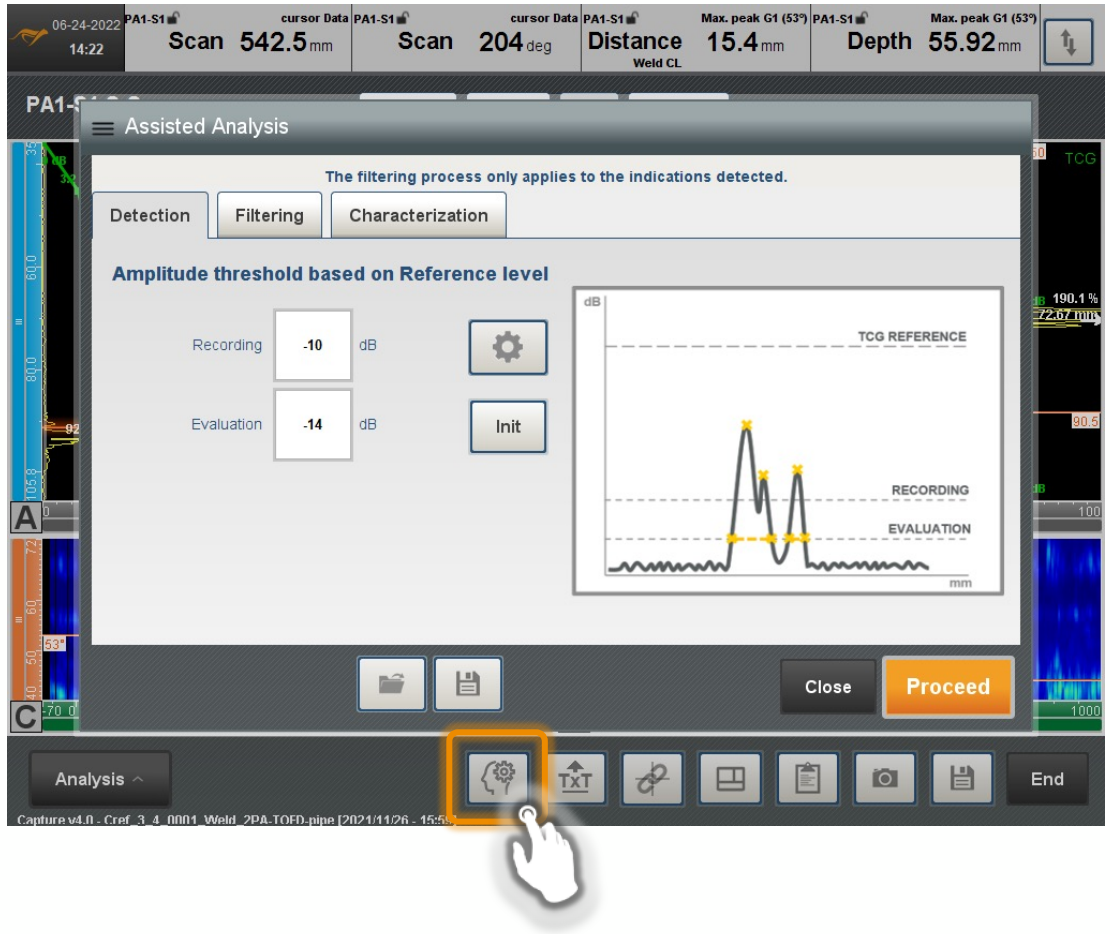
- Welded pipe or plate with a V or X bevel, thickness between 3.2 and 50 mm (1/8” to 2”)
- At least one PAUT group on each side of the weld
- Sectorial, linear and/or compound scanning
- Amplitude calibration for each PA group (TCG)
- 1-axis trajectory

To get access to the assisted analysis feature, update your license by connecting your PC or unit to internet.

Quick start #1

ASSISTED ANALYSIS (2/6)

When an inspection is compatible, a button appears in the bottom banner to open an assisted analysis menu. Pressing the button will open a popup window. It contains the 3 steps required to define the parameters.



How it works

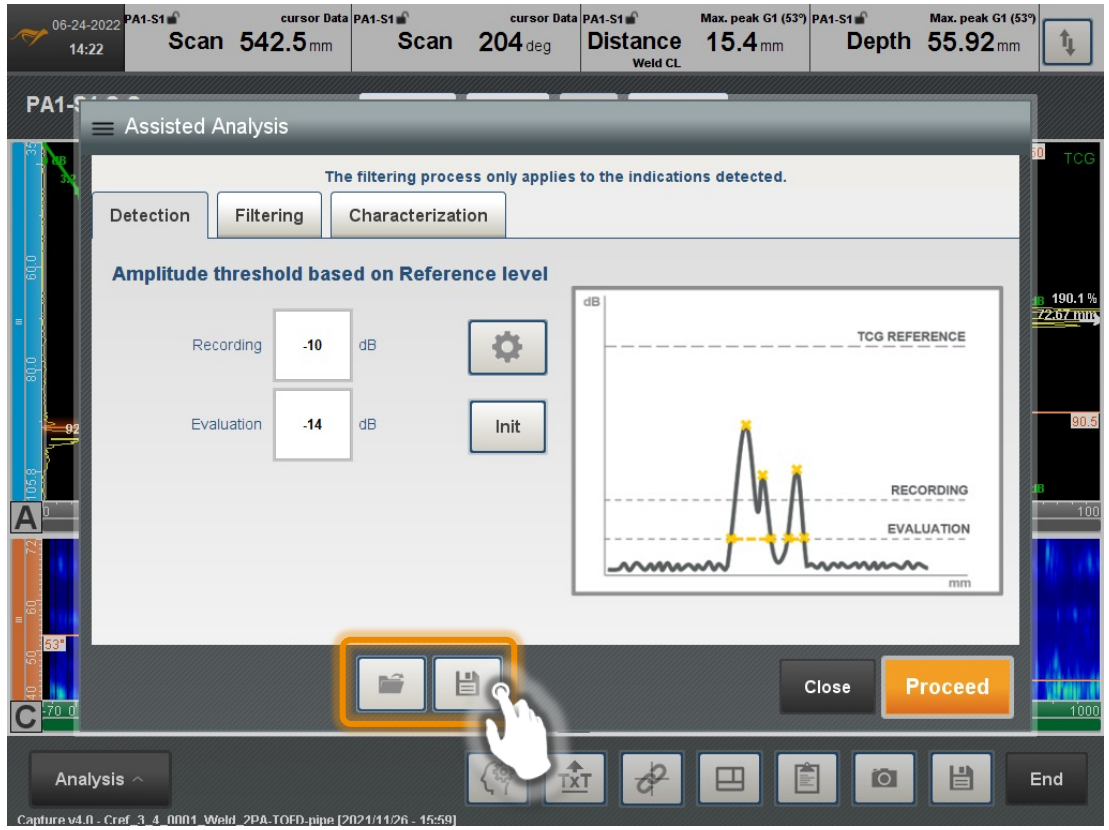
- Three configuration steps to be filled : Detection, Filtering and Characterization
- Several standards are available setting automatically the detection levels
- Custom sets of parameters can be saved

Once the Proceed button is pressed, the three steps of the workflow are immediately applied. Please check all your parameters before proceeding

Quick start #1

ASSISTED ANALYSIS (3/6)

The first step of the workflow is the detection of indications based on amplitude criteria in relation with the TCG reference level defined in the preference panel.



How to adjust thresholds

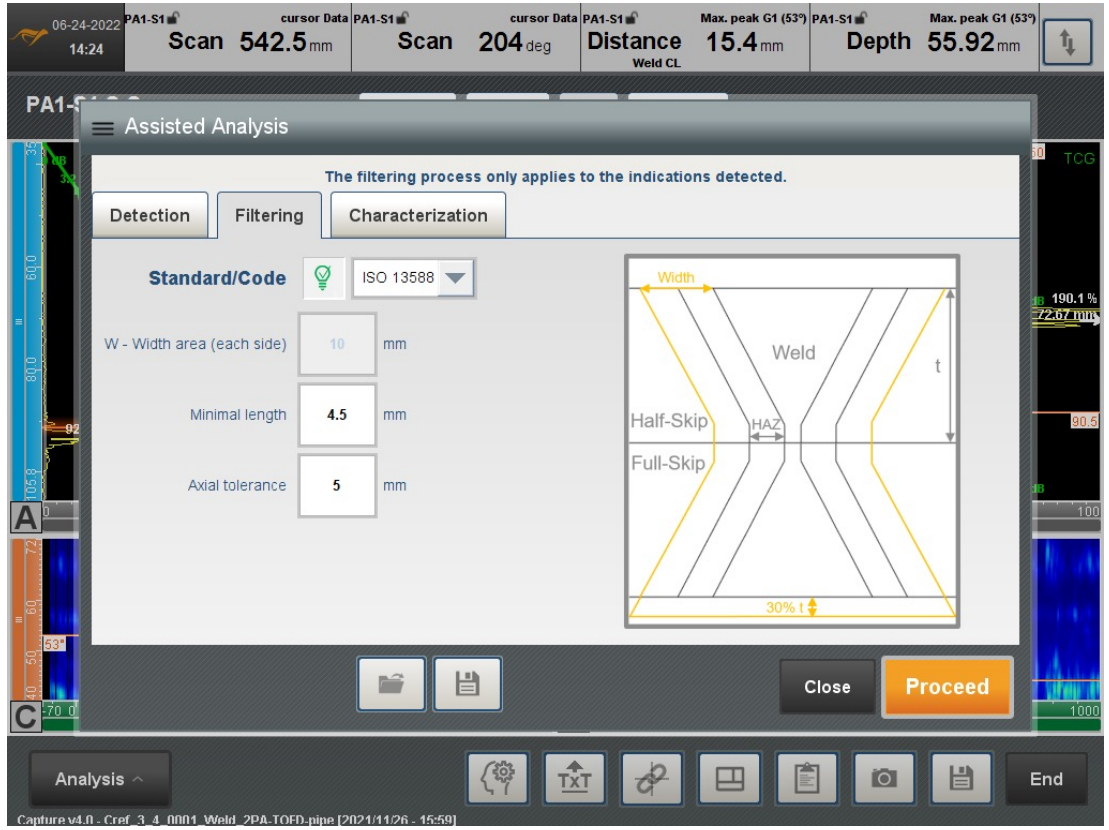
- Recording level means that any indications with an amplitude greater will be recorded by the analysis
- Evaluation level indicates the threshold used for measuring the length of the defect
- Init button resets all parameters to the most adapted configuration.
- Press to access the advanced parameters

The default threshold setup refers to the ISO13588 code

Quick start #1

ASSISTED ANALYSIS (4/6)

The second step is the filtering of the indications in order to exclude those outside the region of interest or those too short to be taken account. This step gives also a tolerance in the index offset of the probes during the scan.



How to filter and characterize indications

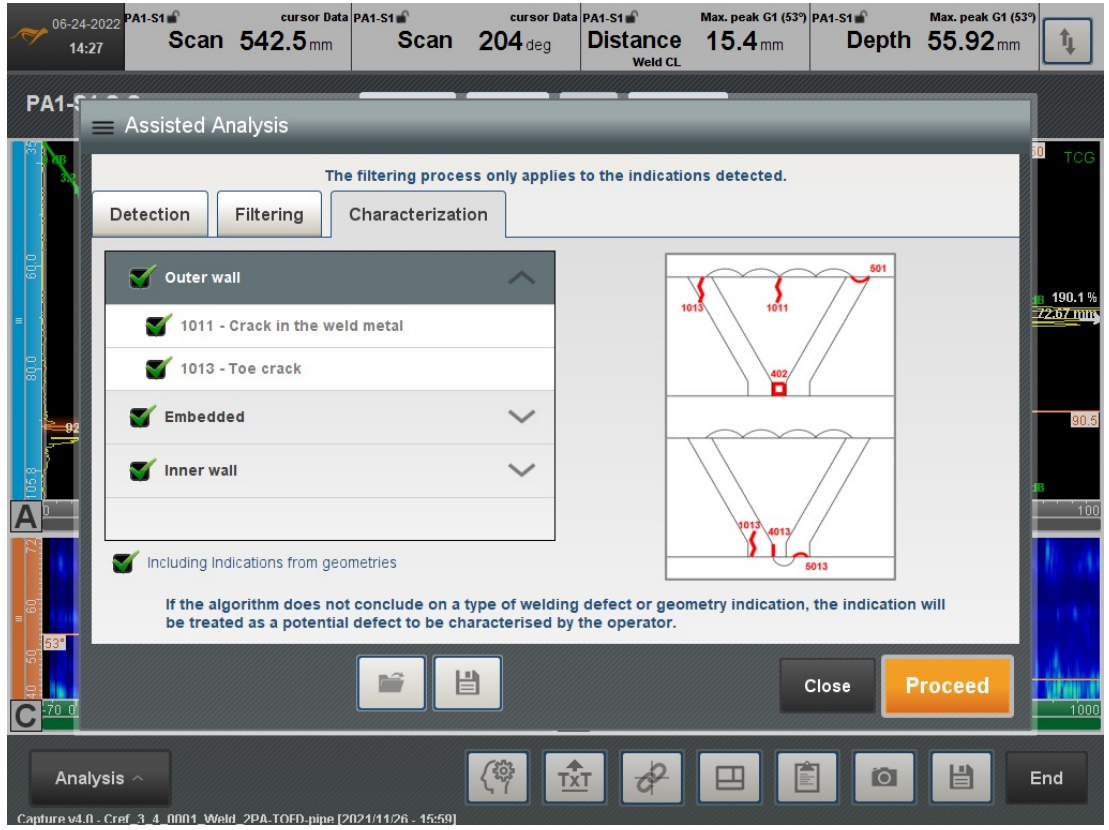
- Conditions of filtering are initialized following the ISO 13588 standard but a manual mode exists.
- The width area corresponds to the area on each side of the weld cap.
- The minimal length corresponds to the minimal indication length detected. This avoids detecting and classifying small indications
- The axial tolerance refers to the maximum scanner error offset accepted while scanning

The specimen geometry, the weld prep and the probes offsets are inputs for the assisted analysis

Quick start #1

ASSISTED ANALYSIS (5/6)

Characterization is done at the third and finale step. It sorts indication into different pre-selected categories in function of the reflectivity and the position into the weld.



How to set characterization info

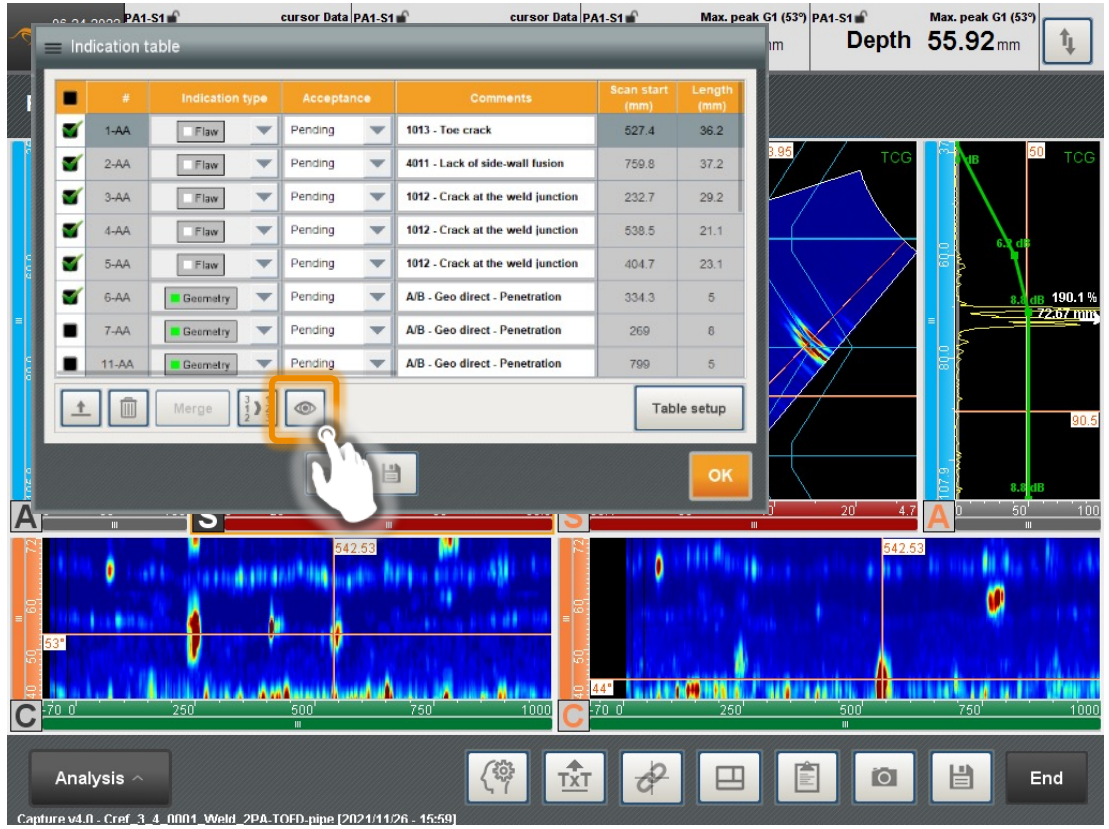
- Classification uses information based on position and amplitude from each PAUT group located on each side of the weld
- The tag for each type of defect corresponds to the international codes defined in ISO6520
- Categories of defects or geometry indications can be excluded from the process

By default, geometry indication are included and can be removed by unchecking the last checkbox

Quick start #1

ASSISTED ANALYSIS (6/6)

At the end of the analysis, the indications are directly highlighted in the views and the indication table is automatically filled.



How to review the analysis results:

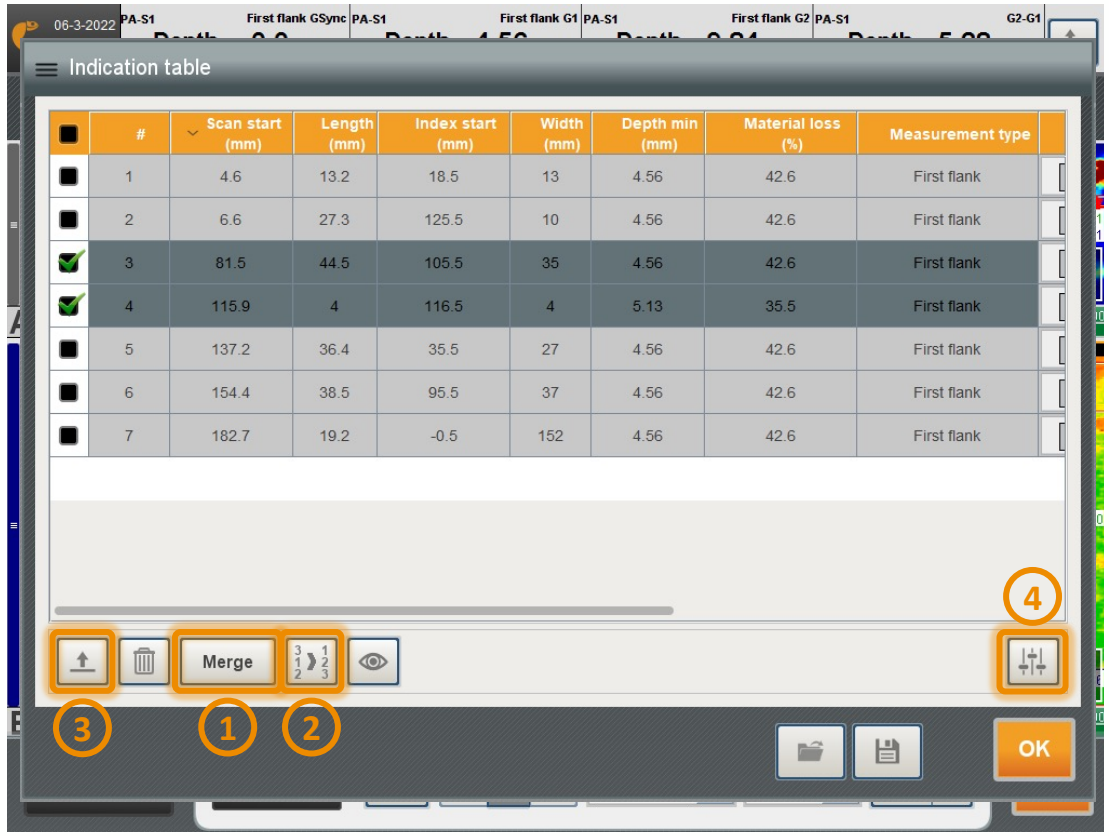
- Defects classified by the algorithm are highlighted in white with the type of defect. If the algorithm is not able to classify an indication as a type of flaw or geometry, it is considered as a ”potential defect” and highlighted in red
- Geometry echoes are highlighted in green
- The user remains responsible for modifying, completing, accepting or rejecting the results. The goal is not to replace the operator but help him

To avoid reporting an indication twice, the indication is only shown on the most reflective side/group

Quick start #1

INDICATION TABLE MANAGEMENT

It is possible to reorganize the indications, delete them, merge them and export them to CSV.



How to manage the indication table

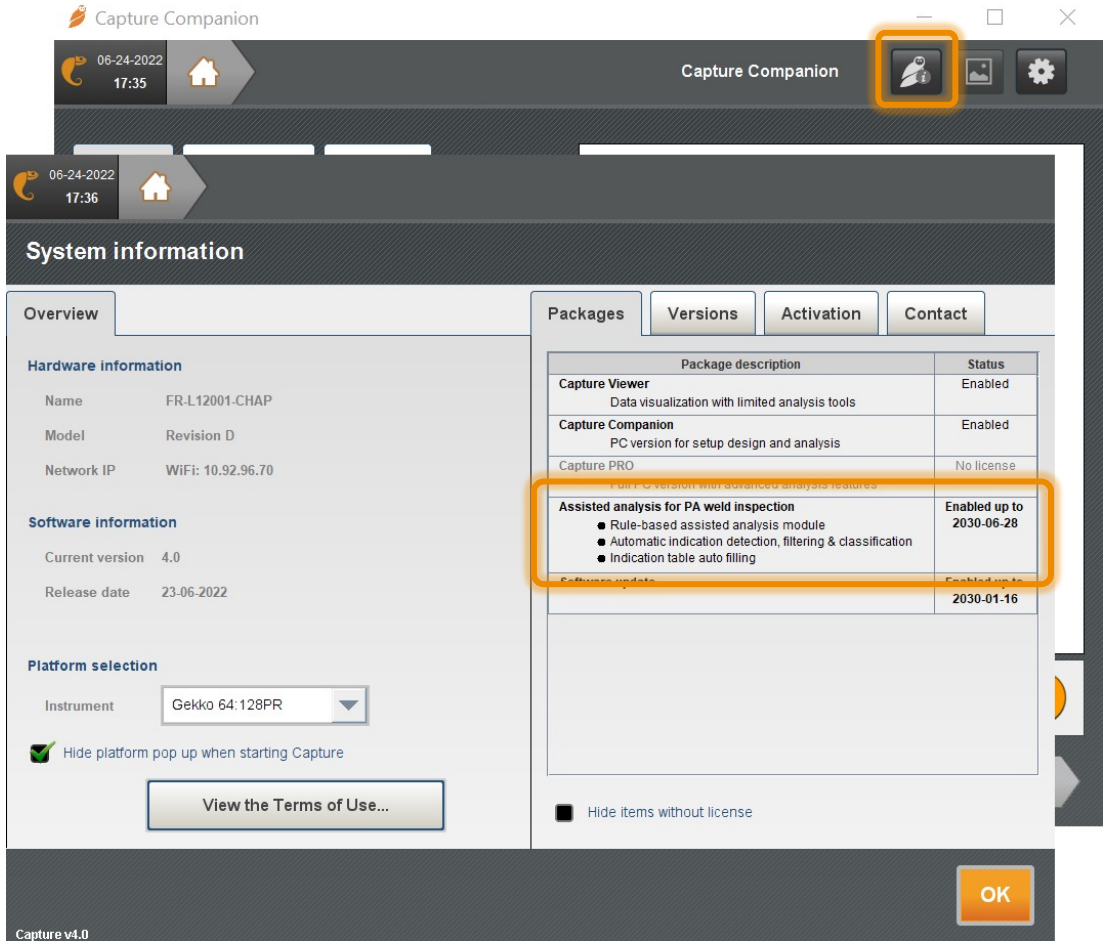
1. If two or more indications of the same group are selected, then it is possible to merge them. This creates a new indication (tagged '-M'). The former indications reappear by deleting the new one or by pressing the eye button
2. Reordering: please press the columns title to sort the table. The button 2. reorder the number of each indication
3. The button exports all the selected indication in .csv format. The column are those present in the indication table (customize them with the button 4.)

License activation

PA weld assisted analysis

ACTIVATION CHECKING

Assisted analysis for PA weld inspection is a module released with Capture v4.0 in June 2022. This feature is offered until the June 28th, 2023 to all Capture PRO & GO users under subscription plan.



Check the package activation

- In the system information panel, access to the Package tab.
- Check if the *Assisted analysis for PA weld inspection* package is activated
- If the feature does not appear, connect the PC or the instrument to the Internet, go to the “Activation” tab and press “Refresh”
- If the package does not appear, contact **support@eddyfi.com**

Configuration & set-up

Quick start - overview

Set up: The setup must be realized using 2 groups or more of phased-array shear waves (e.g., 2.25-10MHz)

- Frequency choice relevant with thickness and expected defect sizing
- Minimum 2 groups PAUT (1 group minimum each side of the weld)
- 1-offset sectorial scanning (raster scanning is not handled yet)
- Focused or unfocused sectorial scanning
- Same TCG and reference gain for the 2 groups

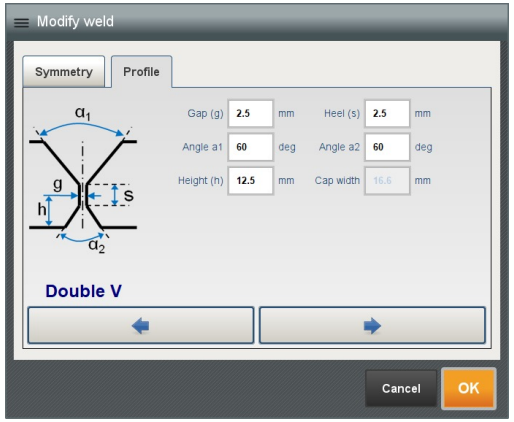
Evaluation: The evaluation is based on amplitude and length of longitudinal defects (search for specular echoes). Note: the feature does not cover transverse defects.

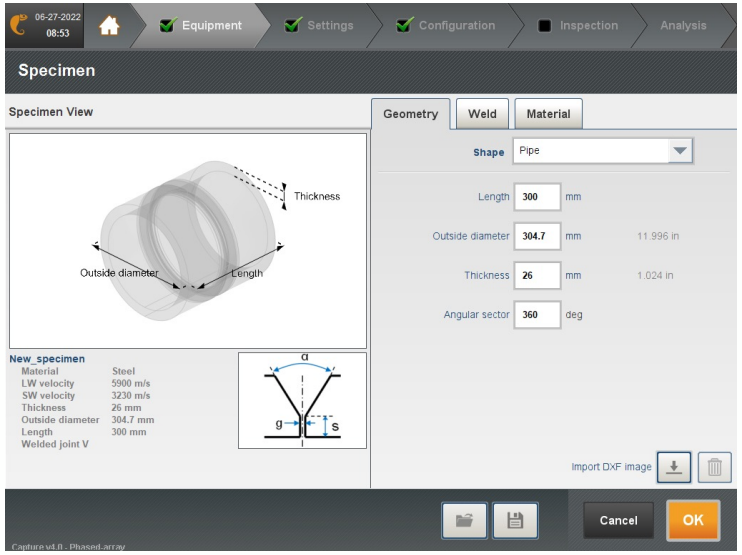
User responsibility: the user can confirm and the type and the sizing of indications, as well as fusion several indications together. Please note that the user is responsible for accepting or refuse the assisted-analysis results.

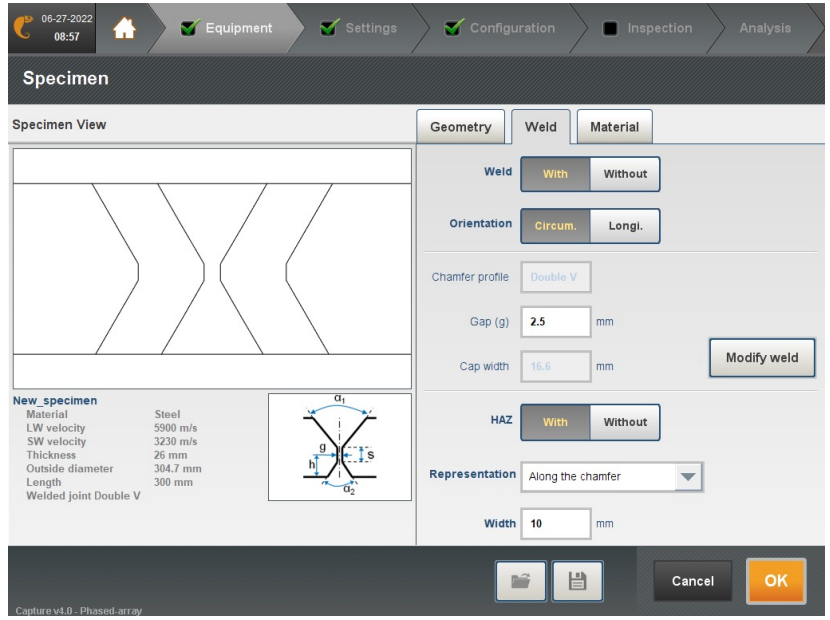
Configuration & set-up

SPECIMEN PANEL

- Plates and pipes circular welds
- V- and X-prep welds
- HAZ is not mandatory but recommended for a more complete scan plan.







Configuration & set-up

PROBES & GROUPS

- Number of probes: 2 identical linear phased-array probes with shear-wave wedges
- Probe positioning: upstream and downstream positioning (90 and 270), same offset with respect of weld centerline
- Supported scanning types: electronic scanning, sectorial scanning, compound scanning
- Supported focal laws: unfocused, focused (point, depth, projection, sound path)
- Supports multiple groups per probe
- Supports TOFD groups and/or other groups (e.g., coupling check)
- Scanning pattern: fixed offset with respect to weld centerline (raster not yet supported)

If the setup is supported by the AA feature, the AA button shows up in the bottom banner

Configuration & set-up

PROBES POSITIONNING

- Probe positioning: upstream and downstream positioning (90 and 270), same offset with respect of weld centerline
- Scanning pattern: fixed offset with respect to weld centerline (raster not yet supported)

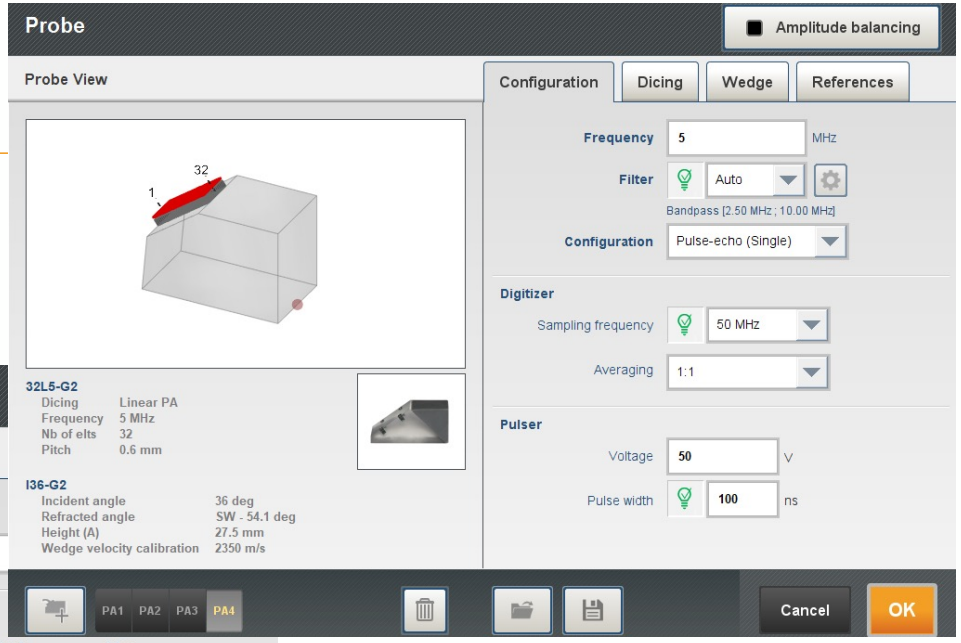
If the setup is supported by the AA feature, the AA button shows up in the bottom banner

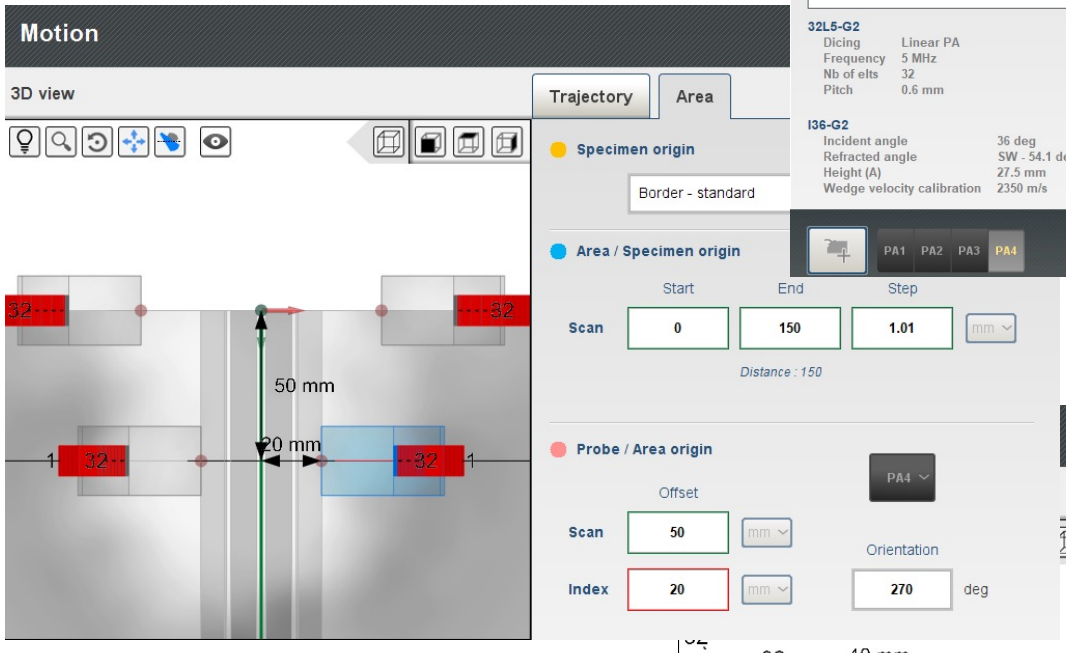
Configuration & set-up

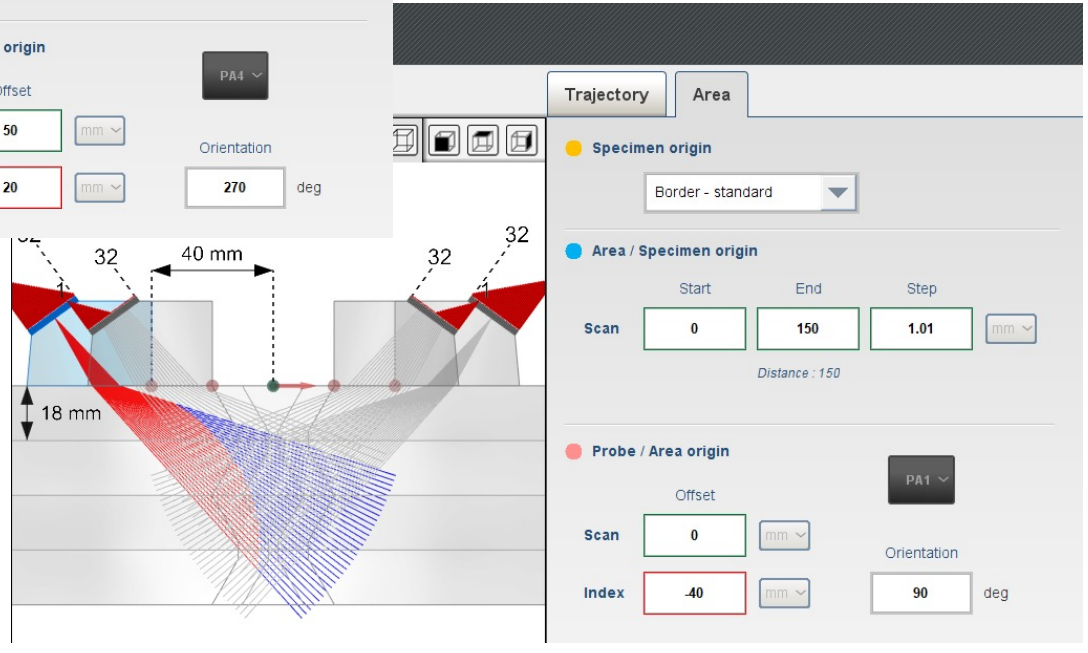
EXAMPLE #1

Four 32-element probes, 5MHz with 2 offsets:

- 1 group per probe
- Groups are symmetrical with respect to weld centerline
- 2 groups sectorial scanning
- 2 groups compound scanning
- Motion and encoding along weld axis





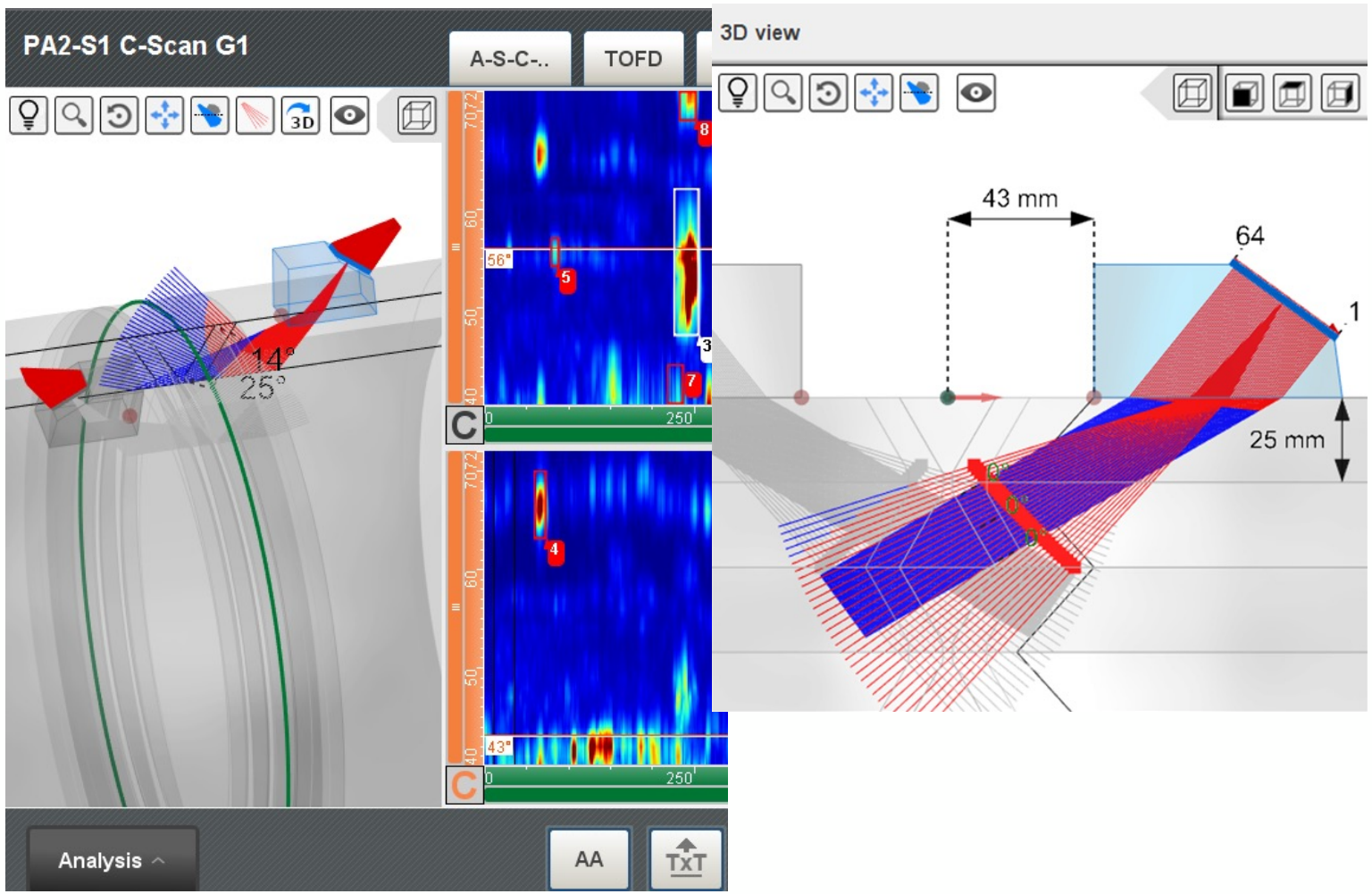


Configuration & set-up

EXAMPLE #2

Two 64-element probes, 5MHz with 2 offsets

- 2 groups per probe
- Groups are symmetrical with respect to weld centerline
- 1 group sectorial scanning with focusing
- 1 group electronic scanning
- Motion and encoding along weld axis



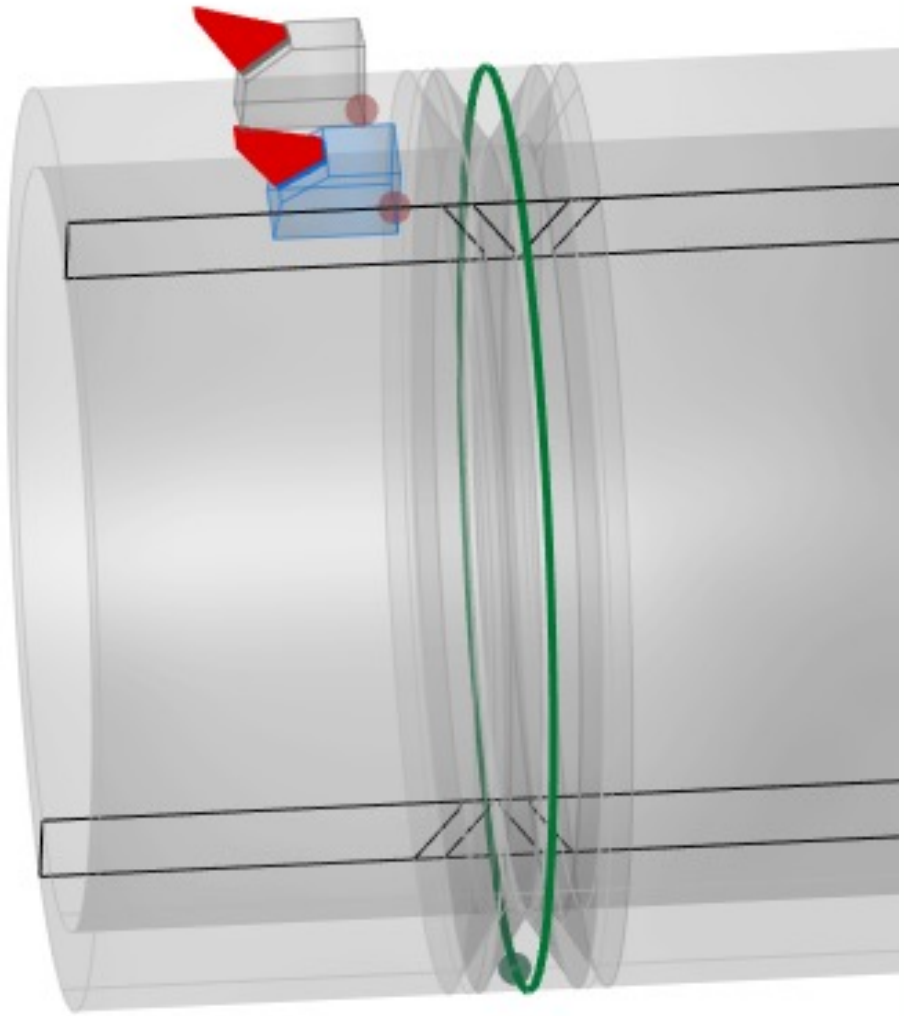
Scan offset supported

Configuration & set-up

EXAMPLE #3

- 1-sided inspection with 2 probes
- Unsymmetrical groups with respect to weld centerline

This configuration is not handled handled by the Assisted Analysis module of Capture v4.0



Configuration & set-up

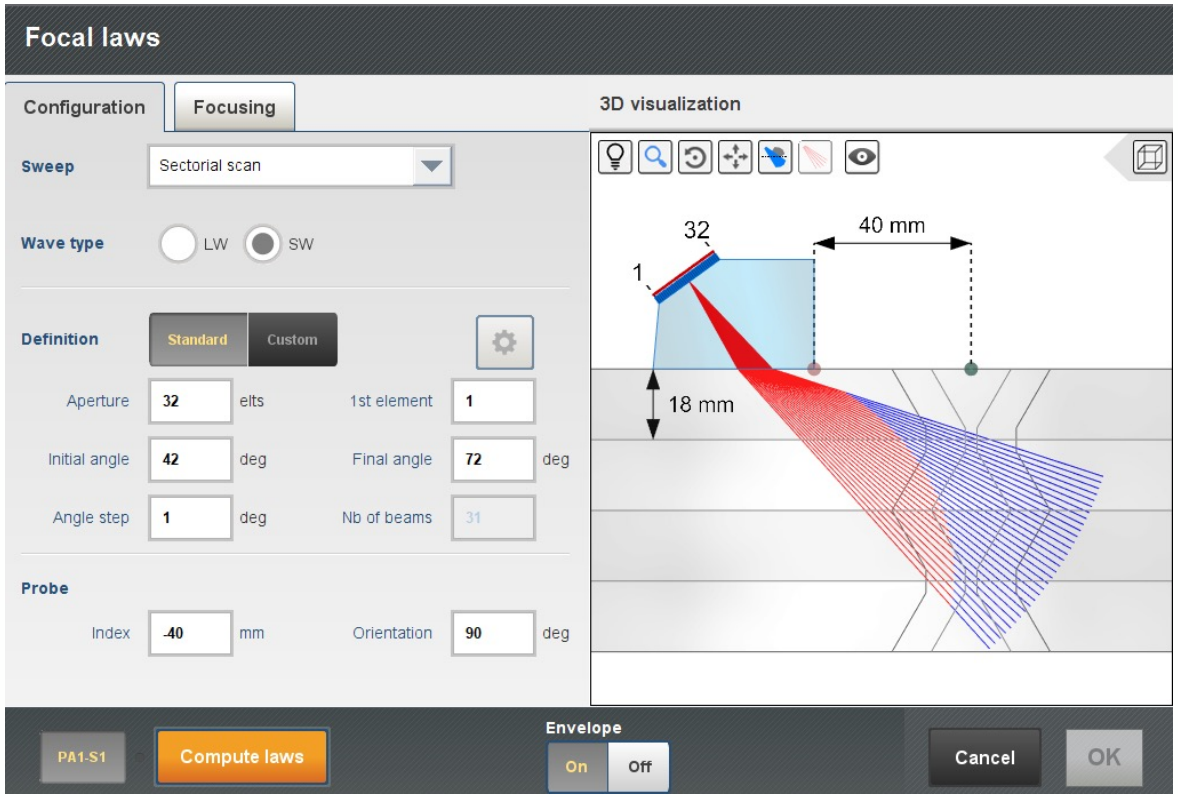
REMINDER OF GOOD PRACTICES

- Zone coverage: the range must be set to cover the inspection of melted metal + HAZ using half skip and/or full skip mode.
- TCG: groups used for the diagnostic of the weld must include a TCG with the same reference gain. The TCGs must be done using the same reference block. The TCG zone must at least cover the distance from half skip to more than full skip. In this zone, SNR must be equal or greater than the evaluation threshold.
- Probe positioning must be done according to good practices, i.e., spread the ultrasonic beams as normal as possible to potential welding defects, optimize corner effects, etc.

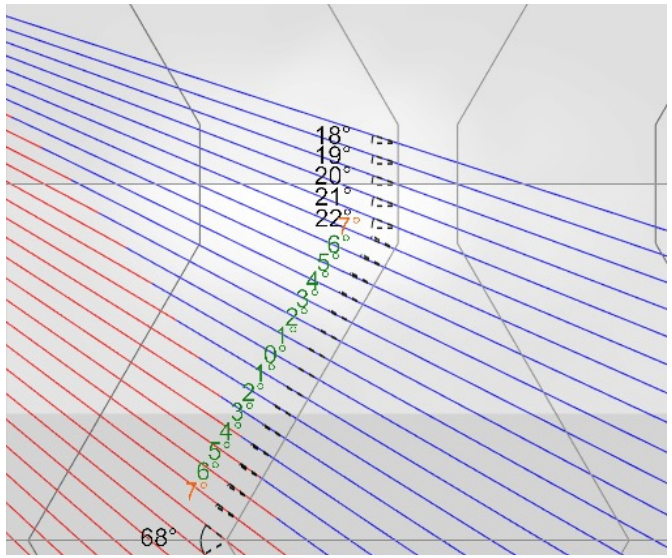
Note: no restriction is brought to the inspection sensitivity, however if over-sensitivity is noticed in acquisition, the gain may be adjusted in analysis before launching the AA process for better results.

Configuration & set-up

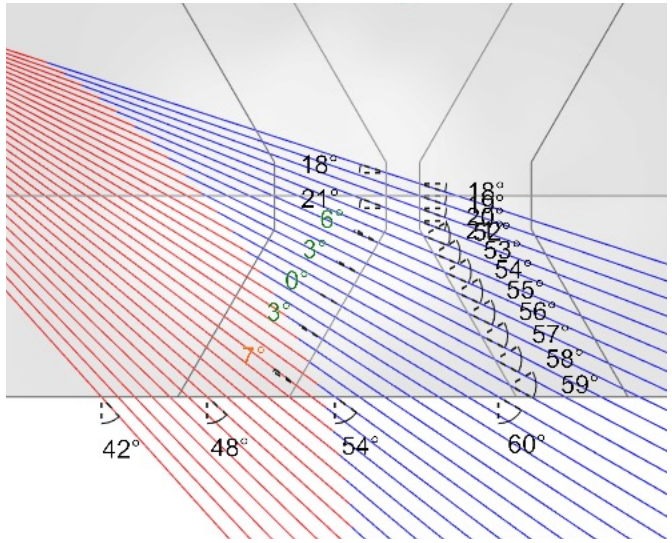
EXAMPLE #4



Good practice: Range must be extended to cover weld and extended coverage zone for each group.



Good practice: aim for specular reflections (i.e., normality +/- 6° on chamfer full skip



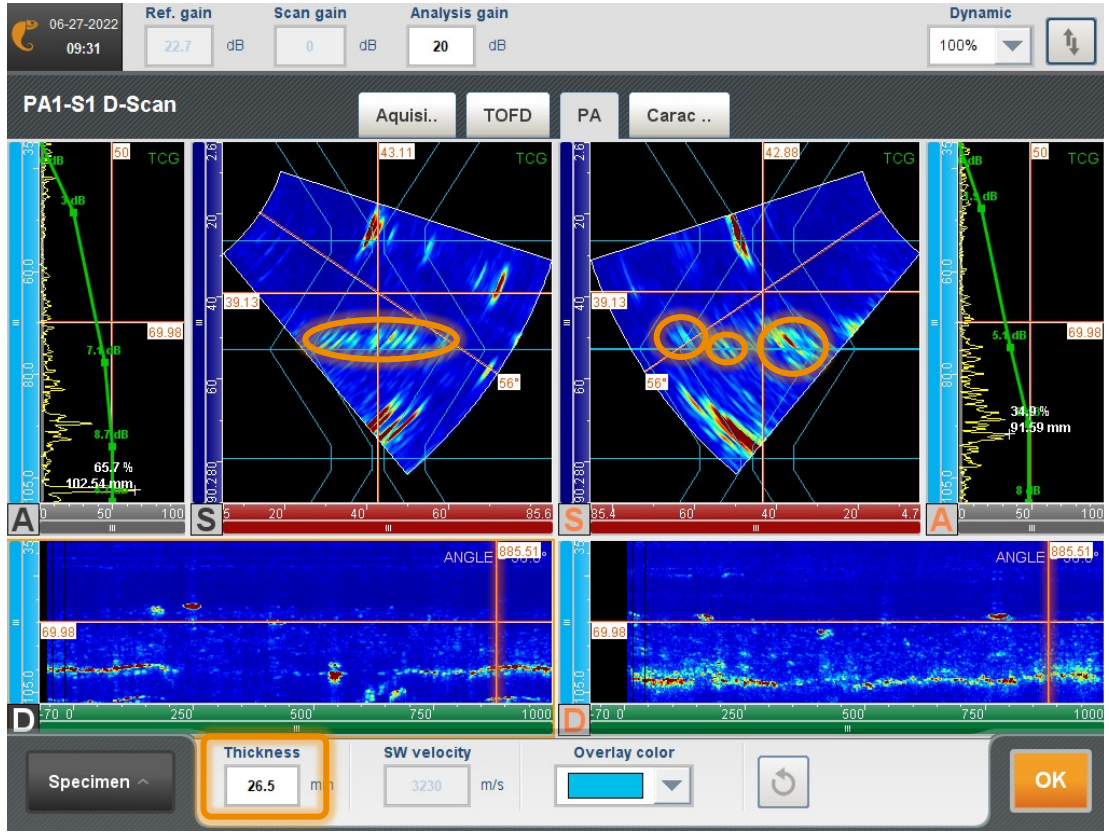
Good practice: optimize corner echo for the ID side after reflection off the back wall.

Pre-analysis

Pre-analysis

THICKNESS CHECK

Checking and correcting the thickness is strongly recommended in case of a substantial difference between the input thickness and the real thickness. The AA feature being based on time-of-flight information to locate echoes, it is advised to check this value.



How to check the specimen thickness

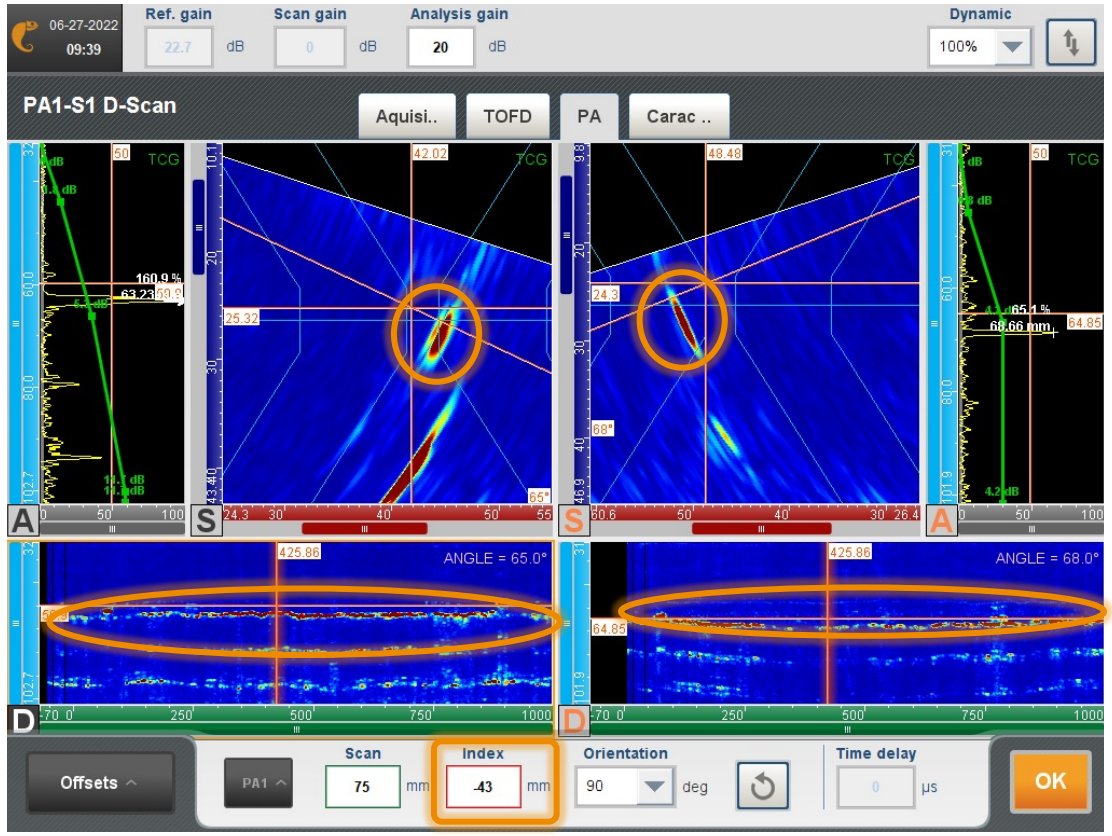
Here is an example where the thickness is corrected from 25 to 26mm. To visualize the thickness using 1 shear-wave group, a good practice is to search for the « grass ».

Increase the gain enough to see the back wall direct echo (the grass). It should represent a line at constant depth, visible on the sector scan as well as on the D-Scan. If the thickness is correct, this depth corresponds to the real thickness. If the thickness does not correspond to the input value, an adjustment is needed.

Pre-analysis

SCAN OFFSET CHECK

The AA feature being based on time-of-flight information to locate echoes, it is advised to check the value of the offset. It is strongly recommended to adjust this value if a strong discrepancy is observed between the input offset and the observed offset.



How to check the index offset

The observed offset can le located thanks the root echo that typically shows high amplitude.

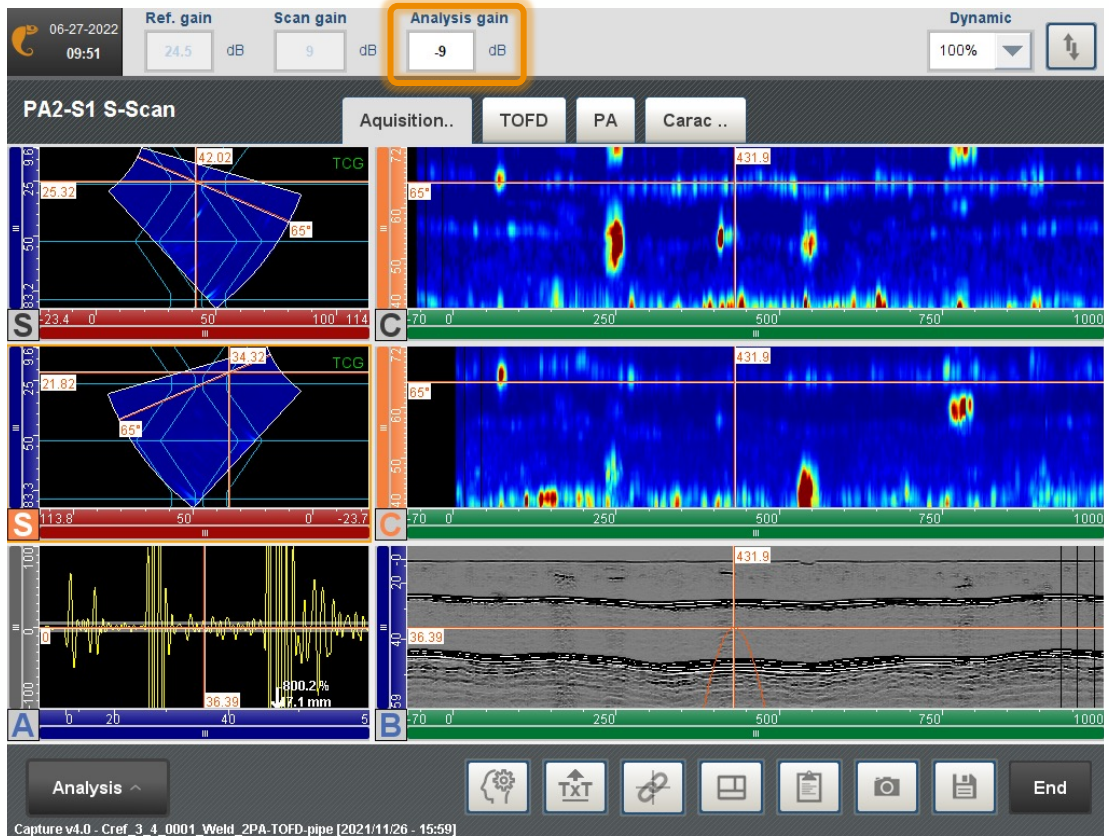
If not clearly seen along the scan, add gain to make it more visible. The root echo should be roughly located at the middle of the weld prep. Edit the offset value and get back to normal gain values.

The offset can be set for all groups at the same time or individually.

Pre-analysis

AMPLITUDE CHECK

The AA feature is based on signals calibrated with respect to calibration reference block (e.g., SDH). If the scan gain or the analysis gain has been set too high, it will impact the sizing based on reference signals.



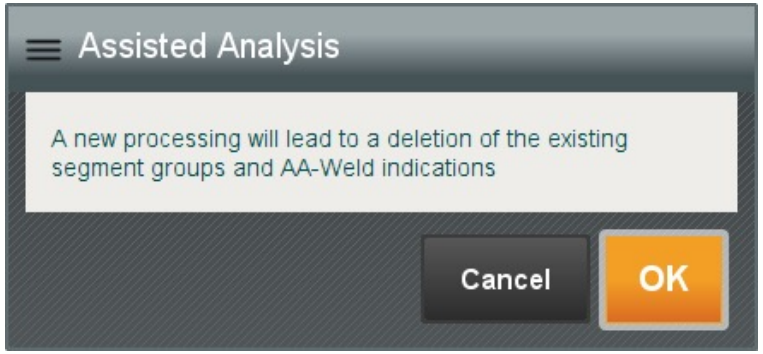
How to check the amplitude

The user needs to make sure the analysis is made using the reference gain.

Detailed workflow

Detailed workflow

DETECTION (1/3)



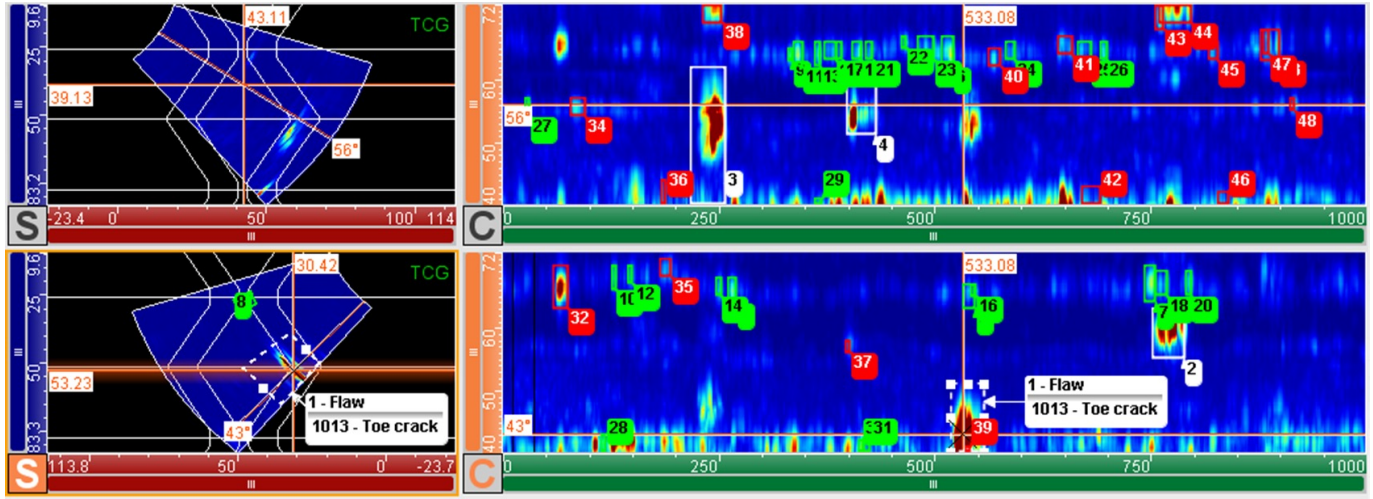
The AA feature aims to suggest an indication table with sized and characterized indications in one click. The goal is to save time to the analyst. The suggested indication labels and sizes remain to be validated by the analyst.

The process time typically is comprised between a couple seconds and a minute.

Note: each AA run cleans pre-existing AA-generated indications in the table but does not erase existing indications edited manually by the user.

Color coding:

- White: weld defect
- Green: geometry
- Red: unconclusive, potential defect



Detailed workflow

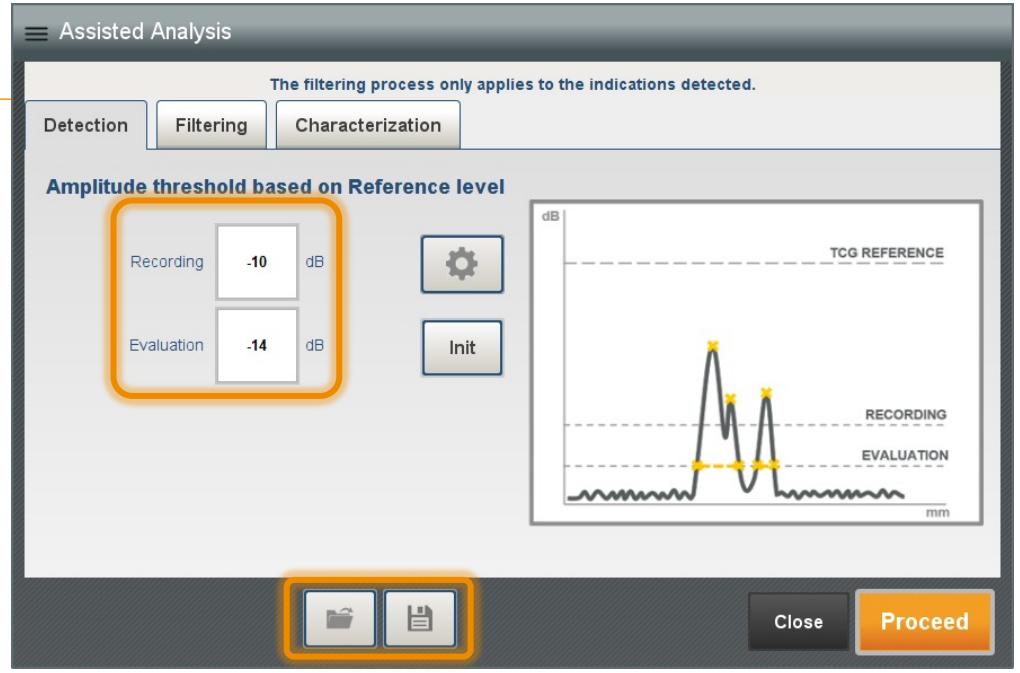
DETECTION (1/3)

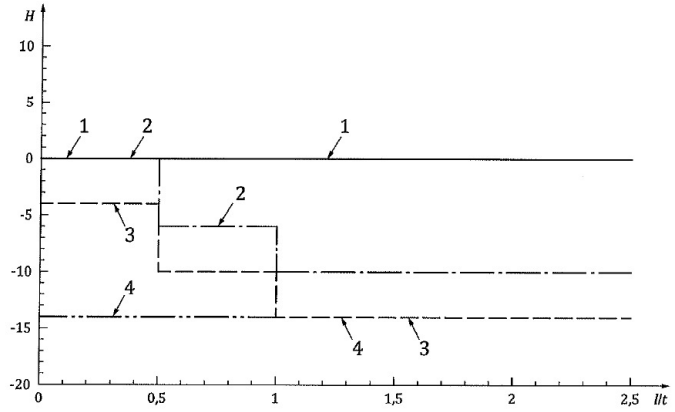
The detection tab allows for editing 2 types of amplitude thresholds:

- The first threshold is the recording threshold. It is the one that triggers indication recording. A signal with an amplitude above that threshold is going to be recorded as an indication.
- The second threshold is the evaluation threshold. This is the lowest level of amplitude used for evaluation.

The both values are preset by the AA feature, based on levels commonly used/recommended by **ISO 19285**.

- The user may edit these values and save them as default and/or as other standards, via the « save » button.
- The gear button leads to advanced parameters explained later.





Légende

1 niveau de référence
2 niveau d'acceptation 2
3 seuil d'enregistrement
4 niveau d'évaluation
H amplitude en dB
l longueur de l'indication
t épaisseur

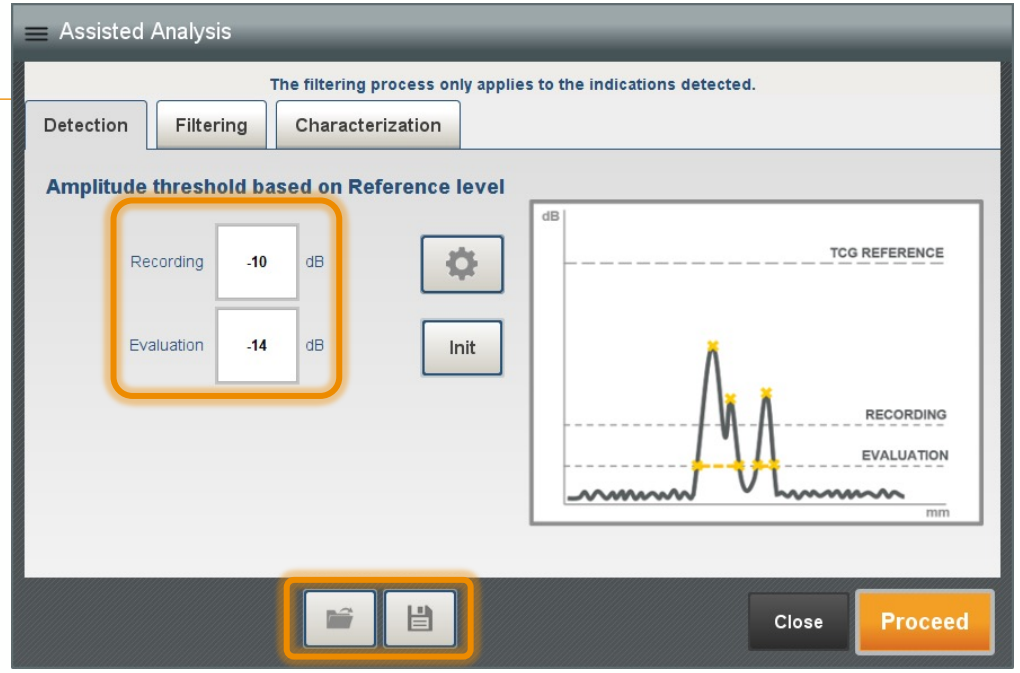
Figure A.3 — Niveaux pour la technique 1 pour des épaisseurs comprises entre 15 mm et 100 mm – Niveau d'acceptation 2

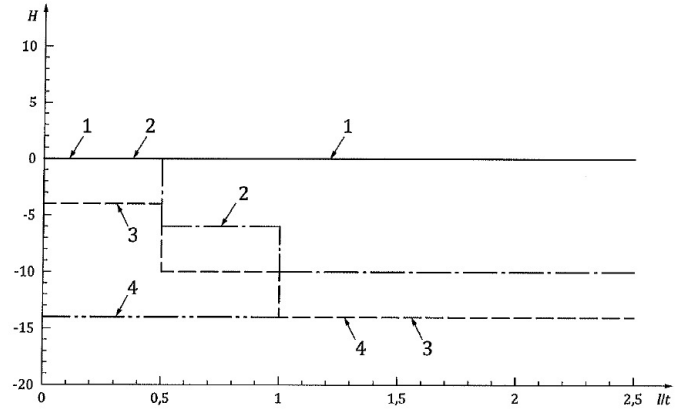
Detailed workflow

DETECTION (2/3)

What are the effect of threshold modification

- The evaluation threshold cannot be greater than the recording threshold.
- The evaluation level must not be lower than noise level.
- The lower the recording level, the more indications will be present in the table.
- The lower the evaluation level, the bigger the resulting indications.





Légende

1 niveau de référence
2 niveau d'acceptation 2
3 seuil d'enregistrement
4 niveau d'évaluation
H amplitude en dB
l longueur de l'indication
t épaisseur

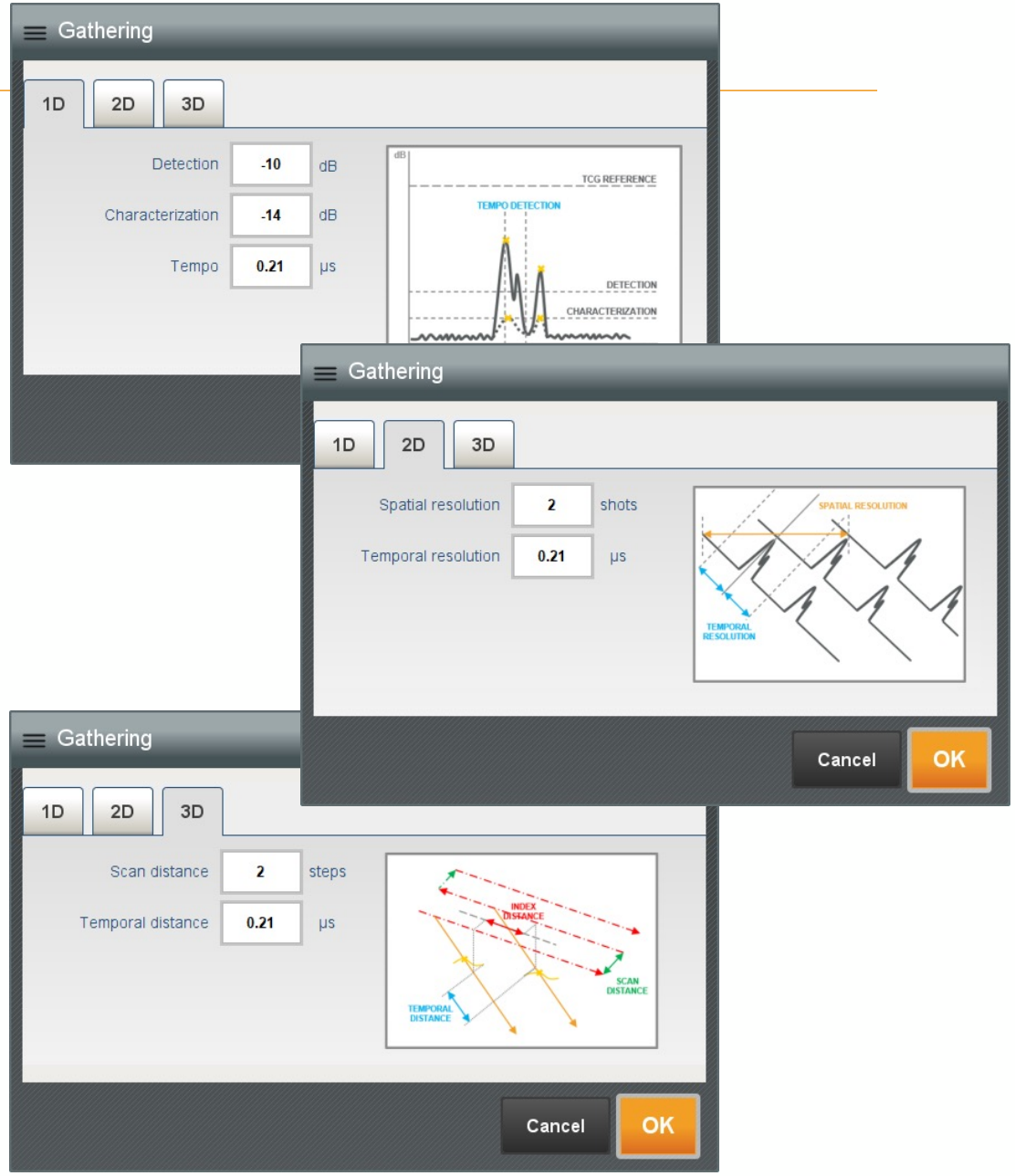
Figure A.3 — Niveaux pour la technique 1 pour des épaisseurs comprises entre 15 mm et 100 mm – Niveau d'acceptation 2

Detailed workflow

DETECTION (2/3)

How to change advanced parameters

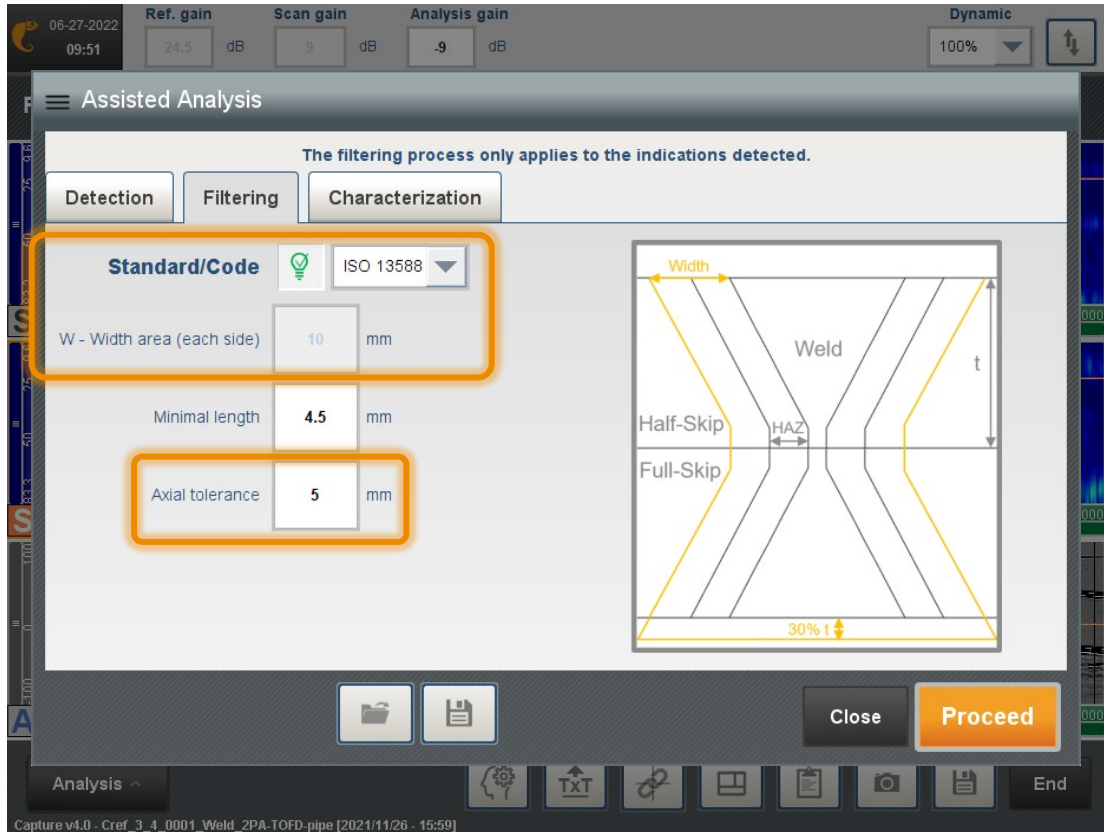
- Press on the gear button to access advanced parameters for the detection level of the AA feature. This feature is based on the ‘segmentation’ algorithms. These algorithms aim to compact the threshold data into sized indications.
- Users interested in the details of the segmentation algorithms can refer to CEA publications or contact us for more information.
- The 1D, 2D, and 3D tabs of this advanced menu gathers options to consolidate signals into geometrical indication in depth, width and extension.



Detailed workflow

FILTERING (1/2)

Indication found outside of the area of interest defined in the Filtering tab wil be deleted.



How to set the width

The analysis is performed in a zone specified in width and depth. The depth is automatically computed to include the full thickness plus 20%. The width can be selected via a drop-down menu offering a choice of standards. A user-selected mode can also be selected.

How to set the axial tolerance

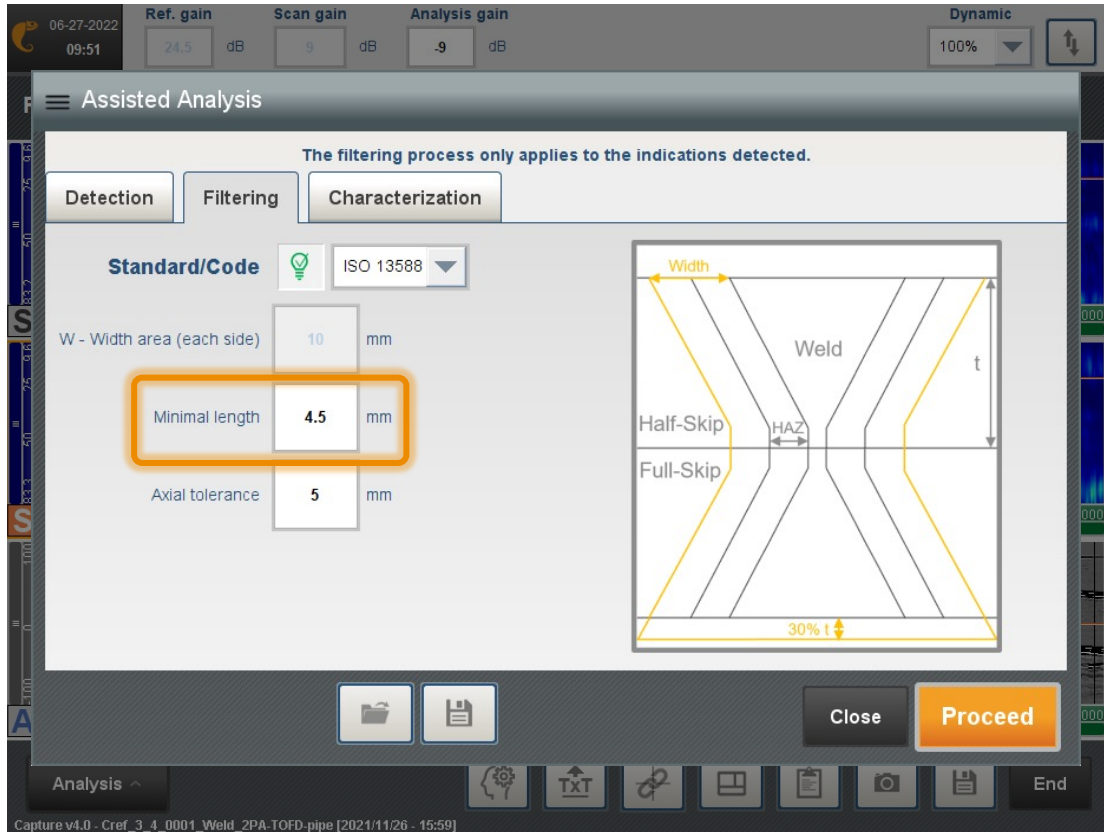
This value corresponds to the tolerated error of the offset with respect to the weld centerline (+/- 5mm according to ISO13588, +/- 2 mm according to ISO20601)

The bigger the “width” value, the more potential for indications not regarding the main zone of interest. The value of this parameter shall consider the axial tolerance of the scanner.

Detailed workflow

FILTERING (2/2)

Indications found outside of the area of interest defined in the Filtering tab will be token account.



How to set the minimal length

The minimal length corresponds to the minimum extension that needs to be recorded as an indication. It typically is dimension along the scanning axis, most often the passive direction of the phased-array probe.

The bigger the « minimal length » value, the less indications are going to be found by the AA feature. The recommendation is to enter the value recommended by the standard used for the inspection.

Detailed workflow

CHARACTERIZATION (1/2)

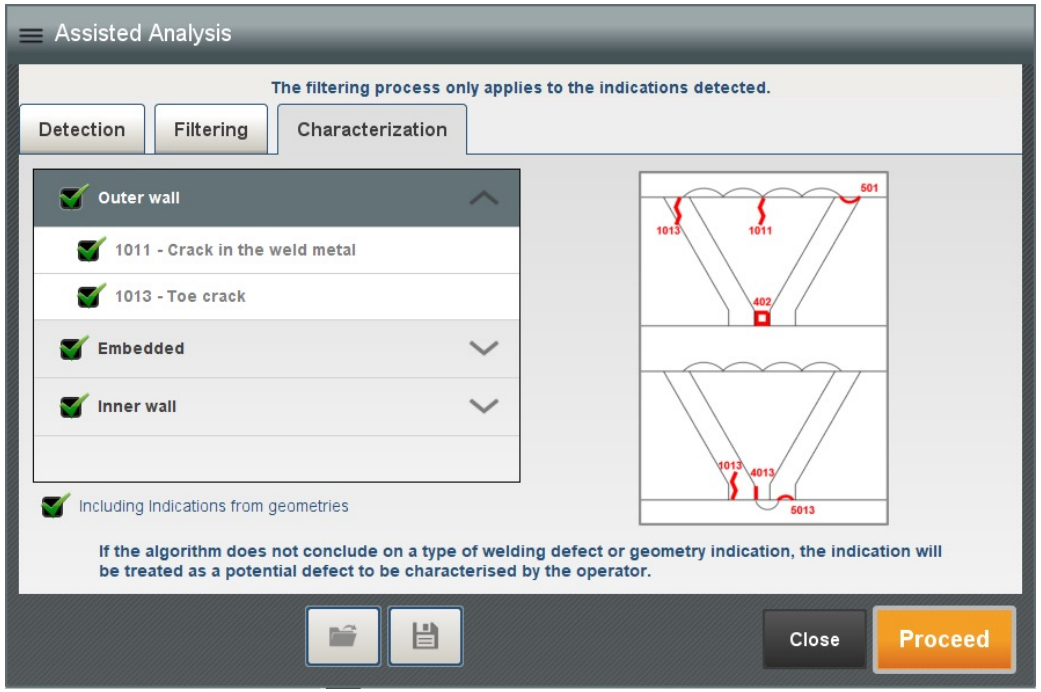
Assisted analysis feature fill automatically an indication table with the geometrical and positioning info. AA module can characterize defect depending on the reflectivity or the position inside the weld.

How to use the characterization tab

The characterization tab allows the selection of searched defect types by the AA feature.

The user can tick/untick the types of defect to be recognized by the pattern-recognition algorithms.

The user can also select to have geometrical indications to be recognized by the AA feature.



Detailed workflow

CHARACTERIZATION (2/2)

Here are listed the defects handled by the Assisted Analysis of Capture v4.0.

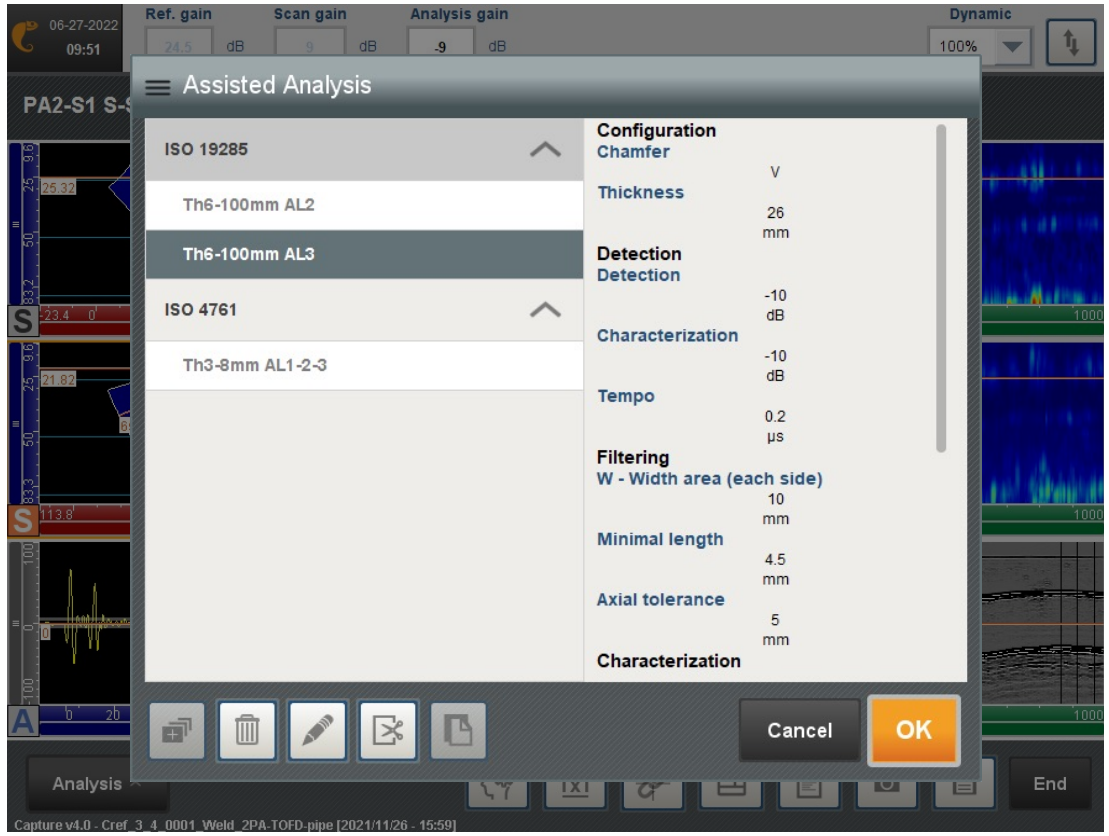
Note: some defect types are not handled by the AA feature. E.g., 501 and 5013.

Outer Wall / Paroi Externe / Aussenwand	Embedded / Embarqué / Eingebettet	Inner Wall / Paroi Interne / Innenwand
1013 (V et X) Toe Crack Fissure au raccordement Riss in der Verbindung	4011 (V et X) Lack of side-wall fusion Manque de fusion des bords Flankenbindefehler	402 (V uniquement) Incomplete penetration Manque de pénétration Ungenügende Durchschweißung
1011 (V et X) Crack in the weld metal Fissure dans le métal fondu Riss im Schweißgut	4012 (V et X) Lack of inter-run fusion Manque de fusion entre passes Lagenbindefehler	4013 (V uniquement) Lack of root fusion Manque de fusion à la racine Wurzelbindefehler
501 (V et X) Undercut Caniveau Einbrandkerbe	1012 (V et X) Crack at the weld junction Fissure dans la zone de liaison Riss in der Bindezone	1013 (V uniquement) Root Crack Fissure en racine Wurzelriss
C/D (V et X) Geo Direct - Bead Géo Directe - Cordon Geo Direkte – Raupe	1011 (V et X) Crack in the weld metal Fissure dans le métal fondu Riss im Schweißgut	5013 (V uniquement) Shrinkage groove Caniveau à la racine Wurzelkerbe
	402 (X uniquement) Incomplete penetration Manque de pénétration Ungenügende Durchschweißung	1013 (X uniquement) Toe Crack Fissure au raccordement Riss in der Verbindung
	4013 (X uniquement) Lack of root fusion Manque de fusion à la racine Wurzelbindefehler	1011 (X uniquement) Crack in the weld metal Fissure dans le métal fondu Riss im Schweißgut
	300 (V et X) Inclusion/Line of Inclusion/Ligne d' Einschlüsse/Zeile	504 (V uniquement) Excessive penetration Excès de penetration Zu große Wurzelüberhöhung
	200 (V et X) Cavities/Clustered Cavités/Nid Hohlräume/Nest	501 (X uniquement) Undercut Caniveau Einbrandkerbe
	G/H (V uniquement) Geo ModeConv, Penetration - Bead Géo ModeConv, Pénétration - Cordon Geo ModusKonv, Wurzel – Raupe	A/B (V uniquement) Geo Direct - Penetration Géo Directe - Pénétration Geo Direkte – Wurzel
		C/D (X uniquement) Geo Direct - Bead Géo Directe - Cordon Geo Direkte – Raupe

Detailed workflow

SAVE USERS SETTINGS

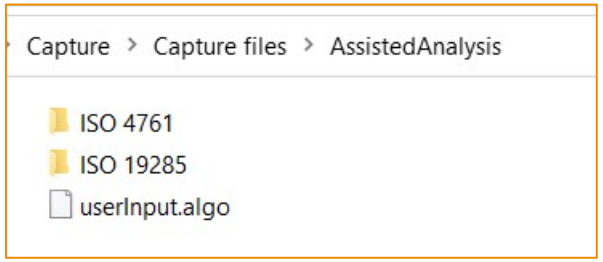
At each step of the workflow, it is possible to save the parameters that have been customized .



How to save users settings

The user may customize and save the entire set of parameters used by the AA feature.

Saved parameters are in the Capture folder, as indicated below.

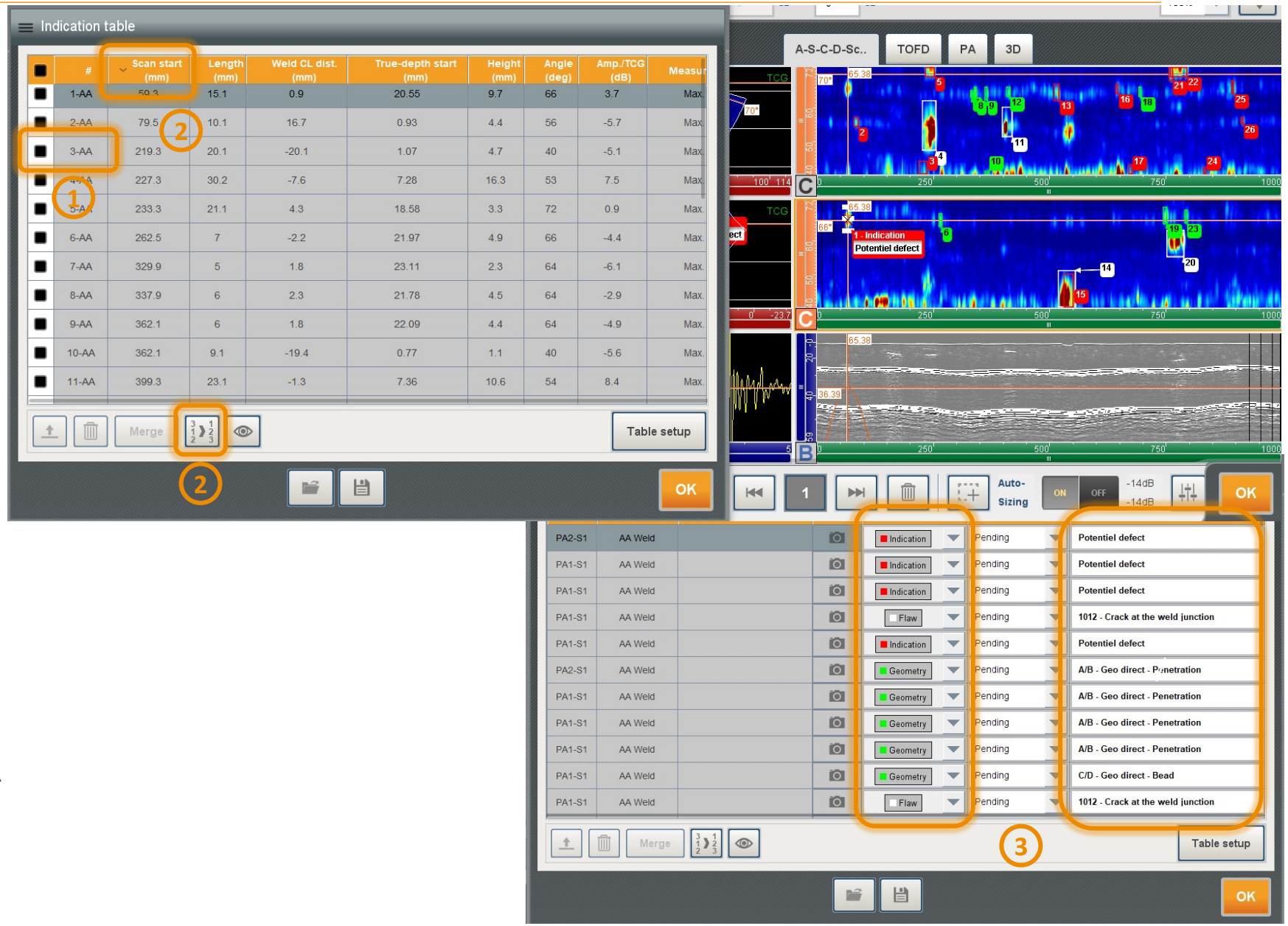


Indication table management

Indication table management

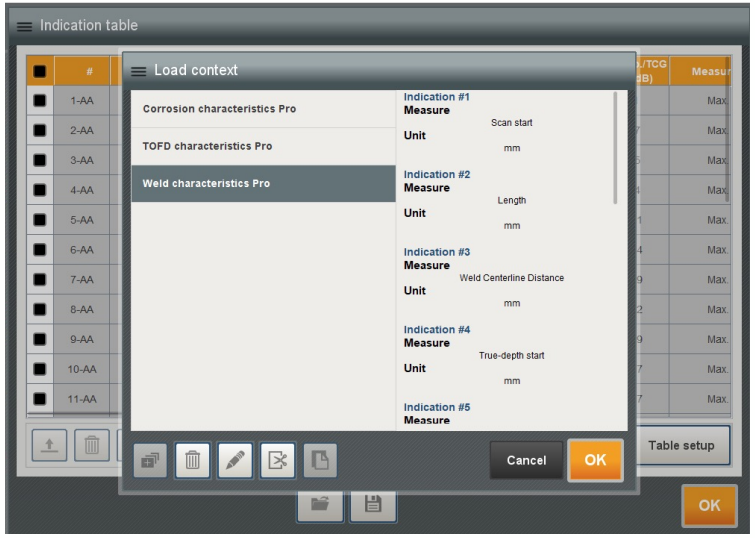
INDICATION TABLE (1/4)

1. The AA feature fills up an indication table. Indications found by the AA feature are labeled with the –AA suffix.
2. The user can sort indications by clicking on the column's title.
   Press to re-number the indications according to the new order.
3. For each indication, the type and comments are automatically filled-in and are pending review by the analyst.
4. Editing AA indications (size, type, comment) remains possible. If user edited, the-AA suffix is removed from the indication name.

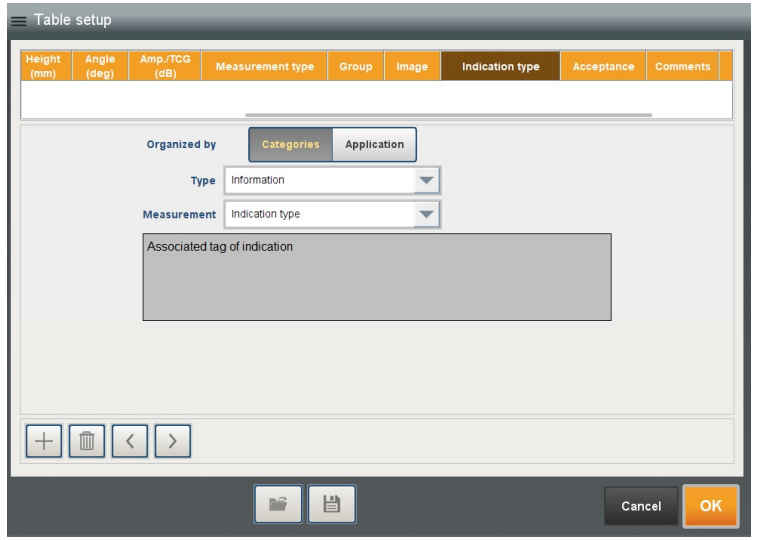


Indication table management

INDICATION TABLE (2/4)

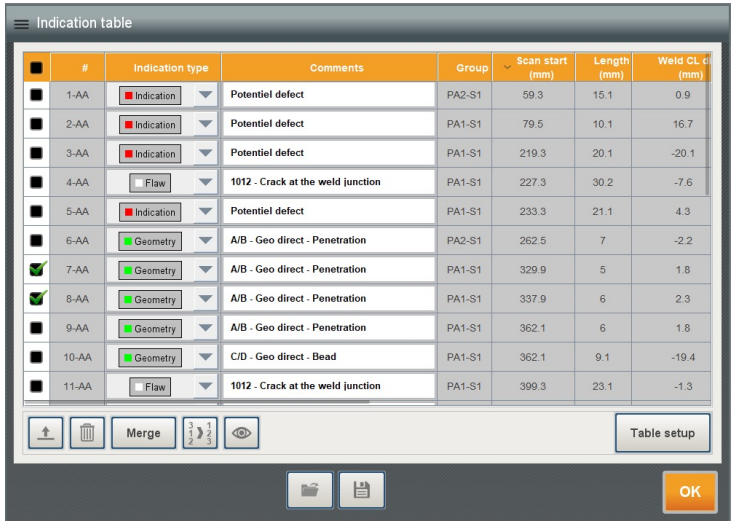


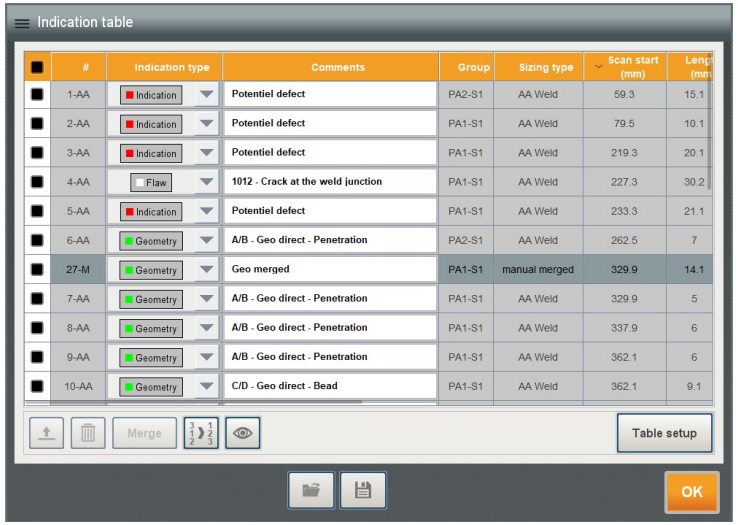
Reminder: the indication table header is entirely customizable by the user. This context or template can be loaded and saved through the interface.



Reminder: merging of indications is possible for both manually created and AA-generated indications.

Merged indications show the –M suffix.





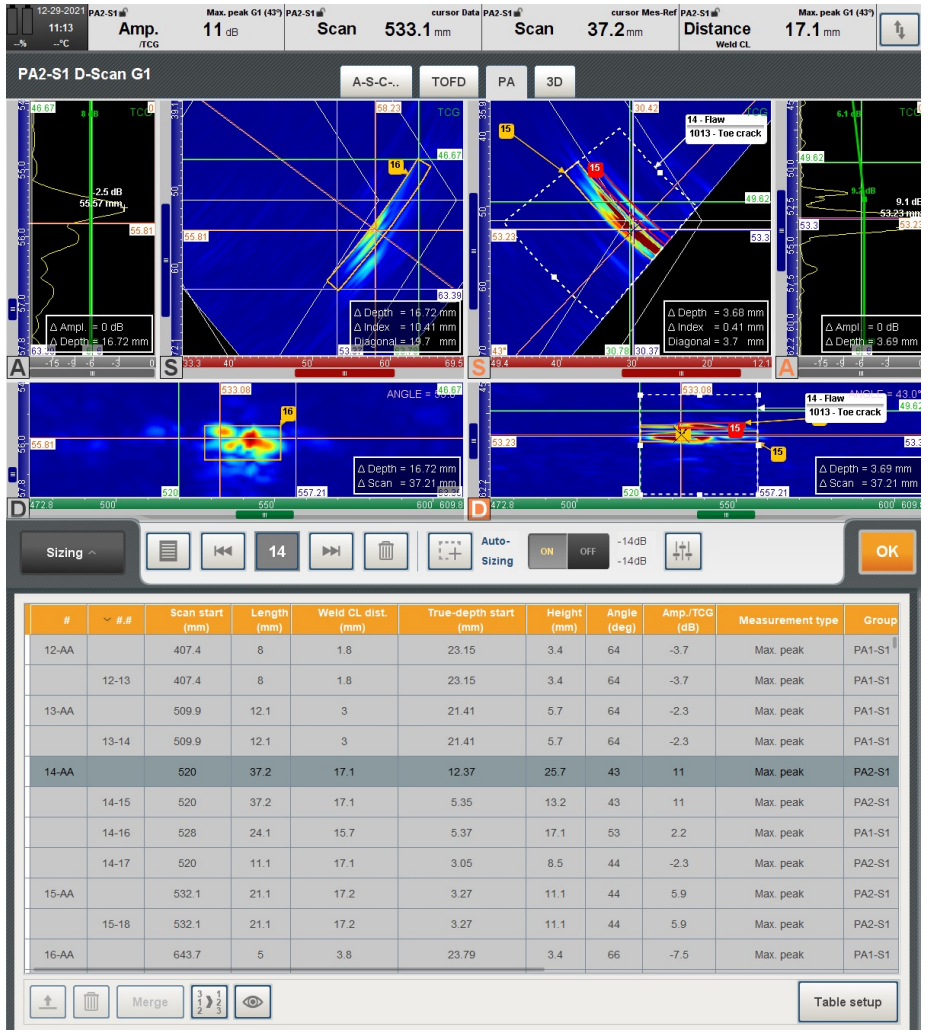
Indication table management

INDICATION TABLE (3/4)

B-, C-, D- scans as well as side-, front- and top-views display the ROI using the same color code as for the indications.

Clicking on the indication activate the cursor on the maximum amplitude point.

The button shows the sub-groups of the indications.

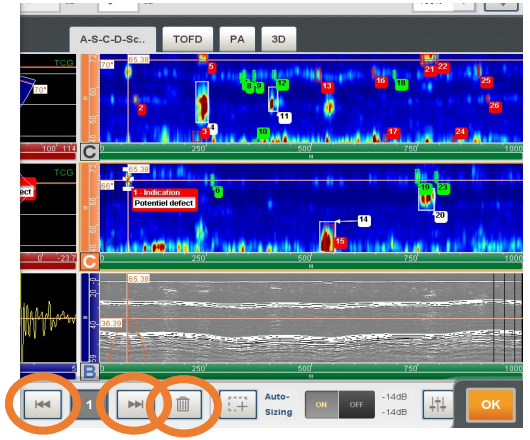


#	#.#	Scan start (mm)	Length (mm)	Weld CL dist. (mm)	True-depth start (mm)	Height (mm)	Angle (deg)	Amp./TCG (dB)	Measurement type	Group
12-AA		407.4	8	1.8	23.15	3.4	64	-3.7	Max. peak	PA1-S1
	12-13	407.4	8	1.8	23.15	3.4	64	-3.7	Max. peak	PA1-S1
13-AA		509.9	12.1	3	21.41	5.7	64	-2.3	Max. peak	PA1-S1
	13-14	509.9	12.1	3	21.41	5.7	64	-2.3	Max. peak	PA1-S1
14-AA		520	37.2	17.1	12.37	25.7	43	11	Max. peak	PA2-S1
	14-15	520	37.2	17.1	5.35	13.2	43	11	Max. peak	PA2-S1
	14-16	528	24.1	15.7	5.37	17.1	53	2.2	Max. peak	PA1-S1
	14-17	520	11.1	17.1	3.05	8.5	44	-2.3	Max. peak	PA2-S1
15-AA		532.1	21.1	17.2	3.27	11.1	44	5.9	Max. peak	PA2-S1
	15-18	532.1	21.1	17.2	3.27	11.1	44	5.9	Max. peak	PA2-S1
16-AA		643.7	5	3.8	23.79	3.4	66	-7.5	Max. peak	PA1-S1

Indication table management

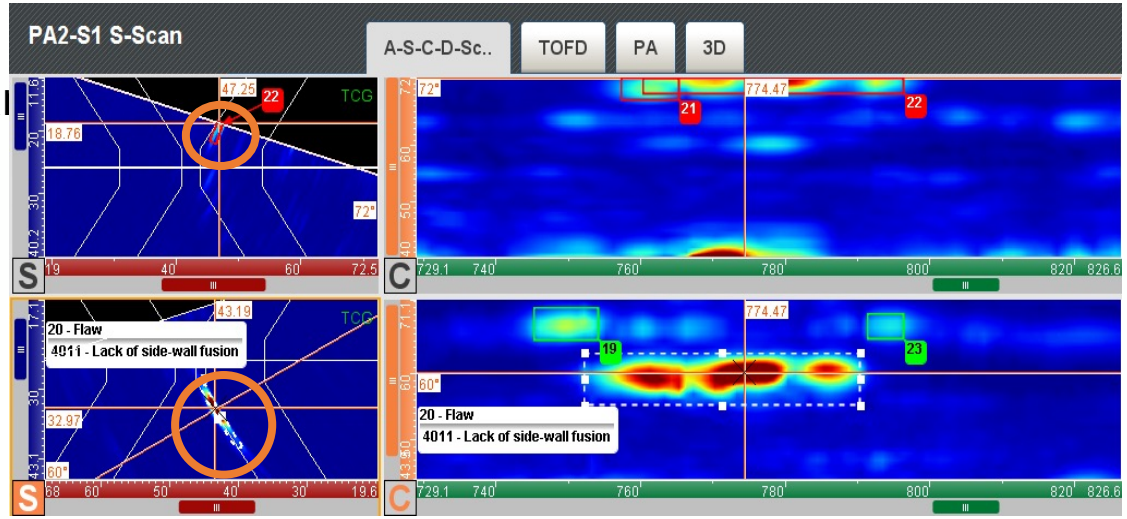
INDICATION TABLE (4/4)

Indications can be selected using the scrollers located at the bottom menu.
To edit indications, the user needs to access the indication table.



The AA-feature is an automatic application of rules specified by the user. The suggested classification of indications as well as the sizing is to be checked by the analyst.

Adding and editing indications using cursors a
the auto-sizing button remains possible.



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