CREASING

SCORING

FOLDING

EMBOSSING

Are critical steps in the box forming process

CREASY

FAG

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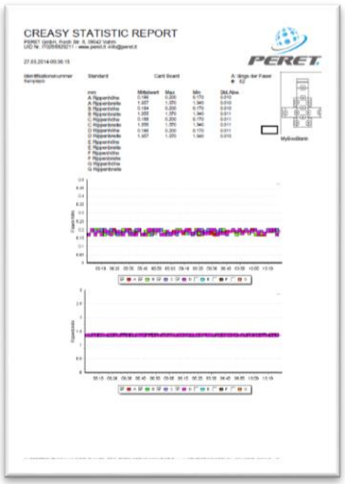
Satisfied Customers will make you successful

- **The quality of the packaging determines the expectation in that the quality of the content**
- packaging without cracking or rupture
- packaging without tears on the ends of the folding edge
- uniform packaging with sharp edges
- documented quality of the Edition

Reputation through quality assurance


CREASY STATISTIC REPORT

PERET

- Constant quality from job to job, from machine to machine and from site to site
- Documentation of quality over time
- Specify reference numbers and tolerances
- Detecting process variations and improvement opportunities

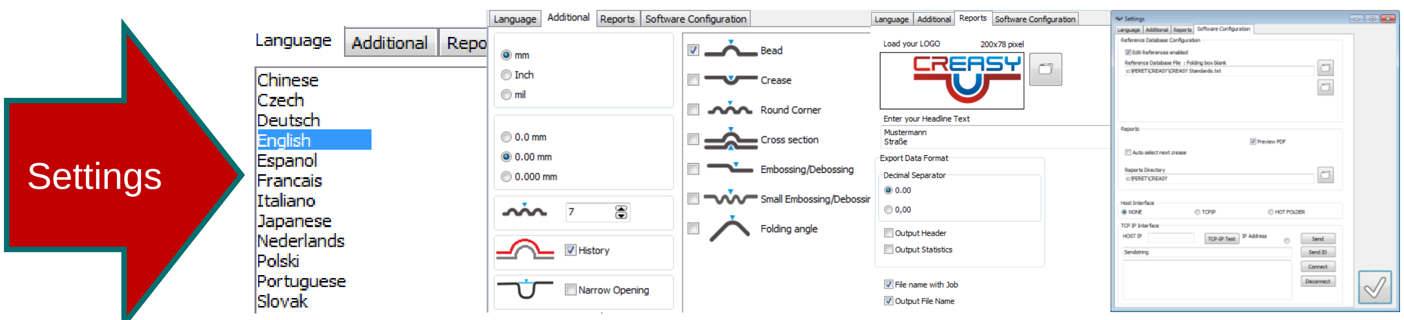
Process Chain or Supply Chain?
Who defines what to do?

Save money in production

- Long service life of the tools
- short make-ready times
- no shutdowns
- controlled, reproducible process
- No problems on the folding gluing machine or packing plant
- low waste because of useless boxes
- Build know how about the process
- Efficient problem analysis

CREASY – The measurement solution to control the creasing, scoring, embossing and folding process

- Camera based hand held device
- Powered by USB
- Windows XP, W7, W8, 32bit/64bit
- Options
  - PREMIUM
  - Power Crease
  - Power Box
  - EGUIDE / EGUIDE PRO



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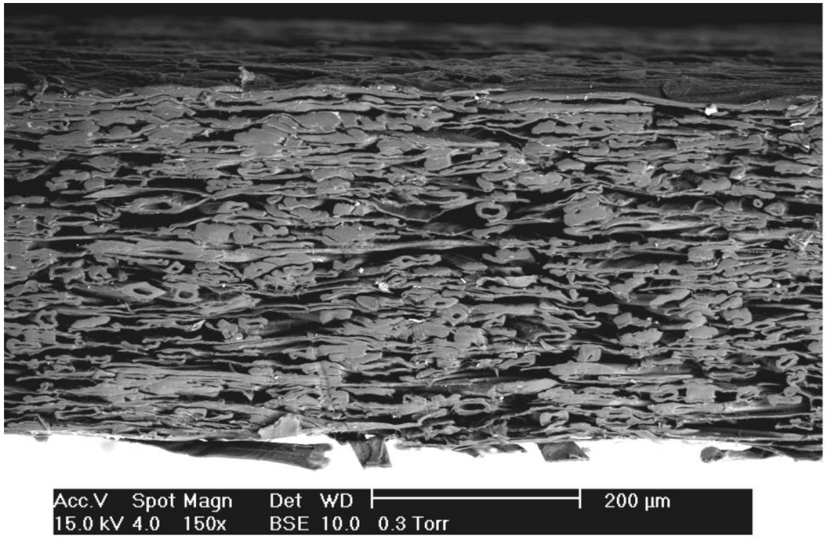
Paperboard is …

- A thick, single or multiply paper based material.
- composed of several layers of pulp fibres with preferred orientation
- bonded by starch or adhesive material
- Bending stiffness is one of the most important mechanical properties for paperboard packaging
- bending stiffness is mainly attributed to the outer ply's with higher Density

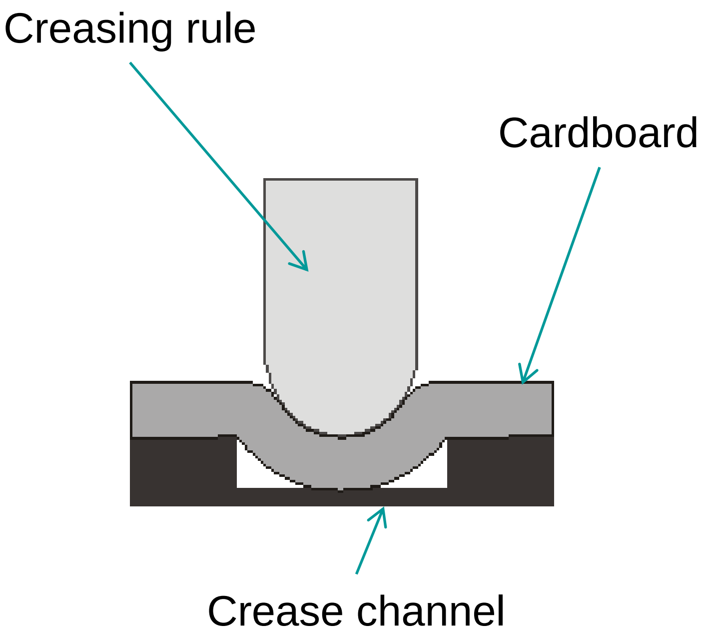


[Source: Hui Huang, KTH Stockholm]

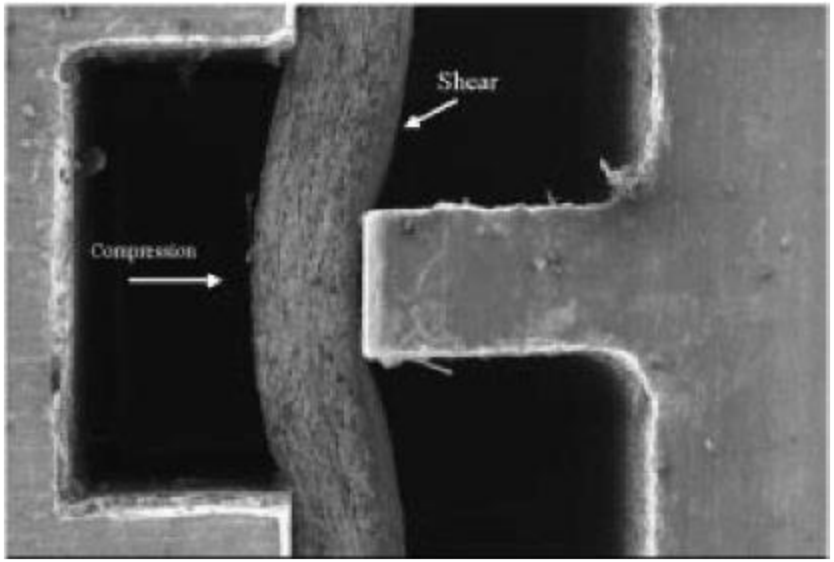
The creasing process

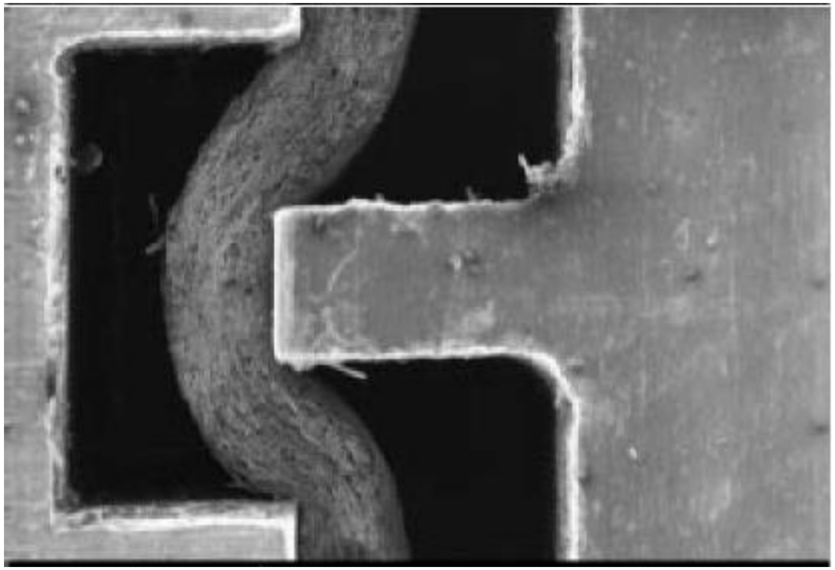
- fibre-fibre bonds between ply's are broken
- Some fibres are damaged
- Plastic deformation occurs
- Sheare, tension and compressing stresses arise

- Locally reduced bending stiffness
- Creased area = hinge



The Creasing Process

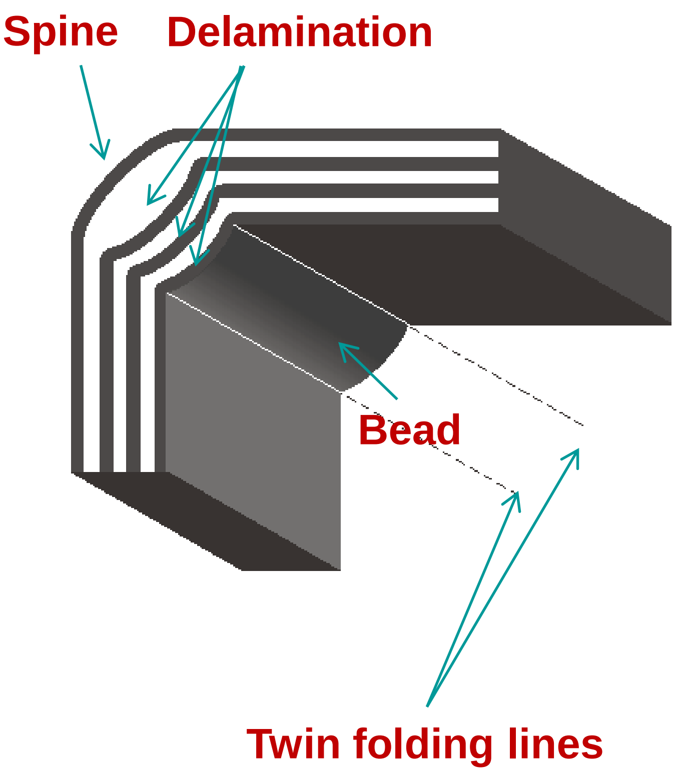




[Source: Hui Huang, KTH Stockholm]

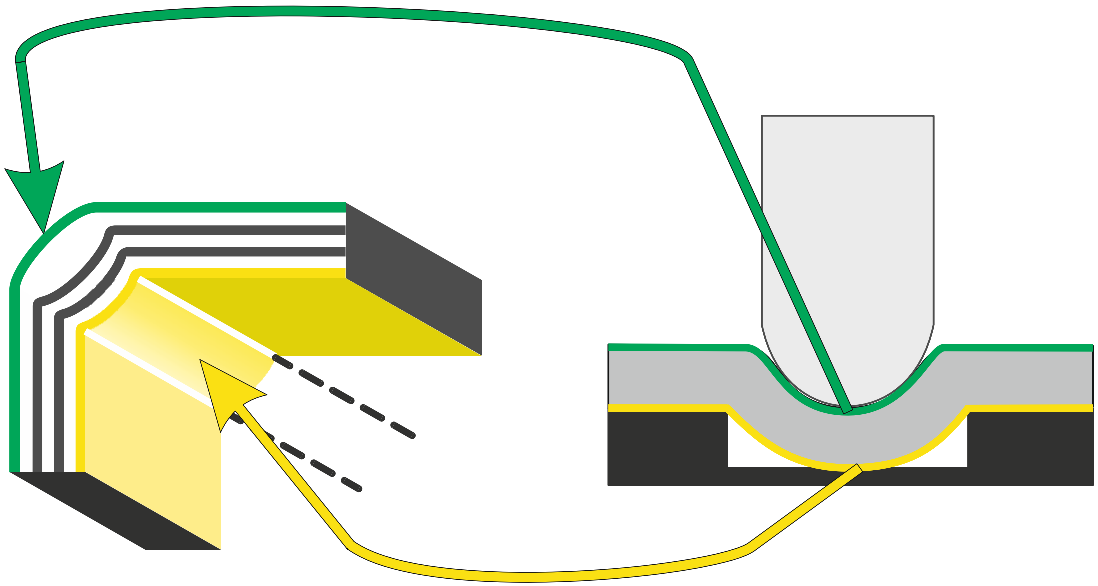
The folding process

- Folding uncreased paperboard results in cracks on the outside
- The ability to delaminate (fracture surface in parallel to the ply's) is an important property for folding
- Tensile stress arises on the outside ply (Spine)
- The inner ply's (Bead) are compressed and bulge
- Deformation and delamination takes place

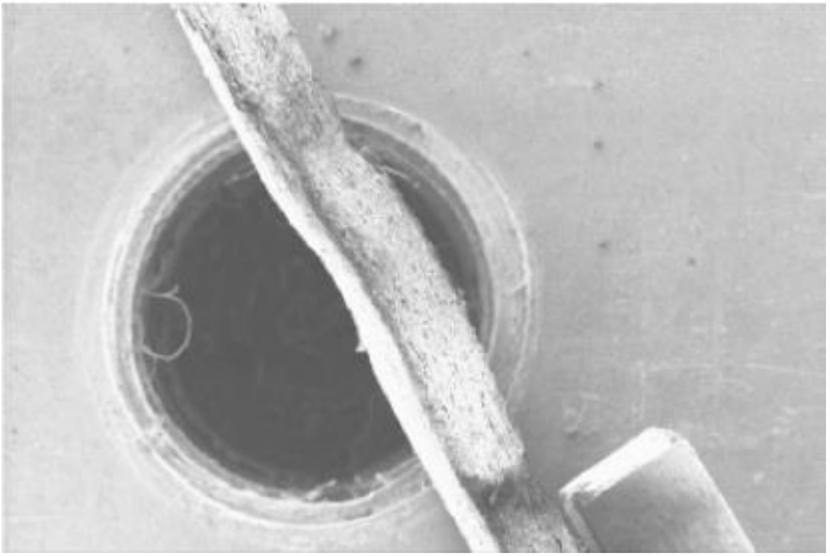


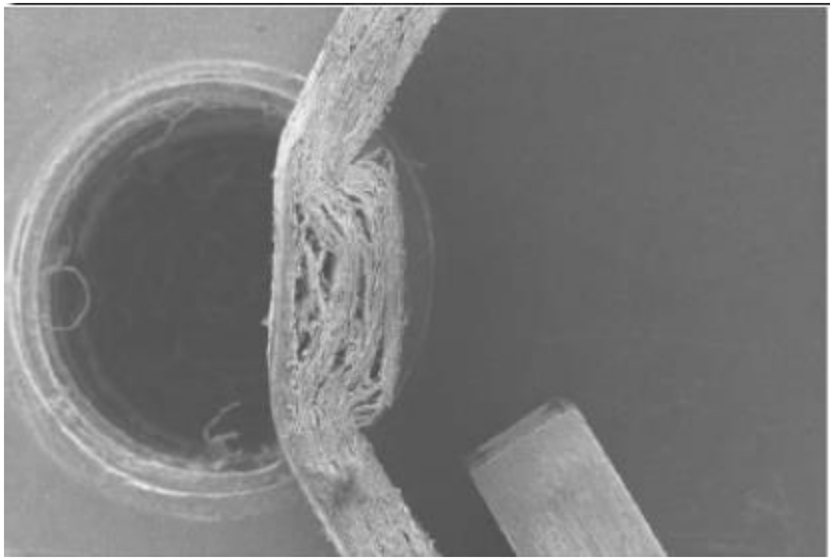
A crease is a double fold!

Find optimum between ‚sufficient Material for the out side‘ and ‚not too much Material for the inner side‘



The folding process:

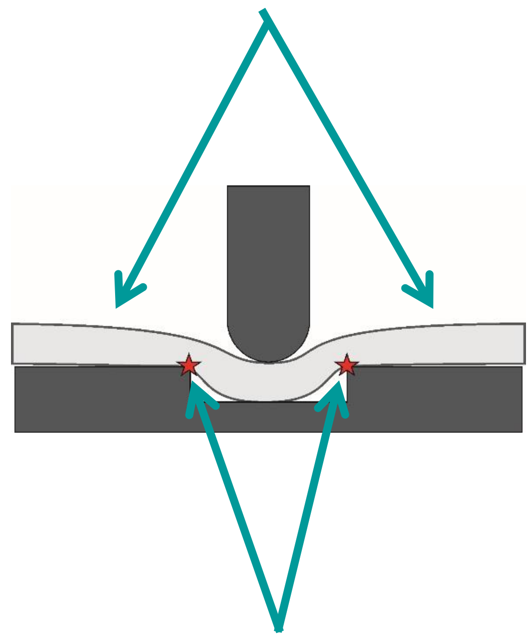




[Source: Hui Huang, KTH Stockholm]

Control the creasing process using CREASY

No well defined sharp edges



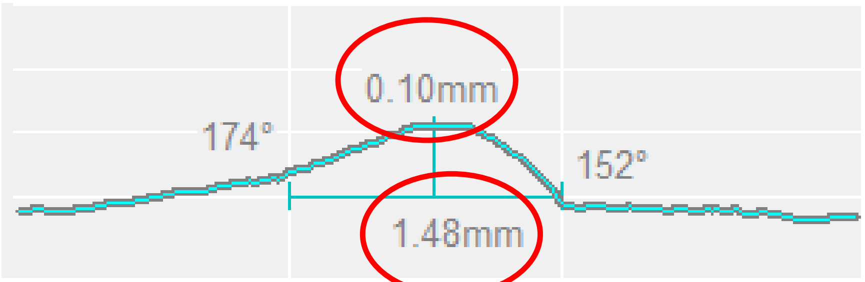
Sharp edges

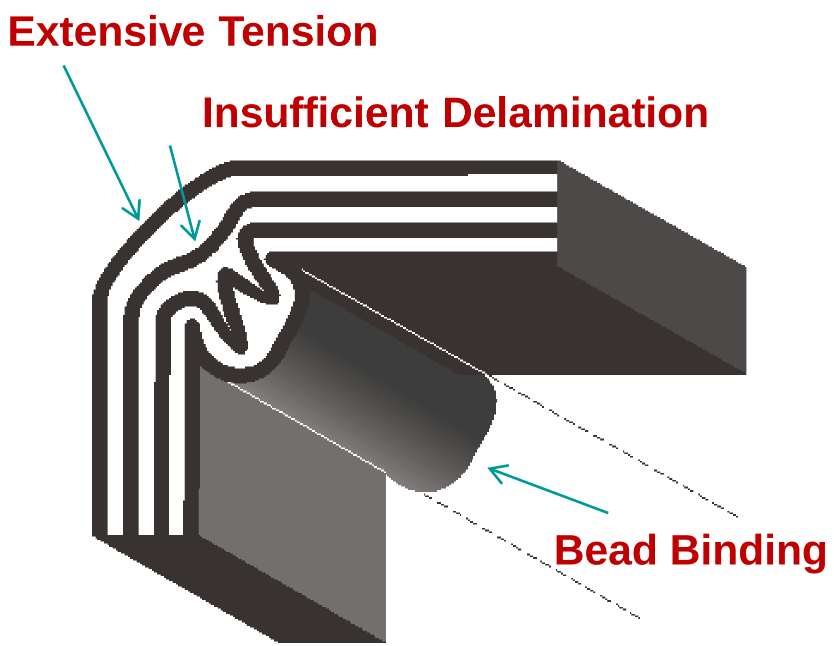
The Bead tells you significantly more than the crease!

Bead Size
predict delamination and bending stiffness

Bead width and Bead height:

- Un-sharp folding points
- Insufficient internal delamination and inflexible bead
- Low flexibility – bead gets crushed during folding
- Hard contact at the intersection between side and bead
- Extensive tension stress on spine
- Spine fracturing or crease end splitting



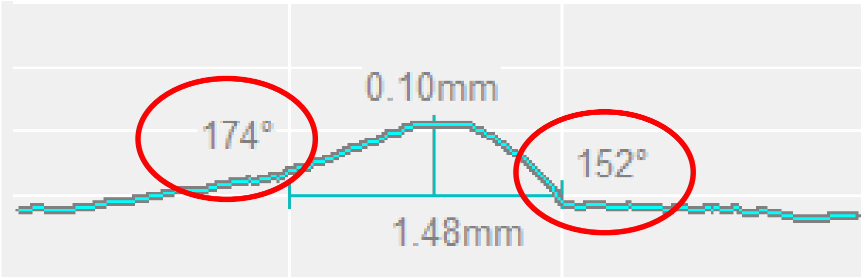


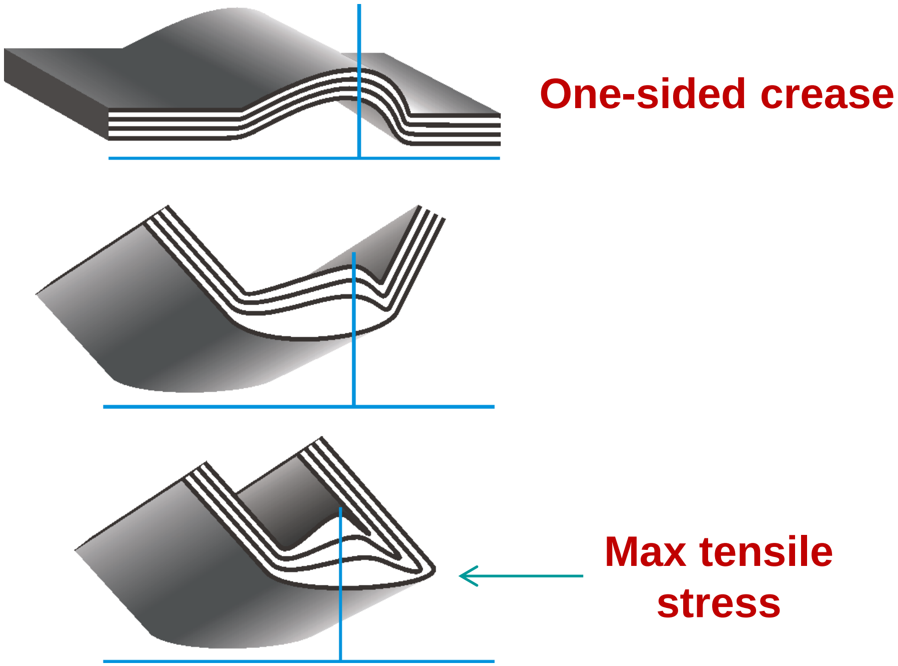
The folding point sharpness defines the symmetry of the bead

Non symmetric folding points

- Off-center folding
- non uniform boxes
- Extensive stress in an arrow area of the spine
- Fracturing and folding failure

- Is the creasing tool well **centered** and **parallel** to the crease channel?

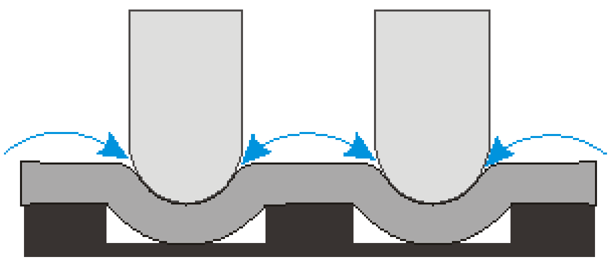


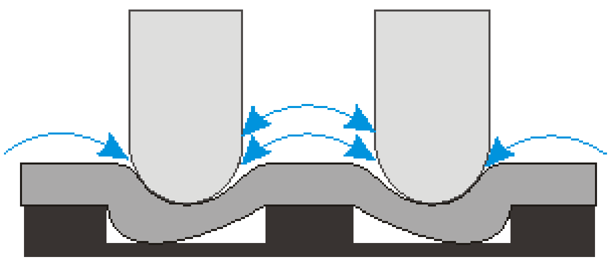


Optimize your creasing process

- Parallel crease close to each other
  - limitation in material stretch
  - Competition in drawing the material
  - Each crease is poorly formed
  - With asymmetric bead
  - Asymmetric internal delamination
  - The resistance to crease formation grows fast after a critical distance

Theorie

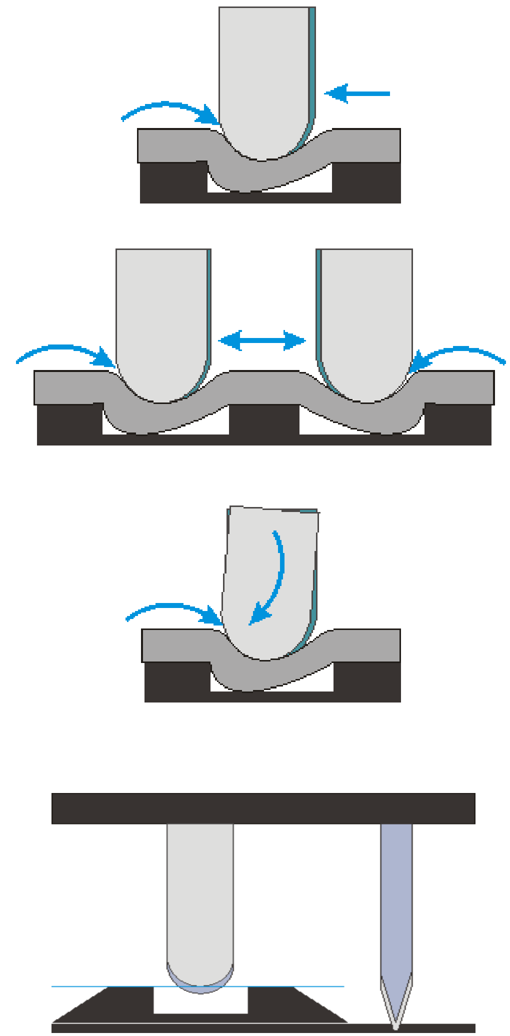




Real world

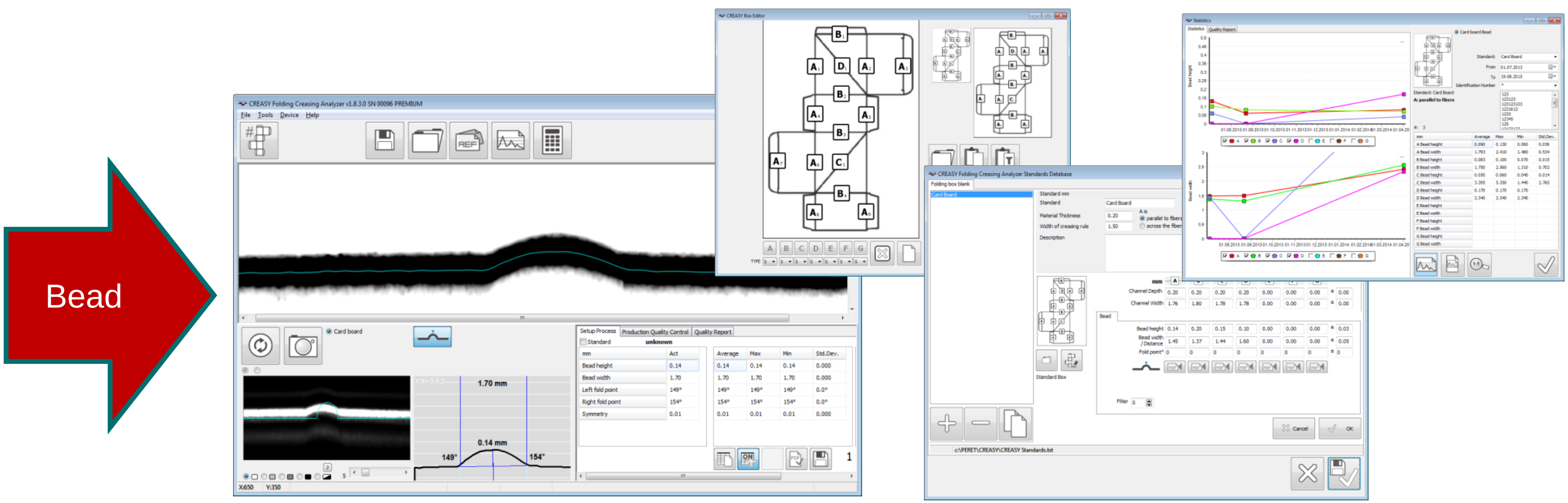
Avoid problems in creasing and folding

- Rule – channel misalignment
- Tool to tool misalignment (tolerance mismatch)
- Crease rule dish
- Incorrect laser die-board cutting vertically
- The knife (position/setting) changes the penetration depth of the rule
  - changing the tension forces which can result into die-cut edge chipping or flaking,
  - or breaking the cardboard material
  - or faster erosion the upper corners of the crease channel
- Cutting knife abrasion leads to resetting of the knife position

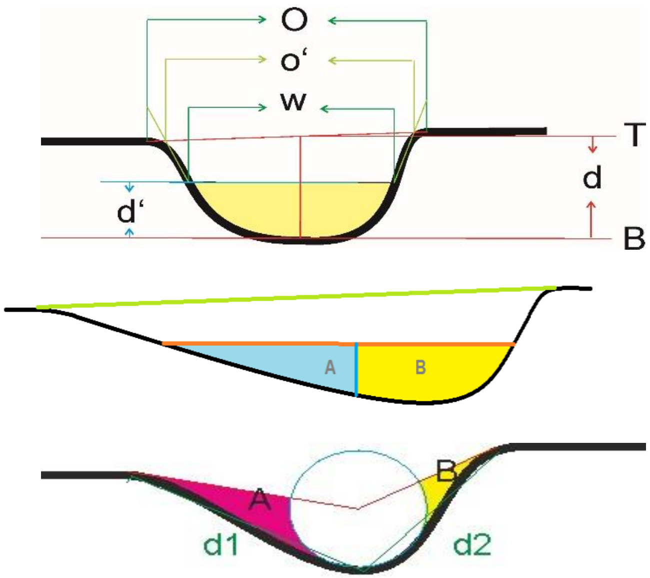


Control the Bead using CREASY

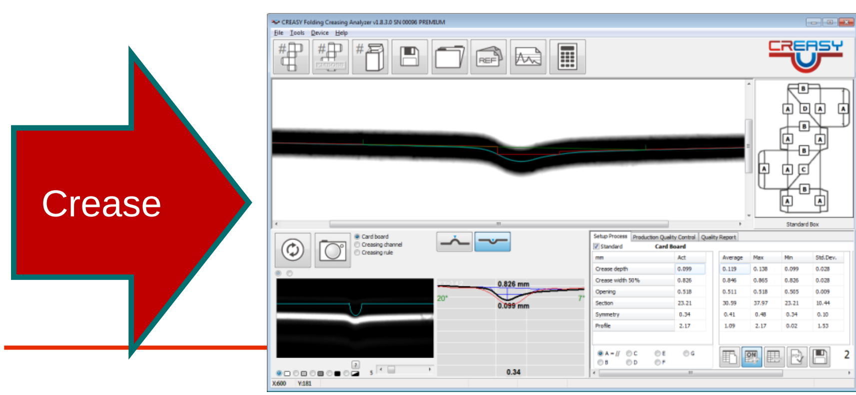
- Ad-hoc Control of Bead
- Define a box blank reference using the Box Editor
- Define a Standard using performing sample boxes
- Take measurements for a Job
- Create quality reports for the Job



If the bead can not be measured we measure the crease: POWER CREASE

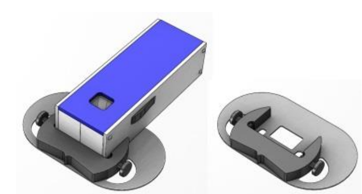


f1 = A/d1 f2 = B/d2
Profile = max(f1,f2)-min(f1,f2)



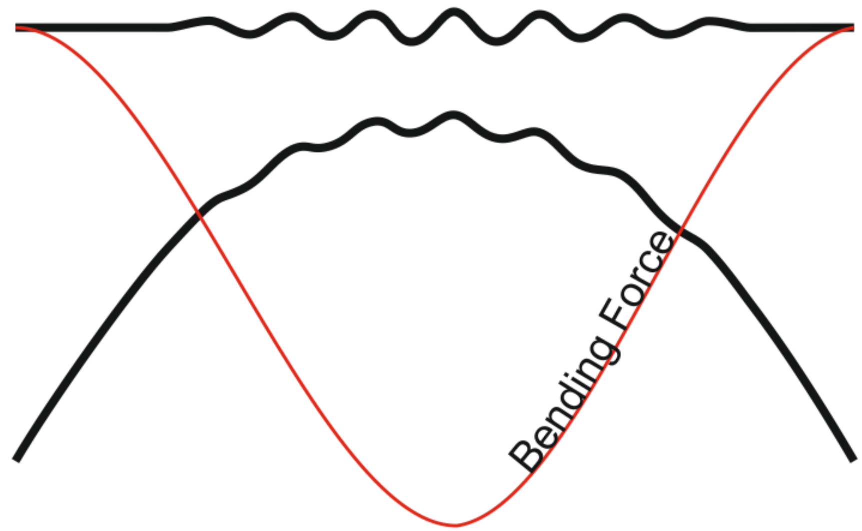
Measure crease width at half depth

- Crease Depth = d
- Half Crease Depth = d*50% = d‘
- Crease Width at half Depth = W
- Small Aperture = o‘-W
- Wide Aperture = O-W
- Cross Section = A+B
- Symmetry = B/(A+B)

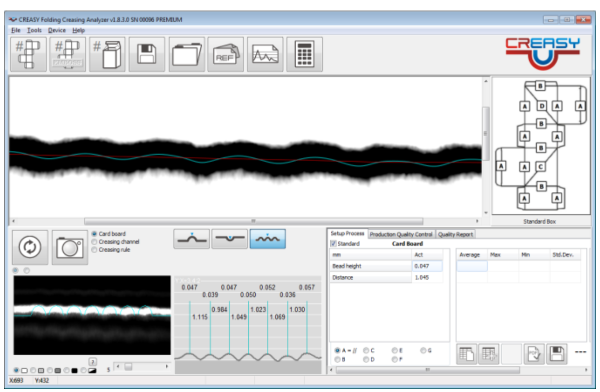


Round Corner – no sharp folding points

- Average Distance
- Average Height
- Displays individual Height



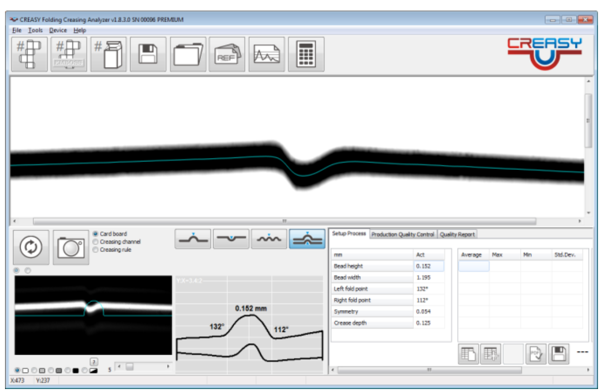
Round Corner

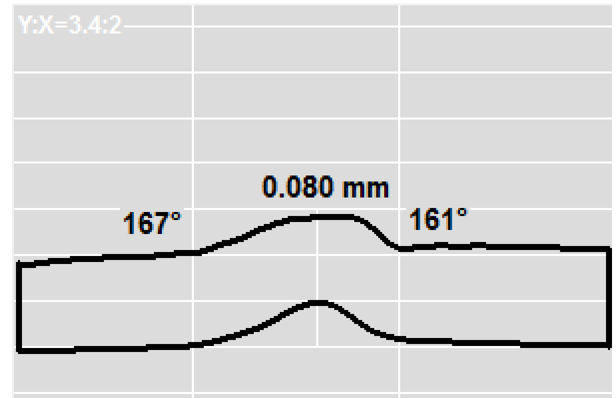


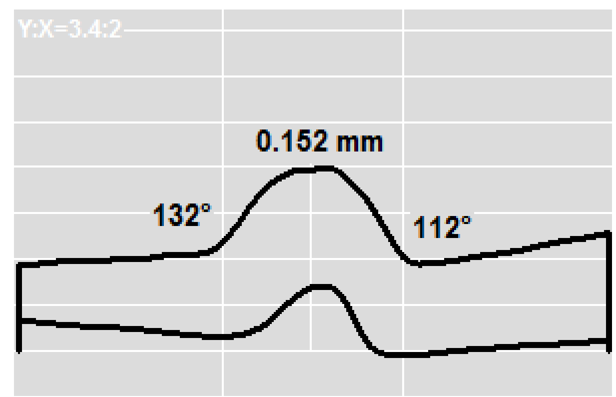
Check a cross section using CREASY

- Measure Bead
- Rotate sample by 180°
- Measure Crease
- Compare before and after pre-break

Cross Section

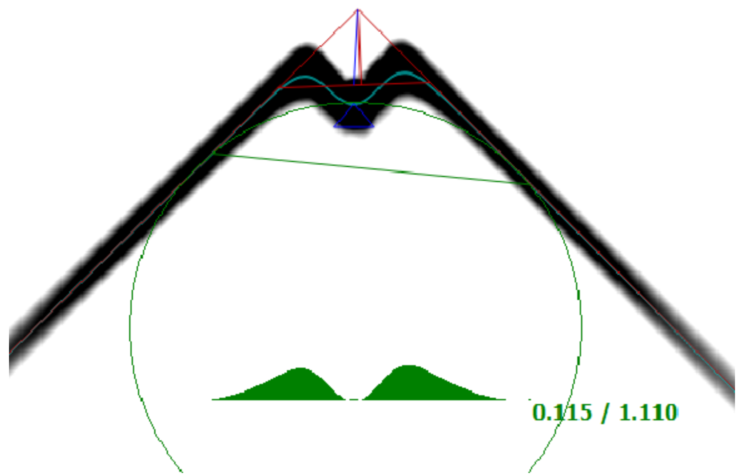




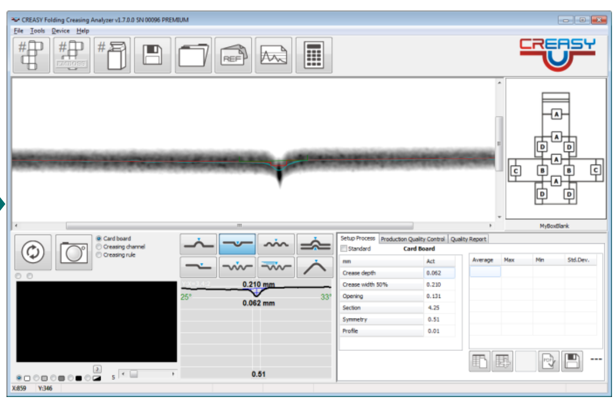


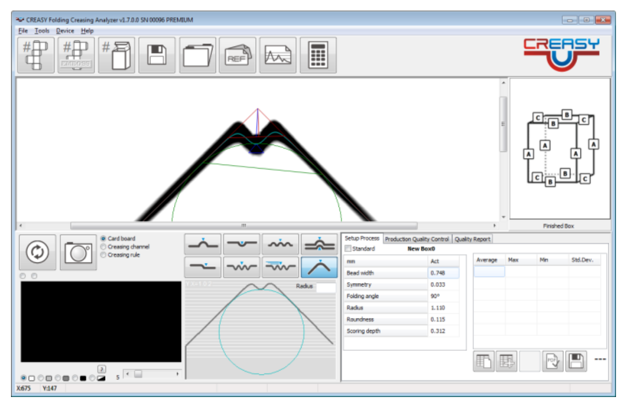
Scoring – (PowerBox)

- Material closes the scoring line in flat position
- Carefully fold the sample by 90°.
- Do not pull hard as the scoring area could extend easily



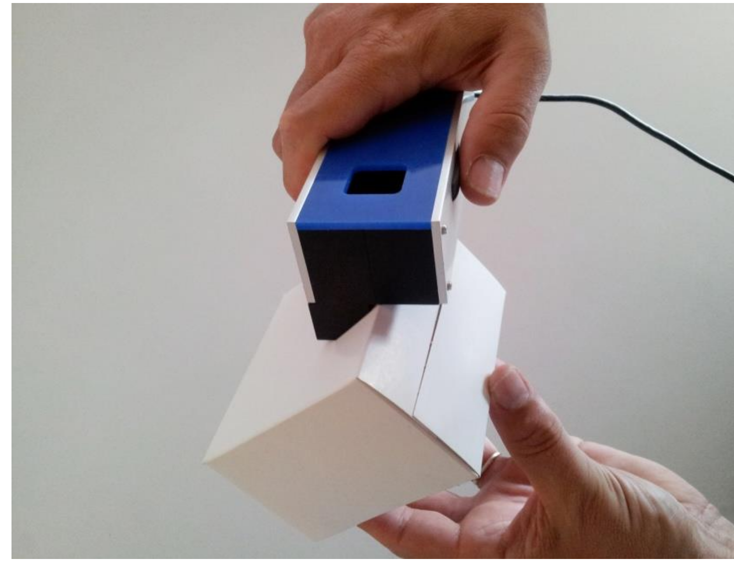
Scoring



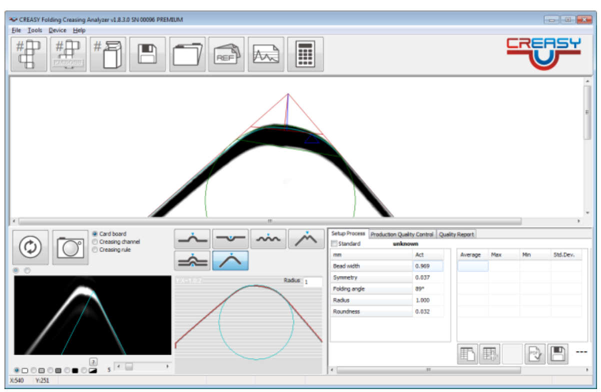


Check the finished box using CREASY

- The box angle is expected to be as sharp as possible
- The box angle is expected to be as symmetric as possible
- The angle between the folding panels is expected to be close to 90°



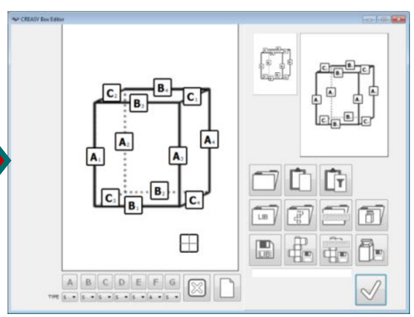
Folding

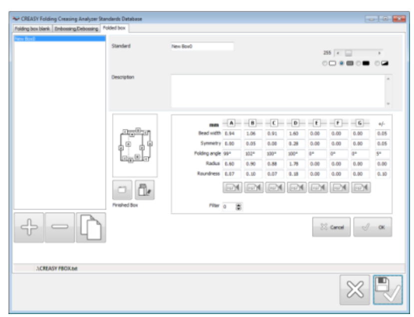


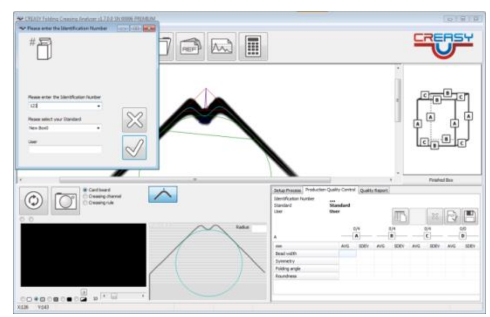
Control the finished box using the PowerBox Option

- Simple and repeatable positioning
- High repeatability
- Fast operation for large volumes
- Define references and tolerances
- Job Statistic

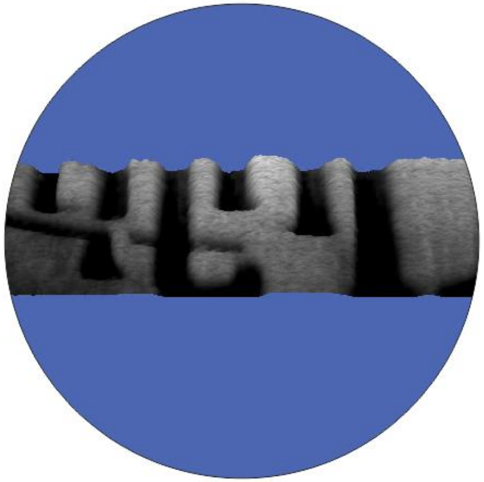
Power Box



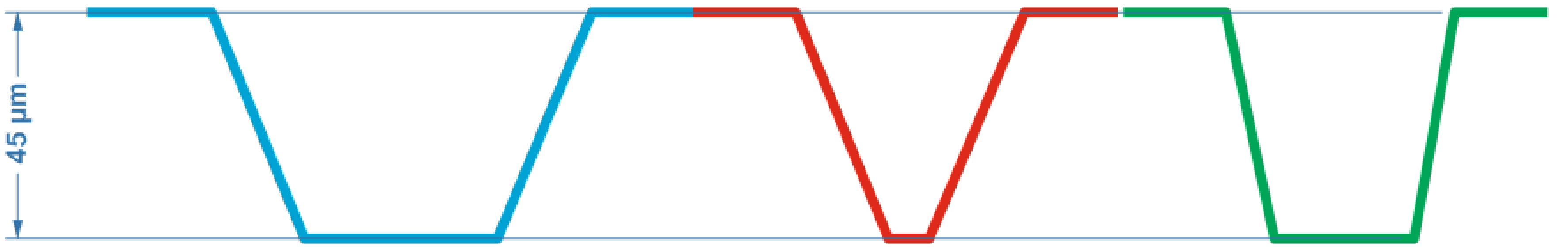




EMBOSSING



What is the depth of embossing?

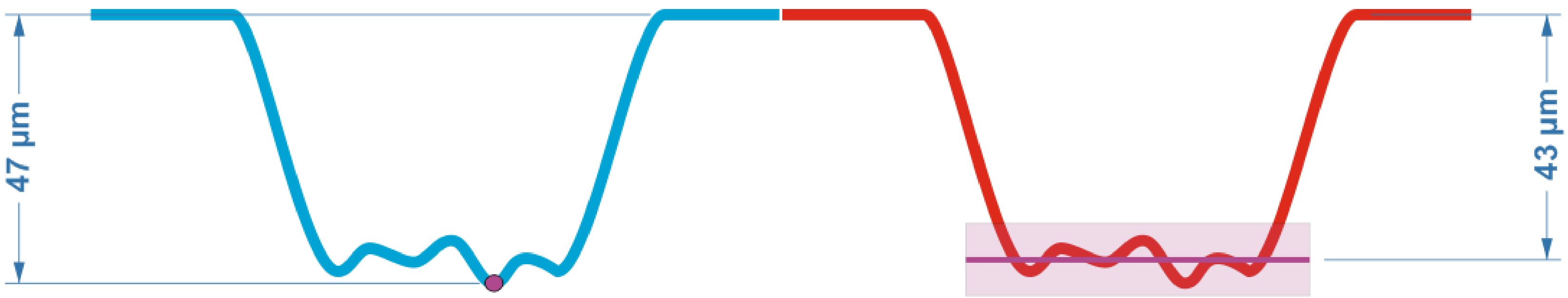


Any embossing depth measurement tool is expected to measure the **identical depth** for above three embossing samples

To measure a simple average of the entire area is not appropriate as it would deliver different depth numbers for every single sample

.

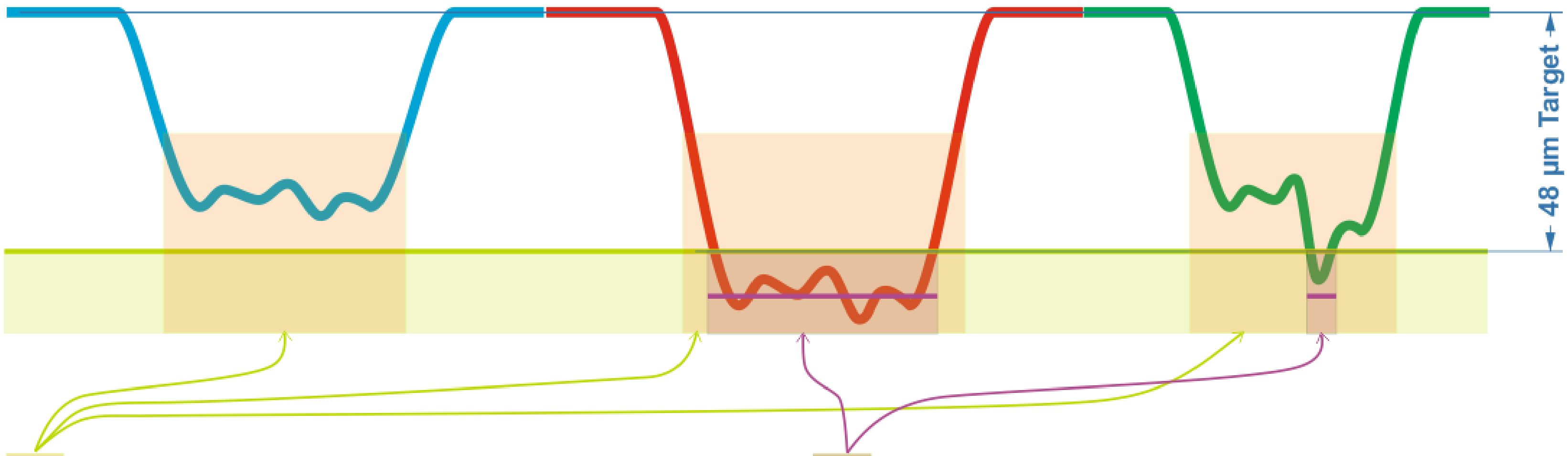
What is the depth of embossing?



Any embossing depth measurement tool is expected to measure the **average depth** of the bottom area

To measure the deepest point delivers a random value that can not be reproduced in a manufacturing environment

What is the depth of embossing?



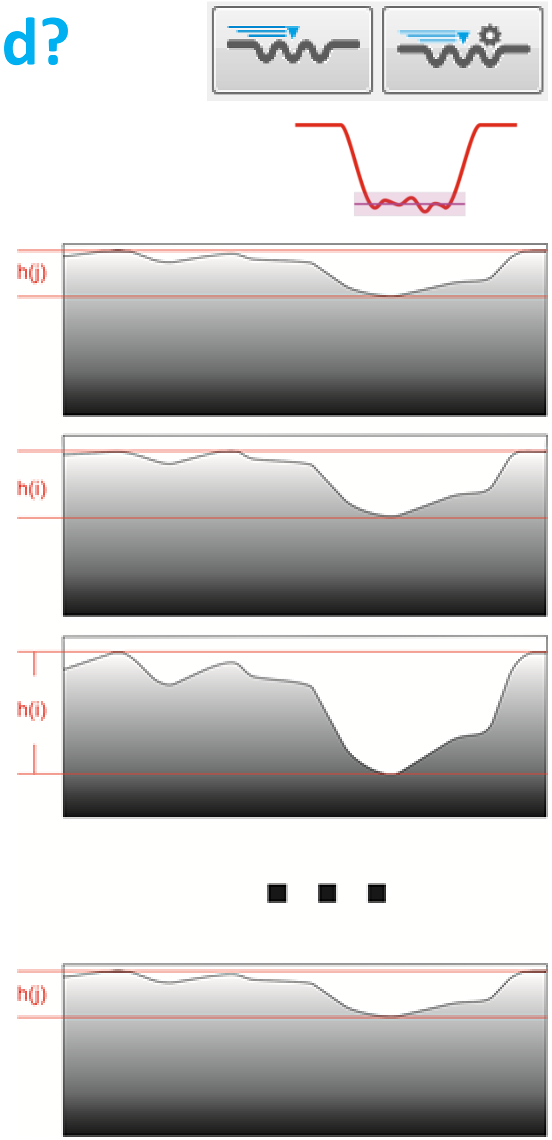
a : Area of interest (embossed area)

b : Area deeper or as deep as target

Area deeper than Target = 100 * (b / a) %

If a target depth is defined it is of interest to know the percentage of the embossed area that is deeper or as deep as the target

10% Max Embossing – how is it calculated?

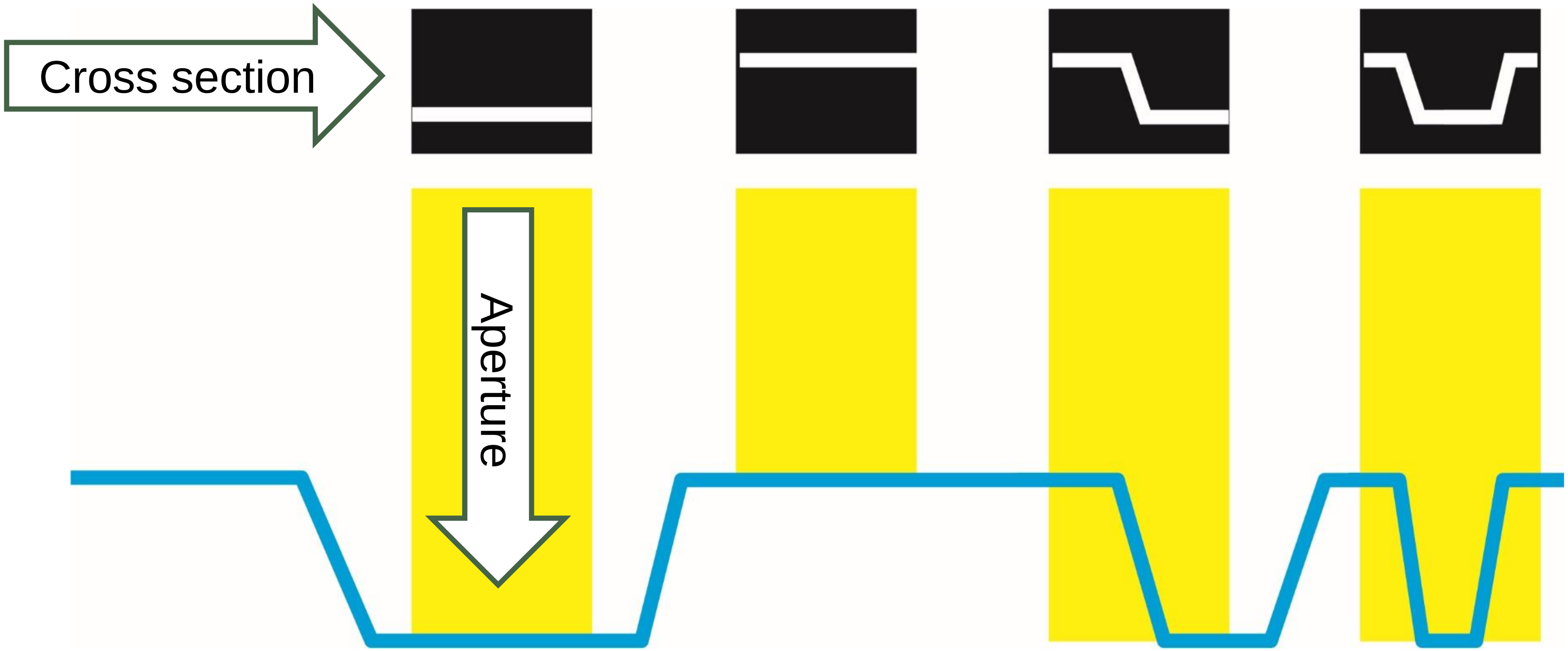


- CREASY captures up to 500 cross section images during one single scan.
- For every single cross section image the maximum difference in depth h(i) is calculated
- The average of the MAX% highest h(i) values is calculated and displayed
- The parameter MAX% can be set between 5% and 20%
- 5% will find the really deepest embossing – but small differences due to broken fibers will lead to variation in the measurement result
- 20% is very repeatable, but in case of smooth embossing edge it could show a lower value as expected

The cardboard surface reference

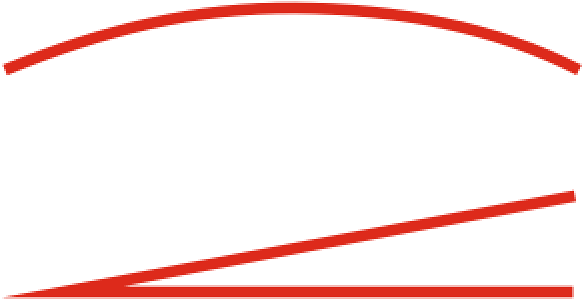
- Embossing Depth is a ratio between the embossed area and the surface area in a 3D terminology
- Any 3D measurement technology requires a zero (surface) reference on the Z-axis
- Because card board is a week, non flat, non stable material, there can not be taken an external absolute reference.
- **THE REFERENCE HAS TO BE TAKEN FROM THE CARDBOARD SURFACE!**

What happens if no surface reference is available?

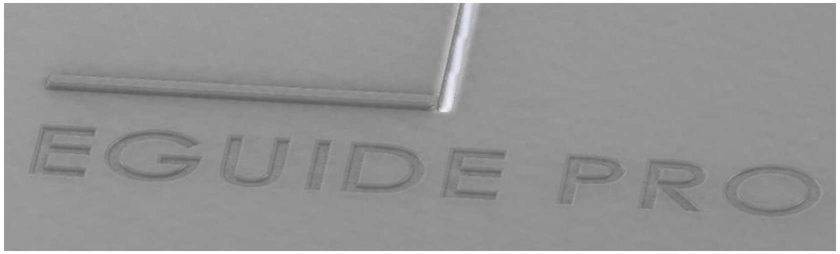


- The cross section shows the identical straight line in both cases
- The absolute 3D layer can not be calculated because no absolute reference is available.
- **THE REFERENCE HAS TO BE TAKEN FROM THE CARDBOARD SURFACE!**

The neighbourhood of embossing areas

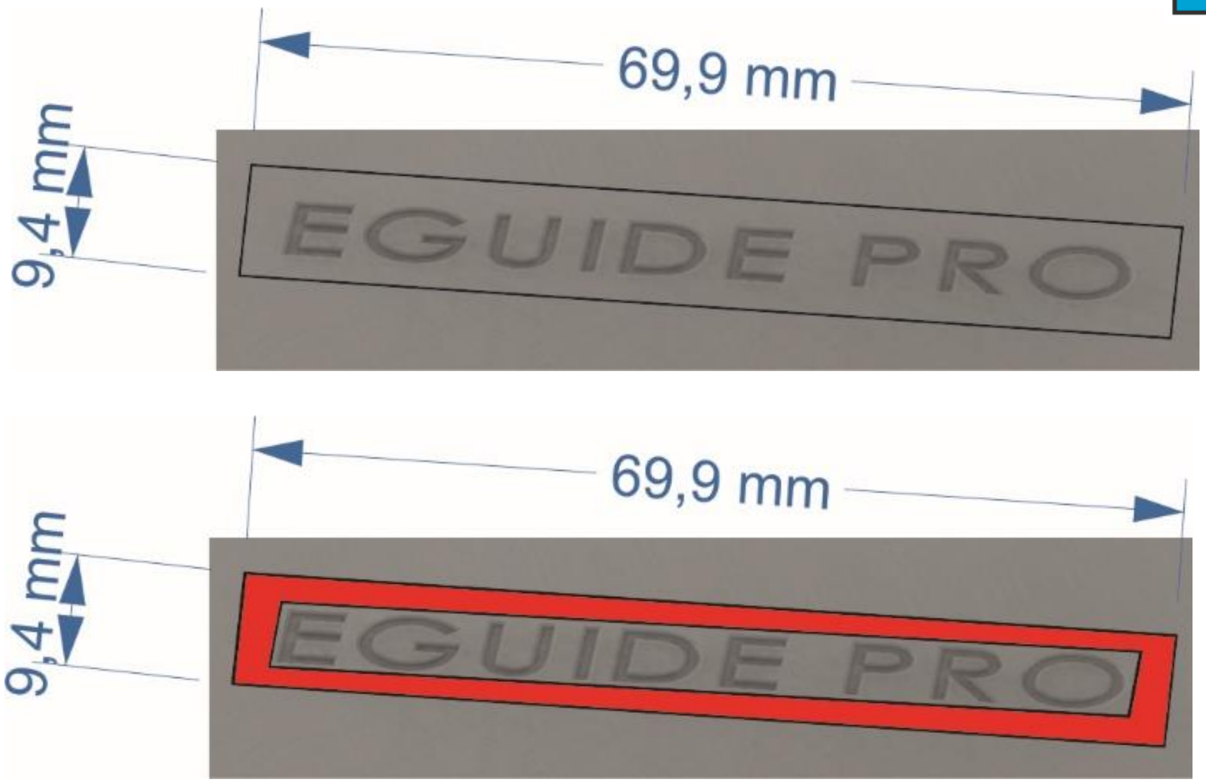


The CREASY is ‘flying’ over a 3D area changing its absolute orientation all the time



The availability of surrounding surface area inside the measurement area is a MUST!

Substrate reference best case scenario



- There exists surface reference all around the embossed area.
- Any single cross section image can be surface calibrated

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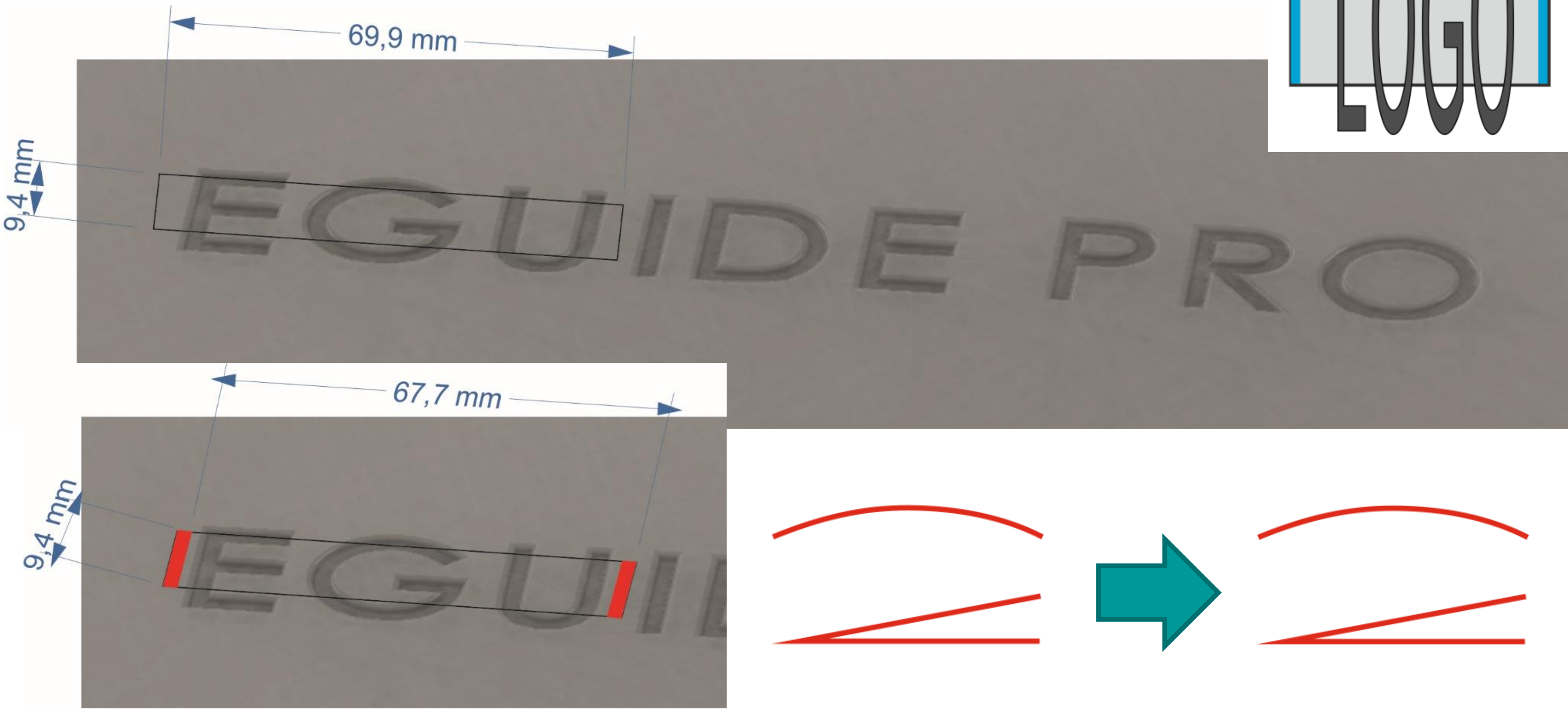
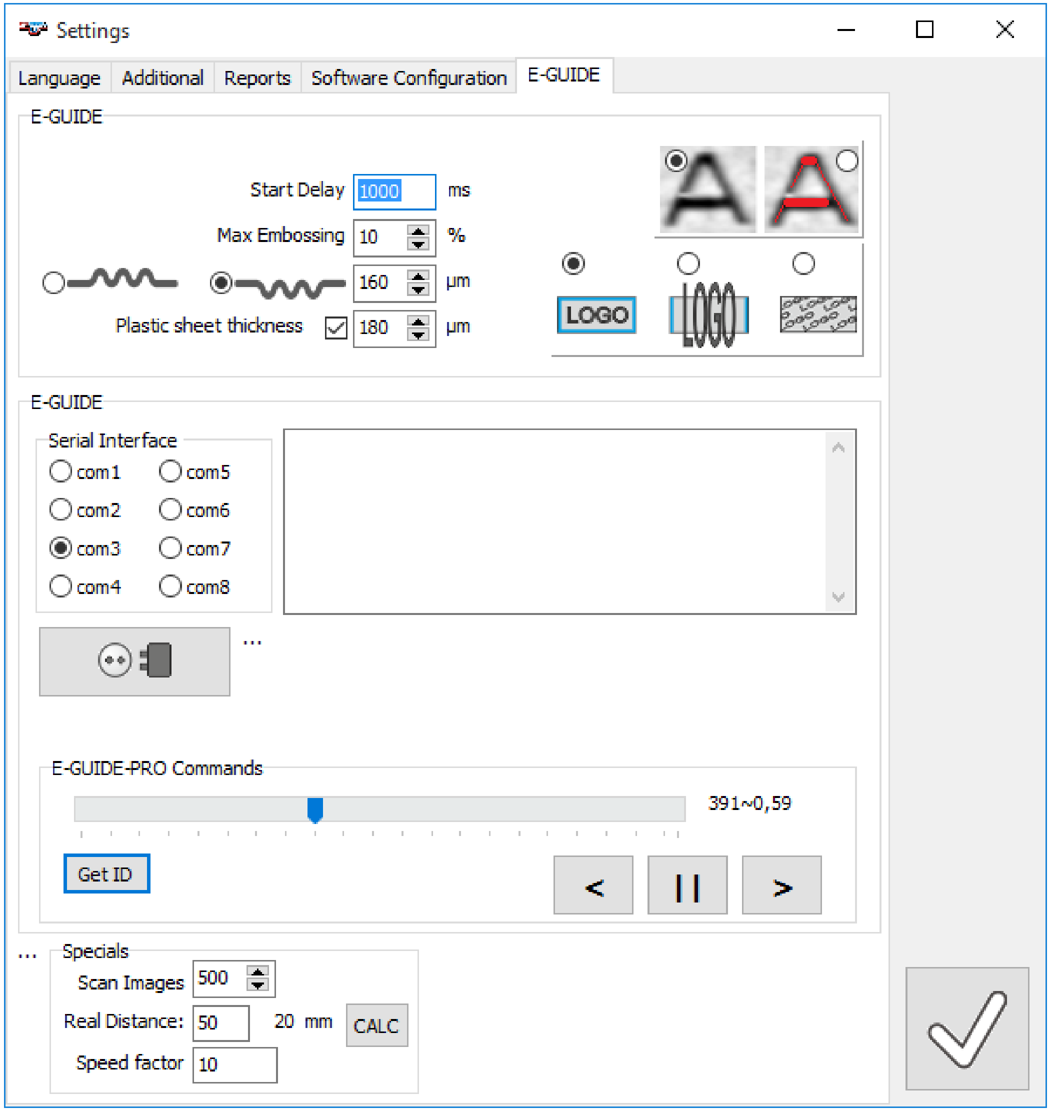
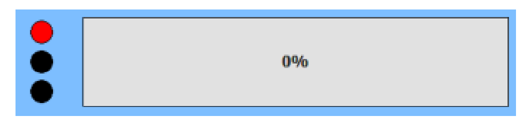
Substrate reference alternative scenario



- There exists surface reference at the beginning and at the end of the embossed area.
- Any single cross section image can be calibrated by linear interpolation between the two reference areas

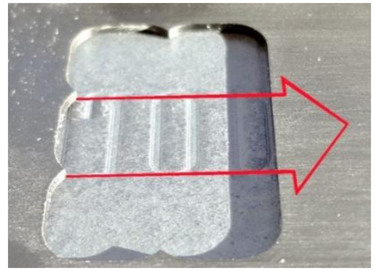
EGUIDE-PRO to control the Embossing



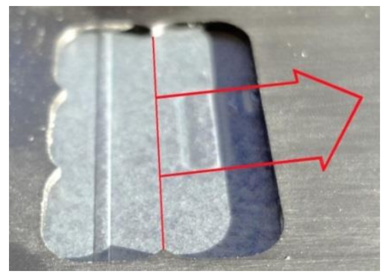


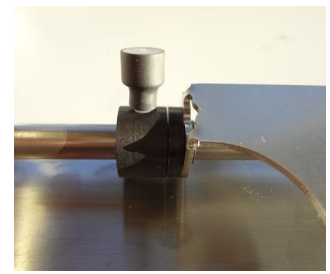
Setup measurement positions in 3 steps

- Center Vertically

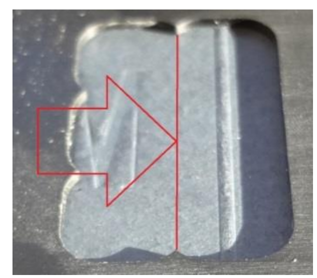


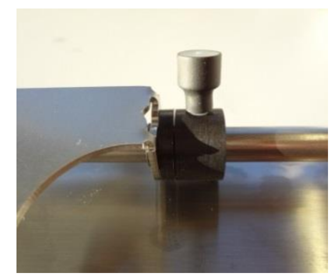
- Start Point





- End Point





- Distance
- (EGUIDE-PRO)

What exaclty needs to be corrected and how is this done?

- The box blank can show different distorion on every single side.
- The distortions do not need to be equal left and right or top and bottom
- Having a reference on all 4 sides will leed to the most precise calculation of the physical surface plane

What exaclty needs to be corrected and how is this done?

- The reference surface at the starting point of the scanning is used to compensate the distorion at the left side
- Just having the starting surface reference could not be enough in many cases

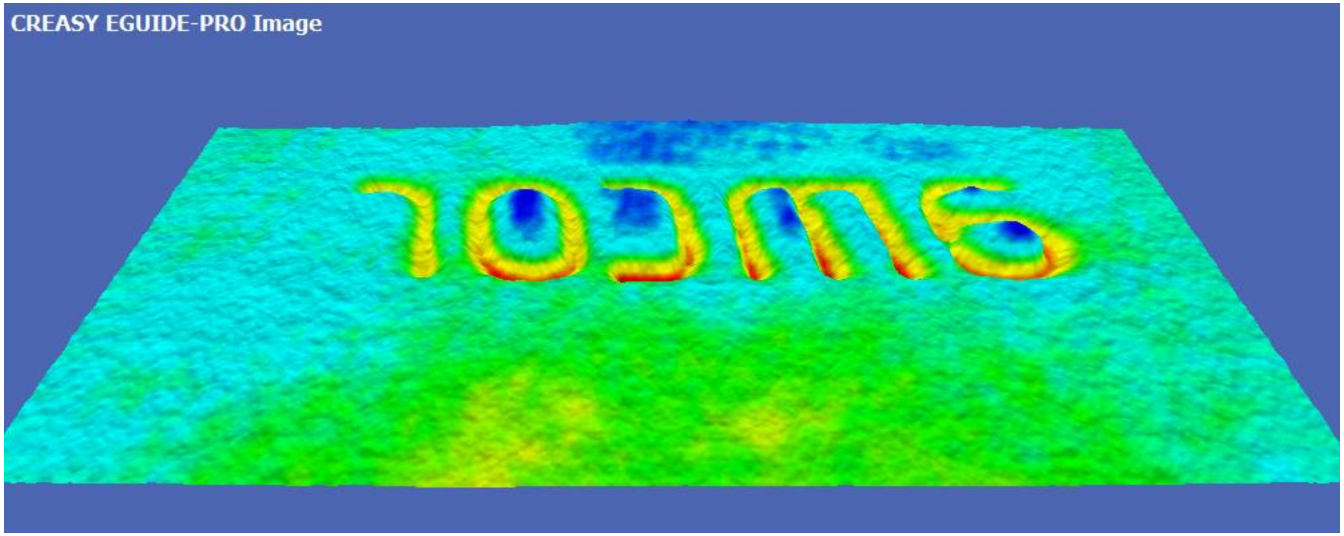
What exaclty needs to be corrected and how is this done?

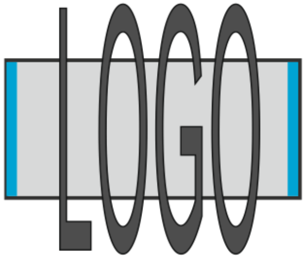
- Having a surface reference at the beginning and at the end of the scan will lead to a compensation of the major distortions.
- Hight differences are obtained across the scanning direction. Therefore the compensation of left and right distortions are important for the measurement result

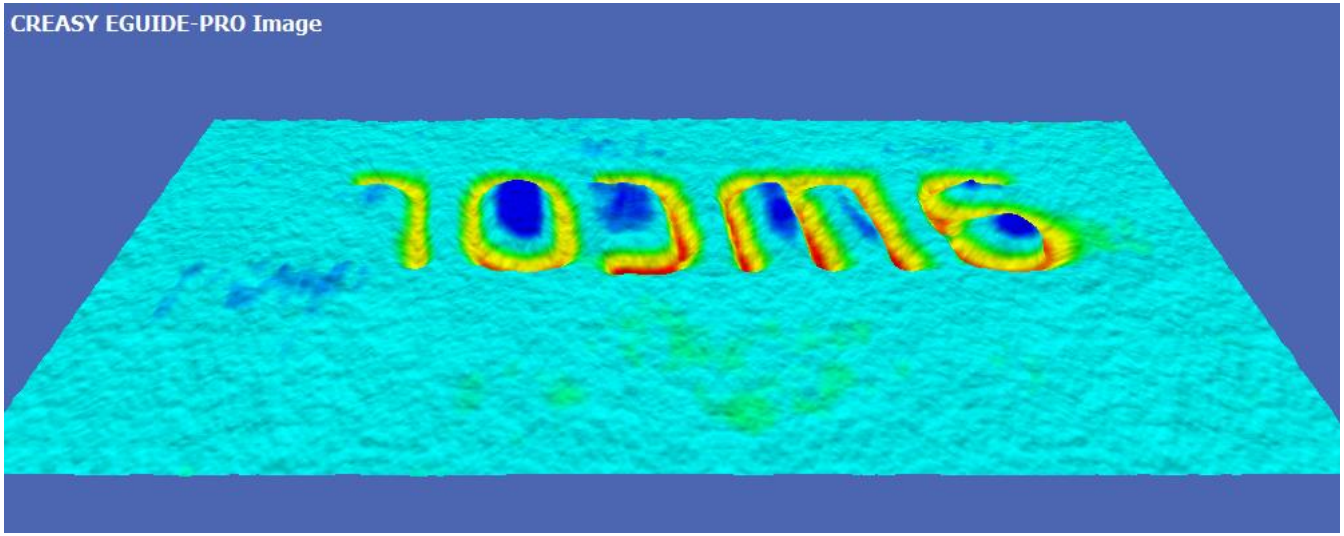
What exaclty needs to be corrected and how is this done?

- In case there is availlable surface reference all around the embossed area, the surface plane can be perfectly aligned to a flat plane.

What exaclty needs to be corrected and how is this done?



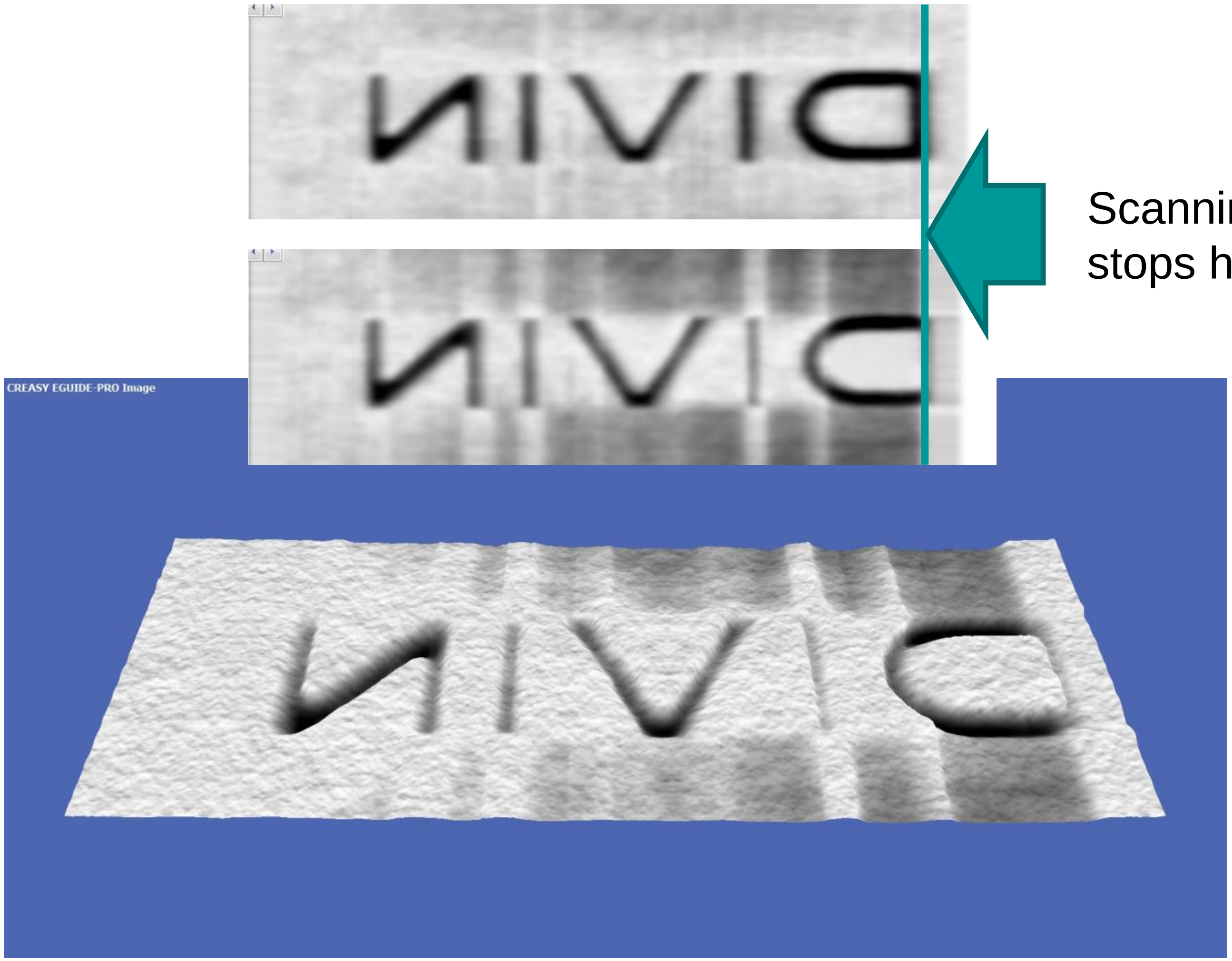




How it looks like if both, i.e. starting and ending surface reference are valid

LOGO

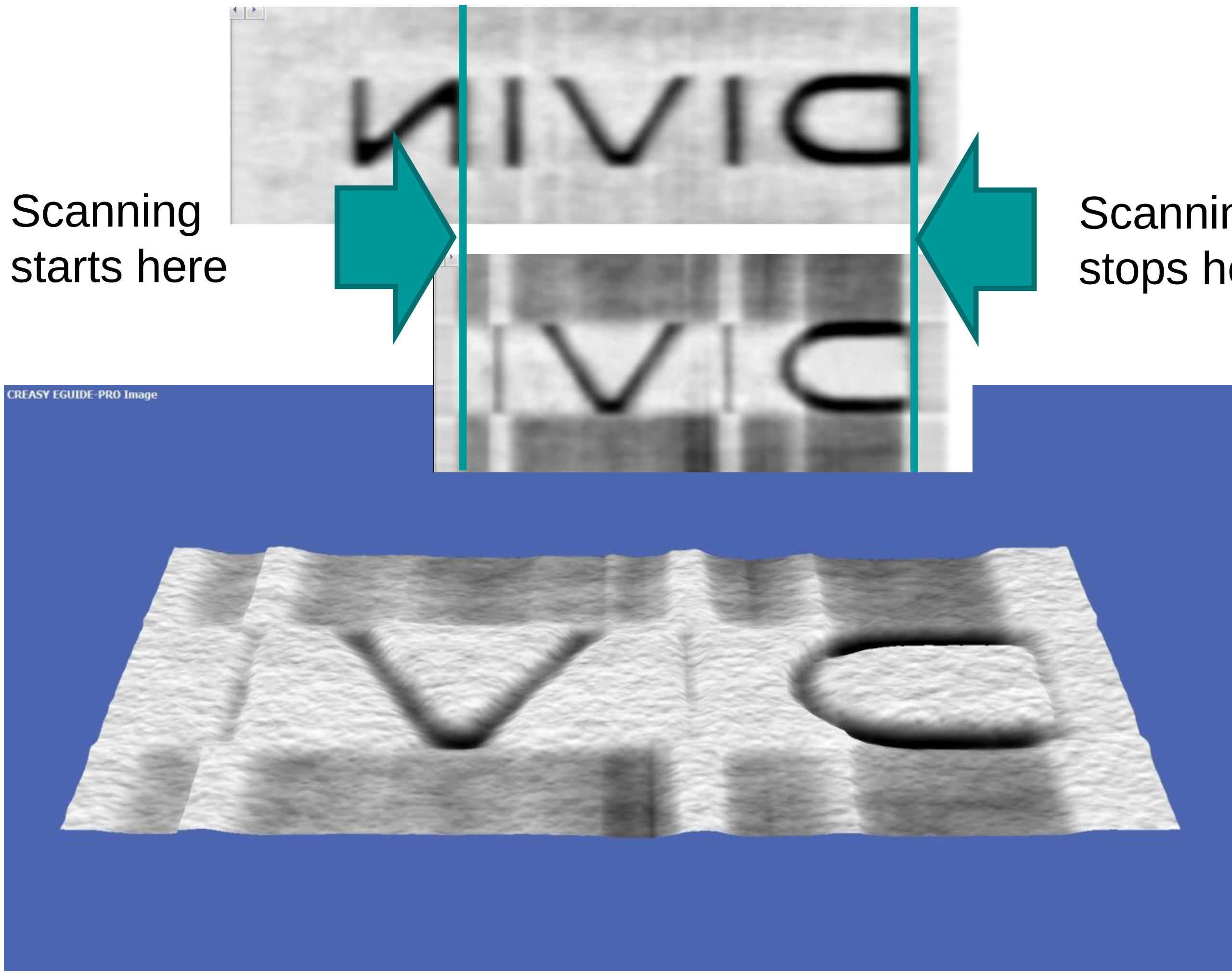
How it looks like if at the end of the scan there is no valid surface reference available



Scanning stops here

LOGO

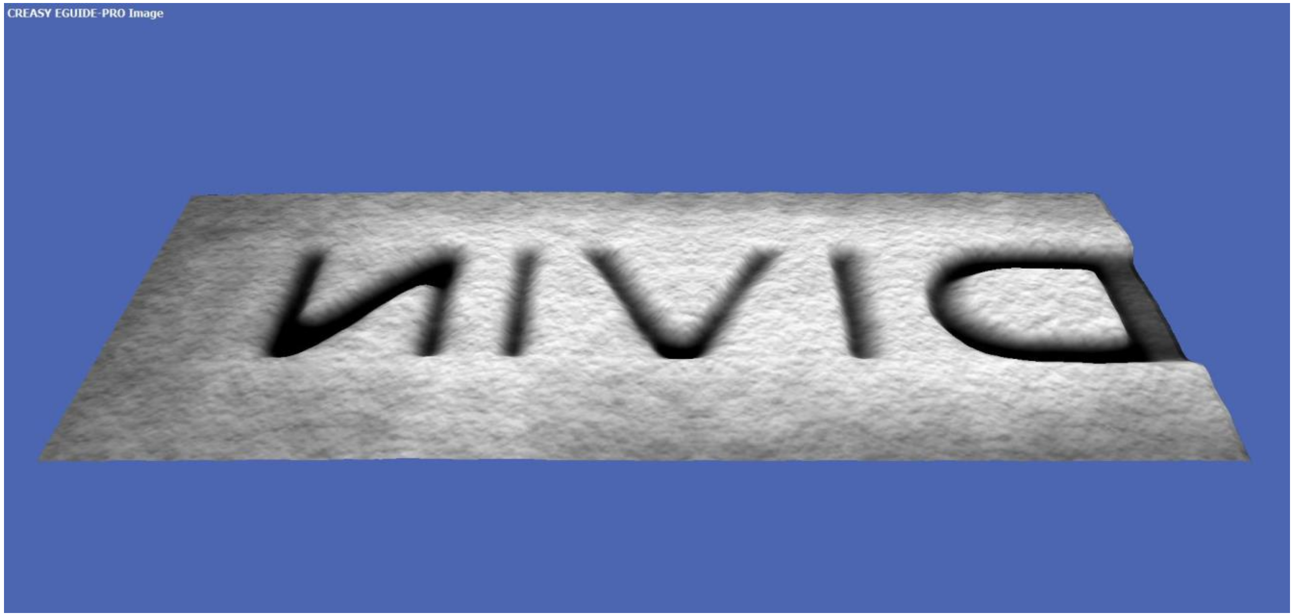
How it looks like if there is no valid surface reference at the beginning an no valid surface reference at the end



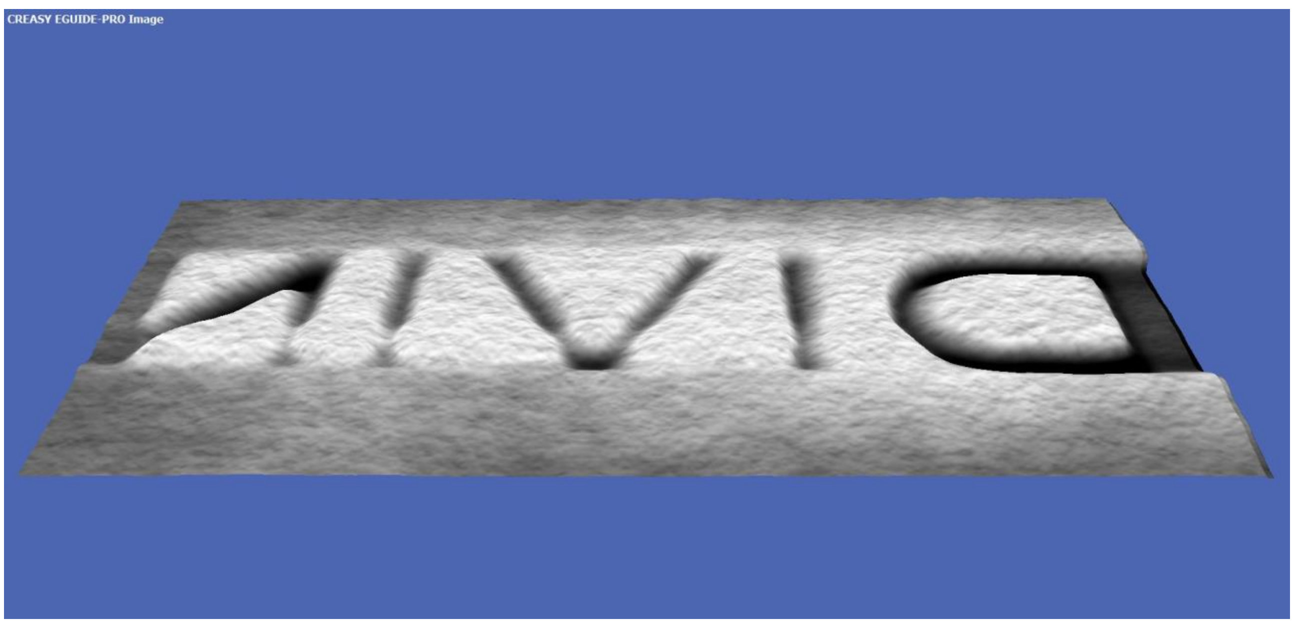
LOGO

How it looks like if both, i.e. starting and ending surface reference are valid

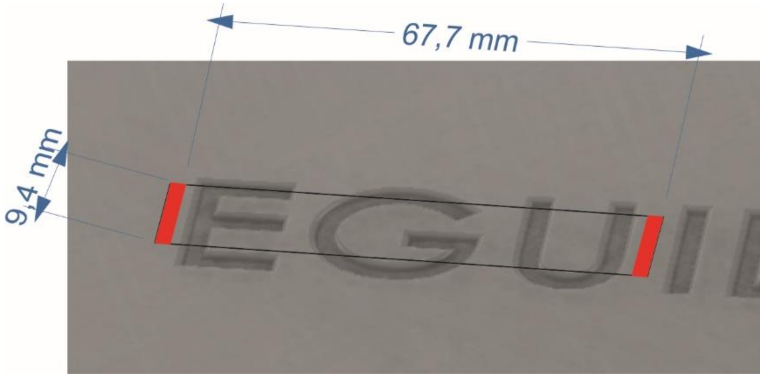
How it looks like if at the end of the scan there is no valid surface reference available

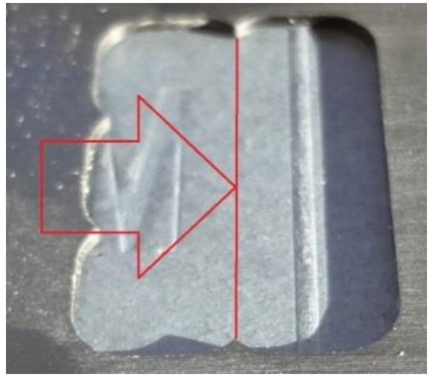


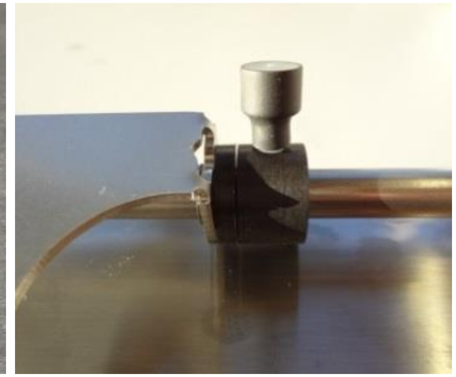
How it looks like if there is no valid surface reference at the beginning an no valid surface reference at the end



Setup end positions for EGUIDE PRO





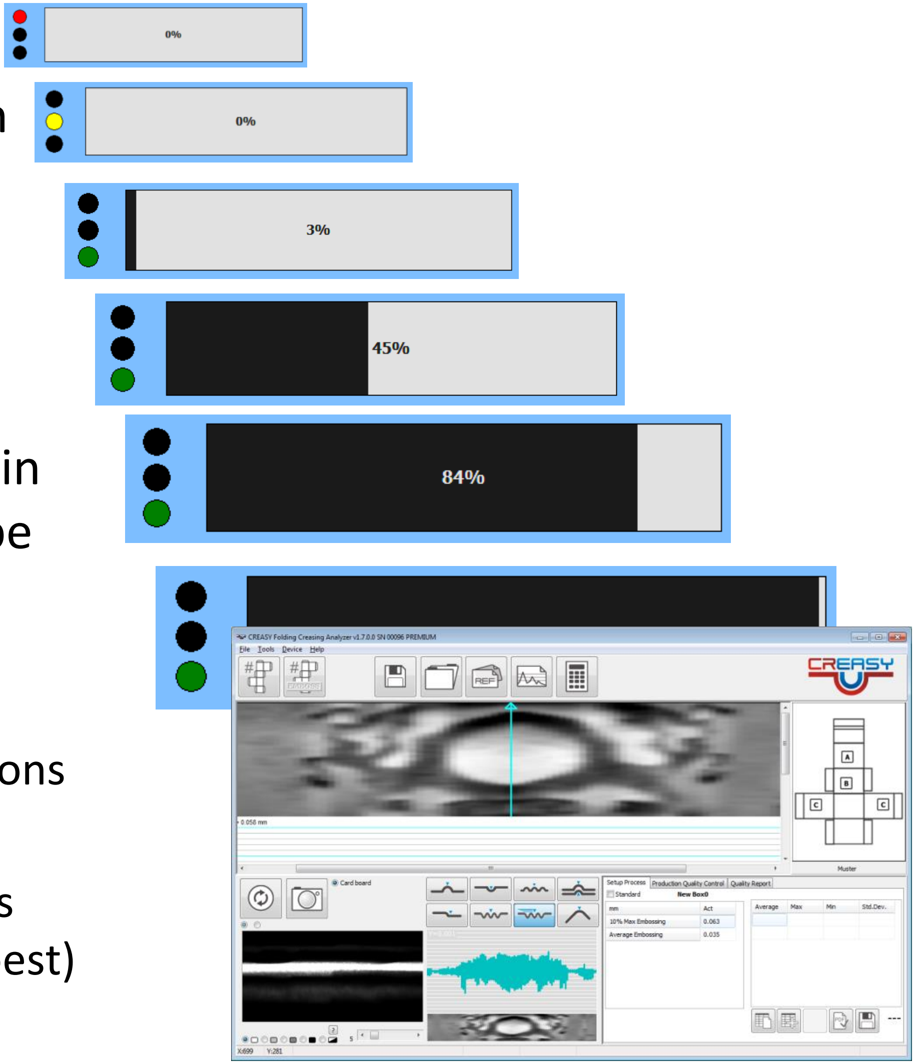


Scanning distance 30 mm

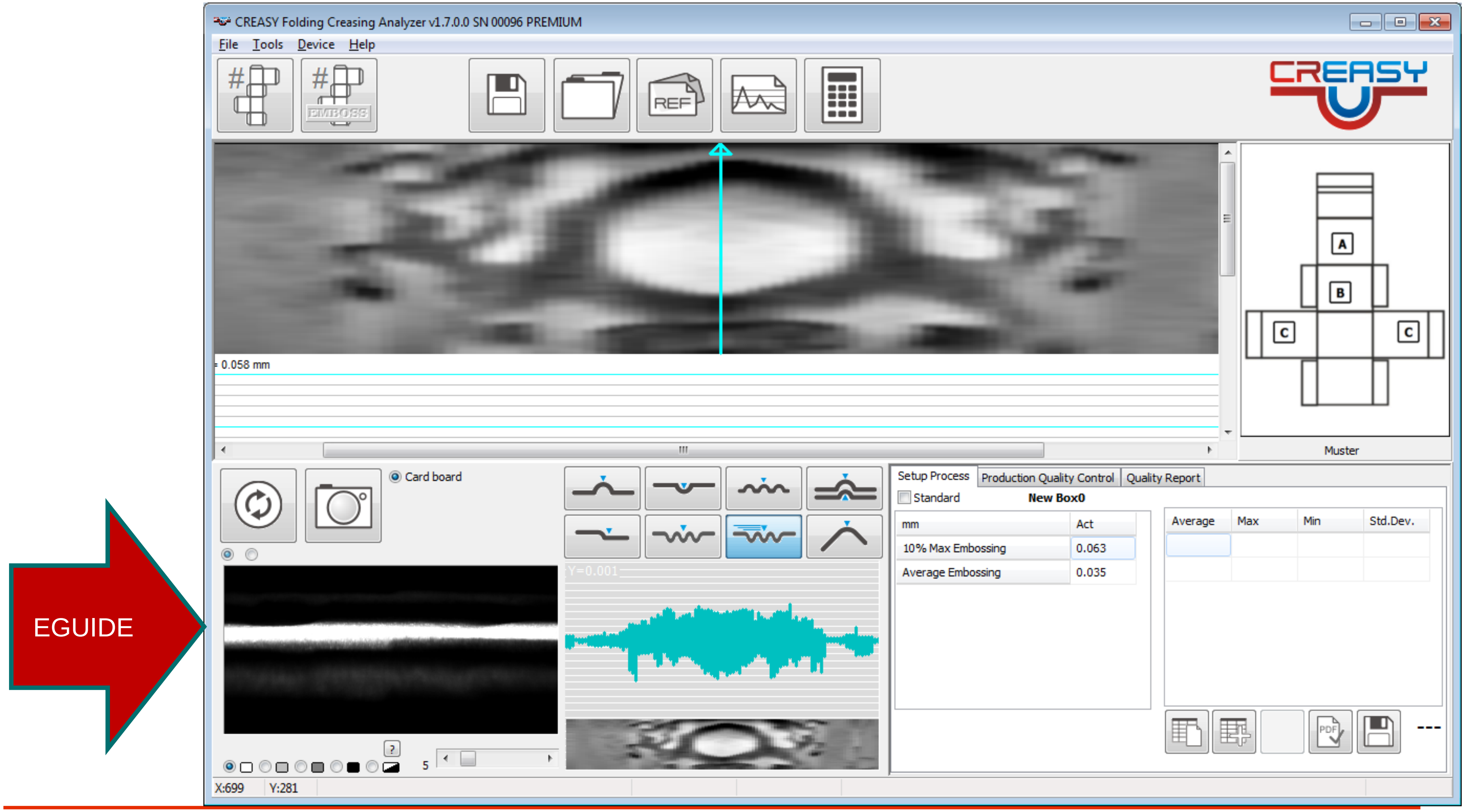
- Use the end block to make sure the last cross section image is captured on the card board surface
- Insert a scanning distance equal or typically slightly longer than the real distance. The EGUIDE-PRO will stop anyway when it does reach the end block
- This will guarantee an identical scanning distance all the time independent of your temporary computer performace

Measure Embossing using E-GUIDE

- Position the box blank
- Move the device to the start position
- Press the measurement button
- Wait until the traffic light gets green
- Move the device over the box blank according to the bar on the screen – in case of EGUIDE-PRO the device will be moved automatically
- The software automatically creates
  - a 3D image based on 200 cross sections with 1280 measurements each
  - and calculates the Embossing value as the average of the 10% highest (deepest) areas

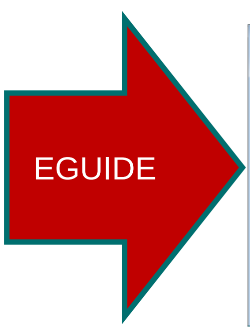


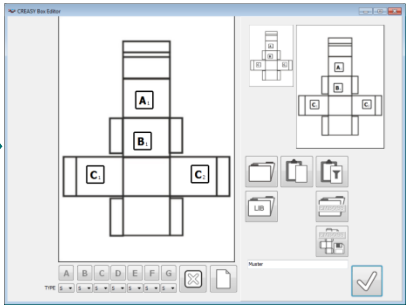
Ad-hoc measurement with EGUIDE-PRO

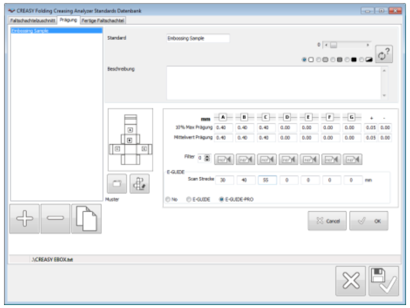


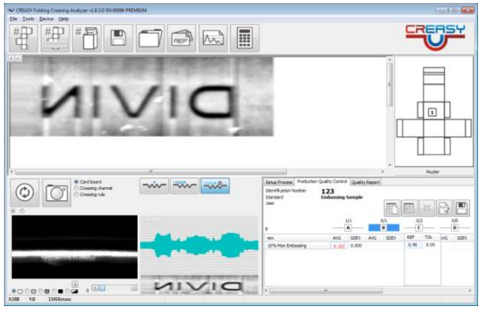
Job control with EGUIDE-PRO

- Box Editor
- Define reference numbers and tolerances
- Measure a box
- Create reports and job reports



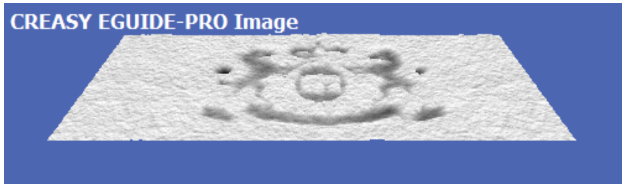


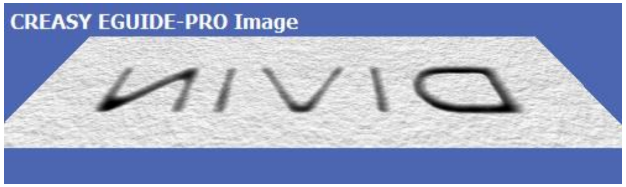




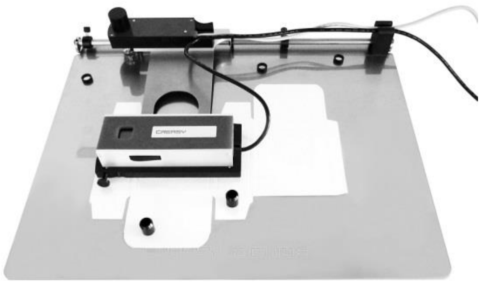
EGUIDE PRO Inter Instrument Agreement

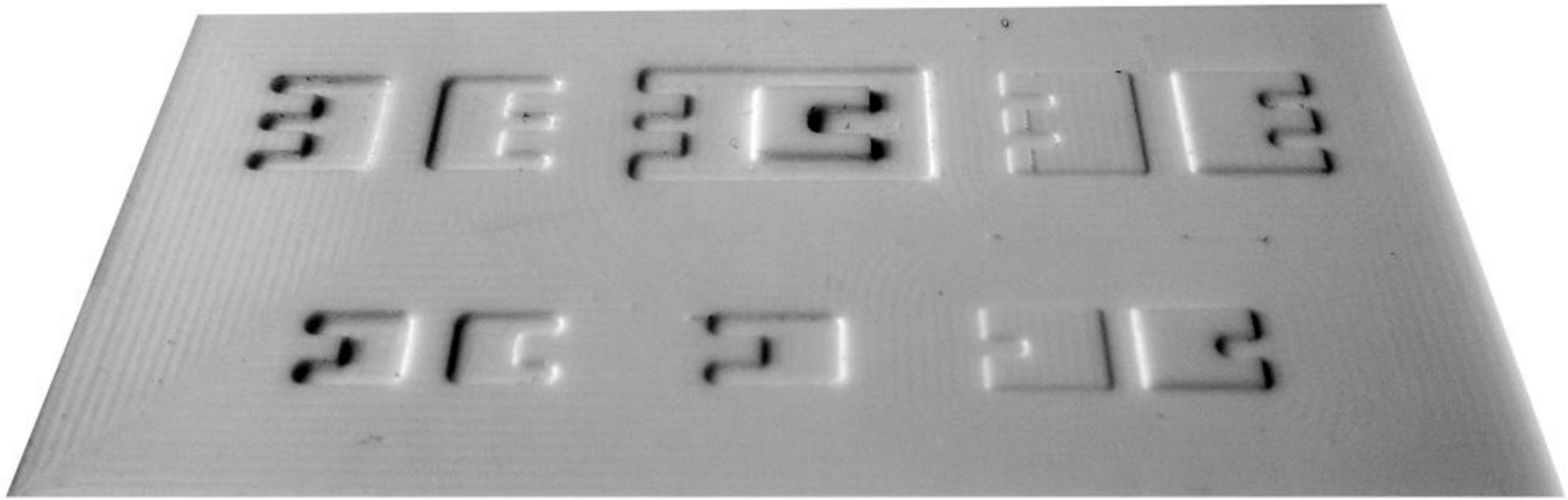
	µm	PVC-SLOPE	PVC-SLOPE	Marlboro	PMI Logo	DIVIN
	FILM	100	100	180	180	180
	REF	51	198	|...|	|...|	|=|
	Device	40mm	40mm	40mm	20mm	25mm
1	**00096**	51	198	88	72	113
2	**00356**	51	198	88	71	113
3	**00358**	50	198	87	69	113
4	**00359**	50	198	86	69	113
5	**00360**	51	198	86	69	111
6	**00361**	51	198	88	68	113
7	**00362**	50	198	88	71	111
8	**00363**	50	199	85	69	112
9	**00364**	51	197	85	68	111
10	**00365**	50	198	88	70	112
11	**00366**	50	198	87	71	112
12	**00367**	51	198	87	70	113
13	**00368**	51	199	85	71	112
	Max-Min	**1,0**	**2,0**	**3,0**	**4,0**	**2,0**
	StdDev	**0,5**	**0,5**	**1,2**	**1,3**	**0,8**
	AVG	**50,5**	**198,1**	**86,8**	**69,8**	**112,2**





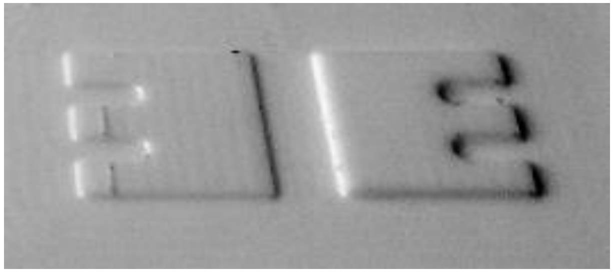
FAG CREASY EGUIDE PRO
Embossing Patch





Terminology

- **Embossing :** whatever is at least 0.020mm higher than the card board surface

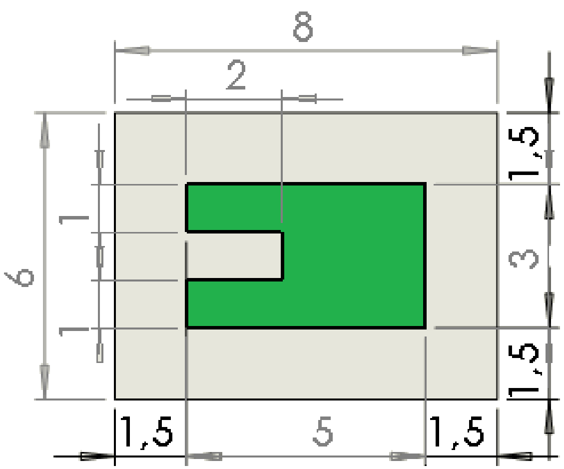


- **De-bossing :** whatever is lower than the card board surface

What are the criterias that need to be considered

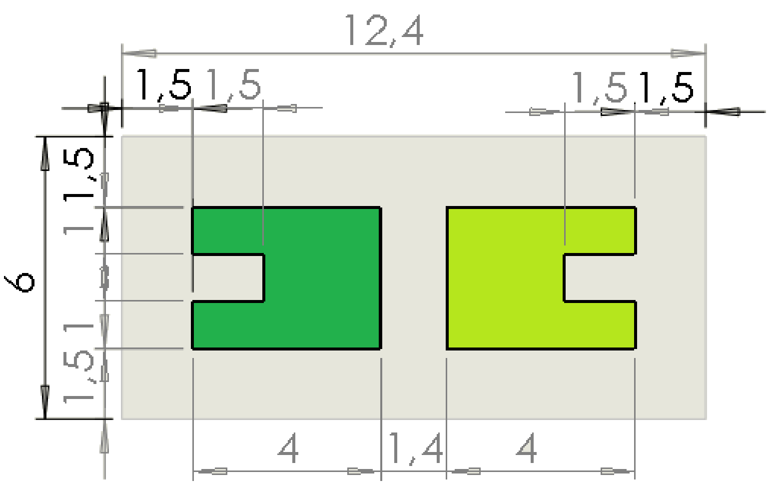
- Size:
  - Space: Small to fit into small spaces at the gluing areas of the box
  - Embossing area: Large enough to be representative for embossing forces
- Embossing Depth – Debossing Height
  - Small Lines: Large areas need more depth than small ares for the same tactile effect
- Embossing – De-bossing
  - Embossing – De-bossing separately
  - What happens if inside an embossed area theres is a de-bossed area

CREASY Embossing Patch A
Design criteria: SMALL SIZE



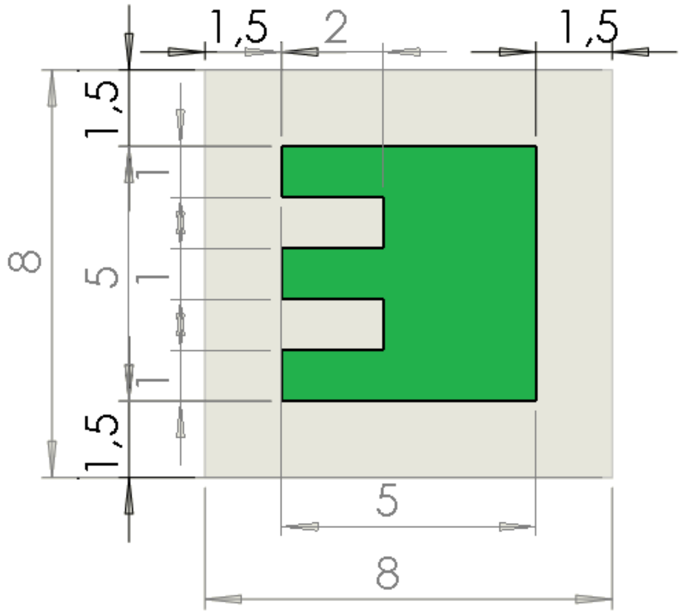
- Space required: 6mm x 8mm
- Embossing area: 13mm²
- Embossing **OR** De-bossing
- 2 small line areas of 1mm x 2mm
- 1 invers small line area of 1mm x 2mm

CREASY Embossing Patch B
Design criteria: SIZE + DOUBLE DEPTH



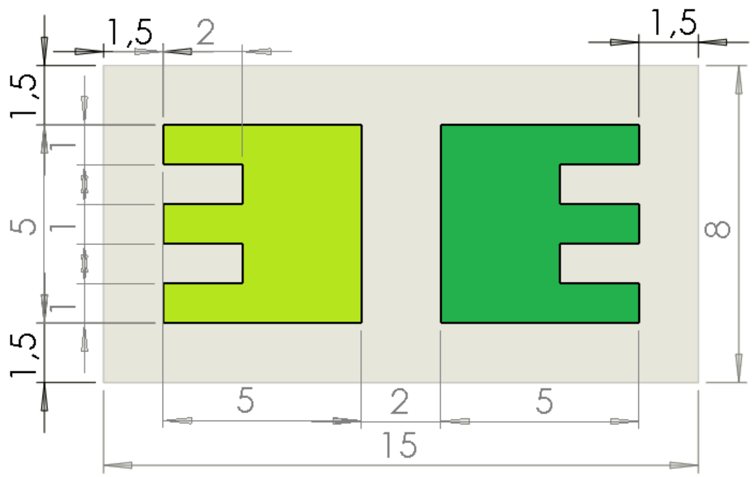
- Space required: 6mm x 12,4mm
- Embossing area: 26mm²
- Embossing **OR** De-bossing
- 4 small line areas of 1mm x 1,5mm
- 2 invers small line area of 1mm x 1,5mm

CREASY Embossing Patch C
Design criteria: SIZE : EMBOSSING AREA



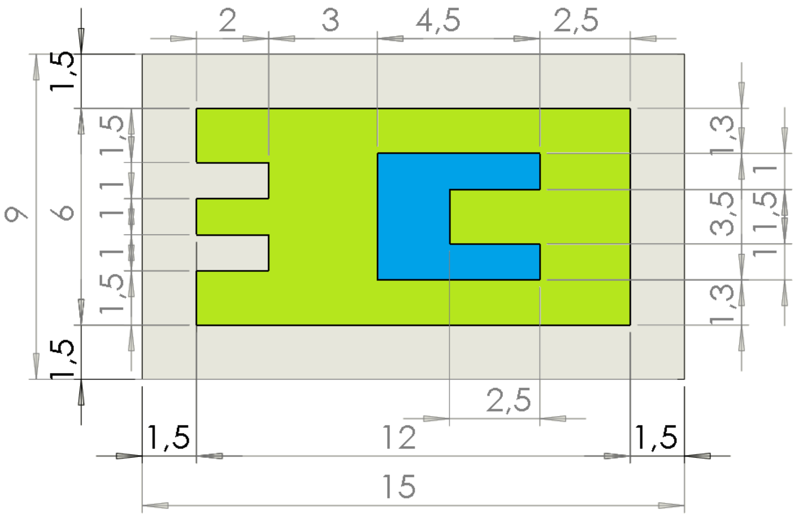
- Space required: 8mm x 8mm
- Embossing area: 21mm²
- Embossing **OR** De-bossing
- 3 small line areas of 1mm x 2mm
- 2 invers small line area of 1mm x 2mm

CREASY Embossing Patch D
Design criteria: SIZE : EMBOSSING AREA DOUBLE DEPTH



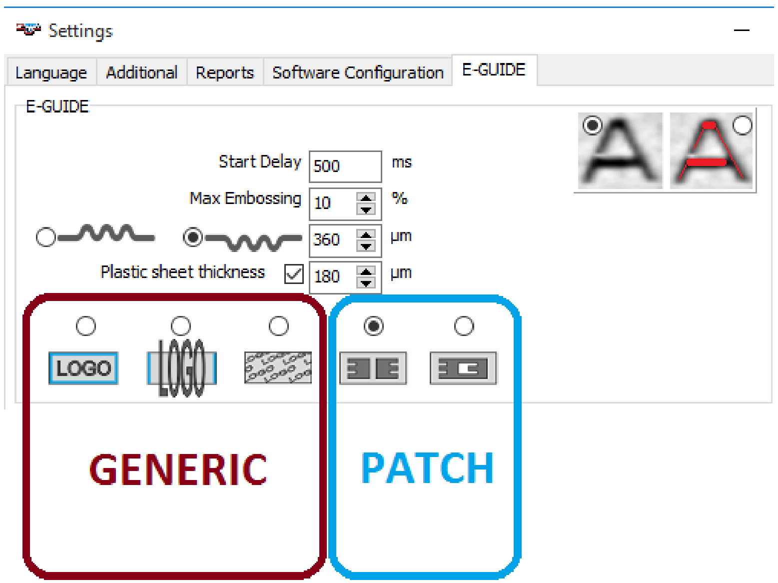
- Space required: 8mm x 15mm
- Embossing area: 42mm²
- Embossing **OR** De-bossing
- 6 small line areas of 1mm x 2mm
- 4 invers small line area of 1mm x 2mm

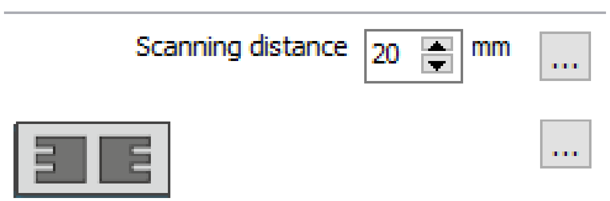
CREASY Embossing Patch E
Design criteria: EMBOSSING + DEBOSSING

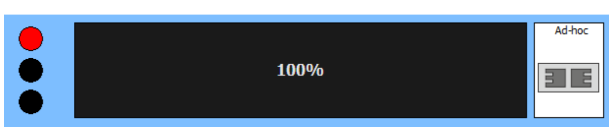


- Space required: 9mm x 15mm
- Embossing area: 56,5mm²
- De-bossing area: 15,5mm²
- Embossing **AND** De-bossing
- 2 small line areas of 1.5mm x 2mm
- 2 invers small line area of 1mm x 2mm
- 2 small de-bossing lines 1mm x 2.5mm

FAG CREASY SOFTWARE MODIFICATION

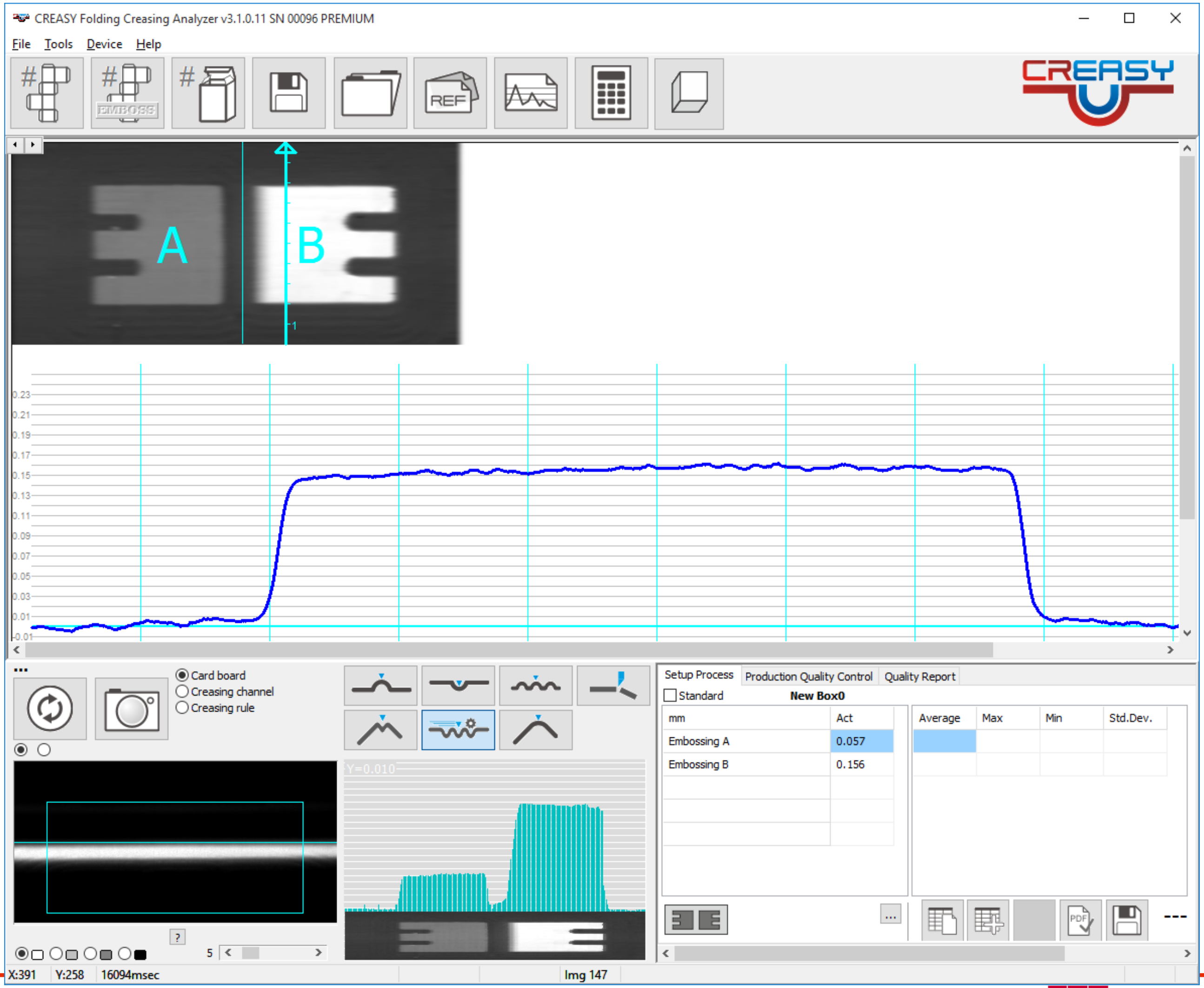




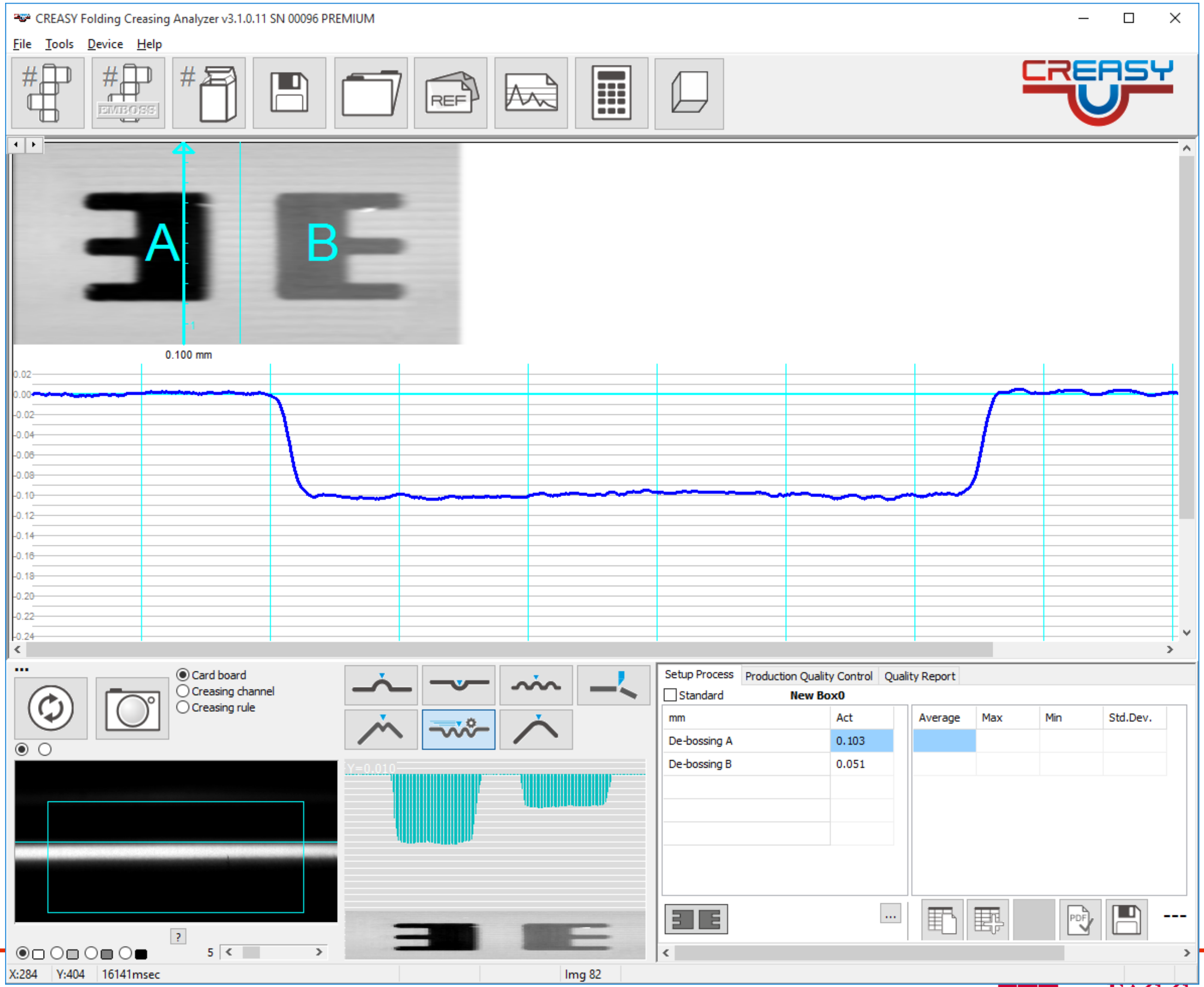


- Beside the three generic embossing algorithms there have been implemented two specific patch analysis algorithm.
- Patch Analysis ignore the following parameter settings using fixed settings instead:
  - Max Embossing
  - Embossing/Debossing Depth
  - Scanning Distance
- The main screen shows the selected Patch in case of Patch measurement.
- The progress bar shows the selected Patch in case of Patch measurement.

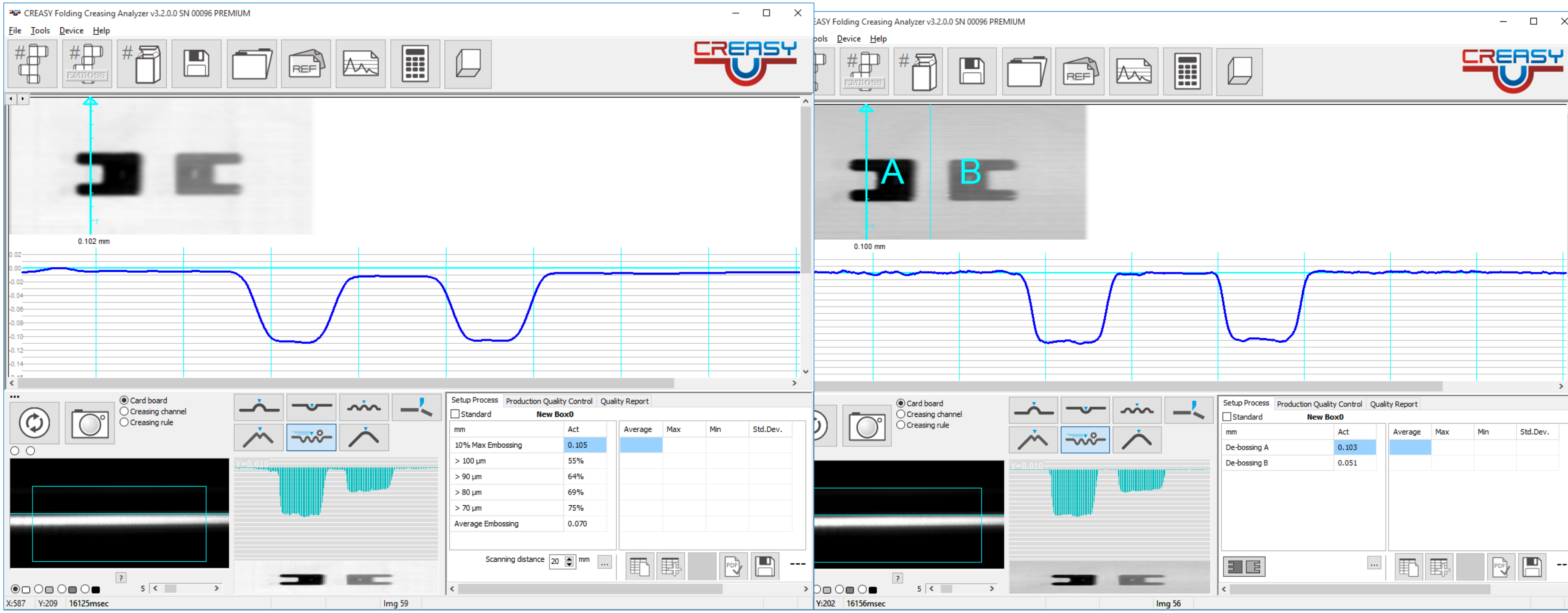
The software automatically detects the 2 embossing patches



The software automatically detects the **2 de-bossing** patches

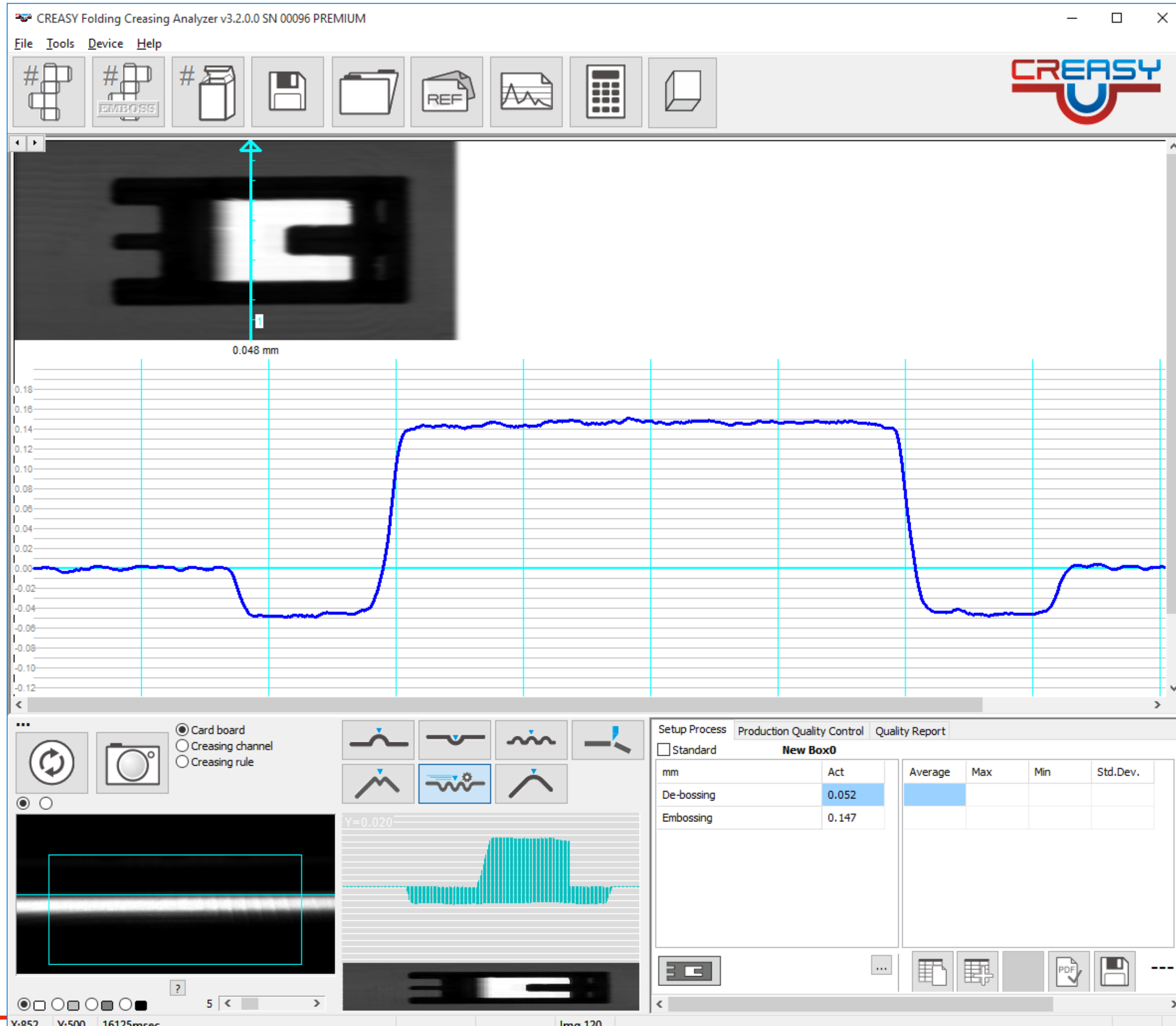


Generic versus Patch



- Unknown Sujet :
  - more filtering is necessary for repeatable measurements
  - Smaller area is picked for average calculation
- <u>Known Sujet:</u>
  - **less filtering is necessary for repeatable measurements**
  - **Total area can be used vor average calculation**

The software detects Embossing inside De-bossing and meassures both



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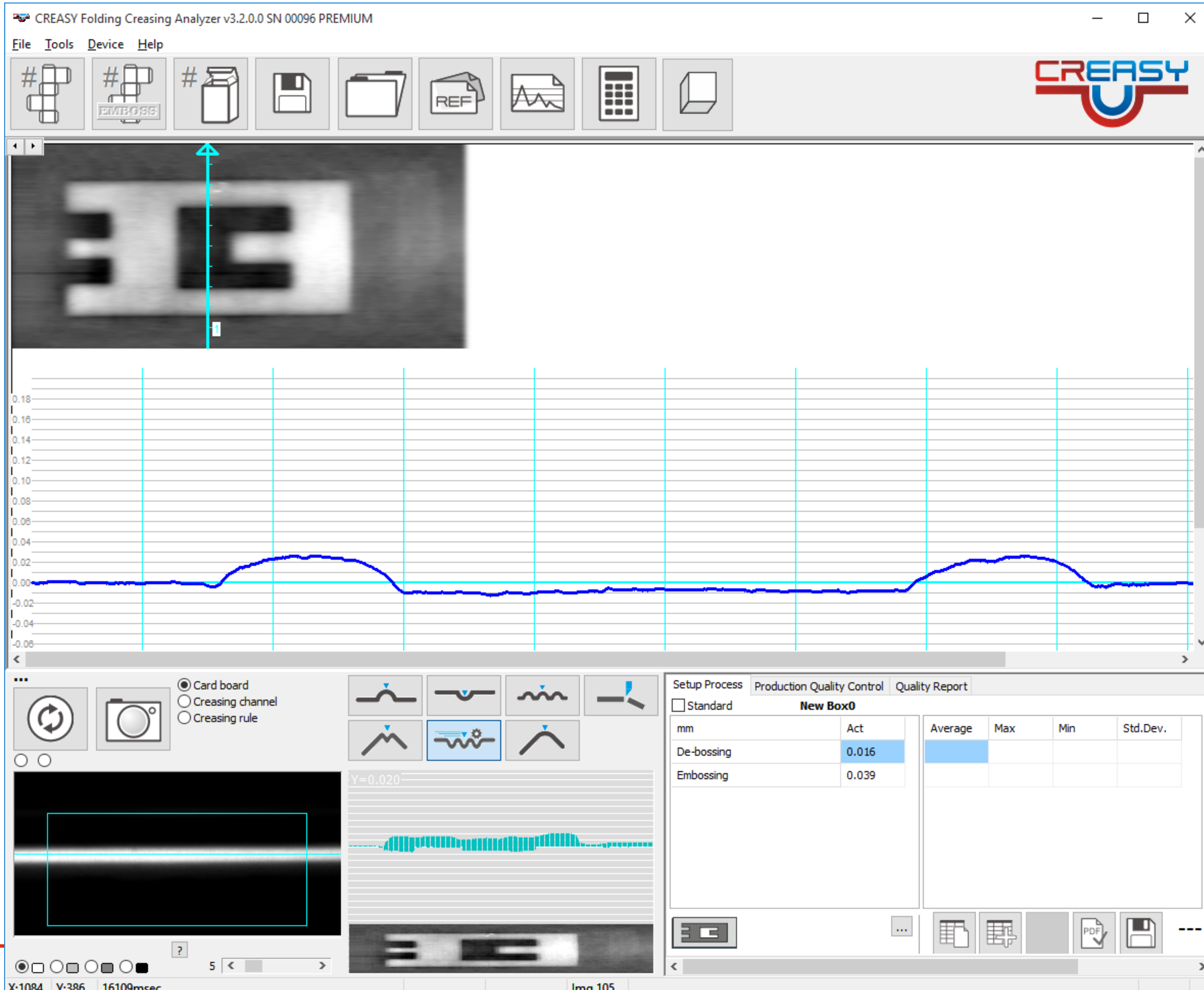
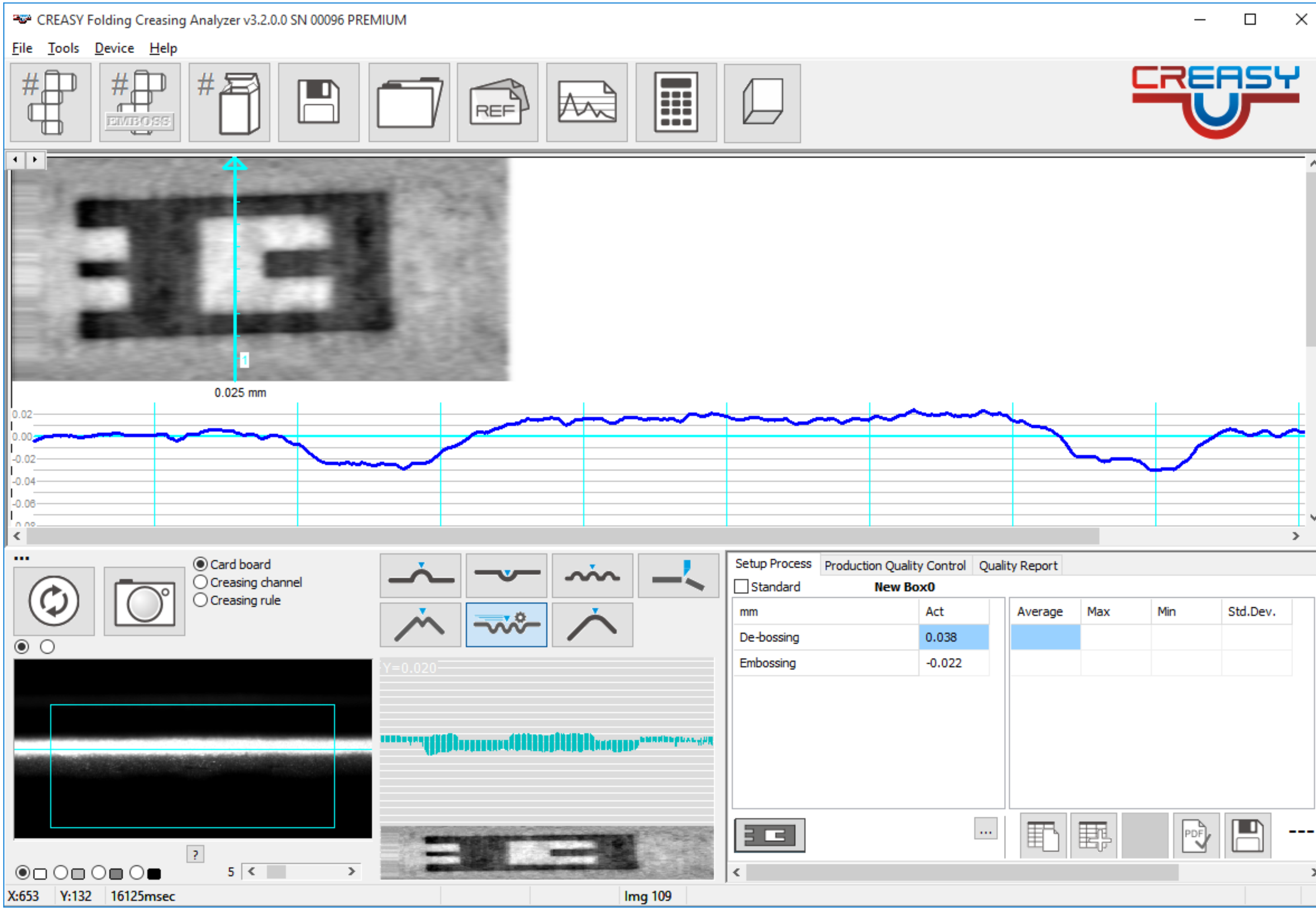
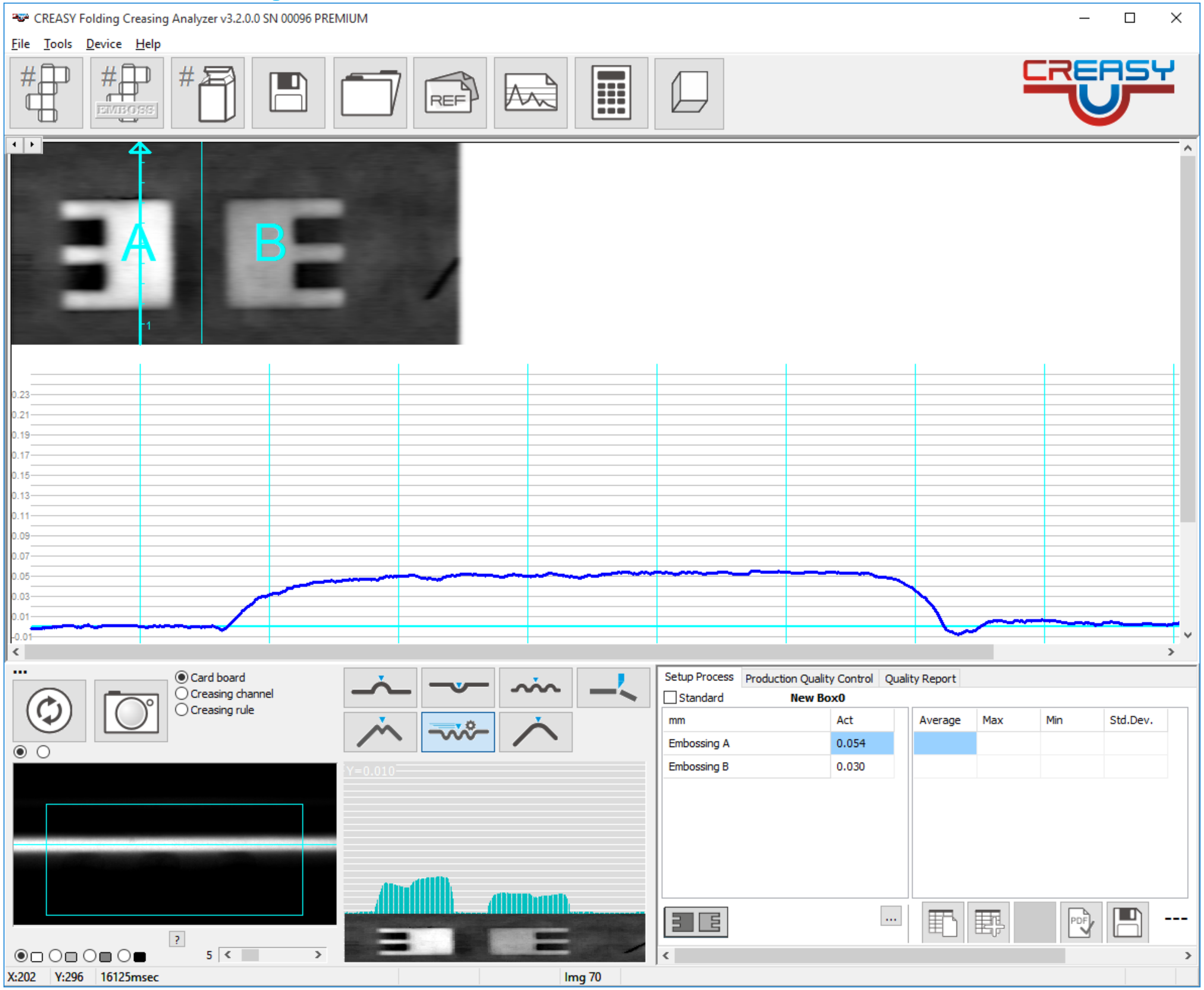
Card Board Sample



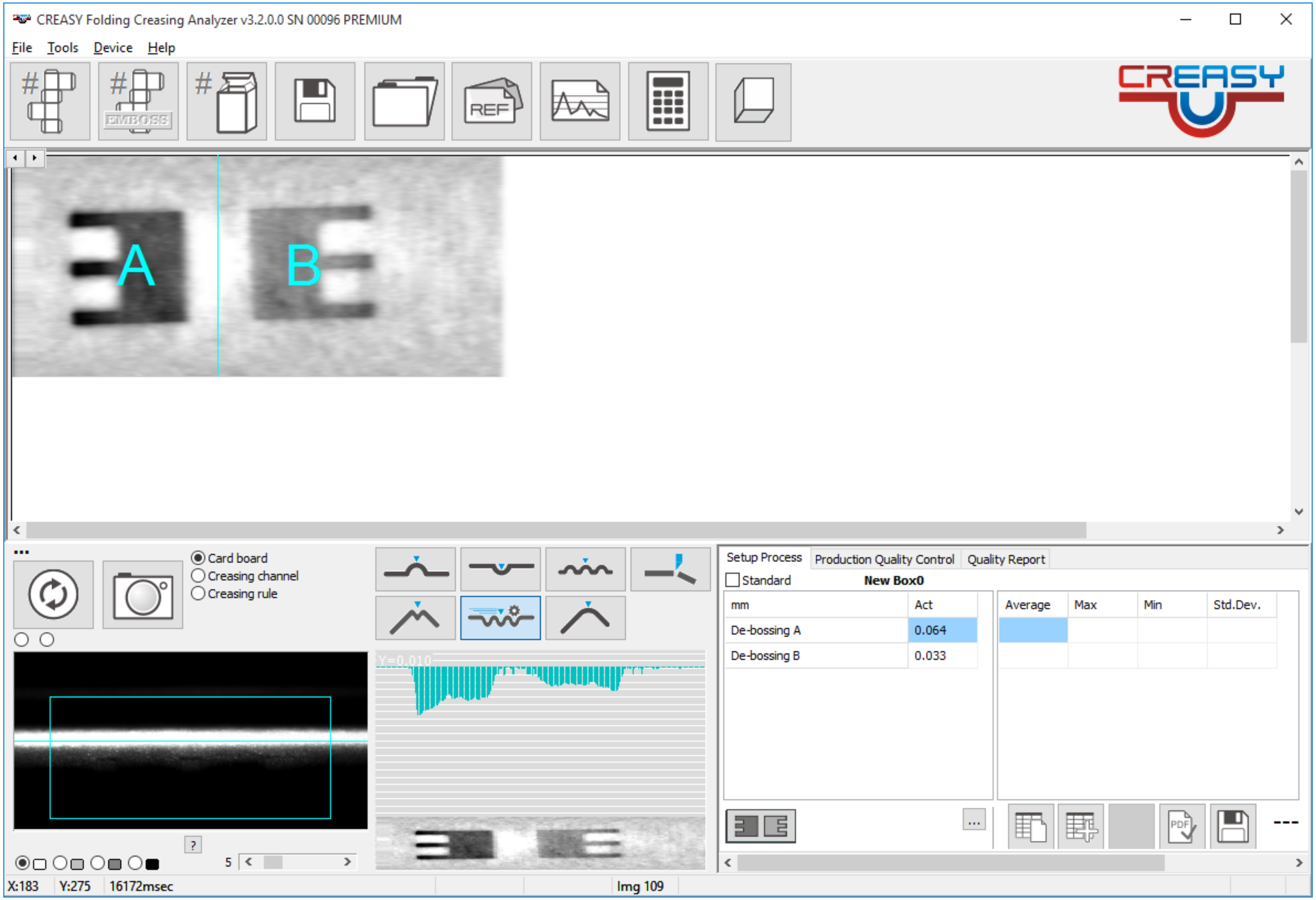
Card Board sample



Card board sample



Card Board Sample



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Thank you…

See what happens

Understand why it happens

Take corrective actions