

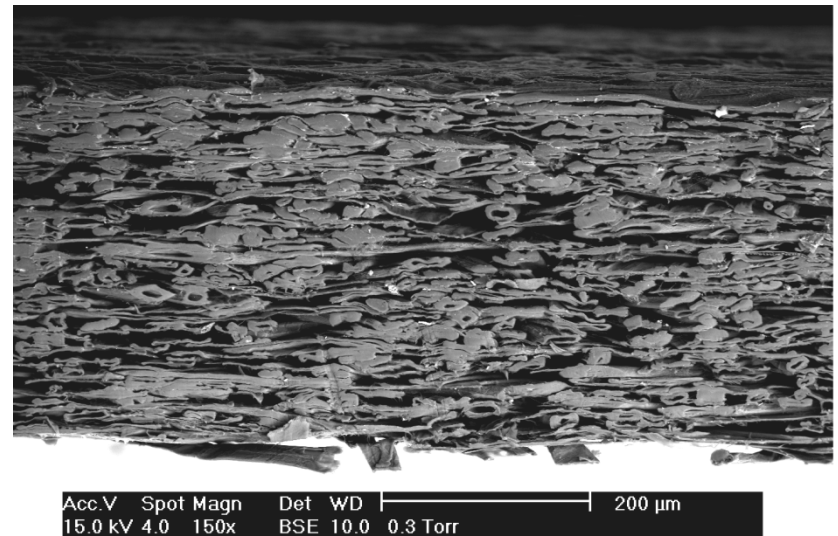
Creasing and Folding are critical steps in the box forming process

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Paperboard is ...

- A thick, single or multiply paper based material.
- composed of several layers of pulp fibers 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 plies with higher Density



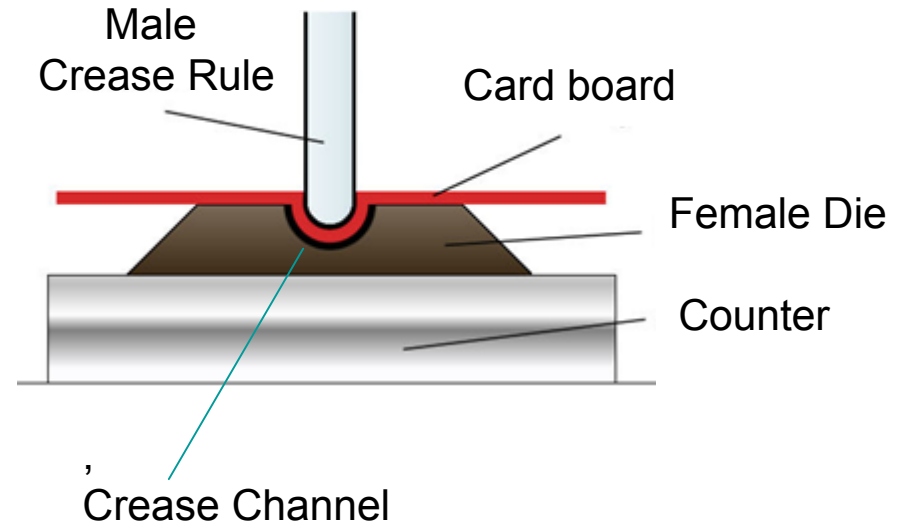
[Source: Hui Huang, KTH Stockholm]

The Creasing process

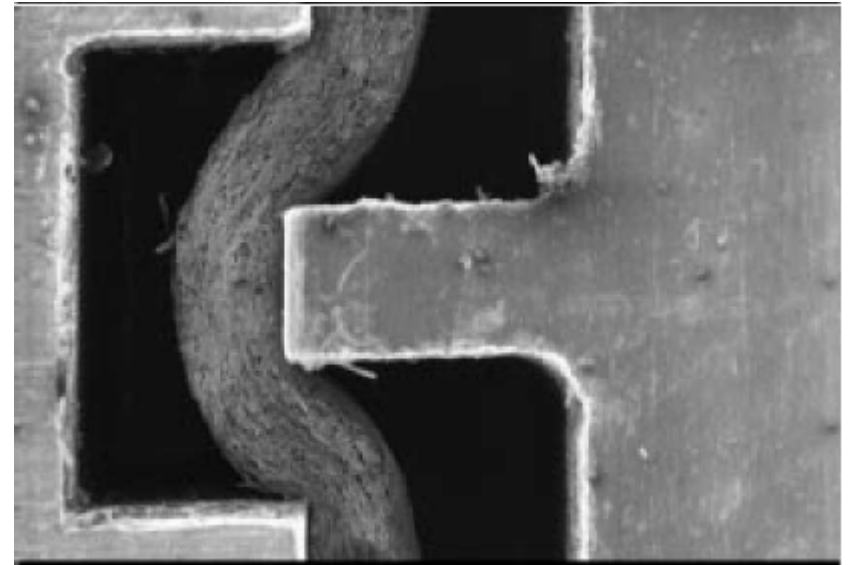
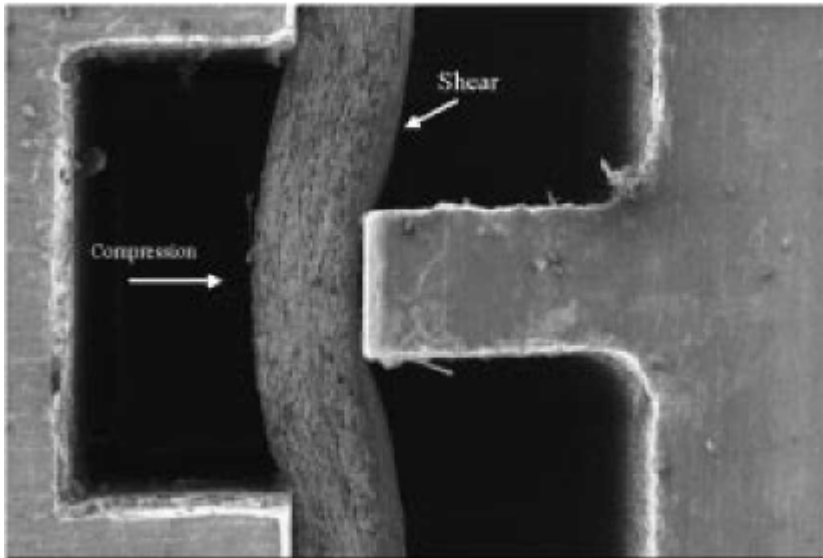
- Fiber-fiber bonds between plies are broken
- Some fibers are damaged
- Plastic deformation occurs
- Shear, tension and compressing stresses arise



- Locally reduced bending stiffness
- Creased area = hinge



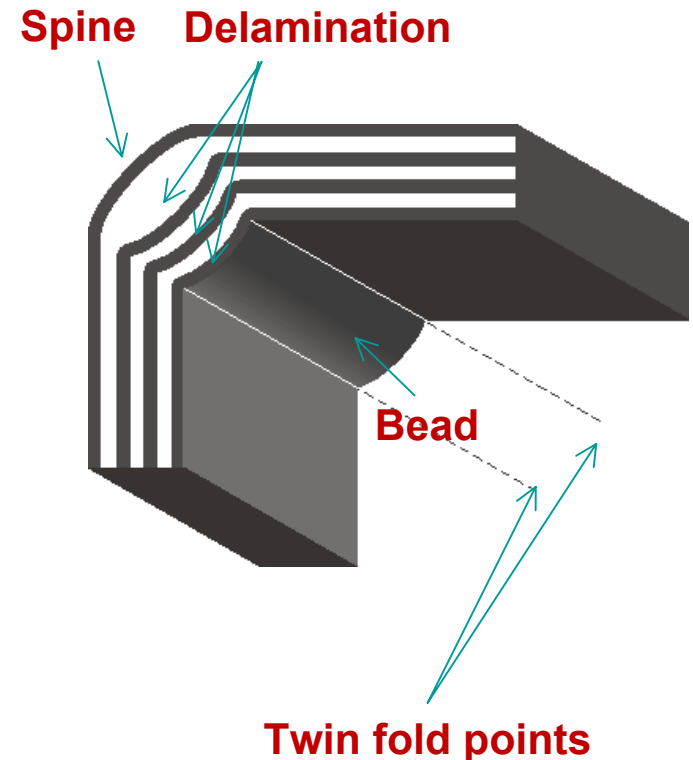
The creasing process



[Source: Hui Huang, KTH Stockholm]

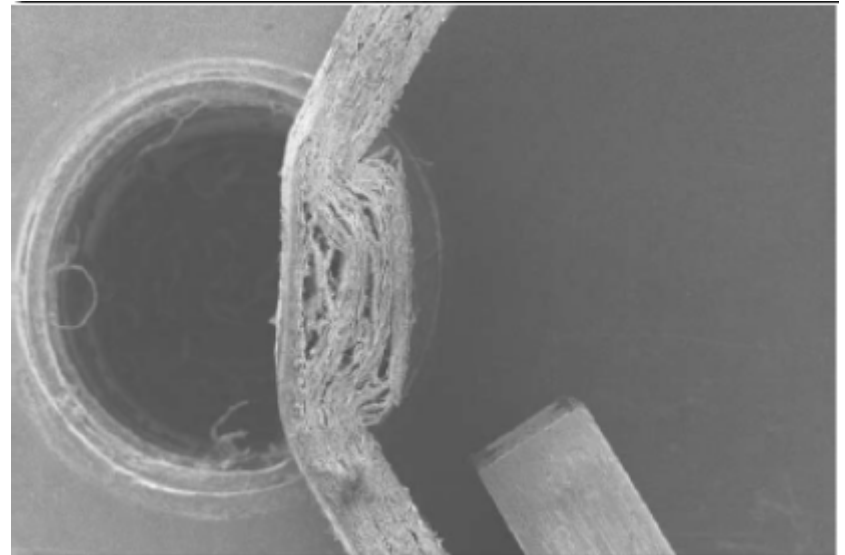
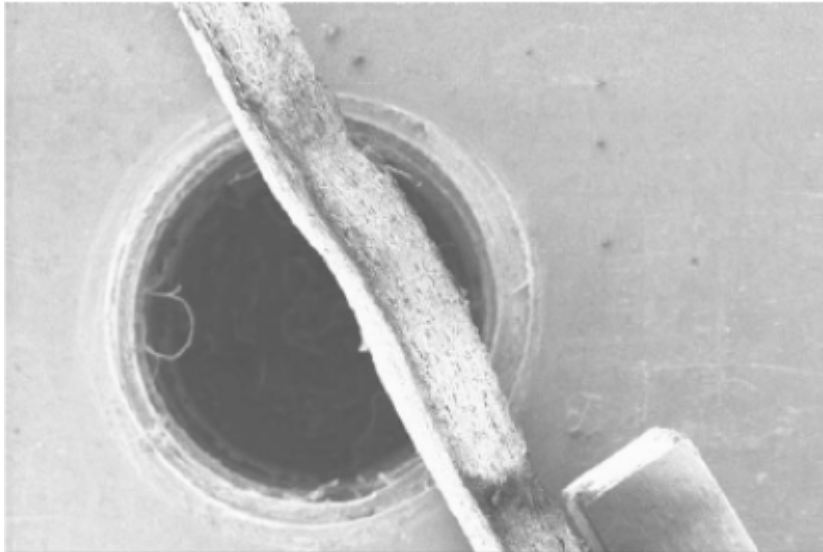
The folding process:

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



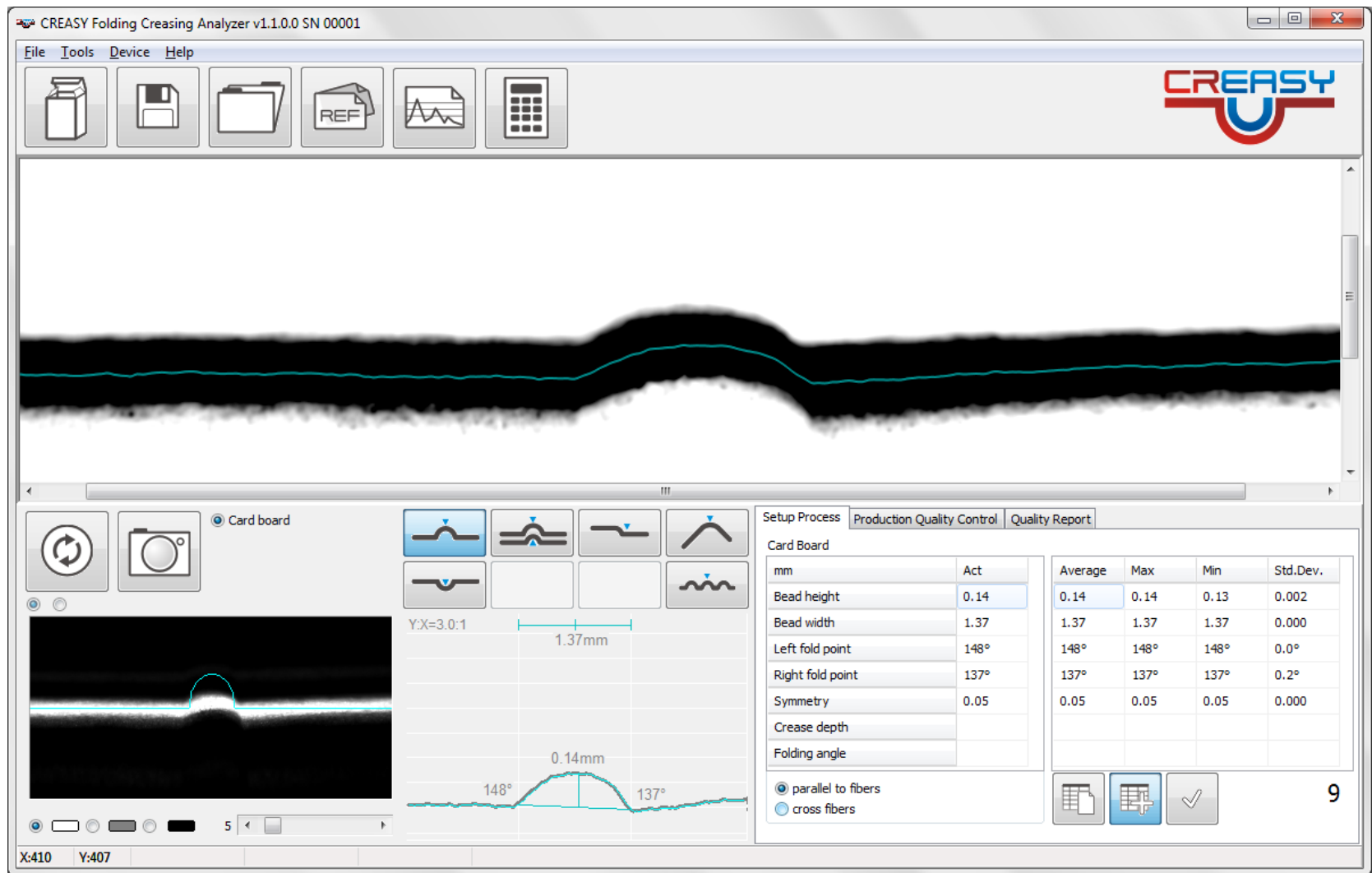
A crease is a double fold

The folding process



[Source: Hui Huang, KTH Stockholm]

Analyze the Bead with CREASY

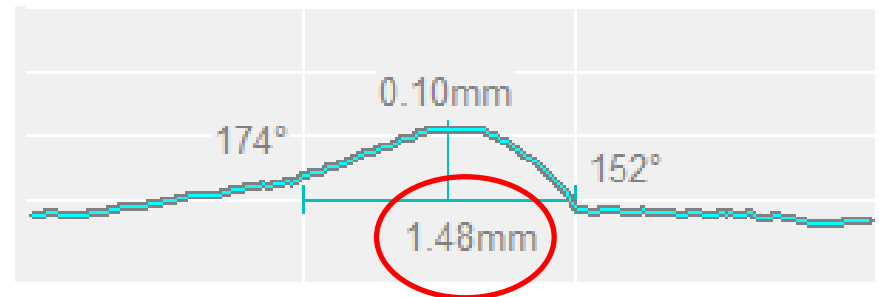


The Bead width – a delamination parameter

the distance between the twin folding points

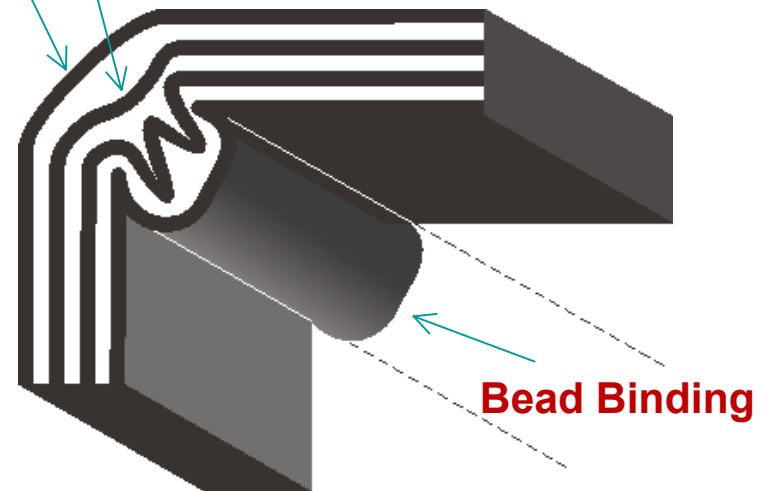
Problems with wide bead:

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



Extensive Tension

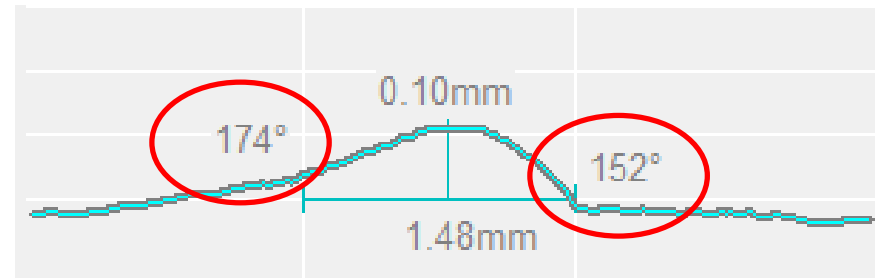
Insufficient delamination



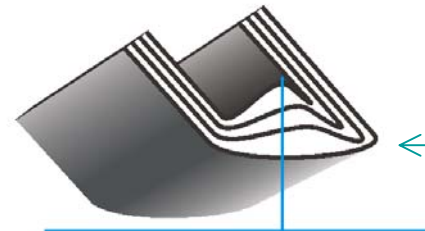
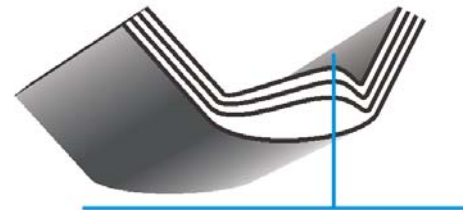
The folding point sharpness defines the symmetry of the bead

Non symmetric folding points

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



One-sided crease

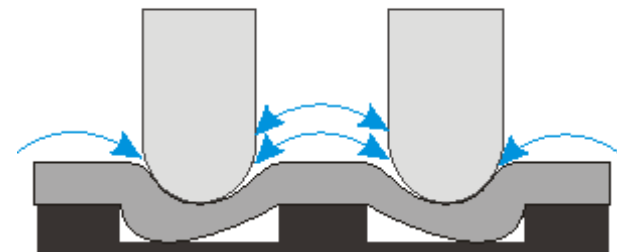
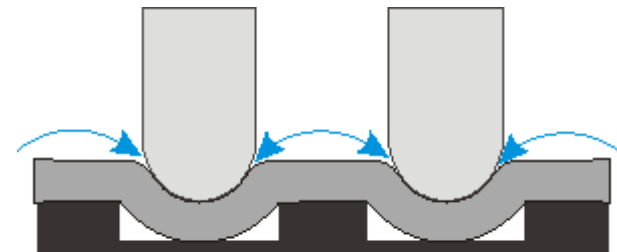


Max tensile stress

Reasons for assymetric bead

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

theory

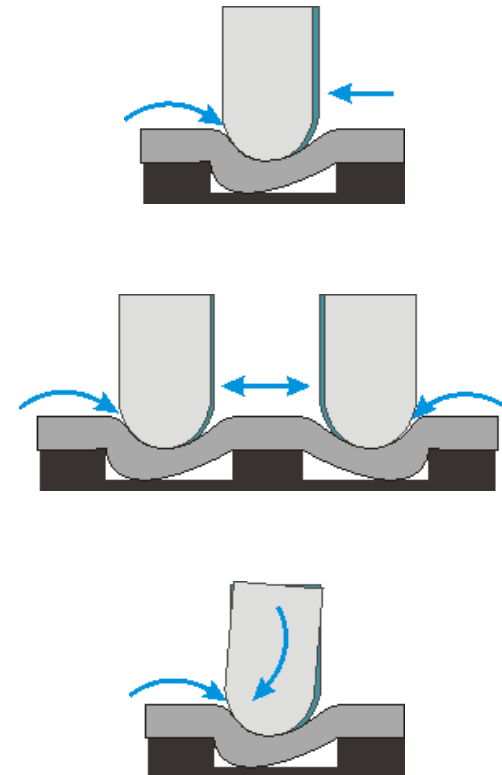


practice

Reasons for assymetric bead

- Rule – channel misalignment
- Tool to tool misalignment (tolerance mismatch)
- Crease rule dish
- Incorrect laser dieboard cutting vertically

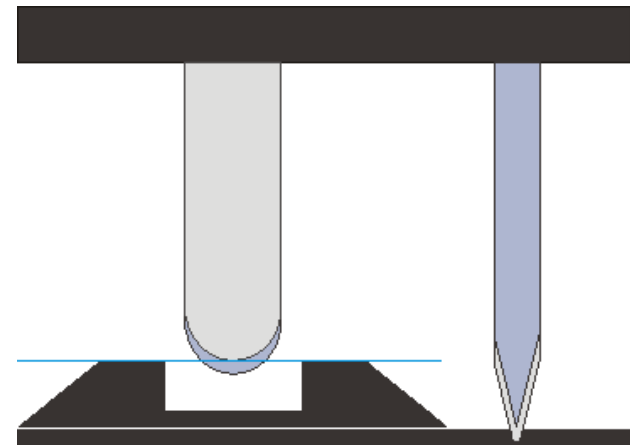
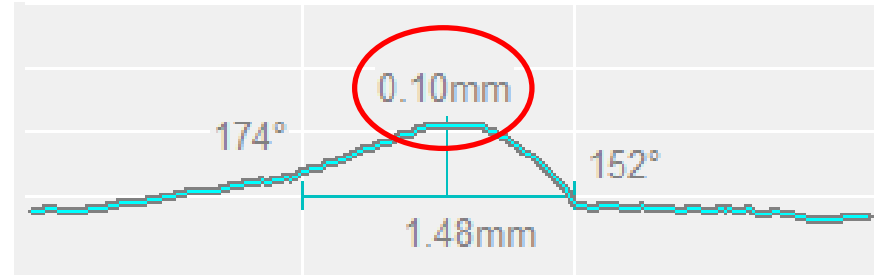
Have a look at the adjustment proposal in 0.01mm resolution:



Symmetry	0.08
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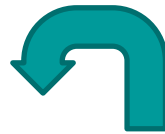
The bead height as an indicator for the penetration depth

- The knife consumptions changes the penetration depth of the rule
 - ❑ changing the tension forces which could result into diecut edge chipping or flaking,
 - ❑ or in breaking the card board material
 - ❑ or faster erode the upper corners of the crease channel

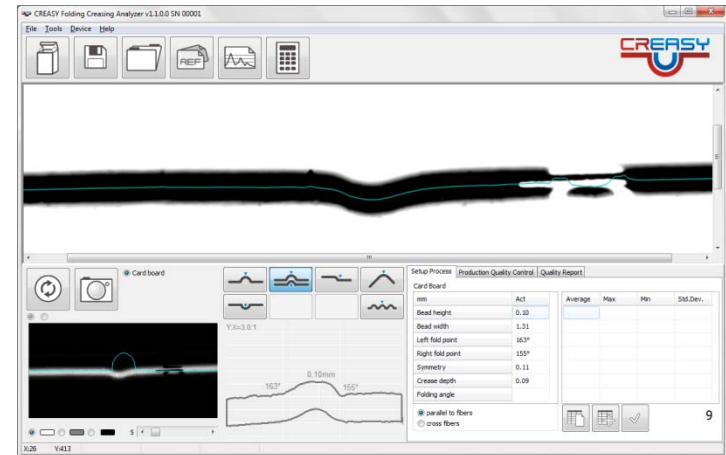
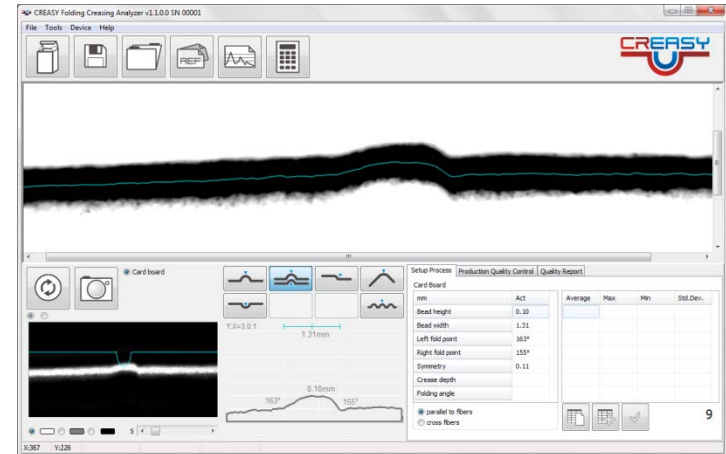
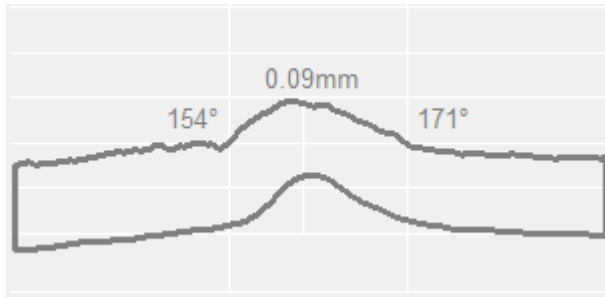


Crease cross section analysis with CREASY

- Measure beat
- Rotate sample by 180°
- Measure crease

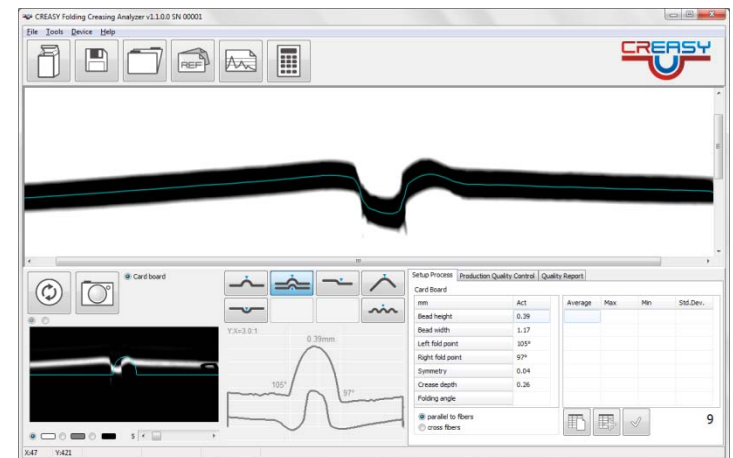
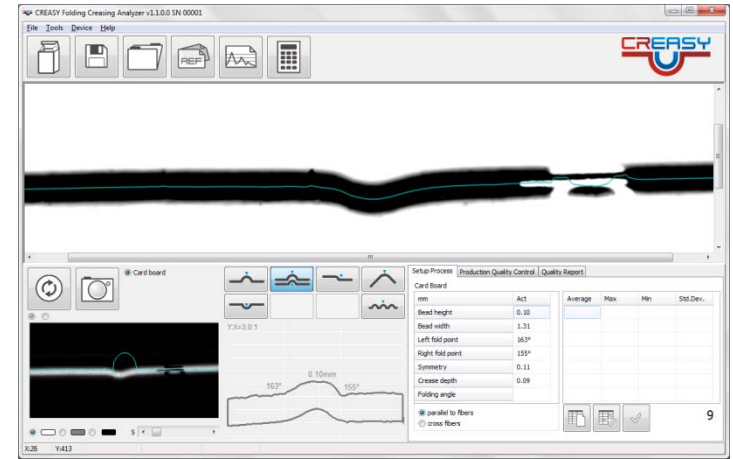


The software will overlay the two images showing the result in terms of a card board cross section



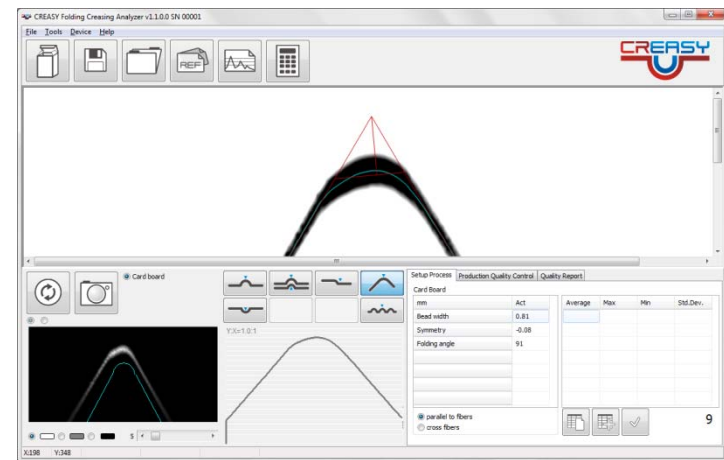
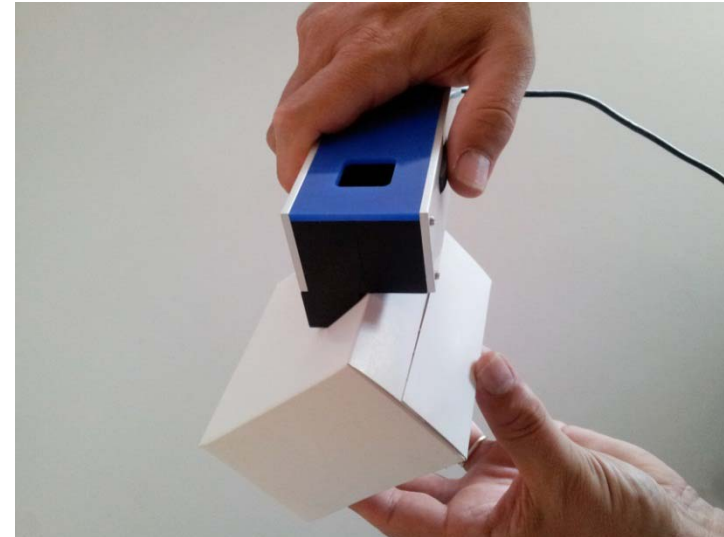
Compare crease before and after first break

- The first break defines the final location of the twin folding points
- The first break defines the final symmetry of the folding
- The first break shows problems with cracks, fracturing and folding failures



Control the final product box quality with CREASY

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



Why control of creasing is important

- No customer will accept cracks and splitting on folded packaging products
- No customer will accept non-uniform packaging boxes
- The paper structures and folding behaviour vary with
 - ❑ Fiber lengths, fiber content, fiber orientation
 - ❑ Coatings, bond between coating and paper
 - ❑ Printed ink, varnish
 - ❑ Heat to dry the ink of the print sheet reduces flexibility
 - ❑ Environment – humidity in the pressroom
- The cutting & creasing process itself has variations
- Help to avoid runnability problems on the packaging line
- Help to avoid waste because of un-usable boxes

Thank you...

See what happens

Understand why it happens

Take corrective actions