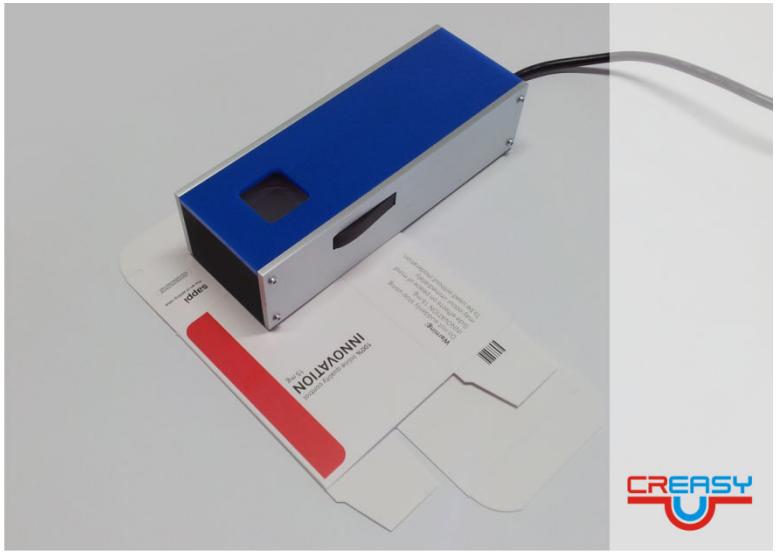
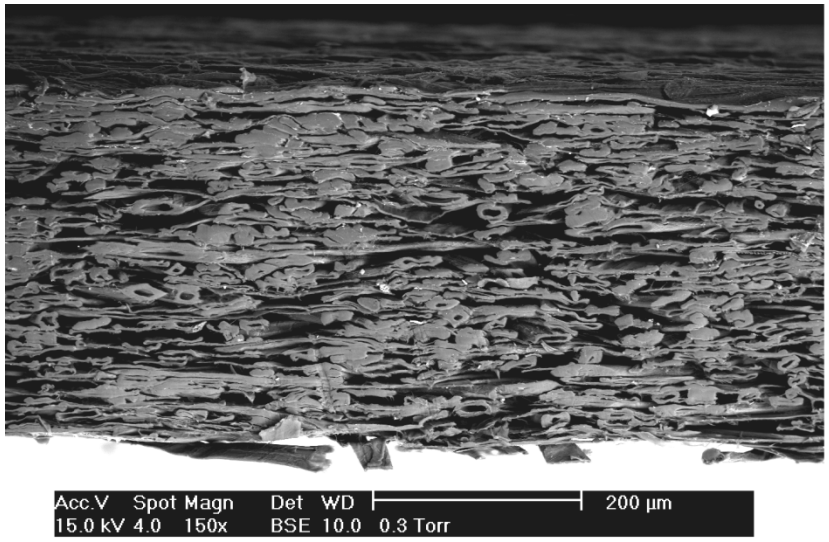
Creasing and Folding are critical steps in the box forming process

Dipl. Ing. Lukas Pescoller



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

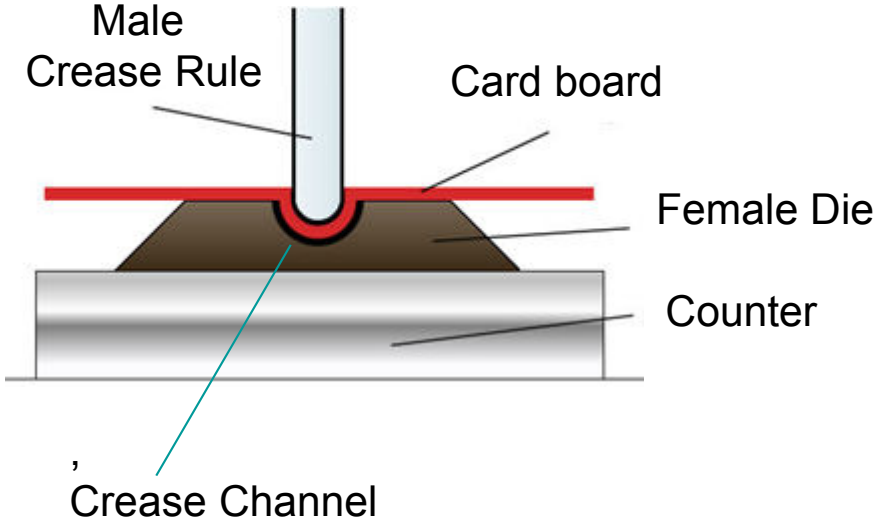


[Source: Hui Huang, KTH Stockholm]

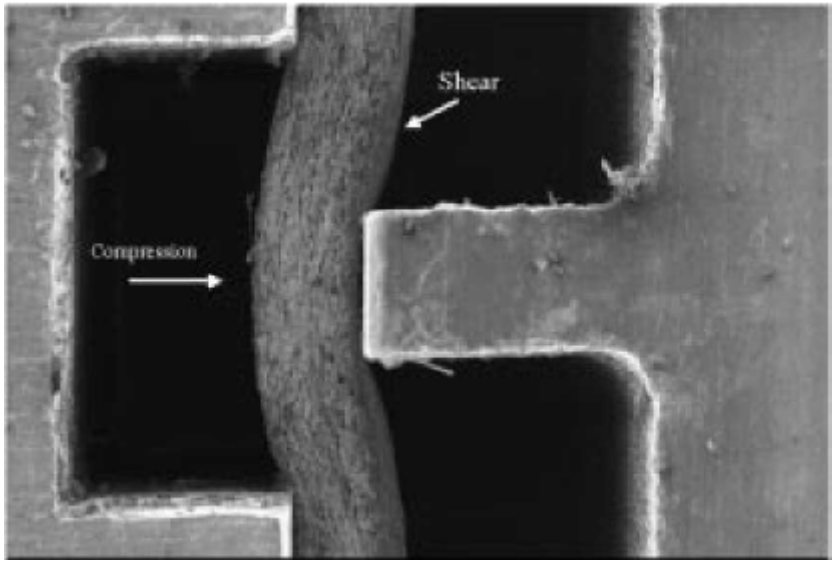
The Creasing process

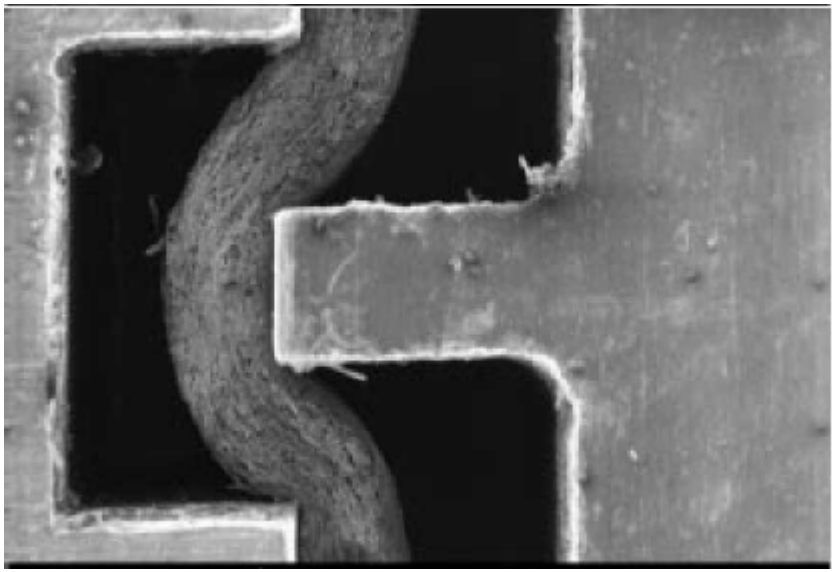
- Fiber-fiber bonds between plies are broken
- Some fibers are damaged
- Plastic deformation occurs
- Sheare, tension and compressing stresses arise

- Locally reduced bending stiffness
- Creased area = hinge



The creasing process

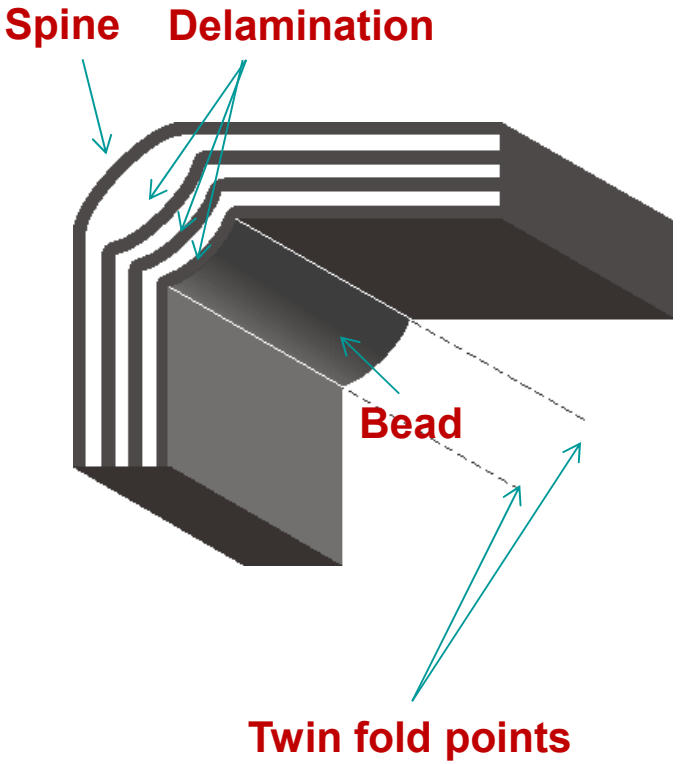




[Source: Hui Huang, KTH Stockholm]

The folding process:

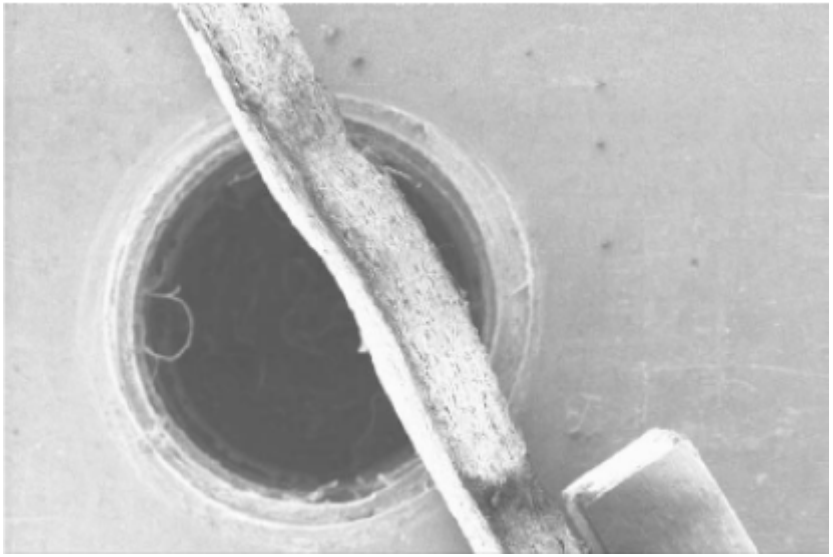
- Folding uncreased paperboard results in cracks on the outside
- The ability to delaminate (fracture surface in parallel to the plies) is an important property for folding

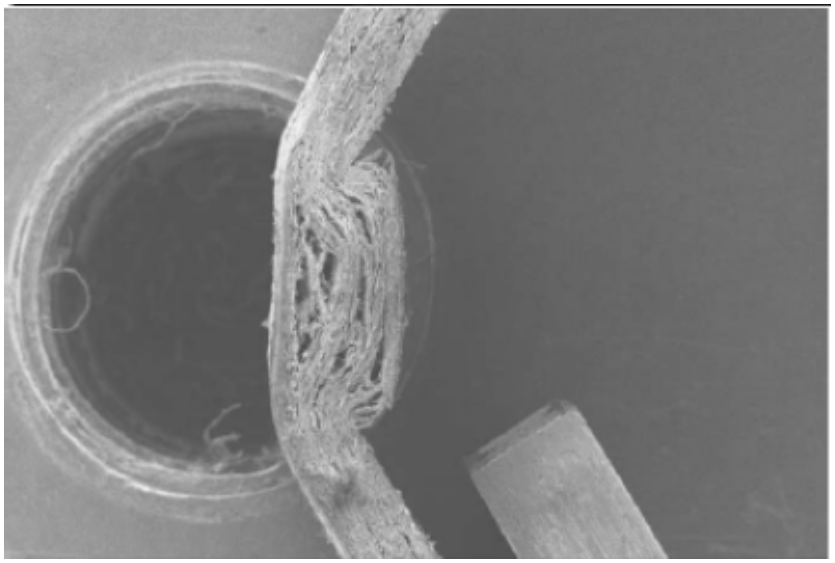


- Tensile stress arises on the outside ply (Spine)
- The inner plies (Bead) are compressed and bulging
- Deformation and delamination takes place

A crease is a double fold

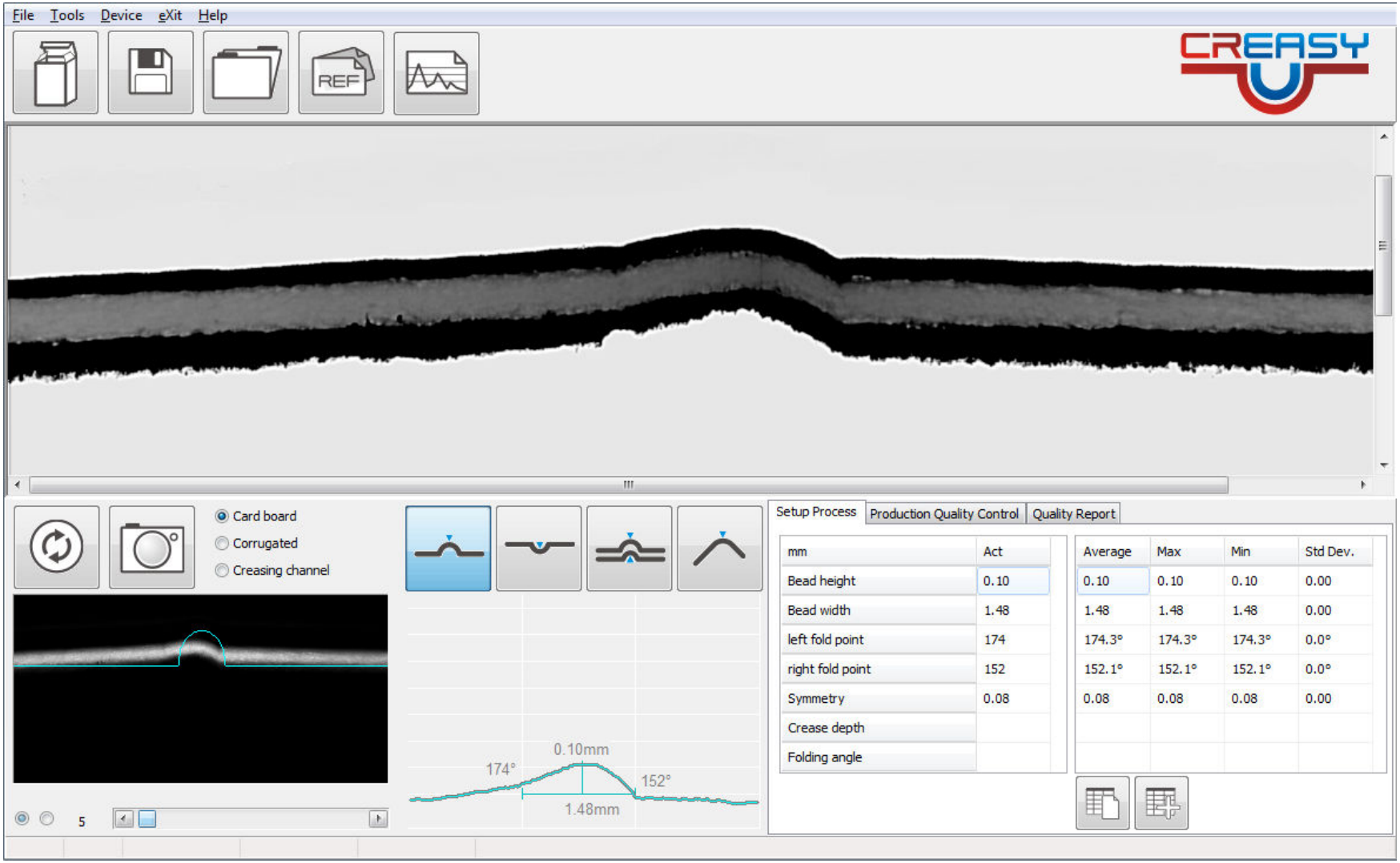
The folding process





[Source: Hui Huang, KTH Stockholm]

Analyze the Bead with CREASY

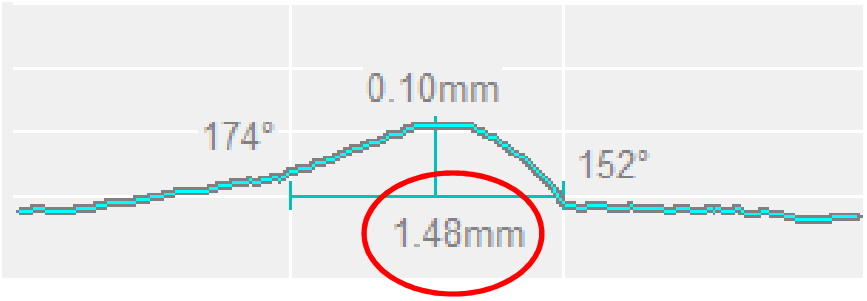


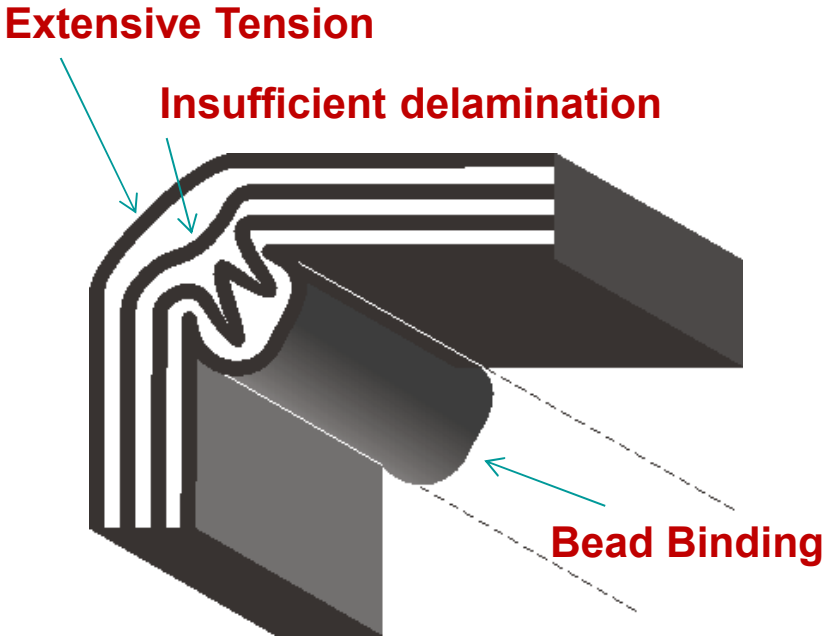
The Bead width – a delamination parameter

the distance between the twin folding points

Problems with wide bead:

- Un-sharp folding points
- Insufficient internal delamination and inflexibel 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

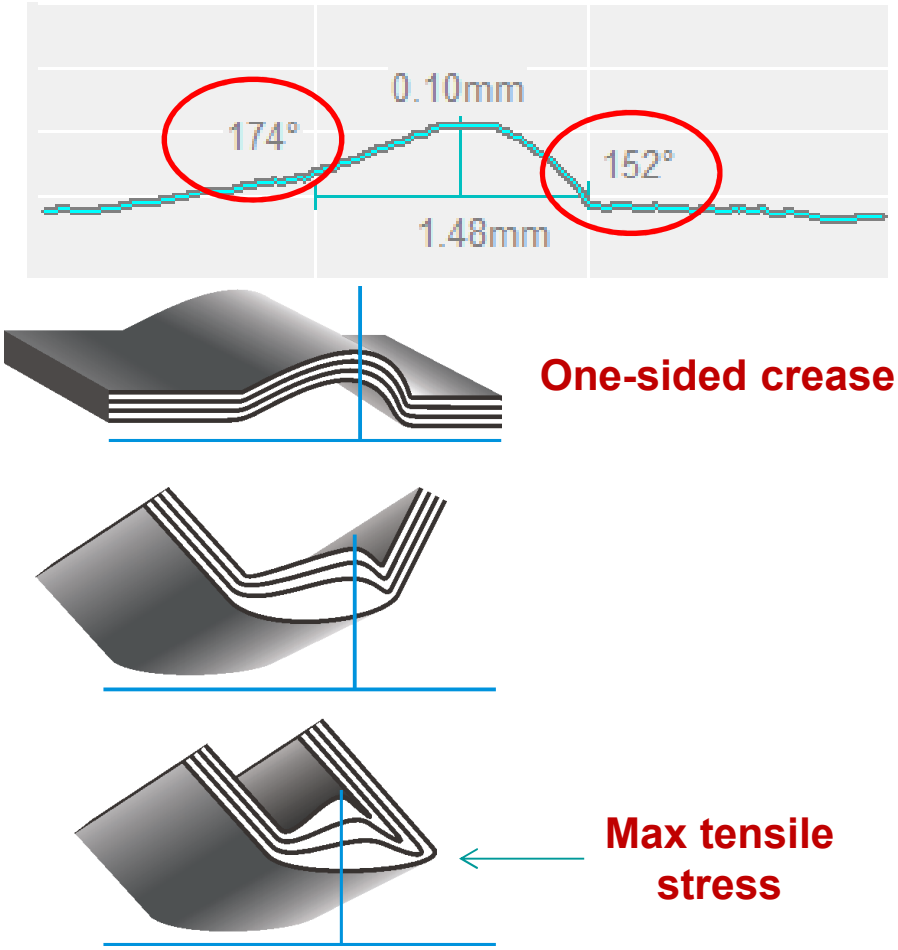




The folding point sharpness defines the symmetry of the bead

Non symmetric folding points

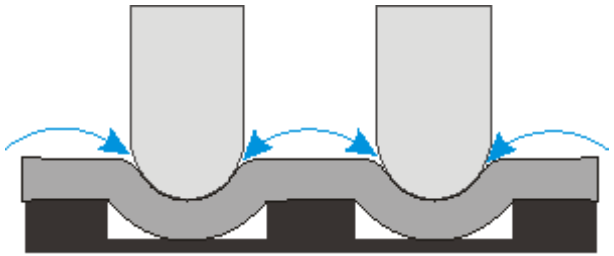
- Off-center folding
- non uniform boxes
- Extensive stress in an arrow area of the spine
- Fracturing and folding failure

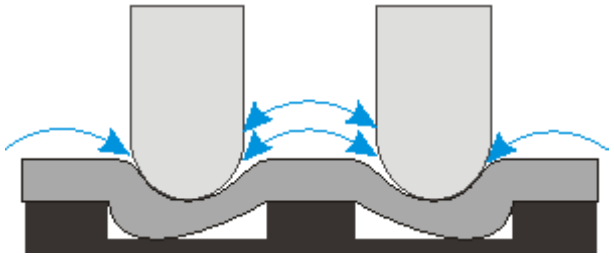


Reasons for assymetric bead

- 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

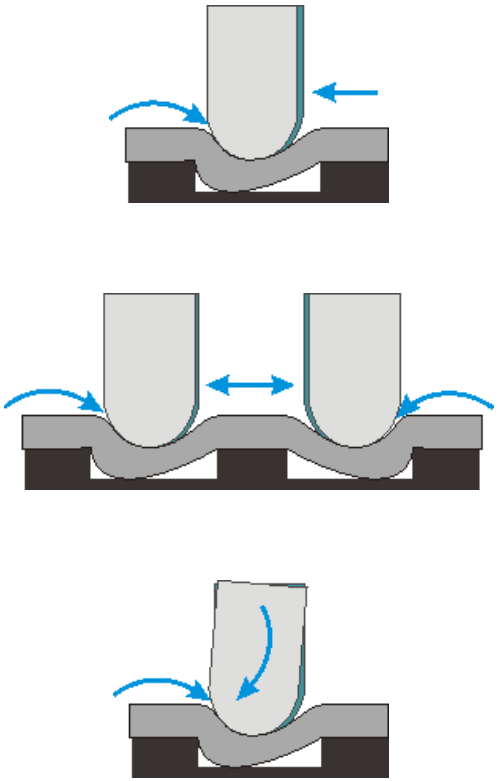




practice

Reasons for assymetric bead

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



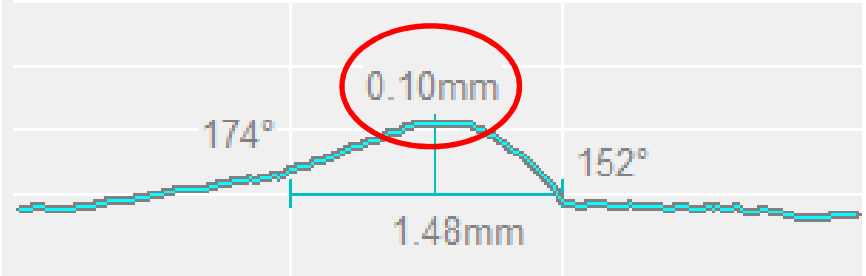
Have a look at the adjustment proposal in 0.01mm resolution:

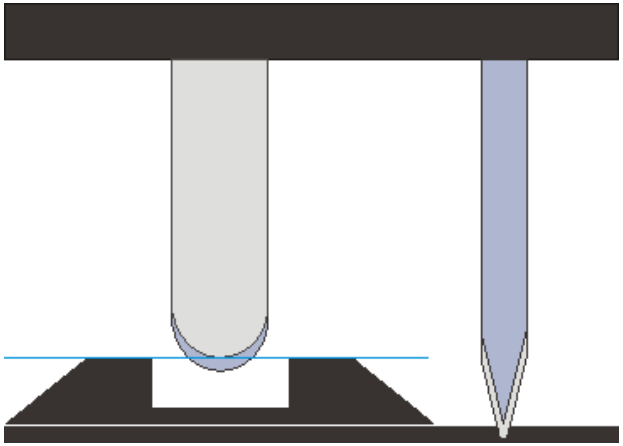
Symmetry	0.08

PERET

The bead height as an indicator for the penetration depth

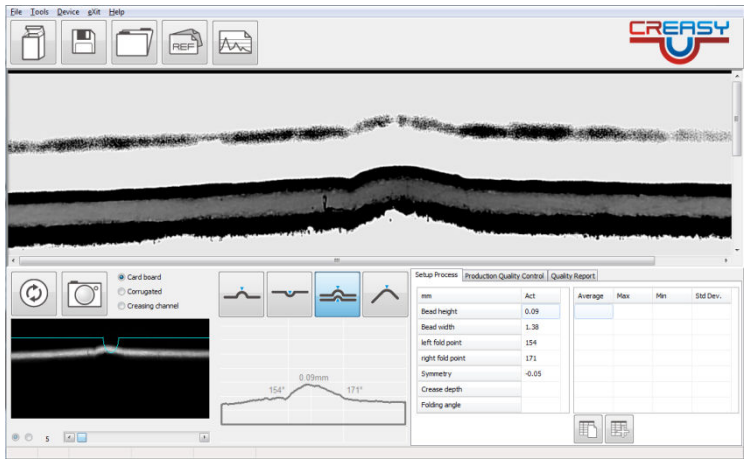
- The knife consumtions changes the penetration depth of the rule
  - changing the tension forces which could result into diecut edge chipping or flaking,
  - or in breaking the card board material
  - or faster erode the upper corners of the crease channel



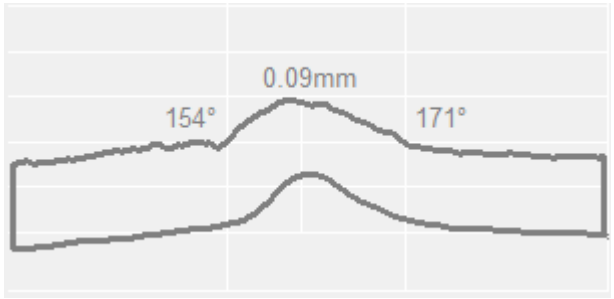


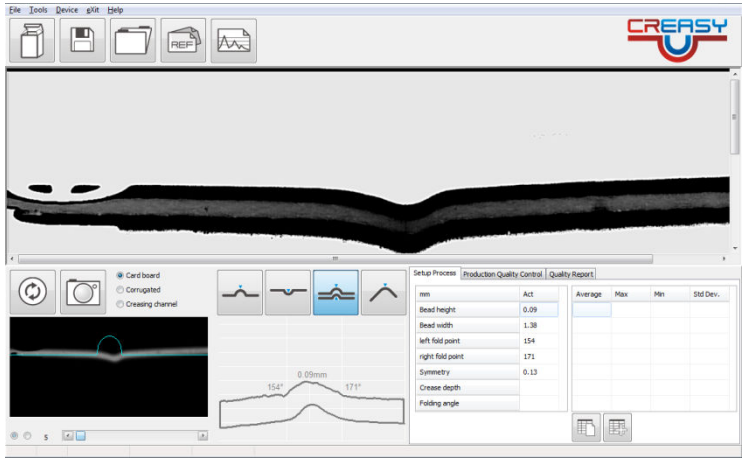
Crease cross section analysis with CREASY

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



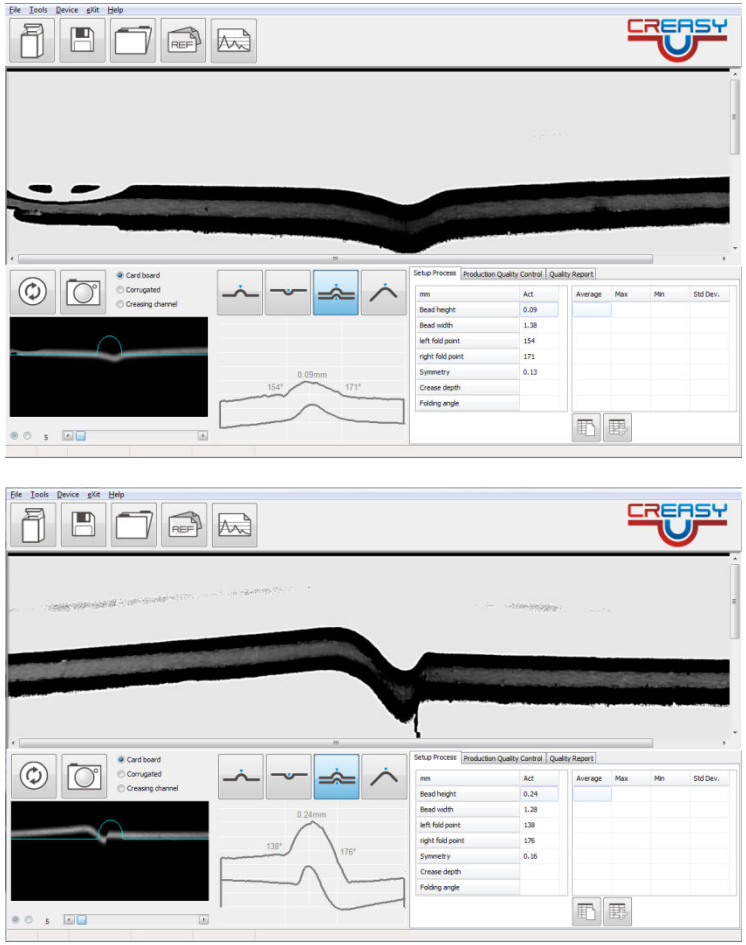
The software will overlay the two images showing the result in terms of a card board cross section





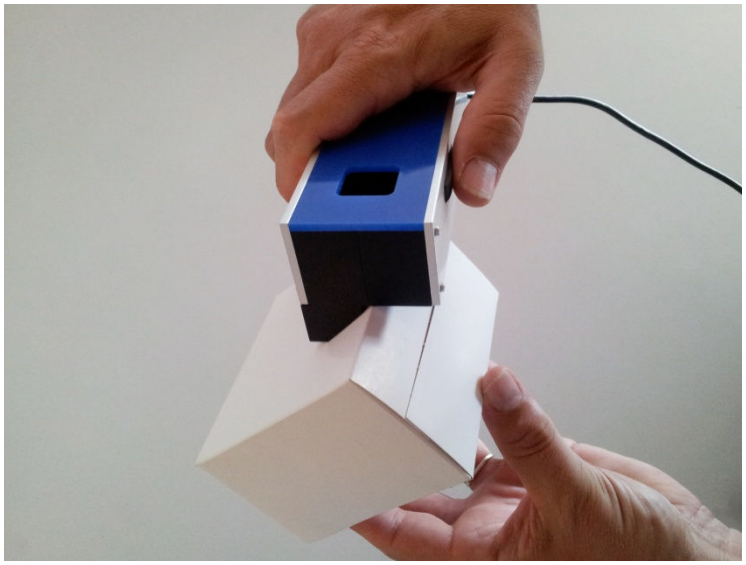
Compare crease before and after first break

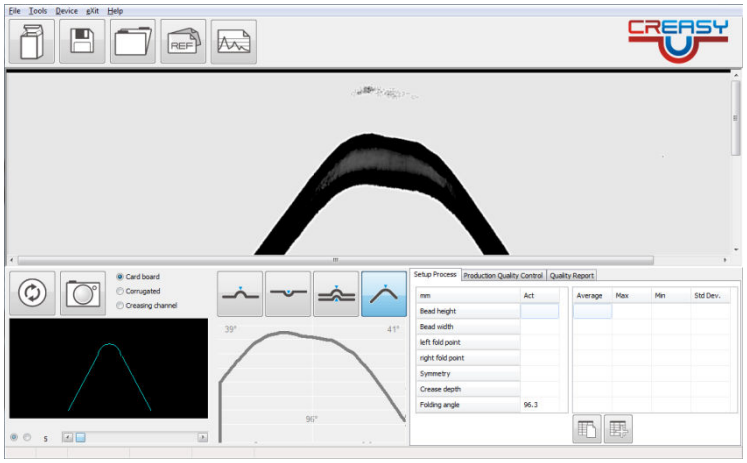
- The first break defines the final location of the twin folding points
- The first break defines the final symmetry of the folding
- The first break shows problems with cracks, fracturing and folding failures



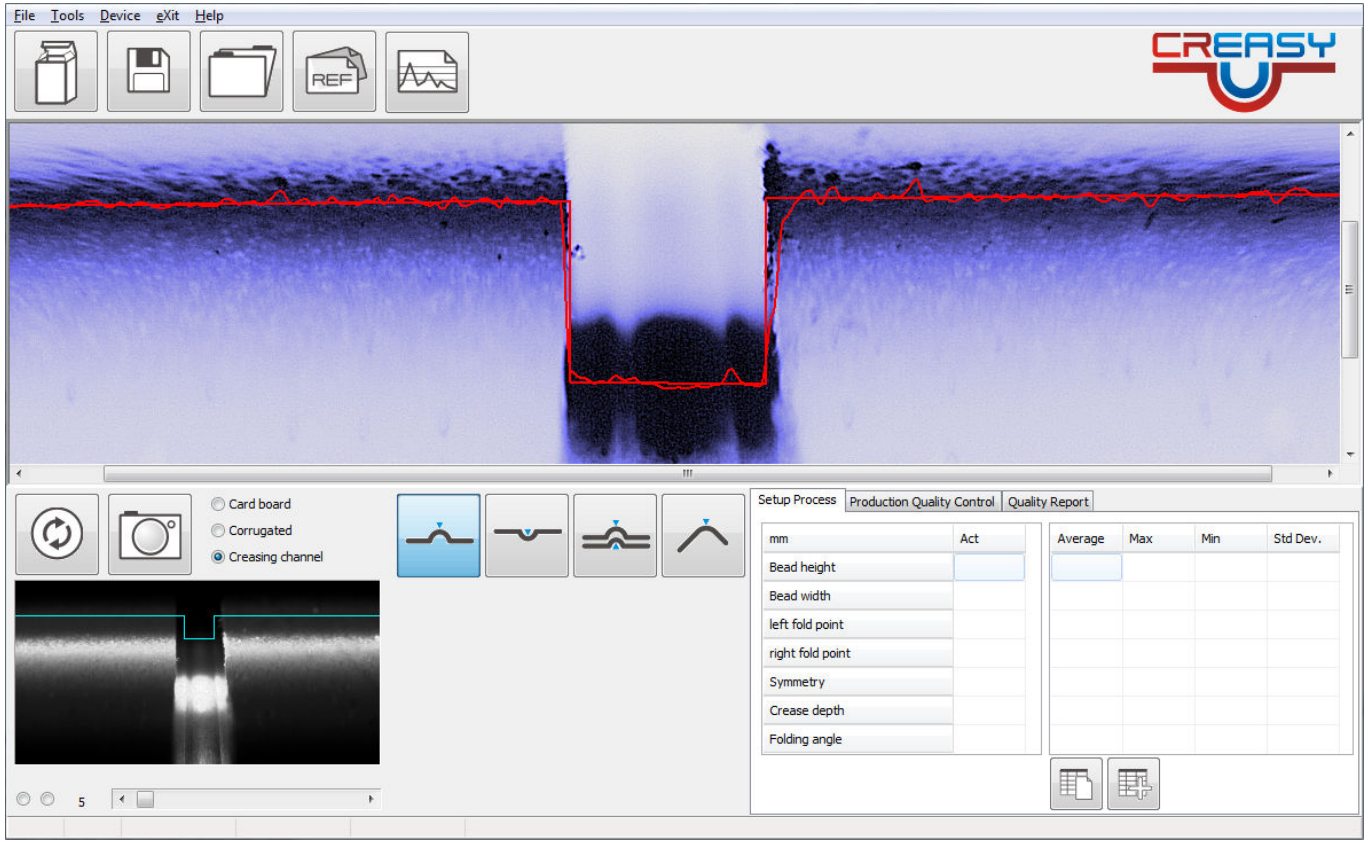
Control the final product box quality with CREASY

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





Control the Crease Channel with CREASY



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 lengts, 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