BETA FOLD

CREASE & FOLD ANALYZERS

Controlling Creasing & Folding in the Box Forming Process

BETA INDUSTRIES

The Quality Control Company

BETAFOLD CREASE & FOLD ANALYZERS

Beta Industries introduces the FIRST Quality Control tool for the folding carton industry. The BetaFold Crease & Fold Analyzer System is designed to bring the advantages of quality control to creasing and folding.

BetaFold Crease & Fold Analyzers incorporate rugged, portable, handheld, non-contact optical, high resolution sensors that capture an image of the crease or fold and automatically displays, analyzes, and record the data to the PC prior to folding and glueing in a system that is easy to use.

Fully automatic analysis of crease height, width, angles, and symmetry is automatically saved to a database with NO USER INTERVENTION required.

When used for package design, material and process evaluation, or machine make-ready, detailed information is available to the professional.

In the high-volume production environment the machine operator needs only one click on each critical detail to automatically capture production data in the database. Statistics are automatically calculated and formatted reports are generated for documentation and process control.

The device is uniquely suited to both in-depth analysis of the many variables that affect the finished product by skilled managers and QC staff , as well as quick grab-samples by low-skill production workers.

The BetaFold Crease & Fold Analyzer System maintains a database of job setup parameters and production samples. All of this is combined with the high precision, ease of use, and Beta product support that has made the Beta name the standard of the industry in flexographic analyzers.

Measure crease and channel width, depth, angles, and symmetry. Save images and data with a single click. Display, save, and print data for complete control.

The "ADVANCED" software option adds extensive customization options to the dieline diagram, reporting, and data collection functions. Generic box diagrams are replaced with the actual die diagram, greatly improving the production workers understanding of the areas to be tested, etc. Networked data collection is also implemented, allowing data to be checked across different production locations.

Folding cartons are paperboard and the multi-layer construction that contribute bending stiffness to the board. To make a high quality fold with good appearance and structural integrity, the bending stiffness has to be reduced by the creasing matrix. This localized weakening of the board in a well-defined pattern act as hinges during the subsequent box forming process.

Uncontrolled variations in the creasing process can create defects that affect the appearance and function of the finished carton. Proper setup is critical to assure a consistent product. BetaFold hardware and software measure and document the dimensions, angles, and symmetry of the crease and the bead to aid in proper setup and process method to control to the production run.

CREASING breaks fiber bonds between plies, allowing controlled delamination and creating a hinge

- **MEASURE** Bead crease, folding angle
- **VERIFY** Bead height, width, symmetry, fold points
- **DOCUMENT** crease images and data, generate reports and statistics
- **IMAGE and ANALYZE** bead dimensions
- **CREATE** Production reports with images and statistics
- **DETECT** changes in die penetration due to knife wear

CONTROL

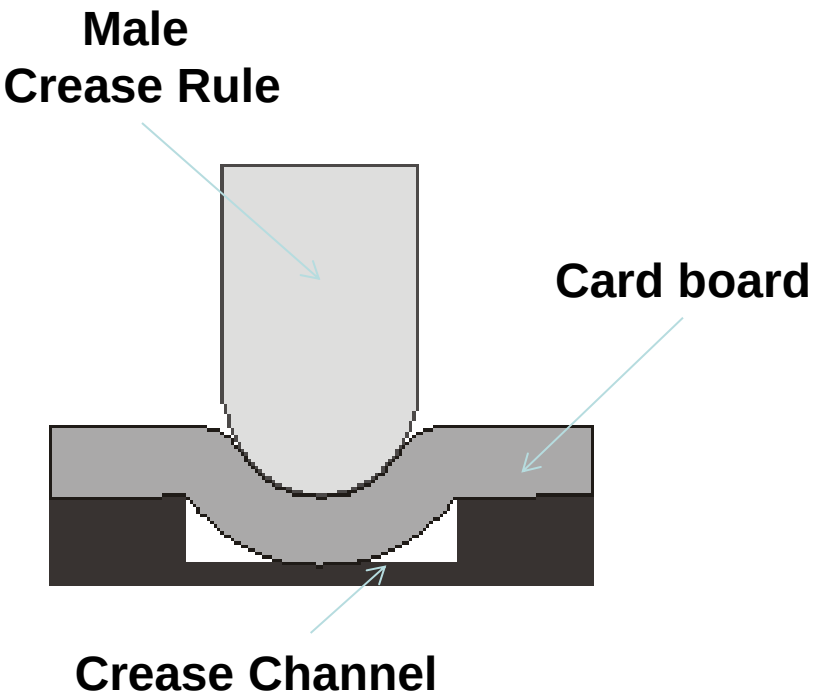
- Faster creasing makeready
- Minimize cracks and splitting
- Reduce running defects and waste
- Improve package performance and profits

ANALYSIS

- Measure sample vs production crease parameters
- Detect ink and coating effects on folds
- Verify proper drying and environmental conditions
- Track die performance vs time and operator

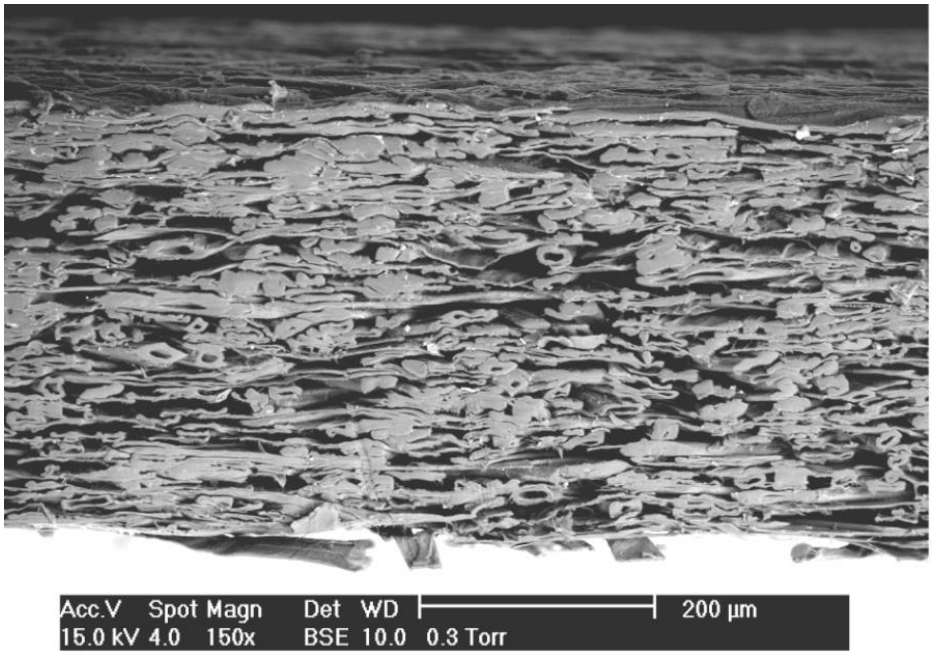
The Creasing Process

- Fiber-to-fiber bonds between plies are broken
- Some fibers are damaged
- Plastic deformation occurs
- Shear, tension and compression stresses arise
- Locally reduced bending stiffness
- Creased area becomes a hinge



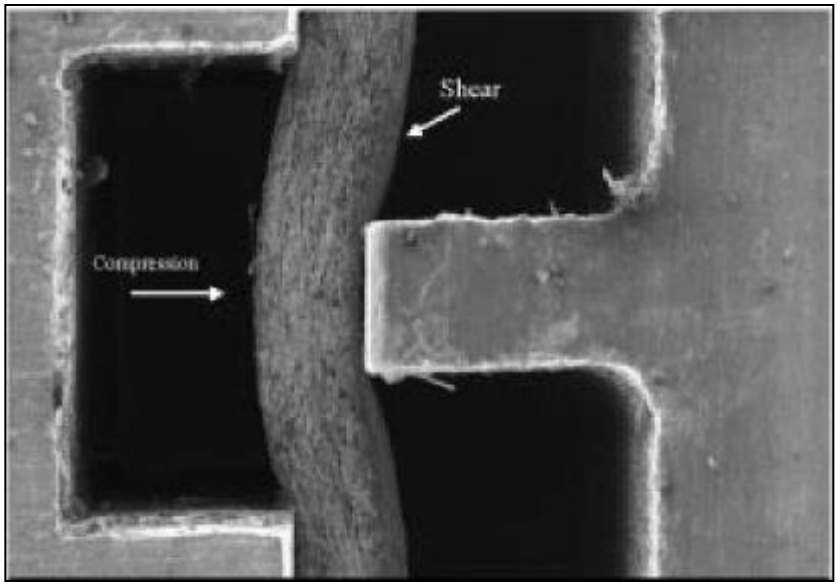
Paperboard is…

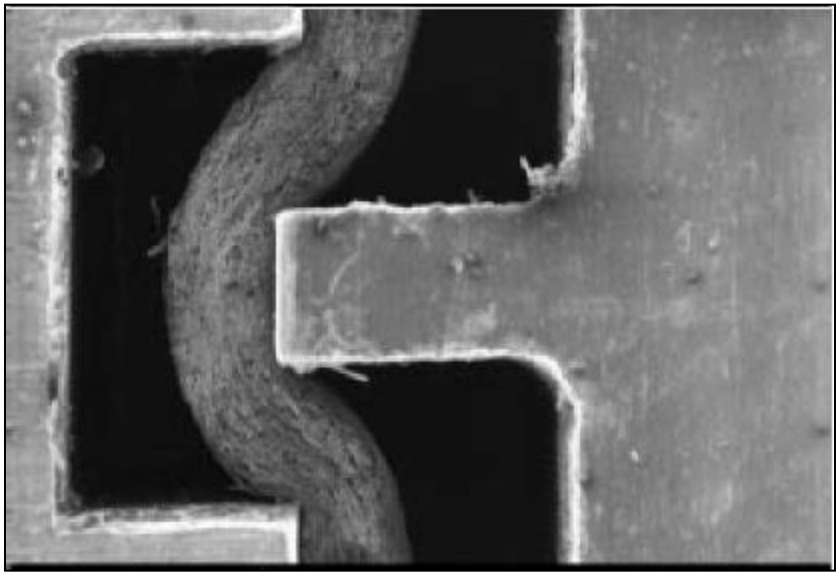
- A thick, single or multi-ply paper based material
- Composed of several layers of pulp fibers with a preferred orientation
- Bonded by starch or other adhesive material
- This construction creates bending stiffness, one of the most important mechanical properties for paperboard packaging
- Bending stiffness is mainly produced by the higher density of the outer plies



[Source: Hui Huang, KTH Stockholm]

The Creasing Process

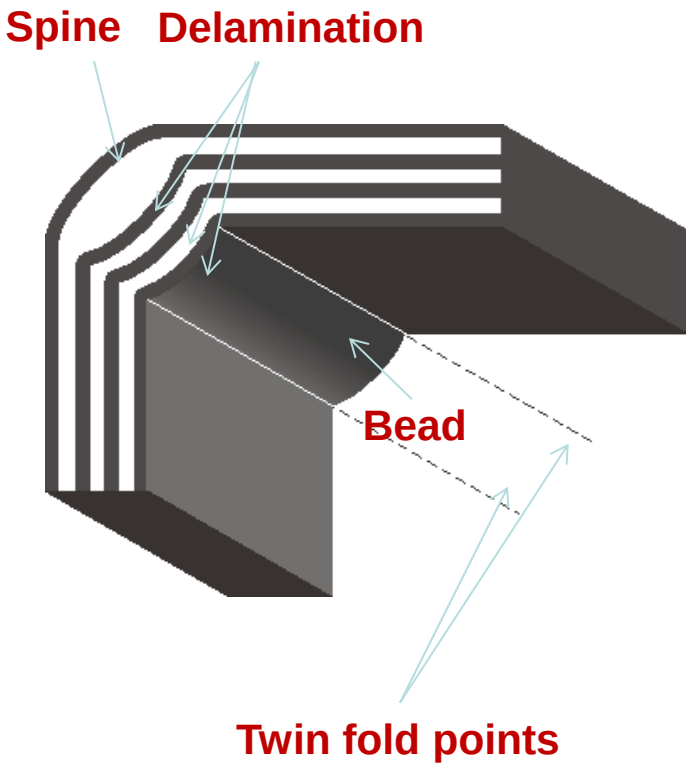




[Source: Hui Huang, KTH Stockholm]

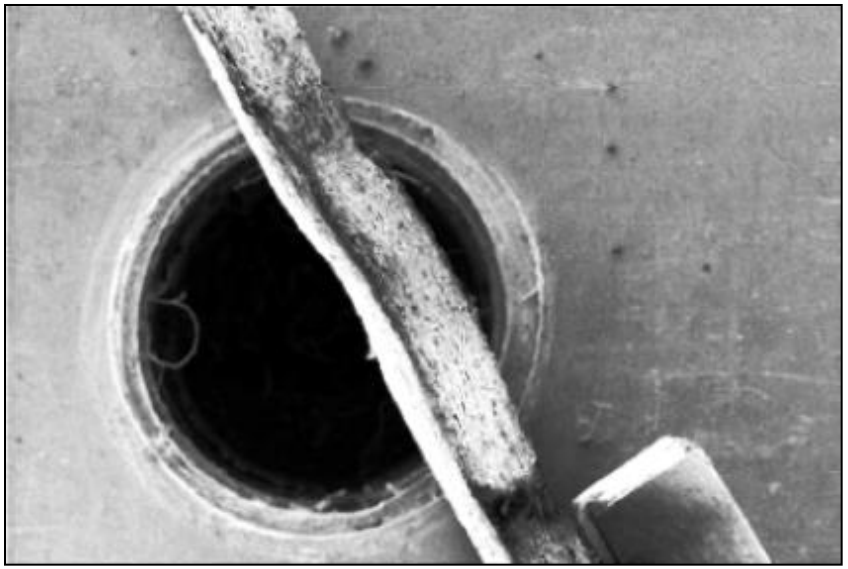
The Folding Process:

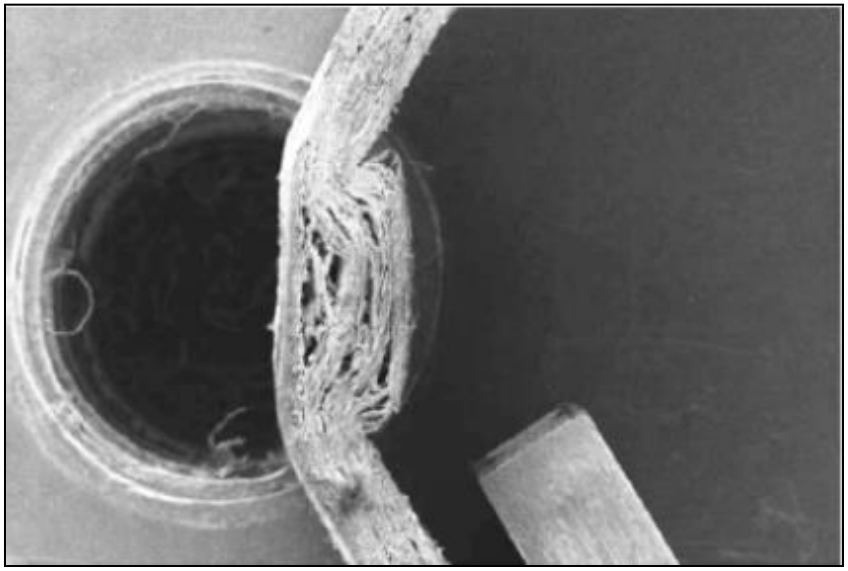
- Folding uncreased paperboard results in cracks on the outside
- The ability to delaminate (fracture surface parallel to the plies) is an important property for folding
- Tensile stress arises on the outside ply (Spine)
- The inner plies (Bead) are compressed and bulge
- Deformation and delamination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



A crease is a double fold

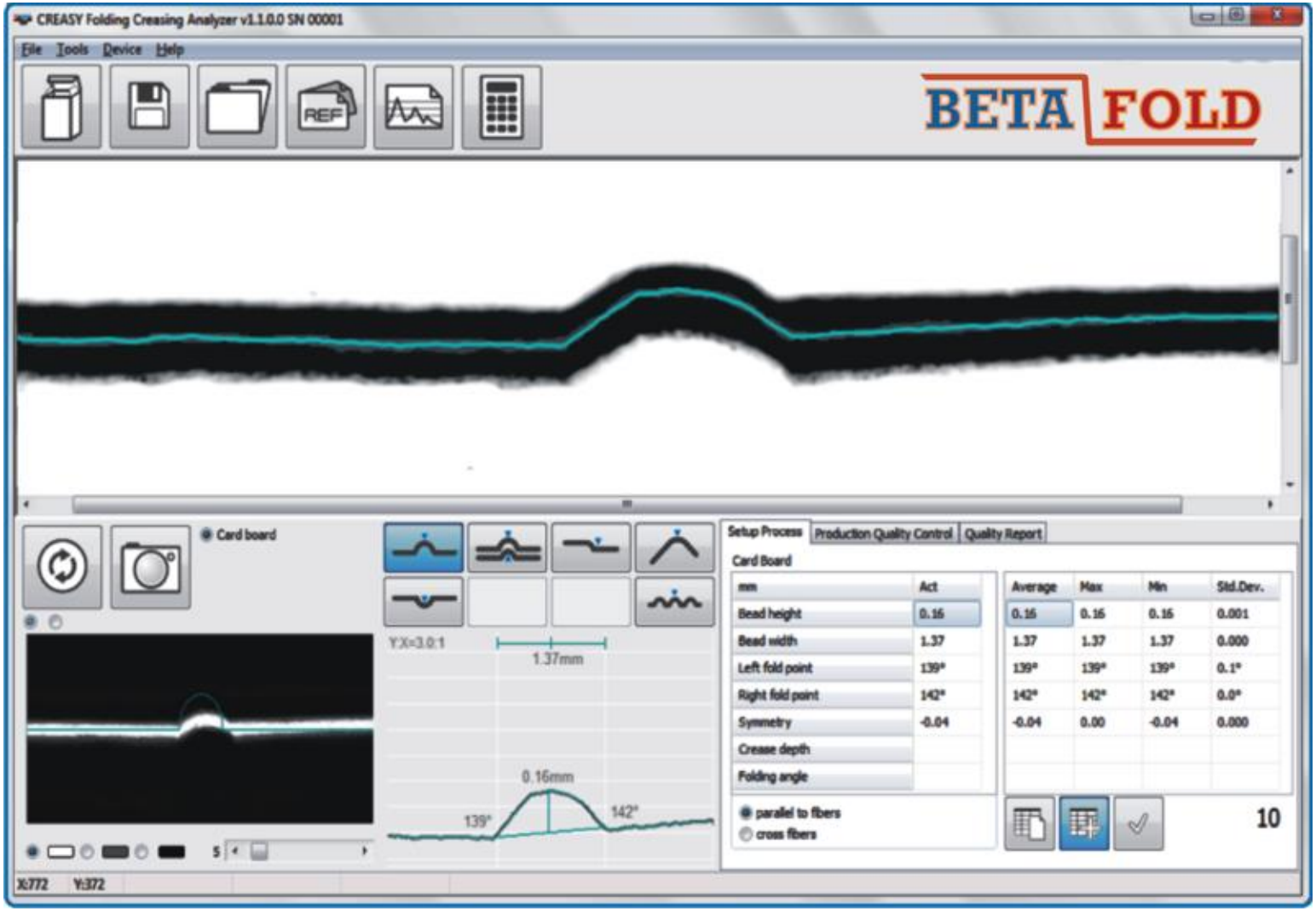
Deformation and Delamination of Creased Cardboard





[Source: Hui Huang, KTH Stockholm]

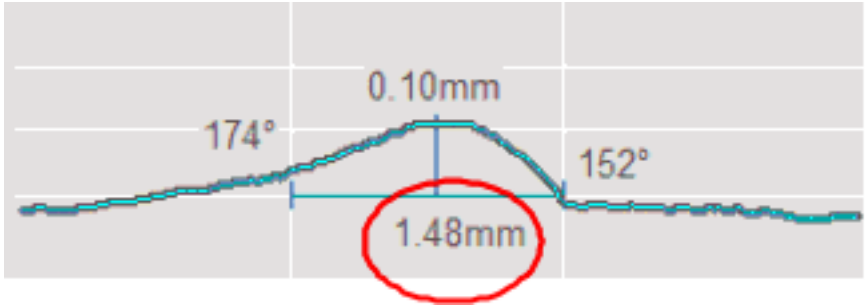
Analyze the Bead with BetaFold

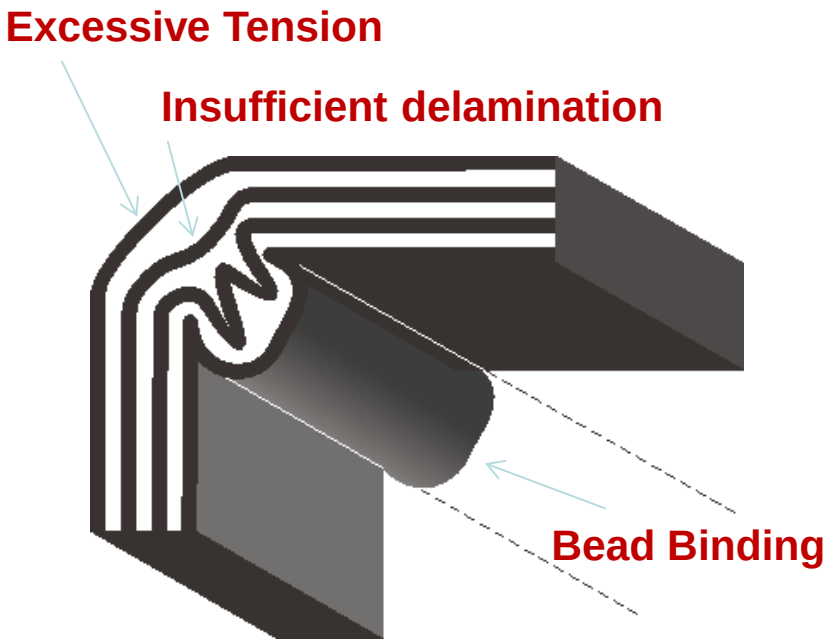


The Bead Width – A Delamination Parameter
The Distance Between the Twin Folding Points

Problems with a wide bead:

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



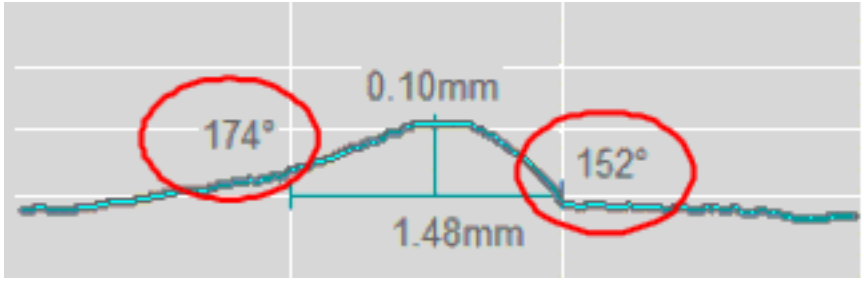


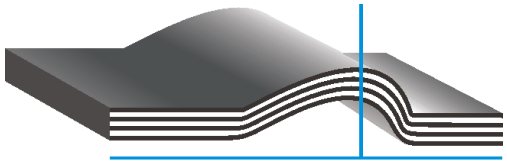
The Folding Point Sharpness Defines the Symmetry of the Bead

Problems caused by non-symmetrical folding points

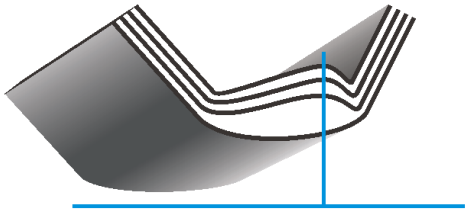
- Off-center folding
- Non-uniform boxes
- Excessive stress in a narrow area of the spine
- Fracturing and folding failure

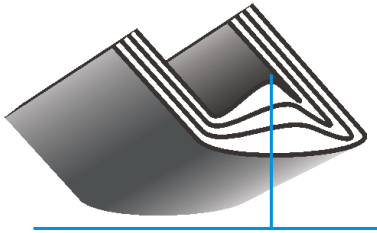
Is the creasing tool well **centered** and **parallel** to the crease channel?





One-sided crease





Max tensile stress

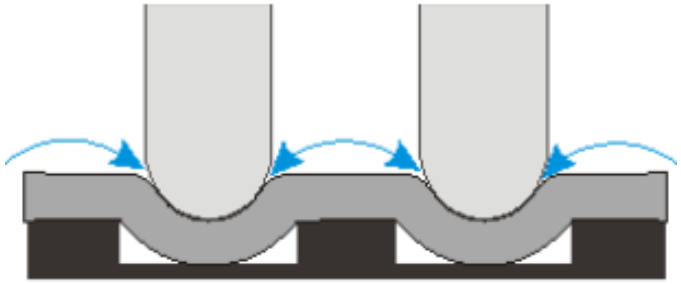
Causes of Asymetrical Beads

Parallel creases close to each other can cause:

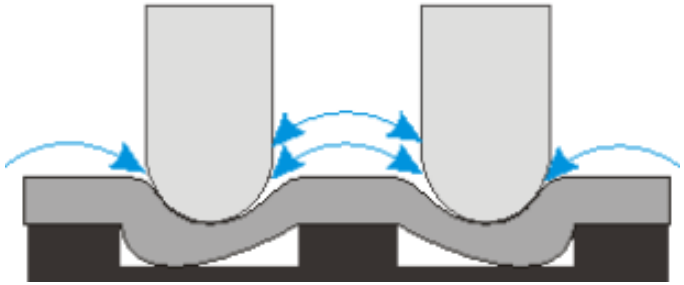
- Limitation in material stretch
- Competition in drawing the material
- Each crease is poorly formed
- Asymetrical internal delamination

Resistance to crease formation grows quickly beyond a critical distance

The Theory



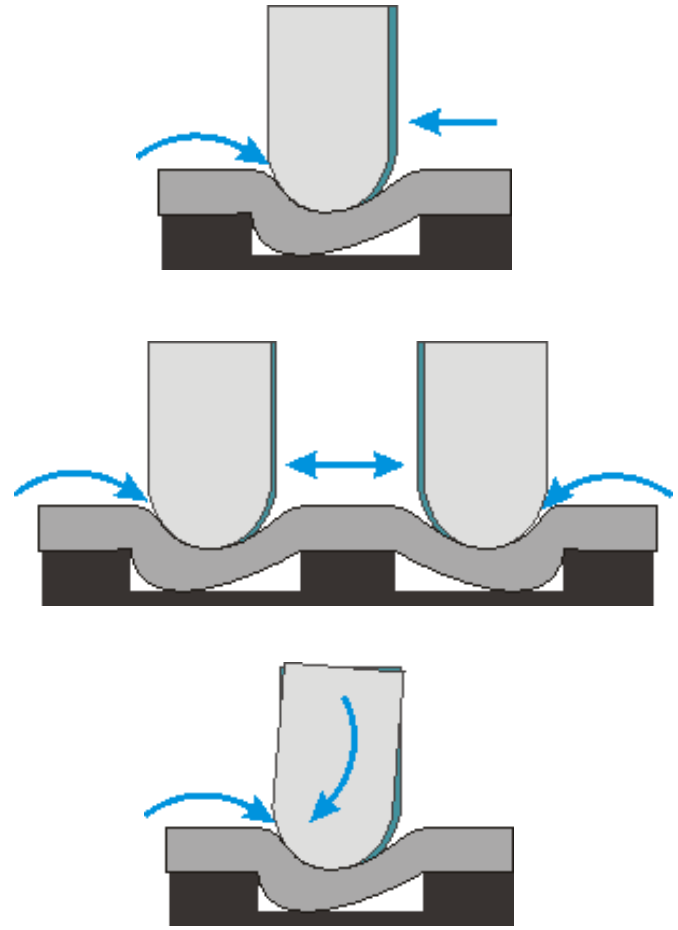
The Reality



Causes of Asymetrical Beads

- Rule-to-channel misalignment
- Tool-to-tool misalignment (tolerance mismatch)
- Crease rule distortion
- Non-vertical cuts in laser die board

Proposed adjustment at 0.01mm (.0004 inch) resolution:

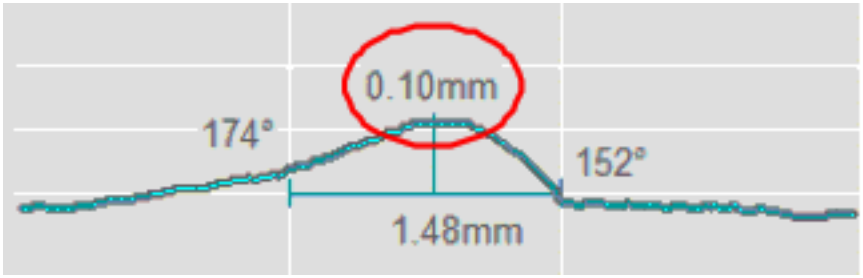


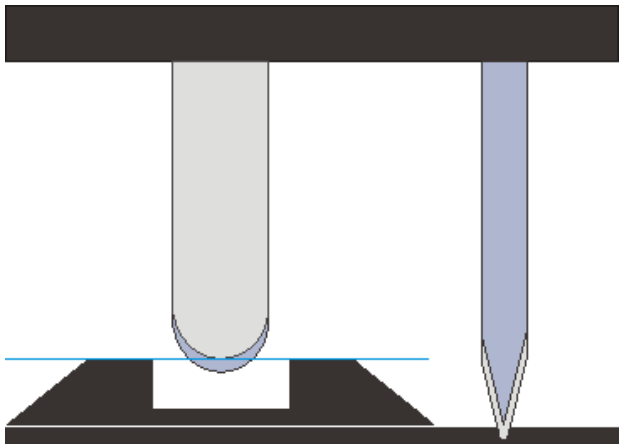
Symmetry	0.08

Bead Height as an Indicator of Penetration Depth

Knife position or setting changes the penetration depth of the rule:

- changing the tension forces causing die-cut edge chipping or flaking
- breaking the cardboard material
- faster erosion the upper corners of the creasing channel

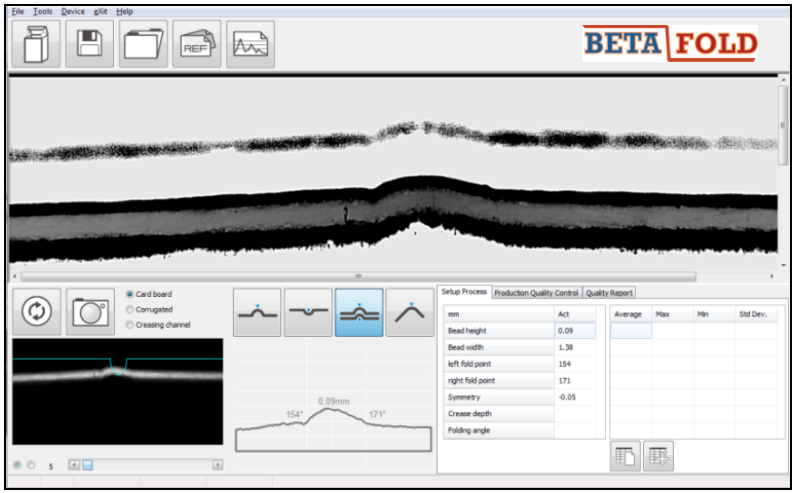


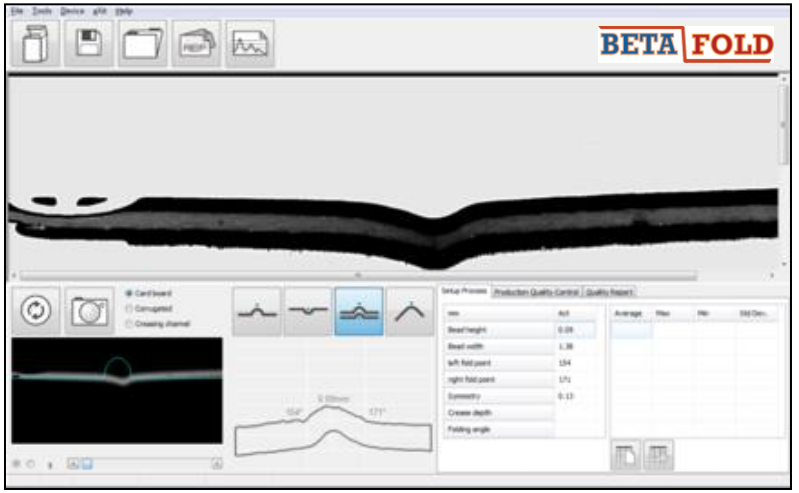


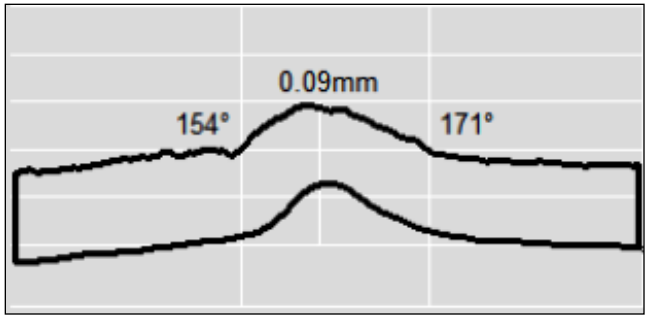
Crease Cross Section Analysis With Betafold

- Measure bead
- Flip sample over
- Measure crease

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

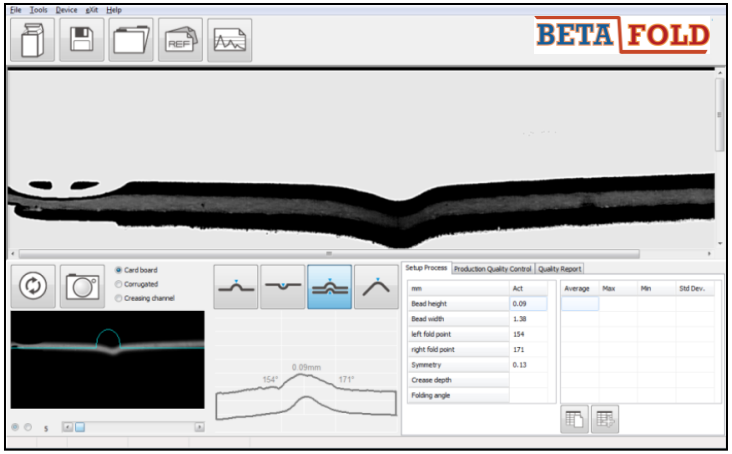


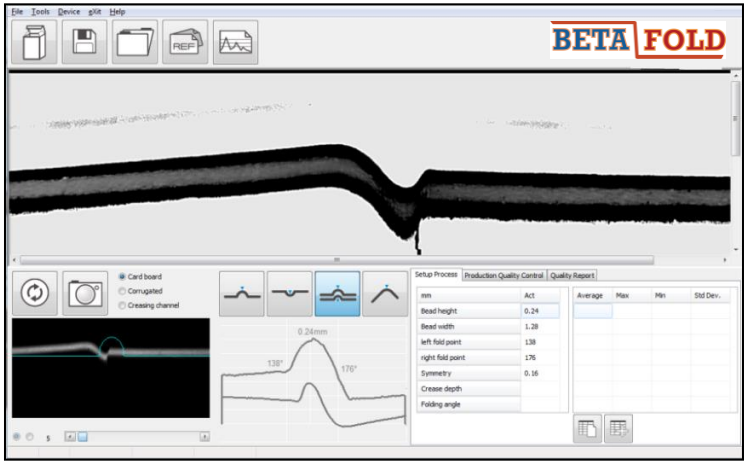




Compare the Crease Before and After the First Break

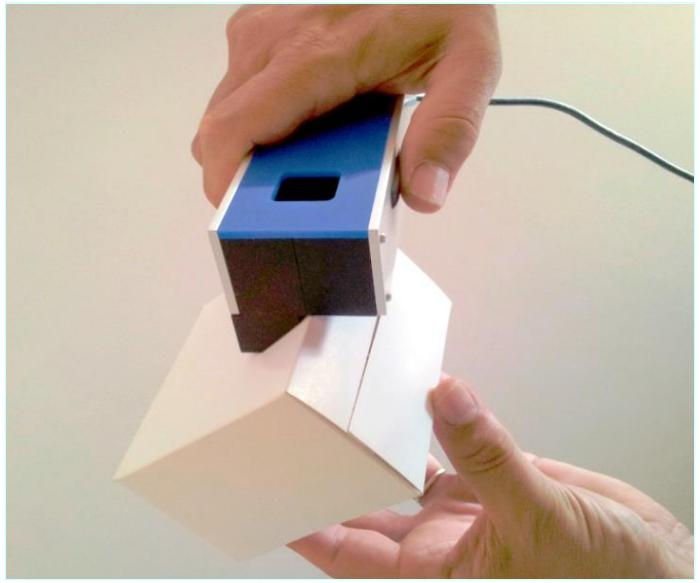
- The first break defines the final location of the twin folding points
- The first break defines the final symmetry of the folding
- The first break shows problems with cracks, fracturing and folding failures

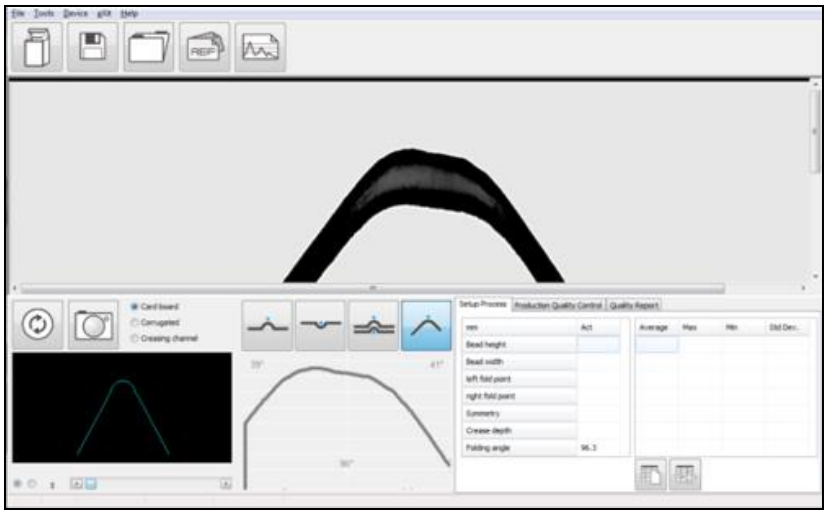




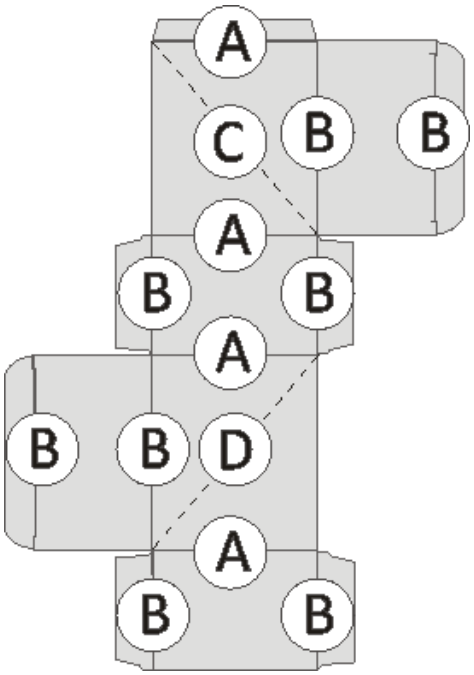
Control the Final Box Quality with the Betafold

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





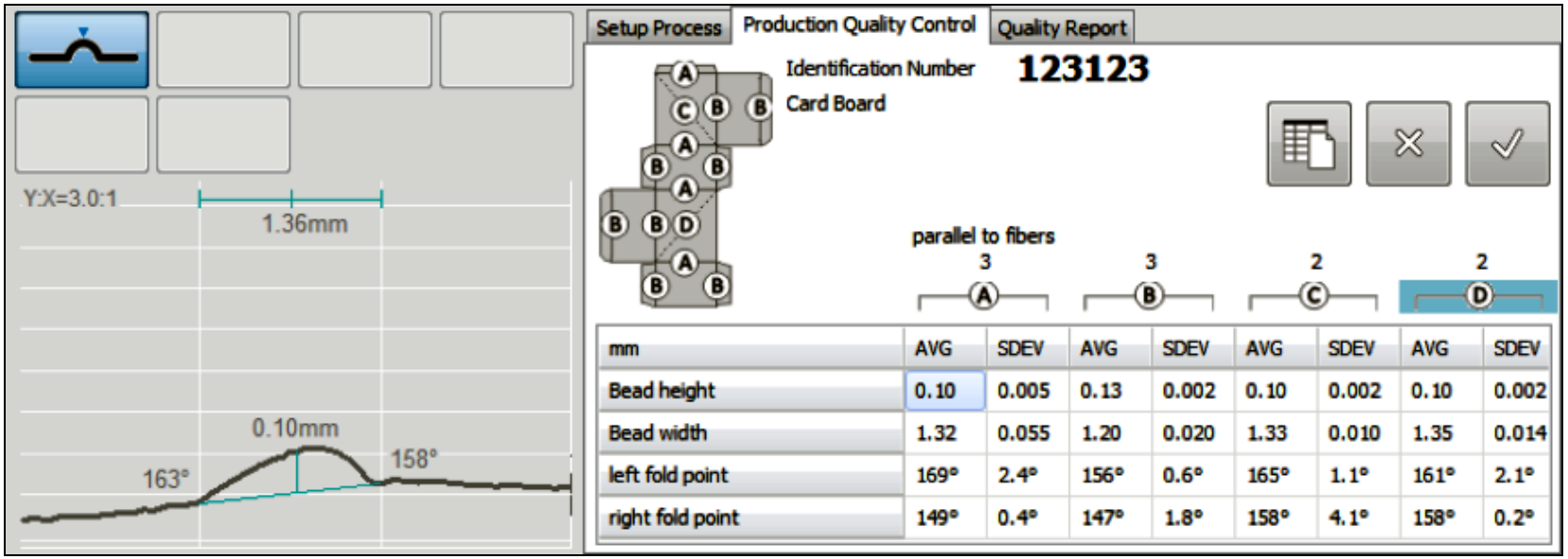
Control the Setup Process with BetaFold



- The bead shape and size will differ depending on the orientation of the fibers and creasing channel
- The bead can be optimized by setting the creasing tools properly
- Optimization can be measured with BetaFold and statistics can be calculated
- A PDF report can be
- Created with BetaFold

Folding Box Manufacturing Control with BetaFold

- Measure beads of the same orientation with BetaFold and collect measurement data
- BetaFold supports bead 4 orientation
- BetaFold creates a PDF report for each folding box
- BetaFold calculates statistics for the entire job



mm	AVG	SDEV	AVG	SDEV	AVG	SDEV	AVG	SDEV
Bead height	0.10	0.005	0.13	0.002	0.10	0.002	0.10	0.002
Bead width	1.32	0.055	1.20	0.020	1.33	0.010	1.35	0.014
left fold point	169°	2.4°	156°	0.6°	165°	1.1°	161°	2.1°
right fold point	149°	0.4°	147°	1.8°	158°	4.1°	158°	0.2°

Process Parameters: The Crease Channel

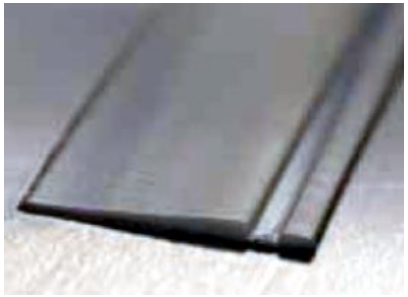
Fiber board:

- Dependent upon paper board thickness and rule width
- As narrow as possible
- Parallel to fibers more narrow than cross fibers

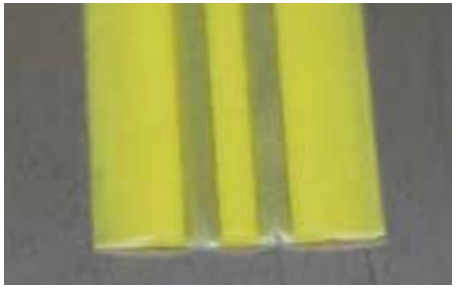
Corrugated:

- Dependent upon Crushed thickness and rule width

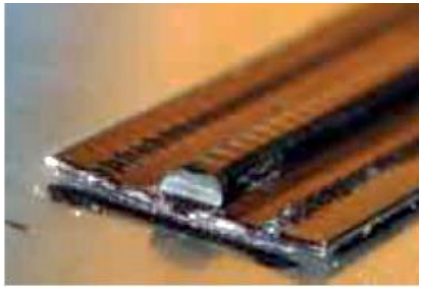
Center crease matrix
Most popular



Off Center crease matrix
Cutting close to creasing

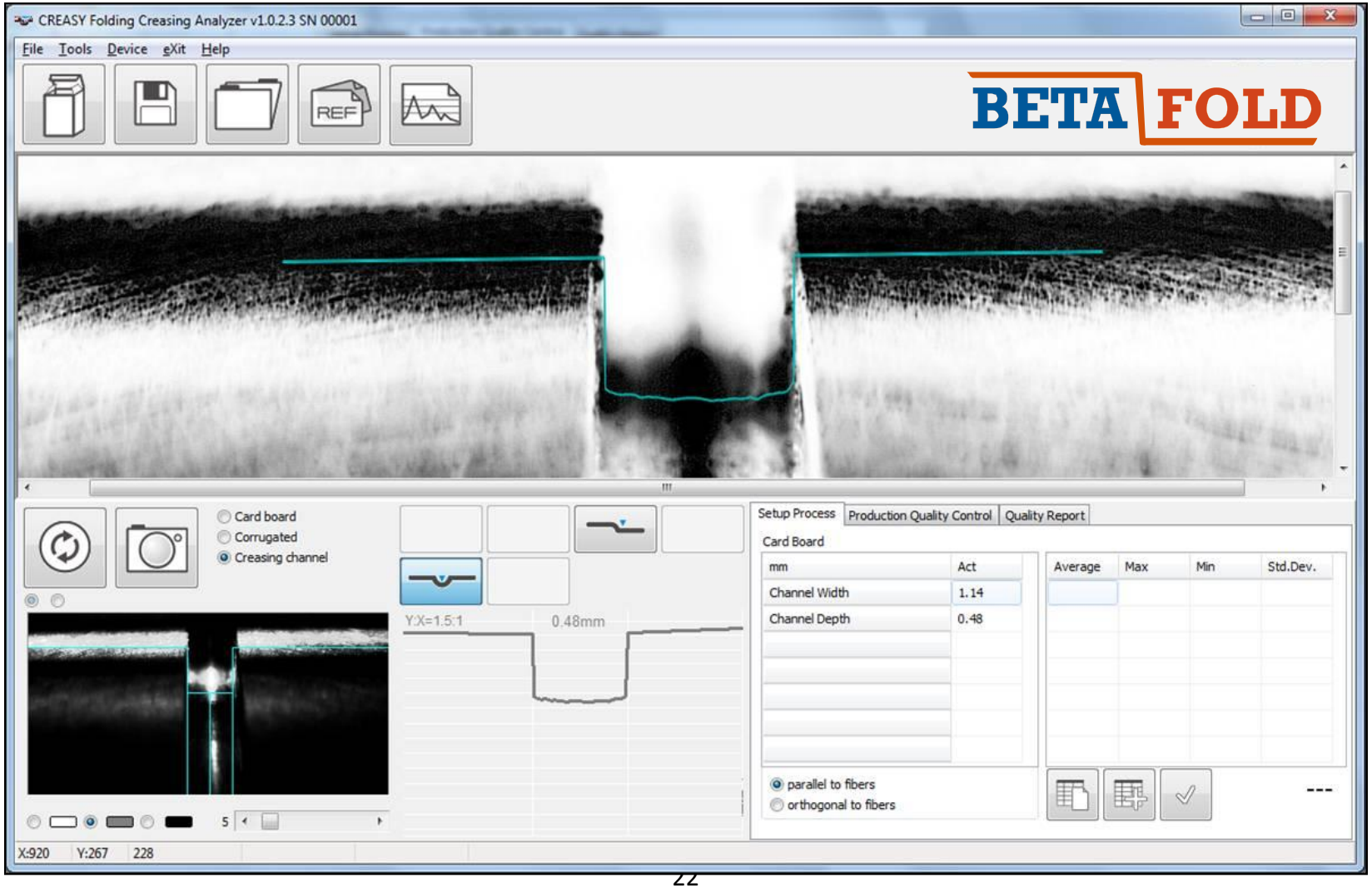


Multiple crease matrix
Double folding



Reverse crease matrix
Reverse folding

Control the Crease Channel With BetaFold



Why Creasing Control is Important

- Customers will not accept cracks and splitting on folded packaging products
- Customers will not accept non-uniform packaging boxes
- Paper structure and folding behavior varies with;
  - fiber lengths, fiber content, fiber orientation
  - coatings, bond between coating and paper
  - printed ink, varnish
  - reduced flexibility due to heat drying the printed sheet
  - environmental conditions, humidity in the pressroom
- Cutting and creasing process itself has variations
- Help to avoid runability problems on the packaging line
- Help to avoid waste because of unusable boxes

BETA INDUSTRIES

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