Case Study

Precision Bending Tester for Flexible Electronics

Automated 0–180° bend cycling and stable electrical contacting for validation

About the Cooperation

The project involved the design and construction of a compact bending test machine for performing repeatable mechanical cycles on flexible electronic parts. The system enables defined bending radii and angle sequences while maintaining electrical contact for continuity/stability tests during movement.

The fast and pragmatic development of customer-specific automation and test equipment, in-depth mechanical/mechatronic expertise, close collaboration and a structured verification approach through FAT qualified Konrad Technologies as the partner of choice.

Project Scope

Challenges

- A need for a repeatable, verifiable bending test for sensitive flexible electronics, including reliable electrical contact during dynamic motion to validate performance under mechanical stress.
- Specific requirements:
  - » Adjustable bend radius 0.5–5.0 mm (nominal range)
  - » Bend angle range 0–180° with defined target angles (e.g., 0/45/90/180°)
  - » Uniform circular arc (no flattening or asymmetry)
  - » Electrical contact stability during bending (no interruption)
  - » Repeatability of flap motion (position/angle)
  - » Host communication and triggers (Start/Stop, Flat/Bent position, dynamic movement)
  - » Safety: E-stop and interlocks, 230 VAC supply validation, ESD/grounding concept
  - » Quick set-up/clamping time for dummy/DUT

Objectives

- Deliver a validated bending test system that supports multiple bend radii and programmable angle profiles/cycles to standardise test campaigns and generate comparable results across designs.

Solution

Konrad Technologies implemented a compact, enclosed bending test machine with transparent guarding and integrated controls, designed to clamp, contact, and bend flexible parts in defined cycles with repeatable geometry settings.

Functions:

- Secure clamping across DUT size range
- Bend radius set-up and verification (mechanical stops + arc measurement)
- Angle control 0–180° and repeatable cycling (e.g., 0–90° process or customer profiles)
- Electrical contacting during motion (continuity / signal stability monitoring)
- Host communication, triggers and status signals (Start/Stop, Flat/Bent, etc.)
- Safety features (E-stop, interlocks) and ESD/ground path verification

Technologies/processes:

- Mechanical radius/angle architecture with defined stops
- Repeatable flap mechanism
- Safety enclosure/interlocks
- PC/controller interface for commands, triggers and test execution.

Applied test procedures:

FAT verification against a structured requirement list:

- Radius and angle measurement
- Repeatability over multiple cycles
- Visual arc-shape inspection
- Continuity test during motion
- Communication/trigger validation
- Safety/interlock testing
- ESD/ground resistance check
- 230 VAC supply verification
- Operation checks within specified temperature/humidity window.

Challenges during implementation and solution:

At very small radii (e.g., **0.5 mm RoC**) the sample can show an undesired inward kink/reverse bend tendency depending on loading conditions. This was mitigated by introducing a **pre-centring/pre-angling step during loading** that gently guides the sample into the intended bend direction (without over-pressing). After loading, the system returns to the standard sequence: flaps close to a coplanar/parallel position, contacting is closed, and then the normal bending cycles run.

Customer Benefit

From this solution the customer gained a validated, repeatable bending test platform enabling standardised evaluation of flexible electronic parts with configurable radii/angles and stable electrical contacting — supporting faster development iterations and consistent data.

Measurable improvement:

- Repeatable and verifiable test conditions (radius/angle/cycle definition)
- Reduced test variability through defined loading/clamping strategy
- Structured FAT acceptance as a foundation for internal approvals and future test campaigns

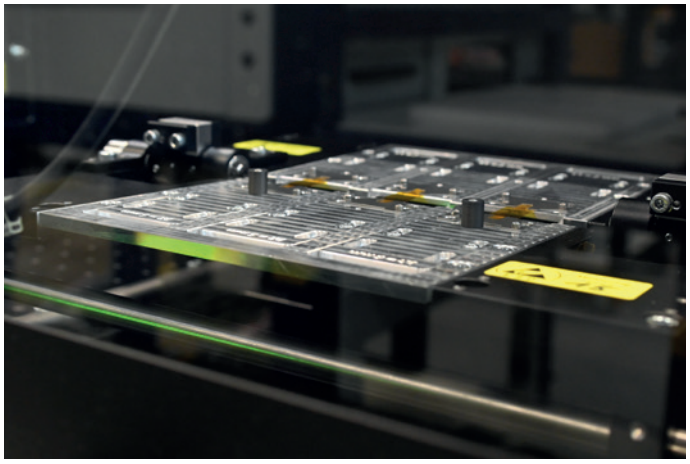
Our Know-how

Strengths that contributed most to the success of this project:

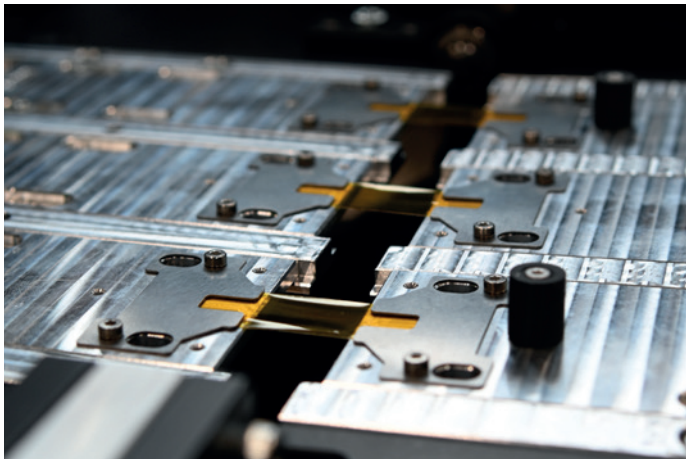
- Rapid, customer-specific mechanical/mechatronic development
- Structured FAT execution with measurable acceptance criteria
- Close, iterative collaboration (PoC-oriented engineering)
- Focus on usability, safety, and test repeatability

Key insights and best practices gained from this project:

- For smallest radii, controlled guidance during the loading phase is crucial to avoid reverse kinks.
- Contacting needs tolerance-robust design for dynamic motion (stack-up, spring travel, strain relief).
- Early alignment on measurable acceptance criteria accelerates FAT and reduces ambiguity



Repeatable mechanical cycles on flexible electronic parts



Flexible electronic parts