MICRON / AUTOMATED TEST CELL

Bi-directional testing and measurement integration

Revision N | Engineering review | 15 September 2026

Six contacts. Two test modes. One trace for every specimen.

The revised simulator uses three upper and three lower bending pins. Instron drives the central pair down and up. The lower center cassette retracts only when empty and unloaded before the torsion fixture indexes beneath the same upper roller.

All displayed forces and curves are ARTIFICIAL demonstration data. There is no live Instron or robot connection, no prediction of actual product strength and no physical pass/fail result.

Design basis	Rev N configuration
Overall CAD envelope	Approx. 1,659 W x 2,116 D x 2,500 H mm. Add installation and service clearance.
Robot	Actual ABB GoFa 5 / CRB15000-5/0.95 link geometry; the optional PoWa 10 view remains a reduced model.
Bending station	Complete module raised 150 mm; 75 mm support span; six diameter 10 mm rollers.
Mode heights	BEND +150 mm / TORSION 0 / TRANSFER +220 mm / SERVICE +214 mm, relative to the low torsion head datum.
Center cassette	50 mm rearward retraction. Positive cross lock carries the bending load; pneumatic actuation moves the cassette.
Complete demonstration	Eight fresh bending specimens, explicit simulated tray replacement, then eight fresh torsion specimens.

What changed from the previous single-contact model

Restoring the lower center pin creates a bidirectional load path and a new mode-transfer clearance requirement. The former TRANSFER +180 mm and the intermediate +210 mm positions are superseded by +220 mm. Individual loading still occurs with the Instron head already near the specimen; there is no full-height approach for each part.

Bending: raw travel and nominal stress

The board sits between an upper/lower pair at each of three stations. The outer pairs stay fixed; the middle pair moves with Instron. Sign convention: downward head travel and the corresponding load are positive; upward travel and load are negative. CAD world +Y is upward, so its animated offset has the opposite sign.

Parameter	Nominal configured value
Product model	90 x 14 x 3.0544 mm
Support span L	75 mm
Width b / thickness h	14 mm / 3.0544 mm
Center pickup clearance	1 mm above and 1 mm below the nominal rectangular envelope
Side opening / reverse free lift	7.800 mm opening; 4.7456 mm reverse support take-up
Loaded deflection example	+0.6 / -0.6 mm after pickup and support take-up
Corresponding head travel	+1.6 mm downward / -6.3456 mm upward

Nominal rectangular-beam relation

sigma = 3 F L / (2 b h^2)
With F = +/-10.8 N: nominal outer-fiber stress = +/-9.3024 MPa.

The signed value follows one chosen reference fiber; opposite board faces have opposite stress. This section-level relation does not calculate local chip, solder-joint, laminate-feature or SSD assembly stress. Those require an approved product model, strain measurement or FEA.

Separate the channels

Store the Instron head displacement unchanged. Separately calculate center pickup, rigid support take-up and corrected load-point deflection. After the reverse phase, confirm the specimen has re-seated on both lower supports before robot re-entry. Actual crosshead travel also contains frame, tool and mounting compliance; it is not automatically specimen deflection.

The source DUT has detailed surface features. Exact nearest distances are approximately 1.2184 mm to the center upper roller and 5.0891 mm to the side upper rollers. The animation uses the nominal rectangular-envelope model above. A real test method must establish contact and compliance from the installed fixture.

Displayed graphs: force-displacement, nominal stress-displacement, nominal stress-time, displacement-time and force-time. Displacement axes are explicitly head travel; corrected deflection is retained separately in the export.

Torsion: moment and derived angle

The common powered shuttle moves bending out and torsion in. The lower center cassette remains retracted. The same upper Instron roller presses the torsion lever while both pneumatic end clamps retain the specimen. One shaft rotates; the opposite end stays fixed.

Calculation	Example, artificial channels
Nominal moment M = F x a / 1000	F = 11 N; perpendicular arm a = 64.95 mm; M = 0.71445 N m
Angle theta = atan(delta / a)	Corrected lever travel delta = 2.2 mm; theta = 1.9400 degrees
Raw head travel	3.2 mm including 1 mm nominal contact pickup
Sampling	50 Hz for 18 seconds: 901 samples, including both endpoints

Why this angle relation

This model assumes a fixed vertical force line with sliding/rolling contact along the lever. The horizontal perpendicular arm remains 64.95 mm, giving delta = a tan(theta). A fixed material-point follower uses a different relation. Do not substitute an arc-length or sine relation without matching the actual mechanism.

F x a is the nominal axial-force moment estimate. Calibrate angle-dependent contact reactions, effective leverage, force zero, contact pickup, backlash and fixture compliance. Finite roller radius, contact migration and parasitic bending affect real conversion. A shaft encoder is the preferred option for a direct angle channel. Pneumatic pressure is neither clamp force nor specimen torque.

Displayed graphs

Torque-time; torque-angle; angle-time; raw head displacement-time; raw force-time. Torsional shear stress is intentionally not calculated for the complex board without a qualified section model.

Per-specimen record

Every job keeps an immutable ID, product/mode, robot, source and destination tray IDs and pockets, timestamps, method revision, dimension/arm inputs, raw channels, derived channels and completion or quarantine status. Bending stores 1,201 samples per 24-second trace. Torsion stores 901 samples per 18-second trace. Playback speed does not change this time base.

Online saving is acknowledged per full trace. Reopening the same browser session restores saved records. Clearing its session cookie removes that browser access. Failed saves remain visible with retry and CSV/JSON export. Interrupted specimens keep partial traces and are not marked as physical passes.

Integrating the installed Instron system

Use an approved on-site Windows adapter between the cell PLC and the installed Bluehill interface. Confirm the Instron model, serial number, controller, Bluehill version, licensed modules, supported SDK and test-method permissions with Instron before implementing the real interface.

Stage	Required behavior
1. Cell ready	PLC checks specimen/tool/fixture IDs, central pin position and lock, shuttle/head position, retention, guards and robot-clear.
2. Request test	Send a unique job/request ID and approved method revision. Transfer specimen dimensions, lot, tray and pocket metadata.
3. Correlated execution	Match accepted, running, complete or error to the same request ID. The instrument executes its approved method. No automatic second start on timeout.
4. Acquire raw trace	Use the OEM-supported export/API route for time, force and displacement. Retain the original export and calibration identity.
5. Validate and store	Verify completed file/export, matching job, columns, units, monotonic time, finite values and row count. Preserve raw channels; version derived calculations separately.
6. Recover faults	Stop issuing requests, retain partial data and specimen ownership, reconcile the actual Instron job and quarantine where required. Missing data is never a pass.

Live waveform availability

Instron documents Bluehill Universal API support for metadata, automation actions and results integration. Real-time waveform access depends on the installed interface. If live waveforms are unavailable, display supported progress/status during testing and import the full trace after completion. This simulator contains no invented OEM API commands or executable Instron method file.

Network and safety boundary

Keep physical controls in the approved OT network. Use authenticated outbound result transfer to the dashboard. The web app is a display and request layer; independently validated safety hardware/PLC functions retain control of hazardous motion and energy.

Verification and release boundaries

Checks completed for this revision

Signed bending and gap take-up calculations; moment and angle units; 8 + 8 distinct specimens; complete 50 Hz traces; animation-rate independence; partial-fault quarantine; immutable database round-trip, idempotent retry and session isolation; central-pin interlocks and TRANSFER +220 sequence. The CAD package includes the separate exact geometry audit and STEP export checks.

The supervised interactive browser preview was unavailable for this turn. Data paths, source structure, CAD assets and the offline film are checked separately. The film samples the same web simulation program and actual GoFa joint transforms, then renders those CAD states with an offline graphics renderer. It has no narration or other audio.

Before fabrication or commissioning

Approve allowable product contact/strain and tolerances; center cassette/lock load rating and stiffness; released machining drawings and fits; sensor diagnostics; continuous robot, tool, cable and hose sweep; ABB controller/RobotStudio trajectories; Instron travel and method limits; compression/tension calibration and compliance; ESD/cleanroom criteria; fault recovery and data-retention policy. Existing selected SERVICE clearances include a 0.681 mm nominal gap and remain review limits.

Primary technical references

Instron Bluehill Universal API overview

Instron Bluehill Universal / TestProfiler

Instron flexure testing guide

UNSW engineering formula sheet

ABB GoFa source CAD and URDF

Commercial scope remains unchanged: common machine USD 275,000; one separately listed product kit USD 20,000; initial total USD 295,000. This technical addendum does not expand the agreed product-kit scope.