

BAYFLEX TECHNOLOGIES



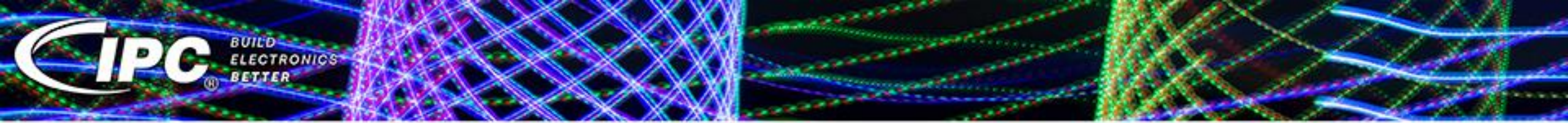
Emerging Flexible Electronics
Reliability & Performance Criteria in Wearables



January 2023

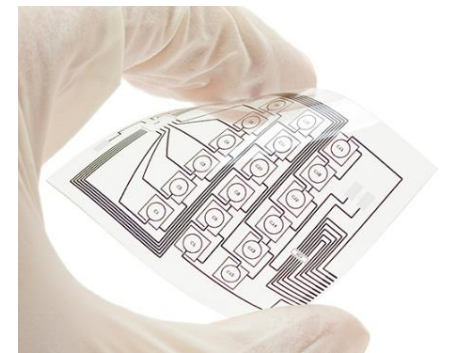
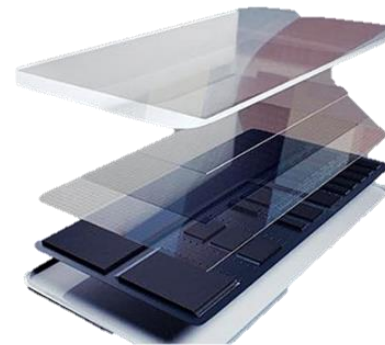
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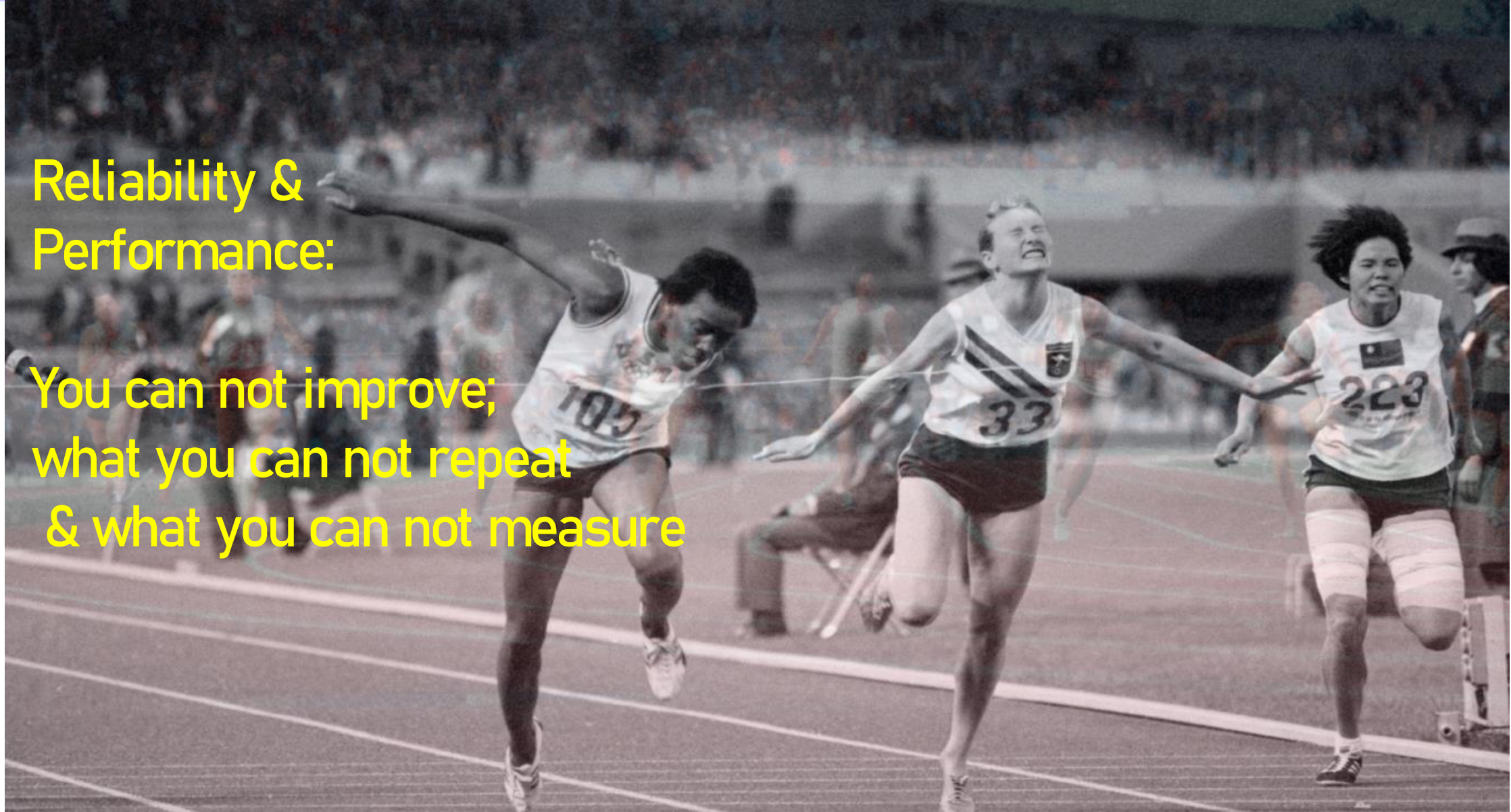
About us

- **Yuasa Systems**, is the global leader in continuous reliability test systems for R&D and manufacturing since 1992, with over 1,100 installations worldwide including many in the flexible electronics supply chain from Europe, North America and Asia. (participant in IEC and ISO standards bodies & member SID) www.yuasa-system.jp/en
- **Bayflex Technologies** is Yuasa's representative for North America and Europe. Based in San Francisco bay area, also develops lab automation and data analytics optimized for reliability systems since 2015. (Member IPC*, OE-A, SEMI/Flex, Nextflex, AFFOA*)
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Reliability & Performance:

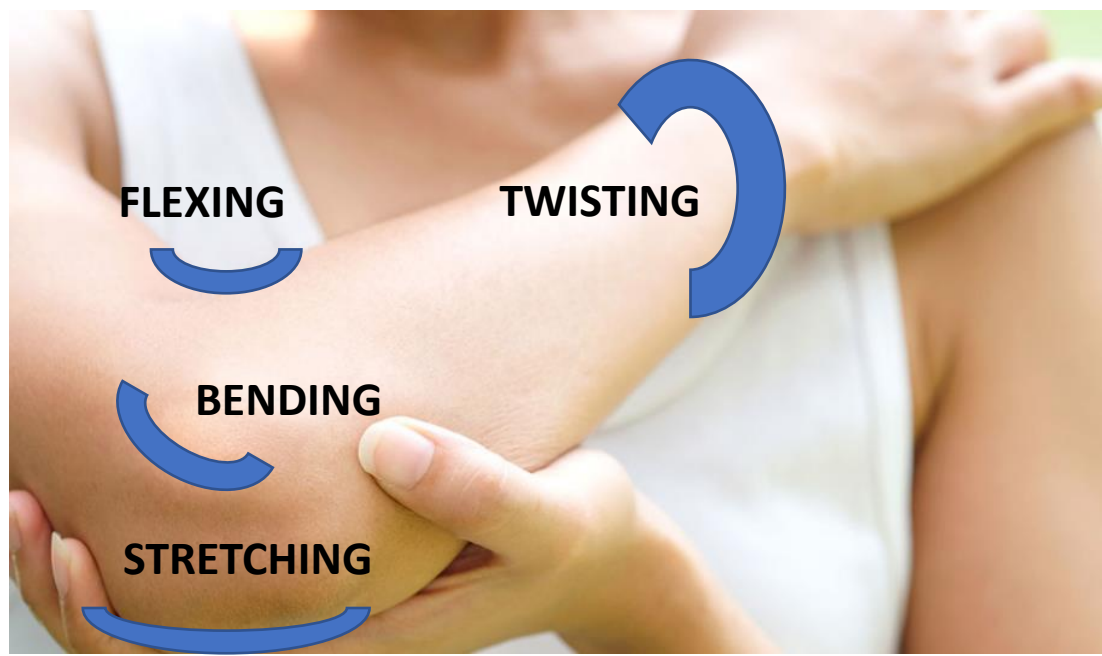
**You can not improve;
what you can not repeat
& what you can not measure**

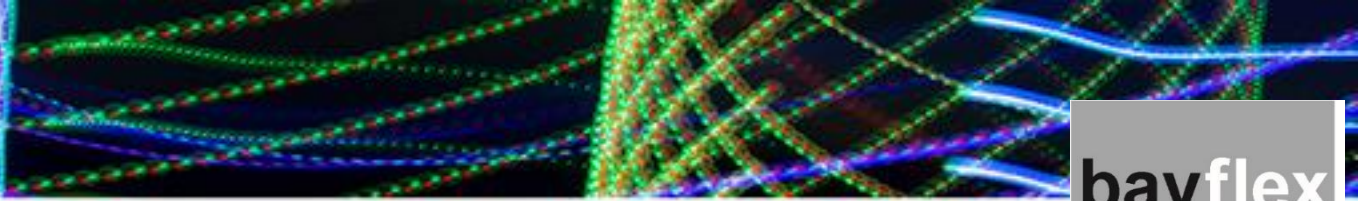


Human Body Movement

Mechanical Breakdown can be achieved by combination of;

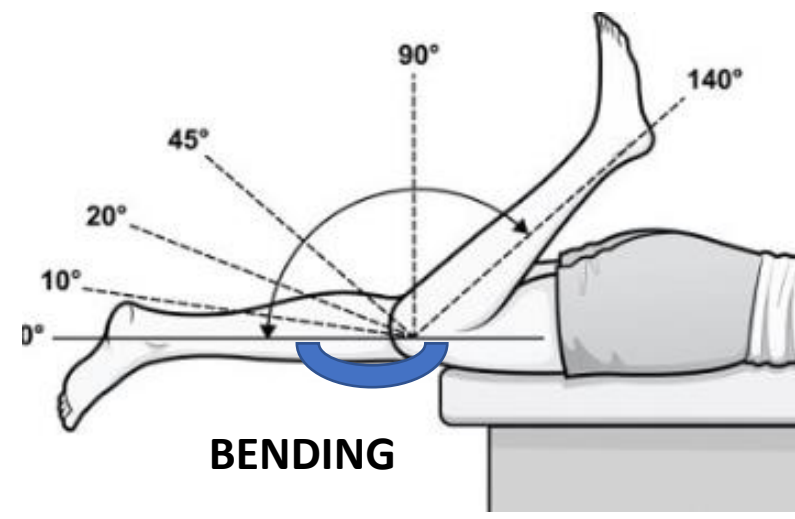
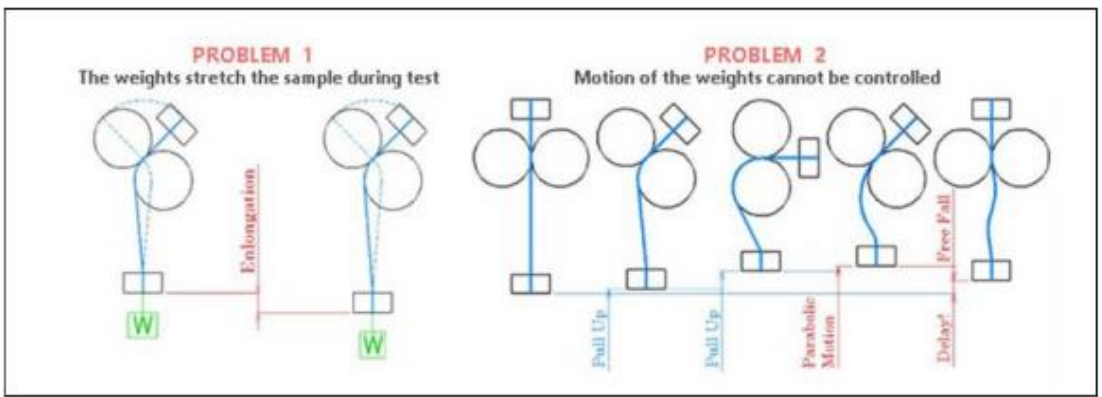
- Bending
- Stretching
- Flexing
- Twisting





Bend

Replicate Simple Human Movement
 Various mechanical methods using counter-weights



Precise Repetitive Accuracy is not guaranteed;

- Sample Stretches
 - Momentum of Counter weights causes distortion
- ➔ System of Clamps, Springs and Pulleys eliminate Gravitational Pull (Tension-free)


Torsion

Replicate Simple Human Movement (Washing) : 50 washes*200 revs = 1000 cycles, +/- 45' @ 10RPM
 Various mechanical methods using Fixed and Revolving Clamp
 Sagged Sample, Adjustable Tension, Stretched and Tension-free Methods
 → Many methods but Tension-free has more accuracy



TWISTING

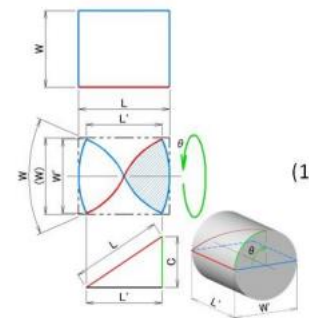
Result ① -1 ~ Metallic Foil ~



Length: 100 [mm]
 Width: 100 [mm]
 Thickness: 0.011 [mm]

	± 45 deg. 10 rec./min. 5 times	Sagged	Tension-Free™	Weight [200 g]	Weight [500 g]	Stretching
Straight						
Turned						
Overview Crease	Pass	Pass	Fail (50 times)	CANCEL	CANCEL	
With Backlight Crack				CANCEL	CANCEL	

Basic Knowledge ~ Torsion ~



$$L' = \sqrt{L^2 - C^2}$$

$$W' = (L - L') \sin \psi / (1 - \cos \psi)$$

$$C = \pi W' (\theta / 360)$$

$$(1 - \cos \psi) / \psi = \pi (L - L') / 180 W$$

Length of Sample: L [mm]
 Width of Sample: W [mm]
 Torsion Angle: θ [deg.]

Emerging Failure Assessments

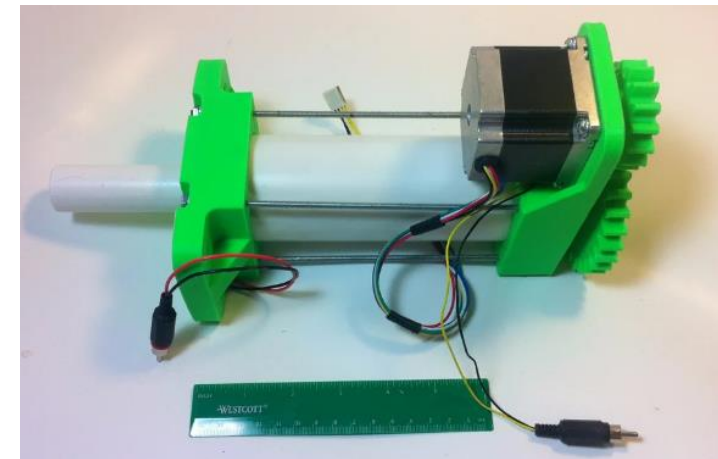
- Ensure Integrity of New Materials & Micro Electronics while in Continuous Use (cracks, contact failures)
- Detect Micro Strain fractures of New Materials (delamination, deformation)
- Continuous Testing in Complex Hostile Conditions (flex, elongation, torsion etc. temperature, humidity)



Reliability Challenges

Legacy Testing Environment

- Legacy Universal Testers designed to test physical limits of hard materials
- Home-built Testers not suited for endurance, scale and established supply chain networks
- Compliance with Emerging De-Facto and De-Jure Standards (Displays, Wearables) requires precision, accuracy and control
- Incorporate new data/image analytical tools
- Integrate into Hostile and Climatic conditions



Three Flexible Electronics Trends for E-Textiles (not include medical devices)

Integration of Display devices in Wearables & Metaverse-like experiences → scale manufacturing

- Integration of OLED, Flexible Batteries, Thin Semiconductors on Textiles / CS-R, FS-N
- Established Consumer Electronics standards over 1 mil cycles, 200K component level

Integration of Comfortable and Safe Mobile Environment (first use of flexible materials) → new inks/materials

- Heated Seats, Sensors on Textiles, Steering wheels / P150, FS-N
- Established Automobile standards over 1-2 mil cycles, some in harsh environments

Integration of Electronics on or in Clothing

- Integration of Smart Electronics (Sensors, Thin Semiconductors, Batteries) / FS-N, PD, P150, FT
- Evolving standards; thousands to 50K cycles, eventually in hostile environments

Bayflex provides complete flexible electronics reliability tools to identify defects & faults in the entire R&D, Manufacturing/Supply Chain, and Customer Deployment networks

Mechanical Testers

REPEAT

Inter-changeable Mechanical Testers
Tension-free (Less Distortion from Counter Weights)

Motor Drive Units

REPEAT

Multi-modal Rotary & Linear Motion Movement
Constant RPM (Less Jolting than CRE machines)

Lab Automation & Analysis

MEASURE

Designed for Third Party Device Integration
Client-Cloud Based Predictive Solutions

Hostile Integration

OBSERVE

Legacy or Integrated Multi-Climate Unit

90% of lab time used to refine own tools
And run tests and only 10% for data analysis

REPEAT

Failure Modes & Mechanical Motions

Deformations	Fold	Flex	Twist	Roll	Stretch	Bend
Cracked	possible	possible	YES	YES	YES	YES
Delaminated	YES	YES	YES	Possible	possible	possible
Bent Permanently	YES	YES		YES		possible
Stretched Permanently			possible		YES	possible
Torn			YES		possible	

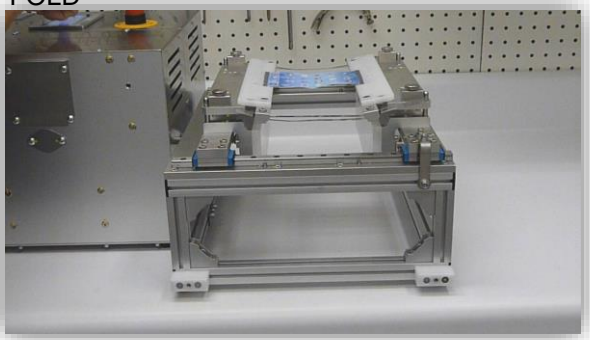
BEND



PUSH



FOLD



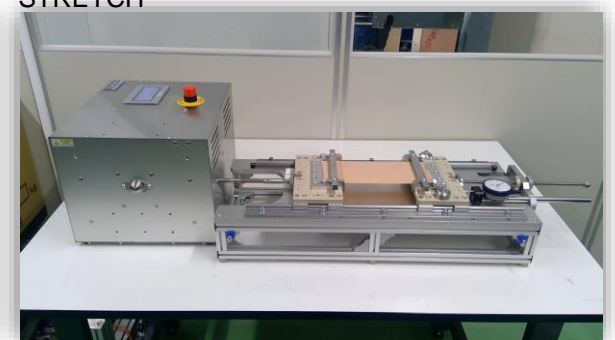
FLEX



TWIST



STRETCH

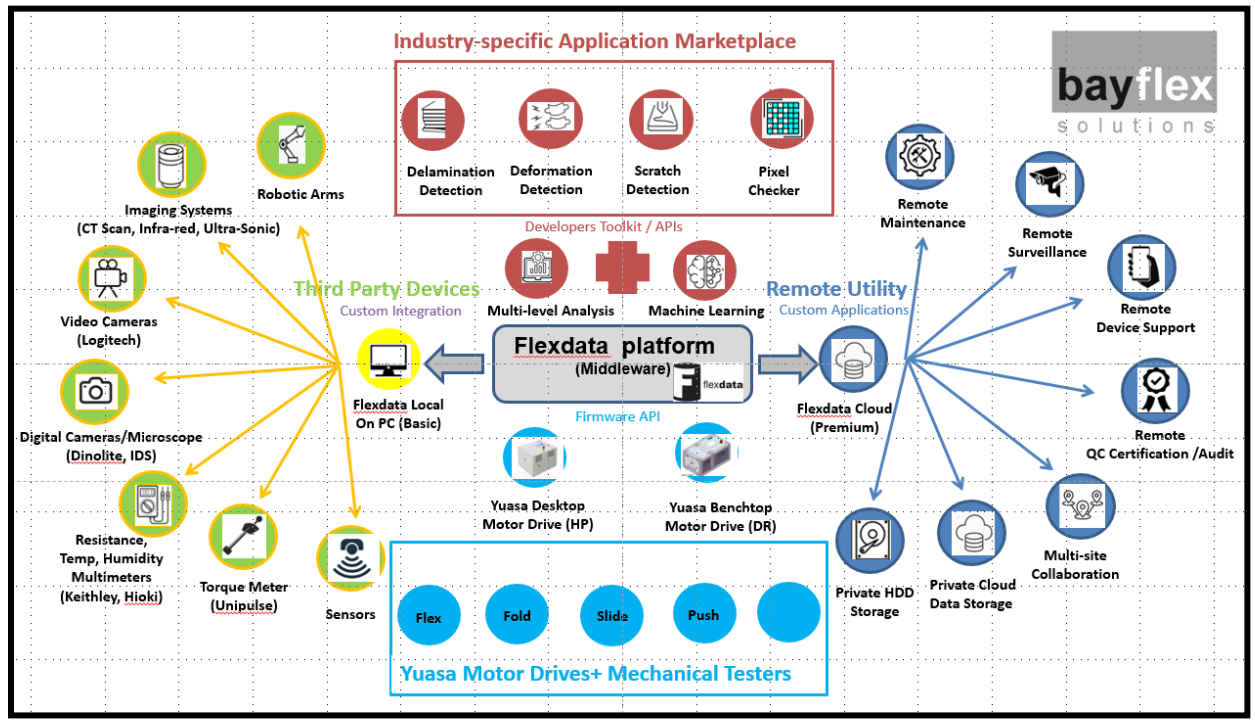




MEASURE

Data Automation & Analytics

- Lab Automation, Remote Surveillance, & Communication
- **System Control for Third Party Devices** (Cameras, Meters, Sensors, Robots, Hostile Chambers)
- Optimized for higher performance with Yuasa endurance testers
- Your **cloud architecture** AWS, MS Azure, Google Cloud, iCloud
- Smart & Predictive Advanced Analytics (Delamination, Deformation, CT Scan) with evolving Machine Learning capabilities and compatible with existing Visualization libraries

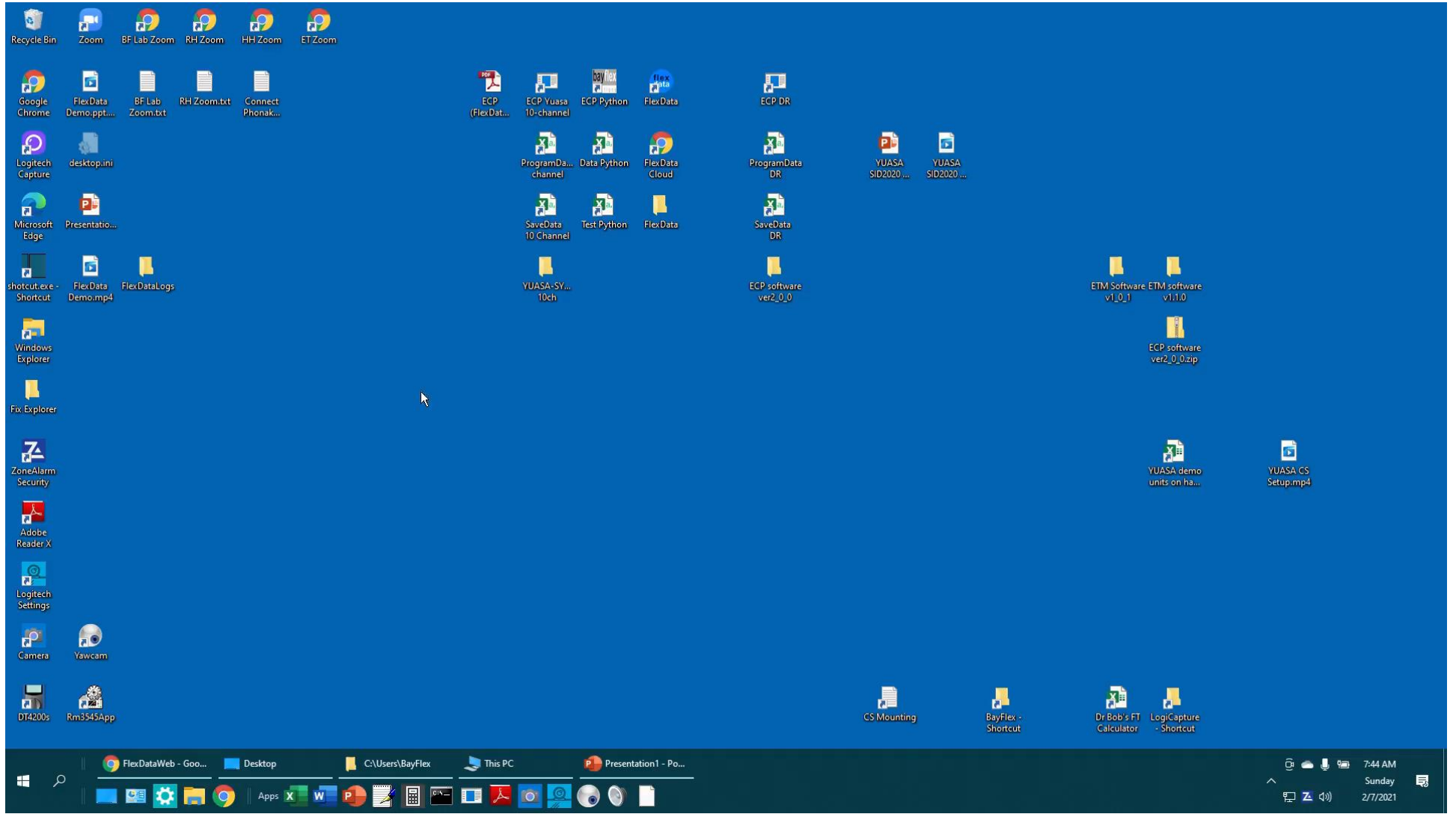


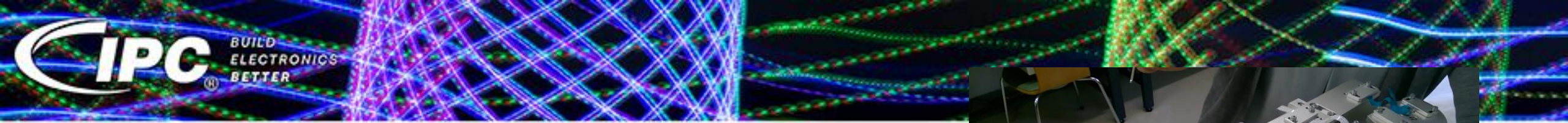
- ➔ Build your own proprietary Materials Database
- ➔ Configure your own Test Assessment Methods



MEASURE

Flexdata Test Drive





SCALE

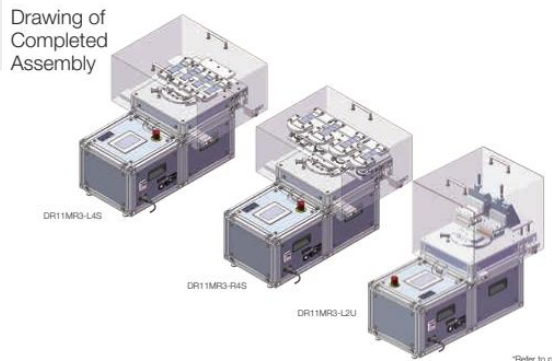
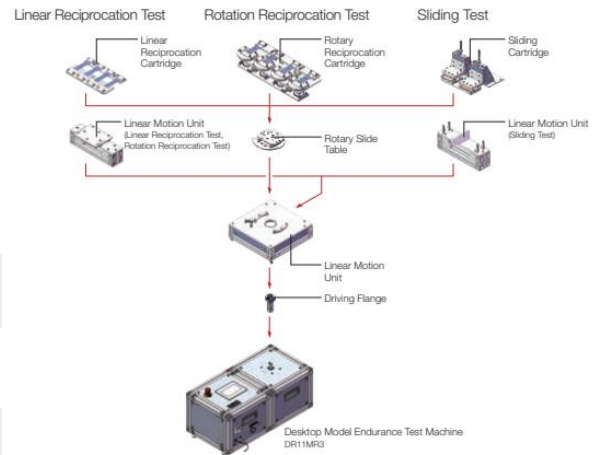
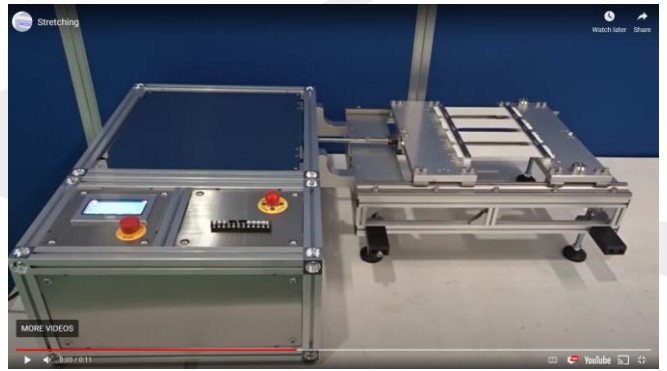
Recent Developments

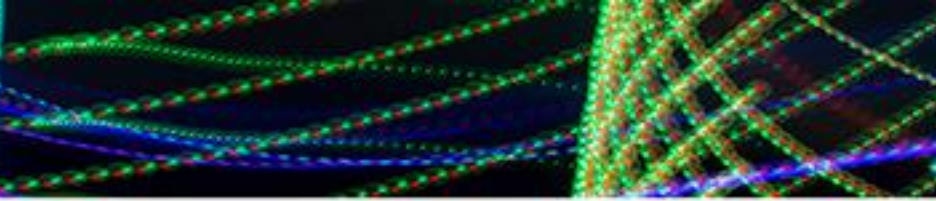
Manufacturing

Experience with Single Multi Sample Units,



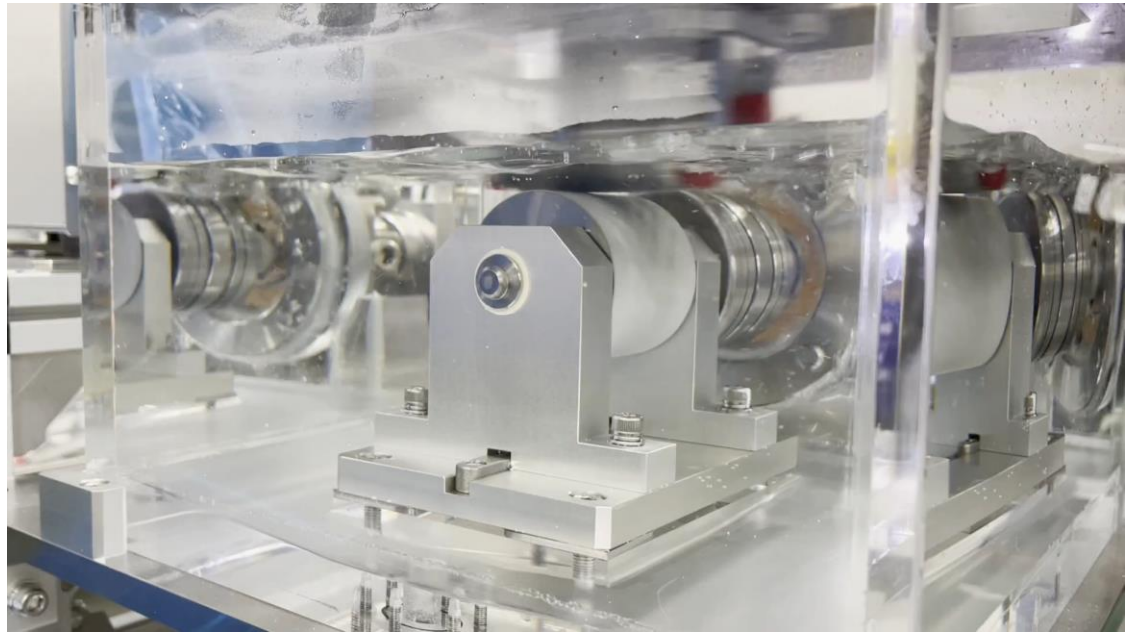
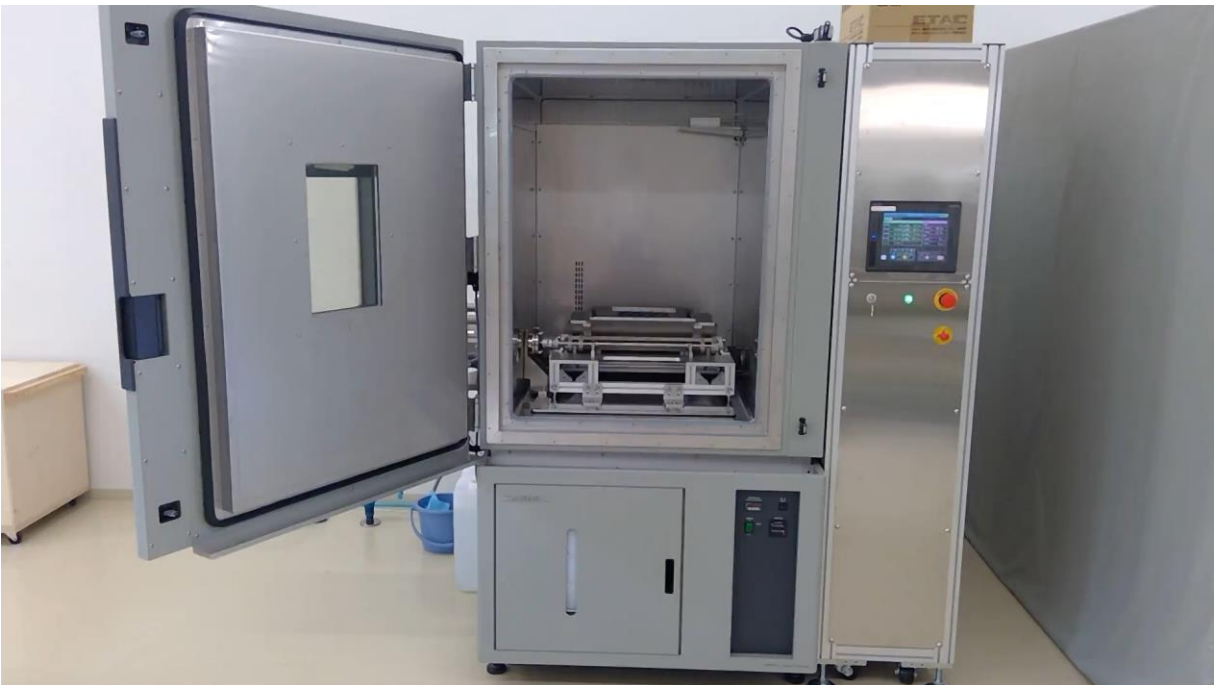
Factory Automation





OBSERVE

- Retrofit Kits for Existing Chambers (temperature, humidity)
- Requests for Compact (Mobile), Multi-purpose, Fully Integrated Multi-environment (incl. altitude, liquids, shock)



YOUR REWARD

When you think of flexible electronics reliability..

Just contact us...



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[#bayflexsolutions](https://www.linkedin.com/company/bayflex-solutions)



YouTube:

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