Design-in Confidence in Medical Devices

MedTech Pavilion: Foundation and Function — Emerging Materials and Novel MedTech Equipment Sales

Eisuke Tsuyuzaki
Endurance Testing Systems, LLC
FHE Systems Integrator, including Yuasa Systems

July 9, 2019

ETS
ENDURANCE TESTING SYSTEMS
design-in confidence.

Abstract

- New form factors in components and products are continuously being introduced today. Some examples of products for personal use are foldable smartphones, wearable sensors, and smart IoT speakers with AI. Examples of components are curved screens, metal ink compounds, bendable batteries, connectors, cables and bendable antennas. New material components will be needed for flexible electronics in wellness and medical products.
- As the design of our future electronics systems shifts from their past rigid state to being made from flexible hybrid materials and components, innovators will require new methods to design continuous and lasting mechanical performance into their product designs, as well as new methods for testing those new products.
- What will be needed is a series of unique, scalable, and modular mechanical endurance testing solutions for ambient and hostile conditions, with the added ability of measuring the performance of the flexible components throughout the enhanced testing cycle.
- Those testing solutions may include, as examples, stretching, flexing, twisting, and bending machines. You may wish to increase the stress during testing to the breaking point, to determine the limits of the components. And you may wish to use equipment that allows you to test twisting, for example, without tension to better understand how the component reacts to different types of stress.
- The machines should provide the capability of simultaneously making measurements of resistance, temperature, tension, capacitance, etc., of the components as they are undergoing testing in order to provide information that can be used for worst-case design.

Speaker

Eisuke Tsuyuzaki

- San Francisco Bay Area, California
- BSc: Sophia, UCLA, Stanford
- Founder, Endurance Testing Systems, LLC
- Founder, Nikkei Ventures
- Ex-CTO, Panasonic
- Ex-SVP, Sony
- Ex-GM, Yuasa Systems

Overview

- Opportunity (what)
- Generic Testing Methods (why & how)
- Execution & Support (who)
- Q&A

Just recently…

- **Record attendance**
- **Record exhibit space**
- **Record # companies**
- **Record # start-ups**

CES2019

Consumer Technology Association

LAS VEGAS

JANUARY 08 - 11,2019

Opportunities

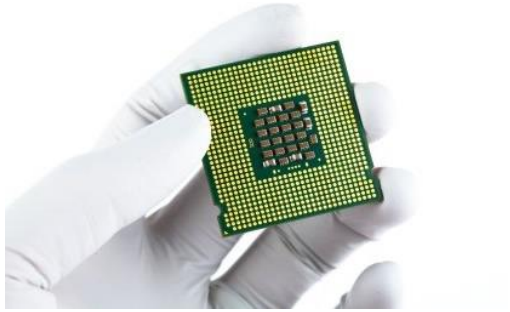
FLEXIBLE HYBRID ELECTRONICS

- Multiple Sensors
- Wearable Devices
- eTextiles
- Flexible Batteries
- OLED Displays
- Medical Components, Cables

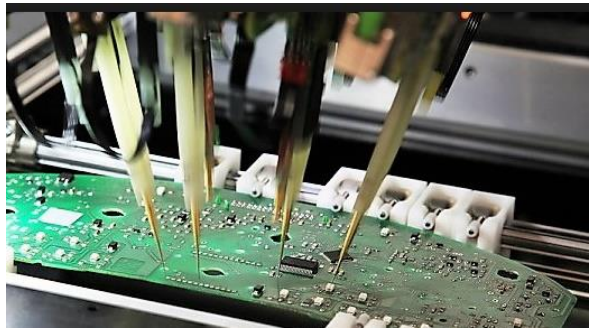
A New World

Experiences from three separate but intertwined industries working towards New applications and New approaches

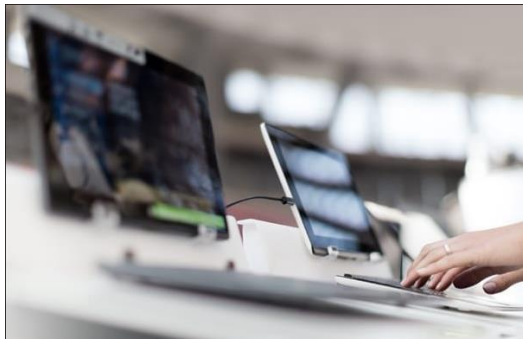
Semis
Nano scale
Probe
Conductivity
Clean room



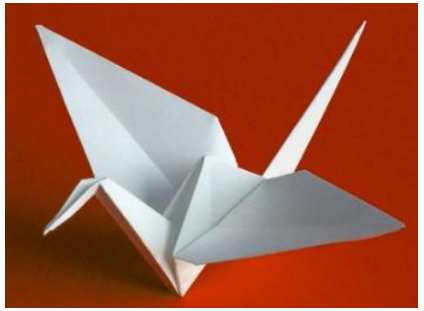
PCB
Rigid board
Conductivity
Visual Inspection
Probe



Display
Large
Mass production
Long-lasting
Materials



STRETCH



FOLD / FLEX

BEND

TWIST

ROLL

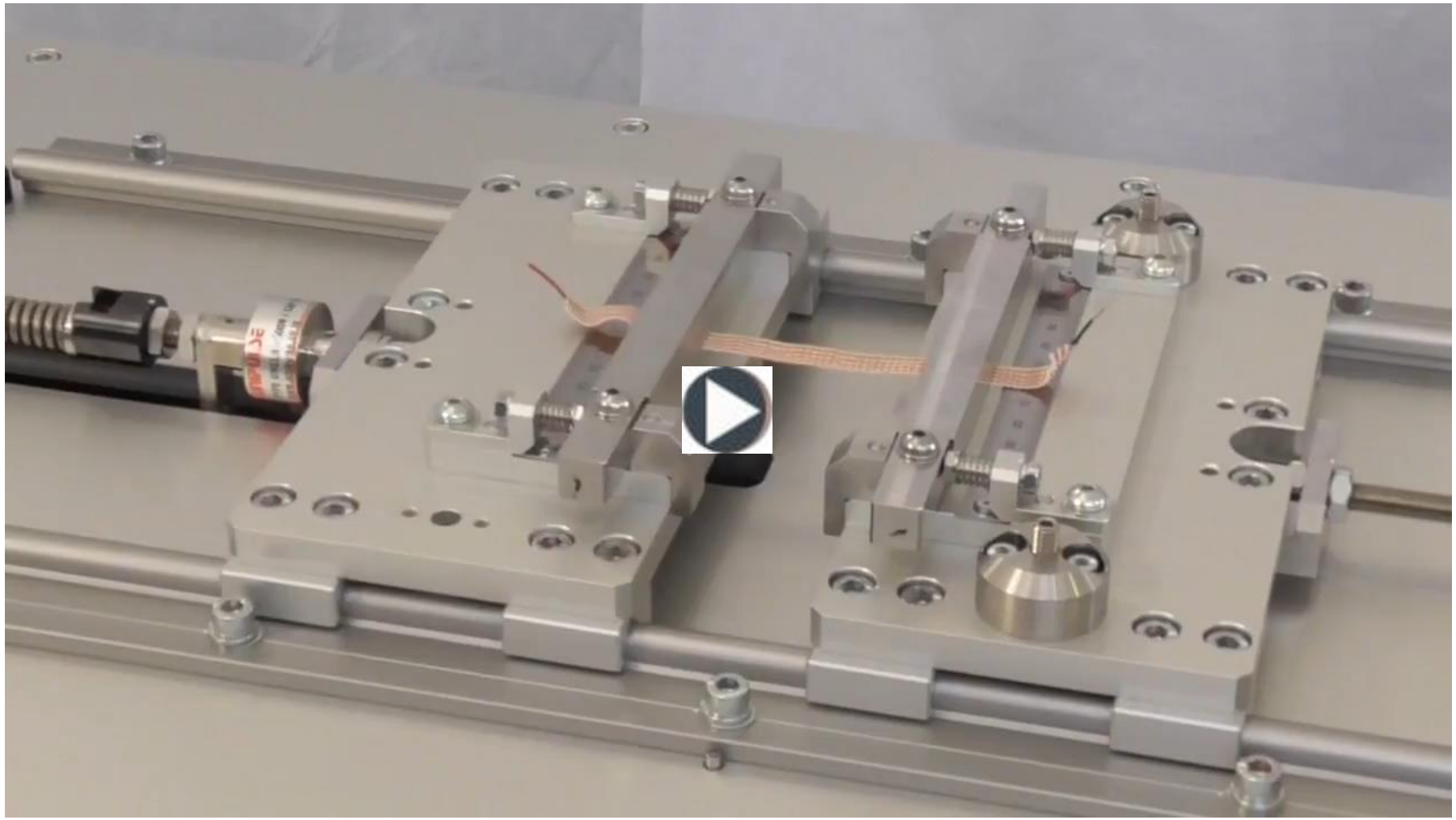
New Testing Functions

New Testing Functions

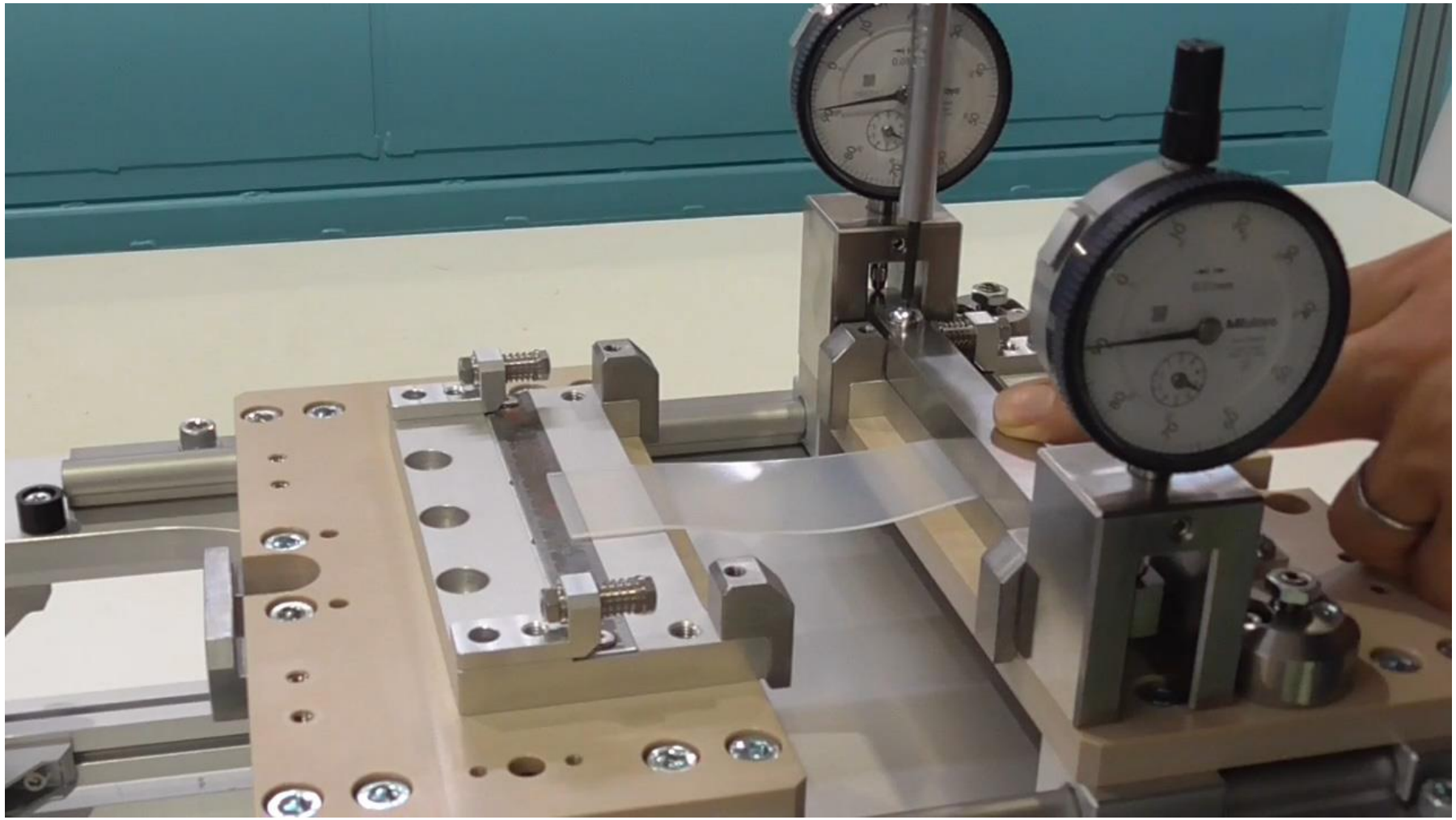
- **Stretching**
- **Flexing** (Folding)
- **Twisting** (Washability)
- **Rolling**
- **Bending**

Topics

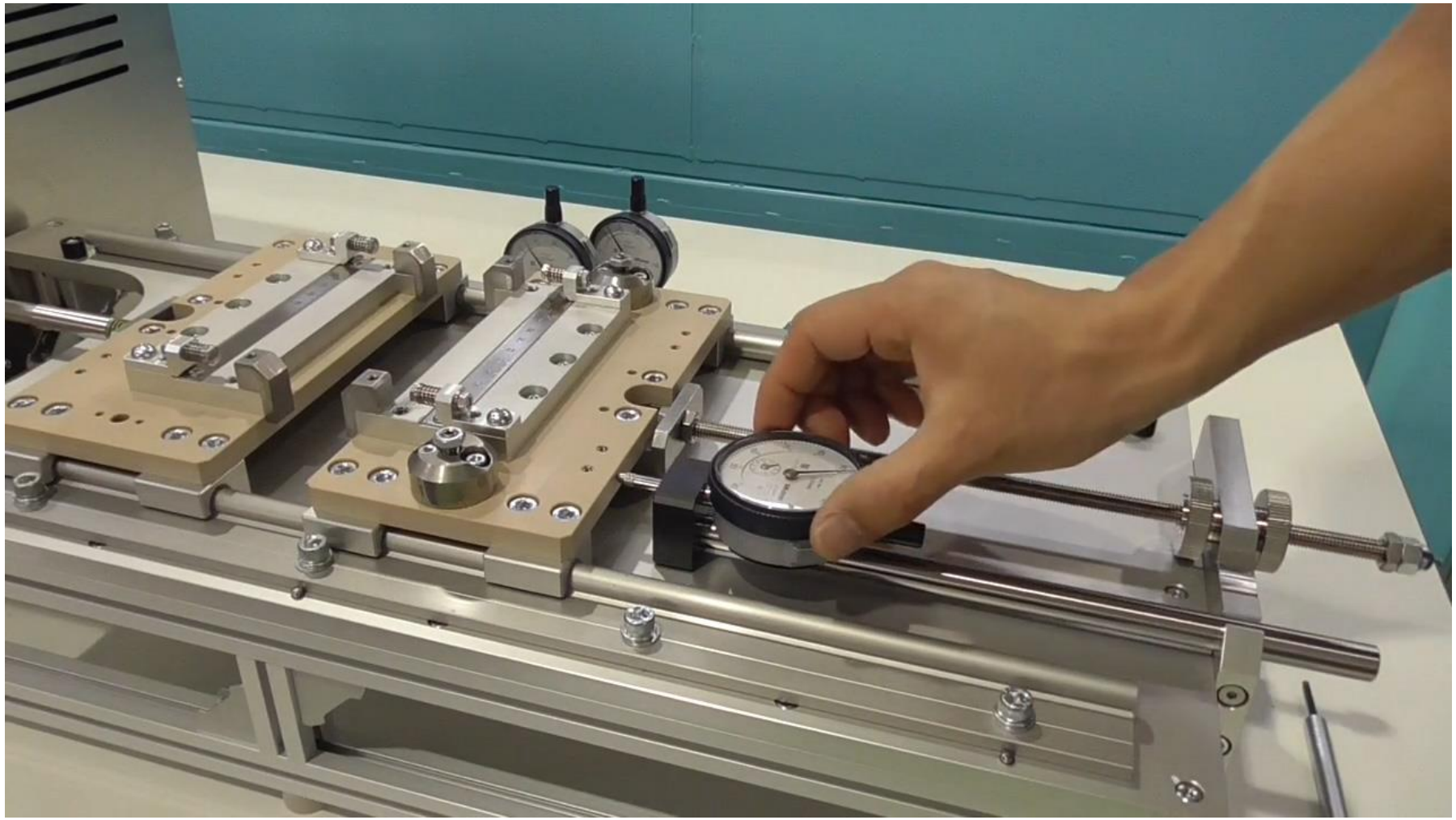
- Stretching Testing Machines
- Types of Flexing Machines
- Tension-Free Machines
- Measurements
- Environmental Chambers
- FHE Failure Modes



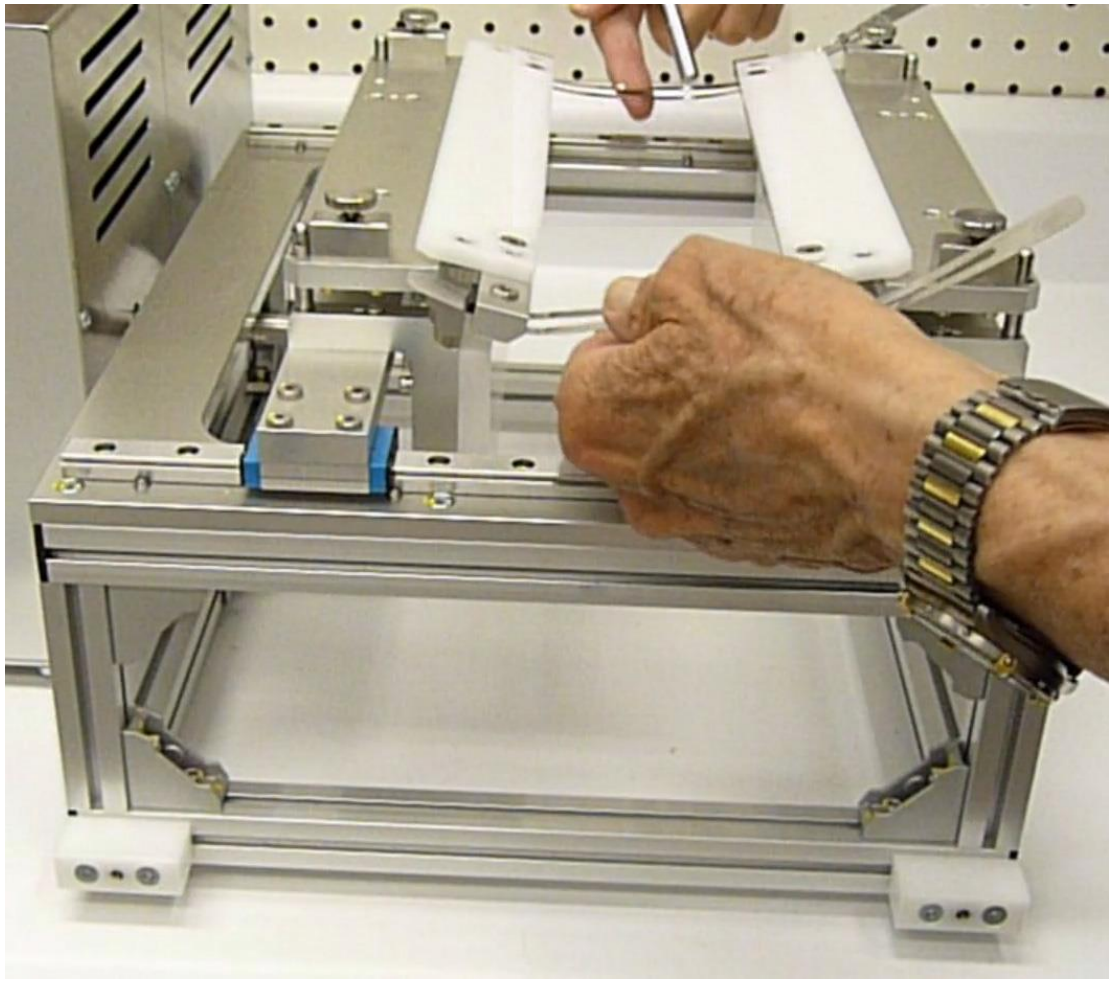
Stretching in action



Squashing Gauges

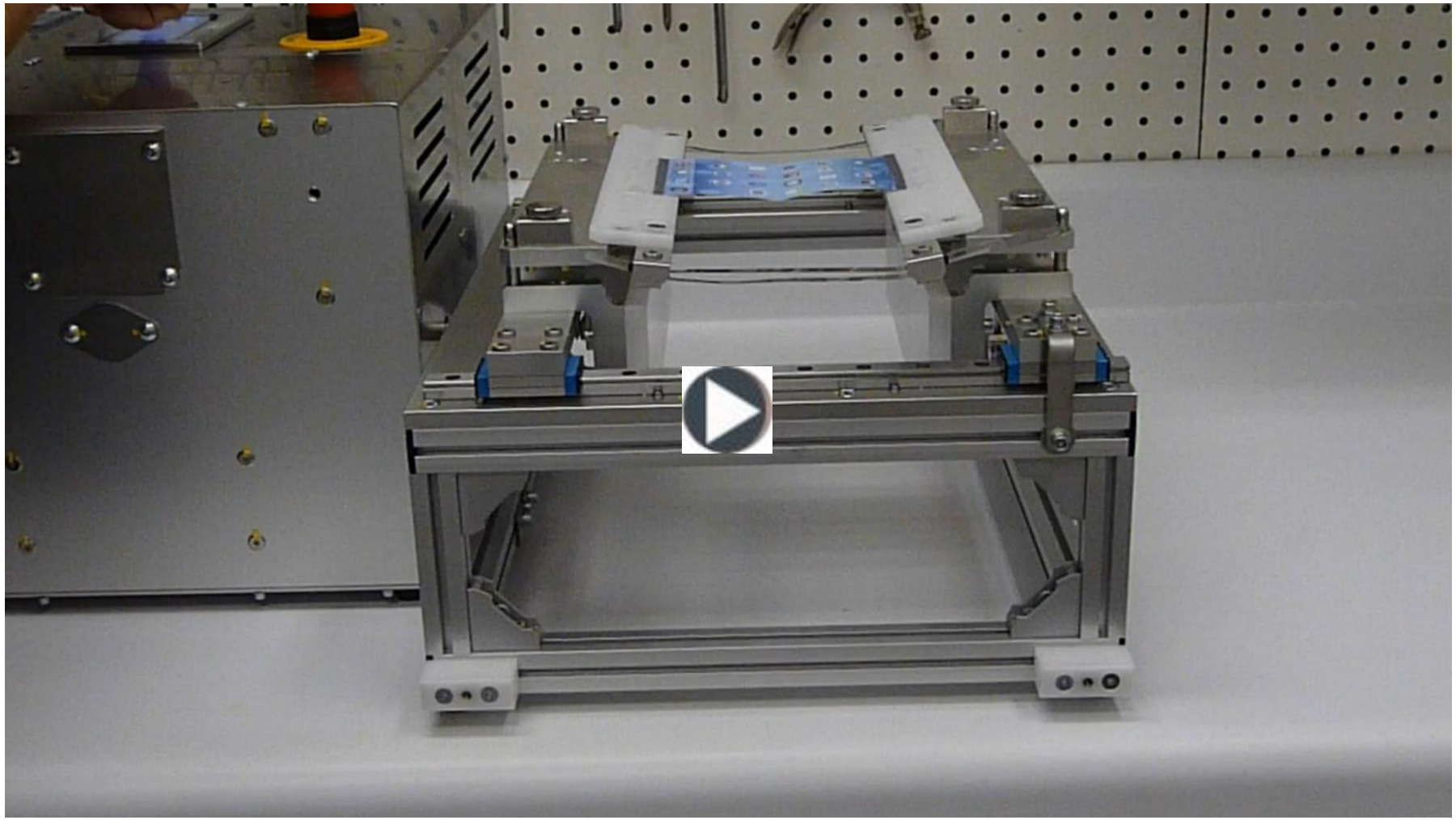


Position Adjuster

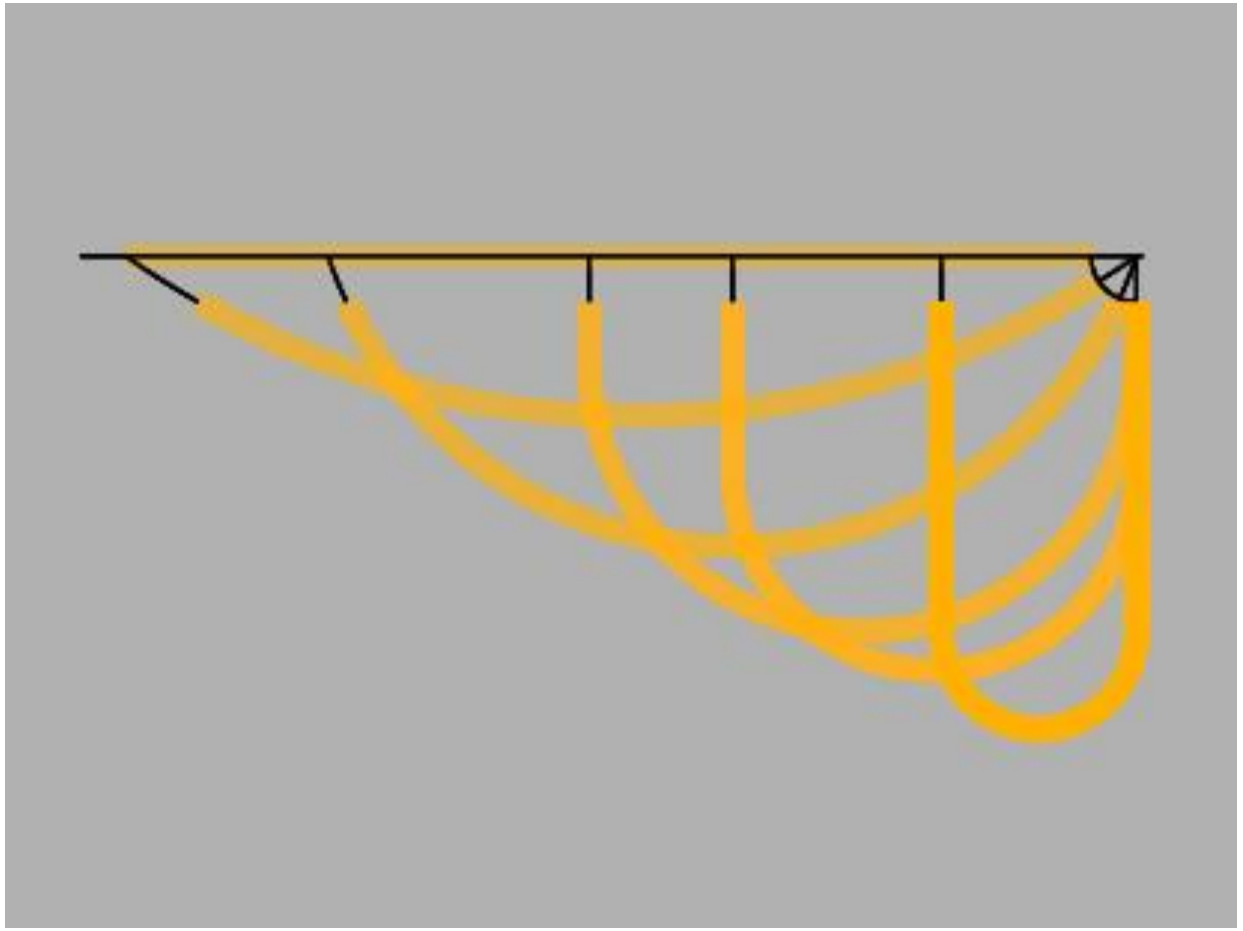


Tension-Free Flexing

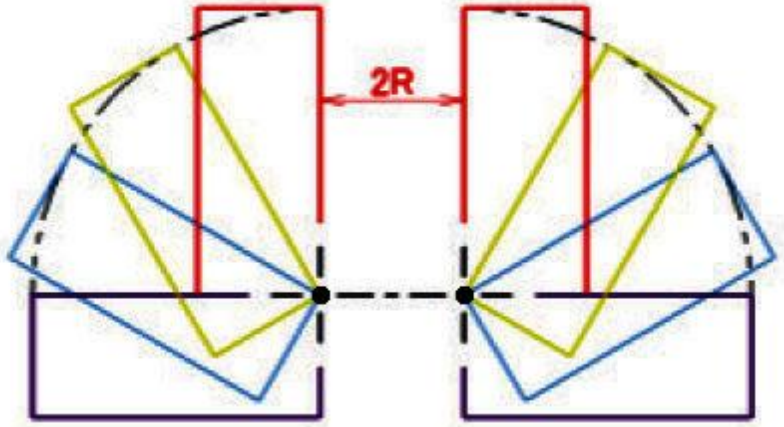
Tilt Controllers absorb the tension so the flexing can proceed Tension-Free

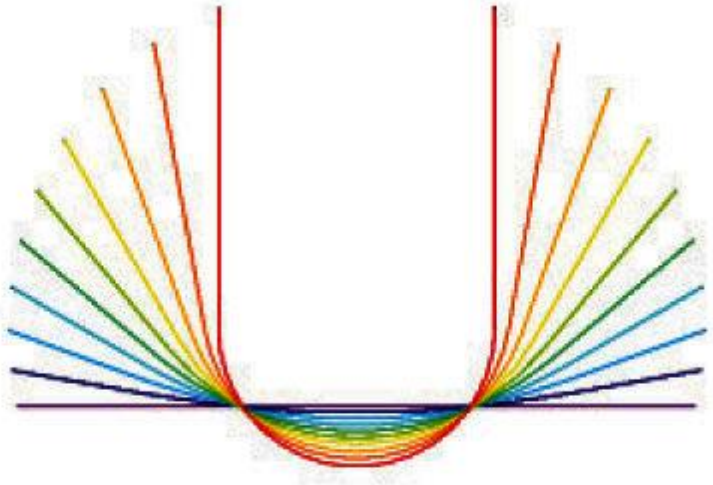


Butterfly flexing in action



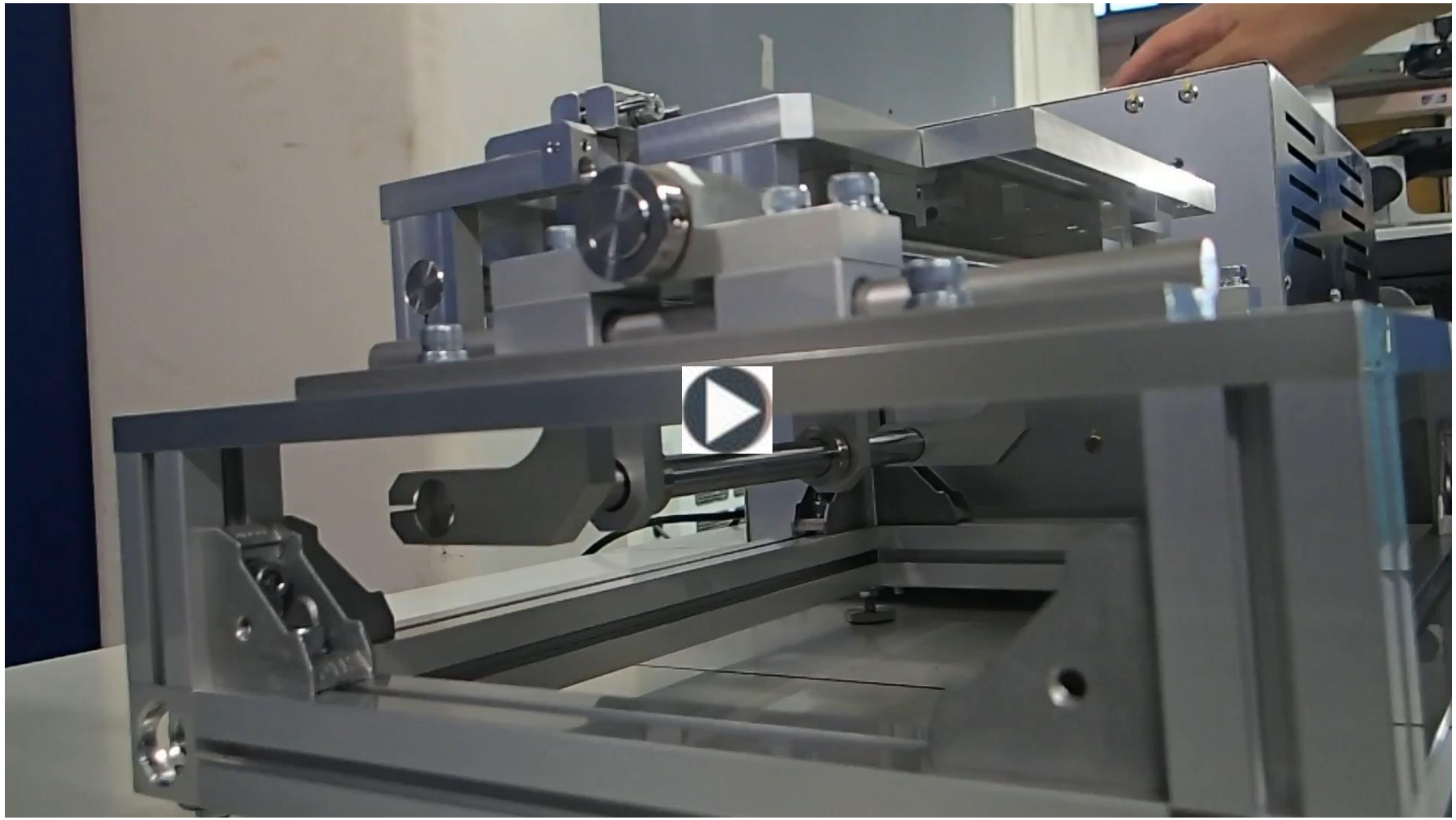
Movement of sample during Butterfly flexing





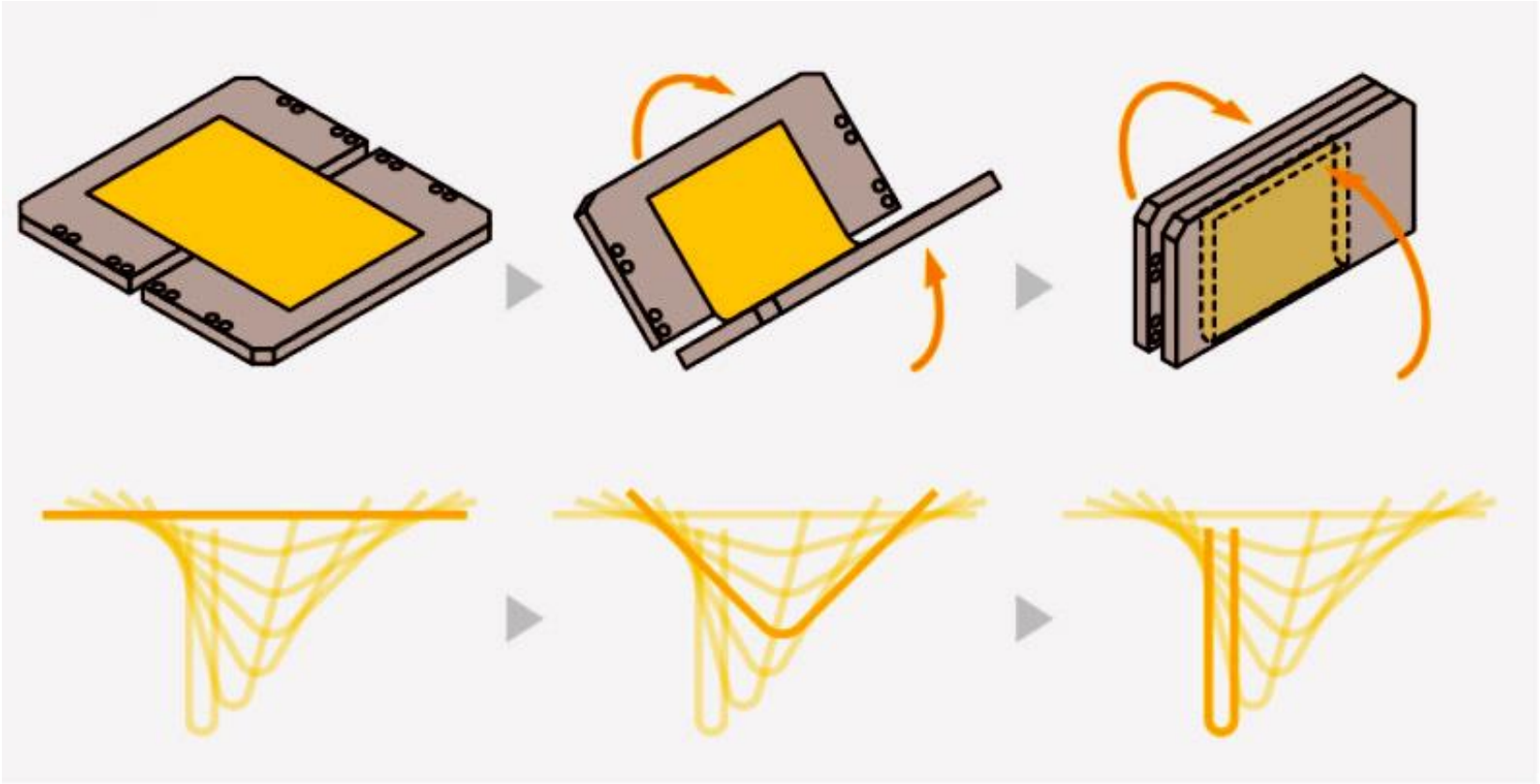
Clamshell Tension-Free Double Hinge

The holding plates rotate centered on the edges of the holding plates so the sample maintains a constant radius



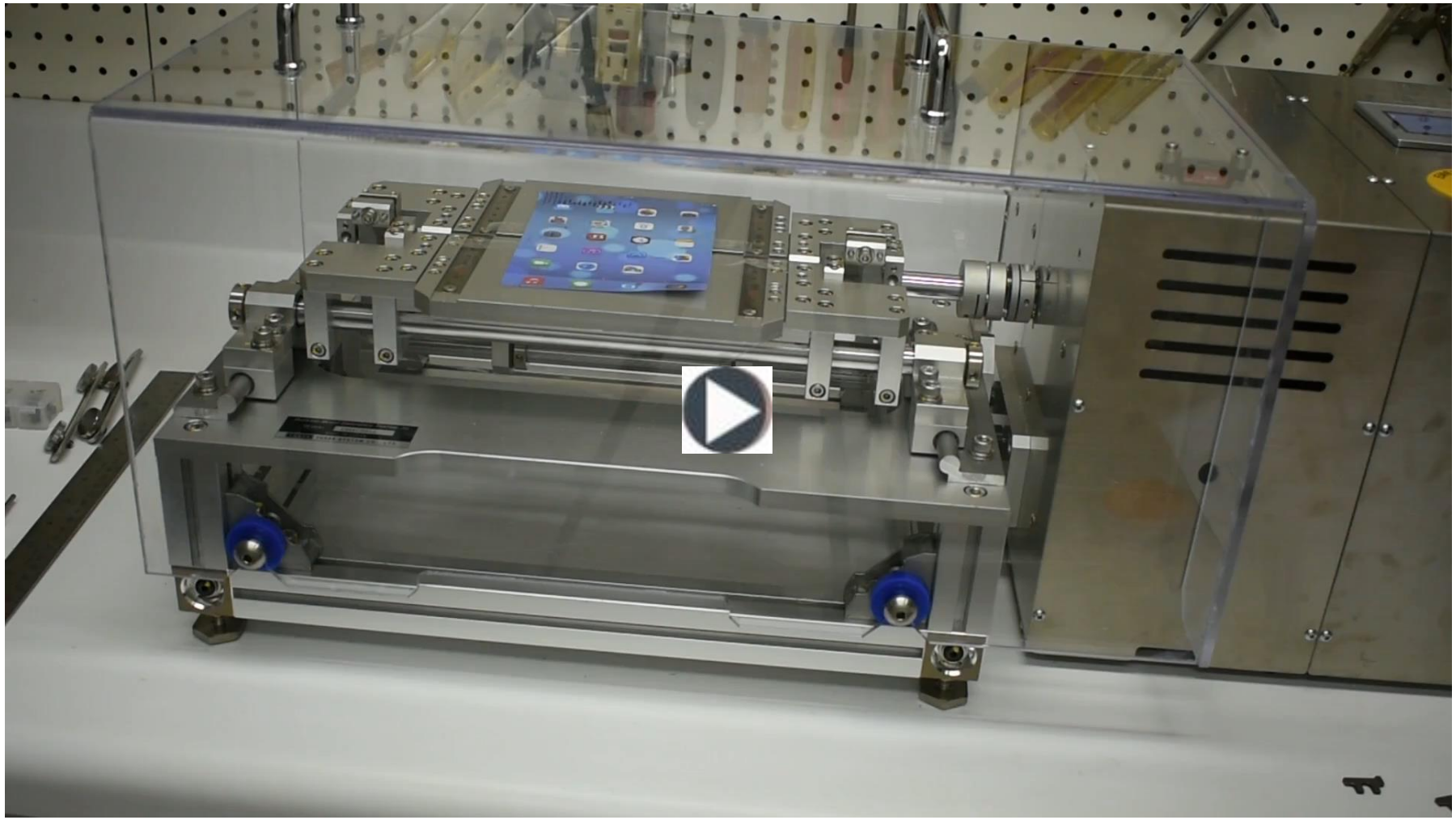
Clamshell Tension-Free Double Hinge

Hinges are kept the same distance apart as the holding plates rotate



Clamshell Tension-Free Double Hinge

As the holding plates rotate the sample is flexed with a constant radius



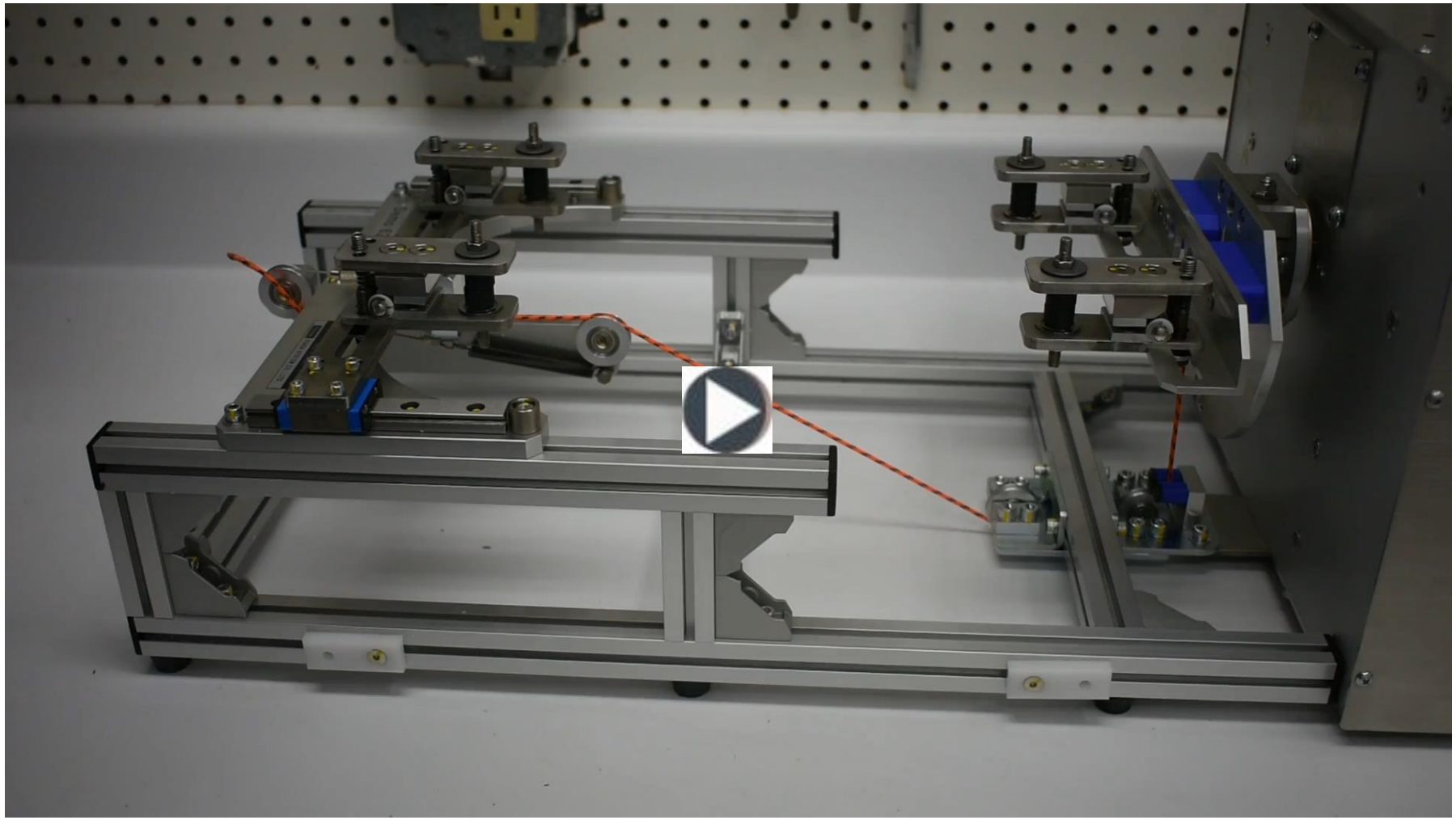
Clamshell in action

Comparison of Butterfly and Clamshell

- Clamshell flexes only the center $\pi \cdot R$ portion of sample
- Butterfly flexes entire length of sample

- Some Butterfly Machines also can be Stretch Machine

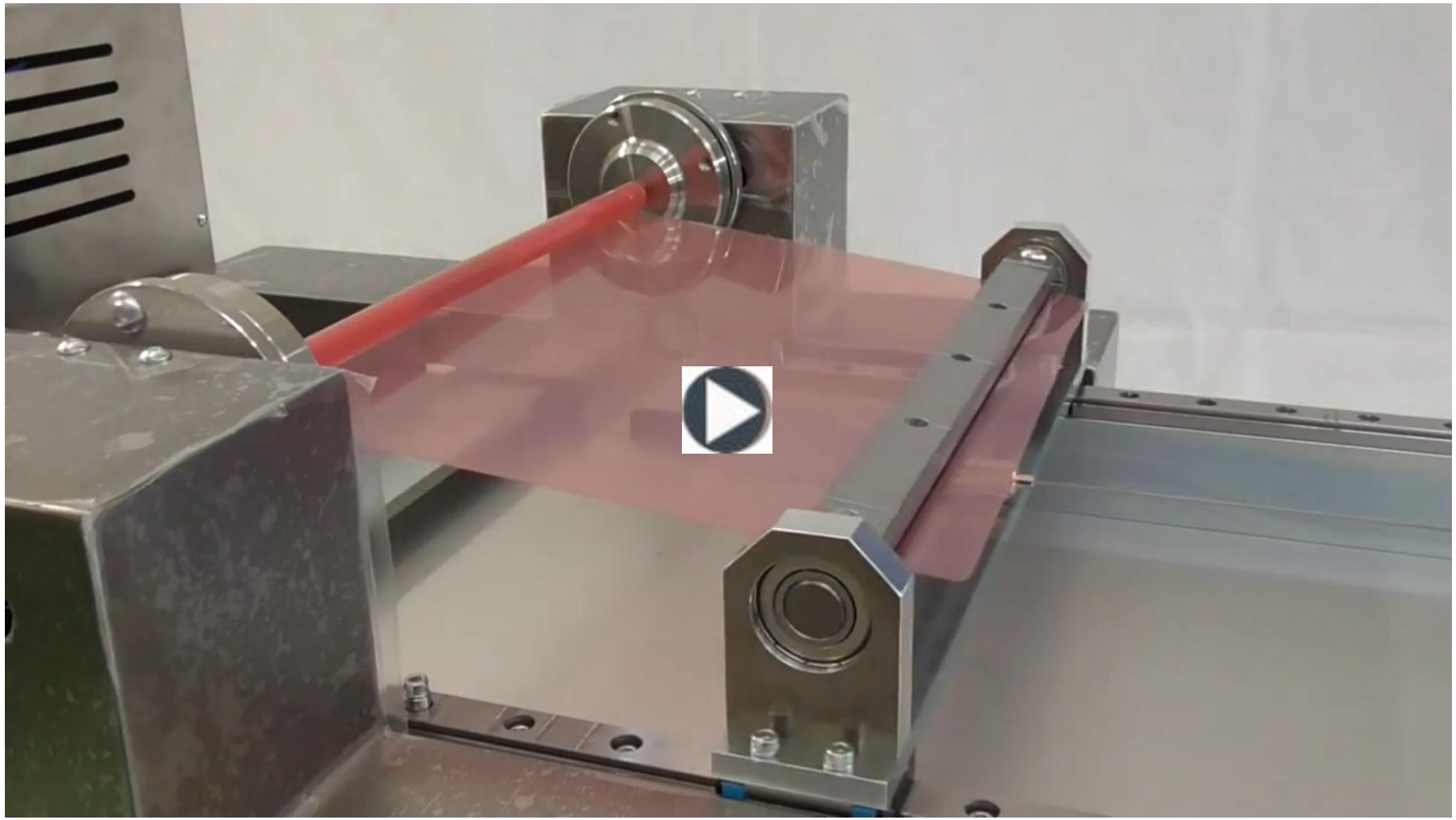
- Clamshell accepts shorter samples



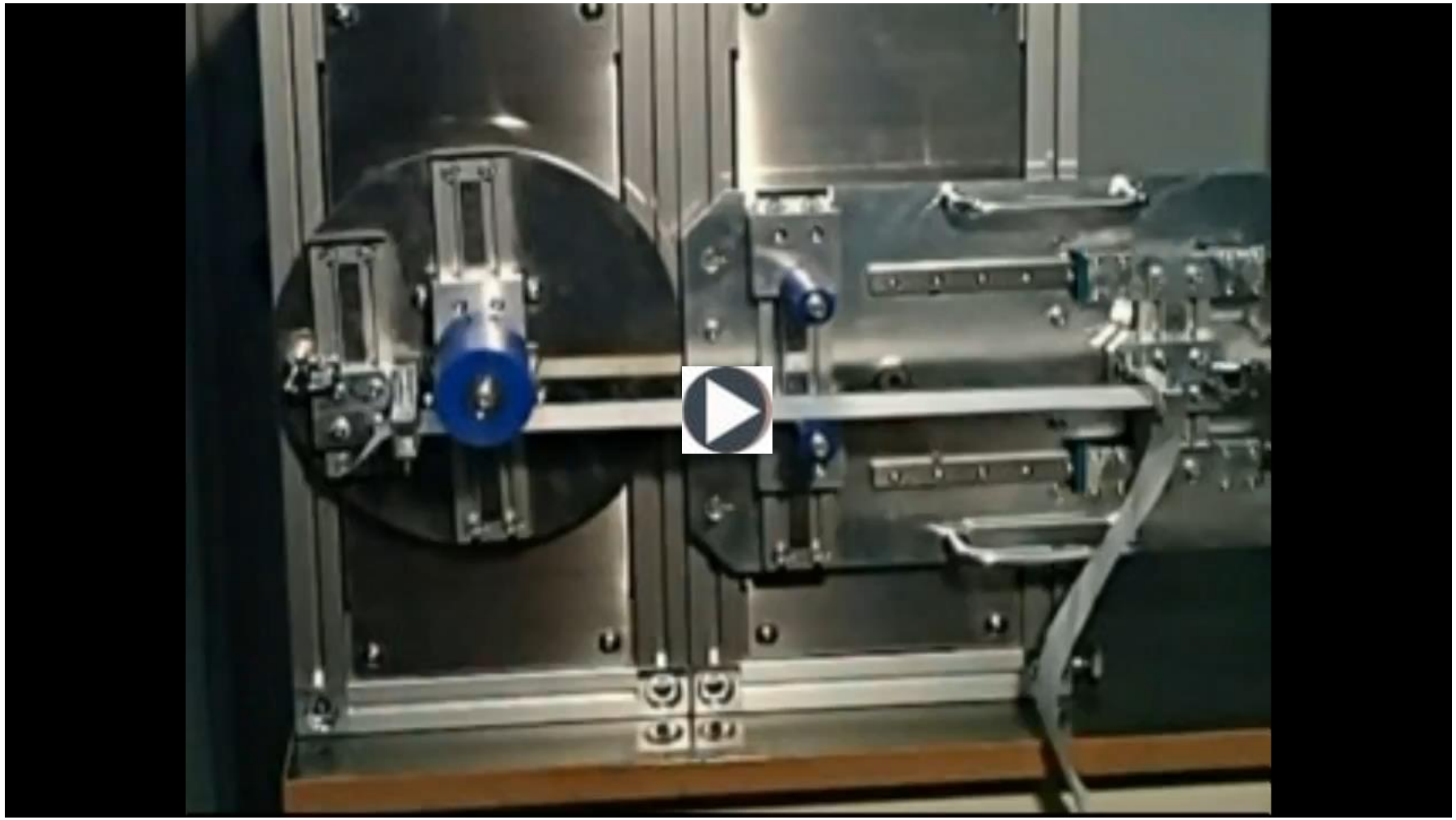
Tension-Free Twisting

As the twisting clamp rotates the String pulls the fixed clamp closer to the twisting clamp

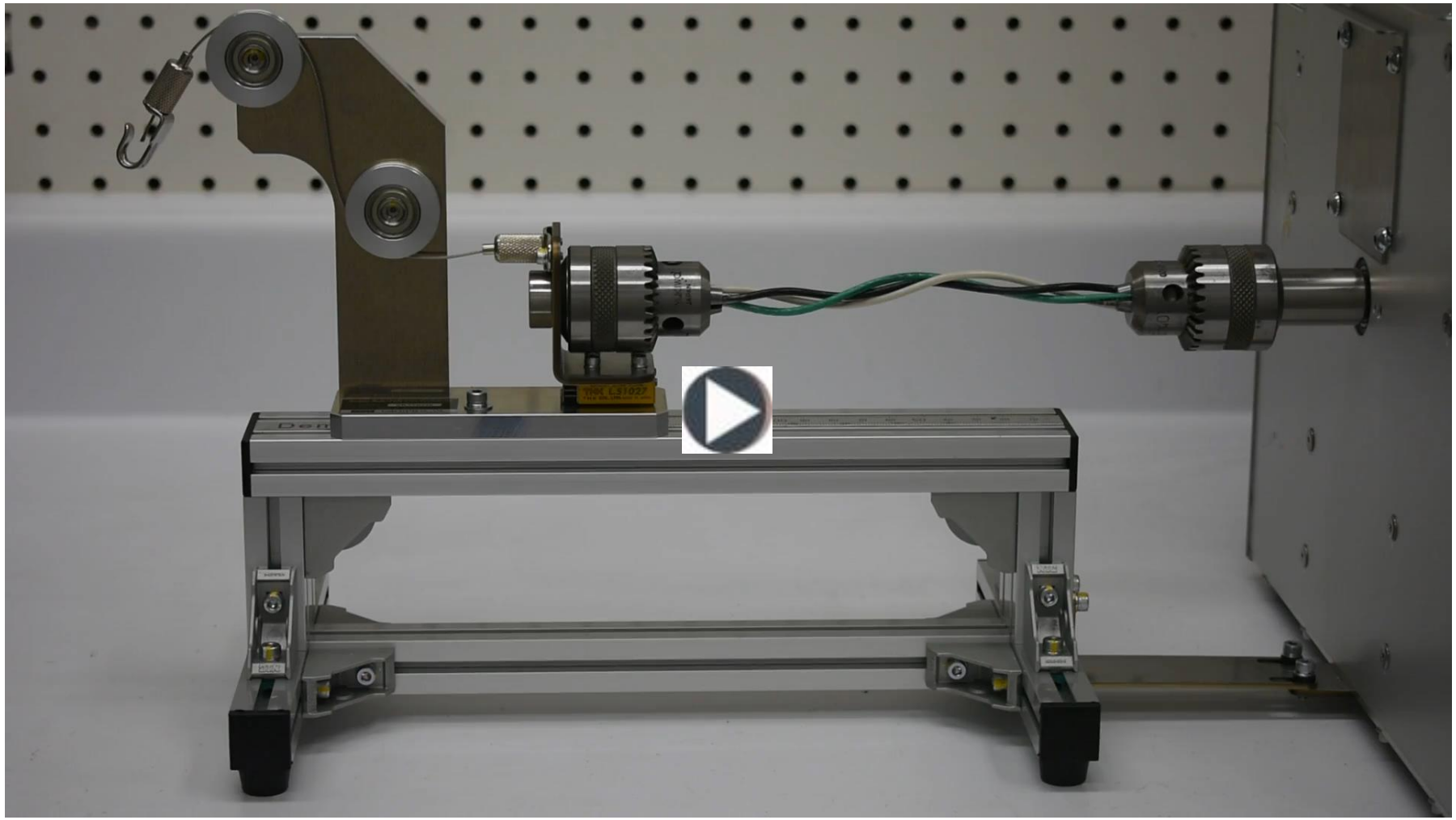
Twisting in action



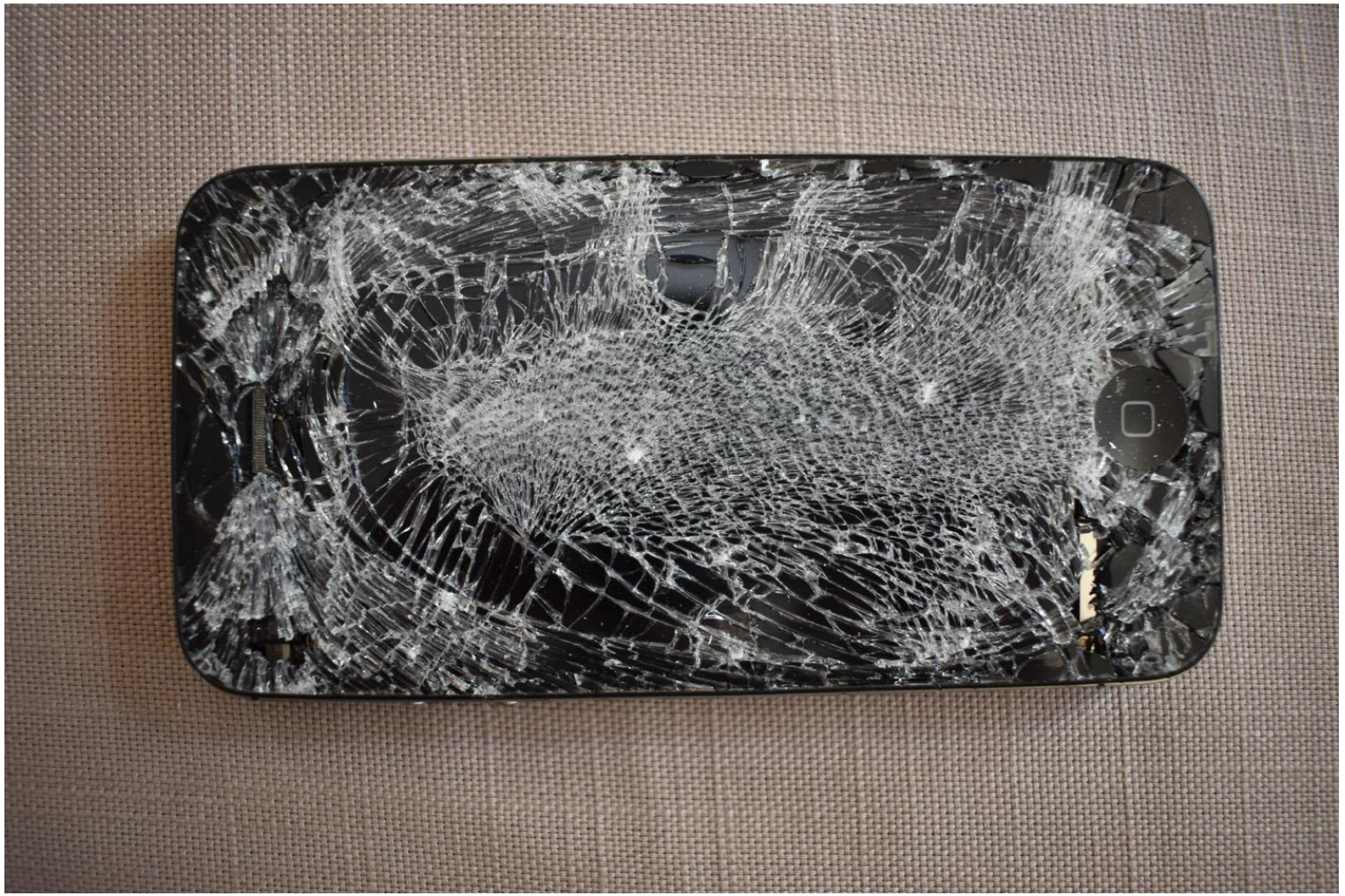
Rolling in action



Tension-Free Bending in action



Linear Sample Twisting in action



Breaking Test – My Smartphone

After it was run over by a truck!

How to Make Measurements

- **Examine sample with a microscope**
- **Removable cartridge made it easier**

- **Measure resistance while testing**
- **Add wires from sample to resistance meter**

- **Measure tension while stretching**
- **Add stress sensor with meter**

- **Measure temperature while testing**
- **Add thermal sensor with meter**

Testing in Environmental Chamber

Test at different temperatures and different humidity

Which Test Machine for FHE Failure Modes

	Butterfly Flex	Clamshell Flex	Twist	Roll	Stretch	Bend
Cracked	XX	XX	XXX	X	XXX	X
Delaminated	XXX	XXX	XXX	X	XX	X
Bent Permanently	XXX	XXX		XXX		X
Stretched Permanently	*X**		X		XXX	XX
Torn			XXX		X	

** Some Butterfly test machines also can be configured as a stretch machine*

Problems

- Engineers make their own custom rigs for testing
- Not based upon emerging or defacto standards
- Consistency at scale; Global R&D collaboration
- Efficiencies at scale; Vendors and Mass Manufacturing
- Need to build-in lasting quality

About Yuasa System

- Established 1941
- 25 Years in Endurance Testing Systems
- Office in San Francisco Bay Area
- US technical support

- **Field proven technology with established reliability in high demand Consumer Electronics Auto and FHE industries working with leading manufacturers**

YUASA YUASA SYSTEM CO., LTD.

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Modular Configuration

Step 1

PICK MOTOR DRIVE

5 types

Step 2

SELECT JIG

30 types

Option Chamber ?

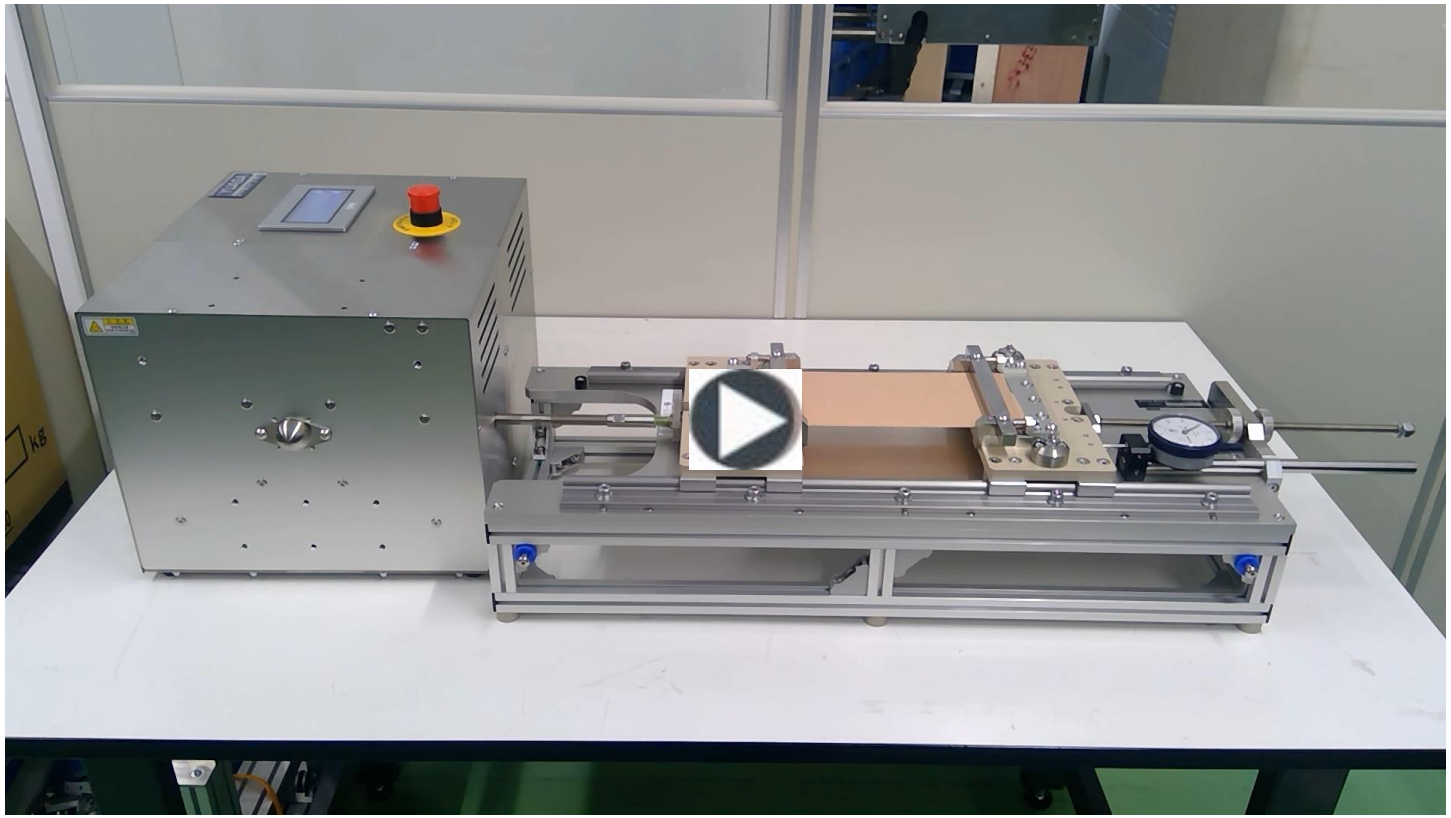
Step 3

ELECT MEASURE

2 types

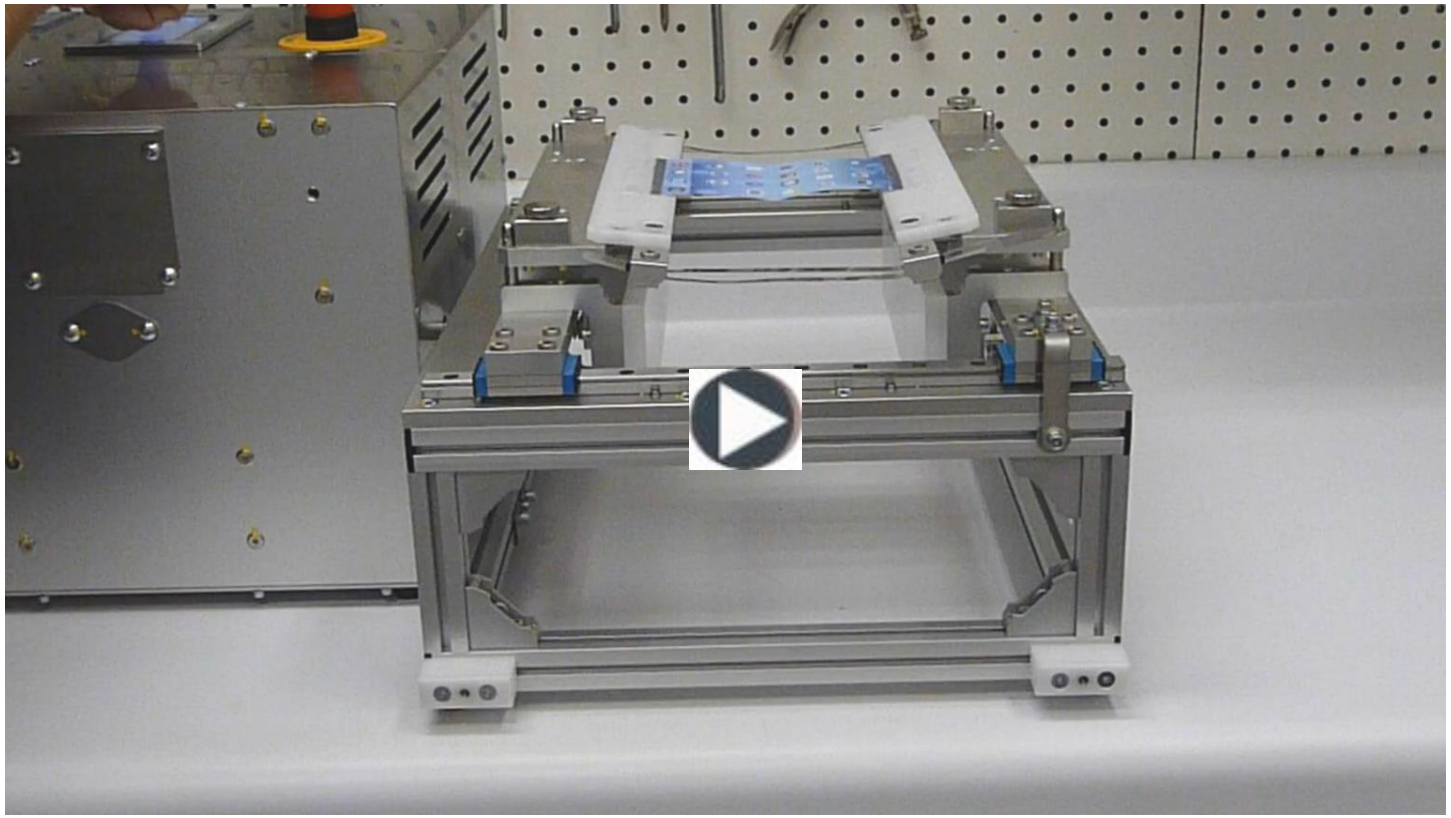
NEW PRODUCT — STRETCHING — ST

- Stepping motor drive for accuracy
- Stretch planar and linear objects
- Stretching length up to 100 mm
- Tension up to 70 N (15.7 ft lbs)
- Up to 90 stretches per minute
- Total tester weight 26 kg (57 lbs)
- Can use the ECP resistance measurement equipment
- Usable in Environmental Chamber



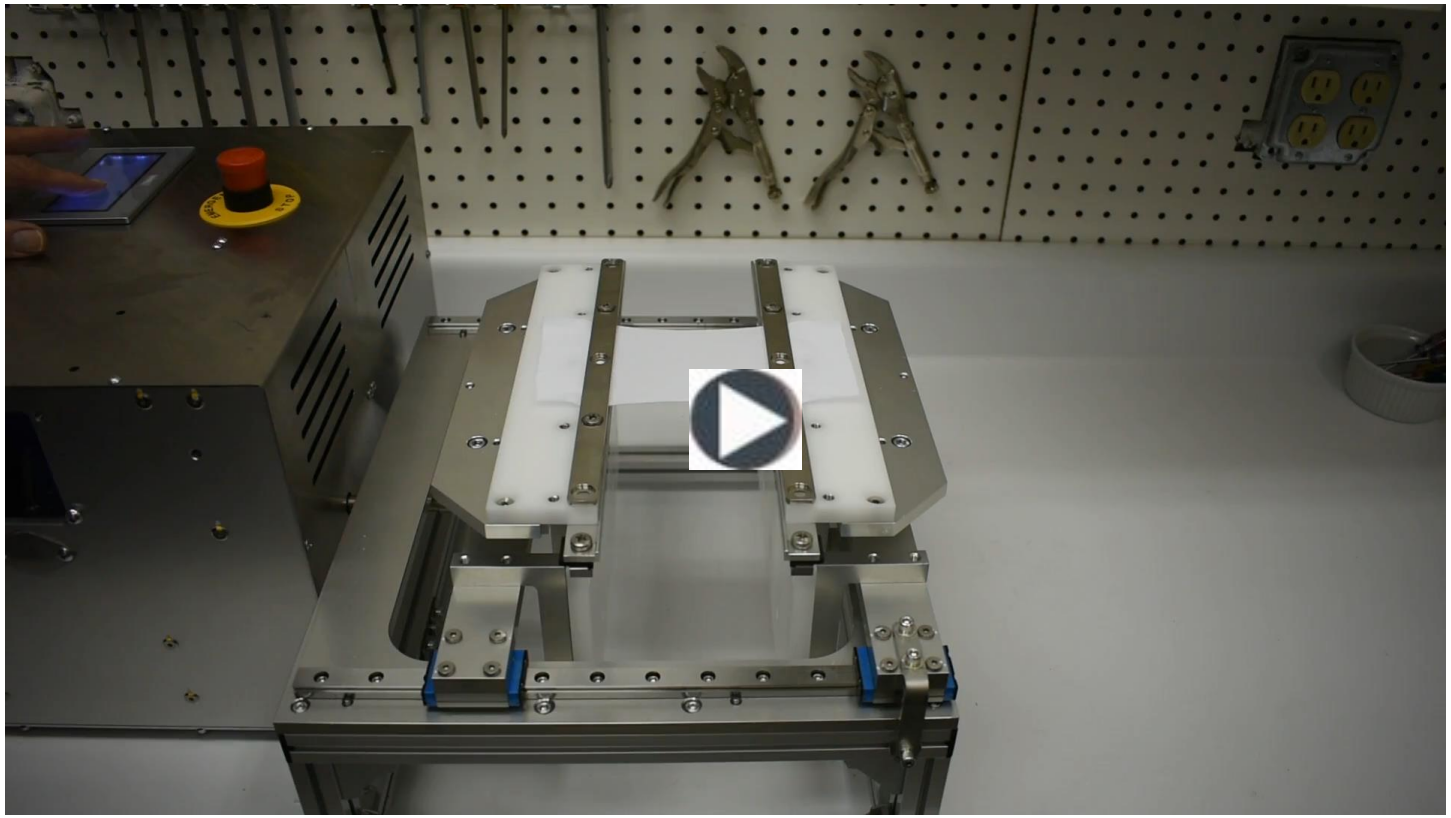
TENSION-FREE ™ U-SHAPE FLEXING — FS-C

- **Tension-Free™ technology enables more rapid, consistent, & accurate testing**
- **Maintains ideal bending shape**
- **Plate Spring, not the sample, absorbs tension**
- **Can use the ECP resistance measurement equipment**
- **Cartridge to simplify examination during testing**



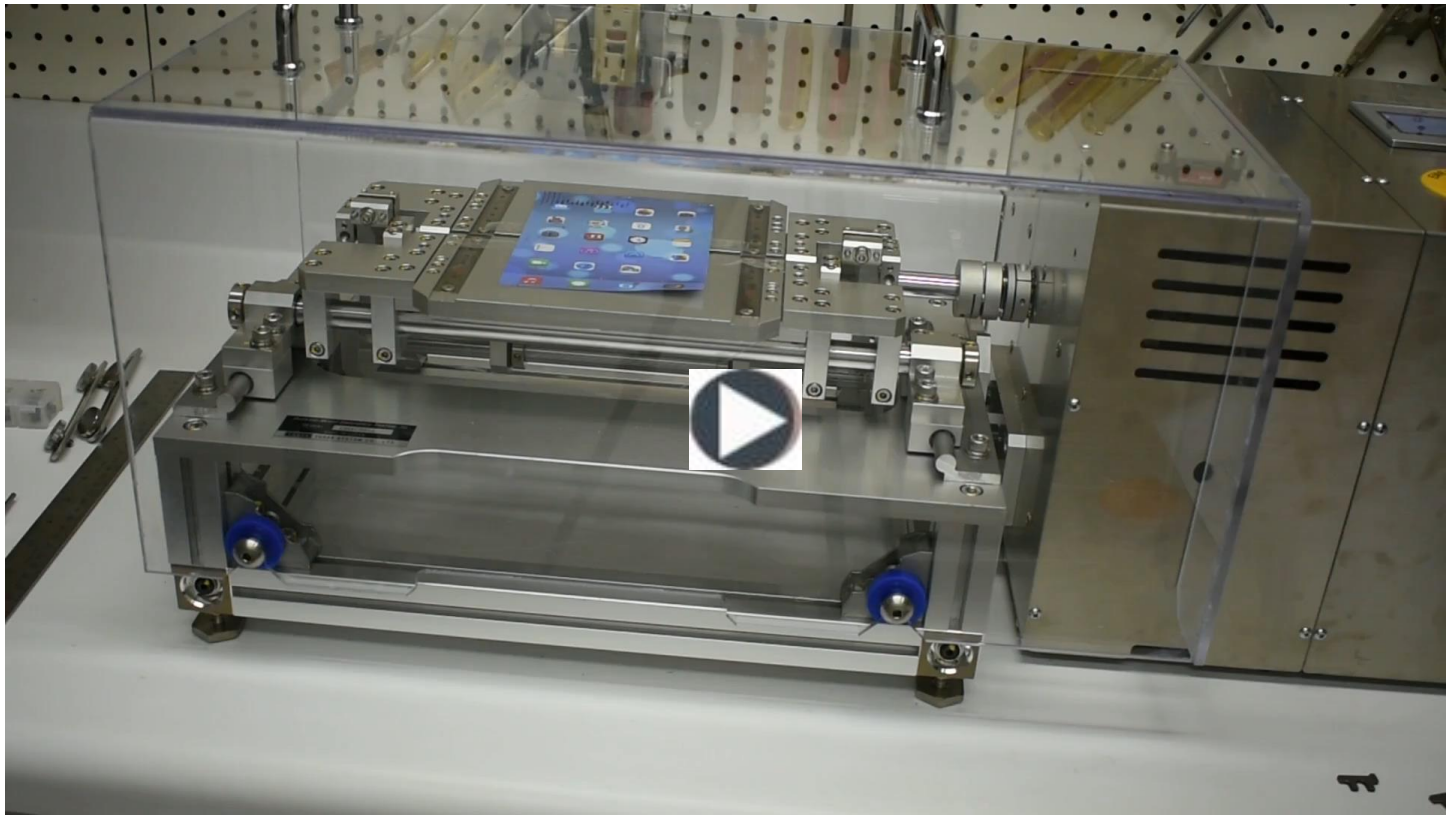
TENSION-FREE™ U-SHAPE FLEXING AND STRETCHING — FS

- **Same features as FS-C without cartridge**
- **Tension-Free™ Flexing**
- **FS can be used for Stretching**



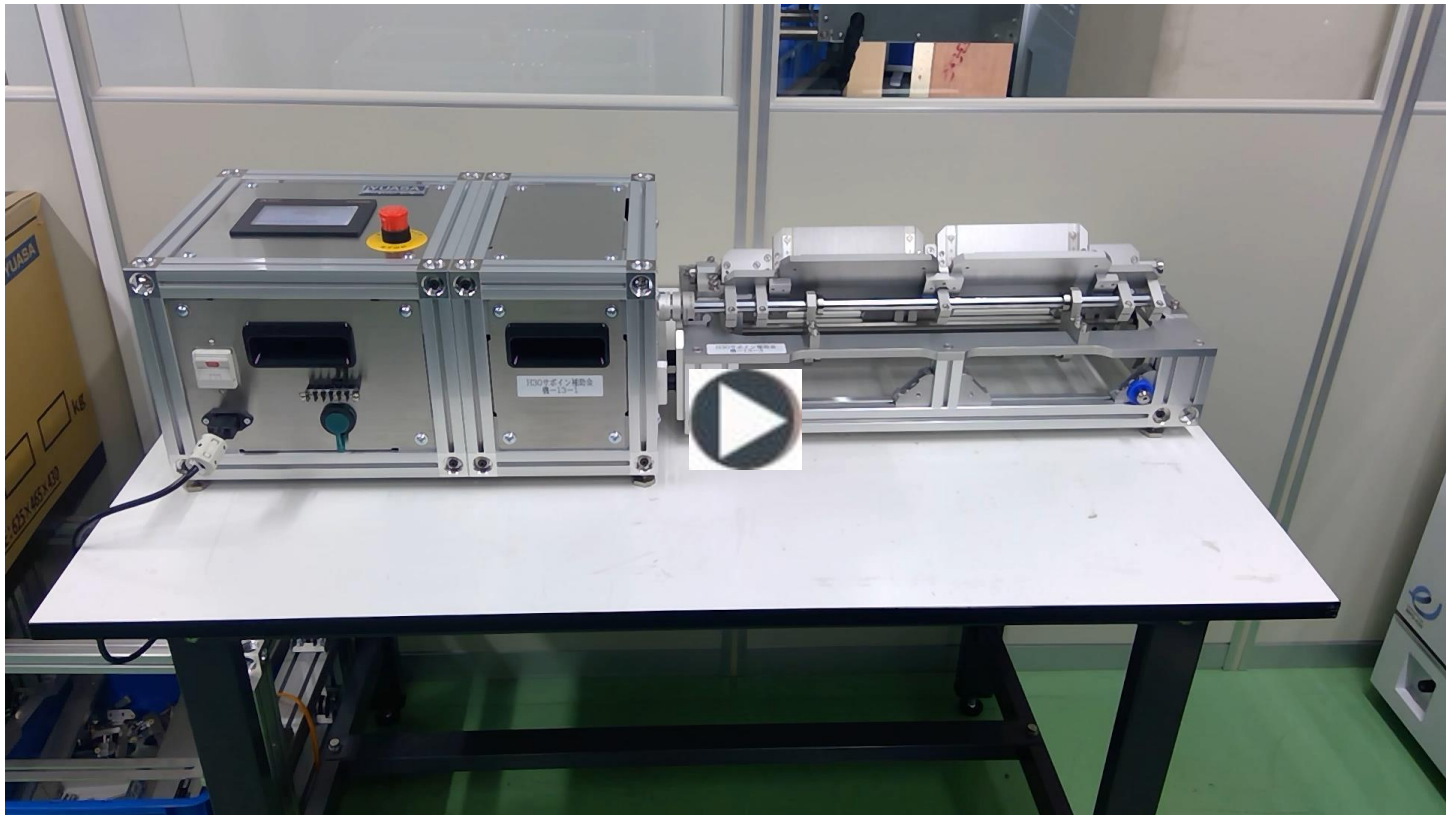
TENSION-FREE™ CLAMSHELL FLEXING — CS

- **Stepping motor drive unit for accuracy**
- **Linear or planar objects**
- **Objects can be flexed to 0.5 mm radius**
- **Can use the ECP resistance measurement equipment**
- **Cartridge to simplify examination during testing**



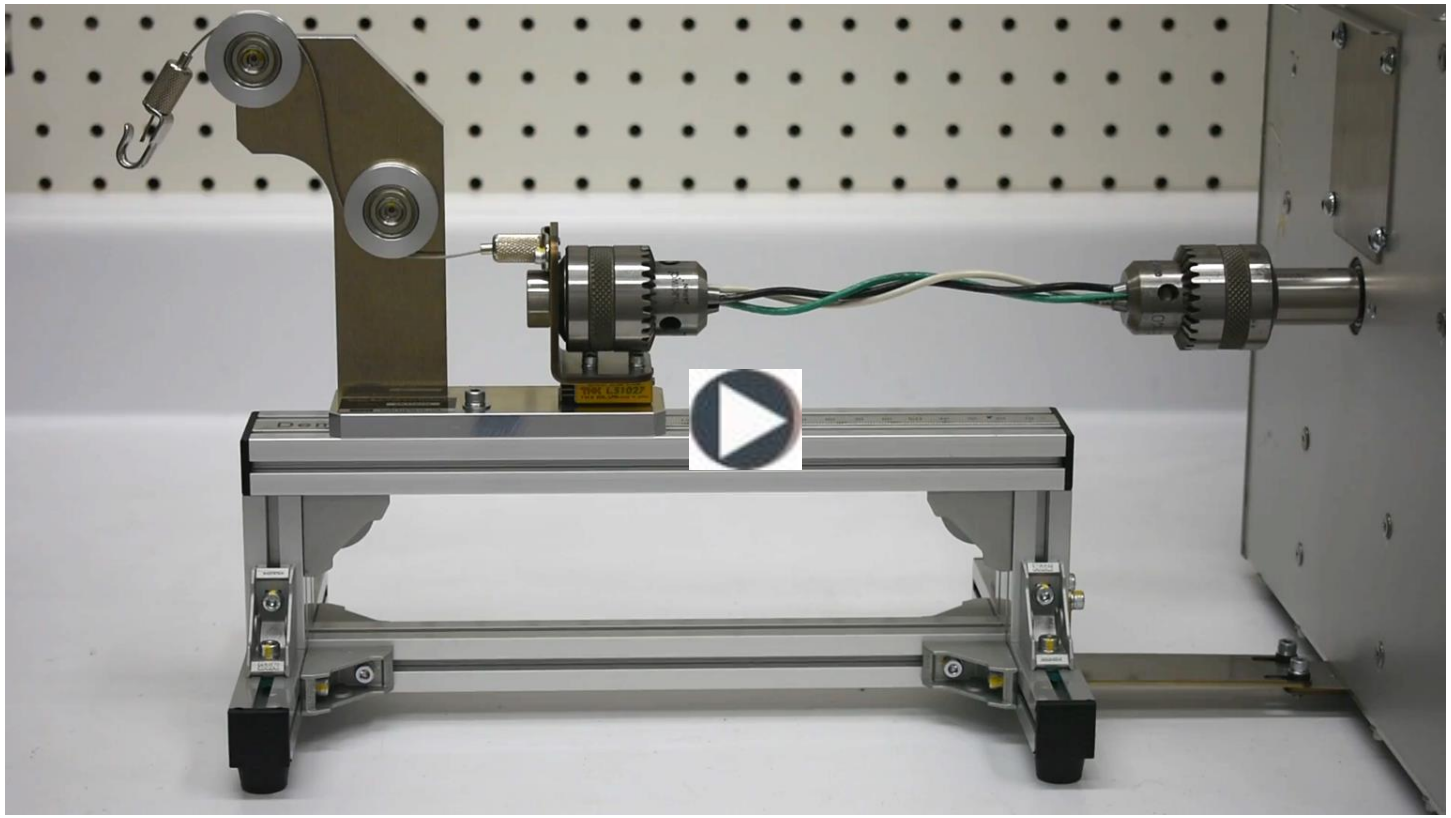
NEW PRODUCT CS-TWIN TENSION-FREE ™

- New stepping motor drive unit
- Linear or planar objects
- Can be flexed to 0.5 mm radius
- Four times the throughput of CS
  - Double speed of CS
  - Twin Plates for twice the samples
- Cartridge to simplify examination during testing



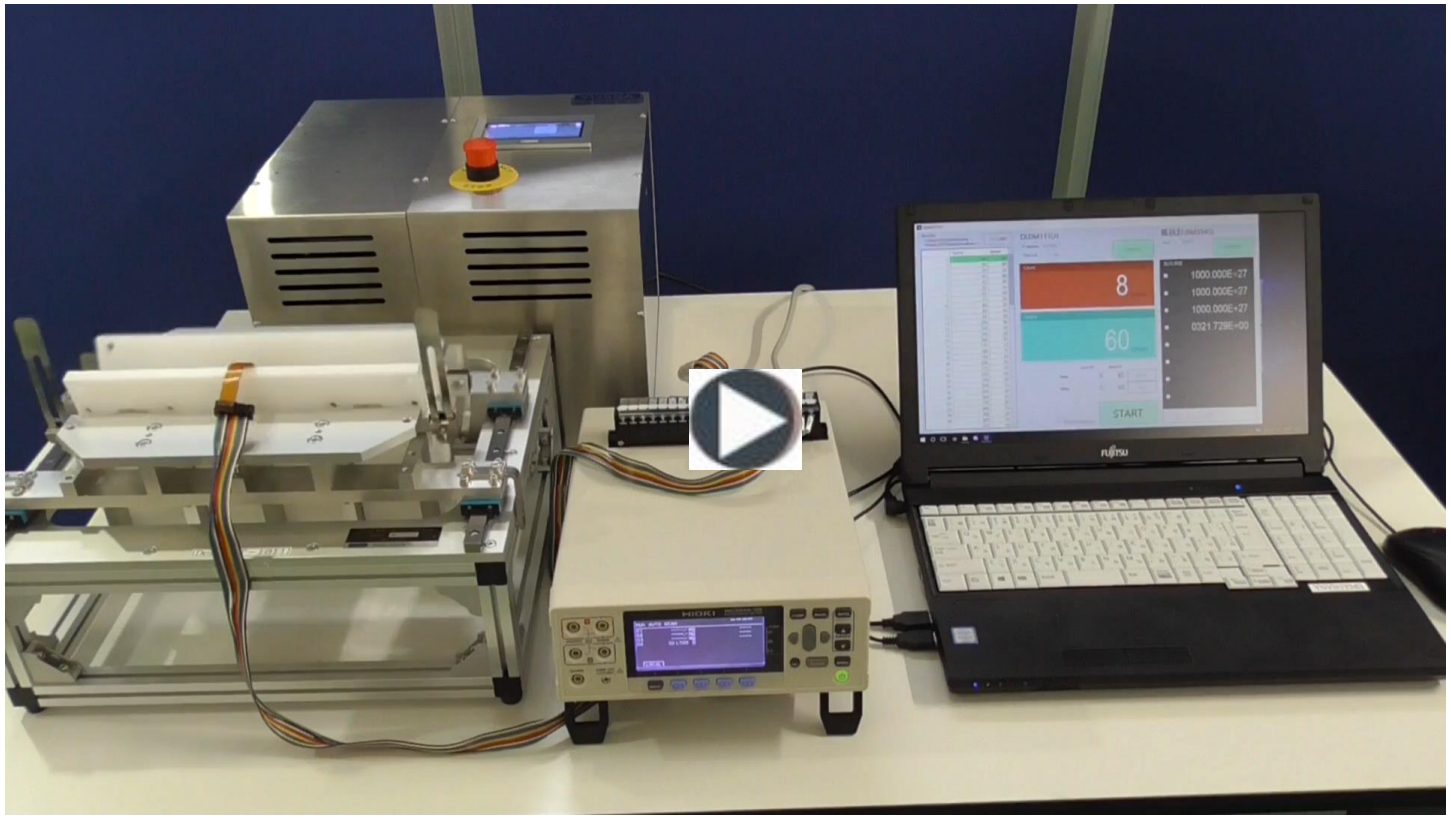
TW — TORSION TEST

- Twisting test, linear objects
  - Electric Wires
  - Cables
  - Harnesses
- Samples up to 10 mm radius
- Up to ± 10 revolutions with DMLHPR Motor Drive Unit



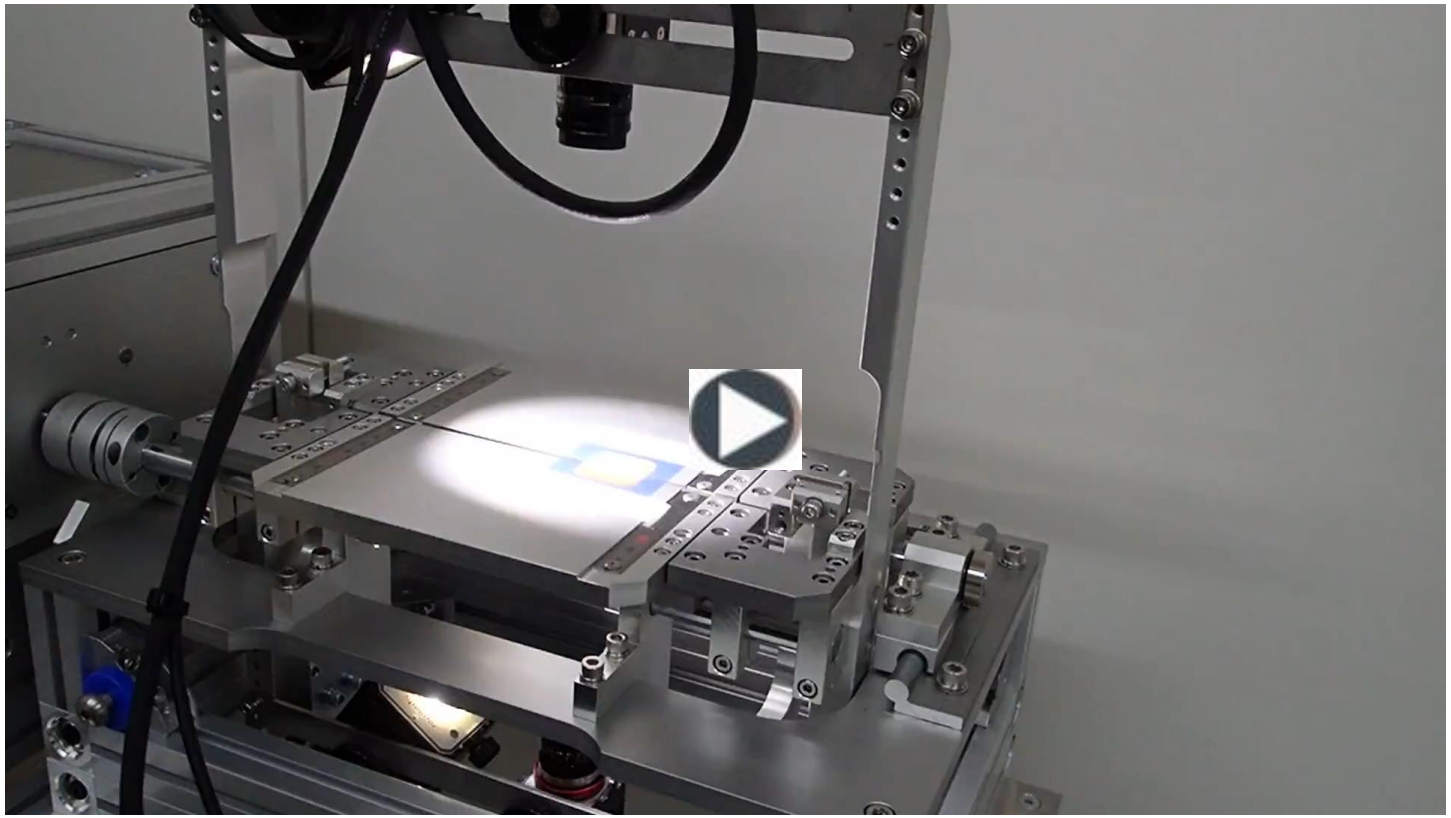
ECP — RESISTANCE MEASUREMENT AND LAPTOP CONTROL

- Flexing test example of ECP
- Sample has multiple wires attached for resistance measurements
- Wires attached to Resistance Meter
- Laptop uses testing program set up by user
- Motor slows and stops at programmed points to measure all Resistance values
- Endurance test resumes



NEW PRODUCTS — CS-CAM and ECP-CAM

- CS-CAM Clamshell flexing
- Optical Inspection System
- Camera Output on Monitor
  - One or more Cameras mounted above sample looking at the bending point
  - Can be used to find cracks automatically



Overview

- Opportunity (what)
- Generic Testing Methods (why & how)
- Execution & Support (who)
- **Q&A**

YUASA Demo Reel 2019

YUASA SYSTEM CO., LTD.

GLOBAL LEADER IN
ENDURANCE
TESTING SOLUTIONS

Tension-free

Worry-free

Modular systems

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