# SMAC

## Moving Coil Actuators

*“The ability to do work and verify its accuracy at the same time.”*


SMAC

# Achieving 100% Quality

- **100% quality check** of parts - components - and products – is becoming common and also evolving.
- Emphasis on **“Zero Defects”** is becoming the norm. This is quite understandable as product complexity increases. Makers of Cars, Phones, and Machines continue to expand the features and capabilities they offer.
- As this occurs, the number of things that can **possibly go wrong** increases as well.

# Achieving 100% Quality

- A Pessimist will cite Murphy's Law: ***"If a thing can go wrong, it will go wrong"***- when faced with the challenge of zero defects.

- At SMAC we have another, more optimistic view: ***"When everything is done correctly, it will work."***

# Achieving 100% Quality

- The idea of checking 100% **used** to be considered a waste of money.
- *"You can't inspect quality in"* (true) but you <u>can</u> **prevent bad quality from getting out**.
- Gradually, as technology improves and costs drop, the ability to make 100% quality checks **increases**.

# Case Examples

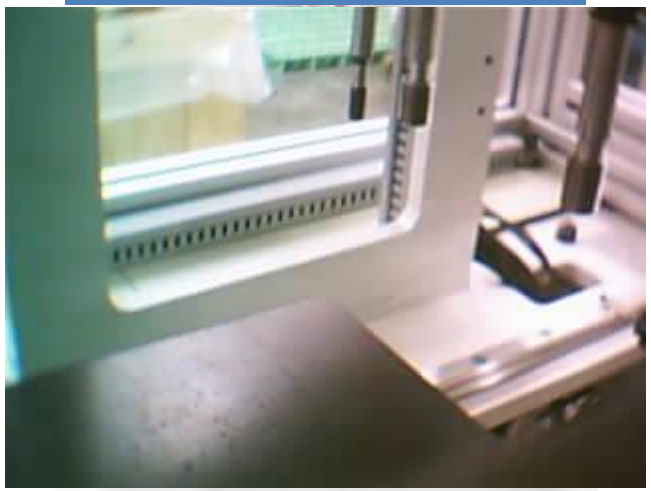
**Thread Inspection**

**Part Measurement**

**Switch Testing**

# Thread Inspection

Thread Inspection



This inspection process checks a machined thread and feeds back quality data immediately. The device used is a 2 axis - independent linear and independent rotary - Moving Coil Actuator. Both axes are servo controlled and allow programmable control of:

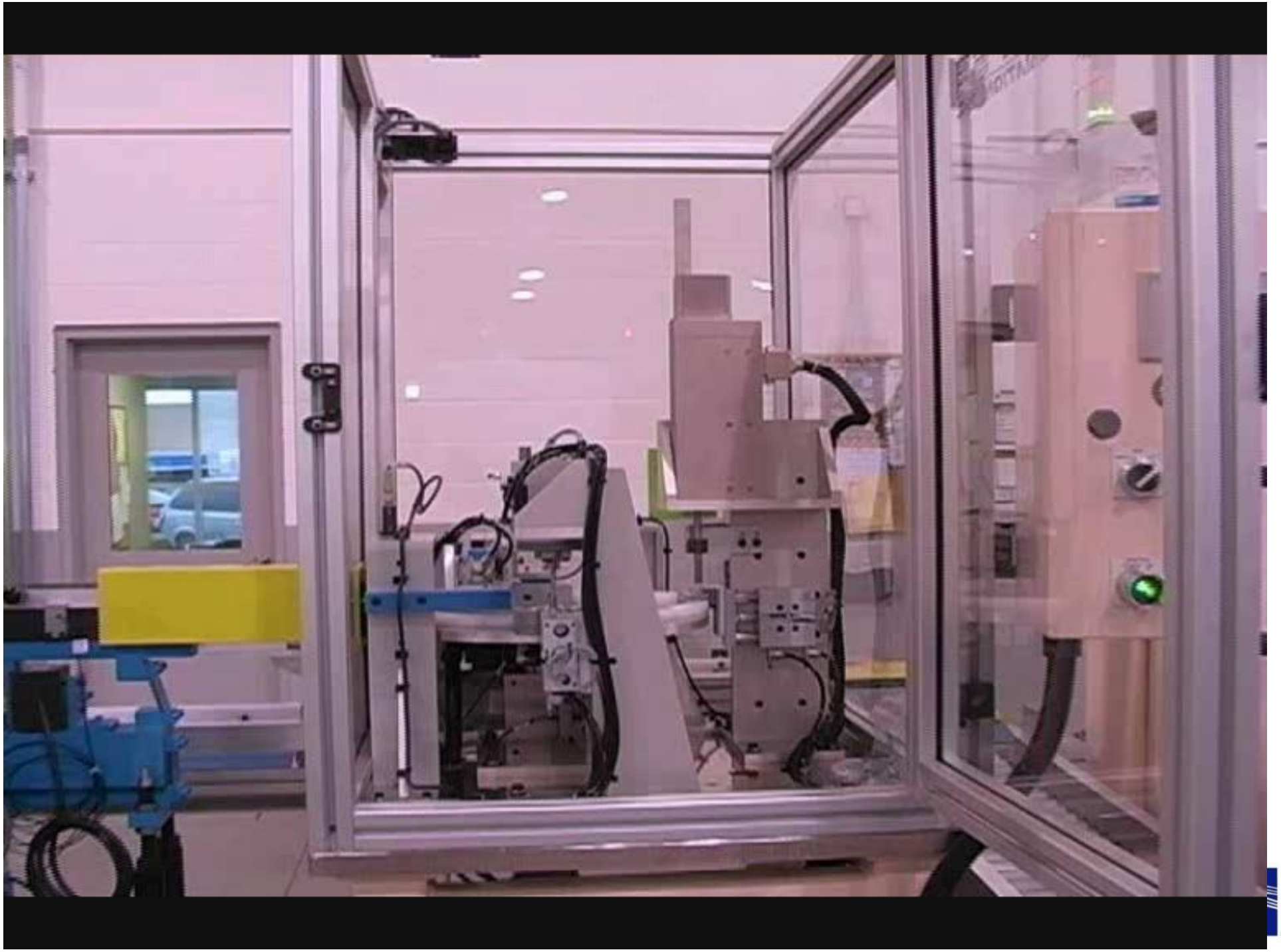
- **Position** - micron level for the linear and 0.1 degree or lower for the rotary.
- **Velocity** - micron to meter per second for linear and up to 3000 RPM for the rotary.
- **Force** - grams to 100 N for linear and up to 10 NM for rotary.

Attached to the shaft of the actuator is a thread gauge – i.e., giving gauge compatibility.

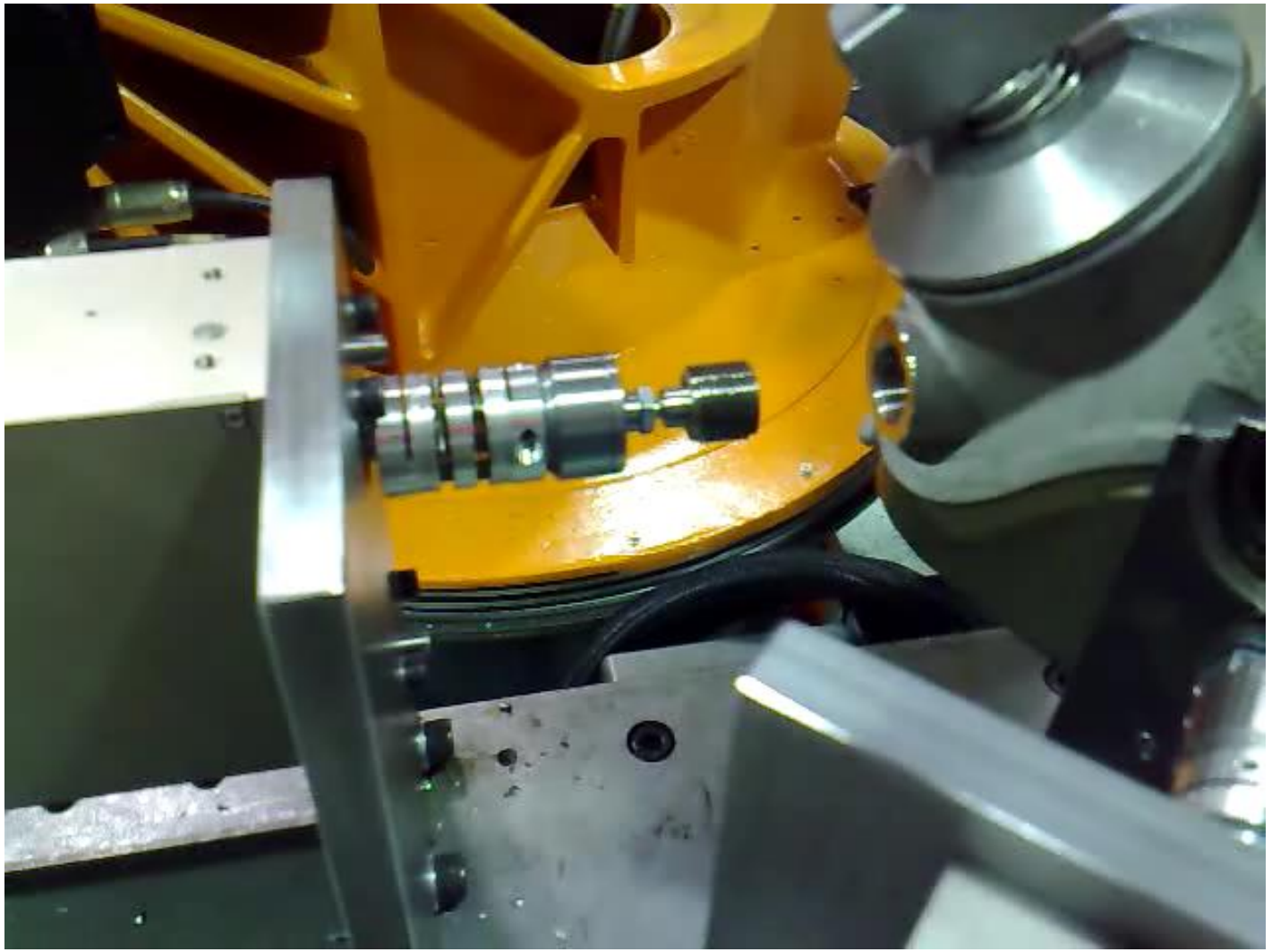
Here's how it works...

# Thread Inspection

# Thread Inspection



# Thread Inspection



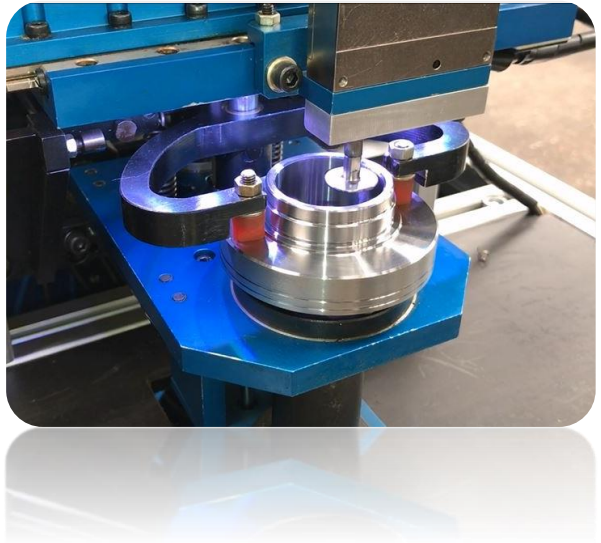
# Part Measurement

**Part dimensional measurement** is perhaps the most common type of 100% Quality Check being demanded today. Challenges are:

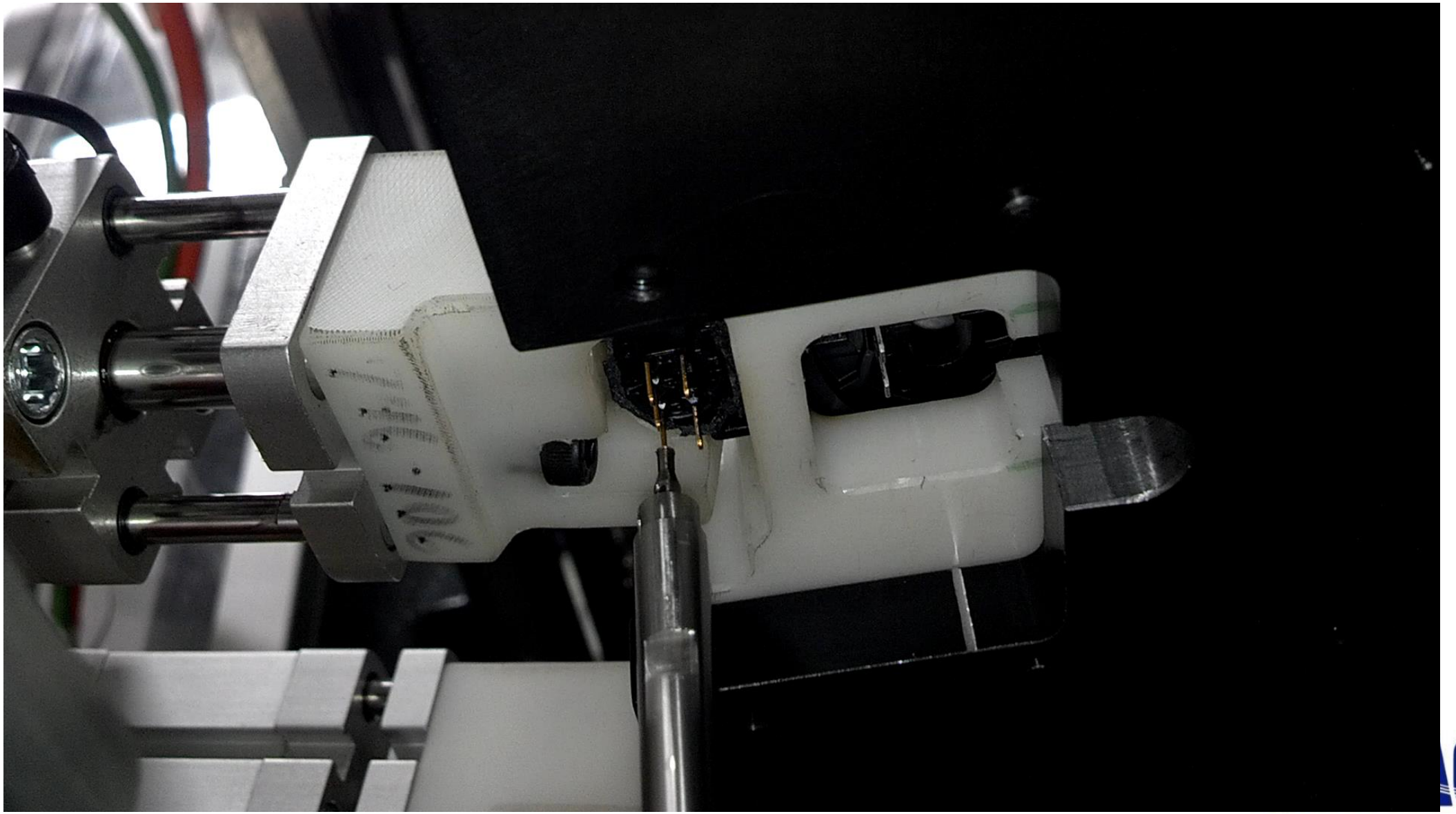
- To get resolution to micron level and below.
- **High speed** is required in order to rapidly measure a dimension
- There is also a requirement for low impact and a controlled force during the measurement.

Mechatronic actuators are quite useful for this work - They are fast - have Soft-Land capability - **programmable force** - and encoders with resolutions to 0.1 micron.
Both single and multipole devices are needed. Examples of this type of work will now be shown.

Part Measurement



# Part Measurement



# Part Measurement

# Part Measurement

# Part Measurement

# Switch Testing

Switches are quite often designed to be operated by the human finger. So testing needs to check:

- **Force** required to turn switch on.
- **Distance** required to move before switch turns on.
- Force **level required** to turn switch off.
- **Location** of point where switch turns off.

(And all this turns into a hysteresis loop check).

# Switch Testing

The best way to test this is with a **mechatronic** device that can operate like a human finger. It should find the switch start location without causing movement. Apply programmed force - often in increasing or decreasing levels. Track and feed back  position and force in real time. Have the ability to detect the switch point. The MCA has these capabilities - including "**Soft-Land**" and so can be used to test switching devices.

Incidentally,  a  new type of MCA - developed for a major consumer products company - has a moving mass of less than 3 grams and is used to test the minimum amount of force required to turn on a touch screen.

Here's how tests are made.

# Switch Testing




SMAC

# Switch Testing

# Achieving 100% Quality

- The devices used here to check are **MECHATRONIC**.
- They have the ability to **“Soft-Land”** on a surface:
  - use that as a reference
  - apply a programmed force
  - record the relevant quality data
  - then compare it to the specification and decide if the item is good or bad.
  - **All in a matter of a  second or so.**

# Achieving 100% Quality

- These are **Moving Coil Actuators.**
- Very fast linear and linear rotary servo devices that have built in sensors and controllers that enable them to measure/test/compare and feedback the results.
- And they are quite reasonably priced,  some **as low as a few hundred dollars**.

# Achieving 100% Quality

- This is all very good but it is still checking items **AFTER** they have been made.
- A better method would be to **verify the quality as it is made** - better yet - to be able to *adjust* the item during the production to insure it is good.
- Reducing specification tolerance variance and centering up the spread can **virtually eliminate product failure** due to “edge” stack - up as well.

# Achieving 100% Quality

- That is starting to happen and here are some recent examples at some very capable makers of complex products.
  - Airbag
  - Phone lens
  - Capping

# Achieving 100% Quality

*Mechatronic devices - ones that have the programmable ability to do important work functions **AND** have the ability to verify the success of the work done at the same time - can be a key part of the effort to produce zero detect parts - components - and finally products.*

.0007 Wire

# Airbag

- In air bag manufacturing the ability to do work and adjust on the fly to insure quality is quite useful. A key operation is the welding of an ignition wire to an explosive pellet. Several  variables can cause problems:

1. There are different sized pellets depending on the type of air bag. So set-up's are different.
2. When welding the same air bag there is variation in part height and, of course, the pellet is explosive.

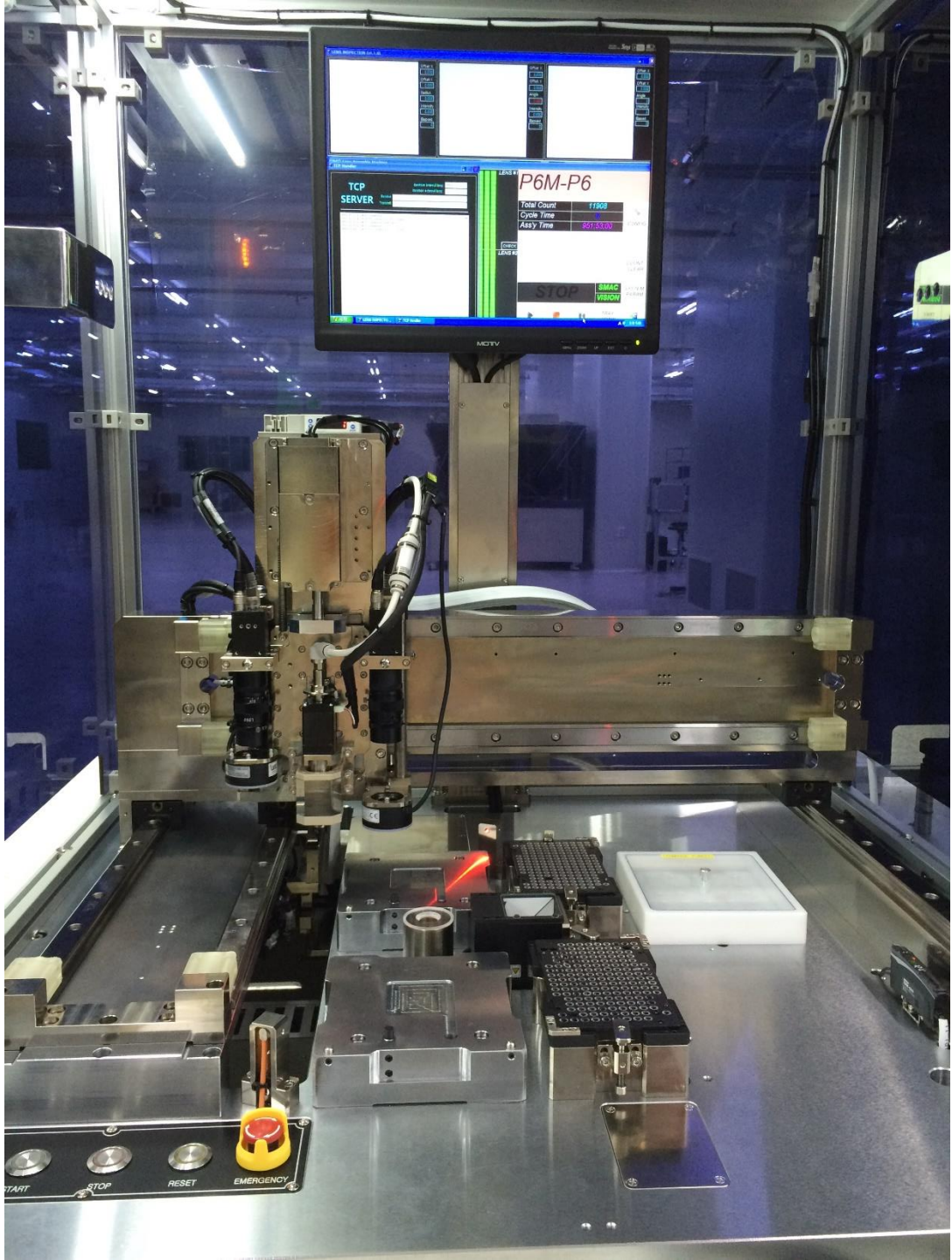
- Old open loop technology using air cylinders or ball screws produced inconsistent welds. And the variation was not reported back.
- By using a Moving Coil Actuator and its Soft-Land ability, programmable force, and the ability to feed back its position these challenges can be overcome.

# Airbag

- The actuator can locate the surface of the wire as it moves onto the part in Soft-Land velocity mode. So part height variation is no longer important. **Force control** is maintained within a matter of grams. So variation due to spring clamp force or air pressure is eliminated. (As well as inconvenient ignition of the pellet!).
- The contact is maintained as the wire heats up and the final position is **reported**.
- Customers have found the quality - measured by wire resistance - has **improved substantially** as resistance variation from weld to weld is over 90% less than using the old tech.
- Additionally set up change has become automatic - **no human participation** is needed so that cause for error has been eliminated.

# Camera Lens Assembly

- Camera lens assembly for phones has also benefited from the introduction of mechatronic devices that can programmably adjust to different requirements. The ability to monitor on the fly what is going on in a process and adjust to get the required results has real benefit.
- An example is an 12 piece stacked assembly. Here the parts are press fitted one on top of the other. Key items to control are speed, press force, and most importantly position.
- The original process used pneumatic slides with hard stops. Force control was dependent on the pressure regulator and flow controls. Neither could adjust on the fly and position feedback was limited to the switch on the slide.
- Product failure at assembly was over 30%. And - what did pass included assemblies on the edges of the margins. This leads to field failure.



# Camera Lens Assembly

- The switch was made to MCA mechatronic devices. Parts were picked up and the “Soft-Landed” onto the assembly. Position was noted and target assembly position called out. The correct force - achieved by programmable adjustment of the current in real time - was applied. Position change was monitored and the correct target position was achieved. 100% feedback of the results was made.

- Reject % dropped to 2% and that was caused by out of spec parts. Reason for reject was also reported by the device.
- An additional benefit was realized because the tolerance stack - up variation was reduced by over 2/3rds and this was centered. Thus field failure due to “on the tolerance edge” assembly was eliminated.
- It can be noted that several leading pneumatic valve makers - have also used this capability and achieved the same results.

# Smart Capping

- A final example of modern mechatronic automation using the programmable and information feed back tools found in the MCA is in Cap assembly.

# Smart Capping

A cap can be screwed - or snapped in - in the following way:

- First a **Soft-Land routine** is made onto the bottle top - this verifies there is a bottle present.
- Next the cap is rotated CCW. **If the cap moves up** there is verification that there are threads and that they are good.
- The cap threads and the bottle threads match - *prevents cross threading* - the cap will **drop** a measurable distance without turning. So cross threading can be prevented. (This also works for screw driving).
- Cap is then rotated CW. Torque is **monitored** as is linear distance travelled and number of turns. All are checked against standard. So cap is down in final torque out position is confirmed.
- Cap can be **snugged** and then final torque applied. Note this is a programmable selection. Verification that cap has stopped moving is made. This also is reported back.

So again - **mechatronics** enables the work to be done - and verification of its success made in real time with feedback.


# Bottle Capping with Quality Feedback

# To Summarize

To summarize - Making sure things work correctly is of value - particularly when they are parts / components that are part of larger assemblies. If they are not good then then larger more costly assembly must be rejected or reworked.

However - with Smart Robotic technology - there are now Mechatronic devices that can be programmed to make decisions and adjust on the fly AND verify/feedback the results of the operation. That is a useful development in high quality Automation.

# Thank you

Now let’s further discuss your problems with achieving 100% Quality.

# Q & A

**SMAC Moving Coil Actuators**
**Booth #121368**
5807 Van Allen Way
Carlsbad, CA USA

Phone: 760-929-7575
Email: info@smac-mca.com

www.smac-mca.com