300°C COATER/EXTRUDER GAP MEASUREMENT

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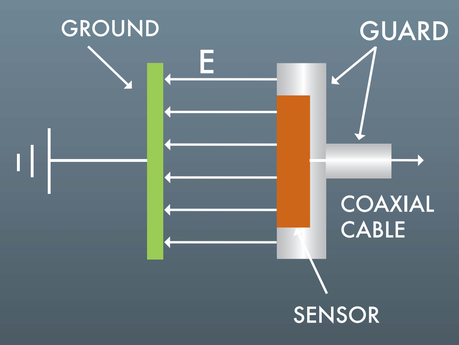
ABSTRACT

Capacitec is introducing three new GPD non-contact capacitive gap measurement sensors that measure adjustable coating and extruder lip gaps at constant operation temperatures of 200°C, 250°C and shorter term measurements up to 300°C. This opens up new possibilities for use in considerably hotter coating and extrusion die processes to control gap uniformity. This is the only electronic gap gauging tool to validate gap sizes in adjustable coater dies and extruders operating at 300°C.

CAPACITIVE TECHNOLOGY

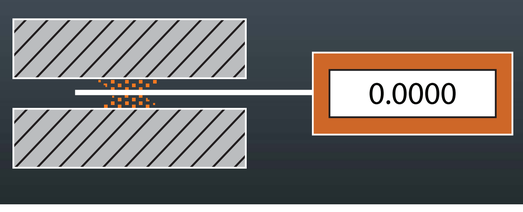
DISPLACEMENT MEASUREMENT

Capacitive non-contact displacement sensor probes have a central sensing element with a typical diameter of between 2 to 5 mm. A ring layer called a guard, which is approximately twice the diameter of the sensor, surrounds the sensor. The guard ring, when driven, alleviates degrading fringing effects, which would rob the capacitive sensor of its range. Both the sensor and guard are isolated from each other, with the center conductor wire of a 100% shielded coaxial cable electrically connected to the sensor and the coaxial shield connected electrically to the ring guard.



GAP MEASUREMENT WITH SENSOR PAIR

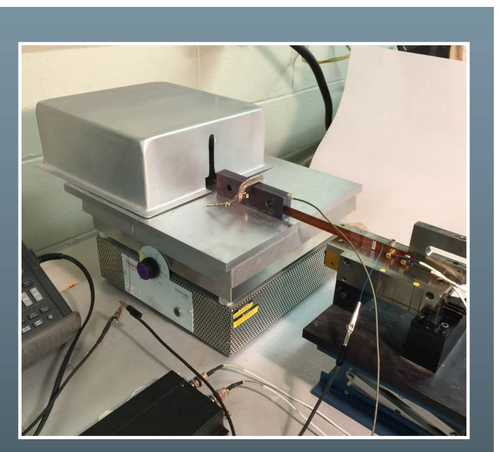
- Two sensors placed back to back in a thin film or ceramic epoxy wand package



TESTING METHODS

A hot plate with a thermal insulated metal cover was the source of heat for the gap test fixture.

- A thermocouple allows temperature capture vs. gap measurement changes that are ramped up over 3 to 5 hours.
- Temperature reported in increments of 50 degrees (25°C to 300°C)
- Recorded gaps measurements in microns from ambient to higher temps.



WHY ARE MEASUREMENTS IMPORTANT?

- To make coater/extruder gap measurements for small to large gaps at process temperatures
- Allows users to accurately adjust gap sizes during pre production at room temperatures
- After nominal heat up, confirm measurement of the thermal expansion of the coating/ extruder gap
- Allows users to accurately adjust gap sizes during pre and post process production

SLOT DIE COATER/EXTRUDERS GAP MEASUREMENT DEVELOPMENT

TRADITIONAL LAB SYSTEM

A Complete Slot Die Coater System Contains:

- Non Contact Sensor Wand
- Custom Wand Holder
- Signal Conditioning
- Bargrafx Software

PORTABLE PRODUCTION SYSTEM

A Portable Slot Die Coater System Contains:

- GapmanGen3® Portable Gap Measurement System
- Optional High Temperature Wand Holder

200°C TO 300°C FLEXIBLE AND RIGID WANDS

#1 - Gap Sensor Wand 200°C

- GPD-3(.020)-E-150-FX90
- Polyamide material
- Wand thickness .508mm
- 1.5mm gap

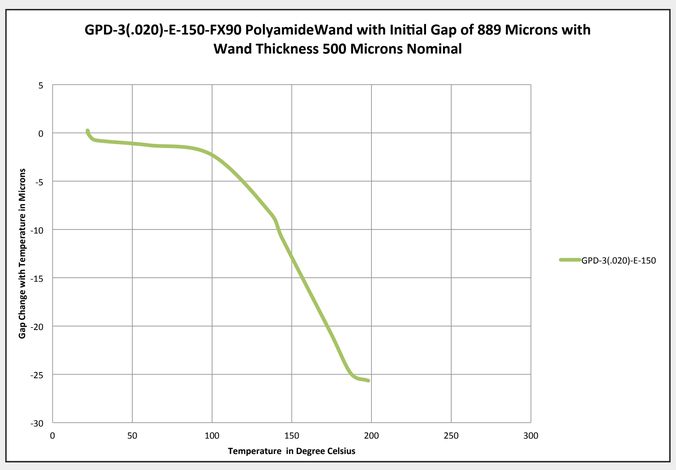
#2 Gap Sensor Wand 250°C

- GPD-2(.009)-E+-150-5509-8808
- Kapton™ material
- Wand thickness .230mm
- .406mm gap

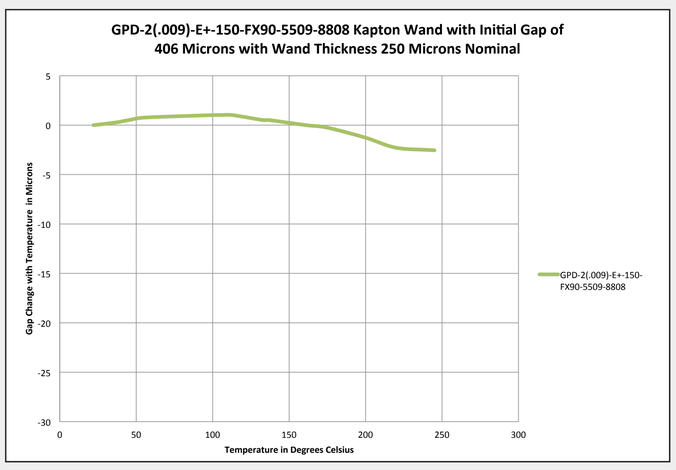
#3 Gap Sensor Wand 300°C

- GPD-3(.065)-E+-150-5509-8670
- Ceramic/epoxy material
- Wand thickness 1.65mm
- 2.56mm gap

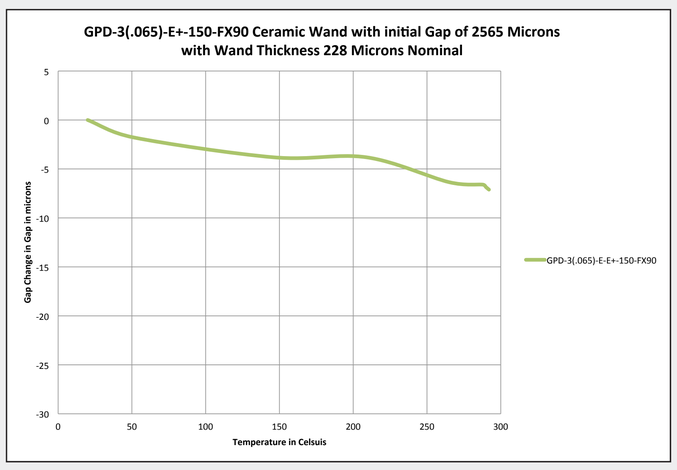
TESTING RESULTS GRAPHS



200°C



250°C



300°C

RESULTS AND CONCLUSION

RESULTS: The three Graphs seen in the Experimental section represent three different wand thicknesses and gauge block gap widths measuring the output change in microns versus temperature. This represents the unique thermal expansion profile to this ferritic steel gauge block/target set.

Test results show that a 2.7%, 0.7%, and 0.3% of full scale output changes at approximately 1,000 micron gap and maximum test temperature. These values are predominantly a thermal offset as a result of the Z axis (Tg) expansion of the wand material.

Additional testing will add more gap target sizes (thicker and thinner) for each wand. These added dimensions will additionally clarify any sensitivity changes.

CONCLUSIONS: Capacitive non-contact sensor technology has demonstrated minimal error from temperature effects compared to other displacement or gap measurement sensing technologies.

Data shows the expected total change before reaching an isothermal die temperature for the 3 types of wands tested. This data confirms that the deviation from nominal gap standards is similar to past test result of similar families of gap wands.

The general gap measurement procedure is to “Set To Standard” (Tare value) before inspecting the die or slot gap uniformity. Since slot die uniformity is the goal, absolute offset and accuracy is of generally less importance.

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