Qualification of Gap Measurements (300°C) for Coater/Extruder Dies

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Introduction

Capacitec presented a Poster at the 2010 ISCST titled "Test Results of Electronic Gap Tool to Confirm Gap Sizes in Adjustable Extruder Dies Operating at 250°C" Since that time Customers have been requesting higher temperatures and more robust gap measurement wands. Based on this Capacitec developed additional wand options that can sustain temperature up to 300°C.

Today Capacitec is introducing two new GPD non-contact capacitive gap measurement sensors that measures fixed and adjustable extruder lip gaps at constant operation temperatures of 250°C and short measurements up to 300°C. This opens up new possibilities for use in considerably hotter extrusion and coating die processes to control gap uniformity.

These measurements are important because gap widths change in relationship to the thermal expansion of the extruder die lip between ambient and production temperatures. This new Capacitec extruder die gap measurement system now allows users to accurately adjust gap sizes during pre and post process production.

The poster will present a preliminary summary of test results. We will show photos of the test set-up along with presentation of summary results, conclusions with recommendations of best practice usage.

Testing Schedule: The GPD-3(.020)-E measures up to 200°C and is the traditional workhorse design that has been used for >10 years. In the past 2 years Capacitec has developed two new GPD higher temperature wand versions. They were used for the recent testing:. The 2 new models are:

GPD-2(.009)-E+ retaining the flexibility design and the GPD-3(.065)-E+ a very rigid design for larger gap openings.

Comparison of wand test parameters (250°C to 300°C)

Model	***Test #1*** ***GPD-2(.009)-E+-150-5509-8808***	***Test #2*** ***GPD-3(.065)-E+-150-5509-8670***
Max Temperature (°C)	250	300
Gap Wand Material	Polyimide	Ceramic/epoxy
Wand Thickness (mm)	.230	1.65
Calibration Sensitivity (Millivolts/Micrometer)	10	4
Thermal Drift (Micrometers)	2.5	7
Gap Range (Micrometers)	406	2565
Gap Change with Temperature as a (% of Full Scale Range)	0.62	0.27

Measurement procedure:

A hot plate with a thermal insulated metal cover was the source of heat for the testing. (see Figure 3) It was used to heat up 2 steel parallel precision metal plates at a unique nominal fixed gap range. A fixed gap value was chosen to match the wand thicknesses.

A thermocouple was used to capture the temperature vs. gap measurement changes as the temperatures were ramped up over 3 to 5 hours.

The temperature was increased (ramped up) in increments of 50 degrees C from ambient to 250°C and 300°C for the three different gap wand measurement studies.

Once the target temperature was met and measured the oven was cooled overnight to record a value at ambient. Measurements were recorded in microns to capture the difference gap in measurement from ambient to higher temps.

Experimental

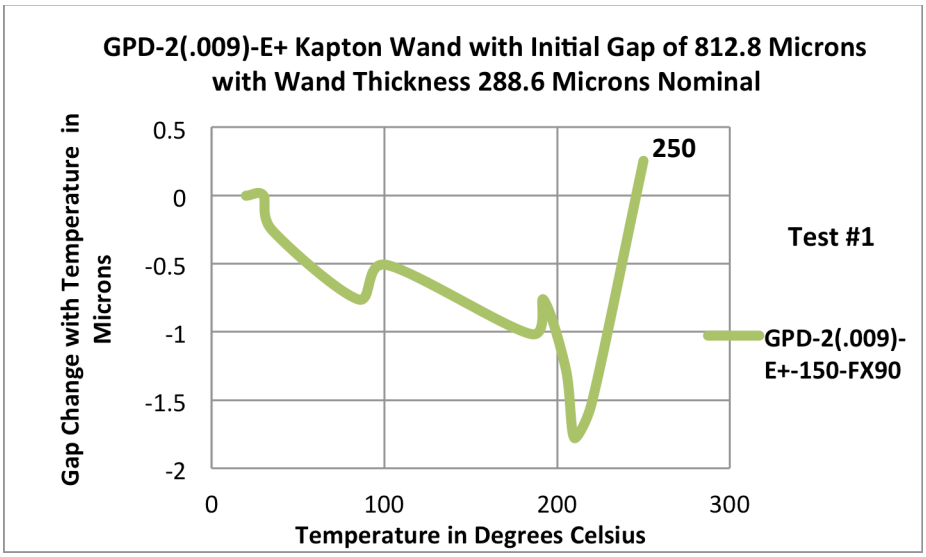

Figure 1: Measurement from ambient to 250°C

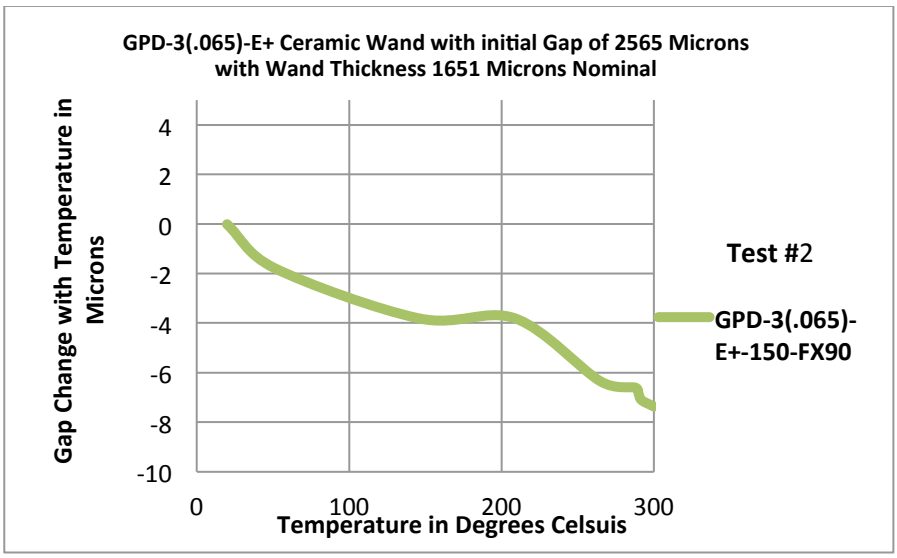

Figure 2: Measurement from ambient to 300°C

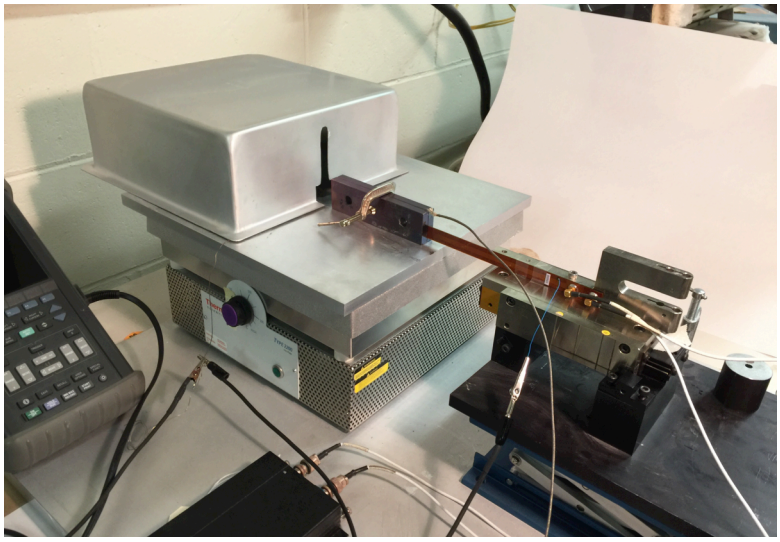

Figure 3: Parallel steel plates separated by gauge bloc

Results

The two Graphs seen in the Experimental section represent two 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.

Additional testing will add more gap target sizes (thicker and thinner) for each wand. These added dimensions will additionally clarify any sensitivity changes. In addition these results will be compared to earlier high temperature testing. The past test results have seen data presented which has seen less than 2% of the full-scale value at 1,000 microns. This information will be added to the poster to be presented at ECS17.

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 2 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.

References

1. DOUSSIN, J.-F., High Temperature Testing used to present the Poster Session at the 2010 ISCST, Manning, B presenter
2. Foster, R.L., Manning B.D., Coating Magazine (CH) “Maintaining 250°C Gap Uniformity on Extruder Dies Issue 4/2014
3. Magee, R.V., High Temperature Testing used to present the Poster Session at ECS 2017