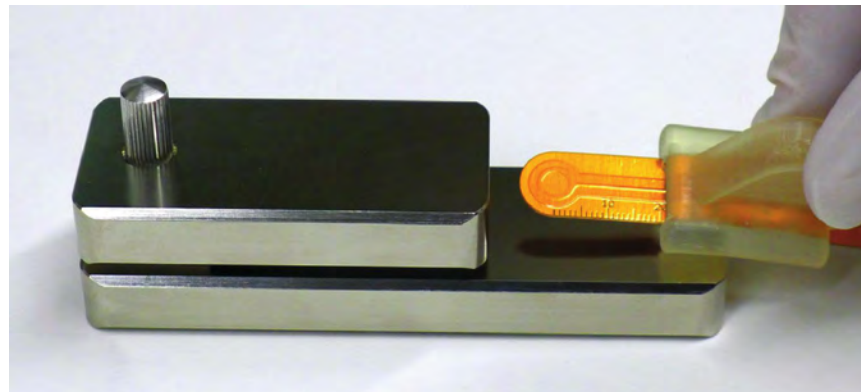


gap targets. This matched combination provides a traceable solution for metrology calibration labs because they know that the data is certified to lab standards. The downside to this approach is the added time to support these multiple Gapman calibrations. An additional concern is the ability for calibration labs to build well-controlled flat painted or CFRP targets. They are very costly to produce and very difficult to control the flatness to 25-50µm; the typical tolerances using readily available matched CFRP material for use as standards for calibration. These targets are typically cut from available stock and can have excessive radii. This is in conflict to the preferred metrology sample flatness goal is 1µm for calibration target standards.

Compare and contrast

An alternative solution to this dilemma is now available from Capacitec. It combines new custom Gapman Set to Standard software with a simple baseline metal-to-metal calibration. When used in conjunction with certified metal calibration blocks as targets, well-controlled highly-repeatable certified gaps can be achieved. Capacitec performed a study by comparing the metal-to-metal calibrations to a variety of different target material types focusing on CFRP combinations. The results showed that 80% of the deviations from the readings are simple offset value adjustments.

The table below shows the results of how Capacitec successfully takes advantage of this new 'Set to Standard' software process using a series of custom offset adjustments correlating to the target material and finish. The table specifically shows the differences between the baseline metal-to-metal calibration and the subsequent



ABOVE: Metal to metal gap standard

nominal gap readings between metal-to-CFRP smooth combined targets. A unique best-fit offset, derived from the standard deviation for each material type, can be applied if the user requires tight linearity (25µm or better).

If the linearity is not as stringent (50µm or better), one single average of all best-fit offset adjustments across all material combinations may work. The data shows that by applying this best-fit offset (0.031mm average deviation) to any of the data will result in greatly improved linearity of 0.008mm shown on the right hand side of the table. CFRP to CFRP rough glass targets, tested but not shown here, represented the largest deviations (about 100µm) in outputs due to the unique surface dielectric coatings of the materials used (and not being conductive metal).

The compromise of making an offset adjustment leaves a slightly higher residual non-linearity due to the slope variation of the material combination. Engineers can investigate whether this offset adjusted variation meets the requirements for their particular assembly. This new approach to

certified gap measurements creates added efficiency of the complete shimming process.

Furthermore, a new Gapman Gen3 wireless option has a higher level command set of communication protocols to allow an external software program to adjust this Set to Standard offset of any material combination (CFRP to metal etc.) being measured at any location. Customer designed database software could readily apply this offset value, by communicating via the wireless option. Calibration check standards can also be used in production to validate proper operation without the additional cost burden of special composite standards for each gap target combination.

The Gapman Set to Standard calibration process can have a high impact on improving gap measurement and shimming process throughput. It also improves quality of calibration recertification as it is based on known metal-to-metal standards while reducing the time it takes to certify under normal metrology cycles.

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BELOW: Gapman test results with offset calibration

Location	Nominal	Raw Readings BEFORE Offset Gap (mm)	Metal/CFRP smooth Deviation	Corrected Readings AFTER Offset -0.030mm Gap (mm)	Deviation
1	0.200	0.238	0.038	0.208	0.008
2	0.400	0.428	0.028	0.398	-0.002
3	0.600	0.627	0.027	0.597	-0.003
4	0.800	0.828	0.028	0.798	-0.002
5	1.000	1.030	0.030	1.000	0.000
6	1.200	1.230	0.030	1.200	0.000
7	1.400	1.429	0.029	1.399	-0.001
8	1.600	1.629	0.029	1.599	-0.001
9	1.800	1.828	0.028	1.798	-0.002
10	2.000	2.027	0.027	1.997	-0.003
11	2.200	2.229	0.029	2.199	-0.001
12	2.400	2.430	0.030	2.400	0.000
13	2.600	2.632	0.032	2.602	0.002
14	2.800	2.835	0.035	2.805	0.005
15	3.000	3.038	0.038	3.008	0.008
			Average: 0.030	Maximum Deviation: 0.008	