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## Desktop CMM tracks down bad blades

A desktop CMM system let **Steven B. Kushnick P.E. Inc.**, Marietta, Ga., eliminate repeated delays and inaccurate measurements in analyzing turbomachinery failures.

In checking the dimensional accuracy of a turbine blade. The MicroScribe MX system from **Immersion Corp.**, San Jose, Calif. took point-by-point measurements with a hard probe of a sample blade that had been cast and then final-machined. Kushnick compared this data to the vendor's original CAD file.

Blade measurements began after Kushnick calibrated the software against a digitized gage ball. This gave the machine a measuring accuracy of 0.00025 in. or better. "Surface-to-surface registration between measured and CAD surfaces was fairly easy. I clamped a precision pin ground to within 0.0002 in. against the blade, and measured in two locations to determine the pin's central axis in space. I positioned an outline of the pin on the CAD drawing, and the drawing oriented to match the axis of the blade model," he says. This accurately registered two degrees of freedom.

Next, Kushnick clamped another pin along the opposite side of the blade. He digitized and outlined the pin on the drawing. The orientation of the pins and taking a measurement on the blade's flat face locked down the remaining degrees of freedom. This matched the orientation of the CAD drawing to the blade model.

"First, I measured the CAD model, made a surface that overlaid the drawing, and compared the two. But a better and easier method was to take measurements, each time placing spheres on the model that were the same diameter as the probe ball. Where the model surface is correct, the spheres just touch the drawing.

For reverse engineering an airfoil CAD surface, an accuracy of 0.0004 in. would normally not be sufficient. That's because when one point measures high and an adjacent point measures low, the surface will show an obvious kink like a crumpled piece of paper. "To overcome this, I use the MicroScribe digitizer to 'brush with splines,' which creates a spline cloud instead of a point cloud. The average spline eventually becomes obvious and has an accuracy that provides excellent surface-generating results," says Kushnick.

### MAKE CONTACT

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The MicroScribe MX system accuracy is said to be 0.004 in., but many of the digitized points can be within 0.003, 0.0002, or even 0.001 in.



The digitizer's red probe ball rests on the blade neck, which is next to the blade. Points taken on the blade's flat face match the orientation of the CAD drawing to the blade model.



The easiest check was to generate spheres the same diameter as the probe ball at each of the digitized locations. Green spheres touch the CAD drawing as expected, but red spheres are oversized, which indicates

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disagreement between the manufactured turbine blade and the original CAD drawing.

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