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Sceptre Application Notes
Aircraft and Power Generation Industry

Sceptre 3.0 has been enhanced with a variety of specialized analysis and reporting features that simplify the analysis and make possible complex measurement tasks on a variety of turbine blades. Along with a tutorial "Air Foil" macro library, users can now perform these example evaluations and reports. These macros can then be modified and tailored to the user's needs.

You will find enclosed actual reports that Sceptre is now capable of generating on airfoil type parts. An AIRFOIL element evaluates the most frequently inspected features of an air foil or turbine blade type of component. Simply feed this routine a scan data set, consisting of a sequential set of points on a cross section, and the analysis will report the following:

- **Chord Length** – the maximum length between the leading and trailing edge.
- **Pitch Diameter** – the maximum width across the blade body.
- **Leading Edge Thickness** – at a given depth from the leading edge the thickness of the blade.
- **Leading Edge Radius** – calculate the actual radius of the leading edge.
- **Trailing Edge Thickness** – at a given depth from the trailing edge the thickness of the blade.
- **Trailing Edge Radius** – calculate the actual radius of the trailing edge

Data from a scanned cross section at 8 mm/sec, using 5.0 mm probe tip.

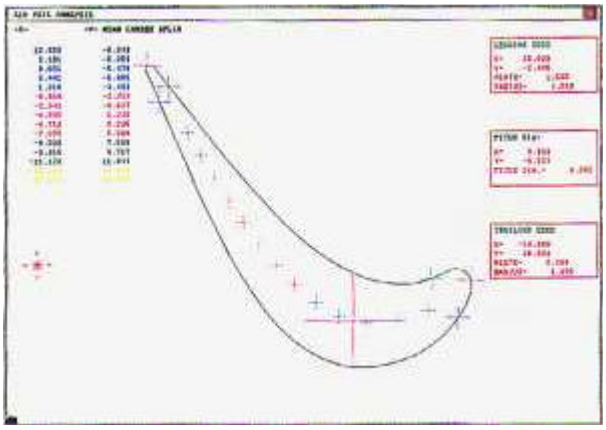

Figure 1. Screen display after Air Foil analysis in which the Mean Camber spline and the standard Airfoil outputs are displayed.

Not only can you report the numeric dimension – you can also set graphic marker points that permit the system to pictorially show you where the AIRFOIL element decided to make these measurements.

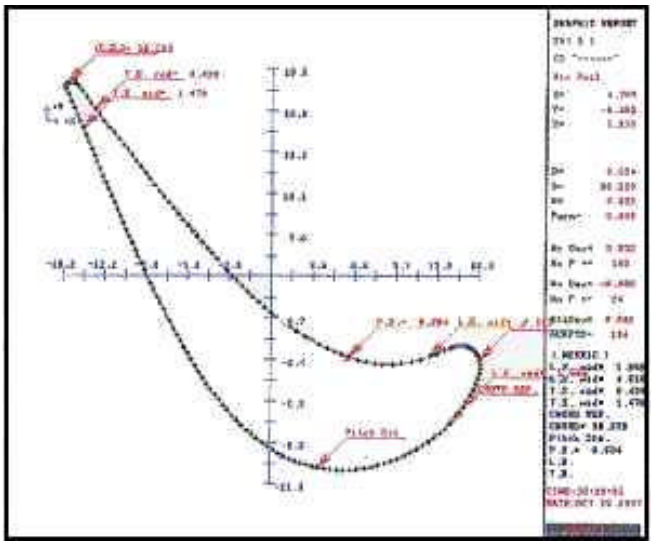

Figure 2. Graphic display of air foil analysis with displayed marker points.

In addition to performing the airfoil analysis, you can cut out a subset of data from the full data set based on the function. This gives the programmer the flexibility to separately analyze, plot, or process in some other manner – the leading edge, trailing edge, pressure side, or suction side.

The leading edge points have been isolated and displayed.

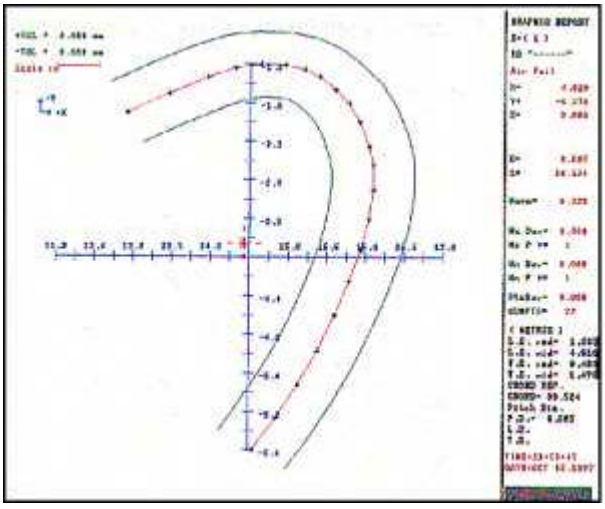

Figure 3. Graphic display of a subset of the data in Figure 2.

Compare

In an established reference system based on a common datum system from a blueprint, the COMPARE command will mathematically compare the *actual* data measured to a *nominal* blade section. With this mathematical model of points and variation, it is now possible to magnify the variation between the two. On a single Piece of 8 ½ x 11-inch paper we can portray microinches of variation by using a deviation scaling factor.

Nominal – black cross marks

+Tolerance Green Line (.1mm scaling factor)

Deviation Red Line and Spike uses same scaling Factor

Note: Variation indicates location of airfoil is incorrect.

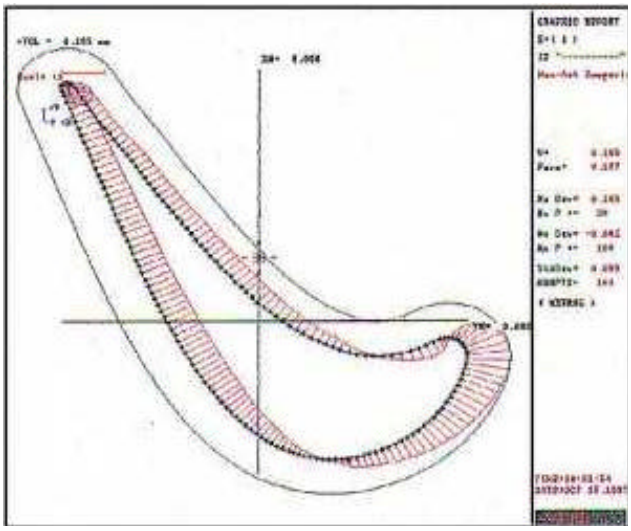

Figure 4. Graphic display of a comparison between a nominal air foil section and an actual air foil section.

Best Fit

After comparing them, go ahead and best fit them together. The system will then determine the combination of shifts and rotations so that the variations become a minimum.

Nominal – black cross marks

+Tolerance Green Line (.1mm scaling factor)

Deviation Red Line and Spike uses same scaling Factor

Note:

- Variation is now symmetrical and thus blade location has been corrected.
- The scaling factor is now smaller. The variation has been reduced thus we can magnify the variation more.

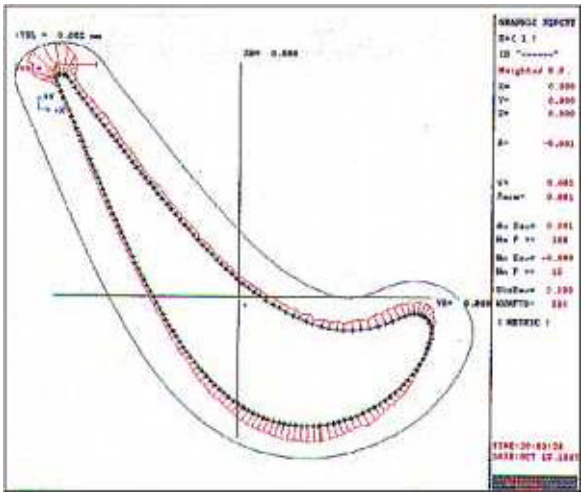

Figure 5. Graphic display of data in Figure 4 after a best fit.

See arrows marking point on leading pressure side of foil.

This simulates inspectors with overlay charts having a selective preference for doing “best fitting” based on human interaction.

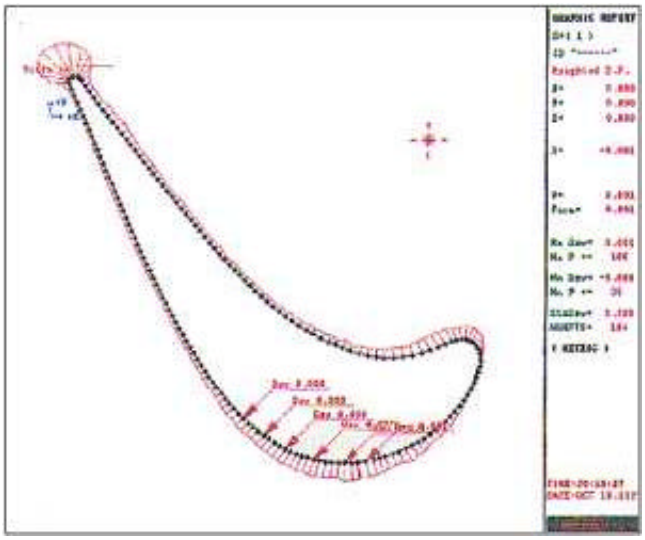

Figure 6. Graphic display of data in Figure 5 after entering point editor and marking points.

Note that at the selected marker point the variation has been reduced. The remaining points that were not selected have had their variation increased.

A prominent foil best-fit philosophy is based on taking some points near a selected zone at the leading and trailing edges on both foil surfaces.

Sceptre also allows the user to do several best fits and combinations of them, which allow for the determination of bow and twist in 3D.

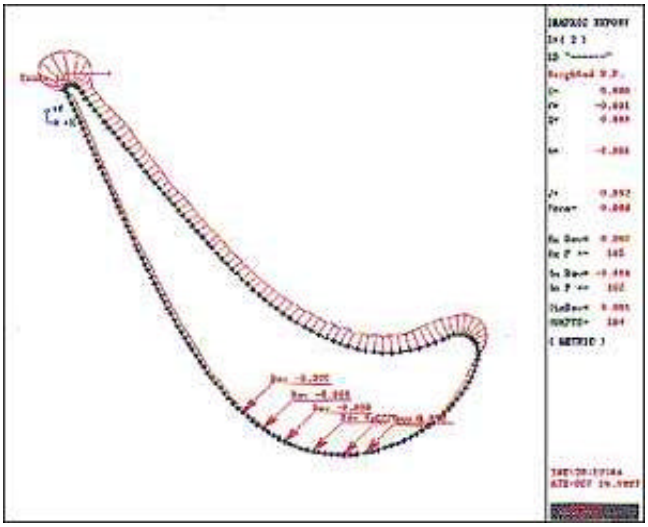

Figure 7. Graphic display of data in Figure 6 after best fitting utilizing weighted marker points.

In this mode Screen display shows nominal and actual data as the operator shifts and rotates data to each other via mouse and cursor moves.

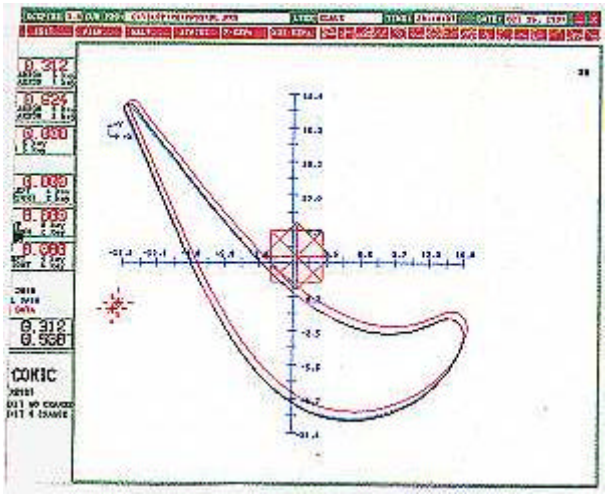

Figure 8. Screen display during MANFIT Manual Fit editor screen.