

# Serving up Raptor wings, Seattle style

Welcome to the place where a massive oven ‘cooks’ F-22 wing skins

By DOUG CANTWELL

Joe Habersetzer and his team at Seattle’s Composite Fabrication and Assembly Center use a mighty big oven to “cook” the fiber-composite wing skins for the world’s most advanced air-dominance fighter, the U.S. Air Force F-22 Raptor.

It’s actually one of two 25-by-90-foot (7.6-by-27.4-meter) cylindrical autoclaves, among the largest in the world, which were originally built to cure the massive composite wings of the Air Force’s B-2 stealth bomber.

The F-22 Assembly Center will celebrate a major milestone in mid-December when it delivers the 100th set of Raptor wings. As a first-tier partner in the F-22 program, Boeing builds the wings and aft

fuselage, integrates the avionics and leads the pilot/maintenance training effort.

Before the Raptor wing skins find their way to the autoclave, CFAC specialists perform an unlikely combination of robotic magic and highly skilled hand layout to sculpt them into existence. With help from a programmable contour-tape-layup machine, they laminate as many as 400-plus layers of graphite fabric in fairly small pieces, some of them only a few inches square.

This approach allows teammates to arrange the fabric for maximum flexibility over contoured areas and to increase thickness at designated stress points such as drill holes. The entire wing-surface layup is programmed into the contour-tape-layup machine in paint-by-number fashion to achieve the appropriate thicknesses.

Before it’s sent to the autoclave, each wing skin is covered with a special plastic material and sealed around the edges. A vacuum unit is attached that evacuates every tiny bubble of air from between the layers of graphite material.

“Porosity is our nemesis,” Habersetzer

said. “Air trapped between the plies of graphite would seriously degrade the skin’s strength, and we’d have to surplus some very expensive layups if we ever got lazy about the evacuation process. So we don’t.”

Once evacuation is complete, each skin is cured in the autoclave for a total of 18 hours at 350 degrees Fahrenheit (177 C). That’s followed by a post-cure at 440 F (227 C).

To ensure that no air bubbles have survived, the skin goes to nondestructive test for an ultrasound checkup. Still riding on its contoured stainless-steel fixture, the skin then moves to a massive five-axis router that trims it with laser precision to final dimensions. The router bit is blasted continuously with a liquid coolant during this operation to prevent any buildup that might change its radius—even minutely.

Since delivering Raptor No. 1’s wings in 1996, the F-22 team has continually improved its quality, cost and delivery performance, and CFAC technicians keep pace as they lay up, evacuate, cure, test and trim these state-of-the-art composite wing skins. ■

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At the Developmental Center in Seattle, operator Arnaldo Rivera (background, right) works with a robotic contour-tape-layup machine to sculpt an F-22 Raptor wing skin into existence. Once operator Pam Parker (foreground) has programmed the CTLM, the machine applies small segments of graphite-composite fabric, laminating them to varying thicknesses for greater flexibility over contoured areas or added strength at stress points. Quality Assurance inspector Anthony Jackson (background, left) and manager Joe Habersetzer keep an eye on the proceedings.

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