Vought Aircraft Industries, Inc.

Rising to the Challenge

Vought Aircraft Industries is one of the world's largest independent suppliers of aerostructures and the largest U.S. manufacturer of Airbus aerostructures. Vought has produced more than 10,000 wings and tail sections for a variety of prime aircraft contractors. The company's Nashville, Tennessee location has 70 years of experience in aerospace design, manufacturing and assembly. The site specializes in long and large machining and processing of aircraft parts—the components for the Airbus A330/A340 aircraft measure more than 100 feet long.

Vought's Nashville facility used two horizontal machines to shot peen wing components for Airbus and Gulfstream aircraft: one machine for peening wing panels, one for peening spars. Both parts required multiple passes and time-consuming material handling to complete the peening process. A few years ago, the company considered purchasing a vertical machine to replace both machines and Vought engineers spent eight months working on conceptual design reviews and writing specifications. After review, the company decided to rebuild the existing equipment. Recently, it was determined that the machines, after 37 years of service, were beyond useful life and Vought moved ahead with plans to purchase a vertical machine.

Vought's engineering team needed a unique machine. "We specified a vertical peening system and we wanted to stay away from maintenance issues associated with oscillating panels. We peen large parts and, generally, the surfaces are flat. We wanted to achieve the blast patterns with multiple banks of blast wheels and we wanted to eliminate part manipulation and achieve intensity and coverage requirements in a single pass," said Rick Nicholls, Manufacturing Staff Engineer at Vought Aircraft.

The machine would be a one-of-a-kind vertical shot peening system that must meet Vought's saturation peening specification, must peen in one pass (except for spars with masking that would require a second pass), must have stationary wheels, and the wing panels and spars were not to be rotated, raised or lowered as part of the peening process. Additional challenges were floor space and height limitations. Vought needed to keep one of the horizontal machines operational until the new machine was fully functional and all recipes were approved by Airbus. The older machine required floor space that would have been appreciated by the manufacturer of the new machine. Just as restrictive was the vertical space. The plant had a crane clearance of only 26 feet and because of a high water table, a special pit design with minimal depth was needed.

The company that received the bid would need to overcome seemingly insurmountable challenges to build this system. "We choose Pangborn because they brought more to the table than just a standard machine," said Mr. Nicholls. "Pangborn was willing to invest extensive man hours in their lab to determine the right wheel and line speeds to achieve the saturation curves required."

And so research and development began in the Pangborn lab. The test specimen, a section from one of Vought's most complex aluminum spars, had multiple pockets, thin floors and walls, and enclosed angles. The Pangborn R&D staff mounted 20 Almen strips on all the flats, vertical, horizontal and angled ribs that needed to have saturation peening. The specification required that all of those locations meet saturation within a set range on an "N" Almen strip. The challenge was to determine the quantity of wheels, and most importantly, the wheel positions that would satisfy the saturation requirements. Improper wheel setup would cause some locations to fall within specs while others would be outside of the spec. Wheel rpm and flow entered into the equation and again, all of this must be achieved in one pass.

"We worked seven days a week and many times put in 18 hours a day to find the combination of parameters that met Vought's specifications. We used nearly 3,000 Almen strips during the testing process," said Lynn Keller, a member of Pangborn's engineering staff. Pangborn engineers determined the depth of the machine pit and designed an elevator system that enabled the machine to accommodate large wing components and still not exceed the overall height restrictions.

The final system design included Programmable Logic Controllers (PLC) and a Human Machine Interface (HMI) that were interfaced with an industrial computer to ensure enhanced recipe capability. All motion, travel speeds, travel distances, part position, wheel RPM and flow were monitored with closed loop feedback. Additional components of the system included:

- Twenty-four Rotoblast peening wheels with variable frequency drives and encoders for closed loop feedback
- Twenty-four MagnaValves with closed loop feedback for shot flow control
- Dual shot recovery systems with internal cross-over valves and controls to balance the system
- Monorail system and product load beam for material handling with servo drives and encoder system for closed loop feedback
- Air wash separators and Sweco system for proper fines and shot distribution control

The overall dimensions of the peening cabinet are 5 ft. wide x 46.5 ft. long and 21.5 ft. high (1.5 m x 14.1 m x 6.5 m). The overall dimensions of the system from the bottom of the machine pit to the top of the elevator are approximately 41 ft. high x 60 ft. long x 25 ft. wide (12.5 m x 18.2 m x 7.6 m). A monorail system extends approximately 120 ft. (36.5 m) from each end of the machine.

The system was delivered to Vought in 16 truck loads and reassembled in their facility by Pangborn personnel. Pangborn's field service engineer supervised the set-up, start-up and operator training.

The Pangborn vertical peening system is now fully operational and has successfully met the demands of Vought Aircraft. "We've achieved process improvement with the Pangborn machine. Before, it was very labor intensive to position the large parts and run them through the horizontal machine and then flip them over and run them through again. We eliminated running multiple passes and the time savings have been big," said Mr. Nicholls. ●