

AVIATION WEEK

Overhaul & Maintenance

THE MAGAZINE FOR MRO MANAGEMENT

Transforming Tinker

As it plunges in to the 21st century, the mid-America air force base is trying out fresh ideas and using new methods to repair aging aircraft.

By James Ott

TINKER AFB, Okla. — The transformation taking place at the 76th Aircraft Maintenance Group is palpable as one walks the alley of flags that divides the nearly mile-long Building 3001 constructed in the early days of World War II. On one side a well-lighted and newly designed workplace looks clean and inviting. The other flank, dim and cluttered, recalls Rosie the Riveter and monkey wrenches, now faded, dusty and grimy with age.

The area around the start of the flag-draped alley serves as a meeting place for many of the 2,200 people of 76 AMXG who are in the midst of change. They gather at a crossroads sign that reads “Hollywood and Vine.” The sign, or one like it, has been positioned there since the early days. It’s a World War II relic, and yet it is symbolic of Tinker’s mission in the 21st century as the key intersection for maintaining and keeping combat ready the war-critical aircraft types of the aging USAF fleet.

Specializing in heavy equipment — routinely B-52s, B-1s, E-3s and KC-135s — Tinker’s got some hefty challenges. Simply put, old aircraft need more maintenance, the line of aircraft is getting longer, demand for on-time delivery is greater and the workforce has stayed about the same. A growing workload



A well-lighted work space is one of the changes that has helped reduce KC-135 programmed depot maintenance flow time at Tinker AFB, Okla.

Tinker AFB/Margo Wright



The E-3 AWACS aircraft that Tinker sees are younger in terms of average age than many of the other aircraft that flow through the facility, but the E-3s often have more hours in-flight.

Before applying theories to the tasks, managers implemented parts kitting across all maintenance lines. “This is part of our effort to make the mechanic our center of gravity, to give him or her exactly what they need to keep them on the aircraft performing value added work,” O’Connor said. In response, line employees have produced 50 shop aids that have eased their labor. These range from work tables and tools to a rack that loads panels and can be shifted around to the point of use.

B-1 flight chief Jerry Hoegger uses project management software to focus on identifying needs, setting the work content and assigning mechanics to jobs. In the pre-Goldratt period, Hoegger spent a third of his time resolving issues, locating materials and tools. Post-Goldratt he is able to set the work schedule and perform other critical duties such as assuring the integrity of the supply chain. Knowing with precision what is needed and when, Hoegger said, has provided him with “better justification” to procure parts and keep the line active.

Flow days, or turn times, for the B-1 line have been reduced by 41 percent between FY01 and FY07. The average work-in-progress has been reduced by 40 percent, from 10 aircraft in work for PDM to 6 aircraft, effectively returning 4 aircraft back to war fighters.

Based on its successes in speeding up the process thus far, the bomber squadron forecasts that 11 B-52s will undergo PDM each year. The average number of aircraft “possessed” at Tinker — and not returned to the active fleet — will slide from 9 in FY07 to 7 next year and six in FY09.

The B-52s are on a four-year heavy maintenance cycle. The 56 aircraft in the fleet average 47 years old. Each receives 33,000 hours of heavy check work. This year marks the first for extensive rewiring. Technicians and mechanics have found center wing tank cracks and defects in the landing gear trunnion. Center wing defects are repaired by stripping, inspecting, shot-

like this would be beyond the capacity of an old-style maintenance depot, said Kevin O’Connor, deputy director of 76 AMXG. Something had to give.

The changes started about seven years ago with some fresh ideas from management and workforce and some assistance from the Air Force Research Laboratory at Wright-Patterson AFB, Dayton, Ohio.

The first step was improving the workplace. Tinker still is in the process of cleaning, painting, streamlining and installing new lighting, space by space, in the 10 hangars and 4 million sq. ft. of active ramp area. O’Connor said productivity increased 12 percent in the early stages of the transformation. The results recall the Hawthorne Effect, first observed in the 1920s, when bosses at the Hawthorne Plant of Western Electric improved the working environment and took a greater interest in what was going on. In that case, employees responded favorably. Productivity kept rising.

What else is happening at Tinker sounds like an academic exercise, and it is. If there is a theory on how to improve the speed and quality of a heavy check, called programmed depot maintenance (PDM) in the military, it’s had an airing at Tinker. Three are in steady focus: The Theory of Constraints pioneered by Israeli physicist Eliyahu M. Goldratt, the Lean Manufacturing Principles applied by Taiichi Ohno in the Toyota Production System and Six Sigma

methodologies brought into the public eye by Jack Welch at General Electric. Elements of all three are at work.

Goldratt’s ideas of identifying and removing bottlenecks are being applied to heavy maintenance of B-1s and E-3s. Lt. Col. Tol Singer and his team at the 565th AMXS bomber squadron are in the process of transitioning Goldratt techniques to B-52s. KC-135s will get the treatment early in 2008.

Singer’s group took two months in Fiscal 2006 to implement the program for the B-1. A similar preparatory period followed for the E-3 and is underway for the B-52. In these times teams get organized and assemble all required information and parts. Next, they look at the job under the scope of Goldratt’s Critical Chain Project Management. In a nutshell, it instructs on how to manage constraints, or bottlenecks, versus managing the schedule.

“There’s a leap of faith required,” said Singer. “You look at critical points and work to them.”

One of the chief advantages of the method is flexibility in the workforce so that mechanics can be stationed where the work is needed. Under this regime, the lead aircraft on the line more than likely will not get the mechanics’ first and full focus all of the time. They will be where the work is needed to keep the flow going. Mechanics are skilled in 42 separate areas, from painting aircraft to avionics.

peening and recoating the affected areas. Trunnion defects require stripping, shot-peening, recoating of bulkheads and nondestructive testing. In some cases parts are replaced, some forged at the plant.

Flow-day reductions have been achieved with the B-52 line, officials said, but not to the level of other aircraft. They plan to focus transformation efforts on the B-52 in 2008.

Nondestructive testing searches for cracks and corrosion, important issues for any of these aging aircraft. The five NDT methods used are X-ray, ultrasound, magnetic particle, eddy current and dye penetrant. Steve West and David Campbell are part of a 41-person team that spends at least 300 hours doing detective work on each aircraft. For clues on where to look for corrosion and cracking, they get advice from Tinker's engineers and Boeing.

A tool for examining surfaces is the Mobile Automated Scanner System (MAuS) developed in cooperation with Wright-Patterson's Research Laboratory. The first unit came to Tinker in 1997. Now in its fifth iteration, MAuS is growing more capable, the sweep of the scan is getting broader and deeper. The next step is toward a three-dimensional view. Use of the scanner has reduced what had been a 96-hour piece of the aircraft inspection to as low as 12 to 14 hours.

Tinker personnel also are testing the Aerial Multi-axis Platform developed by the Air Force lab. The AMP is a platform that moves where a technician directs it and allows access to the tops and sides of aircraft. It has been used for de-painting, and a four- to five-day reduction in de-paint flow time has been recorded for C-5 aircraft. A 40 to 50 percent reduction in depot de-paint flow time is anticipated.

The typical annual workload for the 76 AMXG, the largest wing at the Oklahoma City Air Logistics Center, is 80 to 85 PDM checks and more than 40 unscheduled depot level maintenance (UDLM) requests. This work generates approximately \$640 million in revenue a year. The group ended Fiscal 2007 with a 99 percent on-time delivery rate, four percentage points better than last year, the best schedule performance in the group's history. The quality defect rate was 0.62 per aircraft, down from 0.94.

That's a tough goal to accomplish, particularly as the group has the task of maintaining the busiest aircraft, E-3s, and KC-135s. The E-3's average age is 27 years, but the average airframe hours per aircraft is 22,000, which is higher than the older KC-135, B-52H and C-5 aircraft. Inspectors have found unexpected corrosion in the lower lobe of the E-3, which required a refurbishment plan.

P-3 PDM Milestone

Lockheed Martin's maintenance and modification facility in Greenville, S.C., recently re-delivered a U.S. Navy P-3C that had undergone phased depot maintenance and a special structural kit mod at the same time. The company said this is the first time the two tasks have been completed simultaneously. The aircraft was completed on-time in November. The P-3 Orion, a four-engine turboprop aircraft, entered Navy service in 1962 as an anti-submarine and maritime surveillance aircraft, but its mission has been expanded to include battle space surveillance over land and sea. Firefighting variants exist as well. Lockheed Martin currently provides PDM, significant structural inspections, heavy structural modifications and kit installations for P-3 aircraft at its Greenville facility.

In FY06, specialists in the 566th AMXS dedicated to the E-3, began to find bearing problems in the dome, which is increasing repair and replacement work. At the same time lower lobe corrosion was discovered. To keep the production going, mechanics began to do concurrent work on the aircraft. In FY07, they produced eight aircraft in 236 calendar days compared to FY05's record of five aircraft in 212 days. E-3 PDM flow days have been reduced by 31 percent since FY01. The average work-in-progress has declined by 40 percent, from 5 aircraft in PDM work to 3.

The 566th also carries out Enhanced Phase Maintenance on Navy E-6 aircraft, about 25 of these jobs a year, and mid-interval re-painting of C-130s.

The Herculean task at Tinker is dealing with the KC-135 tankers and their corrosion problems, the work of the 564th Tanker Squadron. Since FY01, the tankers have operated 33 percent more flying hours than originally planned. Actual flying hours reached

In addition to KC-135s, such as the one shown here, E-3s, B-52s and B-1s flow through Tinker AFB.



Tinker AFB/Margo Wright

200,000 in the last fiscal year and new missions are emerging. The KC-135s are conducting special operations air refueling, aeromedical evacuation and air refueling of unmanned combat air vehicles in addition to normal operations.

Tinker's mission is to keep the aircraft safe for another 35 years. Corrosion issues began to surface in the late 1980s and have continued to be a problem, although to a lesser degree. The KC-135 was designed and built in the 1950s era of "throw-away" aircraft, said chief engineer Gaddis Gann. Durability was not a major concern, and manufacturers adopted assembly techniques, such as lapping two pieces of metal without sealant, that made the aircraft corrosion prone.

The challenge is all the more difficult, said Gann, because it's "hard to model and predict" where defects will occur. The engineering team has identified a total of 119 major structural repairs across the fleet. Each aircraft averages 2.5 to three major structural repairs, but few have needed similar repairs that would indicate a trend. Every so often in the 70-plus KC-135s that pass through each year, a rogue aircraft emerges.

Aircraft 61-0306 was one of the rogues on the overhaul line in late October. Major repairs were being carried out on the wing attachment fitting, the center wing aft spar, and wing skin. "It is unusual to have that combination," said Gann.

Technicians spoke of tracking down corrosion on KC-135s and pursuing it down a path as if it were a vein of gold. Mechanics typically grind out the corrosion, use shot peening or even at times an emery cloth to remove corrosion. They've been applying corrosion preventative compound since the late



Tinker AFB/Margo Wright

KC-135 PDM turntimes have dropped 52 percent since fiscal year 2001, according to USAF figures.

1980s. "We see the occasional rogue airplane and see stress corrosion issues," Gann said, "but it seems to have slowed the rate of corrosion. It's not as voracious as it once was."

Gann runs a structural integrity program that tracks fatigue-critical areas, and he has concerns about micro-cracking. "Nobody envisioned that this aircraft would be around for so long." He has outlined some 16 future maintenance concerns. Many relate to corrosion fixes and include replacing such items as the boom "rudderlevator," horizontal stabilizer terminal fittings and fuel bladders, in addition to an overhaul of flight controls.

Although budget cuts have been threatened, the 76th wing has fared well, Gann said. He has not encountered specific budget issues, and funds have been sufficient to "fix something critical."

Turntimes for the KC-135 have dropped 52 percent from FY01 through FY07. Average work-in-progress declined 48 percent, from 42 aircraft in

work to 22. At this rate, 20 aircraft are being turned back to their squadrons for mission support.

The 76th Wing is commanded by Brig. Gen. Judith A. Fedder, whose responsibilities include the 564th, 565th, 566th squadrons and the 654th Combat Logistics Support Squadron. The latter squadron comprises 60 to 70 active military personnel, certified to perform depot-level repairs in the field. The wing also performs maintenance, repair and overhaul of F100, F101, F108, F110, F118, F119 and TF33 engines.

The wing is prepared to expand E-6 maintenance and attract additional C-130 re-painting jobs. NASA's Super Guppy got a recoating recently and is expected to reappear in 2008 for a heavy check. Also, the wing is getting out the paint brushes to do its first KC-10, and it is working on getting credentials from the FAA. ■

James Ott is a contributing editor for Aviation Week & Space Technology.

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