LIGHTWEIGHT, TOUGH BLADDERS FUEL A GROWING MARKET

ATL GROWS FROM MOTORSPORTS INTO UNMANNED SYSTEMS

by David Dack

A U.S. soldier with the 10th Special Forces Group assists in moving an RQ-7B Shadow unmanned aircraft onto its launcher during recent exercises in Florida. AAI Corp.'s Shadow was an early unmanned aircraft adopter of fuel bladders. U.S Air Force photo by Staff Sgt. Andy M. Kin.

Twenty years ago, the company Aero Tec Laboratories (ATL) noticed the growing market for unmanned aircraft and decided it could play a key role.

The company, located in the sleepy suburbs of northern New Jersey, had for years designed and built crashworthy fuel cell bladder tanks for motor sports. It had become the industry's leading manufacturer of explosion-proof tanks for all types of racing, including NASCAR, rally racing, off-road racing, drag racing, sprint and even Formula One (for the last quarter century, ATL has provided the fuel bladders for every Formula One Grand Prix team).

"We had been making them [fuel bladders] for decades, even before UAVs appeared," says Peter Regna, ATL's president. "It was a rather easy transition for us, because we had been making heavy, high-strength fuel bladders for racing cars and off-road vehicles that had to resist high-speed crashes."

For the unmanned systems market, he says, "That's not really a requirement. The requirement is to offer lightweight, flexible bladder-type tanks. It was kind of an easy step to go from something that's very heavy duty to something that in our parlance is more of a light duty."

The company began this move in the late 1980s and early 1990s, when "we started to see repeat [system] builds, when the Army started awarding contracts," says David Dack, the company's vice president of sales.

One early customer was AAI Corp., builder of the Shadow UAS, a mainstay of U.S. Army and Marine Corps efforts in Afghanistan and Iraq. Now the company's bladders are also found in General Atomics' Predator and Reaper systems. Through these three programs alone, ATL's bladders have racked up nearly two million flight hours.

ATL is also moving in the maritime and ground system markets and also provides bladders for Arctic fuel sleds, special forces combat craft, satellite command trailers and even for supplying water to the International Space Station.

How It's Done

The design of a bladder starts with the rubberized fabric that makes up the bladder.

"We specify the yarn, the type, the twist; then we design a weave," Regna says. "During that process you can impart certain qualities to the fabric. You can put in a ripstop to keep it from tearing, or make it seam together better, or make it more or less flexible. The way it's woven can be very influential."

ATL's technical staff and engineers use modern computer-aided design systems to exchange drawing files and sort through design considerations such as geometry, collapsibility, venting, fittings, hardware, interconnects, baffling, sensors and other considerations.

"Pretty much every bladder is custom made," Dack says.

The company takes the CAD model and downsizes it in 3-D to produce an envelope drawing of the bladder that fits into the required space. "Unfolding" software then takes that model and opens it up flat in panels, which can then be cut out of the rubberized fabric.

"It's like assembling a cardboard box, really," Regna says. "We actually fuse, vulcanize or seal the seam together to make a leak-tight joint. Some of these shapes are pretty complicated. Some have cutouts where the nosewheel has to retract inside a little cavity. The geometries of them can get very complex."

ATL has amassed a variety of unique bladder-friendly lightweight fittings, hard points and hardware and also has complete in-house CNC (computer numerical control) capability for those applications requiring custom hardware. The company also has electronic templates so it can recreate a given bladder over and over. ATL produces its rugged bladders in most any configuration, including simple rectangles, cylinders, radius edged, convoluted fuselage and wing shapes with notches, pass-throughs and cutouts, all of which are in current production.

"There is one [aircraft] we do that has seven bladders in it … and they are all linked together in a common system," Regna says.

Useful for Unmanned

ATL's bladders have many attributes that are extremely valuable for unmanned winged aircraft, rotorcraft, ducted vehicles, missiles, airships, and even unmanned maritime and ground vehicles — USVs and UGVs. Chief among them is that the bladders can be light and thin. For example, ATL's 794-A bladder material has a thickness of only .013 inches (0.3 mm). This ultra-thin and lightweight design not only makes it easy to install or remove the bladder, but more importantly allows the resulting weight savings to be used for either more fuel — and therefore greater endurance — or increased payload.

In addition, ATL's thin-skin bladders are able to contain more fuel within a given fuselage or wing compartment. The company's motorsports background gave it a wealth of experience in the design of very specialized internal fuel collection traps. By employing these internal collector techniques, including trap doors, weirs, guide vanes, piccolo tubes, baffles, flop tubes, hangers, sumps, etc., ATL is able to assure near complete scavenging of remaining fuel. Again, this additional usable fuel translates to greater mission endurance for the unmanned vehicle.

The company foresees a growing market in the unmanned systems world, including for maritime and ground vehicles, including future legged robots that could benefit from lightweight fuel tanks.

"It's certainly an expanding market," Regna says. "At the moment, we're building all kinds of fuel bladders from ones the size of your desk to ones the size of your fist."

The company foresees that in the very near future unmanned aircraft will be operating within civil Federal Aviation Administration airspace. To prepare for this, and the likelihood of the increased regulation that it will bring, ATL has already begun the arduous process of qualifying its UAS bladder materials and processes to the stringent FAA TSO C80 standard with crash-worthy and ballistic self-sealing variants.

Fuel bladders offer weight savings and immunity to vibration and impact. All bladder images courtesy ATL.

Fuselage bladder with nose-wheel packet.

A belly bladder, header bladder and wing bladder.

David Dack is vice president of sales for Aero Tec Laboratories.

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