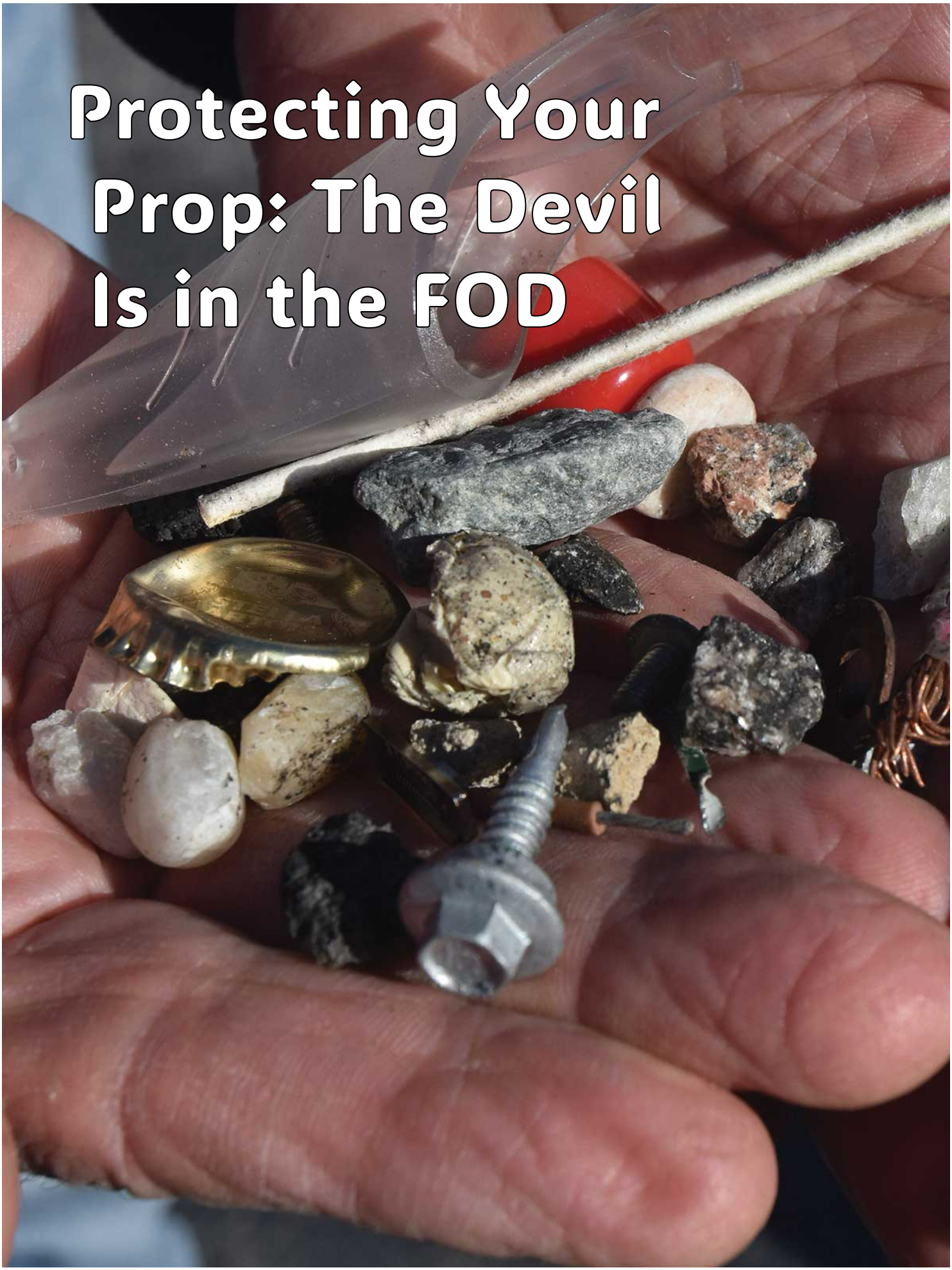
Protecting Your Prop: The Devil Is in the FOD



Protecting Your Prop: The Devil Is in the FOD

By Mike Jones

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In this journal a few months ago, I related the sad demise of the 40-year old McCauley propellor on my Centurion. Over four decades the blades of that prop had eroded a quarter of an inch along the leading edge. Multiply a quarter of an inch across the 40+ inches of a blade, times each of the three blades, and my prop was too small for the plane Cessna had riveted together in 1979. It simply was not grabbing as much air as the Cessna engineers had calculated. That meant sluggish acceleration, longer take-off rolls and slower speeds. A scant $20,000 later, a snappy and stylish "scimitar" Hartzell prop now hangs on the nose of my bird, delivering five extra knots and silky-smooth performance with nary a shake or shuggle.

Happy ending, right?

Not quite. What if it happens again?

Root Cause Analysis

Working my way backward towards the root cause, the principal source of the erosion on my prop was the annual ritual of "dressing the blades." While it sounds like something Mr. Darcy would be doing in a Jane Austen novel, "dressing" actually is a delicate process deployed by A&Ps everywhere. During the annual inspection, a skilled A&P runs a finger over the lead-edge of the

prop's blades until he detects a jagged nick. The A&P then takes a fine-grained file and gently smooths those nicks and gouges, eroding metal up and down the blade. Even a small, harmless-looking crater can cause a prop to crack or even fail when it is subject to the enormous twisting pressures of flight. The trade-off is clear: by removing those nicks the A&P is keeping you safe. All in favor, say "Aye!"

Digging deeper, I asked, what causes the nicks? The most common cause is FOD, which is a grammatically-challenged abbreviation for "Foreign Object Damage." Speaking more precisely: unseen and unexpected foreign objects ("FO") hit the prop blades, causing ("D") damage. So "FOD" actually is the result of "FO" moving at high speeds. But "FO" is a silly abbreviation and causes conniptions with Microsoft Word, so we'll stick with industry tradition and call everything FOD.

FOD is almost invisible but can be found in hangars and on ramps, taxi lanes, and runways. It could be a nut which fell from a loose bolt; a bit of safety wire carelessly dropped on the ramp by a mechanic, or a chunk of gravel breaking off from the asphalt. Twenty years ago, a Concorde supersonic jet, departing from Paris, ran over a piece of titanium which had fallen from a preceding departure. That strip pierced the Concorde's tires and caused a blowout. Fragments of the shredding tires were hurtled into the underside of the wing at nearly 200 mph, puncturing it and spewing fuel, which ignited and brought down the plane. Foreign objects are a serious threat; the airlines spend $16 billion annually repairing FOD damage.

The problem is that FOD debris usually is very small which makes it hard to detect and impossible to dodge. Once it’s accelerated by prop wash it becomes a missile with serious kinetic energy. That’s probably what dinged my prop, time and time again, until it no longer passed muster. The best answer is to simply remove the foreign objects from the ramp. That breaks the chain of causation and will keep your prop — and your paint, your engine, and your plexiglass — looking sharp for years to come.

One very good way to rid your runway of FOD is to vacuum the entire runway, but that’s time consuming and expensive. Another good option is an old-fashioned broom, either a manual sweeping or a powered rotary broom. But the best option is from an Australian company, AeroSweep, which produces a clever device called the FODBoss. I called them to learn a little more about their secret sauce.

A Better Mousetrap

Tim Boyd is the managing director of AeroSweep, based in Melbourne, Australia. Bearded, handsome and energetic, he’s in his mid-30s and is a serial entrepreneur. This is his fourth business venture, so he knows his way around a balance sheet. Working with him is Russell Nicholson as Veep of Marketing

and Sales. Nicholson is a private pilot and joined the company three years ago, in the middle of COVID, attracted to the company because it is a local invention with a global market. Young, skinny, handsome, articulate, and rich: I hate both of these guys already.

Although it's an odd claim to fame, AeroSweep asserts that nobody knows FOD as well as they do. The company was founded in 1987 by a tinkerer named Warwick Tozer. Tozer enjoyed tennis but his court was always littered with leaves, twigs, and nuts from the trees overhead, requiring him to sweep the court before every match. Combining his imagination with his knowledge of engineering and aerodynamics, Warwick invented a sweeping system which worked better, faster and more reliably than other choices. When a friend pondered if the system would work on airport tarmacs, a new industry was born.

The AeroSweep team is a tight group of just six people. The main benefits of FODBoss are simple: safety, productivity, and cost-avoidance. Each FODBoss is hand-made; this is low volume production with high quality and high care. "The product works pretty hard, and our people know they have to keep up with that expectation," Nicholson said. "For example, we're very particular about the materials we use on a FODBoss, because we can't have a FODBoss making FOD itself."

The AeroSweep customer roster is impressive, with tens of thousands of units in service. Almost all the airports in Australia and New Zealand are users, such as Melbourne and Sydney. London Heathrow, Gatwick and Charles De Gaulle are all users. In the US, NASA, JFK, LaGuardia and DFW are customers. "DFW is an interesting case, because they have fifteen vacuum trucks, and each truck drags a FODBoss behind it because it works better than the vacuum truck," Boyd reported proudly.

The US Air Force shared a case study with AeroSweep. “They found FOD to be a very expensive problem at Eglin AFB, where F-35 pilots train,” Nicholson said, “and by simply implementing a FODBoss program they reported a 99.91% reduction in FOD damage,” Similarly, RAF Mildenhall switched to using FODBoss systems reported a 13,000 hour/year reduction in time they wasted on FOD management. About six months ago, a major airport in Australia reported back to AeroSweep that they had been using FODBoss for twenty years, with not a single FOD claim on the airport in all that time.”

FODBoss systems are in use on all six continents, by many major airports, and by military operators as well. The USAF keeps FODBoss systems running on all of their fields not just to protect their expensive aircraft but also to avoid damage to radar-defeating stealth coatings found on the F-22, F-35 and B-2 aircraft. Shown here: a technician prepares to tow a FODBoss in front of a KC-135 tanker aircraft.

They have observed that some airports use their FODBoss equipment 24/7, while smaller fields clean every other day. AeroSweep has designed special hitches which allow a tow vehicle to pull two or even three FODBoss units simultaneously, sweeping a path up to 23 feet wide at speeds up to 40 mph (vacuum trucks can only operate at 8 mph). Boyd reports a typical FODBoss will last 4,500 to 6,000 miles. Heavier loads (that is, not emptying them regularly) cause them to wear out faster. “We’ve heard of FODBoss units being used for seven years, but by then it’s just a corpse of what is was new.”

What wears out? “Underneath the catcher mat are the ‘aerobrushes’, which is a patented design of bristles. Those bristles are really stiff, and they just flick the FOD up on to the catcher trays,” Boyd explained.

Some of the trickiest details of the FODBoss is the catcher tray. “The issue for an effective catcher is to work at slow speeds, catching all the debris coming on to it, and to hang on to that debris,” Nicholson said. “We figured out a way to stop debris from flinging out the slide of the catcher on a turn. That’s a real problem because the driver is never going to see the stuff slipping off the catcher.”

I asked Boyd how he handles the competition, and he was relatively sanguine. First, they’re always improving the product. “Our design team is clever, they look at our weaknesses and make it better. There’s always an opportunity to improve.”

Another layer of protection is the intellectual property embedded in the product. They have about forty patents, mostly on the blades and barriers. “There are some competitors, like from China, that have been making copy-cat products,” he said. “We’ve heard of customers buying those and getting three months of use out of it, while we get two years.”

Into the Real World

Candace Baxcom is the Product Manager for the FODBoss product at MJL Enterprises, the FODBoss distributor within the U.S. She’s a quiet and competent manager; a retired Navy veteran who has worked on Navy flight lines and aircraft carriers. MJL has been distributing FODBoss for three tears, and she’s very pleased with it.

“A majority of our customers are USAF bases, and this is a huge time-saver for them,” she said. “We’ve had customers use the FODBoss while they were in the service, and when they start working at a civilian airport they tell their

bosses they *have* to use FODBoss." "One of our commercial sales reps, Kip Foster, has a customer right near the ocean. They use their FODBoss to sweep up egg shells and sea shells that birds have dropped on the runway, due to them being on an island."

Paul Puszynski, the Ops Manager at the Pinehurst/Moore County Airport in central North Carolina, demonstrates the ease with which a simple utility vehicle (or even a golf cart) can tow a FODBoss on the ramp. For the runway, they usually use a truck. A FODBoss is effective up to 40 mph, so runway sweeping behind a pick-up truck is faster and returns the runway into service more quickly than when using a smaller vehicle.

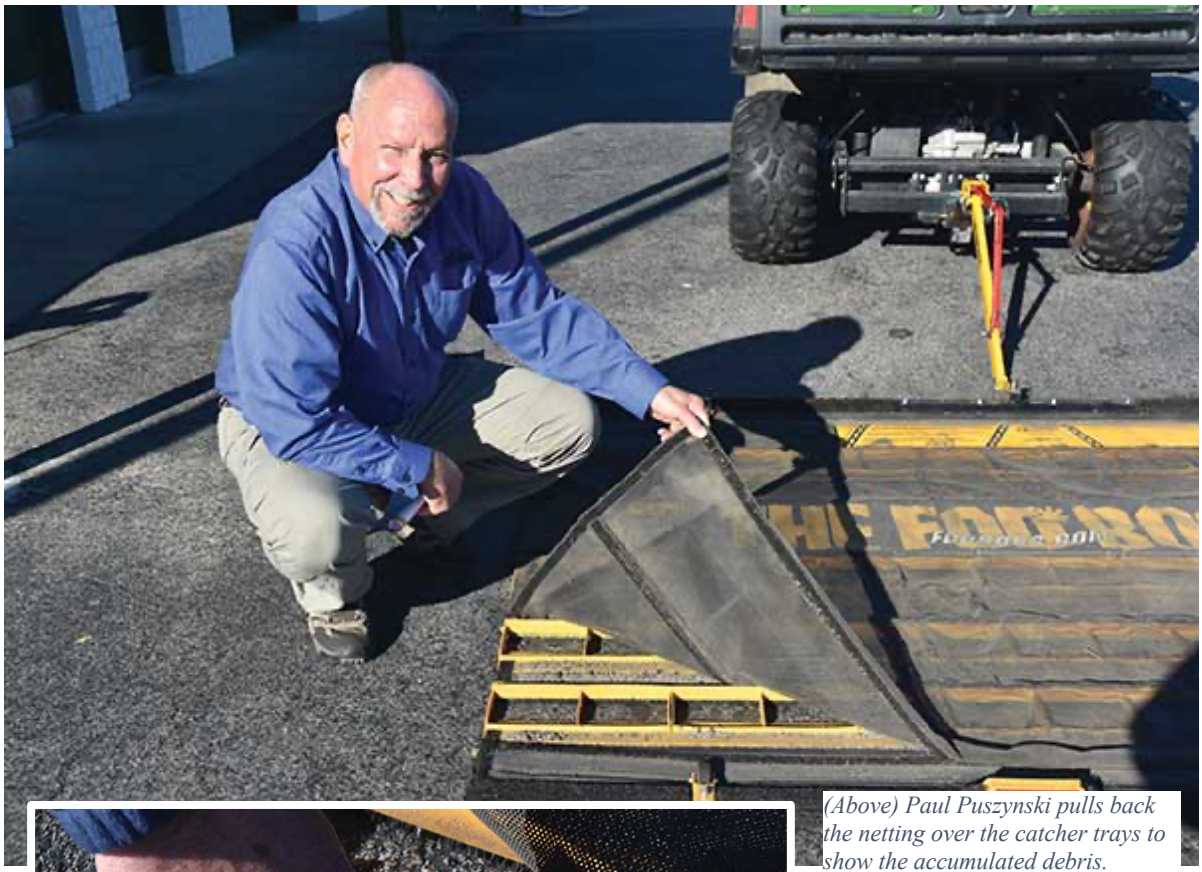
MJL has "hundreds and hundreds" of FODBoss units in service. "Some days we sell one, some days we sell ten." She agrees the sweepers stand up really well, even in heavy use. MJL offers a generous warranty, but the FODBoss is so durable that "I honestly don't think anybody has ever used it."

But there are problems with logistics, coming half-way around the world from Australia.

"We have to carry a big stock right here in our warehouse in Virginia Beach, both the main products and the spare parts. We need a big inventory because sometimes international shipments can get really messy," she explained. "We placed a big order before Christmas, and instead of arriving at an East Coast

port like they usually do, it landed in Los Angeles. We had to put it on a truck to get it here, and that took a long time."

My local airport bought a FODBoss this past summer, so I called Paul Puszynski, the Ops Manager there, to gauge his reaction.



(Above) Paul Puszynski pulls back the netting over the catcher trays to show the accumulated debris. "Emptying the FODBoss is a pain," he said. "You have to lift one side to open the flaps, and then lift it and shake it, and all the debris just tumbles out." But he agrees the FODBoss is catching far more debris than he ever suspected of lurking on the ramp or the runway. (Left) Once the ramp and runway have been cleaned several times, the exotic debris is usually gone and what is left is gravel: small bits of asphalt or concrete that have weathered off the ramp. These small rocks are the principal cause of FOD damage. They're small, light-weight, and rock-hard, so when the prop-wash of a jet or a propellor catches them they easily go flying into an adjacent aircraft.

Prior to the arrival of the FODBoss, the airport's FOD program was to simply drive down the runway every day and eyeball it. Nicholson scoffs at those "FOD walks" as a waste of time, and considering the quantity of debris the FODBoss is scooping up Puszynski and I both now would agree. "When we first started using it, it was picking up anything and everything. Much more than we saw. Really surprising," he said.

"We're using it on a regular basis now, towing it behind a golf cart. We're getting ready for the U.S. [Golf] Open to be here this summer, and the ramp needs to be perfect," Puszynski reported. "We've also created a logbook, showing when it was used, who used it, and for how long."

Out for a Ride

At first glance, a FODBoss resembles a simple, eight-foot black *schmatte* stretched over a yellow plastic frame. Other than the golf cart that drags it around, a FODBoss has no moving parts, no "start" button, keyboard, lights or fumes; none of the normal indicators of high-tech engineering. It's just fun. In fact, spending a sunny afternoon driving a golf cart really fast in looping circles might cause those visiting NetJets pilots to wonder if they chose the wrong career path.

Does it really work? Woooeee, yes it does.

Puszynski and his team demoed the unit for me. They hitched it to a golf cart and (literally) took it for a spin. Like a Romba vacuum cleaner, they tracked back and forth across the ramp until they came upon an obstacle, like a Gulfstream. Then they would turn and speed off in a different direction. In an hour, the entire surface had been covered and it was time to see what the FODBoss had picked up.

As Yoda might say, amazed were we.

The FODBoss scooped up enormous quantities of our #1 Most Wanted perpetrator: pea-sized chunks of asphalt which had weathered off the cracks in the ramp. This gravel is the dream of which repair bills are made: small, light, sharp-edged and rock-hard; with more than enough mass to crack a windscreen or chip a handsome paint job.

This photo shows some of the more interesting debris the FODBoss picked up in the first few times it was used at the Pinehurst Airport. Puszynski and his team collected a gallon of exotic materials, including safety wire, food wrappers, nuts and bolts, and even a baby's pacifier.

But so much more was caught in the netting: nuts, bolts, safety wire, pieces of plastic, crackers some wandering pedestrian had dropped, even a baby's pacifier. And make no mistake: this is from a ramp we all thought was pretty clean.

Boyd cautions that merely collecting the FOD is only the first part of the solution. Your operators also have to inspect the FOD; it's an important part of

the protocol. By examining the collected FOD you can determine what's in it, and then find the source of that debris. "Looking at what you are collecting is a really important part of the safety program."

Every airport should have a FOD control program. It saves time, saves money and might even save your paint job. The FODBoss is a reasonable and affordable choice, and does the job very well. With references from experts like the U.S. Air Force, Formula 1, and tennis aficionados everywhere, it sounds like a no-brainer to me.

About the Author

Dr. Mike Jones is a 4,000 general aviation pilot and retired businessman with a passion for things-with-wings. He has served on his local airport authority for the better part of a decade, and has now embarked on his fourth career helping to save endangered airports. He's working with small G.A. airports across the country, helping them to get grants, protect them from avaricious developers and reverse the damage caused by ineffectual politicians.

He's always accessible at PilotMike2012@gmail.com.