# Sky watchers

Maverick fliers in high-tech gyroplanes take on the bad guys

> STORY AND PICTURES BY SEAN WOODS

CABLE thieves do some of their best work at night. Scorning more conventional targets in the urban jungle, where their activities might attract the unwanted attention of watch-dogs and security officers, they prefer to target remote tracts of veld, where they thrive on stealth and anonymity.

There, safe from prying eyes, they roll up their sleeves and get to work. When they're done, and the ripped-out copper cable is safely stored in the boot of their car, they prepare for the next stage of the exercise – transporting their booty to scrap metal merchants that don't ask questions,

Whereas the uninitiated might consider this a minor entry in the annual crime stats, the truth is that cable theft is a big – and extremely expensive – problem. Aside from the millions that have to be spent on tracking the thieves and replacing the stolen equipment, cable theft places an extra load on our country's already overburdened infrastructure.

It's not someone else's problem, either. You may experience the results when your long-planned dinner party morphs into a cold-meats-and-salads snack by candlelight (for which Eskom is, for once, utterly blameless), or when the trains stop running, making you late for work. Again.

Fortunately for us, the guys at Airwatch have our backs covered. Operating military-spec gyroplanes with a gusto reminiscent of the barnstorming era, they're using a combination of advanced technology, cunning strategy and superb flying skills to stop the cable thieves in their tracks.

They work primarily with Eskom and Spoornet, for whom they gather information and function as visible deterrents in areas where thieves target non-ferrous metal, cables and railway sleepers (yes, there's a market for them). Airwatch also documents train derailments in remote areas, helping decision-makers to analyse the carnage and determine what recovery equipment is required on site.

But that's not all they do. Other functions include border patrols, game counting, photography and marketing exercises – basically, anything that requires a stable aerial platform at a reasonable cost.

Airwatch has been operating under the radar for the last six years, but the firm now believes the time is right to come into the open. We can now reveal that all its pilots are commercially rated, and are quite capable of operating from remote areas where no infrastructure exists. It currently maintains four bases: one in Potchefstroom, another in Sasolburg, and two mobile units.

With their open cockpits, powerful Rotax engines and astonishing in-flight stability, these gyros have little in common with conventional flying machines. The essential idea, say Airwatch, is for the gyros to do their thing with minimal fuss and maximum reliability, allowing the pilots to concentrate on flying rather than stress over stall speeds and instrument readouts (although it must be said that they fulfil their professional obligations in these respects).

And what flying! The gyros can loiter at speeds of 30 km/h or less at low altitudes, giving the observers plenty of time to deploy thermal imaging cameras, locate cable thieves at work, and call in the cavalry.

Conventional wisdom dictates that when you go shopping for an aerial observation platform, you'll be looking

**Everything from the cockpit to the rotor disc of these highly modified gyroplanes has been designed for Airwatch's pilots to be able to fly close to the ground, safely, for extended periods.**

for either a chopper or a small fixed-wing aircraft. Airwatch's Gerhard Jacobs vehemently disagrees, pointing out that this is not what they were designed to do.

"When my company, Alto Air, and a firm called Wagtail Aviation began to independently focus on aerial observation, we soon realised that it all came down to low speed, low costs and low cockpit workloads. We started out with a lot of blank pages and at the end of every page, the conclusion was the same – we needed gyroplanes. Only problem was, the technology just wasn't available."

Their solution? Join forces and develop their own observation platform. And so Airwatch was born, with Alto Air becoming the client interface and operational wing, and Wagtail Aviation the technical partner, concentrating on maintenance, research and development. As Jacobs tells it: "We don't like dividing our attention… we put all our efforts into ops. That takes the pressure off Wagtail, allowing them to swing the spanners."

Deciding it didn't make sense to reinvent the wheel, they hunted around for the best sports gyro on the market, eventually opting for the Spanish-built Super ELA. Wagtail kept all the bits they wanted – specifically, the frame, body and tail – and discarded most of the rest. They added a robust rotor head and longer blades, an hydraulic pre-rotation system and electronic trim, and improved the engine's cooling system. In fact, the standard Rotax 914 115hp turbocharged engine was just about the only thing they didn't mess with.

**Top left: In this image from a previous operation, thieves have removed the pilot wire buried under Eskom cables that control sub-stations. Top middle: Gyros don't produce the thumping or turbine-whine associated with helicopters, so they don't startle game. As a result, it's easier to count the animals. Top right: When you are flying in an open cockpit just 150 m above the ground, it's almost impossible to miss what's going on. Bottom left: Airwatch's gyroplanes, with their robust nature, diminutive size and short take-off capabilities, are particularly suited to operations in remote areas where no infrastructure exists. Bottom right: If a derailment occurs in the middle of nowhere, Airwatch pilots dash to the site and gather information, enabling decision-makers to analyse the situation without having to leave the office.**

The original instrument panel was history; in its place went dual displays (for redundancy) with backlighting for night operations. The dual controls were tossed to create more space in the back for an observer. Finally, they installed a long-focus spotlight, loudspeaker system, dual radios and a "black box" that transmitted live flight and engine data to base every half-second.

As a general rule, whatever rotates, vibrates. Consequently, the rotor system – comprising rotor head and rotor blades – is by far the most complex component of a gyro, according to Wagtail's chief designer, Johan von Ludwig. He should know: over the years, Wagtail Aviation has built an international reputation for its technological know-how. Its rotor head is also now in its fifth generation and the technology is mature, to say the least.

"Our rotor system was developed by an aeronautical and military team specifically for low-density altitudes. The system's high inertia means you can even fly safely at low level into a Highveld whirlwind."

He's not the sort of guy who's happy to be stuck in a workshop while others have all the fun, adds Von Ludwig. "I regularly fly the aircraft and work very closely with all the ops to understand what we must do. It's extremely helpful to experience the pilots' issues at first hand."

Aside from its formidable reliability and low maintenance requirements, the rotor head is designed to handle gyro weights of up to 850 kg (the highly modified Super ELA weighs only 550 kg all up). Three high precision load-carrying bearings improve the overall "stiffness" and smoothness of the head. It also allows for more alterations to the vibration spectrum than possible with standard heads. The gimbal-offset distance has been optimised for stable flight in turbulent conditions. Plus, it's tough.

Von Ludwig explains: "When conducting static load tests of the rotating parts, we achieved 15 tons, but that was only because the test equipment couldn't go any further. We're really curious to find out how far it can be pushed, but because the industry norm for rotor heads is only three tons, we're not overly concerned."

Increasing the length of the rotor blades from the industry norm of 8,54 m

to 10 m, as well as adding extra weight at their ends, also presented a number of challenges. Von Ludwig elaborates: "The biggest challenge with the longer, heavier blades was to get the vibration levels down to an acceptable figure. Because they vibrate at a lower frequency, they create a different vibration spectrum that's harder to handle."

But their efforts paid off. The high inertia generated when these blades spin (much like a flywheel) means improved stability and thus the ability to fly in stronger winds or bad weather.

Says Von Ludwig: "The compromise was a slight loss in manoeuvrability, but since the blades contribute to lighter pilot workloads, we're not complaining". The blades have been statically tested to 20 tons for centripetal forces without failure from the root to the blade tip; the industry norm is six.

When flying gyroplanes, most accidents occur during take-off. To minimise the risk, pre-rotation systems help get the rotor speed up to 50 per cent of the flight RPM before taxiing. (No power is applied to the rotor in flight; the rotor system relies entirely on aerodynamic forces to keep the blades spinning and provide lift). Explains Von Ludwig: "The better your 'spin up' phase, the faster you get the blades up to speed and minimise rotor slap. This makes the take-off phase shorter and significantly minimises one's risk profile."

Because more common belt systems have a tendency to wear and slip over time, forcing pilots to rely on skill rather than the design properties of their gyros to take off safely, they are not considered viable. Mechanical systems have other drawbacks: they tend to be maintenance-intensive, add weight to the gyro, and have more fiddly bits that can go wrong.

So instead, Wagtail developed an hydraulic pre-rotation system that's more reliable and much less complicated to maintain than conventional options. Getting it right took a lot of work, but the end result was worth the effort. The final product exerts zero shock loads, creates no torsional vibrations, and minimises fatigue of the rotor head and blades.

Says Von Ludwig: "With hydraulics, the larger a system gets, the more efficient the power-to-weight ratio – unlike mechanical systems, which are totally the opposite." To make the pilots' jobs a little easier, torque, slip and RPM limiting is built into the system.

Other modifications included the installation of a more sophisticated cooling system than that found on sport variants, so the pilots need not stress about engine temperatures. An electrically driven trim system was chosen for its reliability and stability. Says Von Ludwig: "Everything from the cockpit to the rotor disc has been designed for pilots to be able to fly close to the ground, safely, for extended periods."

Thanks to the intrepid pilots at Airwatch and their associates on the ground, cable thieves are no longer able to operate with the impunity they once enjoyed. With luck, your next dinner party will require candles purely for the sake of atmosphere.

● For more information, visit *www.alto-air.com* **PM**

**Top left: One modification was the installation of a more sophisticated cooling system. Top right: The old instrument panel was discarded in favour of dual displays. Middle left: Wagtail Aviation's rotor system was developed by an aeronautical and military team specifically for low-density altitudes such as the Highveld. Middle right: The hydraulic pre-rotation system (see pump on right) exerts zero shock loads and creates no torsional vibrations, minimising fatigue of the rotor head and blades. Bottom left: Wagtail Aviation's Johan von Ludwig (left) and Alto Air's Gerhard Jacobs, who headed up the two companies that merged to form Airwatch. Bottom right: When thieves are spotted, smoke rings provide a visible cue for security personnel on the ground.**