

## Installing Bird Diverters with Drones

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Bird collisions with overhead powerlines are a big issue that is not widely known to the public. It is proven that yearly millions of birds collide with powerlines, causing injuries or their death. It is common to mark the powerlines with mostly big red and white balls, to make them visible for manned low altitude flights. This issue is now taken into consideration with birds as well. Powerlines are being marked with so-called "bird diverters". Their purpose is to make the powerline visible to the birds. There are many types of markers, using different approaches to making the lines visible.

As a standard way of marking the powerlines, heavy machinery or helicopters are used. This has its obvious downsides with heavy machinery getting stuck, or damaging the crops underneath the line, and even not being able to get to some sections of the a powerline due to difficult terrain. Helicopters are expensive and also pose a danger when flying so close to powerlines. As a specialized drone developer, we were approached by a Swedish marking manufacturer with the question, if it would be possible to develop a drone capable of installing bird diverters on powerlines. The biggest challenge would be that we would have to make the drone work with the powerlines kept energized. This meant that a lot of development work was required relative to the electronics of the drone. We decided to not use an existing commercial platform and to develop a totally new

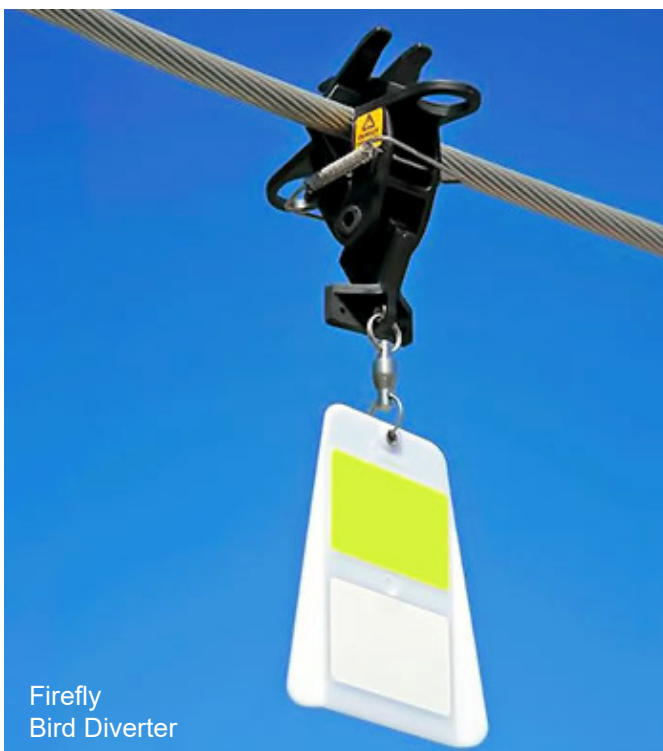


aircraft, with most parts 3D printed for easy replacement in case of crashes.

After a couple of iterations, we started using the BDC-MINI. It is capable of installing one bird diverter per flight, but with an efficiency of up to 350 diverters/day. In most cases, we have been requested to conduct bird diverter installation operations in places that are difficult to get to by the standard ways. Most of the customers, after seeing the operational efficiency, decided to hire us for all of their markings. Since we do not require the powerline to be de-energised and do not use any heavy machinery, outsourcing the service makes the operation very cost effective for utility companies. The drone uses a mechanical mechanism to attach the diverter to the line. The weight of the bird diverter is 2,5 kg.

Structurally, the drone consists of 2 main parts. The drone platform and the installation mechanism. The installation platform works on a mechanical basis whereby the stress in the spring mechanism of the diverter is multiplied by the mechanism itself. The drone pushes the open diverter clamp towards the powerline and the clamp closes under this force. The mechanism is mostly made of 3D printed parts to make sure that they are easily replaceable in case of damage. The drone is a custom built specifically for this purpose. Its main job is to carry the bird diverter and the attachment guidance mechanism, but also keep the flight controller and other essential electronics safe from electronic discharge.

Our attachment guidance mechanism works exclusively with the Snapfast clamp, developed by the Swedish company Hammarprodukter. Hammarprodukter manufactures signs and marking systems. We install not only bird protection products, but also signs and other aerial marking systems. These products make the lines



visible for birds, thus preventing collisions. The birds are capable of seeing the lines earlier and being able to manoeuvre around them. The bird diverters stay on the powerlines for a long periods of time (5-10 years)? The powerlines segments that are to be equipped with bird diverters are carefully selected by bird protection organisations. Research has proven that bird mortality drops with 94% on a powerline that is equipped by the Firefly Bird diverter.

Firefly bird diverter installation operations require, in most cases, involves two persons, a remote pilot and an observer. In a typical scenario, the remote pilot flies the drone and uses it as an “elevator”, while walking under the powerline. A distance is measured on the ground, and subsequently the drone flies up vertically and installs the diverter.

When the powerline is not accessible, a drone with two cameras is used. A forward-looking camera is used during the approach to the powerline; the second upward-looking camera is used to guide the drone to the exact place on the line. In this case, the distance is measured using GPS. Multiple sets of batteries are used each day; they are continuously charged throughout the day. The efficiency of the drone installation is around 200 diverters/day. The record of our crew is 350 diverters/day. This year we have started using a new type of drone that is capable of removing the markers from the powerline.

In Europe we have supplied bird diverter installation service in Austria, Belgium, Cyprus, Denmark, France, Germany, Hungary, and Sweden, and we have a partner supplying these services in the USA.



Thanks to the EU legislation, it is easier for us to fly in Europe. Outside of the European Union, we have partners who fly our drones to make sure that they comply with the applicable legislation.

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