Soaring by Design

Measuring Experimentally

Narrator:
Simple mathematical models are good for predicting the general shape of the polar curve but, in practice, airflow and aerodynamics are extremely complicated, so the only way to get a really accurate picture of performance for a glider is to measure it experimentally. This is best done by comparing the performance with that of a standard test glider and that involves flying the two gliders in formation over a range of different airspeeds and then using photographs to compare the change in height over time. It's necessary to conduct these performance trials in relatively still air, which means flying at the crack of dawn to get those conditions. The photographs are then adjusted for distance and the data accumulated as the new polar curve. In this way it's possible to produce an accurate polar curve for any new glider, but how can the pilot best use that information? In the television programme associated with this Unit you may remember this polar curve measured in knots. We established that to gain maximum height from a thermal the pilot should travel at the minimum sink speed. For any point on the polar curve the slope of the line joining it to the origin is the ratio of the vertical to horizontal speed and also, over time, the ratio between vertical and horizontal displacements. The point at which the tangent touches the curve is the point that gives the largest horizontal distance for a given height. This is known as the 'best glide speed'. It's the speed at which to fly between thermals if the pilot wants to make the most of what is necessarily a limited time in the air, given the glider's continuous descent to the ground. In competitions the challenge is often to fly as fast as possible and also find a means of maintaining altitude, since the strongest thermals are found higher up. So it pays to analyse the optimum speed. For instance, two gliders might choose different speeds to travel between thermals – one very fast, and the other at best glide speed. The penalty accepted by the faster glider is to fall rapidly but it will arrive at the next thermal very much sooner and have the advantage of a longer period of lift. So by the time the second glider arrives, even though it chose best glide speed, it can end up lower than its rival. Let's think about a model for the journey made by just the faster glider. There are two distinct stages - Descent which involves covering a horizontal distance in a particular time at a creatively high speed, followed by a period of Ascent in the thermal at a slower airspeed. The two parts of the model are linked by the common height, which is lost in the descent, and regained in the ascent.