E-Props Test Facilities

Ground and Flight Test Means for Propeller Development and Certification

Technical Note — July 2026

Introduction

Like most propellers, E-Props propellers are tested to meet the requirements of aviation standards and to ensure the highest possible reliability. But E-Props wanted to go far beyond the usual certification requirements, and to offer propellers in constant improvement, always safer.

To achieve this, the company's Research Department has built up a set of test facilities that is rarely found at light-aviation propeller manufacturers: instrumented ground test benches for thrust, fatigue, vibration and bird-strike impact, a laser-scanning dimensional inspection system for blades and components (**Terminator**), an in-house data-acquisition system to record in-flight performance and the stresses the propeller undergoes in flight (**ELIAS**), and an in-house design and optimization software (**LUKY**).

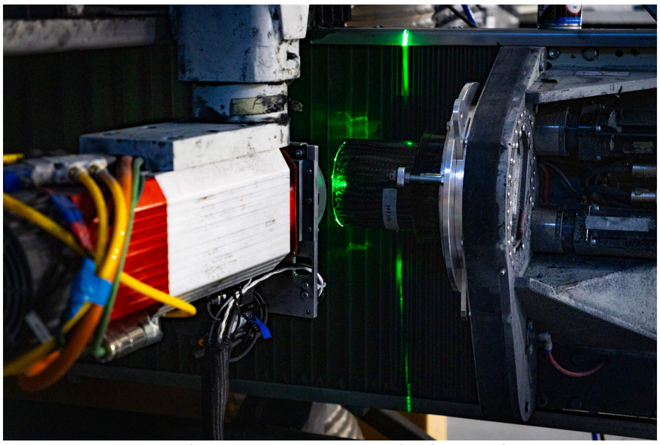
The company's own aircraft allow flight-test campaigns of every propeller model and prototype, flown from the Sisteron–Vaumeilh airfield (LFNS). In 2020, E-Props hired a dedicated test pilot, Samuel "Samy" Dupland, to conduct all flight and ground test campaigns.

> **Scope of this note**
> This note gives an overview of E-Props' ground and flight test means: the aircraft fleet, the instrumented test benches, the laser-scanning inspection system (Terminator), the onboard data-acquisition system (ELIAS) and the LUKY design software. It also summarizes a recent case study — a torsional vibration comparison of four propellers on a Lycoming O-360 engine — illustrating how these means are used in practice.

Ground Test Facilities

All E-Props propeller models are tested on the ground to confirm their performance, their mechanical strength, and their compatibility with the intended engines. For every new model, calculations must be checked against physical reality before flight testing begins. Some additional tests have also been carried out in a wind tunnel, during confidential UAV propeller developments, and cannot be disclosed here.

Terminator — Laser-Scanning Inspection



Terminator laser-scanning system checking carbon part

Every blade and component is checked dimensionally with the Terminator laser-scanning system: a set of high-precision laser sensors that measure the actual surface geometry of the part and compare it, point by point, with its digital reference model. This 3D control is applied systematically — before and after mechanical testing — to confirm that each propeller matches its design geometry, and that no dimensional drift has occurred during fatigue, vibration or impact testing.

Traction (Thrust) Test Bench

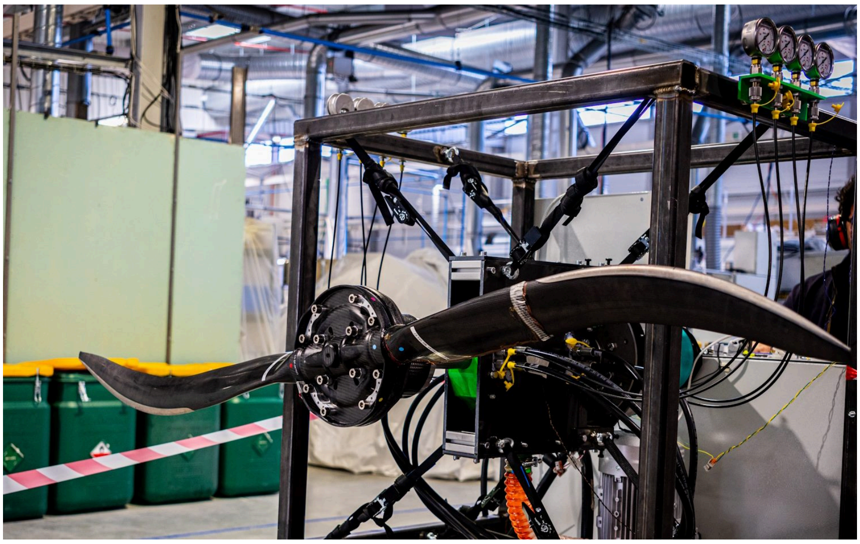
A ground bench fitted with instrumentation and a traction (thrust) measurement system, built around a 40-tonne hydraulic cylinder. It is used to verify the static thrust delivered by a propeller/engine combination and to validate design calculations before flight testing.

Traction (thrust) test bench

Fatigue Test Bench

This bench stresses a blade in alternating bending in order to reproduce the torque delivered by the engine. It is used to establish the real Mean Time Between Overhaul (MTBO) of a propeller, rather than relying only on calculated estimates.

RESONATOR — Torsional Vibration Test Bench



RESONATOR test bench --- a propeller under torsional vibratory load

For the development of propellers intended for direct-drive engines, E-Props built a dedicated vibration test bench able to reproduce, with high fidelity, the vibratory loads generated by aeronautical piston engines — in particular large 4- and 6-cylinder units.

The bench combines four elements:

- a torsion bar,
- a flywheel,
- an electric servo-motor,
- a high-precision digital encoder.

Together, they reproduce the vibratory component of engine torque under severe conditions, up to three times the levels measured in real operation. This makes it possible to test and validate the fatigue resistance of the propeller under torsional vibration, and to determine its service life in line with the requirements of **EASA CS-P §370**. The current objective of these tests, for the ASCALON range, is to demonstrate an unlimited service life.

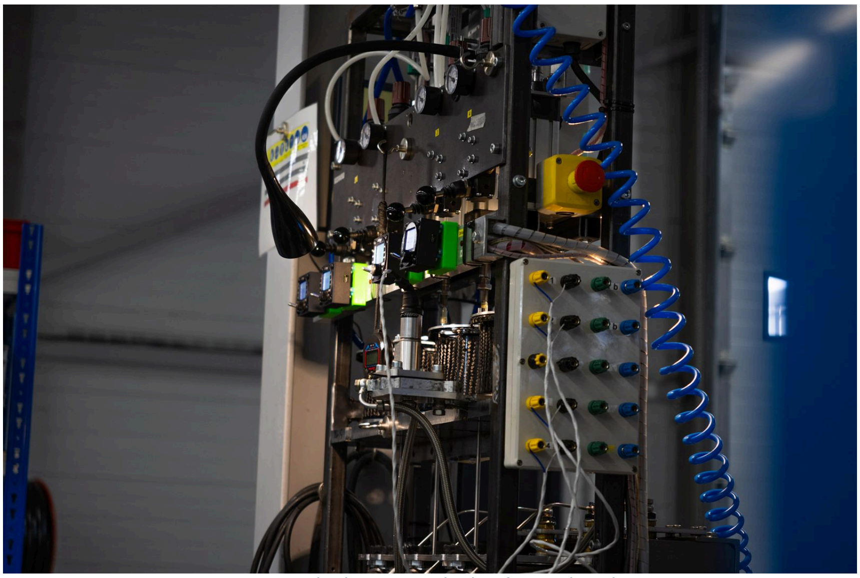
> **Why these tests matter**
> Engine torque vibrations are high-frequency torque exchanges between the engine and the propeller, generally imperceptible to the pilot. Although they cannot be felt in flight, they have a major impact on internal stresses and on component ageing. This is precisely the phenomenon that explains the restricted (forbidden) RPM ranges found on certain engine/propeller combinations: within these ranges, resonance can strongly amplify mechanical loads, which is why they must be avoided in normal operation. See the case study on the following pages.

Chicken Gun — Bird-Strike Impact Test Bench

E-Props' in-house chicken gun bird-strike test bench

Bird impacts are among the most demanding events a propeller can encounter in service. To assess blade robustness under such conditions, the aerospace industry uses a “chicken gun” to simulate a controlled impact with a bird-sized projectile at representative velocity. E-Props designed and built this bird-strike test bench in-house; it is used in the development and validation campaign of the ASCALON range, dedicated to direct-drive engines and currently undergoing **EASA CS-P** and **FAA 14 CFR Part 35** certification. Having this capability in-house gives E-Props a unique level of autonomy and confidence in the robustness of its propellers.

SHEEVA — High-Pressure Hydraulic Test Bench


SHEEVA high-pressure hydraulic test bench

The SHEEVA bench tests the governor, regulator and calculator assemblies of the GLORIEUSE variable-pitch propeller range. It simulates real flight conditions hydraulically, so that every such component is individually validated before delivery.

Flight Test Facilities

Aircraft Fleet and Test Pilot

PENA Bilouis, E-Props' aerobatic test aircraft

JODEL DR1054, E-Props' cruise test aircraft

Ultralight SKYRANGER, E-Props' low-speed aircraft

The company's aircraft allow flight-test campaigns of all propeller models and prototypes, flown by the E-Props test pilot from the Sisteron–Vaumeilh airfield (LFNS).

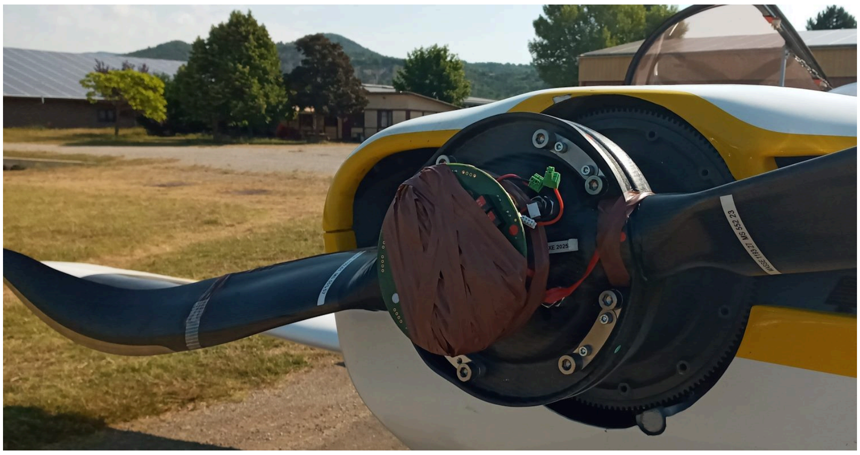
Aircraft	Role	Seats	Engine
SKYRANGER	Ultralight aircraft, low-speed range (30–190 km/h)	2	Rotax 912S — 100 hp
PENA Bilouis	Aerobatic flight test, VNE 370 km/h - 200 kt	2	Lycoming O-360 — 180 hp
JODEL DR1054	Cruise flight test, VNE 270 km/h - 146 kt	4	Lycoming O-320 — 150 hp

The ultralight SKYRANGER, acquired in 2015, is the first aircraft of E-Props: its simple tube-and-fabric structure makes it easy to fit a wide range of measurement equipment (a boom under the wing for airspeed and angle-of-attack measurement, a cockpit fitted with instruments and cameras, etc.), and it covers a useful low-speed test range from 30 to 190 km/h.

Samy, E-Props' test pilot

All flight and ground test campaigns are conducted by Samuel "Samy" Dupland, E-Props' dedicated test pilot since 2020. He has extensive experience: more than 5,000 flight hours.

ELIAS — In-Flight Data Acquisition & Instrumentation System



ELIAS electronic board integrated into an instrumented propeller hub

ELIAS is the onboard Data Acquisition System (DAU) designed and manufactured entirely by E-Props. Originally developed to measure propeller/engine vibration and blade strain, ELIAS now also integrates a complete flight-performance measurement chain.

At every moment of a flight or ground run, it records:

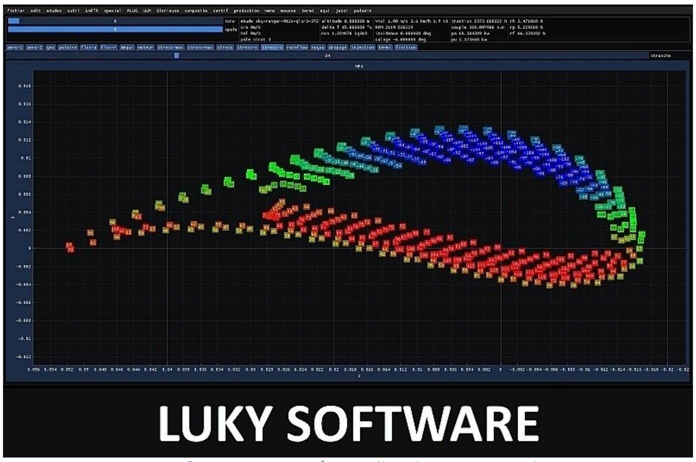
- propeller thrust and propeller torque,
- temperatures, static and dynamic pressures,
- engine RPM, engine temperature and manifold pressure,
- angle of attack and angle of sideslip,
- vibratory loads and blade strain at the propeller hub and blade roots.

A complex set of sensors, an electronic unit and strain gauges are integrated into the propeller hub, into the blade roots, and into other key locations on the airframe or engine. Thousands of measurements are transmitted in real time (Wi-Fi, and 3G for flight campaigns) to an onboard computer and to a cockpit display that lets the pilot refine the flight profile according to the required test parameters. The results obtained are far more precise and realistic than wind-tunnel testing, and are obtained in a fraction of the time — reproducing the same volume of data in a wind tunnel would require years of test campaigns. Flight data is then processed in the LUKY software.

ELIAS was used, for example, in a 16-channel configuration sampling at 6.5 kHz per channel, synchronized with the aircraft's other sensors (GPS, altitude, etc.), for the torsional-vibration case study summarized on the next page.

> **ELIAS for ASCALON customers**
> A streamlined, customer-facing version of ELIAS is supplied with every ASCALON propeller. It is integrated into a spacer fitted between the engine flange and the propeller hub, and lets the owner perform, in a few minutes of static ground running, a personalized vibration survey of their own engine/propeller installation — a service rarely offered in light aviation. Because every engine has its own vibration signature (service history, manufacturing tolerances, ignition timing), and because direct-drive engines have no gearbox to attenuate crankshaft torsional vibration, this individual check confirms that the installation's resonance conditions fall well outside the normal operating RPM range — in the same spirit as the historical Hartzell Technical Manual 193 vibration campaigns that led to today's restricted (yellow/red arc) RPM ranges on many certificated aircraft.

LUKY — Design and Optimization Software



LUKY software: engine/propeller dynamic simulation

LUKY is the in-house propeller design and optimization software developed by E-Props. It incorporates a coupled engine/propeller torsional dynamic model to predict vibratory torque transmission across the operating speed range, and implements evolutionary optimization algorithms to explore blade geometry, mass distribution and aerodynamic parameters, with the objective of minimizing torsional excitation while preserving aerodynamic performance. LUKY also predicts blade-tip motion under resonance conditions, allowing potential resonances to be identified and mitigated early in the design phase — and it is the software into which ELIAS flight data is ultimately integrated for analysis.

Case Study: Torsional Vibration on a Lycoming O-360

Reference
J. Buiatti *Experimental Torsional Vibration Analysis of Different Propellers on a Lycoming O-360 Engine*, E-Props, Jan. 2026.

To illustrate how these test means are combined in practice, E-Props instrumented a Lycoming O-360-A1D engine (hollow crankshaft, internal strain gauges) with the ELIAS system (16 channels, 6.5 kHz/channel, GPS-synchronized, Wi-Fi + 3G transmission) and compared four propellers on ground and in flight:

Lycoming crankshaft assemblies (O-360, O-320, O-235) instrumented with internal strain gauges for torque measurement

Propeller	Resonance	Remarks
Aluminium (Sensenich 2-blade)	∼2350 RPM	Strong resonance, within the manufacturer's restricted RPM range
Wood (Hoffmann 2-blade)	∼2225 RPM	Moderate torque level; range not currently flagged as restricted
Carbon, 5-blade (DUC FLAIR-2)	∼2625 RPM	Ground test only — propeller decertified by EASA; included for research purposes
Carbon, 3-blade (E-Props A42)	∼2250 RPM	Very slight resonance, lowest torque levels of the four propellers

Vibratory torque was extracted with a rainflow cycle-counting method applied to one-second windows, keeping only cycles occurring at ≥ 20 Hz to build a conservative envelope of high-frequency loading versus engine RPM. The E-Props three-blade carbon propeller, designed with the LUKY dynamic engine/propeller model and evolutionary optimization, showed markedly lower torsional excitation than the other three propellers — demonstrating, on real flight and ground data, the value of designing the propeller and engine as a single dynamic system rather than tuning the propeller afterwards.

Certification Framework

The test means described in this note support compliance with the applicable propeller airworthiness requirements, in particular **EASA CS-P** (including the fatigue/vibration requirements of §370), **ASTM** standards, and **FAA** requirements, as applicable to each propeller model and market.

Links to the corresponding test reports are available in the comments section of each propeller in the E-Props catalog, and additional test videos can be found on the E-Props YouTube channel (`youtube.com/c/eprops`).

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