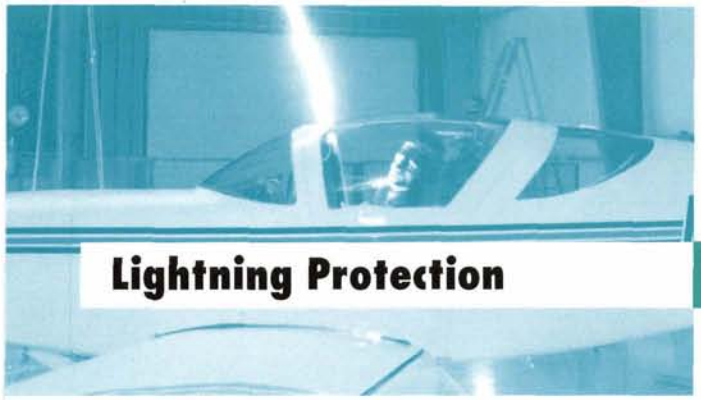


Lightning Protection

Transportation

The Glasair III is a homebuilt aircraft produced from a kit manufactured by Stoddard-Hamilton Aircraft Company, Arlington, Washington. Kit-built airplanes are more affordable, in part because they are assembled by the owner and in part because they do not require Federal Aviation Administration (FAA) testing and certification, which can be costly.

FAA treats homebuilts in different fashion from factory produced general aviation planes. They are considered to be experimental, thus cannot be used for commercial purposes, and the owner/operator is considered to be the manufacturer and therefore responsible for safety — so the rigorous safety testing and certification process normally required for general aviation aircraft is waived.

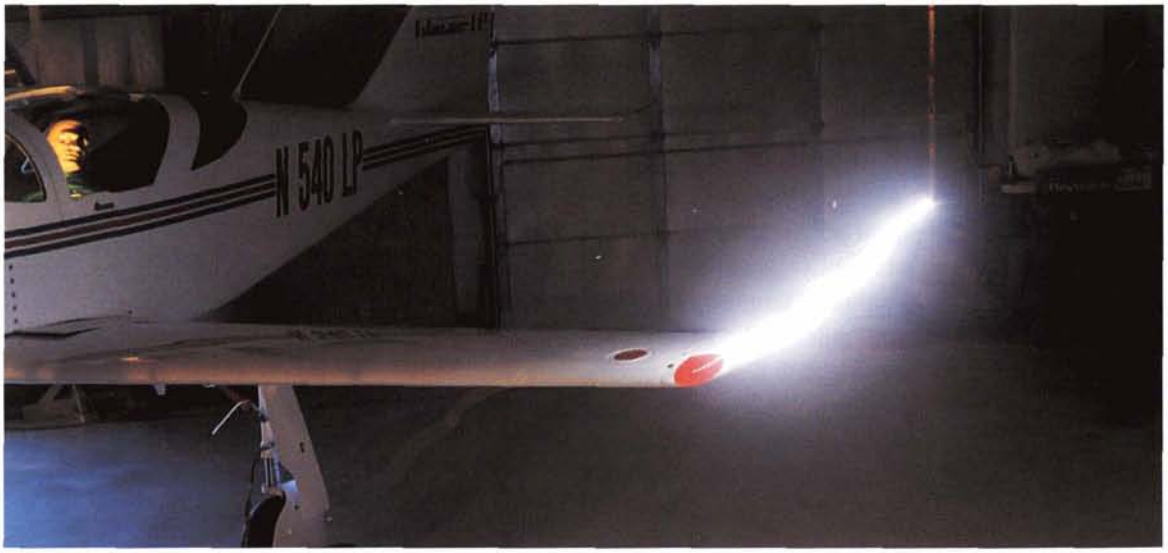
The Glasair III is an advanced technology homebuilt, constructed of a fiberglass and graphite fiber composite material and equipped with digital instruments. Composites offer greater airframe strength at reduced weight; digital systems provide greater efficiency in cockpit displays. However, both technologies tend to make the airplane more susceptible to lightning effects than conventional instruments and metal airframes because composites are less conductive than the aluminum alloys they replace, and because lightning strikes may interfere with sensitive digital electronics.

Since the Glasair III is capable of cross-country flight, Stoddard-Hamilton felt that its customers wanted the ability to use the airplane in instrument flight conditions. Because instrument weather conditions are very often the same conditions that produce lightning, the company decided that a lightning-protected version of the Glasair III would also enable more extensive instrument flight, enhancing safety and improving the marketability of Glasair III.

Because NASA conducts a continuing program of research toward improving general aviation safety and performance, Stoddard-Hamilton proposed to Langley Research Center a joint development program to develop and test a Glasair III-LP (Lightning Protected) version that would be able to land safely if struck by lightning. Langley, which had long conducted a multiyear Storm Hazards Research Program, was interested because the airplane was made of composites and there was need for a database on this type of general aviation aircraft.

Accordingly, Langley awarded a Small Business Innovation Research contract to Stoddard-Hamilton for the development. Lightning Technologies, Inc. (LTI), Pittsfield, Massachusetts, one of the key players in the Storm Hazards Research Program, was selected as the subcontractor responsible for the lightning protection design and testing. Analytical Services and Materials, Hampton, Virginia and Aero Space Consultants, Newport News, Virginia provided engineering and documentation support.

The accompanying photos illustrate a key test in the Langley/industry Glasair program. The prototype Glasair III-LP is being subjected to a 1.5 million volt strike-attachment test in LTI's simulated lightning laboratory, one of a battery of tests normally required by the



FAA for certification of a factory-produced aircraft. The Glasair III-LP successfully passed this and other tests and became the first kit-built composite aircraft to be lightning tested and protection-verified under the guidelines used by the FAA to certify general aviation aircraft.

To achieve that status, LTI designed a protection system to ensure that lightning would not cause catastrophic structural damage, disabling electrical shocks to occupants, loss of aircraft control, ignition of fuel vapors, loss of propulsion, loss of instrument flight rules (IFR) capability, or loss of electrical power or engine controls.

Because the Glasair III is constructed of fiberglass composites that offer no inherent protection against lightning, a layer of expanded aluminum foil was added to the surface of the fiberglass to provide basic electrical continuity and shielding for the entire airframe. Special attention was given to the electrical bonding of aircraft components to allow safe passage of lightning currents on the exterior of the aircraft.

The fuel system was protected by a specially designed fuel filler cap and by the isolation of fuel and fuel gauges from conducting surfaces. The interior compartment was entirely isolated from the exterior conducting surfaces and an equipotential plane was provided to minimize voltage difference throughout the airplane. The electrical and avionics systems were protected by careful attention to grounding and shielding and by the use of surge suppression devices.