TRI-TAIL BONANZA

Playing it straight with a nagging question of structural integrity

BY J. JEFFERSON MILLER

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Signs of radical surgery are readily apparent on Michael D. (Mike) Smith's Model 35 Bonanza. At first glance, one might suppose that the airplane had been damaged in some sort of unlikely accident, perhaps the collapse of a hangar or a taxiing collision, then rebuilt from the trailing edge of the wing aft. Like a post-surgical scar, the primed but unpainted tail is not a pretty sight.

Nor is it meant to be. The unpainted area shows what has been replaced in this conversion of Smith's original V-tail Bonanza (shown below) to a straight-tail Bonanza. The Mike Smith Aero, Incorporated, "Tri-Tail" conversion is the latest—

Piloted by Mike Smith, who is at the controls in this photograph, N11MS has twice won the CAFE efficiency race.

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The Tri-Tail Bonanza is indistinguishable from a Model 33.

and most expensive—attempt to modify the tail of the Model 35 Bonanza and allay owners' fears about the V-tail's alleged structural defects.

The controversy surrounding the V-tail Bonanza has been reported on several times in *Pilot* (see "For Further Reading," p. 74) and in other publications. It is a debate that continues to elicit strong opinions, both in defense of and opposition to the design.

In the process, the Bonanza's V-tail, once a symbol of design excellence, has become a source of nagging concern for many Bonanza owners. The debate over the Bonanza's V-tail focuses on a few key facts and assertions. Critics of the design point to its high rate of in-flight structural failures compared to straight-tail Bonanzas—the 33- and 36-series models. Statistics available from the Federal Aviation Administration show that the Model 35 Bonanza has an in-flight failure rate 20 times that of the straight-tail Bonanzas.

Roughly one-third of these failures, it should be noted, occurred in the original Bonanza Model 35, produced in 1947 and 1948. These airplanes were certificated in the Normal category, with a positive load limit of 3.8 Gs. Later models, which were built from 1949 on, had more strongly built wings, were certificated in the Utility category and had a positive limit load of 4.4 Gs.

In 1951, the chord of the V-tail's stabilizers was extended approximately 20 percent, or seven inches, and the dihedral was increased from 30 degrees to 33 degrees. Both of these changes were made to improve directional stability and to decrease the airplane's tendency to yaw in turbulence.

Some believe that Beech made a serious mistake in not attaching the leading edge of the enlarged stabilizer to the fuselage. Under extreme structural loads, critics say, the unsupported stabilizer leading edge will bend, twisting the stabilizer main spar and eventually leading to failure of the tail.

Defenders of the V-tail Bonanza argue that, in a situation where there were structural loads of sufficient force to pull off the tail, the pilot almost surely was at fault. Indeed, there have been many instances where non-proficient or non-instrument rated pilots have lost control of V-tail Bonanzas in instrument meteorological conditions, which ultimately led to structural failure.

A number of loss-of-control accidents in V-tail Bonanzas have been attributed to overloading or improper loading. The Model 35 has a rather narrow center of gravity envelope, and the CG shifts aft as fuel is burned. Therefore, pilots must calculate the CG at both takeoff and landing weights to ensure that the aircraft is within the CG envelope for the duration of the flight.

Except for the straight-tail conversion, all tail modifications to date have served to reinforce the leading edge of the V-tail's stabilizers.

Smith developed the first such modification for the Bonanza. His "stub spar" kit consists of a one-inch-long stainless steel leading-edge stub spar and hardware for attaching the leading edge of the stabilizer to the wing. The bracing is entirely internal. To install the stub spar, the airplane's tail surfaces must be removed. The kit costs $825 uninstalled; $1,975 installed.

The development of the stub spar was an outgrowth of Smith's drag-reducing modifications for the Bonanza, which can add about 17 knots to the airplane's cruise speed. Because these modifications made an aerodynamically clean

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BIG BLOCK A-36

Having improved the Bonanza's speed, range and rate of climb through more than a dozen aerodynamic modifications, Michael D. (Mike) Smith now has turned his attention to improving the airplane's performance through brute power.

The source of that power is a 568-pound block of aluminum and steel known as a Lycoming IO-720-A1B. It is an eight-cylinder, fuel-injected, normally aspirated, 720 cubic inch, 400-hp engine. As horizontally opposed powerplants go, it's one of the biggest.

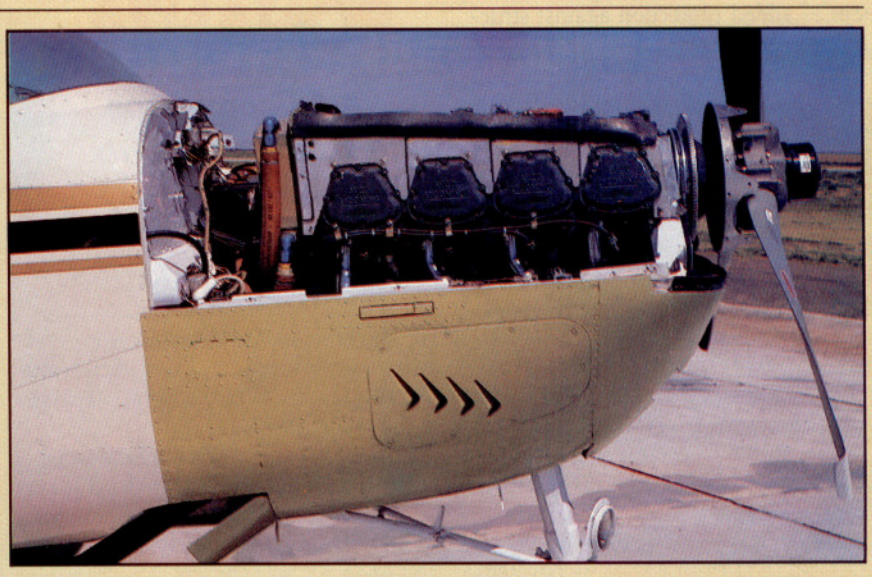
A new, somewhat bulbous cowling has been created to house the engine, and there isn't much room to spare. What the installation lacks in sheer eye appeal, however, it makes up for in oomph.

The prototype 400-hp Bonanza has flown only a few times, as of September, and there is little actual performance data for it. But the modified A36, which has received some Smith speed modifications, has been flown at a 75-percent cruise speed of 202 knots at 13,000 feet. Projected cruise speed at that altitude with a full complement of speed modifications is 208 knots.

Projected service ceiling is a remarkable 27,000 feet, and initial sea level best rate of climb, at gross weight, is expected to be about 2,000 fpm.

Smith intends to offer the engine conversion for the A36 Bonanza only, initially, and perhaps later for the F33A, depending on how well the converted A36 sells.

The greatest advantage of the IO-720, in Smith's opinion, is its ability to provide the Bonanza with more power for high density altitude operations. The standard A36 has a 285-hp Continental IO-520 in pre-1984 versions and a 300-hp Continental IO-550 in later versions.



Installation of the 568-pound IO-720 does not alter the CG limits of the A-36 Bonanza.

Further advantages, as Smith sees them, are that the Continental IO-720 is simpler and more reliable than a turbocharged installation, and it is more likely to reach its recommended time between overhauls (TBO) interval of 1,800 hours.

In some earlier installations, such as the Piper Comanche 400, the engine gained a reputation for hard starting. The Comanche 400 had the A1A version of the IO-720. The A1B, however, has an improved ignition system that, according to Smith, has alleviated the starting problem.

Providing adequate cooling airflow to all cylinders can present a problem for an opposed engine of this size. Smith says that attention to baffling will keep the rear cylinders running as coolly as the forward ones. His experience in developing baffling for the tight cowling offered as part of the Smith speed conversion package should help.

The engine is offset 3.5 degrees (versus 1.5 for the standard installation) to counteract torque effect. Vortex generators will be added to Bonanzas not already equipped with them in order to enhance aileron response at low speeds and improve stall- and spin-recovery characteristics. An experimental 81-inch-diameter, three-blade Hartzell Q-tip propeller is being used on the prototype.

Empty weight of the IO-720-equipped A36 increases by 121 pounds. By moving the battery to the rear of the fuselage, the fore and aft CG limits of the standard A36 are retained. Smith will apply for a 250-pound gross weight increase.

Customers may want to use the extra gross weight to fill up a pair of 20-gallon tip tanks, which can be purchased from other Bonanza modifiers such as Beryl D'Shannon Aviation Specialties of Lakeville, Minnesota (800/328-4629), and Osborne Tank & Supply of Oro Grande, California (619/245-8477). Fuel flow in the modified A36 at 75-percent power is 20 gallons per hour.

Much engineering and testing remains to be done on the IO-720 installation. Although Smith is convinced that the installation is feasible from an engineering standpoint, he is not so certain about the financial feasibility of the project, and he intends to conduct more market research before committing to the certification process.

The projected price for the conversion is between $70,000 and $80,000. But the cost of product liability insurance—a familiar bugaboo these days—may boost the price tag for the conversion to as high as $100,000. And for all but a few power fiends, that simply may be too much. —JJM

A new aluminum and fiberglass cowling has been designed to house the 400-hp engine.

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A CG envelope extension of two inches may help prevent an inadvertent out-of-CG condition.

airframe even cleaner, Smith required that purchasers of the speed modifications also purchase the tail reinforcement as added protection against structural overload.

Other companies have followed suit with their own tail reinforcement kits. Both Knots 2U, Incorporated, and B & N Industries offer external cuffs that surround and brace the leading edge of the stabilizer where it abuts the fuselage. These kits do not require removal of the tail. The kit from Knots 2U costs $575. The company's address is: 1941 Highland Avenue, Wilmette, Illinois 60091; telephone: 312/256-4807.

B & N Industries' kit costs $595. The company's address is Cameron Park Airport, 3280 Cameron Park Drive, Shingle Springs, California 95682; telephone: 916/933-1367.

In 1984, Smith introduced his own external tail reinforcement kit, which sells for $395.

And now there is the ultimate tail modification. Smith's "Tri-Tail" conversion offers the maximum reassurance that the Bonanza's V-tail, at least, will not play a role in a loss-of-control accident. It is a major modification in every sense, including the projected price, which is $25,000.

The idea for the conversion, according to Smith, came from several Bonanza owners who had inquired whether it would be possible to replace the V-tail with a straight tail.

Initially, Smith thought he could offer a tail conversion for $15,000, replacing only the tail surfaces and the last five-and-a-half feet of fuselage.

But in its certification requirements, the FAA insisted that the fuselage and empennage of converted airplanes must duplicate those of a Model 33 Bonanza. Hence, there is new sheet metal from the trailing edge of the wing aft, a length of just over 10 feet.

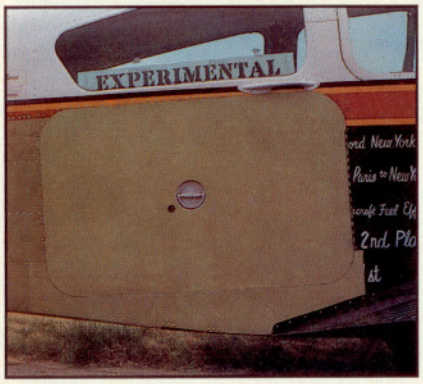
All fuselage panels and tail surfaces are new Beechcraft parts. The green coloring in the accompanying photographs is the result of the zinc chromating process, which protects the aluminum against corrosion. A standard baggage door or an optional enlarged cargo door is available as part of the conversion for the Bonanza.

In the Model 35 Bonanza, cables from the rudder pedals and control column run aft to a control mixer, a device that converts conventional pitch and yaw control inputs into a combination of ruddervator deflections. In the straight-tail conversion, the control cables and mixer are removed, and new cables are routed from the controls of the airplane to the tail surfaces.

Although a converted airplane would be virtually indistinguishable from a Model 33 Bonanza, the Model 35 designation will be retained, with the addition of an ST for "straight tail." Smith's own airplane, therefore, would be known as a V35ST.

The modification has not yet been approved by the FAA. Smith says he expects to receive a supplemental type certificate by the end of the year. First, however, structural loading and flight tests must be completed. Under the terms of the STC, the straight-tail modification will be available initially only for S- and V-series Model 35 Bonanzas. This would include all V-tail Bonanzas that have been produced since 1964. After the STC is obtained, Smith will begin work to certify eariler versions of the V-tail for the conversion.

The straight-tail conversion offers one significant advantage over the V-tail design. The center of gravity range is expanded by 2.3 inches, increasing the aft CG limit from 84.4 inches to 86.7 inches. Since an out-of-CG condition has been blamed for many accidents, the wider envelope should help reduce the chance of inadvertently exceeding center of gravity limits. Weight and balance still must be calculated for takeoff and landing weights, however, as the CG still shifts aft as fuel is consumed.



An enlarged cargo door, such as this one, or the standard cargo door may be ordered as part of the Tri-Tail conversion.

One problem not solved by the conversion is the Bonanza's tendency to yaw in turbulence. All of the short-fuselage Bonanzas and Barons share this particular trait.

Will Smith find takers for the modification? His market analysis is based, as much as anything else, on the sentimental attachment of many Bonanza owners to their airplanes. He points to the number of owners who have invested as much as $100,000 upgrading airframes with book values of only $30,000 or so, with little hope of recouping their full investment. For these individuals, the tail conversion could make more sense than trading a highly modified (in effect, custom-built), V-tail for a straight-tail Bonanza. Smith estimates a market for about 100 conversions.

For more information on the straight-tail conversion and other Mike Smith Aero modifications, contact: Mike Smith Aero, Incorporated, Stanton County Airport, Box 340, Johnson City, Kansas 67855; telephone: 316/492-6840. □

FOR FURTHER READING

"The Bonanza Mystique," *AOPA Pilot*. Edward G. Tripp. (February 1981, p. 34.) Bonanza history and report on a 1980 V35B.

"The Bonanza Besieged," *AOPA Pilot*. Barry Schiff. (February 1981, p. 46.) An attempt to put the Bonanza controversy into perspective.

"Speedy Beech," *AOPA Pilot*. J. Jefferson Miller (October 1984, p. 38.) Pilot precis on Smith speed mods.

"Tough Tails," *AOPA Pilot*. J. Jefferson Miller (October 1984, p. 45.) Discussion of various tail reinforcement kits for V-tail Bonanzas, not including the Smith "Tri-Tail" conversion.

"V is for Value," *AOPA Pilot*. J. Jefferson Miller. (June 1985, p. 34.) V-35 bargain hunting, modifications and Bonanza history.

"Beech Bonanza F33A," *AOPA Pilot*. Mark M. Lacagnina. (August 1985, p. 34.) Beechcraft holds a sale; report on an F33A Bonanza.