The MU-2 Story

A viable product today - despite being, out of production nearly 25 years.

by Mike Potts

The pressurized twin-engine cabin-class Mitsubishi MU-2 is a business turboprop that was produced between 1966 and 1986 during the formative years of business aviation - a period we now see as the golden age of the turboprop.

Mitsubishi was one of six manufacturers that did battle for the turboprop market during a time in business aviation history when turboprops outsold jets by as much as three to one, and business operators were first being introduced to the reliability and efficiency of turbine-powered aircraft.

Today, in spite of being out of production for nearly 25 years, the MU-2 is still a viable product, strongly supported by its manufacturer and with a network of service centers to keep it flying. Based on data published by Mitsubishi in November 2009, there are still 373 MU-2s operational today, out of 704 built for the commercial market. With no life limit on the airframe and a comparatively young fleet, MU-2s are likely to be flying in significant numbers for several decades to come.

Questions regarding the MU-2's once controversial safety record now seem resolved. A new FAA Special Federal Aviation Regulation (SFAR) effective February 2009, mandates initial and recurrent training for all MU-2 pilots. Mitsubishi has been promoting training to the standard specified in the SFAR for more than a decade. Accident data over the past 10 years shows that, when

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flown by pilots trained in the Mitsubishi program, the MU-2s safety record is comparable to, or better than its turboprop competitors. There has not been an MU-2 fatal accident in nearly four years.

SITTING COMFORTABLY...?

The MU-2 story begins in 1959 when Mitsubishi Heavy Industries (MHI) in Japan began to consider a design for a twin engine utility aircraft built around a new generation of small turboprop engines just starting to come off the drawing boards of a number of engine manufacturers.

Mitsubishi had a long history of building aircraft, dating back to 1921, and was perhaps best known for the legendary A6M Zero fighter in WWII. After the war, Mitsubishi was prohibited from building aircraft for more than a decade, but by the late 1950s, it was ready to resume, and eager to make up for lost time.

The target was the US market – at that time the only significant venue for private aircraft. Records kept by the General Aviation Manufacturers Association (GAMA) showed their member companies delivering 7,689 airplanes in 1959, all of them piston-powered, including 840 twins. More than 80 percent of the twins were in the light category, including the Cessna 310, Piper Apache and Beech Travel Air.

Working through the company's New York operations office, Mitsubishi hired a US firm to conduct a market study to help determine what it should build. The study told the company many twin operators wanted a step-up airplane that would offer more speed, and at the same time good short field performance, and function well on unpaved runways.

Armed with this information, Mitsubishi made a gutsy decision – it would introduce an entirely new category of light airplane – a twin-engine turboprop. This aircraft would offer a significant upgrade in performance over the light piston twins in the market, with cruise speeds faster by 100 knots or more, and pressurization that would allow comfortable operation in the flight levels.

Turboprop aircraft engines had been around since the 1940s, but they were sized to power transport category aircraft such as the Lockheed L-188 Electra and the C-130 Hercules military transport – too large for the light aircraft category utility airplane Mitsubishi was designing. But now a new generation of small turboprop engines was under development, suitable for powering an airplane in the 6,000- to 12,500-pound gross weight category.

One of the earliest light turboprop engines was the Turbomeca Astazou. Turbomeca, based in France, had begun testing the Astazou in 1957, and Mitsubishi engineers began designing their MU (Mitsubishi Utility) aircraft around the 562 shaft horsepower (shp) Astazou.

MU-2s IN PRODUCTION

THE NEED FOR SPEED

In the market survey, customers had made it clear they wanted speed. For Mitsubishi's engineers, the best way to achieve high cruise speed was to minimize wing area. At the same time, however, customers also wanted good short-field performance, and that meant having plenty of lift at low speed. That would present the designers a conundrum: lift and drag rise proportionately, so lift becomes the enemy of high speed.

To handle these competing and somewhat contradictory requirements, the Mitsubishi engineers added full-span double-slotted Fowler flaps to the MU-2's wing. When deployed, the Fowler flaps increased the effective wing area by nearly 30 percent, giving the MU-2 the best of both worlds – high lift for low-altitude low-speed operations and a highly loaded low-drag wing to optimize high-speed performance at altitude.

The full-span Fowler flaps took up the space where a wing would ordinarily mount ailerons for roll control, so Mitsubishi's engineers employed another state-of-the-art solution, using spoilers for roll control, just like some of the supersonic jet fighters being introduced in the late 1950s. Besides contributing to the aircraft's high-performance image, the spoilers provided the MU-2 with some nice handling characteristics, maintaining positive roll control better than ailerons in slow flight, and requiring less rudder input to maintain a coordinated turn.

In response to prospective customers' desire for an airplane that could operate well from unimproved runways, Mitsubishi opted for a high-wing design that would get the engines and propellers out of harm's way, and gave the airplane a rugged tricycle landing gear mounted directly to the fuselage.

FLIGHT TESTING

By 1963, Mitsubishi was flight testing the Astazou-powered MU-2A in Japan and moving toward certification with the Japan Civil Aviation Bureau - introducing the MU-2 as a static exhibit at the New York World's Fair in the spring of 1964. It had taken Mitsubishi almost six years to design and develop the MU-2 because it was an all-new aircraft. Throughout its production history, it would compete against a series turboprops from other manufacturers, all developed as derivatives from piston-powered models.

Despite its bold initiative, Mitsubishi would not be the first to reach the market with a turboprop twin. That distinction would go to Beech Aircraft, which fitted Pratt & Whitney PT6A turboprop engines on its Queen Air airframe in early 1964. By August of that year Beech had certified the King Air, and before the year was out, had recorded nine deliveries – and launched the era of the business turboprop.

Mitsubishi, meanwhile, had decided that the new Garrett AiResearch TPE331 turboprop engine was better suited to the MU-2 than the Astazou. Three MU-2As had been built with the Turbomeca engine, and were used in development, but none were ever delivered to a customer. Equipped with the Garrett engine, the aircraft was re-designated MU-2B. To boost range, a 65-gallon tip tank was added to each wing, giving the MU-2B its distinctive appearance.

Mitsubishi never seriously considered

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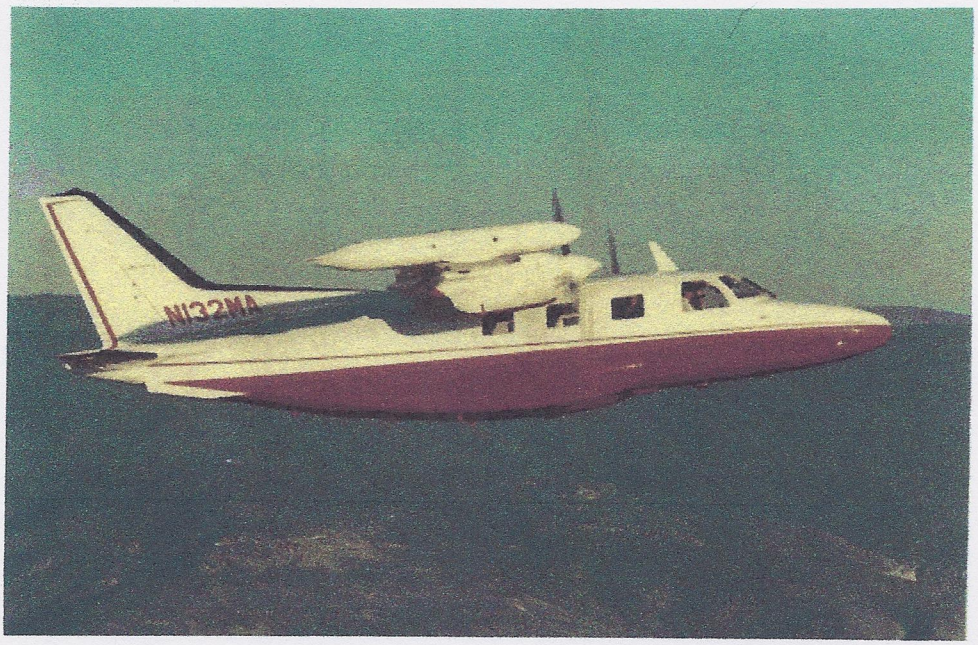

using the PT6, finding that its power-to-weight ratio didn't provide the performance it wanted for the MU-2. With development and flight test nearly complete, Mitsubishi was making plans to market its new airplane.

In 1965 it signed an agreement with Mooney Aircraft of Kerrville, Texas, to have Mooney assemble and sell the MU-2 in the United States. Mitsubishi would fabricate the airplane at its factory in Nagoya, Japan, and ship completed wings and fuselages to a new facility Mooney was building in San Angelo, Texas. Mooney would assemble the aircraft, including installation of engines, propellers, avionics, systems and interiors, flight test them and paint them to customer specs prior to delivery.

In late 1966 the first MU-2Bs were delivered to customers and Mitsubishi was poised to capitalize on its investment.

EVOLVING MARKET

The market had evolved somewhat since Mitsubishi did its market study back in 1959, and the changes were generally positive. GAMA reported 15,768 aircraft deliveries in 1966, more than double the 7,689 deliveries recorded in 1959. The business turboprop had arrived on the scene, with a market accounting for 165 deliveries in 1966, including seven MU-2Bs.

The other manufacturers delivering turboprops were Aero Commander, Beechcraft and Swearingen Aviation.

It took a while for Mooney to set up the assembly line in San Angelo to accommodate full production, but by 1968, the line was geared to turn out four aircraft per month and Mooney's distributor network was selling the MU-2B at close to that rate.

Notwithstanding the MU-2B's success, Mooney was having problems with its own business, and in late 1969 the company went bankrupt, leaving Mitsubishi in an awkward position.

Terminating its agreement with Mooney in early 1970, Mitsubishi established Mitsubishi Aircraft International (MAI) to perform the functions Mooney had been assigned. Initially based in San Angelo, MAI would also handle support for the growing fleet of MU-2s. Instead of selling airplanes through Mooney's distributor organization, MAI would sell the MU-2 direct, through its own sales organization.

In some respects Mooney's failure came at a fairly advantageous time for Mitsubishi, although it could have hardly known it then. The market for business aircraft was entering a recession in 1969 that would last nearly three years, dropping from 12,457 units deliverd in 1969 to 7,292 in 1970. Turboprops were down in the same period from 214 to 135.

The market slowdown allowed Mitsubishi to make the transition from Mooney to MHI at a time of reduced demand, when it was less likely to cost market share and lost sales opportunities.

Turboprop deliveries would continue to fall in 1971 to just 89 units, but would begin a rebound the following year to 179, and continue on an upward trend every year for the next nine years, peaking at 918 units in 1981. This would be the golden age of the twin-engine turboprop, and the Mitsubishi MU-2B was very much a part of it.

As mentioned, between 1966 and 1986 Mitsubishi would deliver 764 MU-2Bs – 703 to the commercial market and 61 to the Japan Air Self Defense Forces. The commercial versions would include 13 different model designations, although the basic structure and aerodynamic configuration of the MU-2 was largely unaltered.

EVOLVING AIRPLANE

The most outwardly obvious change to the Mitsubishi was the addition of a stretched version of the aircraft, which debuted in 1970. The stretch added six feet to the fuselage, three feet ahead of the wing and three feet immediately behind it. For the remaining 16 years of production, both short- and long-body versions of the MU-2 would continue to be built.

Mitsubishi built 32 basic MU-2Bs before introducing the first model change in 1968, designated the MU-2-D. The first upgrade featured an increase in maximum operating altitude from 23,000 to 25,000 feet. A total of 15 MU-2-Ds were built, as well as three MU-2-DPs, which had larger 90-gallon tip-tanks, and an upgraded version of the Garrett engine, designated TPE331-1 that produced

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665 shp, up from 585 shp on the first airplanes.

At the end of 1968, Mitsubishi introduced the MU-2-F, which would remain in production through 1972. It incorporated a gross weight increase of 570 pounds, bringing the MTOW to 9,920 pounds. Other improvements included those of the DP model (above). Fuel capacity was further expanded in the F-model with the addition of a 15-gallon fuel tank in each outer wing panel, and a total 95 MU-2-Fs were built.

In 1970 the first long-fuselage model reached the market, as mentioned above, designated the MU-2-G. Its features were essentially the same as those in the MU-2-F. 42 MU-2-Gs were built by the close of 1971. From that point, Mitsubishi would introduce model changes approximately in pairs, with long- and short-fuselage versions each incorporating comparable upgrades.

The first new upgraded long-fuselage model was the MU-2-J (there was no H or I model), introduced in 1972. It featured the "Dash 6" version of the TPE-331, with an increase in maximum output to 840 shp, although the engine was flat-rated at 665 shp. The J-model also got a further increase in gross weight (to 10,800 pounds).

In mid-1972 the short fuselage MU-2-K was introduced, incorporating all the mechanical changes from the J model. A total of 106 J-models and 76 K-models were delivered between 1972 and 1974 into an expanding turboprop market. Turboprop deliveries as reported by GAMA for the three-year period from 1972 to 1974 totaled 676 units.

The next long fuselage upgrade model was the MU-2-L, which was produced in 1975 and 1976. Gross weight on this airplane was increased to 11,575 pounds. The short-fuselage version was MU-2-M, which had a gross weight of 10,470 pounds, and a total of 41 L-models and 26 M-models were delivered during the production run.

During this period, Mitsubishi achieved a milestone for the MU-2 by having the airplane certified by the FAA. The initial development and certification of the MU-2 was accomplished in Japan through the Japan Civil Aviation Bureau (JCAB). The early aircraft were brought into the U.S. on an import type certificate (A2PC) under a bilateral agreement between the FAA and JCAB.

The first models of the MU-2 series built entirely on the FAA type certificate were the long-body MU-2-N and the short-body MU-2-P, both built during 1977 and 1978. These aircraft were fitted with the 'Dash 5' slow turning version of the TPE-331 and four-blade Hartzell propellers. All previous MU-2s had three-blade Hartzells. Prop rpm at 100-percent power was lowered from 2,000 to 1,591, reducing external noise and vibration. A few late production L-models also received the slow-turning engine. A total of 31 N-models and 40 P-models were delivered.

Unlike earlier versions of the airplane, the final two models of the MU-2 received name designations rather than letters. 'Marquise' was the name of the long-cabin version built between 1979 and 1985 as it received the more powerful Dash 10 version of the TPE-331, with a maximum power output of 1,000 shp, flat rated to 715 shp. Fuel capacity was increased by expanding the wing fuel tanks to 35 gallons.

'Solitaire' was the name given to the short version of the final MU-2. Like the Marquise, it had added fuel capacity and the Dash-10 version of the Garrett engine, although it was flat-rated to 685 shp. A total of 139 Marquise models and 57 Solitaires were delivered between 1979 and 1985. The vast majority came in the first four years.

THE END OF THE 'GOLDEN AGE'

After nine years of continuous growth, the turboprop market reached 918 units in 1981, then fell back sharply. By 1984 delivery totals were down to 271 – a year in which GAMA's records show just three MU-2 deliveries. The golden age of the turboprop twin was over.

Even as production was shutting down, there was regulatory trouble brewing for the MU-2. The airplane had developed a reputation for being accident prone. The problem lay in the confluence of the MU-2's high performance design, and the training and flight habits of the market it was designed to reach – pilots of light piston twins.

Certified to light aircraft standards, under-12,500 pounds MTOW, the MU-2 required no type rating. A multi-engine rated pilot could qualify to fly it with just a simple ›

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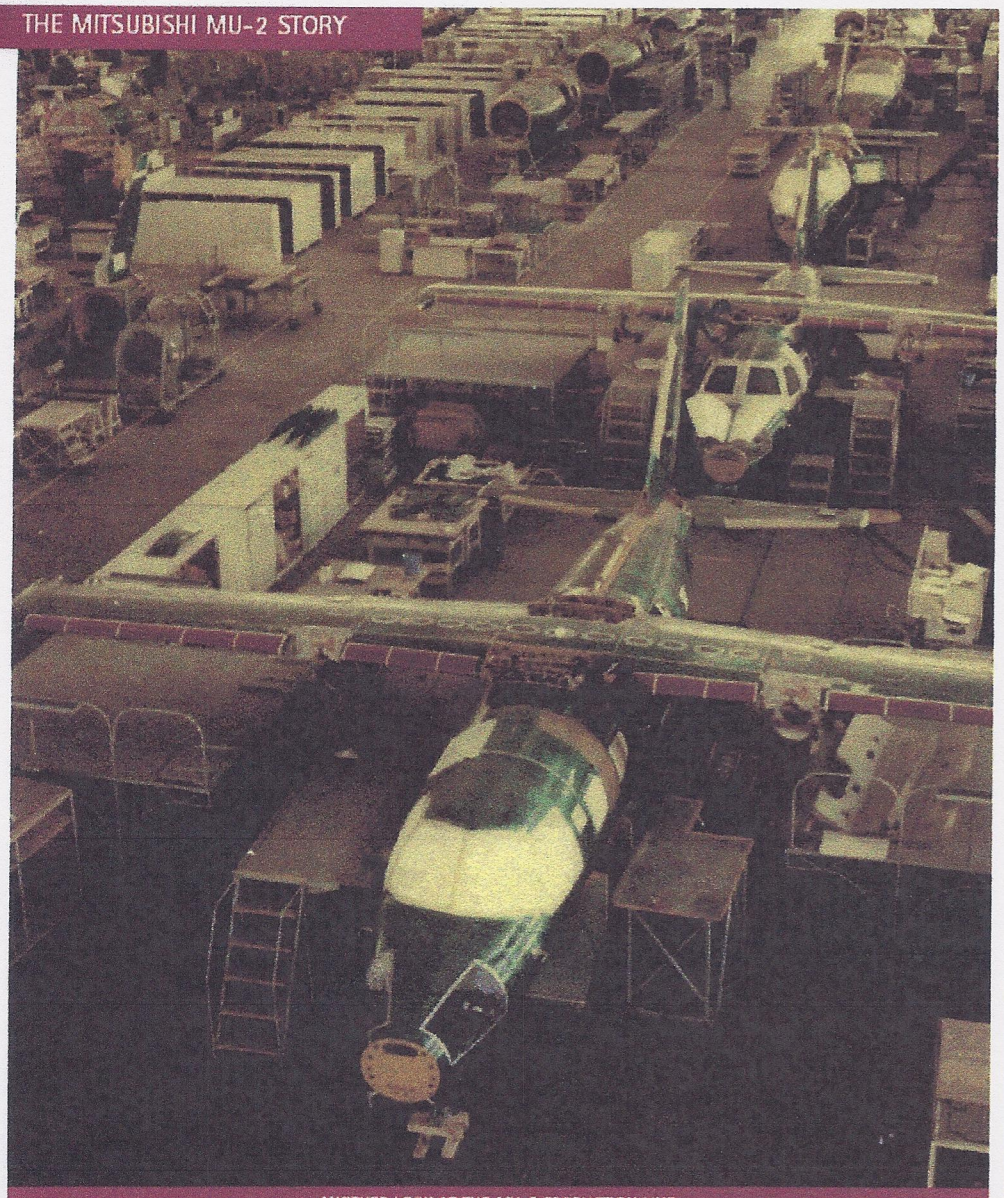

ANOTHER LOOK AT THE MU-2 PRODUCTION LINE

check-out. Unfortunately, many procedures taught to light multi-engine pilots didn't transfer well to many heavier turbine powered aircraft such as the MU-2

In 1982 the FAA was prompted to re-examine the certification basis of the MU-2. After a thorough study, however, it concluded the MU-2 met the certification criteria and no further action was required. Mitsubishi, though, decided it would benefit the MU-2 program if all MU-2 pilots were well trained in how to properly operate the aircraft.

SUPPORT PROGRAM DEVELOPMENT

The company placed renewed emphasis on formalized simulator training, and also instituted a one-day seminar called Pilot's Review of Proficiency ('PROP') and presented it to more than 550 MU-2 pilots before production of the aircraft was halted.

In 1994, in an effort to make sure MU-2 pilots were appropriately trained, Mitsubishi revived PROP as a free one-day seminar held in multiple locations around the US. It has continued to present PROP every two years ever since. Yet PROP is just a small part of a continuing support program that is unique in the industry for an airplane that has been out of production for a quarter century and has no prospects of ever being built again.

Every part on the aircraft is still available today, although Mitsubishi says lead times could be an issue for seldom ordered assemblies. Nobuhito (Noel) Takayama, general manager of Mitsubishi Heavy Industries America's Aircraft Product Support Division (APSD) considers it a matter of honor and reputation for Mitsubishi to continue to support the MU-2. The company continues to be in aviation as a supplier to Boeing, Bombardier and others, and is now taking orders on a new regional jet - so it intends to stay in the aviation business.

Takayama says Mitsubishi feels a responsibility to the customers of its products – even those long out of production – and therefore intends to continue supporting the MU-2 for the next decade and beyond. That support includes air safety programs, FAA coordination, maintaining the MU-2 type certificates, coordinating with the NTSB and providing field service and technical support.

Over the past decade Mitsubishi's support program has won awards for outstanding service and parts support, and consistently ranked highly in customer surveys – and that's very unusual for an out-of-production aircraft.

In 2005 the FAA again reviewed the MU-2's certification basis, and again concluded that it met the requirements. This time, however, FAA gave Mitsubishi something it had been requesting for some time – a set of mandatory training requirements for MU-2 pilots. These requirements were finally codified in SFAR 108 early in 2009.

Of the 373 MU-2s still reported in service today, 290 are based in the U.S., 20 are in Europe, 35 in South America, 14 in Canada, four in Mexico, five in Australia, four in Africa and one in Russia.

According to Mitsubishi data supplied by operators, the high-time aircraft in the fleet (an L-model) has accumulated approximately 21,500 hours while the low-time aircraft (a Solitaire) has about 2,250 hours. The average aircraft has about 7,100 hours.

› More information from www.mu-2aircraft.com

MARQUISE FLIGHT REPORT
by Mike Potts

As part of the research for this story, Turbine Aircraft Services offered me an introductory flight in the company's Marquise demonstrator. As a 2,000-hour commercial pilot who hasn't flown twins in a decade, I nonetheless found the airplane easy to adapt to, and confidence inspiring.

Taxiing is solid and much more stable than I had expected with the closely spaced main gear. Take-off is a big-aircraft procedure – accelerate to V1, rotate to eight degrees nose-up and fly off, rotating to 10 degrees nose-up after gear retraction.

Handling with the spoilers is solid throughout the speed regime, even in slow flight. The airplane tends to stay where you put it. Like any big turboprop, it's easier to fly if you keep it trimmed properly.

The stall was benign. On one engine, a little rudder trim was all that was necessary. A stabilized approach was easy to maintain, and power all the way to touchdown produced a satisfactory landing.

Used MU-2s sell in the $500,000 to $800,000 range - a bargain for a 300-knot cruise airplane that's well supported by its manufacturer. If I were in the market for an airplane of this class, I would have to give the MU-2 serious consideration. For performance and value, it makes an interesting alternative to a light jet.