Alex McMahon

What's Wrong With the MU-2?

Is the fault with the airplane or the pilots and mechanics? We flew it to find out some of the answers.

By Fred George

According to several of its operators, the Mitsubishi MU-2B is one of the fastest, most fuel efficient, strongest and most responsive handling general aviation twin turboprops yet built. With flaps retracted, it has virtually the highest wing loading of any popular twin turboprop, providing a smooth ride in turbulence and minimal frontal area for reduced drag and efficient cruising. Fitted with Honeywell (Garrett) TPE331-10 turboprop engines as standard or retrofit equipment — the prototype MU-2, or A model, was fitted with twin Astazous but did not go into production — the short-body MU-2B models, including the Solitaire, will cruise as fast as 315 KTAS at 20,000 feet. The long-body models, including the Marquise, can fly faster than 305 knots. The MU-2B, without a doubt, provides more speed for the dollar than any other general aviation turboprop on the resale market.

It's also able to fly slowly in general aviation airport traffic patterns because it's fitted with full-span, double-slotted Fowler flaps that increase overall wing area by almost one-quarter when extended. The MU-2B can slow down to 120 KIAS to sequence with other general aviation aircraft on downwind. Vref speeds on final range from 100 to 110 KIAS, depending upon landing weight. In many ways, the MU-2B flies like a current-production light jet with turboprop engines.

Dick Allan, president of Internet Jet Sales, a well-known MU-2B broker in the Northeast United States, says the aircraft's jet-like performance has special appeal to a special set of pilots, ones who are notably different from those who fly more matronly turboprops. He likens the aircraft to "a stanine test that separates fighter jocks from bomber pilots."

But Allan points to another part of the MU-2B population. He believes the aircraft's popularity with low-budget canceled check transporters and all-night air freight operations is problematic since they can afford to buy the airplane, but don't have the money (or the will) to invest in rigorous pilot training or top-notch maintenance.

That view is shared by FAA insiders. "The business model has changed. It's now migrated to the bottom-feeders in the air freight industry," said one FAA source. "We need to bring up pilot qualifications to a level that the aircraft demands. And we may see some recommended Service Bulletin and factory maintenance procedures made into ADs."

The MU-2B has been a dream-machine for the plaintiffs' bar for several years. Of the 800 or so aircraft that were built between 1967 and 1985, more than 200 have been involved in incidents or accidents, according to NTSB statistics. The accident rate was particularly bad in 2004 and 2005, with a dozen-plus crashes and 13 fatalities. Overall, its five-year accident rate from 2000 to 2004 was 3.17 per 100,000 flight hours, compared to 1.73 accidents per 100,000 flight hours for that time frame among other popular turboprops, according to Robert E. Breiling Associates. During the same five-year period, the Mitsubishi's fatal accident rate was 1.66 per 100,000 flight hours, or more than triple that of popular turboprops, Breiling asserts. Since the airplane's entry into service 37 years ago, more than 200 people have been killed in MU-2 accidents, trial lawyers say. Those statistics also focused the attention of the FAA on the aircraft. About 400 MU-2B aircraft are still in active service.

To understand how that history impacts fleet values, see this month's *20/Twenty* on page 112.

So, what's wrong, if anything, with the MU-2? The answer depends upon whom you ask. Few aircraft incite such polarized opinions as does the MU-2. The two camps are divided primarily into folks who have flown it or in it for years without incident, and those who have never gotten in one and don't intend to do so under any circumstances.

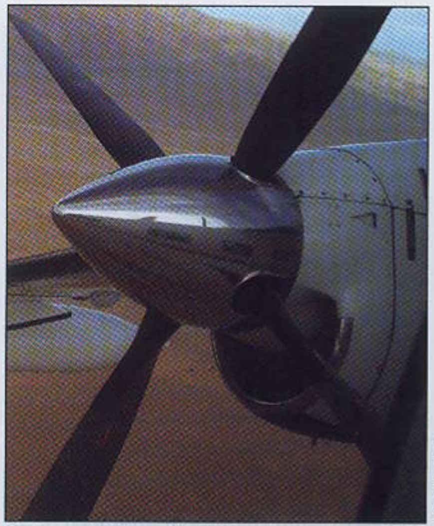
MU-2B Foes

Among the current group of MU-2B foes are several members of the U.S. Congress who have received letters from constituents with relatives who have perished in recent Mitsubishi crashes. Many of these letters request that the aircraft be grounded immediately by the FAA and that a full investigation be launched as to why it's so accident prone. Some of those letters look very much like documents written by trial lawyers because of their precise accident analyses, bar graphs and inclusion of pilots', passengers' and even pets' names for each crash. It's rare that heirs of crash victims independently undertake such thorough accident history research and have access to so many personal details of other crash victims, numerous sources told *B&CA*.

The letter writing campaign nonetheless has been effective. Members of Congress are demanding action from the FAA to ground the aircraft or at least mandate stringent standards for pilot training. The FAA, under pressure from these lawmakers, recently concluded its fourth look at the MU-2B, as we'll discuss later in this report.

"This is a dangerous bird, with an extraordinarily high crash incidence rate. We are not convinced that it's ever been fully tested. I think there's a design flaw in the aircraft," said Terry Van Keuren, constituent advocate for Rep. Tom Tancredo (R-Colo.). Van Keuren said he's had several letters from constituents who are heirs and relatives of people killed in MU-2 accidents in Colorado. He said he doesn't believe the FAA properly evaluated the Japanese-designed and -built aircraft during the initial 1965 type certification, the follow-on 1984 Special Certification Review or the 1997 Fact Finding Focus Special Certification Review related to approval for flight into known icing.

"It has a very thin, high-performance wing. It's the only aircraft in its class with spoilers [for roll control]. It has an inherently wrong fuel system. And a Mitsubishi test pilot was told to lie about its icing vulnerability [sic] in the Rickert [v. Mitsubishi Heavy Industries] case," he said. "It has a disturbing history of icing problems, of prop problems and there's a lot of sneaky stuff going on. Too many things just don't pass the sniff test."



Fred George

Cannon shut down the right engine and we added power on the left engine to maintain 140 KIAS, while trimming the aircraft in roll and yaw. Then we did a series of 45-degree bank turns both away from and into the dead engine.

Van Keuren also said the engines have a tendency to "burp" (lose power) and the NTSB is looking into aircraft problems related to power interruption. Notably, NTSB accident analyses don't appear to in-

Quality Airplane Maintenance Is Critical

Bob Kidd, head of Tulsa-based Intercontinental Jet Corp., has no illusions about the painful learning curve associated with the MU-2B's entry into service decades ago. It had multiple propeller and prop-coupler failures, a resonant vibration that cracked prop blades and plenty of engine failures. But now the aircraft is a mature design and it's as reliable as any general aviation turboprop — if it's properly maintained.

Fine-tuning the flight idle fuel flow and prop governor performance is high on Kidd's list of must-do maintenance items. He believes that Honeywell (nee Garrett Aviation) Service Information Letter P331-141 that describes adjusting the functioning of the prop governor in relation to both the underspeed and overspeed fuel governors needs to be made an Airworthiness Directive. Every time work is performed on a propeller, prop governor, engine or fuel control, a post-maintenance flight check should be done to check proper flight idle fuel flow and torque, along with prop blade angles.

Kidd also believes the FAA should issue an AD requiring a specific procedure to rig the flaps and check for proper flex shaft and worm-gear box functioning. If the system is out of adjustment, the flaps can bind and/or extend/retract asymmetrically. That can degrade lateral control to the point at which the aircraft becomes dangerous.

Honeywell issued a mandatory Service Bulletin requiring that prop shaft couplers be replaced with modified versions that are more robust. Kidd believes this SB should be made an AD to prevent the possibility of prop coupler failure, an event that has caused some fatal accidents according to NTSB records.

Early aircraft have three-piece wings. The outer sections are attached with hardware fittings, including barrel nuts that should be inspected, if not replaced, at 7,500-hour intervals. This maintenance requirement is often overlooked by some MU-2B operators, according to Kidd.

There's also a one-time inspection requirement to check for indications of tiptank bracket overload. Kidd claims that two-thirds of the fleet has never undergone this critical inspection.

But he was quick to add he believes that the vast majority of MU-2B accidents are caused by pilot error, especially if folks don't abide by AFM procedures.

dicate that the aircraft has an abnormally high, unexplained engine failure rate.

He also claims the aircraft provides very little stall warning. "There's even a warning in the Flight Manual," Van Keuren pointed out, in reference to Mitsubishi's caveat about fully stalling the aircraft with one engine providing "lift producing thrust" that could cause a "rapid rolling and yawing motion." He did not mention that this would be an unsafe maneuver in virtually any other high-performance twin turboprop. It's useful to note that the same section of the Pilots Operating Manual also states that the aircraft's stall characteristics are "conventional in all configurations" and that a stick shaker warns of the impending stall four to nine knots above stall speed.

"The airplane is just unsafe. Rep. Tancredo wants the aircraft grounded or for the FAA to follow Mitsubishi's recommendations for pilot training," said Van Keuren.

Although a former U.S. Air Force B-52 pilot with extensive flying experience, Van Keuren admitted he's never flown the MU-2. So when questioned on technical details, rather than respond, he suggested *B&CA* contact Robert Cadwalader, an 11,000-hour former Part 135 pilot and columnist for the *Atlantic Flyer*, a regional general aviation publication. Van Keuren claimed that Calwalader was a leading industry expert on the airplane. However, when we contacted him, Cadwalader said he'd not flown the aircraft extensively and later clarified that to say all of his MU-2B time was accumulated in an approved flight simulator. Nonetheless, Cadwalader is cited by some trial lawyers as an authority on the aircraft. They quote from his numerous columns in which he has criticized the aircraft extensively.

"It simply doesn't matter how good a pilot is — if he loses power at low altitude [in an MU-2] he is going to crash," Cadwalader asserted in a recent issue of *Atlantic Flyer*. "An MU-2 with one engine out is a very, very dangerous airplane and it can go out of control without the pilot being able to stop it."

When pressed for specifics, Cadwalader told *B&CA* that his accounts of the aircraft were "apocryphal" rather than statistically based. He asserts, for instance, that the NTSB mentions engine failure or power loss due to undetermined reasons. Engine failure indeed has been a contributing factor in many fatal MU-2B crashes, but the NTSB has named it as the probable cause only in a handful of incidents. In most engine failure events that led to fatal accidents, the NTSB has placed primary blame on pilot error, according to our review of NTSB accident statistics. The Safety Board investigator leading the review of the December 2004 crash of an MU-2B-60 at Denver's Centennial Airport, for instance, told *B&CA*, "Certainly, that aircraft is very capable of flying single-engine. Granted, you need to be on top of the airplane and very attentive to airspeed [control]."

Cadwalader also claimed the FAA never retested the aircraft adequately during the 1984 Special Certification Review. He said the FAA's pilots never flew it outside of the flight envelope published in the Approved Flight Manual but offered no proof of that assertion.

He also claimed that the original FAA certification of the MU-2 was tainted by the State Department's putting political pressure on the FAA on behalf of the Japanese, who became a strong U.S. ally during the early years of the Cold War. That assertion was hotly contested by FAA insiders who consider that statement an indictment of their professionalism.

Cadwalader further notes that plaintiffs' representatives are not allowed "to witness or be involved in" MU-2 accident investigations. But as a matter of practice, the NTSB and FAA only invite representatives of the accident aircraft's airframe and engine manufacturers, plus a few other select parties with a vested interest in the aircraft or operation, to participate in the investigations. The NTSB often requests assistance from manufacturers to expedite fact finding but limits their participation and normally bars their contact with witnesses. Cadwalader views this exclusion of trial lawyers and plaintiffs as a cover-up.

During the interview Cadwalader made several references to observations by Donald Kennedy, Ph.D., a retired aerodynamics professor from the University of Colorado at Boulder — and now based in Kihei, Maui, Hawaii. As it turns out, Kennedy is frequently called as an expert witness in aviation litigation cases on behalf of the plaintiffs' bar.

In one expert opinion letter about the MU-2B written for a Denver-based trial lawyer, Kennedy cites 37 reference documents and comes to several adverse conclusions about the aircraft. One opinion is that the aircraft fails to meet FAA standards for controllability, based upon its high accident rate and wing loading, which, he wrote, is "well beyond the prudent standards of aircraft design . . ." Kennedy also opined that the "choice of spoilers for roll control in a light aircraft is a defective design and an unusual application." Yet a third opinion is "the choice of airfoils for wing and horizontal tail surfaces were chosen to reduce drag at the expense of poor stall characteristics in icing conditions. . . ."

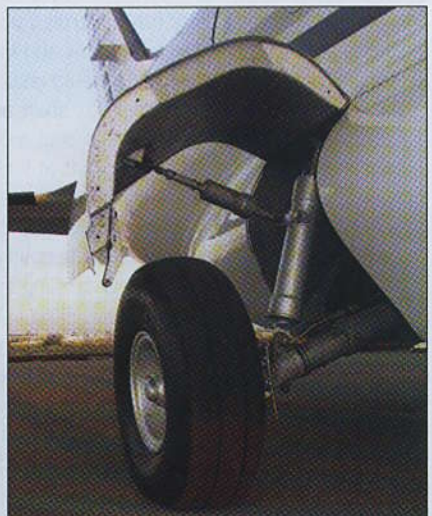
These opinions are in direct contrast with the FAA's conclusions in the original and two subsequent special certification reviews of the aircraft. Agency officials said that there's "nothing wrong" with the MU-2B's fundamental design and that it meets or exceeds all type certification standards that were in effect in 1965 when it was undergoing its certification trials. One former NTSB investigator said Kennedy was trying "to rewrite the laws of physics".

However, trial lawyers have prevailed in numerous MU-2B product liability cases.

Generally, they question the FAA's competence in approving the MU-2B and insist that the FAA's initial certification and subsequent certification reviews were inadequate. NTSB conclusions, according to them, are equally suspect. And they hold that any caveat in the Approved Flight or Pilots Operating Manuals warning pilots

Fred George (2)

Nosewheel steering linkage must be disconnected for towing. Don't forget to replace the quick release pin in the scissors link before start.

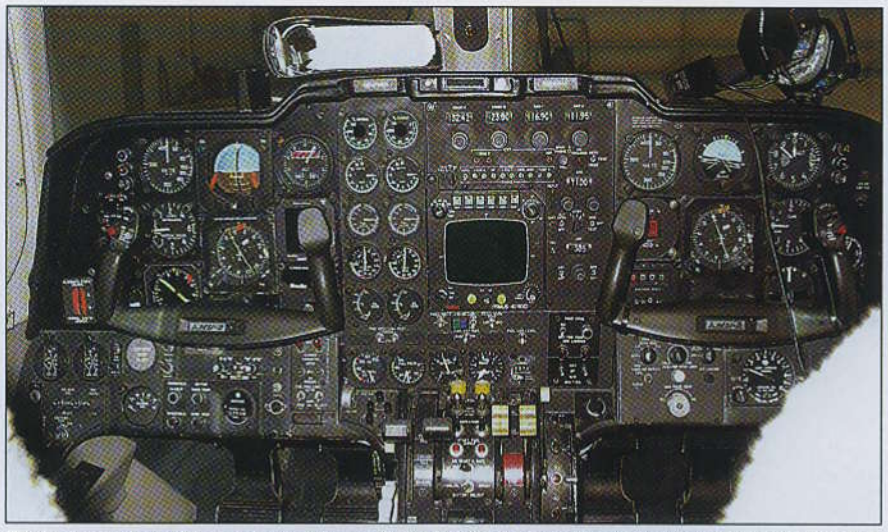


The main landing gear are beefy, well-suited for rough field operations. On long-body models, they're positioned 16-inches aft of the c.g.

not to venture outside the published flight envelope is a tacit admission by Mitsubishi Heavy Industries that the MU-2B is inherently unsafe.

When interviewing the aircraft's critics, we heard lots of hyperbole such as "when you use a [roll] spoiler, you lose all lift on that wing;" and "the MU-2 lacks the controllability at slow speed during single-engine operations;" and "below 153 knots, you can't maintain directional stability if you lose an engine. . . ." We figured we'd find out for ourselves.

But we also concluded that there's no way to change the minds of MU-2B foes if they won't accept a basic level of competency and honesty on the part of the FAA and NTSB in the first place.


Alex McMahon

The instrument panel is very busy with gauges, switches, knobs and controls, just as one expects from a mid-1960s vintage airplane design.

MU-2B Friends

We spoke with several experienced MU-2B pilots who strongly dispute the opinions expressed by the aircraft's detractors. None believe exceptional piloting skill is required to fly it safely. But none had any illusions about the need for vigilance in the cockpit, the mandate to operate the aircraft within the flight envelope and the critical need for comprehensive recurrent training and good maintenance.

John S. "Jack" Broome of Oxnard, Calif.-based Broome Ranches has been flying MU-2B aircraft for more than three decades, accumulating more than 2,700 flight hours in type. He first soloed in 1935, later became a military pilot and airline captain, and he served on the NBAA's board of directors for 20 years. He owned and operated Beech 18s for 27 years before buying his first MU-2B in 1973. He hasn't had an accident in 70 years of flying.

He has forceful opinions about the MU-2B allegedly being unsafe. "Going back years ago, folks said the same thing about the V-tail Bonanza, Learjets and Aerostars." He puts prime importance on being a competent, well-trained pilot. "People can get out of a Cessna 310, legally step into an MU-2B and say 'I don't need any training.' Then they get themselves into trouble." That results in accidents, which in turn, drive down resale prices and drive up insurance premiums.

"There are lots of good airplanes out there, but this one will do 300-plus knots on 80 gallons per hour. It will also slow down to 120 KIAS on approach. There's just no way to get into trouble with the airplane if you fly it by the numbers. For example, I don't use full flaps until I'm over the fence and slowing to final landing speed. I don't want any surprises; I'm too old for surprises," he said.

Broome insists on undergoing rigorous recurrent training and has high praise for Mitsubishi's Pilot Review of Proficiency (PROP) training program. "That makes the best pilots out of MU-2 pilots," he said.

A veteran pilot with thousands of hours in DC-3s, DC-4s and Beech 18s, Broome claims that each of those aircraft was considerably more difficult to fly than the MU-2B. "I've had 'memorable landings' in all those aircraft," he said, "but I've had no memorable landings in the MU-2."

He thinks the MU-2B is a "pussycat' and he wouldn't sell the aircraft unless he couldn't fly it. Now 88, Broome still flies his current MU-2B regularly.

Col. Frank Borman, the former Apollo astronaut, flew three models of MU-2B aircraft during a 15-year period, accumulating a total of 3,500 hours flight time.

"They run very, very well and they're most robust, built like military airplanes," he told *B&CA*. "It's a solid, honest airplane."

Borman said he underwent FlightSafety recurrent training yearly while operating the MU-2 and attended the Mitsubishi-sponsored, three-day PROP course. He believes other MU-2B pilots should do the same, but that most just don't get enough training. "If you're a relatively new multi-engine pilot, if you lose an engine you'll have your hands full."

The Las Cruces, N.M., resident believes that the recent pressure from certain congressmen to force grounding of the aircraft is totally unwarranted. "I don't understand the criticisms of the aircraft. It went through two FAA certification procedures, plus the most extensive flight into known icing approval I can remember."

Jack Jaax, an experienced, former Part 135 MU-2B charter operation owner and chief pilot, echoed these comments. "It's a great airplane, mechanically and it has a high build quality. But you need to fly it by the numbers." Jaax flew the MU-2B on air ambulance and charter missions for several years in the Southern California area. Well-known in San Diego, Jaax recently sold his MU-2B charter operation and now flies a locally based Beech King Air F90 for its owner.

Don Taylor, vice president of training at Eclipse Aviation, owns an MU2B and says he "really likes the airplane. It's fast, extremely well built and the pressure vessel is really tight. It's 15 knots faster than a Twin Commander with the same engines."

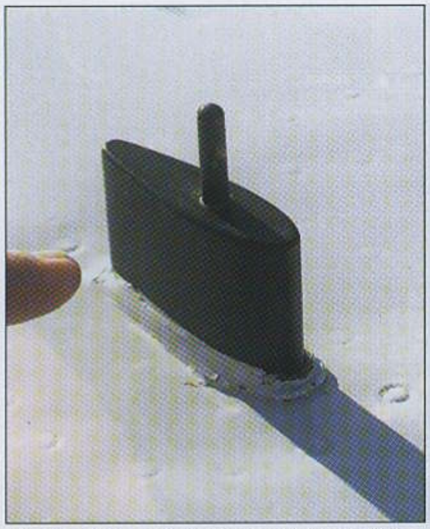
Having logged about 325 hours in the aircraft in less two years, Taylor admits it flies differently than airplanes with aileron roll control. He said it's a "little disconcerting" in that it has a slight tendency to keep rolling in a turn, lacking the spiral stability of some other aircraft he's flown.

"I think the main issue is training," said another experienced MU-2B pilot. "So many accidents have occurred in the Part 135 community among those who haven't had formal training. It's all done in house. You need frequent proficiency training in this aircraft and it needs to be standardized."

This pilot said he lost an engine on climb-out leaving a Philadelphia area airport. "It was a non-event. The engine went 'whoosh' and NTS [negative torque sensing] reduced the prop pitch. I checked the torque gauge and feathered the engine."

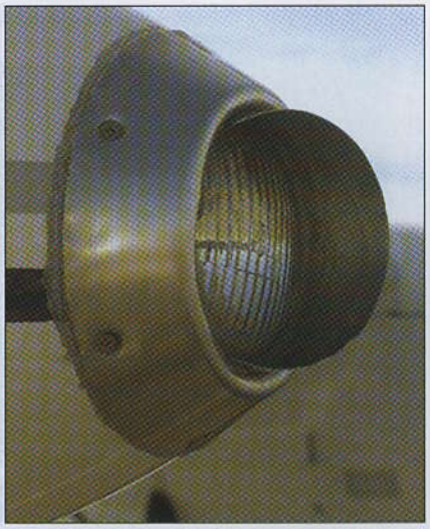
The same pilot said the aircraft has somewhat of a split personality.

"It flies like a Patriot missile with the flaps up and a Cessna 172 with the flaps down." At MTOW, for instance, the Marquise stalls at 105 KIAS in the clean configuration, but only 87 KIAS with flaps set to 20 degrees. Its 64000-series NACA airfoil also doesn't provide much aerodynamic stall warning, thus the need for a stall warning

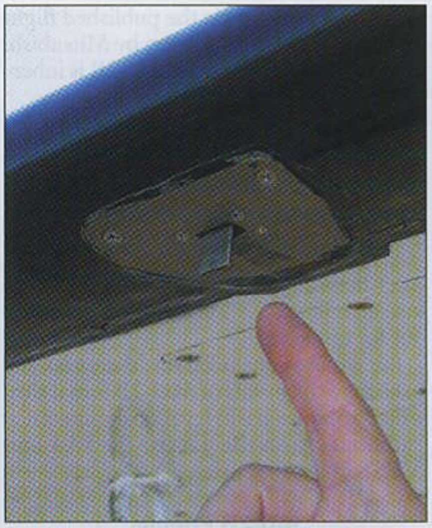


Fred George (3)

An optional ice detector is a must, in our opinion. It provides the crew timely warning about impending ice accretion so that ice protection systems can be used effectively and an exit strategy can be executed.



Ice buildup on the leading edge of the landing light shield glows through refraction when the light is illuminated at night.



The stall detector on the right-wing leading edge is linked to the stall-warning stick shaker.

stick shaker, a safety device commonly fitted to many jet aircraft.

Experienced MU-2B pilots emphasize the need to stay ahead of the aircraft, particularly in the Window of Risk associated with takeoff and landing.

"Fly it with your left hand and think with your right hand," one cautioned. "On departure, don't make any turns until you get it cleaned up." Gaining altitude is critical, the old pros say. Several cautioned to keep the flaps extended until reaching 400 feet agl and never touching the flap switch in a turn. They also said that it's very important to get the gear up as soon as a safe landing cannot be made and you've established a positive rate of climb.

Flying stabilized approaches is equally important. Allow yourself ample distance to get configured and stable, they recommended. Once you get the gear down and flaps to 20 degrees on approach, 120 KIAS comes up quickly. You can't afford to get distracted, especially on "black hole" approaches. Concentrate on the basics. Fixed shaft turboprop engines can cause some inexperienced MU-2B pilots to confuse the sound of high prop speed with high power, according to Broome. Airspeed control is especially critical.

The consensus was clear from all with whom we spoke. Fly the MU-2B as you would a jet, they advised. Use the same operational protocols, fly it by the numbers and fly it with discipline.

"Amateurs should not be flying the airplane, " said William Seaman, chief pilot at Flightpath Aviation.

And yet, Dick Allan of Internet Jet Sales says the MU-2B's jet-like performance pulls them in, attracting "people who don't belong in it." He describes this group as "a very odd set of pilots — the fire eaters, the sword swallowers and the lion tamers. All of them are like bent nails in a can in your garage. When you need some, you look for the least bent ones and then try to straighten them out before you can use them."

We Fly the MU-2B-60

In late December 2005, Tom Berscheidt, president of Dallas-based Turbine Aircraft Services (TAS), invited *B&CA* to fly a 1980 MU-2B-60 Marquise, s.n. 794, accompanied by chief pilot Pat Cannon. TAS is under contract to Mitsubishi Heavy Industries to help support the MU-2 and specializes in sales, service and parts for the aircraft. It is closely associated with both Mitsubishi and Simcom and is a co-sponsor of the PROP seminars.

Our mission profile consisted of a normal VFR takeoff from San Diego-Montgomery Field, a climb to 7,500 feet for air work over Borrego Springs and then a series of normal and simulated one-engine-inoperative (OEI) takeoffs and landings at Thermal's Jackie Cochran Field.

Cannon started the preflight briefing by showing us a number of inflight video clips that help dispel common misconceptions regarding the aircraft. First, MU-2B foes often say that Mitsubishi's use of spoilers for roll control causes the entire aircraft to drop when one deploys, rolling the aircraft about the centerline of the upwing tiptank. The video, though, shows clearly that the aircraft rolls crisply about its longitudinal access with virtually no adverse yaw.

Another video clip disproves the naysayers' assertions that the aircraft is uncontrollable at low speed with flaps extended and OEI. The sequence was shot at 5,000 feet agl, with the landing gear down, flaps extended to 20 degrees and aircraft stabilized and trimmed at 120 KIAS. One engine then is suddenly shut down. This is accompanied by a momentary yaw and a slight roll into the dead engine. The pilot them trims and stabilizes the aircraft while increasing power on the operating engine to 100 percent torque. The aircraft remains fully under control. A gradual climb is achieved at 125 KIAS at a mid-range weight.

After landing gear retraction is initiated, the opening of the gear doors causes a 50- to 100-fpm decrease in climb rate. Once the gear are fully retracted, though, the climb rate increases substantially and the aircraft begins to accelerate. The flaps are retracted to five degrees at 140 KIAS, then fully retracted as the aircraft reaches 150 KIAS. The pilot then accelerates to 154 KIAS, the best rate of climb speed at MTOW.

Video clips also show the aircraft is fully controllable during symmetric power stalls, with no tendency for wing roll-off at the stall break.

Cannon explained that we would repeat some of these maneuvers during the demonstration flight, but at no time would he allow the aircraft to be operated outside of the approved flight envelope. With that we readily concurred.

The external preflight of the MU-2B is conventional. Along with the usual fluids, pressures and integrity checks, though, it's essential to check that the props are set at zero pitch, frozen in position on the start locks. This assures minimum drag on the fixed-shaft engines during start. It's also important to extend the flaps and check the rigging. The MU-2B has one flap motor and a series of interconnected shafts and flex cables that drive flap jack worm screws. To ensure proper operation, the flaps must extend symmetrically and exhibit no evidence of binding.

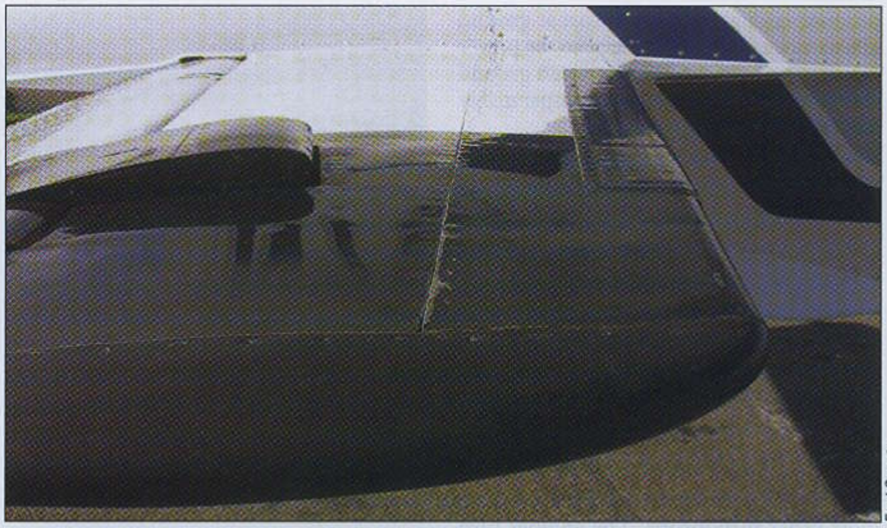
Checking the fuel caps can be a challenge. Tall pilots, flying the long body models, can step on the main doorsill and peer over the wing to make sure the caps are secure. We prefer, however, to use a short ladder to get a close-up view and tactile confirmation of the fuel caps' being secured. Folks flying short body models must use a ladder because the entry door is under the wing.

Cannon mentioned that it's also important to check operation of the tiptank recognition lights, if the aircraft will be flown at night and in icing conditions. The light shields collect ice quickly if icing conditions are encountered. The tiptank lights make it easy to see the ice accumulation, thereby warning the crew in time to activate ice protection systems and execute an exit strategy from the adverse weather. The aircraft we flew also was equipped with an optional ice detection system, an addition we strongly recommend on any business aircraft operated in icing conditions.

After a rash of icing-related accidents in the early 1990s, the MU-2B underwent a thorough Fact Finding Focused Special Certification Review of its approval for flight into known icing (FIKI) conditions. After a full series of ice shape tests and also supercooled large droplet (SLD) icing tests flown behind a water-spray tanker, the MU-2B was shown to be fully qualified for FIKI by the FAA. However, Mitsubishi added caveats to the flight manual that actually apply to any aircraft flown in icing conditions: Maintain minimum recommended speed, ask for priority handling by ATC to exit the conditions without delay, avoid abrupt control movements, don't lower the flaps and don't use the autopilot.

Serial number 794 had an empty operating weight of 8,260 pounds. With two crewmembers, the BOW was 8,660 pounds. Filled with 1,900 pounds of fuel, the ramp weight was 10,560 and our computed takeoff weight was 10,500 pounds. Using the flaps 20 degrees takeoff configuration, the all-engine takeoff distance was 3,000 feet based upon the airport's 423-foot elevation, ISA+3°C OAT, 30.02 altimeter and calm winds. Cannon recommended using a 102 KIAS rotation speed, three knots above VMCA. This was two knots faster than the book value for VR.

Many useful charts have been eliminated from newer MU-2B manuals. The original books provided accelerate-stop distance charts, OEI takeoff distance charts for flaps five degrees and 20 degrees, and maximum takeoff weight limited by OEI climb requirements. The FAA directed those charts be removed from the manuals because they



Fred George

The horizontal tail actually is an upside-down wing. It's very effective and it has been proven to be highly resistant to ice contaminated tail-plane stall during the FAA's icing-related fact-finding focused special certification review in the mid-1990s.

did not conform to the GAMA standard and involved "demonstrated" data as opposed to "approved" data. In our opinion, those charts should be restored to the AFM. They provide useful information to pilots, even though they're not required for certification of this class of aircraft.

The new manuals, though, do provide OEI climb performance data for the gear up, flaps retracted configuration. Assuming the same conditions for our departure from San Diego-Montgomery Field, our climb rate at 10,500 pounds would have been 650 fpm on one engine with gear and flaps retracted. Experienced MU-2B pilots told *B&CA* that the aircraft will climb satisfactorily at flaps 20 degrees under those conditions, but only if the landing gear are retracted. If an engine fails at rotation, "and continued flight is not possible," the AFM advises pilots to "land straight ahead."

In lieu of providing such OEI takeoff data, the AFM now warns "continued climb performance is not assured unless the landing gear are completely retracted, the gear doors are closed and the flaps are at five degrees or less." Experienced pilots told *B&CA* that this caveat is very conservative. They said that if the aircraft will climb at 400 to 500 fpm in the clean configuration it will also climb satisfactorily at flaps five degrees or 20 degrees, assuming the landing gear are retracted.

Pre-start and pre-taxi procedures in the MU-2B aren't as simple as they are in most modern light jets. The MU-2B cockpit is very busy. This is a Learjet 23-era design airplane and its systems are characteristic of the mid-1960s. The instrument and side panels seemingly are stuffed with as many switches, buttons, indicator lights and gauges as a 1960s vintage military airplane. The voltage of each battery, for instance, must be checked individually by using isolation switches. Nickel cadmium batteries are standard and they're recommended for cold weather operations because of their superior starting power. The aircraft may be fitted with lead-acid batteries for operations in more temperate conditions.

AC inverter power is required for fuel and oil pressure indications, fuel quantity indication and several analog avionics functions, so one inverter must be operating prior to engine start. Stall warning systems must be checked, along with fuel low level and empty aux tank indicators, boost and transfer pumps, prop feather valve and NTS functions. It's important to note that most of these checks must be performed in any TPE331-powered turboprop of that era, so the MU-2B isn't much more procedure intensive than a Cessna 441 Conquest, Merlin, Cheyenne 400LS or Turbo Commander.

We'll skip most of the preflight details, but it's reasonable to assume that pilots new to the MU-2B will spend several minutes in the chocks running the various start and pre-taxi checks. The Mitsubishi is a noisesome machine externally and internally (also characteristic of its era), and active noise attenuating headsets are recommended.

With the condition levers in the taxi (minimum rpm) position, prop speed is about 72 to 74 percent of maximum. Before taxiing, the condition levers must be set to maximum rpm and the power levers must be pulled aft from ground idle toward reverse pitch to release the prop blade start locks. This allows the props to increase pitch and produce forward thrust. Off the start locks, the condition levers are returned to taxi. A properly set-up MU-2B won't produce enough forward thrust at ground idle to move out of the chocks, so the power levers must be positioned between ground and flight idle to roll, even at comparatively light taxi weights.

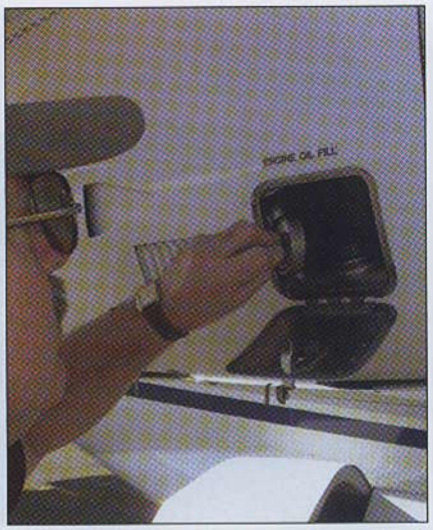
The MU-2B has excellent wheel brakes and somewhat sensitive, direct-link nosewheel steering. The steering design allows the aircraft to be taxied on one engine, if necessary, for repositioning on the ramp.

Once cleared for our VFR departure, we advanced the condition levers to the takeoff/landing [maximum rpm] position and switched on auto ignition to assure a relight in the event of a non-mechanical engine failure. We advanced the power levers to 90- percent torque. Ram rise during takeoff roll increases torque to 100 percent. We noted that P-factor induced yaw is opposite most other turboprops. The engines turn clockwise, but the props turn counter-clockwise resulting in a right yawing moment with increasing thrust. It takes very little pressure on the rudder pedals to counter this yaw because of the effective nosewheel steering. But it takes some practice to reverse old rudder-vs.-thrust-change habit patterns.

Rotation forces at 102 KIAS were considerably heftier than in some turboprops because the main landing gear are well aft of the center of gravity. Minimum rotation speed in the Marquise is never less than 100 KIAS because VMCA is 99 KIAS. Initial pitch force is much heavier in short body models because the horizontal tail is closer to the c.g. and the main gear are much farther aft of the c.g. With weight off the wheels, pitch force was much lighter and we had to take care not to over rotate beyond the recommended eight-degree nose-up attitude. The aircraft quickly accelerated through 120 KIAS.

With a positive rate of climb, we retracted the landing gear. That's a comparatively long process. It takes about 14 seconds for the first 10, and the drag from the gear is considerable. After the gear were fully retracted, the aircraft rapidly accelerated to 150 KIAS and we retracted the flaps. As the large area Fowler flaps retract, it's necessary to increase pitch attitude by four degrees as the flaps move from the 20 degrees to five degrees position. Then pitch attitude must be increased by another four to five degrees as the flaps retract from five degrees to flaps up. Think Falcon 10, in terms of flap position vs. pitch attitude characteristics.

We began an eastward VFR departure and reduced power without delay to maintain 200 KIAS below the floor of San Diego's Class B airspace. Once clear to the east, we climbed to 7,500 feet and rapidly accelerated to 250 KIAS, the aircraft's VMO.



Checking the oil level is easy on preflight. Oil pressure, supplied either by the engine's oil pump or aux electric pump, drives the propeller to lower pitch, overcoming spring force in the hub. Relieving oil pressure allows the spring to drive the prop to lower pitch or feather.

Checking the aircraft's handling qualities, we were surprised by the almost total lack of rudder input needed to maintain coordinated flight when rolling left and right, even with full control wheel deflection. The spoilers prevent virtually all adverse yaw, but lateral control forces are considerably heavier than in most turboprops that use ailerons for roll control.

We slowed to 180 KIAS, the Simcom recommended speed for steep turns. Setting about 60 percent torque, we rolled into a 45-degree left turn, then a 45-degree right turn. The pitch force required to maintain altitude was moderate.

The demo profile next called for an approach-to-stall series. We again noted a conservative warning note in the AFM that says "Up to 560 feet of altitude loss can be expected in recovery from a full stall." We reduced torque to 20 percent. As we slowed the aircraft in the clean configuration at a weight of 10,200 pounds, we trimmed to about 130 KIAS and then just maintained altitude with increasing back pressure on the yoke, decelerating at about one knot per second. At 100 KIAS, the stick shaker activated. We added thrust and recovered with no loss of control along with very little altitude loss.

We then set up for an approach turn stall by extending the flaps 20 degrees and trimming to 120 KIAS. Again we noted the need for eight to 10-degrees nose-down pitch change as the flaps moved from clean to 20 degrees. We rolled into a 20-degree left bank, reduced power and slowly decelerated. When the stick shaker fired at 83 KIAS, we leveled the wings, added thrust and flew out of the maneuver. Again the aircraft suffered no loss of composure and lost just 50 to 100 feet of altitude.

So what about that caveat about losing 560 feet when recovering from a full stall? Later in the flight, we slowed the aircraft in the clean configuration until the stick shaker fired and then just continued to increase back pressure on the yoke. As one expects in an aircraft with a 64000-series wing, there was very light airframe buffet prior to the full stall, highlighting the need for the artificial stall warning system. At the full stall, the nose started to rock and then fall. We persisted in holding back on the yoke. There was a little wing roll that was easily countered with opposite roll spoiler. We held back on the yoke and kept the aircraft fully stalled for several seconds, maintaining wings level with roll spoiler control alone, but being careful to keep the ball in the center with rudder control.

The aircraft's stall behavior reminded us of a Falcon or a Learjet 45. We could not make it lose its composure during the maneuver. However, when we've attempted the same maneuver in some other popular, aileron-equipped turboprops in the past, we experienced considerably more exciting results. Abusing aircraft with NACA 23000-series wings during stalls just invites the onset of a spin.

Recovery from this maneuver in the MU-2B, in contrast, consisted of reducing angle of attack and adding thrust. And, yes, we lost 500-plus feet during the recovery because of the abuse we heaped on the airplane. But it never bit back with a nasty surprise. It's too bad that we didn't have time for a full stall series with the flaps extended to various positions.

Cannon then demonstrated the effects of losing an engine in flight. While we flew the aircraft at 150 KIAS, he switched the run-crank switch to the off position. The negative torque system responded by reducing prop pitch on the affected engine until the prop was slowly windmilling. There was momentary yawing as NTS caught up with the power failure. Cannon pulled the condition lever to feather, which caused the blades to streamline. He also moved the power lever to maximum, the procedure called out by the AFM. This ensures that all oil pressure is relieved from the prop controller and that the spring in the hub fully feathers the blades.

We trimmed the aircraft hands off first by using the trim ailerons to neutralize the need for roll spoilers and then by using the rudder trim to eliminate the need for asymmetric rudder pedal pressure. It's important to trim the aircraft in roll because a deployed roll spoiler will reduce climb performance by 100 to 150 fpm. It's also important to keep the ball in the center, maintaining coordinated flight. Failure to do so results in substantial roll into the dead engine. Cross controlling the aircraft with roll spoiler and not enough rudder during engine-out maneuvers just ruins its climb performance.

We slowed the aircraft to 140 KIAS and performed a series of steep turns both away from and into the dead engine. We added sufficient thrust to maintain speed in a 45-degree bank turn into the dead engine and found no loss of composure, no controllability difficulties.

We then headed to Thermal for pattern work and Cannon restarted the right engine. Cannon positioned the stop-run-crank switch to "run" to arm auto-ignition and fuel flow. Air start must be done by windmilling the engine because the electric starter could never overcome the airloads of a feathered prop on a fixed shaft engine. The condition lever, when moved from "emergency stop [feather]" to "taxi," has no effect on prop pitch because without the engine turning, there is no oil pressure for prop control.

TPE331 engines, as a result, have an "unfeather" function that requires use of an auxiliary electric oil pump. When activated, the pump ports oil pressure to the prop, thereby reducing pitch and causing it to windmill, assuming the condition lever is in the "taxi" to "takeoff" range. The unfeather switch must be held until the engine windmills to 30 percent rpm. As light-off occurs, the engine will continue to accelerate, start to generate oil pressure and drive the prop to the desired position. As thrust is restored, again trimming the aircraft in roll and yaw is imperative. The MU-2B is a trim-intensive airplane, one that rewards precise pilot technique and one that doesn't tolerate sloppy airmanship.

We set up for a left base and straight-in approach to Runway 35 at Thermal at a weight of 10,000 pounds. Based on using flaps 20 degrees, the computing landing distance was 2,750 feet, assuming a 1.3 Vs landing speed. The first landing was flown at 20-degrees flaps at a speed of 120 KIAS on approach, using about 20 percent torque, until we approached the airport boundary. We slowed to the 105 KIAS VREF over the threshold and reduced power to flight idle. The engine fuel flows and prop pitch of this airplane were fine-tuned by Tulsa-based Intercontinental Jet Corp. and they were spot on. Each engine stabilized at 17 degrees torque, very close to zero thrust. The aircraft settled down to the runway with the aplomb of a light jet.

At touchdown, we increased back pressure on the control wheel smartly to prevent the nose from slamming down, moved the power levers to ground idle and flew the nosewheel down to the surface. At that point, we moved the power levers to reverse and the aircraft slowed to taxi speed.

Taxiing back to Runway 35, we flew a second circuit to a full stop, this time using flaps 40 degrees for landing. The aircraft pitch attitude is considerably more nose down using this flap configuration and, ironically, AFM approach speeds actually are higher than at flaps 20 degrees because the book requires use of a 1.5 Vs landing speed. The net result is virtually the same landing distance because the additional drag slows the aircraft quickly in the landing flare with power to flight idle.

Our next takeoff was at flaps five degrees. Cannon said we would "lose" an engine on departure. On takeoff, we rotated at 105 KIAS, about four knots above the recommended AFM speed and accelerated to 120 KIAS. At about 100 feet agl, about 10 seconds into gear retraction and with all gear doors open, Cannon pulled back the right engine power lever to flight idle. We responded by pushing hard on the left rudder and countering the wing roll with spoiler. OEI climb performance indeed was sluggish until the landing gear fully retracted. It then improved to 300 to 400 fpm while we used differential trim aileron to eliminate the need for roll spoiler input and put in plenty of rudder trim to counter pedal pressure. After the aircraft was fully trimmed, it climbed at 400 to 500 fpm and continued to accelerate. At 150 KIAS, we retracted the flaps completely and continued to accelerate to the 154 KIAS blue line, best OEI climb speed. Climb rate exceeded 650 fpm at that point. Meanwhile, we were quite busy retrimming the airplane in pitch, roll and yaw during the level-off and subsequent asymmetric power reduction.

Continuing with the simulated OEI emergency, we flew downwind, delaying extension of gear and flaps to 20 degrees until we were on extended base leg. We turned to final, slowed to 120 KIAS and made the commitment to land. Landing technique was almost identical to the all-engine landing, as we slowed to 104 KIAS over the threshold. Light use of prop reverse and plenty of differential braking and rudder to counter the resulting yaw moment kept us near centerline as we slowed to taxi speed.

Cannon positioned the flaps to 20 degrees for another simulated OEI departure. We used the same takeoff technique and speeds. Cannon pulled back on the right engine power lever at 100 feet agl about 10 seconds into the gear retraction cycle. OEI climb performance was lackluster, but controllability was excellent. Once the landing gear were fully retracted, the aircraft climbed at 200 to 300 fpm as we accelerated to 140 KIAS. At that point we retracted the flaps to five degrees, rotated four more degrees nose up and climb performance increased to 500 fpm. At 150 KIAS, we cleaned the wing and accelerated to blue line.

With all engine power restored, we headed to San Diego-Montgomery at redline. SOCAL approach gave us priority over other arriving aircraft because of our speed advantage. We touched down one hour, 37 minutes after departing Montgomery Field.

Risky Airplane or Risky Pilots

Few multiengine airplanes we've flown demand more skill and proficiency than the MU-2B. The Learjet 23, Citation X,

The wings are relatively short and thin. Twin tiptanks that feed the main 154 gallon (1,032 pound) wing tank increase fuel capacity by 180 gallons (1,206 pounds). Aux wing tanks, outboard of the engines, add another 69 gallons (462 pounds) for a total usable capacity of 403 gallons (2,700 pounds).

Fred George

Crownair's Devin Funderburg and Greg Scott refill the main tanks. The aux tanks and tiptanks must be refilled separately, if needed. Pilots need to check all six fuel caps on preflight inspection.

CRJ700 and Saab 2000 readily come to mind as similarly demanding aircraft, but to fly as PIC in any of them one needs type ratings and annual proficiency checks.

While the MU-2B is more demanding to fly than most business aviation turboprops, we encountered no nasty surprises or untoward handling qualities in any part of the low-speed flight envelope, with one or both engines operating, during our brief demo flight. We never had to assume the role of fire-eater, sword swallower or lion tamer — or experimental test pilot — to keep the MU-2B-60 under control. We concentrated on directional control, airspeed control and trim control while closely following AFM procedures, under the watchful eye of Cannon.

Aircraft performance, though, was severely degraded when flown out of trim during simulated OEI operations. Trim this machine in all three axes in any regime, so that it will fly hands off, and it will perform better than most general aviation turboprops at both low and high speeds, on one or two engines.

It's critical that the aircraft be properly maintained, specifically regarding rigging of the engines, props and NTS functions. If NTS fails to function properly during an engine failure after liftoff, the aircraft could be quite a handful to control until the condition lever of the affected engine is moved to the emergency stop (feather) position. This is another reason why the pilot must perform the NTS ground checks every day before the first flight.

Single-engine takeoff and climb performance in the MU-2B is naturally limited by weight, altitude and temperature. Assuming standard day conditions, if you depart at MTOW, using either flaps five degrees or 20 degrees and lose an engine at 125-plus KIAS with the gear retracted, you're virtually guaranteed a satisfactory OEI climb rate while the aircraft accelerates to the 150 KIAS flap retraction speed.

Below 125 KIAS and with gear down, you may have to pull back the power, slow to 105 KIAS and land straight ahead. Old pros say you'll need 4,500 to 5,000 feet of runway to stay on the pavement if you lose an engine just after liftoff and abort the takeoff.

Departing *B&CA*'s 5,000-foot elevation, ISA+20°C airport, we recommend loading the Marquise to no more than 10,250 pounds and using the flaps five degrees configuration to assure a positive OEI rate of climb once the gear are retracted. Under these conditions, the MU-2B should climb at 500 fpm on one engine after accelerating to 150 KIAS and retracting the flaps, according to the AFM. But if the aircraft suffers an engine failure with the gear down or in transit, you may not be able to maintain a positive rate of climb, especially since it takes 14 seconds for the gear to retract completely. Again, plan on maintaining directional control and land straight ahead if the aircraft won't climb on one engine.

With all engines operating, gaining altitude is more important than accelerating, according to experienced MU-2B pilots. Get the landing gear up with a positive climb rate and when you're out of runway, they say. The AFM recommends climbing at best all-engine rate of climb speed, using 120 KIAS for flaps five degrees and 113 KIAS for flaps 20 degrees.

VYSE speeds are increased respectively to 140 KIAS and 135 KIAS, according to the AFM. If an engine fails after you've reached 400 feet agl, it's a lot easier to trade a little altitude for airspeed to accelerate to the 140 KIAS minimum flap retraction speed, the MU-2B pilots suggested. Some MU-2B pilots recommend climbing to 1,000 feet agl before accelerating and retracting the flaps. They also say they never move the flap switch in a turn to guard against flap asymmetry.

The MU-2B has had two Airworthiness Directives related to flight into known icing conditions, but they're not focused on the aircraft. Rather, they're aimed at the pilots. AD 2003-22-07, along with AD 97-20-14, which it supersedes, requires specific pilot training before they fly the aircraft into known icing conditions. The latest AD requires pilots to view a video that contains critical information on how to recognize the onset of severe icing conditions and how to use ice protection systems effectively. The ADs were issued because of "an increased chance of icing-related incidents or accidents of the MU-2B series airplanes due to *pilot error*" [emphasis added]. Recurrent flight into known icing conditions training is required at 24-month intervals.

Once you've neared your destination, we advise flying approaches in the MU-2B at typical light jet speeds, not typical turboprop speeds. Fly no slower than 150 KIAS with a clean wing. With flaps extended to five degrees, 140 KIAS is the recommended speed. At flaps 20 degrees, use 125 KIAS in the turns and no slower than 110 KIAS on final approach until you cross the runway threshold.

In flight, when the power levers are pulled back to flight idle, the aircraft shouldn't suffer a sudden loss of lift from flat pitch or asymmetric drag. If it does, the props and fuel flows are not rigged properly.

Pilots must truly take command of the MU-2B, especially when it comes to grounding it for maintenance discrepancies. This aircraft can be most unforgiving to those who defer squawks. If you can't afford to fix it, ground it.

Upcoming Mandate for Formal Training

Mitsubishi Heavy Industries has been requesting that the FAA mandate formal training in the MU-2B since the early 1990s, including advocating the need for an MU-2B type rating. But until the recent spate of crashes and resulting pressure from

U.S. Congress, the agency has been reluctant to increase the regulatory burden on operators. A recent analysis of MU-2B fatal crashes, though, indicated that only one or two of the pilots killed successfully completed formal, third-party training.

That's about to change. The most recent review of accidents by the FAA found nothing wrong with the aircraft. Pilot error, in contrast, pointed to a glaring lack of standardized, formalized training. As a result, the FAA convened a Flight Standards Board, under the direction of Johnathon Vetter, in the Wichita Aircraft Evaluation Group, to evaluate the need for better training.

Vetter's FSB team published its draft recommendations on Dec. 16, 2005, using the regulatory guidance of AC120-53, "Crew Qualification and Pilot Type Rating Requirements for Transport Category Aircraft Operated Under FAR Part 121." The upshot is that the FSB recommended airline-quality Level E initial training, such as that normally required for a type rating, for pilots new to the MU-2B. Annual Level C recurrent training, using a specific syllabus, also is recommended. Requalification Level C training should be undertaken by pilots who have flown the aircraft in the past two years, but haven't undergone recurrent training. Differences training will be required when transitioning from certain models of short- and long-body models.

The FSB defines specific requirements for both ground and flight training syllabi, along with areas of special interest and emphasis, such as stall recognition, crosswind landing technique, single-engine operations and flight into known icing conditions.

The FAA's top brass in Washington has made the upgrade of MU-2B training a priority issue. While they're adamant about not making a knee-jerk reaction to the recent pressure from Congress, they do plan to issue a formalized training plan for MU-2B operators by the end of the first quarter of this year. It's doubtful that a type rating will be required for the MU-2B, but most of Mitsubishi Heavy Industries' training syllabus could become mandatory. This one-level-of-training mandate would even out differences between third party training providers such as Reese Howell and Simcom, and in-house training provided by Part 135 operators and some private contractors. Watch the Federal Register for a Notice of Proposed Rule Making in the next 30 to 60 days.

The folks at the FAA's Aircraft Certification Service also reviewed the aircraft in the past several months, but they're convinced that there's nothing faulty with the basic design, especially after three rounds of certification activities.

Already, some Part 91 MU-2B operators are calling the FSB recommendations "overkill," anticipating a significant increase in training expense and hassle because of the Part 121 approach to pilot training. But just look at the accident statistics.

Dick Allan says of the MU-2B, "It's so easy to fly that it breeds complacency." He believes that this higher level of pilot training will slash MU-2B mishaps in half. We agree. The primary reason that so many MU-2B aircraft crash can be found directly behind the control yoke, in our opinion.

We're looking forward to undergoing a complete Level E initial training course in the MU-2B and then getting more experience in the aircraft. The Marquise reminded us a little of our first experience in the Learjet 23 in the late 1970s. It was both exhilarating and illuminating. We could hardly wait to fly it, but only after thorough training. **B&CA**