

# MU-2

*Magazine*

APRIL 2015  
Sixth Edition

## What's inside:

- Maintenance: Winter Engine Ops, Part 2
- MU-2 Artist Keith Ferris
- NBAA Membership Benefits
- Cast Acrylic Window Inspection And Repair



Photo: David Blackburn,  
MU-2 Owner/Operator

[www.MU-2aircraft.com](http://www.MU-2aircraft.com)



## A Commitment To The MU-2

Here we are in Dallas in March, no less, with between four and five inches of snow and ice to deal with. Not only are we waiting for the roads to clear, but this is the second time in two weeks that the weather in Dallas has abruptly reminded me why I moved from Michigan to Texas.

This March has other significance to me and that is the one-year mark before the formal kickoff of PROP 2016. Next year's PROP (Pilot's Review of Proficiency) promises to be better than ever with several very interesting prospects for our guest speaker, or maybe two. Time will tell.

Our theme this year will be how we continue the current great safety record of the MU-2 through an awareness of how to "Live the Safety Culture." This is not just a slogan, it is a lifestyle. We plan on lots of fun, flybys, food and libation, and great new materials and owner/operator videos.

We are still in the process of selecting

cities and hotels for PROP 2016, but will focus on those places that were the most successful in the past, with maybe a new twist or two. See you there.

Please enjoy the magazine this month with a featured article from Helmuth Eggeling in Part 2 of his Winter Engine Operations.

Also featured this month will be a piece on the world-renowned aviation artist Keith Ferris and the MU-2 paintings he created years ago. You may have seen one of those last year in Addison during PROP. We are still looking for some of the missing canvases, and pictures of all the paintings are included in the article. Any help from the field would be appreciated.

Mark James from Intercontinental Jet Service Corp. has submitted his piece on window maintenance as well, which is timely considering some of the recent incidents involving involuntary window removal (exit stage right) that some of our

operators have experienced.

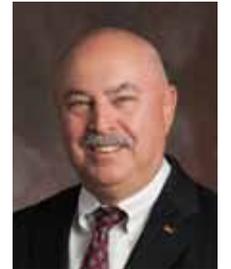
We look forward each quarter to bringing you this publication, so if you have any ideas on how we

can improve on it, please don't hesitate to call or write us with your suggestions.

Have a great and hopefully warmer spring.

Pat Cannon

*Pat Cannon is President of Turbine Aircraft Services. He is an FAA Designated Pilot Examiner, former MU-2 Demo Pilot, and Safety Expert.*



The Mitsubishi MU-2, one of Japan's most successful aircraft, is a high-wing, twin-engine turboprop with a pressurized cabin. Work on the MU-2 began in 1956. Designed as a light twin turboprop transport suitable for a variety of civil and military roles, the MU-2 first flew on September 14, 1963. More than 700 MU-2 aircraft were built before the aircraft went out of production in 1986. Presently, nearly 300 MU-2 aircraft remain in operation with the majority of the fleet registered in the U.S.



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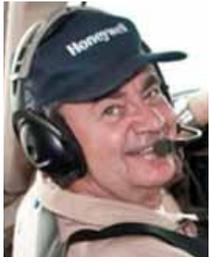
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*MU-2 Magazine, April 2015. Cover photo by Jan Glenn, taken during PROP photo shoot.*

Notice: Although this publication will provide you with useful information regarding the operation of your airplane, it is not and cannot be a substitute for your compliance with all applicable requirements from the appropriate airworthiness authorities.

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# Winter Engine Operations (Part 2)

By Helmuth Eggeling

*Helmuth Eggeling is a lead test pilot and pilot advisor for Honeywell Aerospace at Phoenix Sky Harbor International Airport. With the company for over 24 years, Eggeling conducts lectures and writes about engine operations for Honeywell turbine engine equipped aircraft. Born in Germany, he is a naturalized United States citizen and has logged more than 12,000 flight hours, including military time.*

**W**ell, Punxsutawney Phil kept his promise! Extremely cold temperatures, especially in the Northeast, have been the norm. Therefore, it is appropriate to write Part II of the article on Winter Engine Operations.

In Part II, I want to expand on the subject and emphasize engine-operating tips, which are applicable mainly during the cold season. Employing the pilot checklist format, the following paragraphs outline tips concerning engine components and handling techniques, which require special attention when operating in a cold to very or extremely cold environments.

### NOTE:

The information below is provided to aid you in the proper and efficient operation of your TPE331 engines as it relates to Cold/Winter operations. However, as always, procedures outlined in the applicable FAA Approved Airplane Flight Manual (AFM) take precedence over those tips outlined in this article.

### PREFLIGHT INSPECTION

**INLET** – Remove the inlet covers. Inspect the inlet and remove any water, ice or snow.

**T2 SENSOR (Bendix Fuel Control)** – Inspect the inlet sensor for condition, security and freedom from ice or snow accumulation.

**P2T2 SENSOR (Woodward Fuel Control)** – Inspect the inlet sensor for condition, security and freedom from ice or snow accumulation. Pay close attention to the P2 sensor inlet hole and the anti-ice air (P3 air) discharge hole at the tip of the P2 sensor. Both should be unobstructed.

**PROPELLER** – Carefully turn the propeller in the proper direction (I suggest 10 to 20 blades) to reduce as much as possible the drag imposed by the cold and therefore congealed oil.

### NOTE:

A winter related incident occurred in a northern U.S. area several years ago, in which a preflight inspection had revealed that ice had formed in both engine inlets. The crew decided to turn the propellers through by hand until the impellers could be freed.

Although unusual resistance was met, the propellers were pulled, using force until the impellers broke free. After the engines had been started, the engine whine was so loud that the control tower called the crew, asking if there was a problem. The pilot shut both engines down, and a visual inspection exposed that both impellers were bent to the extent that both engines had to be disassembled and both impellers had to be replaced.

**TAILPIPE** – Remove the protective covers and inspect for ice or snow accumulations.

### ENGINE START

**BATTERIES** – Pre-heating the aircraft batteries under cold-soaked conditions will improve their performance. Alternatively, removing and storing the batteries in a warm place overnight will make a noticeable difference on the starting capacity.

### NOTE:

Removing and re-installing batteries may constitute a maintenance action and could, therefore, require an entry in the logbook and a sign off by a certified and/or licensed mechanic.

**APU START** – An Auxiliary Power Unit (APU) is normally recommended for engine start at an Outside Air Temperature (OAT) of 10° C or less. You should also consult the applicable Pilots Operating Manual (POM) for additional recommendations, procedures, notes and cautions on the use of the APU for engine starts.

**FUEL ENRICHMENT** – The use of manual fuel enrichment during a cold soaked engine start should be a little different than under starts initiated at warmer ambient conditions. Obviously, more attention to engine acceleration, especially in the 18 to 28 percent RPM range is necessary. Observe that the start sequence and rate of RPM rise progresses normally within the specified EGT/ITT limits. During manual starts, use fuel enrichment as necessary to maintain a minimum engine acceleration of about 1% per second; again, you must remain within the specified EGT/ITT start limits.

### NOTE:

DO NOT ENRICH ABOVE 700° C EGT or 900° C ITT, as applicable.

### TAXI

**OIL PRESSURE** – Oil pressure transients above normal limits are possible in cold ambient temperatures.

**OIL TEMPERATURE** – Remember that engine oil does not flow through the propeller dome. Instead, oil is trapped in the dome during a normal engine shutdown. This remaining dome oil can freeze and impede normal governing operation of the propeller. Even when the needle indicates a temperature within the green arc on the indicator face, the trapped oil in the dome may

(Continued on page 11)

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# MU-2 Artist Keith Ferris Earns His Wings and Acclaim With On-The-Job Training

By Mike Taylor

*Mike Taylor is a former aircraft design engineer, 25-year aviation industry veteran, current marketing consultant and private pilot.*

Keith Ferris grew up a military brat on the grass flying fields of the 1930s. As children of service personnel often do, he attended numerous schools. For Ferris these were high schools in Kansas, and in the Texas towns of Fort Worth, Boerne, and Kerrville. The latter initiated what was to be a pseudo-military career. Founded in Kerrville, the Schreiner Institute (now Schreiner University) incorporated military training during Ferris' time there.

As a child, Ferris had always hoped to fly in the U.S. Air Force. He attended Texas A&M College (now Texas A&M University) from 1946 to 1948, majoring in aerospace engineering and hoping for an Air Force commission on graduation. While his father was stationed at Randolph Air Force Base in San Antonio, Ferris spent part of his college freshman and sophomore years working as an artist in the Air Force Training Publications group in a building next to the airport's (KRND) flight line.

Ferris was present at the base at the time Air Force Day was established on August 1, 1947. Instituted by President Truman the celebration was, "In recognition of the personnel of the victorious Army Air Forces and all those who have developed and maintained our nation's air strength." The day marked the 40th anniversary of the establishment, in 1907, of the Aeronautical Division in the Office of the Chief Signal Officer of the Army. The U.S. Air Force came into being immediately after the signing of the National Security Act of 1947.

From his office window, Ferris recalls seeing planes arriving the week prior to the celebration to participate in the weekend-long public open house. While Air Force Day was observed only three sequential years, its heritage endures along with the impressions it

made on the young Ferris.

"The sound of jets for the first time brought me out of my chair. Watching as they effortlessly circled the base, landed and taxied to park right in front of our building, I took one look at those beautiful airplanes, put down my brushes and paid a visit to a flight surgeon friend requesting a flight physical for cadets," commented Ferris. He continued, "I could not wait the extra years for a commission.

"The flight surgeon, whom I had known since I was a little boy, said: 'Keith you are not going to be able to get in the Air Force at all,' recounting an allergy to eggs and tetanus anti-toxin from

my past. I was informed I would not be able to take all of the required immunizations."

Upon his return to Texas A&M, Ferris decided that since he was not going to be able to fly in the Air Force, he would abandon the engineering curriculum and return to the publications unit to pursue a career in aviation art. Ferris attended Corcoran School of Art for half days in 1948-49, while attending George Washington

University in Washington D.C. Following one year of art school, he relocated to St. Louis for a job in offset lithography. There he learned production printing, then later moved to a large St. Louis art studio which had contracts with Air Force Publications.

With his acquired knowledge of the Air Force, art production and printing, Ferris landed a job, at age 22, of managing the studio's Air Force contracts. He also served for a period as Production Manager of the studio.

However, the Air Force eventually closed its St. Louis Publications



*"Mountain Airstrip" by Keith Ferris.*

unit, and “without my Air Force,” Ferris avowed, it was time to move on.

At the time, all of the aircraft manufacturers’ corporate headquarters were in Rockefeller Center and their advertising agencies were lined up along Madison Avenue in New York. So in 1956, Ferris packed up his “little family” and moved his studio to the New York area where he serviced the advertising, editorial, public relations and historical documentation needs of the commercial aerospace industry.

As an illustrator, his initial clients included Curtiss-Wright Corp., Sperry Corp., Pratt & Whitney, Aircraft Radio Corp. (later purchased by Sigma-Tek, Inc.), and Aviation Week & Space Technology magazine. Ferris’ clients also included the military services’ publications units as well as the National Air and Space Museum. He has maintained most of these relationships for the past 68 years.

The prominent New York based Society of Illustrators, founded on the prismatic credo “to promote generally the art of illustration and to hold exhibitions from

time to time,” invited Ferris to become a member. “This was a rare honor,” Ferris relished.

Another surprise invitation was extended to Ferris, this time by Secretary of the Air Force, whereby he was asked to fly a B-52 mission under the Society’s Air Force Art Program. His assignment would be to join the group and document the Air Force mission with paintings. Although the paintings were to be donated to the Air Force, Ferris was amply willing to embrace the opportunity to fly and travel with the Air Force.

His enthusiasm for flying proved ceaseless. In 1953, Keith, and his new wife Peggy, took flying lessons in a J-3 Cub, a Luscombe Silvair, and a Cessna 140. Keith amassed a total of 11.5 hours of flight and two solos when “it just became too expensive to continue,” he conjured.

But the requests kept coming. “Exactly ten years later, in May of 1963, I was invited under the Air Force Art Program to Randolph [AFB] to document, in artwork, the mission of the brand new T-38 Instructor Pilots School,” stated

Ferris. He continued, “As the instructor was briefing me for my T-38 introductory flight, I realized that he expected me to fly this supersonic airplane. I hesitated and said wait a minute. He asked how much flying time did I have? When I told him, and in what aircraft, he said ‘You are fully qualified.’

“Sitting there with the Dash One Flight Handbook in my lap and the Syllabus sequence, I began to really pay attention. He was a superb instructor, for I was able to fly the entire introductory ride for the IP School student, including max performance climb, slow flight, stall recovery, supersonic flight, three touch and go landings, and a full stop landing. I taxied the airplane right past my 1947 Training Publications Unit Offices where [years before] I found out I was not going to fly in the Air Force. From there, I immediately went up to Big Spring Air Force Base (now Webb Air Force Base) in West Texas where I flew the T-38 IP School Syllabus aerobatic ride.”

Ferris is grateful for the many Air Force art assignments that have taken him all



“Night Climbout” by Keith Ferris.

over the world, but his most enjoyable have been the opportunities to fly with each of the USAF Weapons Schools. At Nellis Air Force Base in southern Nevada, he spent “about eight weeks” covering the employment of aircraft from the North American F-100 Super Sabre up through the McDonnell Douglas F-15 Eagle and General Dynamics F-16 Fight Falcon over a period of 25 years.

“In November of 1968, I flew across the Pacific as a civilian backseater with the squadron taking the first gun-equipped F-4E Phantoms to Thailand in Southeast Asia.” Here, coincidentally is where Ferris was to have his first encounter with the MU-2.

“Which brings us to the MU-2,” Ferris diverted. “I had been asked by Womack-Claypoole Advertising agency to come to Odessa, Texas, to discuss art for a U.S. advertising campaign for the new-to-America MU-2. In the discussions, I sketched the “J” and “K” Models in various scenarios and became aware of how proud Mitsubishi was of the tough airframe.”

Ferris talked the team into doing a cutaway as the final painting of the series, since they were putting so much emphasis on the airframe structure. “To create this one, it was going to have to include a visit to the San Angelo factory where aircraft assembly took place,” he punctuated.

“I flew in the agency’s Mooney down to the abandoned Air Force base in San Angelo.” While there Ferris



“Prudhoe Bay” by Keith Ferris.

photographed the production line “to capture all the hidden structure and details I was going to have to paint,” he elaborated. “As I was finishing up the photography I was tapped on the shoulder and told that my airplane was ready. I thought, that’s nice, they are going to let me see what the airplane is like in the air.

“To my surprise, demo pilot Bill Bird

placed me in the left seat, informing me once I had strapped in that he had no brakes over there, nor could he start the airplane. I thought, now this is unusual, as he talked me through the startup procedure. He then asked me to take it down to the south entry point to the runway and I thought I had better ask him for some numbers. Rotation, climb speeds, etc. He told me to climb straight out to



“MU-2 Portraits” by Keith Ferris.

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10,000 feet as I recall.” And off they went.

Ferris recounted the demo pilot having him perform some slow flight and stall recoveries. Then some 360-degree turns left and right, and a left engine shutdown for a left 360-degree turn. He talked Ferris through the air start, then back to San Angelo for some touch and goes. This was followed by a full stop landing in which Bird wanted him to stop the airplane in time to turn off at the entry taxiway. With brakes and reverse thrust, Ferris made the short turn off and taxied back to their parking spot.

“On the way back to his office, Bill said to me: ‘Well what did you think? Is your company ready to buy one?’ To his astonishment I replied: Buy one! I’m the artist creating the art for the ad campaign for the airplane!” Ferris recollected, “I had been asked by so many Air Force pilots to fly their jets that I had just shrugged my shoulder and thought, here is another challenge.”

Some 40 years later, Keith Ferris returns to the MU-2 community. At the behest of Barry Martin, co-owner of Tennessee Aircraft Co., the artist was located and asked about using his artwork for a company Christmas card. To Ferris’

delight, Barry had one of the paintings in his office and was graciously given permission by the artist to duplicate the print.

Mitsubishi Aircraft International (MAI) commissioned the paintings around 1972. The company’s original plan was for six paintings. However, the cutaway Keith talked them into proved to be a much more complex effort. They agreed, and it was counted as two. So history tells us only five paintings were completed.

It is also known that the painting in Barry Martin’s office was awarded by MAI to Dean Dohm, founder of Tennessee Aircraft Co., in recognition of being the number one worldwide service center at the time. The painting hung in Dean’s office, and upon his passing, Barry Martin and a partner acquired both the company and the painting. A second painting, entitled *Night Climbout*, is located in the MU-2 Museum at the offices of Turbine Aircraft Services in Addison, Texas.

Presently, Ferris gives lectures on art and aviation military history including one on “Perspective Projection by Descriptive Geometry” used in his work as an artist to create maximum 3D quality in a painting. Ferris still does not have a pilot license,

despite his 300 hours of jet fighter time, his MU-2 familiarization flight, his tailwheel training, and eight weeks of flying with the Air Force Weapons School.

Now 85, Ferris is still painting and also writing a book. He has plans to create another large painting for Pratt & Whitney, this of the Navy’s F-35C. Ferris was enshrined in the National Aviation Hall of Fame in 2012, notably as the only member enshrined as an artist. Texas A&M University’s Aerospace Engineering Department named Keith Ferris an Honorary Aerospace Engineer Alumni in its Aerospace Alumni Academy in 2014.

Keith Ferris is founder of the American Society of Aviation Artists, [www.asaa-avart.org](http://www.asaa-avart.org). His website can be found at [www.keithferrisart.com](http://www.keithferrisart.com).

*Editor’s note: Pictures of all of the Keith Ferris paintings of the MU-2 are included in this article. However, Turbine Aircraft Services is actively looking for information and the whereabouts of the three “missing” paintings. If you have any knowledge of them, please contact Carol Cannon at [clcannon@turbineair.com](mailto:clcannon@turbineair.com), or 972-248-3108 x211.*



“Cutaway” by Keith Ferris.



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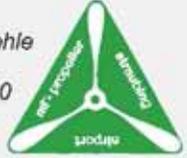


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# Winter Engine Operations (Continued from page 3)

remain cold for a longer period of time.

Therefore, you should limit engine RPM as much as possible to minimum idle speeds until the oil temperature approaches a normal, in the middle of the green arc, indication. Moreover, when taxiing the aircraft with cold oil, keep control inputs smooth and slow. Propeller response in Beta mode may be sluggish. Once the oil temperature reaches the green arc, gently exercising the condition lever(s) may expedite the warming of the oil in the propeller dome.

In extremely cold ambient conditions, e.g. during the winter and especially in arctic regions, it may be necessary to use Type I oil which has a lower viscosity rating than Type II oil.

**NOTE:**

Type I engine oil has a lower Maximum Oil Temperature limit than Type II. Refer to the applicable AFM Section 2, OPERATING LIMITATIONS, OIL SYSTEM.

**NEVER MIX TYPE I OIL WITH TYPE II OIL.**

**INLET HEAT** – If flight in icing conditions is anticipated, test the engine anti-ice and inflight ignition systems prior to departure. Selection of inlet heat at a stable power setting on the ground will normally produce a noticeable increase in indicated turbine temperature. The turbine temperature rise is due to the diversion of some air from the compressor section.

**NOTE:**

Icing conditions should be considered to exist during ground and flight operations in visible moisture (including clouds or fog) at an Outside Air Temperature (OAT) of +10° C (50° F) or below, or an Indicated Outside Air Temperature (IOAT) as specified in the approved aircraft flight manual.

When icing conditions do not exist, the inlet anti-icing system should not be used above 10° C (50° F) OAT for more than 10 seconds.

**NOTE:**

During Inlet Heat ground checks, failure of the EGT (ITT) to rise could mean that the anti-ice valve did not open – or – it could mean that the valve had been stuck in the open position prior to selecting engine anti-ice to ON. Therefore, if the proper operation of the engine anti-ice valve cannot be verified, flights into potential or known icing conditions must be delayed until the discrepancy has been corrected. See Operating Information OI331-15, dated April 30, 1997.

Refer POM SECTION 3, SYSTEM DESCRIPTION, OPERATING DETAILS, COLD WEATHER OPERATION and other sections within the FAA approved AFM.

**TAKEOFF – CLIMB - CRUISE – APPROACH – LANDING**

**PROPELLER GOVERNING** – Propeller governing RPM is affected by oil temperature. With colder oil than normal, governing RPM may be higher.

**IGNITION** – In-flight ignition use and accompanying cautions are addressed in the Operating Information Letter OI331-11R10, dated October 1, 2012. This OI is being supplemented by Pilot Advisory Letter PA331-04R3, dated January 11, 2013.

**NOTE:**

**LACK OF RESPONSE TO THE POWER LEVER** – may be caused by ice blockage of the P2 inlet sensor probe (Woodward Fuel Control Unit). This can occur although visible moisture is not present. If a lack of response is observed, it is recommended that ignition and engine anti-ice be turned ON for both engines. This will introduce anti-icing air to the sensors (as well as the engine inlet) and normal response should return within approximately 3 minutes. Refer to OI331-13, dated April 27, 1995.

**ENGINE SHUT-DOWN and POSTFLIGHT**

**SECURE** – Install inlet and tailpipe protective covers before moisture can accumulate in these areas. If allowed, moisture may freeze and can effectively lock up the rotating group.

Consider using nacelle heaters if the aircraft is allowed to cold soak in ambient temperatures below -20° C. The most effective heaters utilize an electrical heating element in the lower nacelle and an insulating blanket wrapped around the exterior of the nacelle. This should provide heating to the entire engine, oil lines and oil tank. Oil tank heaters alone do not prevent lines or oil coolers from freezing, which could result in blown lines or damaged oil coolers. In the case that nacelle heaters are not available, a hot air blower should be employed to preheat the engine by blowing hot air either up the tailpipe or in the inlet for about ten minutes. Finally, always pull the propeller through by hand prior starting under any ambient conditions. Especially in preparation for cold soaked engine starts, hand rotating is recommended both before and after preheating to gauge the effectiveness of the preheating operation.

In conclusion, the above tips are intended to be supplemental to the published operating procedures. For a complete study on aircraft operations in cold and in icing conditions, please refer to the FAA/CAA approved procedures and recommendations published in the Mitsubishi MU-2B AFM and POM for the appropriate model. As always, pilots can make the difference in engine operating life and maintenance costs.

For additional questions on the above subject or any other TPE331 engine related issues, please don't hesitate to contact the Pilot Advisor Group by calling us at (602) 231-2697, send us a FAX to (602) 231-2380, or email to: [Helmuth.Eggeling@Honeywell.com](mailto:Helmuth.Eggeling@Honeywell.com).

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## 1978 Mitsubishi MU-2 N Model w/ -10s / SN728SA

10181 TT 2791/2791 TSO  
275/275 TSHSI / Props OH 2015  
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## 1976 Mitsubishi MU-2 L Model / SN687

5986 TT 4022/679 TSO  
680/n/a TSHSI  
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## 2015 MU-2 Fly-In

**October 9-11, 2015**

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# Cast Acrylic Window Inspection And Repair

By Mark James, Director of Operations, Intercontinental Jet Service Corp.

Maintenance Update

Mark James is currently Director of Operations for Intercontinental Jet Service Corp. He has a degree in Applied Sciences from Spartan College and is a current advisory board member for Tulsa Tech as well as a former member of the Allied Signal Service Center Advisory Board.

In monitoring the MU-2 Web blog page, which I do religiously between 2 and 4 am daily (just kidding), I ran across a thread relating to another cabin window failure. Since Carol asked (told) me to write an article for the MU-2 Magazine, and since all the service centers deal with this subject every 100 hours, I thought I would spend some time with this subject.

Many years ago MHIA released Service Bulletins 224 (A2PC aircraft) and 87/56-001 (A10SW aircraft) regarding inspection criteria and repair for the cast acrylic windows in all models of MU-2 aircraft. This in turn led to the FAA issuing AD2003-17-04 many years later, which mandated the inspection and repair/replacement, if necessary.

To properly inspect these windows, service centers need three (3) pieces of specialized equipment: ultrasound measurement equipment calibrated to the proper material to establish the actual window thickness, an optical micrometer to determine the actual depth of any damage (nicks, scratches, crazing) that may exist, and an extremely bright light source to illuminate any crazing that might be present in the window. The first step is to clean the window. I recommend using only a mild cleaner such as Plexo and a lint free disposable towel designed for acrylics. Never use cleaners with ammonia, alcohol, MEK or Toluene, and never wipe a dry window. For proper and complete cleaning instructions, please refer to your applicable maintenance manual.

Next, you will need to inspect all windows from both the inside and outside. I highly recommend inspecting the inside as well as the outside because any localized crazing at the window edges may be masked by the sealer bead that covers the edge of the window. The edges of the window are the most critical area of the window as this is the area that is subject to the greatest amount of stress during the pressurization/ depressurization cycles, and this area tends to be where we see most failures propagate from. From an owner/operator standpoint, a great way to inspect a window to gauge the health of the window and provide your maintenance provider with good insight is to inspect the windows in flight **FROM INSIDE THE AIRPLANE, NOT OUTSIDE**. (Sorry, legal and better judgment made me add this statement.) When looking through the window in bright sunlight, the crazing, as I am sure you know, really refracts the sunlight. Pay close attention to the color of the crazing and location. White colored crazing tends to be shallow in nature and this type of crazing is easier to monitor and easier to remove. If the crazing is dark or black, that indicates much deeper crazing that really needs to be brought to the maintenance personnel's attention, especially if it is along the edge of the window.

Once the windows are inspected, it will be determined if the window exhibits damage which requires corrective action. The limitations for this requirement are spelled out in both the respective service bulletin and maintenance manual. If corrective action is required, the



window will be measured to determine if it is thick enough for rework, cabin side windows minimum thickness is 0.215" and acrylic windshields are 0.273", in case you were wondering. Next the depth of the crazing or damage is determined utilizing the optical micrometer to assess if all the damage can be removed without decreasing the window thickness below minimum levels.

The next step, if the damage is repairable, is to remove the damage. For reference, to polish a window generally runs between \$600 to \$1000. I often hear the question "why does it cost so much to simply polish a window?" The short answer is because that replacement window cost is anywhere from \$3500 to in excess of \$10,000, however, the more appropriate and more technical answer is that it is a time consuming endeavor to polish a window properly without distorting it to the extent of a fun house mirror that makes you sick in flight.

The first and very important step is to remove the boundary layer sealant so that the entire window is visible for inspection. This step also reduces a dishing effect during polishing. Next the window is ground with very abrasive media reducing the material thickness and removing all damage. It is critical that this step be done very evenly over the whole surface to reduce distortion; never grind one localized area to remove damage and try to blend—it will not work. At this point the window will be opaque and as transparent as plywood, an inspection will be done utilizing an extremely bright backlighting source to verify if all damage has been removed and if so, the true artistry begins. The window is now brought back to crystal clarity through several grades of higher grit media taking several hours of work to accomplish properly. The last step of this process is to reapply the boundary layer sealant to the window. It is critical that the proper sealant is applied, which is called out in the maintenance manual, as the wrong type sealant may actually cause crazing to set up due to chemical composition of the sealant.

As you can see, this process, when done properly, is roughly a 6- to 8-hour process. The upside to this is that by inspecting the windows properly and at established intervals, proper cleaning and removal of the damage as it arises it can greatly extend the service life of the windows and increase the safety factor of your airplane, not to mention saving costly window replacements.

As a follow-up side note I will mention that the new windows being produced currently for your aircraft are a "stretched acrylic" material as opposed to the current "cast acrylic" material. Stretched acrylic is less prone to crazing and when installed, it removes the repetitive inspection set forth in the AD for that particular window, HOWEVER, it does not remove the requirement for that window to have to be inspected per the 100 hour inspection set forth in MRO178-2 and MRO179-2.

Thanks for allowing me to occupy your inbox.



Dear MU-2 Magazine Reader,

My name is Richard Shine, and I am the CEO and Chief Pilot of Manitoba Corporation, a family-owned metal recycling company founded by my grandfather in 1916, and based in Lancaster, NY. Like many of you, my business would not exist today without my Mitsubishi MU-2. It has allowed us to go outside our region and generate the product we need to stay in business. We're able to make quick trips, see the right people, and yet be back to mind the store. And for nearly 20 years, our NBAA Membership has been indispensable in that process, ensuring we use our aircraft as safely, efficiently and cost-effectively as possible to achieve success for our company.

I believe so strongly in NBAA, in fact, that in 2008 I joined the Board of Directors and am now a past chairman. I am committed to ensuring that the many small and mid-sized companies in NBAA's Membership continue to have a strong voice on the Board.

I have often been asked, "As an MU-2 operator, why do you belong to NBAA?" And my answer is always the same: If you use your airplane for business – no matter how large or small the plane or the company – NBAA has resources to help you succeed. In fact, there are a number of Member benefits designed *specifically* for owner/operators, single pilots and anyone using a light business aircraft (LBA). Here are just a few I think you will find particularly useful:

- **LBA Flight Operations Manual** – provides guidance on topics such as safety management systems (SMS), standard operating procedures, qualifications and training, and includes a risk assessment tool designed specifically for LBA operators.
- **Operations Service Group and NBAA's Website** – gives you access to expert help on *any* issue you face. Whether it's a question on taxes, regulatory changes, personal use of your aircraft or any number of topics, you can research and find the information on [www.nbaa.org](http://www.nbaa.org), or simply call or email one of the on-staff industry experts in NBAA's Operations Service Group Help Desk, and they will have the answers you need.
- **Reimbursement of Flight Expenses for Owner Pilots Handbook** – a comprehensive reference guide to help you gain the maximum Federal reimbursement cost benefit from your airplane.
- **Frontline Advocacy** – NBAA represents the interests of *every* company using an airplane for business, working hard to fight onerous proposals – which could have a devastating impact on your business and your bottom line. Adding your voice to NBAA's will greatly strengthen the Association's work in Washington, and help protect the future of this industry.

I would like to extend a special offer of \$189 first-year dues to all of my fellow MU-2 Magazine readers. Simply join online at [www.nbaa.org/join/MU2](http://www.nbaa.org/join/MU2) and enter Promotional Code: **MU2MAG** when prompted in the payment section. I look forward to welcoming you as a fellow Member.

Sincerely,

Richard Shine  
CEO and Chief Pilot, Manitoba Corporation  
Past Chairman, NBAA Board of Directors

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