

Thoughts on Europa Door Loss

By Bud Yerly

Analysis of the Europa door loss data:

1. Most of the door losses over the last few years have been from highly experienced pilots (many are/were airline pilots).
2. A very high percentage of all doors lost were from secondhand owners.
3. Most of the doors lost were passenger doors.

I am disturbed by the fact that the door losses were not from hurried departures. Overwhelmingly, the door losses were just a failure to assure both latches were in prior to takeoff. My feeling it is most assuredly a discipline/training/knowledge issue.

History has shown many Europa builders/owners complained the doors just don't close right or easily for many reasons I will explain later. The door latches were functioning properly. The door was closed and the Pilot in Command (PIC) failed to properly assure the canopy door was latched.

In the industry of experimental and certified light aircraft, door/canopy operation has been an issue. Even recent certified aircraft have unprecedented door loss. The Cessna 162 door opens upward and has shoot bolts similar to the Europa. Doors still depart so a third latch was installed preventing exterior entry in an accident. The Experimental Aircraft Association in the US has commented on the canopy/door loss issue back starting many years ago. There is an excellent article written by Tony Bingelis for the EAA in October of 1978 on canopy retention. Canopy/door fit and latching has been a problem in aviation since we sealed up the open cockpit. Historically these are not new issues. The RV, Pipistrel, Cessna, Piper and many others have the same issue as the Europa.

I am going to preach and perhaps hurt more feelings now:

In today's world we are pampered with caution and warning systems integral in our vehicles. Door ajar chimes and lights, seatbelt warnings, engine start/transmission lockout, automatic door locks, collision alert devices, GPS maps indicating the speed limit, lane encroachment alerts, hands free communications, automatic collision avoidance braking, and in the case of impact, airbags, automatic emergency transmitters and the like. Today, our machines are programmed to take care of us. In the event of a mishap, it is not uncommon to have folks sue the vehicle manufacturer for failure to warn, or avoid an accident. So, when we get into our very basic and simple aircraft (which is only a mechanical thing with flappy and whirly gigs), we must rely on our experience and muscle memory skills to operate our aircraft safely. We must remember how to inspect the aircraft, its controls, set switches, radios, instruments, lights, check operational controls, clear the area prior to starting the engine which is attached to a rotary chopper, carefully move a wide and not very maneuverable vehicle on a narrow road, clear our ground path and anticipated path visually only, ensure the craft is ready and secure, then use our skill and cunning to get off the ground and while inflight hitting the ground or other aircraft, then dive the aircraft toward a landing on a narrow strip without incident. To assist us, builder, pilots and maintainers have created checklists and placards to jog our memories and help with timely preparations for the various phases of flight.

In light aircraft, especially experimental aircraft, we are responsible for our machine as well as those around us and our fellow Europa/experimental owners. Any mishap or incident reflects on the safety and operations of our fellow aviators and how we are perceived.

We all bear responsibility to be better students of aviation. That's right, not just pilots. Pilots are stick actuators and can operate an aircraft most of the time, as students of aviation we become fluent in and knowledgeable of all things aviation such as: Types of aircraft, flight characteristics, airspace, medical effects, regulations, operational procedures, emergency procedures, abnormal flight recoveries and operational safety to name a few. We apply our stick operator abilities to our knowledge and develop procedures and habit patterns which allow us to become successful pilots. Not great, just successful at piloting aircraft efficiently, safely, and hopefully without incident. Then hopefully move on to master the aircraft we are flying most. Unfortunately, we are human and many of us are getting older. I'm a prime example of older and slower.

In experimental aviation many times we built the aircraft, know every system, nut, bolt, idiosyncrasy, compromise and problem. We studied and became experts in our aircraft ground and flight characteristics, and also became the maintenance technician, maintenance supervisor, test pilot and evaluator. The secondhand owner of an experimental aircraft is normally not intimately familiar with his aircraft. Some secondhand owners have had to completely rebuild the aircraft themselves to have it meet their requirements and others simply paid to have the aircraft modified. The latter is a concern. My opinion is training for these folks and a recurrency training for the rest of us is essential.

What about the kit/aircraft manufacturer's responsibilities. Many Experimental Kit Manufacturers do not produce a POH in the US. It is considered the builders responsibility. Unlike other kit manufacturers, Europa Aircraft produced a thorough POH. Item six before takeoff:

6. Hatches (doors) closed and latched. Check both front and rear shoot bolts engaged.

What is hard about that! Well, read on....

Now off the soapbox. Back to the Europa door loss problems.

Andy Draper and I exchanged emails on the door loss issue. Andy is obligated to fix the UK permitted aircraft issue and I am looking at solutions for the US owners. In the US my focus is twofold. Improve operational door latching procedures (aka training) and suggest repairs to improve door fit and closure. I believe supplemental electronic warning lights, bolt blocking devices, and additional latches have merit, but no electromechanical device is full proof unless combined with disciplined knowledge and disciplined operational procedures.

I may not agree with LAA mandated modification as presented originally. I have "issues with authority" and do not enjoy being directed without consult and prefer to be explained what the objective is and why this is the best method to solve the issue. Upper echelons of authority many times prefer to mandate (as an extension of their power and influence) rather than lead the herd to a solution. That is one of the many serious flaws in my personality. Andy Draper has been working on the issue of the door shoot bolt latching problems since I met him in 2003. We operators also have come up with many different solutions. Most add weight and complexity. However, let's look at each basic type of door unlatch warning/prevention presented. The methods below are often combined by some builders for proper door security.

Methods Employed in Assuring the Europa Door Latches Engage:

A combination of any of these methods have been used.

1. Currently The UK Mod15833 is possibly the lightest for the door and least prone to mechanical failure. Design is a teardrop shape split at the rear door which prevents a partially ajar door from allowing the rear pin from extending the shoot bolt blocking/preventing any possibility of latching. However, it may not be full proof depending on shoot bolt placement and installation particulars. Time will tell. It is mandatory for UK permitted aircraft at this time.
2. Third door latch pin installation which rotates with the linear actuator rod to engage vertically into the lower door sill frame. This has a side benefit in that it will keep the door more closely in to the aircraft side preventing door bulge under high speed but not the upward force. It adds mass to the bottom of the door which makes more of a strain on the door strut and attach points. Door struts often require more pressure to hold the doors open. Latching of the extra bolt is not always assured.
3. Some owners with "springy doors" install hand straps or knobs on the back of the door to pull in on the door to allow latching when a vertical down force does not seem to work due to door and latch geometry.
4. Warning lights. Although normally attached to only the rear door shoot bolts, the electrical mechanical switch attachment varies. Normally the shoot bolt guide is shortened to allow the tip of the shoot bolt to protrude aft of the guide. The tip of the shoot bolt contacts and depresses a switch lever or pin to make a contact (ground normally) which closes a circuit to one or more lights on the instrument panel. Lights are normally directly in the pilot's view. I have never seen an additional audio warning incorporated or a power setting interconnect warning to prevent high power application with the door unlatched light still lit.
5. The Europa POH inclusion of door closing checks is sufficiently descriptive. But there is nothing on HOW TO close and check the shoot bolt latches are both secure.

Why are there issues with closing the door? It looks simple enough. There are a number issues with the door construction I've seen that makes latching difficult for the owner/flier on the following pages.

Construction issues affecting door closure:

1. Builders fail to fit the door so that it is properly curved to fit the aircraft side.
2. Shoot bolt mechanism constructed with poor alignment inboard/outboard, up and down.
3. Fuselage shoot bolt guide is not aligned with the door shoot bolt guide causing binding.
4. Door and sill shoot bolt guides have no or insufficient clearance between the faces. This will cause the door shoot bolt guides to hit each other, forcing the door outward and or preventing lowering the door fully.
5. Door struts attached near the rear hinge (aircraft not equipped with Mod 66) causes the door aft end to lift due to strut pressure and pushes the door aft end up warping the door. This can cause door twisting and misalignment contributing to door latching issues.
6. Factory Mod 66 glass overlay and integral strut attach point interferes with the door seal preventing the seal from compressing sufficiently to allow the door to close properly.
7. Door seals may be poorly fitted and be excessively proud of the surface.
8. Interior fabrics may wrap over the fuselage flange causing the U channel to widen and the sealing bulb to move outboard and decrease the door to fuselage flange distance to less than the typical 12mm or 1/2 inch.
9. At high speed or modest high AoA or maneuvering/G loading, the doors will be pulled up due to aerodynamic forces causing very low pressure above the door. This causes the center of the door to flex upward and slightly outward. Shoot bolts with less than 10mm or 3/8 inch penetration may disengage due to door flexibility.

Remedies for the above closing issues:

1. Remove the doors and refit properly using heat etc. to fit the fuselage curvature.
2. Realign the mechanism and ensure shoot bolt mechanism is drag free.
3. Ensure shoot bolt guides are slightly countersunk into the sill/door and there is a minimum of 1/32" to 1 mm clearance between the shoot bolt guides to allow a smooth closure.
4. Mod 66 strut repositioning must be modified to allow proper closure with the seal yet still not limit the door from closing to very near the latching point.
5. Interior fabrics installation must not decrease the door to sill clearance distance.
6. Door seal must contact the door but not prevent a downward movement on the door from interfering with latching.
7. The door seal bulb must be soft and compress to allow proper door seal. In some cases, the bulb diameter may be larger/smaller and the thickness of the bulb material thinner to accomplish proper operation of the door and still seal.
8. High speed flexing of the door may require a larger diameter seal bulb at the lower area of the door and less on the sides in some aircraft.
9. Pilots unable to properly push down on the door to secure it (or unable to comprehend) may for ergonomic reasons have to install a knob to push down and pull in the rear of the door to assist them in securing the door(s).
10. For those with poor checklist discipline or familiarity issues, the addition of warning light switches, or other physical door modifications may assist them in door latching.
11. Checklist discipline is necessary to check the door latches are both engaged and the door secure.
12. Some builders have drilled a hole in the rear shoot bolt guides to be able to visually inspect the shoot bolt is engaged in the guide. Others have microswitches and warning lights to provide visual warning of a rear shoot bolt is not engaged. Although neither full proof as the pilot will not be able to see his door shoot bolt visually and warning light circuits may fail due to many reasons. Best Warning of a door unlatch is: PUSH ON THE DOOR.

Door closing and inflight departure issues.

The common tendency for most persons when encountering a door, expect to push or pull against the door to open and close it at the knob or handle. Doors that slide, clearly are hinged to do so and pushing/pulling horizontally on the handle is obvious if the handle is vertical. A clamshell door is counter intuitive to nearly all people. The clamshell door handle is a rotating latch handle, not a doorknob or pull.

A clamshell door is different in that the hinges are horizontal in the case of a canopy enclosure such as in the Europa. The door handle is vertical in the open position. When the door is lowered, the natural tendency for most is to pull inward at the front using the handle. The position of the handle is somewhat awkward in that while pulling inboard, the pilot/passenger is also pulling aft. The door will flex and the rear of the door angles up and well outboard of the fuselage side, and the front of the door is pulled down and aft. Hence the forward shoot bolt will normally latch but the rear shoot bolt round end easily slides over the fuselage side and the rear of the door remains propped open and unlatched.

In the event the rear shoot bolt is not engaged, on takeoff the aerodynamics take hold, the door is pulled upward and flexes so as to allow the front shoot bolt to disengage. The door rapidly opens, and the the door hinges are overstressed and fail. Normally, the upward flinging of the door will pull the plastic latch from the door strut, the aluminum hinges will rip apart, or the bolts will pull through the door tang or rip out the top of the cockpit and the door curvature causes the door to flip inboard and up to clear the aircraft. However, the door can unfortunately impact the horizontal or vertical tail.

Impact of the door on any control surface is potentially dangerous. Of most concern is the door hitting the gap between the stabilator and fuselage. This can jamb the stabilator. In the past this has not been an issue but is a possibility that cannot be overlooked.

Some owners strengthen the door hinges which may or may not retain the door and most likely will cause the door to flail and do more damage to the aircraft on eventual separation. Others install metal ball sockets on the door strut, to allow operations with the door open while taxiing but can also retain the door in an inflight opening and cause flailing and more damage. Others install mechanical over center arms to hold the doors securely open. Execution of each of these owner applied modifications must be thought out carefully for unintended consequences.

Training for passengers and pilots in proper door closing starts with a warning then how to's:

Part One-The New Builder/Buyer Warning:

Door loss isn't just embarrassing, a departed door is a dangerous dropped object and very costly to replace. It is not uncommon that the door is completely lost during a departure (requiring completely new parts). The liability of the door hitting someone or something on the ground will vary. An injury to a person on the ground may cause permanent injury and incur costs well beyond the normal aviation insurance policy coverage. Personal liability suits may also be levied, tying up the pilot/owner in court proceedings. A magistrate or jury may feel loss of the door is due to negligence. Since a manufacturing or inspection fault/liability argument could be made, the builder and maintainer may incur punitive liability costs also.

The monetary cost of door replacement parts is considerable. Normally expect \$1000 in parts and 20 hours of labor assembling the new door and 20-30 hours finishing and matching which will cost over another \$1000. But it goes farther than that. Proper glue (Araldite 420A/B is quite expensive) and

Ampreg laminating resin is difficult to get in many countries so substitutes must be procured. Additionally, the fuselage is normally damaged by the hinge failure and there may or may not be empennage damage due to door contact on departure. Inspection time/cost and inspection sign off may be considerable. It is not uncommon to see expenditures of \$4,000 US for a door loss. If the door is never recovered the task will take the average builder approximately three months minimum of down time to refit. Parts procurement will incur large shipping costs and time. The door and glass may not be in stock and fabrication time will be as the factory can get around to it. Glass is produced by LP Aero in Pennsylvania and may not match the original tinting and the door parts and mechanicals supplied by Europa aircraft have changed over the years. Once all parts are in, it will take a proficient builder at least three weeks in shop work to fabricate the door in place. Paint and trim will be extra of course.

Therefore, from a liability, cost, and operational safety standpoint it is essential that the doors be latched properly prior to takeoff. To do that, a complete understanding of the door operation is necessary for all pilots and passengers.

Part Two - Europa Clamshell Canopy Door Closing Operation Training:

The Europa canopy enclosure is a clamshell door. The curved door is not common to the casual observer. In a clamshell door, the hinges are horizontal. Therefore, to close the door, one must push downward on the door to align the door shoot bolts with the holes in the door frame. There is no self-latching catch on these doors. The doors are held by horizontal pins that are operated by a rotating handle. This type of horizontal latching pin set is common in many aircraft. To open, one only needs to pull the handle front up and back. To close, the natural tendency to pull inward on the door handle and slam the door expecting a latching similar to a car door. This must not be done. To close the door from the inside properly, simply lower the door. Using the outer hand on the handle top, reach across the chest with your inboard hand and push down on the glass to door sill area and push down only with a light force. The door handle is spring loaded and when the door is seated and aligned the handle only takes a small force to snap forward to latch. Since there is a pin on the front and one on the back of the door, it is common that the thin door may bend slightly, and the shoot bolts or pins may not slide in fully to their guides in the fuselage. In some cases, a bit of pressure to push the handle all the way down and forward to the horizontal position may be necessary. If properly built the door handle forward end will be rested behind a thin metal guard to prevent inadvertent actuation in flight.

NEVER PULL THE LATCHING HANDLE INBOARD OR PULL ON THE THIN METAL SAFETY COVER TO CLOSE!

Finally, to ensure both latches are engaged, one must push outward on the door at the front and back. The tendency for the uninformed is to pull the door inboard to see if it is closed for some reason. The only assured check of security is to push the door outboard. Since most pilots should be strapped in when they close the door, it is very difficult for some to twist around and push outward on the rear of the door. A technique is to lean inboard and put one's outboard forearm between the door and aft part of the headrest and push with the elbow and forearm on the door. If the rear bolt is not engaged the rear of the door will be held out by the shoot bolt outside the aircraft skin and 5-10 pounds of pressure will flex and open the door. The shoot bolts are buried and it is impossible to see if the shoot bolts are seated properly from inside the aircraft. Only by pushing outboard will the unsecure door flex and most likely pop open as the door bends and pulls the forward shoot bolt out. The gas strut will raise the door rapidly as the door pops open.

To brief customers, prospective buyers, and passengers on door etiquette, I have a simple briefing I go over with all of them:

Door opening and closing Briefing

Door Closure Brief:

1. Strap in.
2. To close the clamshell lid reach to the leading edge of the door and pull it down.
3. With the outer arm ensure the door handle is vertical before the door closes. Reach across your chest with your inboard hand and push down on the glass to sill area and push down with your fingertips forcefully. Do not push outboard.
4. Rotate the door handle forward and down slightly. (DO NOT PULL INWARD!)
5. Apply a light push forward to latch the handle. It should snap forward to the horizontal.
6. Use a light force to fully rotate the handle to the horizontal position and ensure the front of the handle is fully down and is horizontal behind the safety cover.
7. Check shoot bolt/door latch security by pushing outboard at the middle of the door forcefully. Normally it is done by leaning inboard placing the outboard arm and elbow in contact with the door and pushing outboard.
8. Always reach across to the other door and push just aft of the headrest with sufficient force to deflect the door. The door latches will prevent opening.

Door Opening Briefing on the ground:

1. Ensure the power is at or near idle.
2. Using your inboard hand place your fingers over the end of the handle and pull up with a light force (one finger) while holding the handle fully up.
3. Allow the door to begin to open.
4. Move your outboard arm under the door bottom and rest your elbow on the fuselage sill while holding the front of the door outside bottom edge with your hand. This will prevent gusty winds from snapping the door upward and allow cockpit ventilation.

Emergency Release Inflight:

In an emergency it may be necessary to jettison the door prior to ditching or off field landing.

1. Remain strapped in.
2. Stow loose items.

When instructed to do so:

3. Using your inboard hand pull the door handle aft.
4. Suction will rapidly raise the door and the hinges will hopefully fail and the door will exit the aircraft clear of the cockpit.
5. Airflow will cause swirling air in the cockpit. But headsets should not be pulled off.
6. The pilot will slow the aircraft to maintain communication and reduce airflow.
7. Crash position is to lean forward with your forearms covering your face.
8. Pilot control and flight procedures and speeds remain unchanged in the Europa.

I am not against any method to assist owner/operators in assuring their doors are closed and latched. I do not believe any one method is full proof. What makes the door latching full proof is the pilot checking visually and tactilely that the door is secure. In my past the call was: *"Closed, locked, warning light out, stripes aligned, warning lights checked."* We checked the warning lights for quite a few years to eliminate a failed door latch warning microswitch at just the wrong time. (Yes, it was a time of overkill as we lost a lot of canopies.) The latching hooks were getting loose, door inflatable seals were failing, and the deteriorating rubber seals and poorly maintained latch hooks prevented proper latching. If the end of runway crew or the other pilot did not hear the words, confirmation was requested. Finally, the new administration through money at the military to fix things. The focus did virtually eliminate our lost canopies in the T-38 and later in the F-4. It is amazing what attention to an issue will do to improve safety. That is my focus right now with the door loss in the Europa. I may do a photo shoot, and or video. Time is getting short and there are so many things to do.

Preflight your aircraft well, brief the door operations when flying with anyone unfamiliar with the Europa, challenge and check the door is latched. Have the passenger strap in and practice closing and opening the canopy before you strap in. I have the pax push on my door also before takeoff. If it is a non-flier youth orientation flight, I normally secure their door and only leave my pilot door open for ventilation. Brief the emergency door jettison procedure. They see you are careful and that often improves their comfort level that you are a careful professional.

I involve my passengers with the aircraft procedures, and everybody gets an opportunity to fly the plane. On subsequent flights, sometimes repeat fliers remind me I've missed things. Which confirms, the mind is a terrible thing.