NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

AIRFRAME EXAMINATION (Rev A)

NTSB Accident: WPR18FA143
Accident Date: May 19, 2018

Examination Date: June 27, 2018

This document contains 19 embedded images

Photos Courtesy FAA and NTSB

A. ACCIDENT

Location: Near Avenal, California
Date: May 19, 2018
Aircraft: ICA-Brasov IS-29D Lark, N38ES, Serial # 38
NTSB IIC: Michael Huhn

B. EXAMINATION PARTICIPANTS:

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C. SUMMARY

On May 19, 2018, at an unknown time, an ICA-Brasov IS-29D Lark glider, N38ES, was destroyed under unknown circumstances during a flight near Avenal, California. The co-owner/pilot received fatal injuries. The personal flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed.

The Romanian-manufactured 1974 glider was designed with removable wings and horizontal stabilizer to enable it to be stored and transported in a custom enclosed trailer. According to the other co-owner, he and the accident pilot had purchased the dis-assembled glider several months ago from the previous owner in Kansas. The co-owner reported that the glider had last been flown about 7 years prior. The glider was trailered to California, and eventually assembled by the co-owner and pilot. The accident occurred during the first flight after reassembly in California.

Examination of the accident site by Federal Aviation Administration (FAA) and NTSB personnel revealed that both wings had separated from the fuselage. The evidence was consistent with the fact that the pilot, who was wearing a parachute, had attempted to exit the glider. All primary components were identified on-scene. The wreckage was recovered to a secure facility for detailed examination.

This report documents that detailed examination

D. WING ATTACHMENT SCHEME

- Refer to the "Site and On-Scene Information" document for detailed information on the design
    - The design includes removable wings and other components to facilitate storage and transport
- The main spar of each wing is fitted with upper and lower spar cap extensions on its inboard end to enable the attachment of the 2 wings to one another by means of 2 clevis/tang assemblies, all secured by a central through-pin which drive 2 cone nuts into the clevis holes
- Each clevis assembly consists of 2 legs (right wing) and 1 tang (left wing); the tang slides between the two legs until the 3 holes (2 leg, 1 tang) align
    - The holes align vertically, at the sailplane lateral centerline

E. WING/JOINT COMPONENT EXAMINATION DETAILS

1.0 Wing Component Details and Dimensions

- The clevis legs, tangs, and cone-nut holes and other components were measured to determine assembly distances and clearances
    - Because the sailplane was Romanian, the components were likely designed and manufactured in the metric system, but almost all measurements for this examination were done in inches
    - The measurements were visually accomplished with a 6" scale with 1/64" divisions
- The inboard ends of the 4 legs and 2 tangs were chamfered to facilitate initial contact guidance/alignment
- The distance between the bottom of the upper tang and the top of the lower tang was about 5"
- The tangs were 27/64" thick
- The legs were 15/64" thick
- The spacing between the legs (bottom of upper leg to top of lower leg) was 27/64"
    - Therefore, the clevis tang-into-leg fit was a contact or close-tolerance fit, with very limited or no vertical play
- The overall thickness of each clevis-tang assembly was about 57/64"
- The cone nut hole edges were about 54/64" from the respective inboard edges of the tangs and legs
- The cone nut holes in the tangs were about 1-4/64" in diameter
    - Therefore, wing assembly from first tang-to-leg contact to final alignment of the cone-nut holes required a travel of about 1-24/64"
- The 2 plates that affixed to the right wing, and which retained the pin and cone nut assembly, were each equipped with 'fingers' on their top and bottom ends
    - The fingers on the aft plate pointed forward, and the fingers on the forward plate pointed aft
    - All 4 fingers were bent inboard, so that they partially blocked the spaces between the clevis legs- the deformations appeared at first glance to be as-manufactured but were subsequently recognized as being the result of the accident

- In their original configuration they appeared to serve 2 purposes- First, to act as fore-aft guides for the incoming clevis tang during assembly, and second, to serve as retainers for the uppermost and lowermost clevis legs, to absorb vertical loads imposed by the cone nuts as they seated in those 2 clevis legs

- There were 2 studs/pins affixed to the right wing just above the lower clevis, and which inserted into receptacles on the left wing
  - These measured about 48/64" long, and about 28/64" in diameter
  - Their function appeared to be twofold – to align the 2 wings, and also to provide more joint rigidity
- There were 2 other sets of pin-receptacle assemblies on each wing
  - These were situated towards the forward and aft ends of the root rib/fuselage join
  - The pins were located on the fuselage, while the sockets were located on the wing root rib
  - These are sometimes referred to as "lift pins"
  - Their dimensions were similar to those of the other 2 pins near the clevis
  - Their function appeared to be twofold – to align each wing as it mated to the fuselage wings, and to provide wing-fuselage joint rigidity
- The aft pin/receptacles were not readily adjustable, but the forward assemblies were readily user adjustable
  - The forward pins could be laterally extended or retracted by rotating a transverse rod that was located aft of the cockpit
  - This design enabled the user to adjust/improve joint security/rigidity

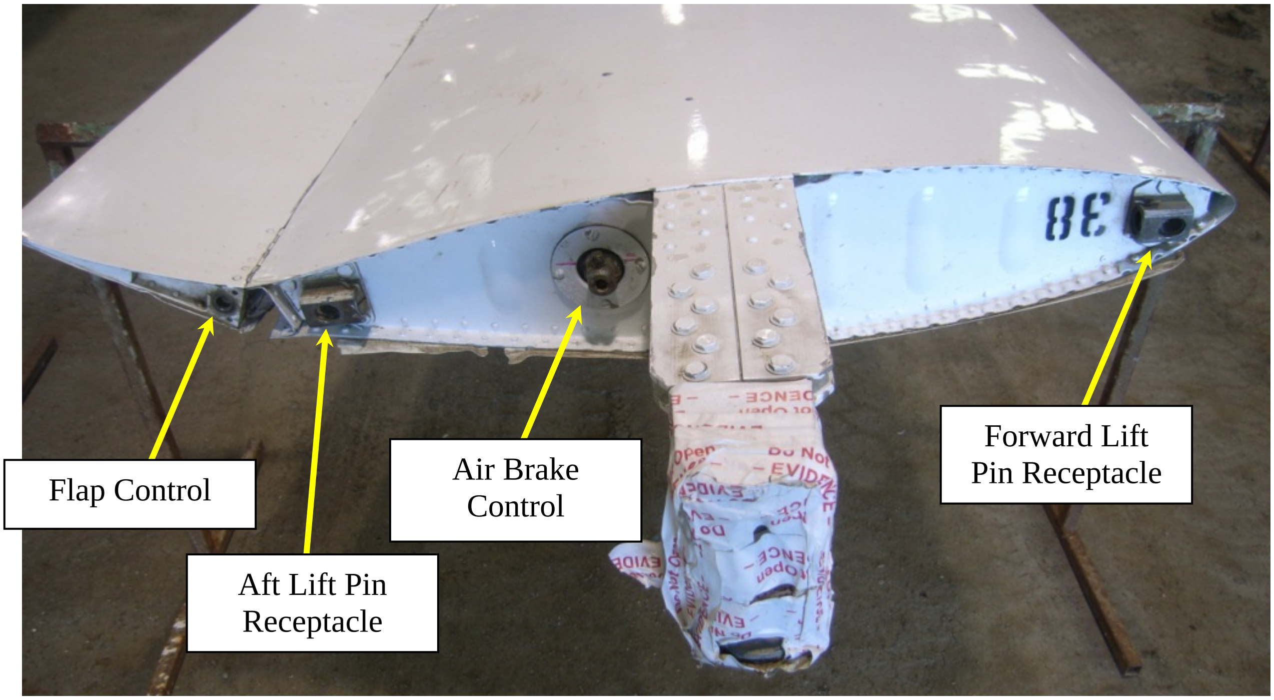

Figure 1 - Right Wing Root (inverted)

Figure 2 - Left Wing Clevis Tangs

Figure 3 - Right Wing Upper Clevis Legs, Fingers, and Cone Nut

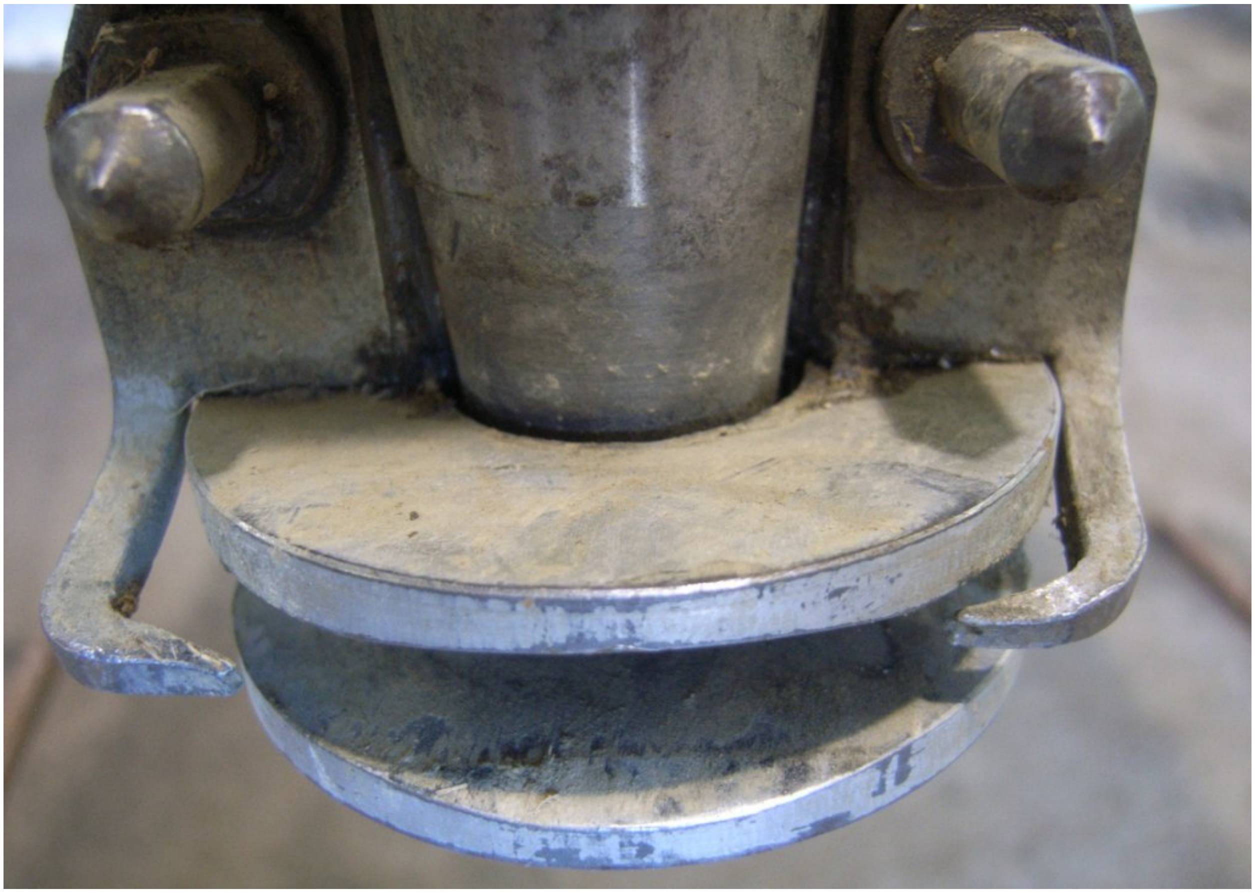

Figure 4 - Right Wing Lower Clevis Legs, Fingers, and Cone Nut

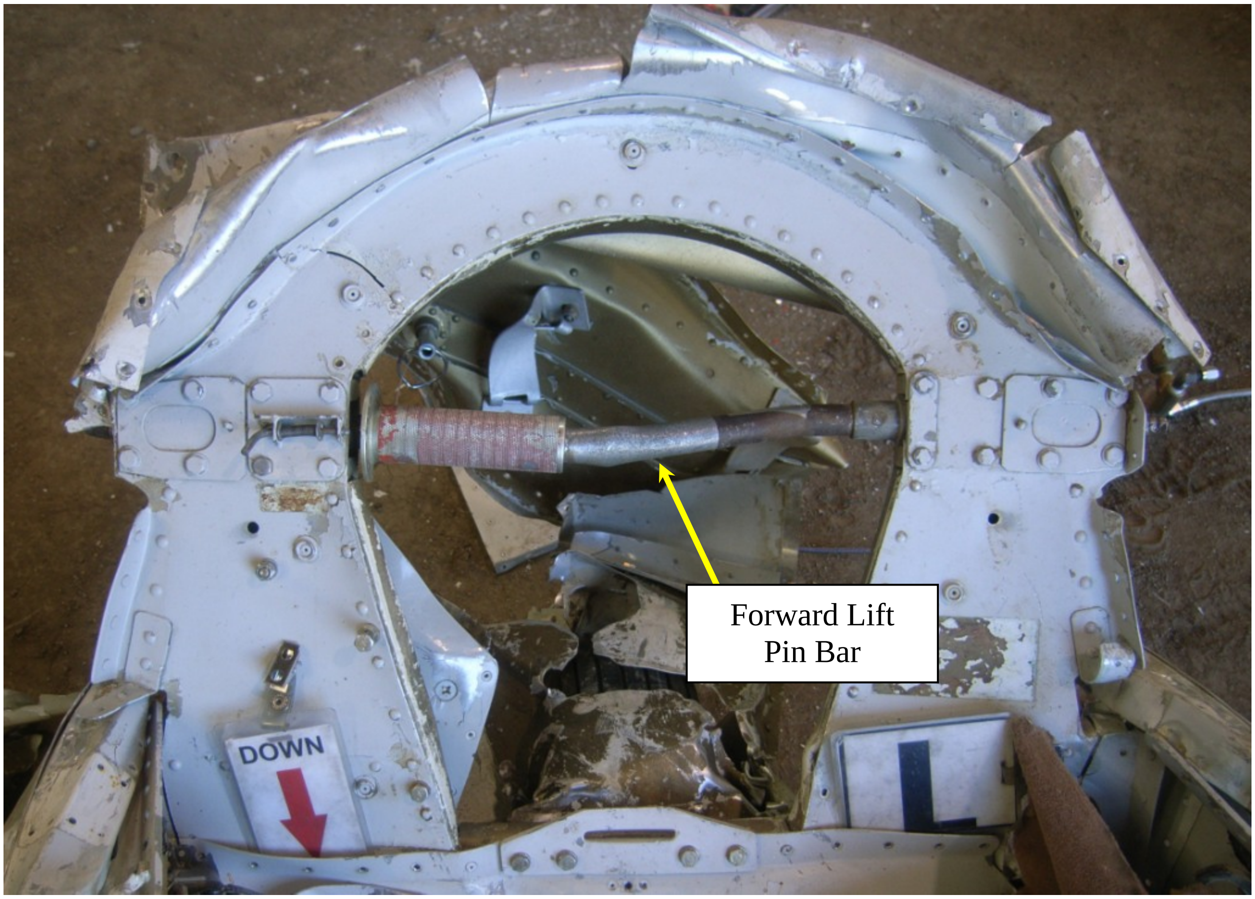

Figure 5 - Forward Lift Pin Adjustment Bar

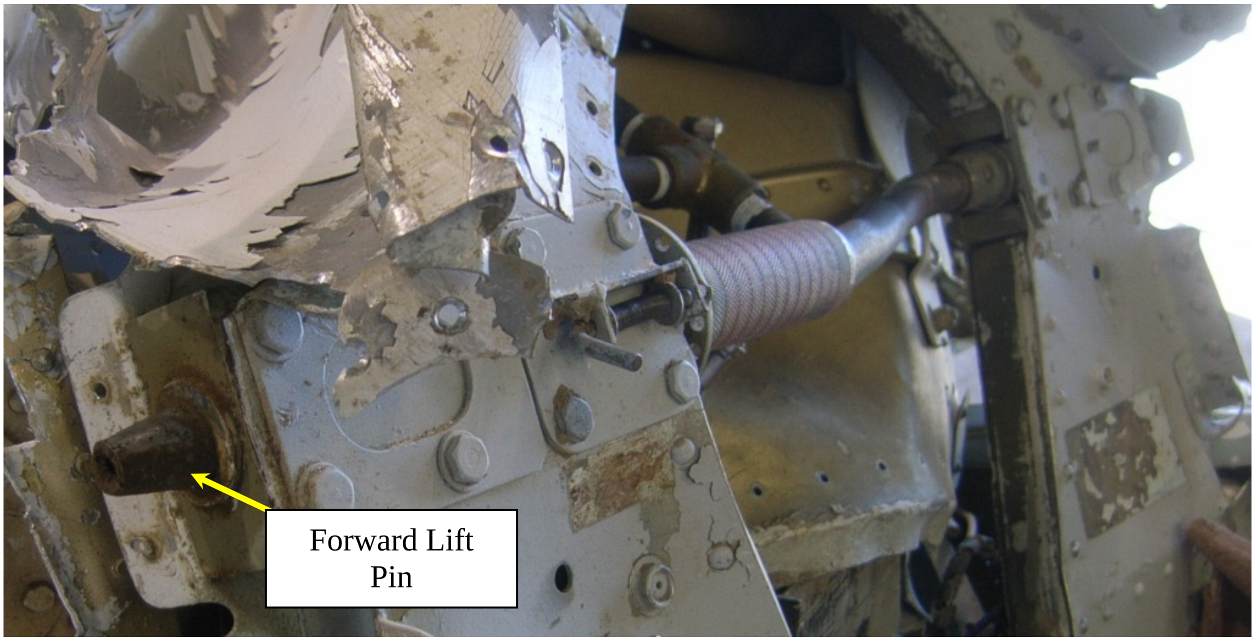

Figure 6 - Forward Right Lift Pin and Adjustment Mechanism

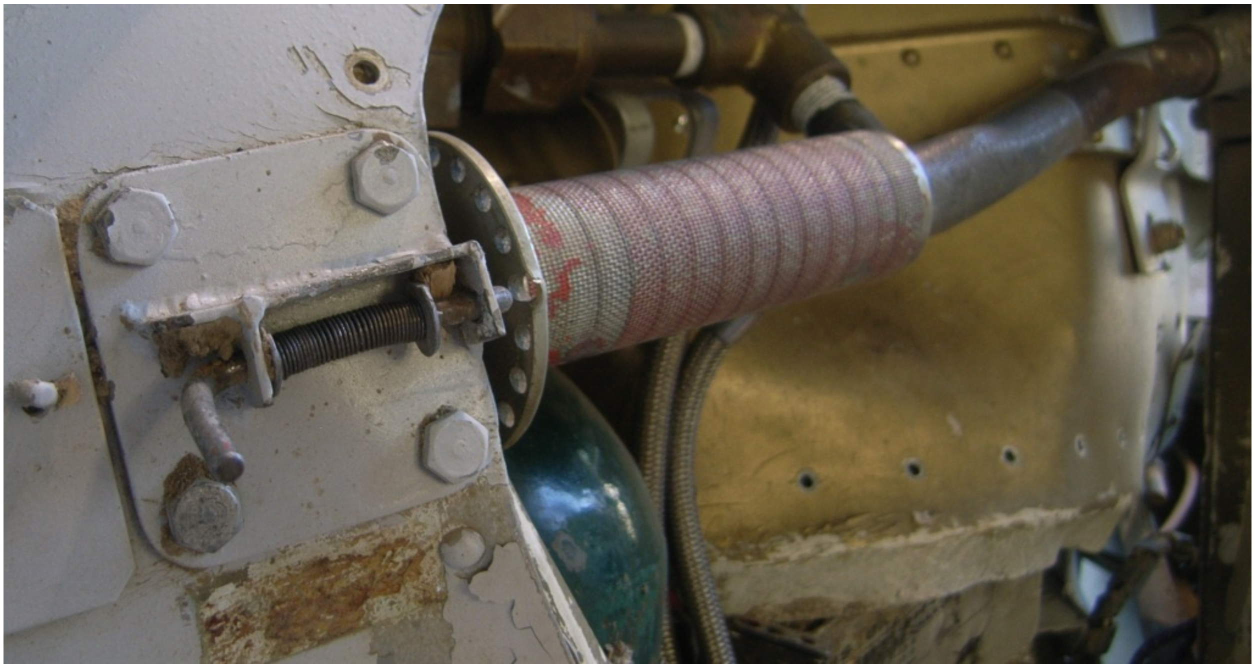

Figure 7 - Forward Lift Pin Adjustment Mechanism

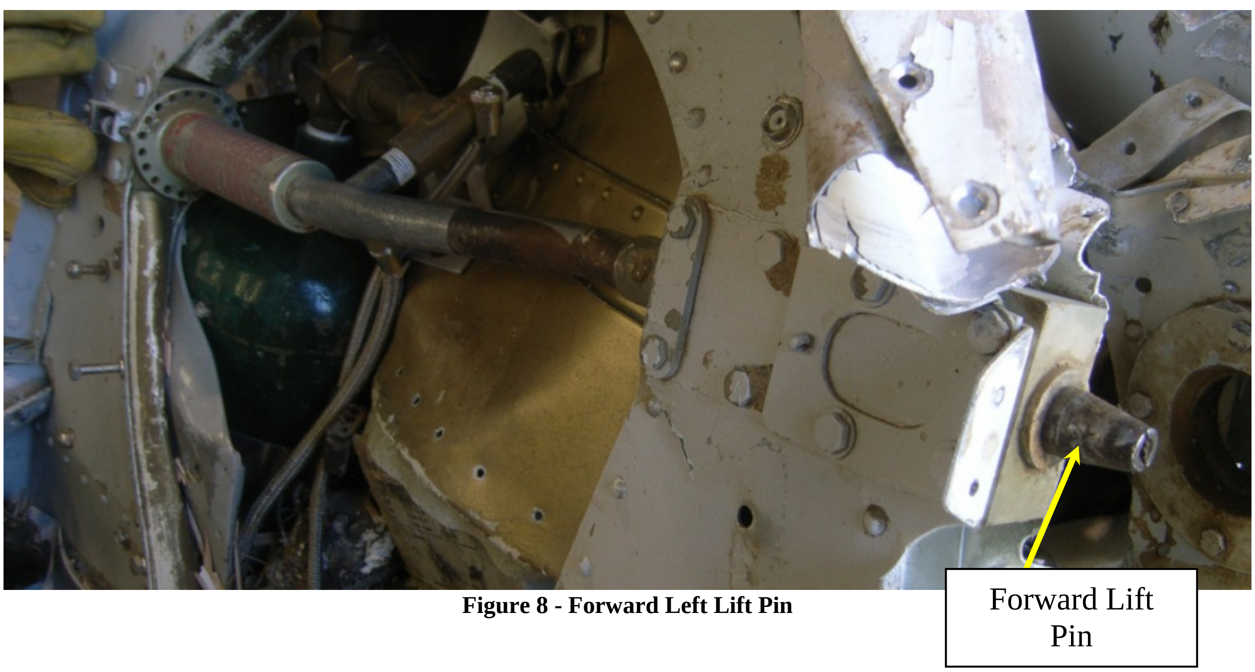

Figure 8 - Forward Left Lift Pin

Figure 9 - Forward Left Lift Pin

2.0 Flight Control Connections

- Each wing was equipped with 3 flight control systems
  - One aileron
  - One trailing edge flap
  - Two 'air brakes' or spoilers – one each on the upper and lower surface of the wing
- The aileron was controlled by a single push-pull rod in each wing
  - The use of push-pull rods eliminated the need for an aileron follow-up system such as a balance cable
  - The rod in each wing was positioned near the aft end of the wing
  - Each push-pull rod connected to the fuselage control system at a bellcrank that was part of the fuselage aileron linkage
  - The rod affixed to the bellcrank via a pin with an integral positive locking mechanism
  - Inboard travel of the rod raises (TEU) the respective aileron
  - Initial or in-service rigging of the ailerons was accomplished by adjusting the rod end at the inboard end of the push-pull rod, but once set, would not normally be adjusted as a function of wing removal/installation cycles

    - Once the wings were installed, the user would attach each aileron push-pull tube to its respective fuselage bellcrank arm
    - In the event of improperly- or incompletely-installed wings, the aileron linkage system design would not result in any connection difficulties; the only possible manifestation would be that the ailerons would be mispositioned, appearing to be misrigged.
- Each flap was controlled by a translating pin in the fuselage that inserted into a socket on the inboard end of each flap
    - The sockets were located near the leading edges of their respective flaps
    - The translating pins were bussed together to preclude independent flap travel
    - The pins translated aft and down to extend the flaps
    - Overall pin travel was about 1"
    - The pins inserted into the sockets as the wings were moved inboard during wing installation
- All 4 air brake panels operated in unison, and panels could not be operated independently or in pairs
    - The panels could be extended via a torque tube in each wing
    - The torque tube exited the wing root rib just aft of the main spar
    - The inboard end of each torque tube was fitted with a keying pin that installed perpendicular to the long axis of the tube.
    - Each keying pin was secured by a cotter key that was oriented 90° to the pin, and the ends of which protruded out the sides of the torque tube
    - The manufacturer's Parts Catalog (PC) specified that the keying pin was to be retained by a "rivet", part number "2017.D-3-24."
    - The PC illustration depicted the "rivet" as straight pin with no head; its appearance is congruent with an aviation hardware item called a "roll pin"
    - The PC contained many unusual, uncommon, or incorrect component names, which were likely a result of translation (Romanian to English) efforts
    - Each keyed torque tube end inserted into a slotted receptacle installed on the fuselage; these mated as the wings were installed on the fuselage
    - The keying pin of the left wing was observed to be properly (symmetrically) installed, but the keying pin of the right wing tube end was displaced
    - The cotter key remained in place but was highly deformed
    - The timing (pre-assembly vs during in flight wing separation) of the right pin displacement could not be positively determined, but it seemed likely that its damaged condition was the result of significant force, and that the pilot would have noticed such damage upon inspection prior to assembly
    - In its displaced-pin configuration, the right air brake wing-fuselage connection could not be fully accomplished; the wing torque tube end could only be partially inserted into the fuselage receptacle; the normal engagement distance of ~3/4" was reduced to less than ~1/4"
    - Attempts to fully insert the visually undamaged left wing torque tube end into its visually undamaged fuselage receptacle were unsuccessful; the apparent cause of this was the improper use of a cotter key to secure the keying pin in the torque tube end.
    - The observed insertion distance was only ~3/8", instead of the desired ~3/4 "
    - Despite this partial connection, the joint was functional; rotation of the fuselage receptacle resulted in rotation of the wing torque tube, and actuation of the air brakes

- This air brake linkage mis-fit, if it existed during the wing installation process, would prevent the affected wing from being fully and properly abutted to the fuselage.
- It could not be determined what effect, if any, either the displaced pin on the right wing, or the mis-fit of the left wing linkage, had on actual wing installation

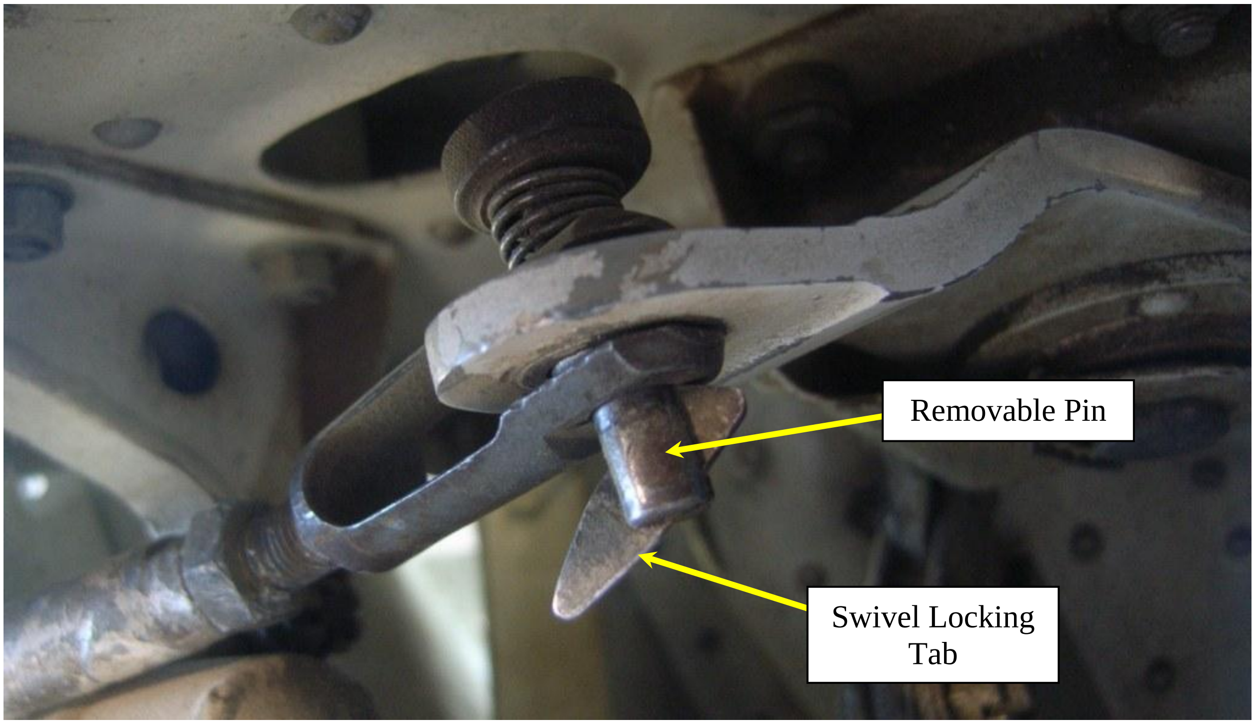

Figure 10 - Aileron Control Assembly/Disassembly Connection

Figure 11 -Right Wing Air Brake Torque Tube End

Figure 12 - Left Wing Air Brake Torque Tube End

Figure 13 - Left Wing Air Brake Torque Tube End (note cotter key)

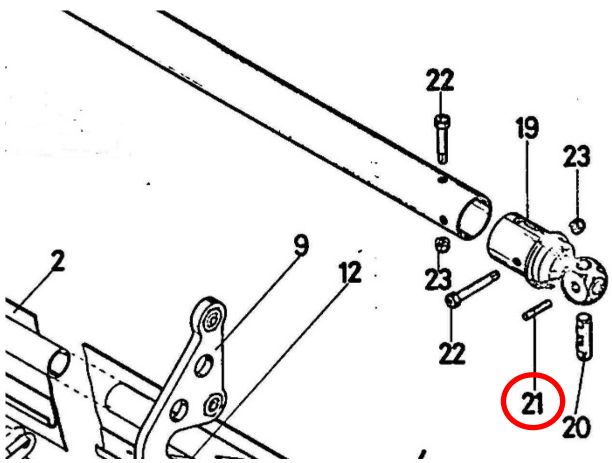

Figure 14 - PC Illustration of Torque Tube End

18.	Tube	29.12.o1.37	1+1	
19.	Joint (E)	29.12.o2.148	1+1	
20.	Pin	29.12.o2.147	1+1	
21.	Rivet	2o17.D-3-24	1+1	
22.	Hexagonal Screw	NIA.1o8.4.41	4+4	
23.	Nut	1125A5o-4	4+4	

Figure 15 - PC Part Callouts

Figure 16 – Improper/Incomplete Fit of Left Wing Air Brake Control Connection

3.0 Wing-Join Access During Assembly

- As the wings are pulled into the fuselage during assembly, access to several components would change.
- As the wings are installed into the fuselage, the clevis assemblies become mostly obscured from view.
    - When the wings are fully installed, the only view of the clevis assembly is through 2 access holes which were situated directly above the central pin
    - The uppermost hole was in the outer skin, and was a circular cutout about 4" in diameter
    - About 2" below that, a horizontal web had a concentric, circular cutout about 3" in diameter
    - The top clevis was situated just below that horizontal web
    - Therefore, visual and physical access to the central pin was limited, and only the upper leg of the upper clevis, and the top of the upper cone nut, could be seen or touched
    - However, the visual access was sufficient to permit relatively simple and clear visual determination of the position of the upper cone nut to an individual familiar with the mechanism
    - The paint on the horizontal web was mostly worn away in a circular pattern around the hole – this was consistent with user-induced wear as a result of use of the hex tool to tighten or loosen the cone nuts
    - Unlike other versions of this sailplane, there were no accommodations to secure/retain the hex key
- As the wings are installed into the fuselage, their respective aileron control linkage joints remain in view, with relatively easy visual & physical access

- As the wings are installed into the fuselage, their respective flap and air brake control linkage joints become completely obscured from view or physical access
- As the wings are installed into the fuselage, the aft 'lift pin' joints become completely obscured from view or physical access
- Damage prevented determination of visual or physical access conditions to the forward lift pin joints with the wings installed

4.0 Wing-Join Clevis Assembly Alignment and Security

Background

- The first and only time the pilot installed the wings were on April 27, 2018
- According to the persons who helped the pilot install the wings, they did not encounter any significant difficulties during assembly
- The owner of a similar exemplar sailplane stated that he needed to use the manufacturer's "lug/camming wrench" to maneuver his wings fully into position; the accident sailplane assemblers reported that the assembly was initially easy but then a tool was needed to complete the wing positioning.
- The pilot was only able to rotate the central pin about 6 to 8 turns during his assembly of the sailplane. In addition, the right and left wing-fuselage gaps appeared to be differently sized, and there seemed to be excessive play (relative motion) in the wing-fuselage joints.
- The pilot then queried the previous owner via telephone about these issues.
    - Although neither of the two assembly assistants heard or were aware of all the conversation details, the pilot's conclusion from that conversation was that the cone nuts had been properly positioned, and no additional activity regarding them was needed.
    - The wing-fuselage gap issue was rectified by partially backing out the left wing, adjusting the forward lift pin extension, pushing the wing back in, and re-securing the cone nuts.
- According to a May 18, 2018 email the pilot sent to that other owner of a similar sailplane, the only wing installation anomalies were described as follows:
  "Once the wings were together there was a lot of movement of the wings to the fuselage. It all tightened up after I cranked out the front lift bar tapered pins. Seemed like the gap was bigger in front than the rear. Normal to you?"

Empirical Results

The pin was rotated to determine the number of full 360° rotations required to move the cone nuts to a series of disengagement or engagement positions

- Until the cone nuts made contact with the clevis hole walls, there was very little rotational resistance to the central pin
- The central pin was rotated to back off the cone nuts so that the top of the upper cone nut was flush with the top face of the lower leg of the upper clevis, and the bottom of the lower cone nut was flush with the bottom face of the upper leg of the lower clevis, so that the cone nuts were positioned to permit the clevis legs to accept the clevis tangs. The pin was then rotated to drive the cone nuts to various positions, with the following results
    - 10 rotations were required to move the cone nuts to fully engage the clevis tangs
    - 16 rotations (6 additional from above) were required to get first contact of the cone nuts in the upper leg of the upper clevis and the lower leg of the lower clevis

    - 18 rotations (2 additional from initial seating) were required to fully seat the cone nuts
- The central pin was rotated to completely back off the cone nuts to the ends of the threaded segment of the pin, which positioned them well clear of their respective clevis legs. The pin was then rotated to drive the cone nuts to their fully seated positions
    - 23-7/8 rotations were required

<u>Calculated Results</u>

- As cited above, the overall cone nut travel distance from just clear of the clevis legs to level with the upper- and lower-most faces of the clevis legs was 57/64", or about 22mm
    - The thread pitch of the central pin which drove the cone nuts was measured using a thread pitch gauge to be 1mm
    - Therefore, because 1 full pin rotation will advance each cone nut 1mm, the theoretical number of full 360° rotations of the central pin to drive the cone nuts from just clear of the clevis legs to level with the upper- and lower-most faces of the clevis legs was calculated to be 22 turns
    - This value does not compare precisely with the observed empirical results. This is possibly due to measurement errors and tolerances, but no definitive reasons were identified. Regardless, both sets of values are significantly greater than the number of actual pin rotations made by the pilot during his wing installation.

F. OTHER OBSERVATIONS

- The left wing was intact for its full span
- The right wing was fractured into 2 sections, at about the 2/3 span point
    - The aileron was also fractured into 2 sections, 1 of which remained attached to the outboard wing section
- The horizontal stabilizer and elevator assembly was separated from the sailplane as a unit,
    - The assembly exhibited significant C-shaped crush damage from the leading edge, in the aft direction
    - The damage appeared to be centered about the lateral center of the assembly
    - The shape and size of the crush damage was consistent with a strike from either the right wing (at its fracture point) or the fuselage just aft of the wing location
- Two oxygen bottles were found inside the fuselage
    - Although damaged from the impact, both bottles/valves remained intact, and both contained some residual gas under pressure

Figure 17 - Fractured Right Wing and Aileron

Figure 18 - Fractured Right Wing and Aileron

Figure 19 - Horizontal Stabilizer and Elevator Assembly