AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:		CA18/2/3/10376	
Aircraft Registration	ZS-UJM	**Date of Accident**		14 October 2023		**Time of Accident**	0653Z
Type of Aircraft	Jodel F12A			**Type of Operation**		Private (Part 94)	
Pilot-in-command Licence Type	Private Pilot Licence			**Age**	68	**Licence Valid**	Yes
Pilot-in-command Flying Experience		**Total Flying Hours**		2 149.0		**Hours on Type**	unknown
Last Point of Departure	Springs Aerodrome (FASI), Gauteng Province						
Next Point of Intended Landing	Springs Aerodrome (FASI), Gauteng Province						
Damage to Aircraft	Destroyed						

Location of the accident site with reference to easily defined geographical points (GPS readings if possible)

Springs Aerodrome (GPS position: 26°15'02.50" South 028°24'02.95" East) at an elevation of 5 340 feet (ft)

Meteorological Information	Surface wind: 150°/6kt, temperature: 15°C, dew point: 4°C, CAVOK						
Number of People On-board	1 + 1	**Number of People Injured**	0	**Number of People Killed**	2	**Other (On Ground)**	0

Synopsis

On Saturday morning, 14 October 2023, a pilot and a passenger on-board a Jodel F12 aircraft registered ZS-UJM took off on a private flight from Springs Aerodrome (FASI) in Gauteng province with the intention to land back at the same aerodrome. The flight was conducted under visual meteorological conditions (VMC) and under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

The ZS-UJM was one of several aircraft that conducted several fly passes for photographers to take pictures. During one of the fly passes, which was conducted above Runway 14 and into the wind, ZS-UJM experienced a structural failure (wooden main spar structure) and both wings folded upwards and separated from the fuselage before the aircraft impacted the grass-covered area next to the runway. Both occupants on-board the aircraft were fatally injured. The aircraft was destroyed.

The main wing spar integrity was compromised by the builder/repairer following a previous accident in which the aircraft was involved; several holes were drilled through the wooden main wing spar beams.

Probable Cause

The aircraft experienced an in-flight structural failure when the main wing spar failed during flight, which resulted in a loss of control and the subsequent crash.

SRP date	8 October 2024	Publication date	9 October 2024

Occurrence Details

Reference Number	**:** CA18/2/3/10376
Occurrence Category	**:** Accident (Category 1)
Type of Operation	**:** Private (Part 94)
Aircraft Registration	**:** ZS-UJM
Aircraft Make and Model	**:** Jodel F12A
Nationality	**:** South African
Place	**:** Springs Aerodrome (FASI), Gauteng Province
Date and Time	**:** 14 October 2023 at 0653Z
Injuries	**:** Two fatalities
Damage	**:** Destroyed

Purpose of the Investigation

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not apportion blame or liability.

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Investigation Process

The Accident and Incident Investigations Division (AIID) of the South African Civil Aviation Authority (SACAA) was notified of a fatal accident which occurred on 14 October 2023 at 0715Z. The occurrence was classified as an accident according to the CAR 2011 Part 12 and the International Civil Aviation Organisation (ICAO) STD Annex 13 definitions. Two investigators were dispatched to the accident site.

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   Accident — this investigated accident
   Aircraft — the Jodel F12A involved in this accident
   Investigation — the investigation into the circumstances of this accident
   Pilot — the pilot involved in this accident
   Report — this accident report

2. *Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving the clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; enhancement of colour, brightness, and contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

Table of Content

Abbreviation	Description
°	Degrees
°C	Degrees Celsius
AGL	Above Ground Level
AIID	Accident and Incident Investigations Division
AME	Aircraft Maintenance Engineer
AMO	Aircraft Maintenance Organisation
AP	Approved Person
ATF	Authority to Fly
CAR	Civil Aviation Regulations
CAVOK	Ceiling and Visibility OK (for VFR flight)
cm	Centimetres
C of R	Certificate of Registration
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
FASI	Springs Aerodrome (ICAO designation)
FDR	Flight Data Recorder
ft	feet
GPS	Global Positioning System
hPa	Hectopascal
hp	Horsepower
IIC	Investigator in charge
kg	kilograms
kt	knots
kW	Kilowatt
m	metres
METAR	Meteorological Aerodrome Report
mph	Miles per hour
MTOW	Maximum Take-off Weight
NOSIG	No Significant Change
PIC	Pilot-in-command
PPL	Private Pilot Licence
QNH	Barometric Pressure Adjusted to Sea Level
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
Sq ft	Square feet
TBO	Time Between Overhaul
UTC	Universal Co-ordinated Time
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 On Saturday morning, 14 October 2023, a group of photographers gathered at Springs Aerodrome (FASI) for the Central East Rand Photographic Society congress. The event, which was aimed at offering a unique experience, included professionals from various industries. Before the commencement of the congress, several photographers took the opportunity to photograph aircraft that were on static display, as well as several aircraft that were conducting fly passes. This was pre-arranged with different aircraft owners and pilots.

1.1.2 The owner/pilot of the aircraft with registration ZS-UJM was among the aircraft conducting fly passes in the south-easterly direction over the grass-covered Runway 14 at FASI. A passenger accompanied the pilot during this private flight. The aircraft flew straight and level before the pilot pulled up. Shortly after the pilot initiated the pull-up, the main spar, composed of a wooden structure, failed and both wings folded upwards and separated from the fuselage. Due to the gyroscopic effect of the propeller turning in a clockwise direction (looking at it from inside the cockpit), the fuselage rolled in the opposite direction (left) and impacted the grass-covered area next to Runway 14. One of the photographers captured the breakup sequence on his camera, which is depicted in Figures 1 to 6.

Figure 1: First piece of debris seen falling (arrow) from the aircraft. (Source: Mr. S. Fletcher)

Figure 2: The wings start to cone upwards. (Source: Mr. S. Fletcher)

Figure 3: The wings continue to cone upwards. (Source: Mr. S. Fletcher)

Figure 4: The wings continue to cone upwards. (Source: Mr. S. Fletcher)

Figure 5: The wings in a near-vertical position. (Source: Mr. S. Fletcher)

Figure 6: Both wings in a vertical position. (Source: Mr. S. Fletcher)

1.1.3 The wreckage spread in a straight line over a distance of 98 metres (m). The right-wing structure first impacted the ground, followed by the left wing and then the main fuselage. The aircraft was destroyed and the two occupants on-board the aircraft were fatally injured.

1.1.4 The accident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be 26º15’02.50” South 028º24’02.95” East, at an elevation of 5 340 feet (ft).

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	1	-	1	2	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	-	-	-	-	-
Total	**1**	**-**	**1**	**2**	**-**

Note: Other means people on the ground.

1.3 Damage to Aircraft

1.3.1 The aircraft was destroyed during the in-flight break-up, followed by ground impact.

1.4 Other Damage

1.4.1 No other damage was caused.

1.5 Personnel Information

1.5.1 Pilot-in-command (PIC)

Nationality	South African	Gender	Male	Age	68
Licence Type	Private Pilot Licence (PPL)				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	None				
Medical Expiry Date	30 September 2024 (Class 2)				
Restrictions	VML – Valid only with Correction for Defective Distant, Intermediate and Near Vision VNL - Valid only with Correction for Defective Near Vision				
Previous Accidents	1. On 8 July 2004, the pilot was involved in an accident near Syferfontein Aerodrome (FASY) when he executed a forced landing after the engine of ZS-UJM failed in-flight. The pilot and the two passengers were seriously injured and the aircraft was destroyed. It took the pilot approximately one year to recover from his injuries. (AIID file reference number CA18/2/3/7830.) 2. On 29 July 2017, the pilot was involved in an accident with the same aircraft when he lost directional control during landing on Runway 03 at FASI when the right rudder cable failed. The				

	aircraft veered off to the left of the runway and nosed over, coming to rest in an inverted attitude. The aircraft sustained substantial damage. There were three occupants on-board, and none was injured. (AIID file reference number CA18/2/3/9632.)

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

Flying Experience:

Total Hours	2 149.0
Total Past 90 Days	11.4
Total on Type Past 90 Days	10.0
Total on Type	Unknown

1.5.2 The pilot's flying hours in the table above were obtained from the documentation he had submitted to the Regulator (SACAA) during the last renewal of his pilot licence on 7 September 2023. According to a copy of his pilot logbook that was attached to his submission, the skills renewal test (PPL Renewal) was the last flight he conducted before the accident flight. The skills renewal test was flown with a flight instructor on a Piper PA-28-140 (ZS-FTB) at Benoni/Brakpan Aerodrome (FABB) on 6 September 2023. Apart from the last three pages of his pilot logbook that accompanied his submission, his pilot logbook could not be obtained by the time this report was concluded. The aircraft flight folio was recovered with the last entry being a flight from FASI to FATP for which neither the date nor the return flight was entered.

1.6 Aircraft Information

1.6.1 Jodel F12A Aircraft (Source: www.mannaaviation.com)

The Falconar F12A Cruiser is a Canadian amateur-built aircraft, designed by Chris Falconar and originally produced as a kit by Falconar Avia. It is a development of the Falconar F11 Sporty which is, in turn, a variant of the Jodel D11. Falconar incorporates a larger cockpit, simplified fittings, shoulder harnesses, and aerodynamic improvements to improve stall characteristics over the Jodel design.

The F12 features a cantilever low-wing, two seats in a side-by-side configuration, an enclosed cockpit that is 112 centimetres (cm) wide, fixed conventional landing gear with a tail wheel, and a single-engine fitted with a two-bladed propeller.

The aircraft is made from wood with its flying surfaces covered in doped aircraft fabric. It has 8.5 metres (m) (28 feet) span wing, with a wing area of 13m$_2$ (140 sq ft). The aircraft's

recommended engine power is 112 to 134 Kilowatts (kW) (150 to 180 hp), and engines that have been used include a 112 kW (150 hp) Lycoming O-320 and the 134 kW (180 hp) Lycoming O-360 four-stroke powerplants.

Figure 7: File picture of the ZS-UJM aircraft. (Source: FlightZone Aviation Photography)

1.6.2 Airframe:

Manufacturer/Model	Jodel F12A	
Serial Number	ZS-WFB-1	
Year of Manufacture	1977	
Date first registered	3 November 1977	
Total Airframe Hours (at time of the accident)	366.39	
Last Annual Inspection (Hours & Date)	361.16	24 August 2023
Airframe Hours Since Last Inspection	5.23	
ATF (Issue Date & Expiry Date)	7 September 2021	30 September 2024
C of R (Issue Date) (Present Owner)	15 April 2002	
CRS Issue Date	24 August 2023	
Operating Category	Amateur built	
Type of Fuel Used	Avgas	
Previous Accidents	1. On 26 February 1984, the aircraft was involved in an accident in Rooipoort farm near Trichardt. The engine stopped shortly after take-off. The pilot landed back on the runway but the runway distance remaining was insufficient and, thus, a runway excursion followed. The right-wing tip contacted the adjacent maize field and the aircraft violently ground-looped to the right. The left main landing gear	

	strut broke off and the right wing and propeller sustained damage. (DCA file reference number; J10/2/4656). 2. On 8 July 2004, the aircraft was involved in an accident following an engine failure in-flight. The pilot executed a forced landing on an open field near Syferfontein Aerodrome. According to the accident report, the aircraft was destroyed. The pilot and the two passengers were seriously injured and were admitted to a hospital. (AIID file reference number; CA18/2/3/7830). 3. On 29 July 2017, the aircraft was involved in an accident at Springs Aerodrome when the right rudder cable failed. The pilot lost directional control during landing. The aircraft veered off the runway and nosed over; it came to rest in an inverted attitude. (AIID file reference number; CA18/2/3/9632).

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

Engine:

Manufacturer/Model	Lycoming O-320-B1A
Serial Number	A67318
Hours Since New	366.39
Hours Since Overhaul	54.39

According to the engine logbook entry on page 102, the engine was subjected to a major overhaul on 15 May 2021; this was after the accident aircraft was involved in an accident on 29 July 2017. There is no evidence to support that this work was undertaken by an approved engine overhaul facility/aircraft maintenance organisation (AMO). With the engine being a Class 1 product, Part 44 of the CAR 2011 and the South African Civil Aviation Technical Standards (SA-CATS) 44.01.16(3) are clear on the requirements that need to be followed.

Propeller:

Manufacturer/Model	Sensenich 74DM6S8
Serial Number	A58873
Hours Since New	366.39
Hours Since Overhaul	268.26

1.6.3 Summary of the History of the Aircraft

According to available information, the aircraft was an amateur built by two friends in Bethal and was first registered on the South African Register on 3 November 1977. The aircraft was involved in several accidents before the fatal flight on 14 October 2023.

(i) On 26 February 1984, the aircraft was involved in an accident in Rooipoort Farm near Trichardt. The left main gear broke off and the right wing and propeller were damaged when the aircraft ground-looped during landing.

(ii) On 16 July 1986, the aircraft was registered under the name of the pilot who was fatally injured in the accident in discussion. According to available information, he bought the wreckage following the accident on 26 February 1984. He then repaired the aircraft and continued to fly it until 1999, when he sold it. The aircraft was registered under the name of the new owner on 19 April 1999.

(iii) The owner then sold the aircraft a few months later and it was registered to a new owner on 23 August 1999.

(iv) According to an article in the South African aviation magazine dated 1 July 2004 the aircraft was involved in an accident in October 2000. It should be noted that AIID has no record of such an accident, as it was most probably not reported to the Regulator (SACAA) as per the provisions of Part 12 of the CAR 2011.

(v) On 15 April 2002, the aircraft was registered again to the pilot who was fatally injured in the accident in discussion. According to available information, he bought the wreckage from the previous owner following the accident in October 2000. He then repaired the aircraft and continued to fly it.

(vi) On 8 July 2004, the pilot and two passengers were involved in an accident on this aircraft. The aircraft (see Figure 8) was destroyed during the accident sequence (see Figure 9). The three occupants were seriously injured and were admitted to the hospital. During an interview with the pilot's wife, she indicated that it took her late husband more than a year to recover from his injuries of which he had spent several months in hospital.

Figure 8: The ZS-UJM before the accident on 4 July 2004. (Source: AIID records)

Figure 9: The wreckage of ZS-UJM following the accident on 4 July 2004. (Source: Newspaper clip)

(vii) The owner/pilot (the same person who was involved in the accident) then started to rebuild the aircraft. According to available information, he bought a partially built similar type of aircraft in 2005, of which the wing structure was completed by a person who was building it at Brits Aerodrome. This person relocated and could not continue with the project. According to an aircraft logbook entry, the rebuild process was concluded in 2010.

(viii) An entry in the aircraft logbook on page 85 stated that the covering fabric was severely damaged when the aircraft was parked outside during a hailstorm. The fabric of the entire aircraft needed to be replaced. All the flight control cables were inspected

during that process. The fuel tank was removed, cleaned and re-installed. It appeared that the work was completed in April 2012 as no defined date was entered in the logbook.

(ix) On 29 July 2017 the aircraft was involved in another accident when the pilot lost directional control during the landing roll at Springs Aerodrome following the failure of the right rudder cable. The aircraft veered off to the left of the runway and nosed over; it came to rest in an inverted attitude. There were three occupants on-board and no person was injured. The aircraft sustained substantial damage. Logbook entries on pages 93 and 95 summarise the damage as follows: left wing and the canopy sustained extensive damage, as well as some of the cowlings.

Figure 10: The wreckage of ZS-UJM following the accident on 29 July 2017.

Figure 11: ZS-UJM after it was turned upright.

(x) The owner/pilot (the same person involved in the accident) started to rebuild the aircraft again.

a. This required the construction of a new wing assembly as the left-wing structure sustained extensive damage. The aircraft has a box-shaped main wing spar similar to the photograph in Figure 12. The wooden main wing spar beams are covered with plywood to give it a box shape.

b. During the rebuild/repair, the owner also modified the cabin/cockpit layout by removing the rear seat and making it a two-seat configuration, as shown in Figure 7.

c. The instrument panel was also reconstructed.

d. On page 95 of the logbook, there was a subheading ENGINE with the following entry: *"The engine was dismantled, the crank bearings, and bushes were replaced with a new standard-size crank. The casing was inspected and tested for any cracks or damage due to the incident, none was found. Bolts and nuts were (word not legible) crankcase cleaned and painted before assembly by a certified AMO.* There was neither evidence in the logbook that a certificate relating to the maintenance of an aircraft (CRMA) was issued by a certified engine overhaul facility in the logbook to support this entry, nor was there an official stamp and signature of an AME.

e. There was neither a logbook entry on the status of the propeller, nor does the accident report CA18/2/3/9632 (29 July 2017) provide any information. Therefore, it is not known if it was damaged during this accident.

f. In Figures 13 and 14, the bending of the left upper landing gear support plate can be seen where it attaches to the main wing spar which is indicative of poor workmanship and stems from the overtightening of the four bolts that secure the leaf-spring strut to the wing support bracket. Further, the four supporting bolt heads were welded (substandard workmanship) to the upper support plate (see Figure 15). Part 66.04.16(5) states: *"The holder of an authorised person certificate who wishes to carry out welding on a non-type certificated aircraft shall be the holder of a welding certificate for the type of welding to be carried out. The certificate does not necessarily have to be for aircraft welding."*

Figure 12: This is an example of a wooden box-spar. (Source: www.mistralaviation.co.uk)

1.6.4 Post-annual Inspection

The last annual inspection before the accident flight was certified on 24 August 2023 by an approved person (AP). According to available information, the two-leaf springs that are part of the main landing gear were removed from the aircraft after the mentioned annual inspection and were taken to a sheet metal shop where they were bent on request by the aircraft owner. On 25 September 2023, the two-leaf springs and the main wheels were installed back on the aircraft. This work was performed by two people who did not possess any aircraft maintenance qualifications, either being an aircraft maintenance engineer (AME) or an AP as per the provisions of Part 44.01.4 (see Appendix B for the Regulation). Also, no dual check was conducted by an aircraft maintenance organisation (AMO), AME or AP on the aircraft as required by Subpart 4 of Part 66 of the CAR 2011. There was no flight folio entry regarding the work performed as per the provisions of Part 44.01.13 of the CAR 2011 (see Appendix B for the Regulation).

Figure 13: The upper attachment support plate of the left main landing gear was bent.

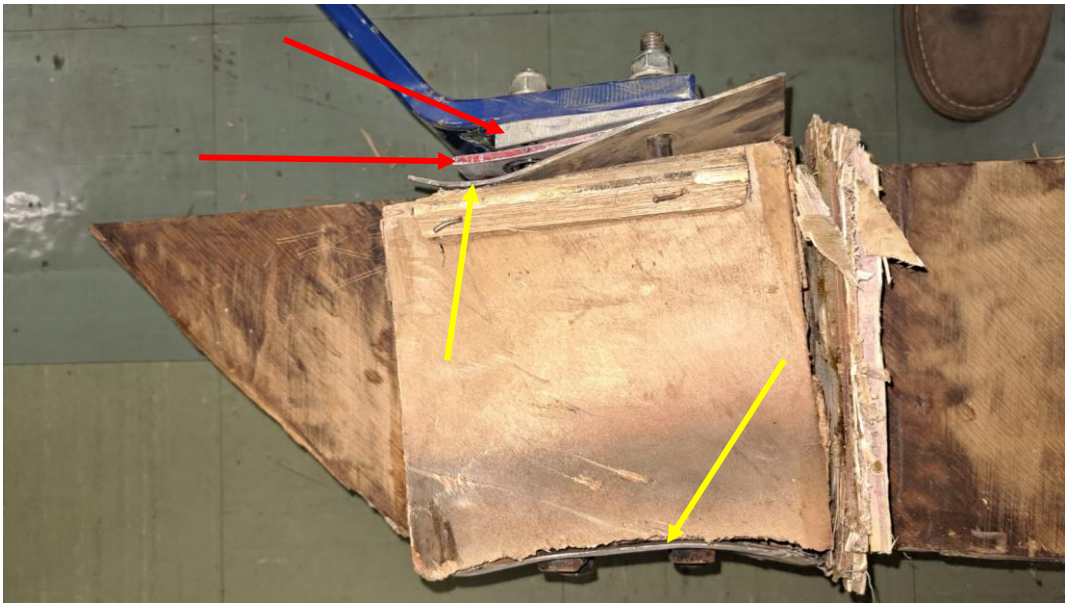

Figure 14: Two homemade spacers, indicated by red arrows were found on the left main gear. The yellow arrows indicate substantial bending of the upper and lower steel support plates.

Figure 15: The four-bolt heads welded to the upper support plate (left gear).

Figure 16: The leaf spring strut secured to the lower main spar (right gear).

1.6.5 Take-off Weight

Item	Weight (kg)
Aircraft empty weight	525
Pilot	94
Passenger	96
Fuel	36
Take-off Weight	**751kg**

According to available information, the maximum take-off weight for this aircraft was 813kg.
*NOTE: The weight of the pilot and passenger used in the calculation was obtained from their respective post-mortem reports.

The last flight folio entry was for a flight from FASI to New Tempe Aerodrome (FATP) near Bloemfontein. No fuel uplifts were entered, and there was no return flight from FATP to FASI recorded. The fuel on-board the aircraft for weight and balance was, therefore, estimated at 50L, which equates to 50 x 0.72 = 36kg.

According to the aircraft logbook page 82 under the heading Aircraft Mass and Balance Records, the aircraft was last re-weighed on 26 May 2021 and the empty weight was entered as 525kg. There was, however, no person who had certified this weighing procedure as per the provisions of Part 44.01.9 2(b) *"the mass and centre of gravity data must be signed by an appropriately rated approved AMO, AME or approved person, rated in accordance with subpart 4 of part 66".* To calculate the take-off weight of the aircraft, the empty weight was used as entered in the logbook.

According to the aircraft logbook, the last reweigh of the aircraft before the one mentioned above was on 26 July 2015 when the empty weight was 510kg. This was before the accident on 29 July 2017. During the repair of the aircraft following that accident, certain modifications were made, which could have altered the aircraft's empty weight.

1.7 Meteorological Information

1.7.1 The weather information below was obtained from the Meteorological Aerodrome Report (METAR) that was issued by the South African Weather Service (SAWS), recorded at FASI on 14 October 2023 at 0600Z.

FASI 140600Z AUTO 15006KT //// // ////// 15/04 Q1026=

Wind Direction	150°	Wind Speed	6kt	Visibility	9999m
Temperature	15°C	Cloud Cover	Nil	Cloud Base	Nil
Dew Point	4°C	QNH	1026hPa		

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator. There were no records indicating that the navigational equipment was unserviceable prior to the flight.

1.9 Communication

1.9.1 The aircraft was equipped with a standard communication system as approved by the Regulator. There were no recorded defects with the communication system before the flight.

1.10 Aerodrome Information

1.10.1 The aircraft crashed at FASI next to the grass-covered runway orientated 14/32.

Aerodrome Name	Springs Aerodrome (FASI) [ICAO designation]
Aerodrome Location	Springs
Aerodrome Status	Licensed
Aerodrome GPS coordinates	26º15'00.00" South, 028º24'00.00" East
Aerodrome Elevation	5 340ft
Runway Headings	03/21 14/32
Dimensions of Runway Used	1 600 x 18m 554 x 20m
Heading of Runway Used	14
Surface of Runway Used	Asphalt
Approach Facilities	Runway lights, PAPIs
Radio Frequency	122.40 MHz

1.11 Flight Recorders

1.11.1 The aircraft was neither equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the aircraft type.

1.12 Wreckage and Impact Information

1.12.1 Following the in-flight structural failure, the wreckage was spread in a straight line on the grass area to the right of Runway 15 at FASI. The right-wing was the first structure in the sequence of break up, it was followed by the left wing and the main fuselage, empennage structure, and the engine. The wreckage spread over a distance of 98m.

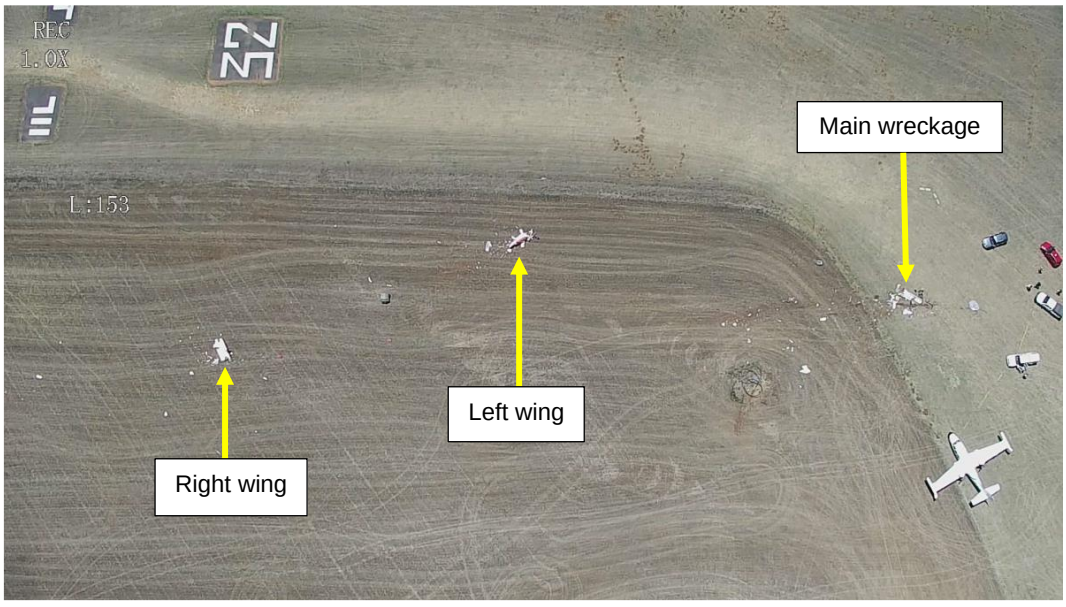

Figure 17: Drone camera footage depicting the wreckage distribution. (Source: Drone Ops)

Figure 18: The right wing.

Figure 19: The left wing.

Figure 20: The main wreckage.

Figure 21: The engine in an inverted attitude with the propeller severed from the crankshaft.

1.13 Medical and Pathological Information

1.13.1 According to the medico-legal post-mortem report, the pilot's cause of death was determined to be: Multiple Blunt Force Injuries.

1.13.2 According to the medico-legal post-mortem report, the passenger's cause of death was determined to be: Multiple Blunt Force Injuries.

1.14 Fire

1.14.1 There was no pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was not considered survivable due to the destruction of the aircraft during the in-flight breakup and the subsequent ground impact.

1.16 Tests and Research

1.16.1 The main wing spar centre section that failed in flight was taken to the Laboratory for Microscopy and Microanalysis for examination. The laboratory report is attached as Appendix A.

1.16.2 The report concludes that the holes drilled through the main spar beams centre section severely compromised the structural integrity of the main wing spar and, in combination with the increased moment-arm force induced by the main landing gear leaf-spring modification, are considered the primary factors to this failure.

1.16.3 There are no inspection panels on the wings of these aircraft that allow for any inspection of the wing spar/wing structure. Should one wish to conduct such an inspection, a hole or holes need to be cut in the fabric, which then has to be patched up after such an inspection was completed. This will only allow for a visual inspection and the main spar structure will remain uninspected.

Figure 22: Several holes that were drilled next to each other through the main spar beam.

Figure 23: A hole drilled through the main spar beam.

Figure 24: Fractured lower main spar beams with holes drilled through them.

1.17 Organisational and Management Information

1.17.1 This was a private flight that was conducted in accordance with the provisions of Part 94 of the CAR 2011. The pilot was the owner of the aircraft.

1.17.2 The last annual inspection that was conducted on the aircraft before the accident flight was certified on 24 August 2023 by an AP. The AP was issued an AP Certificate by the Regulator on 1 August 2022, which was valid until 31 July 2024.

1.18 Additional Information

1.18.1 Maintenance Schedule and General Maintenance Guidelines

The document Maintenance Schedule and General Maintenance Guidelines for this aircraft type were obtained from the AP who had certified the last two annual inspections of this aircraft. The document has a list of daily inspections, 50-hour inspections, and 100-hour inspections for the aircraft type. The 100-hour inspection, bullet point 4 on page 4 of 7 states: *"Inspect main spar and rear spar".* The AP had signed off on this part of the document.

100 Hours Inspection:

In addition to the 50 Hours Inspection:

1. **CHECK:**
2. The internal appearance of the fuselage, particularly the bottom of the rear fuselage and the floorboards of the cabin.
3. The tightening (moderate on wood) of the principle attachment points; 6 airscrew bolts, 4 engine bolts, 8 engine bearer bolts, 4 bolts for mainplane attachment, 4 bolts for tailplane attachment, 3 bolts for tail spring, 8 bolts for undercarriage and possibly the bolts for control surface hinges.
4. Inspect main spar and rear spar

1.18.2 Landing Gear

The aircraft was fitted with two leaf spring main gear struts and a tail wheel. The two leaf spring struts were secured to the main wing spar. The attachment of these leaf springs was dealt with in sub-paragraph 1.6.4 of the report. Figure 25 is a photograph that was taken on 16 November 2016 at Brits Aerodrome, this was before the accident on 29 July 2017. The same landing gear configuration was installed on the aircraft following the rebuild/repairs after the accident, with wheel spats added.

Figure 25: The photograph illustrates the installed leaf spring gear struts.
(Source: FlightZone Aviation Photography)

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 General

From the available evidence, the following analysis was made with respect to this accident. This shall not be read as apportioning blame or liability to any organisation or individual.

2.2 Analysis

2.2.1 The pilot/aircraft owner

The pilot had been flying since 1983 and was involved in several accidents before the accident in discussion, leaving him with extended periods without a valid aviation medical certificate. He was appropriately rated, and his licence was valid at the time of the accident flight. He had a valid Class 2 aviation medical certificate.

The pilot's logbook could not be located but copies of the last few pages were obtained during the last renewal application for his licence. With this information and the flight folio of the aircraft, which was recovered at the accident site, it was possible to calculate some of his flying hours.

The pilot who was also the owner of the aircraft was flying the aircraft type since 1986. He rebuilt and repaired the aircraft after the accidents that occurred in 2004 and 2017 where he was the pilot at the time. He was, therefore, well aware of the structural integrity of the main wing spar. But for the reason(s) unknown, he did not take any corrective action by replacing the essential spar beams with new/uncompromised ones.

2.2.2 The aircraft

According to the aircraft flight folio, the aircraft was flown for the first time on 4 September 2021 after the rebuild/repairs following the accident on 29 July 2017. Documented evidence obtained from the aircraft flight folio and logbook determined that 54.6 hours were flown with the aircraft and 111 landings were conducted over the period 4 September 2021 until the accident flight on 14 October 2023. The failure of the main wing spar most probably developed over a relatively short period.

The main wing spar is the principal structural part of the wings. The box-shaped spar consists

of the upper and the lower spar cap made of glue-laminated plywood covers on all three sides.

A similar main wing spar design as referenced in Figure 12 was used in this aircraft. The design neither allows for any maintenance inspection to be performed on the main beams and inner structure, nor the wood quality or the detection of wood fungi of the spar as it is a box-shaped spar and encased in plywood. There are no inspection panels on the wings of these aircraft that allow for any inspection of the wing spar/wing structure. Should one wish to conduct such an inspection, a hole or holes need to be cut in the fabric, which then has to be patched up after such an inspection is complete. This will only allow for a visual inspection and the main spar structure will still remain uninspected.

What was observed during the structural failure of the main wing spar in-flight was that the integrity of the main spar beams on this aircraft was severely compromised by the builder/repairer following the accident on 29 July 2017. Several holes were found drilled or partially drilled through the main spar beams in the area of the centre section (the area where the failure occurred). It could not be determined with certainty what the actual purpose of these holes was, however, it was noted that wing fuel tanks were installed during the rebuild/repair. What is important to bear in mind is that the builder/repairer was most probably the only person who was aware of this latent defect (the drilled holes through the wing spar structure), which was not at all visible to other people due to the box-shaped design. Not even the AP who certified the aircraft after the rebuild/repairs was completed would have been able to inspect the main spar structure after it was completed to a flyable condition. Any such substandard workmanship would not have been visible to any person during a post-accident repair inspection and could, therefore, not be detected. The fact that the builder/repairer just left the drilled holes and covered them with plywood is of serious concern as the person must have been aware of the consequences and the immense impairment it would have on the structural integrity of the main spar that was compromised by these actions.

Working with wood has its unique challenges and requires an in-depth understanding of all potential hazards associated with the medium. Wood failure analysis has the potential to manifest with one or more of the following scenarios: compression failure, tensile failure, fibre deviations, fatigue of wood, wood-discolouring fungi and wood-destroying fungi, the influence of iron salts, and the failure of bond lines. Unlike metal, wood does not present failure modes in the same way, and it is presently not possible to distinguish between these scenarios for wood. It is, therefore, extremely difficult to detect any possible failure modes or embedded failures that are not visible to the naked eye.

Landings produce an abrupt and high compression of the lower spar cap due to the inertia of the wing mass. In comparison with this impulse within a few tenths of a second, the manoeuvre flight can be taken as a slow process, producing a “static” load.

Regarding the leaf spring gear installation, it was found that two homemade spacers were installed between the leaf spring support bracket and the lower wing structure on the left main gear. These two spacers were installed after the two leaf springs were removed from the aircraft and were taken to a sheet metal shop to be bent. The primary reason for the bending and the two spacers on the left side was that the aircraft owner/pilot was not happy with the aircraft on the ground as it presented a left-wing low attitude. There were, however, no documented flight folio or logbook entries in this regard. It was, however, confirmed with the owner of the sheet metal shop that the owner/pilot had brought two leaf springs in person and explained to him what his problem was and what he required. The two leaf spring gear struts were then re-installed to the aircraft on 25 September 2023 by two people who were not acquainted with aviation maintenance. It would appear that following the installation, the aircraft owner/pilot was still not happy with the aircraft's attitude, hence, the two spacers were inserted to get a wings-level aircraft. The primary reason as to why the aircraft suddenly presented the left-wing low attitude on level ground was not pursued further, yet the owner opted for the easy solution of solving the problem by inserting the two spacers. The accident flight was the first flight after the work was conducted. It could be asked if the main spar did not present any indication of a potential initial failure before the accident flight already, hence, the reason why the aircraft suddenly presented this left-wing low phenomenon.

2.2.3 Environment

Fine weather conditions prevailed at the time of the flight, which had no bearing to this accident.

2.2.4 Conclusion

This accident occurred as a result of the builder/repairer not adhering to basic principles in aircraft repair and a blatant disregard for aviation safety. The main wing spar of the aircraft is a critical structural component if not the most critical component of an aircraft as it carries the weight of the aircraft on the ground and in-flight. The fact that numerous holes were drilled through the main spar beams seriously compromised the structural integrity of this aircraft, which subsequently failed within a relatively short period, with the aircraft accumulating 54.6 flight hours and 111 landings since the rebuild/repair from the previous accident in which it was involved.

The aircraft was found not to be airworthy in terms of Part 24.01.2(1)(c) *"A non-type certificated aircraft, other than an aircraft classified in regulation 24.01.1 (2) (h) to (l), may only be considered to be airworthy if that aircraft has — no known condition which could make it unsafe for flight".*

It is evident from the information gathered and tabled in the report that the rebuild/repair of

the aircraft was conducted without critical inspections being conducted by an appropriately rated AMO, AME or AP at critical phases during the process. The aircraft logbook has an entry where an AP inspected the aircraft after it was restored to a *"flyable condition"*. This inspection is of superficial value as the AP cannot inspect certain critical structural areas. Part 24.01.7(3), which states the following does provide *"indemnity"* to an appropriately rated AMO, AME or AP and with the owner of the aircraft being the responsible person for the airworthiness status of the aircraft: *"Any inspection carried out on a non-type certificated aircraft in terms of subregulation (1) is of a conditional nature, in that the inspector an appropriately rated approved AMO, AME or approved person, rated in accordance with subpart 4 of part 66 shall not be required to guarantee the airworthiness of the aircraft. The owner or operator of the aircraft shall at all times be responsible for the airworthiness status of the aircraft and, if called upon, shall prove to an inspector that the aircraft is in an airworthy condition."*

Part 66.04.16(3) does state the following: *Any inspection carried out on a non-type certificated aircraft in terms of regulation 24.01.8 shall be of a conditional nature in that the approved person carrying out the inspection shall not be required to guarantee the airworthiness of the aircraft.*

The aircraft owner was responsible for the airworthiness status of this aircraft, but he opted to take it to the sky knowingly it had a latent failure, which rendered it unsafe for flight. The aircraft owner/pilot, therefore, did not fail himself but also the people who flew with him during the accumulated 54.6 hours.

The Regulator's decision to reissue the aircraft with an Authority to Fly (AFT) following the previous accidents the aircraft was involved in is of great concern as it displays a lack of oversight over Non-type Certified Aircraft (NTCA) in general.

3. CONCLUSION

3.1 General

From the available evidence, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.

- **Causes —** are actions, omissions, events, conditions, or a combination thereof, that led to this accident.
- **Contributing factors —** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided, or absent, would have reduced the probability of the accident occurring, or would have mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil, or criminal liability.

3.2 Findings

The pilot

3.2.1 The pilot had a Private Pilot Licence (PPL). The pilot was initially issued the licence on 28 November 1983 by the Regulator. His renewed licence was issued by the Regulator on 7 September 2023 with an expiry date of 30 September 2025. The pilot had the aircraft type endorsed on his licence.

3.2.2 The pilot was issued a Class 2 aviation medical certificate on 5 September 2023 with an expiry date of 30 September 2024.

3.2.3 According to available evidence, the pilot was involved in two previous aircraft accidents with the same aircraft. During the accident in 2004, he was seriously injured and spent several months in hospital.

The aircraft

3.2.4 The aircraft was involved in several accidents before the fatal flight. These accidents are listed under sub-heading 1.6, Aircraft Information. Every time the aircraft was rebuilt/repaired the serial number and registration remained unchanged.

3.2.5 The last annual inspection that was conducted on the aircraft before the accident flight was certified on 24 August 2023 at 361.16 airframe hours by an AP.

3.2.6 The aircraft was re-issued an Authority to Fly (ATF) on 14 September 2023 with an expiry date of 30 September 2024.

3.2.7 The aircraft was issued a Certificate of Registration (C of R) under the present owner on 15 April 2002.

3.2.8 The aircraft was issued a Certificate of Release to Service (CRS) on 24 August 2023, which was valid until 23 August 2024 or at 461.16 airframe hours, whichever comes first.

3.2.9 According to the Tachometer, the aircraft had flown 5.23 hours since the last annual inspection. The last entry in the flight folio was when the pilot flew from FASI to New Tempe Aerodrome (FATP). No information was entered in the flight folio following the flight to FATP.

3.2.10 The main landing gear on this aircraft was removed after the last annual inspection was certified. The two leaf springs were taken to a sheet metal shop by the owner/pilot where they were bent. The removal and fitment of the landing gear were conducted by two persons who had no aircraft maintenance qualifications. Also, no dual inspection was conducted by an AMO, AME, or AP as per the provisions of Part 44.01.4.

3.2.11 Two homemade (substandard) spacers were found inserted between the lower wing body (main spar) and the leaf spring strut on the left main gear.

3.2.12 There was no flight folio entry regarding the removal of the two landing gear struts as required by the provisions of Part 44.01.13.

3.2.13 The aircraft was involved in three previous accidents. During the accident on 8 July 2004, the aircraft was destroyed and was rebuilt. During the accident on 29 July 2017, the aircraft came to rest in an inverted attitude next to the runway and was again repaired. In this accident, the left wing suffered substantial structural damage.

3.2.14 Part 24.01.7(3) states *"The owner or operator of the aircraft shall at all times be responsible for the airworthiness status of the aircraft and, if called upon, shall prove to an inspector that the aircraft is in an airworthy condition."*

3.2.15 The aircraft was found not to be airworthy as the owner/pilot was aware of a known condition which made the aircraft unsafe for flight as per the provisions of Part 24.01.2(1)(c).

Environment

3.2.16 Weather conditions indicated good visibility with no clouds at FASI at the time of the flight. The prevailing wind was 150º at 6 knots, which had no bearing to this accident.

Aerodrome

3.2.17 FASI is a licensed aerodrome. There is no Airport Rescue and Fire Fighting (ARFF) service based at FASI and there are no air traffic control services.

3.3 Probable Cause

3.3.1 The aircraft experienced an in-flight structural failure when the main wing spar failed during flight, which resulted in a loss of control and the subsequent crash.

3.4 Contributory Factors

3.4.1 The main wing spar structural integrity was severely compromised when the builder/repairer drilled several holes through the centre section of the wing spar beams.

3.4.2 The fitment of the main landing gear leaf springs after the last annual inspection to the main spar displays evidence of poor workmanship. Spacers were inserted and substantial bending of the support plates was observed that was supported by the main wing spar. This work was conducted by two non-aviation qualified maintenance personnel under the supervision of the aircraft owner.

3.4.3 Due to poor record keeping and lack of traceability of work that was performed on the aircraft, especially during the repair of the aircraft following the accident on 19 July 2017, the aircraft did not meet the required airworthiness requirements, which rendered it not airworthy as per the provisions of Part 24.01.2(1)(c) *"A non-type certificated aircraft, other than an aircraft classified in regulation 24.01.1 (2) (h) to (l), may only be considered to be airworthy if that aircraft has — no known condition which could make it unsafe for flight"*.

3.4.4 Inadequate regulatory oversight with regard to NTCA aircraft that were involved in accidents and being rebuilt and repaired post the occurrences, and then reregistered again by the Regulator.

4. SAFETY RECOMMENDATIONS

4.1 General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2 Safety Recommendation

4.2.1 It is recommended that the Director of Civil Aviation consider a revision of the Regulations and SA-CATS-24 regarding the requirements following the rebuild/repair of NTCA that were involved in accidents. The guidelines should be clear on aircraft that were destroyed in an

accident and intended to be rebuilt/repaired by an individual(s) or an organisation to a flyable condition.

4.2.2 It is recommended that the Director of Civil Aviation rectify the reference (24.01.8) mentioned in Part 66.04.16(3) of the CAR as it should read Part 24.01.7(3).

4.2.3 Regulations and SA-CATS-24 focusing on NTCA aircraft are open for interpretation. It is recommended to the Director for Civil Aviation that they should be more specific to prevent a similar scenario from happening. This recommendation stems from the accident which occurred on 4 July 2004 in which the accident report stated that the aircraft was destroyed. Yet, after it was rebuilt, the Regulator issued an ATF with the same registration and the same serial number.

5. APPENDICES

5.1 Appendix A: Failure Analysis Report from the Laboratory for Microscopy and Microanalysis

5.2 Appendix B: Several extracts from the SA Civil Aviation Regulations of 2011 as amended.

This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa

Appendix A

COMPILED BY:	LABORATORY FOR MICROSCOPY & MICROANALYSIS	PAGE 1 OF 10	
	FAILURE ANALYSIS REPORT: Main Wing Spar Assembly, Jodel F12, Aircraft No ZS-UJM	DOCUMENT NUMBER FA-010-06-24	
COMPILED FOR: SACAA (AIID)		DATE 2024-06-10	ISSUE 1

ITEM: **MIN WING SPAR ASSEMBLY, JODEL F12, AIRCRAFT NO ZS-UJM**

Contents

1. BACKGROUND INFORMATION

1.1. Description: Failed Item

The failed Main Wing Spar assembly (Photo 2) originating from a Jodel F12, aircraft registration No ZS-UJM (Photo1), Serial No ZS-WFB-1, was supplied to determine (a) the fracture mode, (b) the probable cause/s thereto and (c) the most probable Failure Sequence of Events (SoE).

1.2. Accident and Aircraft Information: ZS-UJM

1.2.1. During July 2004 ZS-UJM was involved in an accident resulting in extensive damages. *No information towards the extend of the damages and the subsequent repair were supplied to this investigation.*

1.2.2. During July 2017 ZS-UJM was again involved in a runway excursion resulting in substantial damages. *No information towards the extend of the damages and the subsequent repair were supplied to this investigation.*

1.2.3. On the 14th of October 2023 ZS-UJM was involved in an accident resulting in 2x fatalities and the total destruction of the aircraft. Photos supplied revealed both the Main Wings separated from the main fuselage in flight (Photo 3).

1.2.4. The aircraft had a total of 336.39 operational hours since manufacturing in 1977. The last annual inspection was 5.23 hours prior to the accident.

1.2.5. Post-accident inspections by the AIID on ZS-UJM revealed a non-standard main wing fuel tank modification (Photo 4, red arrow).

1.2.6. ZS-UJM was fitted with a leaf-spring main gear assembly replacing the standard strutted design (Photos 2, red arrows; Photos 5 and 6, red arrows; Diagram 1).

Photo 1: File photo, ZS-UJM[1]

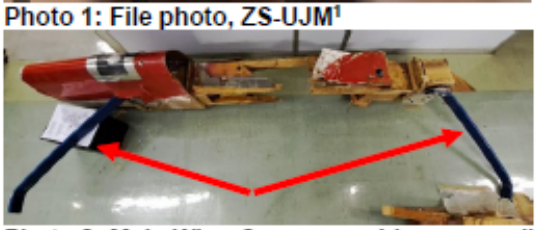

Photo 2: Main Wing Spar assembly, as supplied (digital)

[1] Courtesy Pilots Post.net

Photo 3: Accident Photos[2]

Photo 4: Removal of LH Main Wing fuel tank, post-accident[3]

2. APPLICABLE DOCUMENTS

(a) AIID Preliminary Report No CA18/2/3/10376

3. DEFINITIONS

AAI	Aircraft Accident Investigation	MPI	Mandatory Parts Inspection
AC	Advisory Circular	NDE	Non-Destructive Evaluation
AD	Airworthiness Directive	NDI	Non-Destructive Inspection
AISI	American Iron and Streel Institute	NDT	Non-Destructive Testing
AME	Aircraft Maintenance Engineer	NLG	Nose Landing Gear

[2] Courtesy AIID
[3] Courtesy AIID

AMO	Aircraft Maintenance Organization	OEM	Original Equipment Manufacturer
ASI	Air-Speed Indication/or	OHSA	Occupational Health and Safety Act
ASTM	American Society for Testing and Materials	POD	Probability of Detection
BE	Big End	QMS	Quality Management System
DPI	Dye-Penetrant Inspection	RC	Rockwell C-scale
EBSD	Electron Back-Scatter Diffraction	RH	Right-Hand
ECSA	Engineering Counsel of SA	RoD	Rate of Descend
EDS	Energy-Dispersive X-ray Spectroscopy	RT	Radiographic Testing
ET	Eddy-current Testing	MT	Magnetic-dye Penetrant testing
FAA	Federal Aviation Authority	SABS	South African Bureau of Standards
FOD	Foreign Object Damage	SACAA	South African Civil Aviation Authority
HE	Hydrogen Embrittlement	SB	Service Bulletin
HIC	Hydrogen Induced Cracking	SCC	Stress Corrosion Cracking
HRB	Hardness Rockwell B	HRC	Hardness Rockwell C
HSS	High-Strength Steels	SE	Small End
ICAO	International Civil Aviation Authority	SEM	Scanning Electron Microscope
IG	Inter-Granular	TBO	Time Before Overhaul
IR	Infra-Red or Thermal Testing	TG	Trans-Granular
LH	Left-Hand	TSO	Time Since Overhaul
MAUW	Maximum All-Up Weight	TTSN	Total Time Since New
MLG	Main Landing Gear	UT	Ultra-Sonic Testing
MPI	Magnetic Particle Inspection	VSI	Vertical Speed Indication
RB	Rockwell B-scale	LH	Left-hand
RH	Right-hand	SoE	Sequence of Events
VHN	Vickers Hardness Number	UT	Ultrasonic Testing

4. PERSONNEL

(a) The investigative member and compiler of this report is Mr C.J.C. Snyman. Mr Snyman is a qualified Physical Metallurgist (Metallurgical Engineering, ECSA Registration: Prof. Eng. Tech. No 201670194), Radiation Protection Officer (RPO, NNR, No 281) and Aircraft Accident Investigator (SCSI).

5. APPARATUS AND METHODOLOGY

(a) The apparatus employed for this investigation is a Stereo Microscope and Digital Camera.
(b) The methodology included a visual examination of supplied parts followed by Microscopy Analysis.
(c) Apparatus:

Type	Make/Model	Operator
Stereomicroscope	Zeiss Discover V20	C.J.C. Snyman

6. INVESTIGATION RESULTS

Note 2: *Only the supplied parts were considered.*

6.1. Visual Inspection Results: Main Wing Spar Assembly, as supplied (Diagram 1)

Note 1: The inspection results are based on the supplied parts only.

The MW Spar is of a wooden box-spar design.

The inspection revealed several fractures within the central section of the MW Spar (Photo 2). Referring to the accident photos supplied (Photo 3), the above observation correlates with the images supporting the notion that the MW Spar failed first in the Sequence of Events (SoE).

Within the central section of the MW Spar, underneath the cockpit area, several post-manufactured through holes were noted (Photo 7, red arrows) within the main beams of the Spar assembly. The diameters of these holes (±Ø18mm) extended up to 72% of the wall thicknesses of the main beams. On selected locations the holes were drilled protruding the outer surfaces of the main beams (Photo 7, yellow dashed circles) and at different angles (red dashed lines). The locations of the primary fractures of the Spar Main Beams coincides with these holes. *Although this investigation could not affirm this, it is presumed that the drilled holes have bearing to the wing fuel tank modification*.

The owner opted to replace the standard strutted main gear assembly with a leaf-spring assembly. *This investigation could not affirm if this is an OEM approved modification.*

The relocation of the main wheels in respect to the original strutted layout (±550mm outboard) allowed for an increase of ±290% in the moment arm forces transferred to the MW Spar at the attachment location (Photo 13, red arrows). Furthermore, the original steel box design (Photo 6, red arrow) supporting the strutted gear assemblies were removed in favour of through bolts between two steel plates at the top and bottom of the wings (Photo 10).

The inspection of the steel leaf-spring main gear assemblies revealed several discrepancies between the LH and RH sides, most prominent being 2x spacer-plates fitted to the LH assembly (Photo 8, red arrows).

The wooden construction at the LH leaf-spring attachment revealed severe distress (Photos 10 and 12) whereby the beams were displaced (red arrows) by the applied forces, both operational and during fitment. The outboard, forward through bolt revealed an elongated hole (Photo 11, red dashed circle) that is not impact related. The noted distress and dimensional changes most probably warranted the inclusion of the 2x LH spacer plates to re-align the LH and RH main gear assemblies.

Oher non-standard practices were noted: incorrect thread protrusion (Photo 8, red dashed circle) and welded bolt heads (Photo 9, yellow dashed circles).

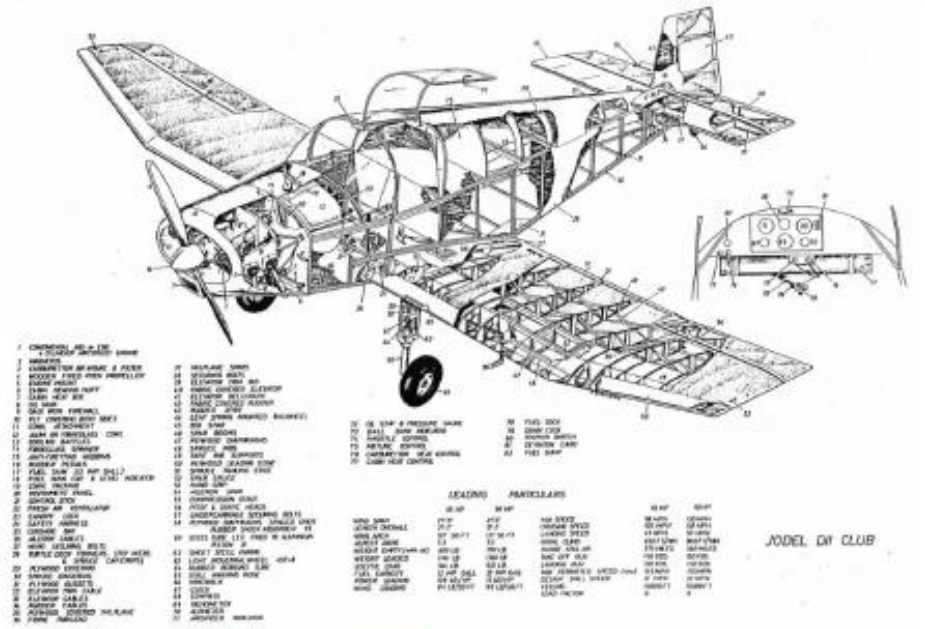

Diagram 1: Schematic: Jodel F12[4]

Photo 5: Reference aircraft (digital)

Photo 6: Reference aircraft (digital)

[4] Courtesy Boeing

Photo 7: Drilled holes (digital)

Photo 8: LH vs. RH Leaf Spring assemblies (digital)

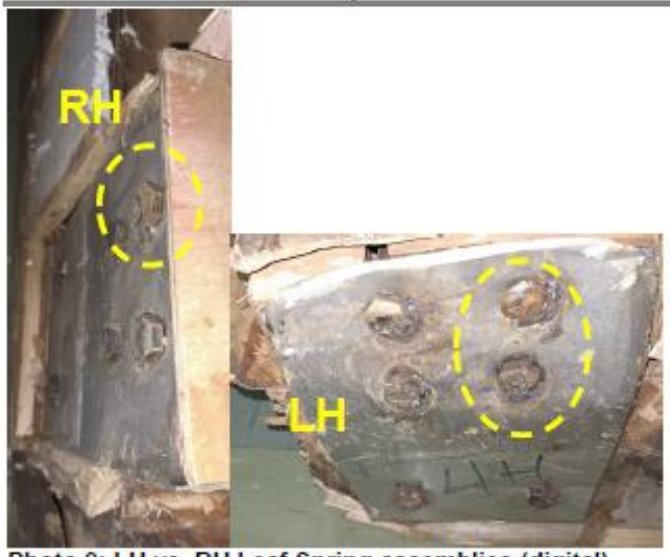

Photo 9: LH vs. RH Leaf Spring assemblies (digital)

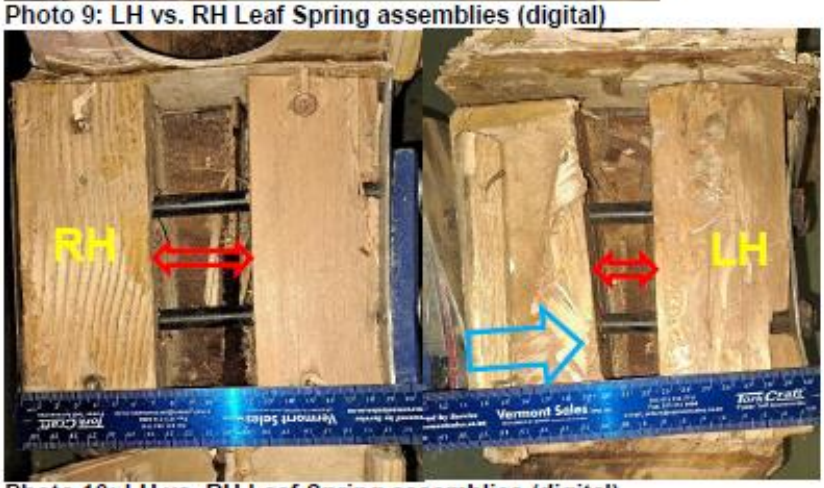

Photo 10: LH vs. RH Leaf Spring assemblies (digital)

Photo 11: LH vs. RH Leaf Spring assemblies (digital)

Photo 12: LH vs. RH Leaf Spring assemblies (digital)

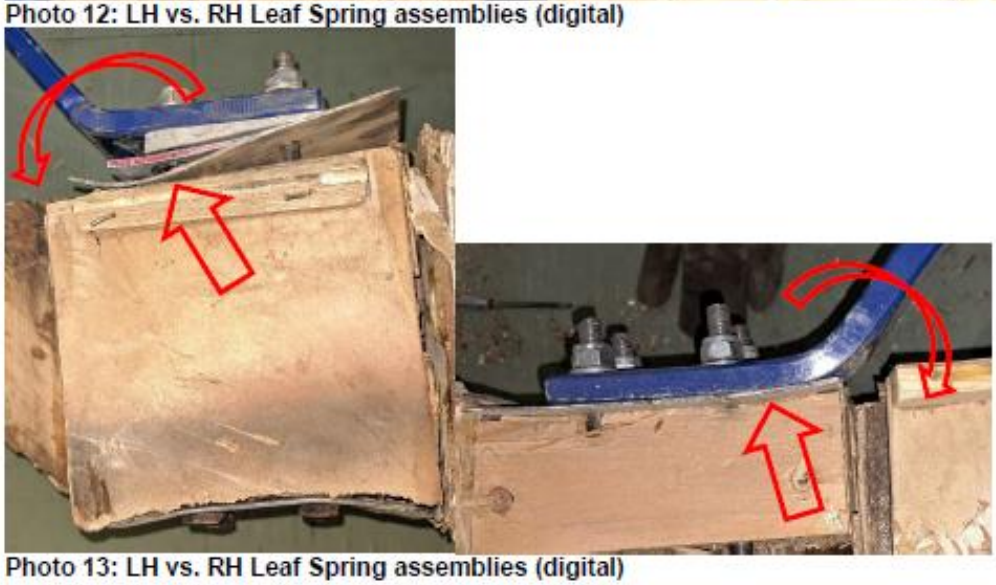

Photo 13: LH vs. RH Leaf Spring assemblies (digital)

7. DISCUSSION AND CONCLUSION/S

Note 2: *All information supplied to this investigation from other parties are considered factual.*

7.1. Visual Inspection Results:

The inspection of the supplied parts revealed the following:

7.1.1. Non-standard/Non-conforming Modifications:

(a) The **wing tank modification** most probably warranted the drilled holes through the MW Spar main beams. This severely compromised the structural integrity. *The added effect/s on the wing loading due to the altered weight distribution was not determined by this investigation.*

(b) The **leaf-spring main gear modification** involved removing the original steel-box support of the standard strutted gear assembly. The elected through bolt with two steel plates design was not well executed with incongruities in **contradiction to acceptable craftmanship**.

The movement of the main wheels outboard increased the moment-arm forces unto the MW Spar by **±290%** (static load) compared to the original design. This allowed for the noted distress to the wing construction and the misalignment between the LH and RH leaf-springs which in turn resulted in the fitting of 2x spacer-plates on the LH side only.

7.2. Contributory Causes:

The following are considered to be contributary factors towards the failure of the **MW Spar** assembly during operation:

(a) **Non-standard/Non-conforming Modifications**. The drilled holes severely compromised the structural integrity of the MW Spar and, in combination with the increased moment-arm forces induced by the leaf-spring modification, are considered as the **primary contributing factor** to this failure.

(b) **Poor craftmanship** and the non-application of **basic engineering principles**.

(c) **Poor oversight** and post-modification **inspection/s**. The deviation in alignment between the LH and RH main wheels should have warranted further examination.

(d) The possible contribution/s from historic post-accident repairs was not determined by this investigation.

(e) No OEM specifications were supplied towards the construction of the MW Spar; therefore, this investigation did not contemplate the original building processes as a possible contributing factor.

8. RECOMMENDATIONS

8.1. Approved Person (AP):

(a) It is recommended that the appointed AP complete detailed inspections of the MW Spar assemblies of all aircraft older than a predetermined age (years and TT) and/or exposed to a repair scheme (post-accident).

8.2. AMO:

(a) It is recommended that the appointed AMO adhere to the OEM specifications and apply acceptable craftmanship and engineering principles.

8.3. Civil Aviation Authority/AIID:

(a) It is recommended that the SACAA/AIID establish if any other similar aircraft models or types were exposed to equivalent non-standard/non-conforming modifications.

9. DECLARATION

9.1. All digital images have been acquired by the author, unless otherwise stated, and displayed in an un-tampered manner.

Appendix B

Extracts from the SA Civil Aviation Regulations 2011 as amended.

Airworthiness

24.01.2 (1) A non-type certificated aircraft, other than an aircraft classified in regulation 24.01.1 (2) (*h*) to (l), may only be considered to be airworthy if that aircraft has—

(a) been issued with an authority to fly or a proving flight authority or special flight permit, as the case may be in terms of this Part;

(b) been maintained in accordance with the provisions of Part 44;

(c) no known condition which could make it unsafe for flight;

Safety inspections and audits

24.01.7 (1) An applicant for the issuing of any certificate, approval or authorisation in terms of this part, shall permit an authorised officer, inspector or authorised person to carry out such safety inspections and flight and ground tests which may be necessary to verify the validity of any application made in terms of this part.

(2) The holder of any certificate, approval or authorisation issued under this part, shall permit an authorised officer, inspector or authorised person to carry out such safety inspections and audits, including safety inspections and audits of its partners or subcontractors, which may be necessary to determine compliance with the appropriate requirements prescribed in this part.

(3) Any inspection carried out on a non-type certificated aircraft in terms of subregulation (1) is of a conditional nature, in that the inspector an appropriately rated approved AMO, AME or approved person, rated in accordance with subpart 4 of part 66 shall not be required to guarantee the airworthiness of the aircraft. The owner or operator of the aircraft shall at all times be responsible for the airworthiness status of the aircraft and, if called upon, shall prove to an inspector that the aircraft is in an airworthy condition.

"Persons to carry out maintenance

44.01.4 (1) No person may carry out maintenance on an amateur built aircraft or a production-built non-type certificated aircraft, or any component thereof, unless such person—

(a) is appropriately rated or approved on type by the Director or the organisation designated for the purpose in terms of part 149, as the case may be, to carry out maintenance; or

(b) carries out the maintenance under the prescribed supervision of a person authorised by the Director or by the organisation referred to in paragraph (*a*). A dual check of the maintenance carried out must be performed by a person referred to in subparagraph (*a*); or

(c) is the owner of the aircraft provided that an appropriately rated approved AMO, AME or Approved Person, rated in accordance with subpart 4 of part 66, performs a dual check on the maintenance which was carried out; or

(d) is an appropriately rated approved AMO, AME or approved person, rated in accordance with subpart 4 of part 66.

(2) (*a*) Components and parts intended to be used on non-type certificated aircraft may be fabricated by a person or organisation not licensed in terms of part 66 or part 145.

(*b*) The owner of the aircraft must provide the Director, or the organisation designated for the purpose in terms of part 149, as the case may be, with evidence that the components or parts meet the minimum specification for the component or part as specified by the Original Equipment Manufacturer.

(c) An appropriately rated approved AMO, AME, or approved person, rated in accordance with subpart 4 of part 66 shall sign off the component or part in the appropriate logbook."

"Release to Service

44.01.13

(1) The release to service for a non-type certificated aircraft shall either;

(a) be an entry in the flight folio; or

(b) be a separate form contained in the aircraft document folder.

(2) An entry to the following effect shall be made:

……

"Aircraft Registration:

Aircraft type:

Serial No.:

"I hereby certify that I am satisfied that the above-mentioned aircraft and all its equipment are in every way serviceable for flight and that all maintenance has been carried out in accordance with the Civil Aviation Regulations of 2011, as amended, and the aircraft's Accepted Maintenance Schedule. This certificate lapses at a total of…… hours of …… flight time or on…….. (date), whichever occurs first, unless the aircraft is involved in an accident or becomes unserviceable, in which case the certificate is invalid for the duration of the period".

Signed:

Licence No.:

Date: