



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

STRUCTURES GROUP CHAIRMAN'S FACTUAL REPORT

October 25, 2017

A. ACCIDENT: ERA16LA209

Operator: Private
Location: Brunswick, North Carolina
Date: June 10, 2016
Time: 0900 Eastern Daylight Time
Aircraft: WSK PZL Mielec M-18A
Registration Number: N2283M

B. STRUCTURES GROUP

Chairman: Clinton R. Crookshanks
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PZL Mielec
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Federal Aviation Administration
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C. SUMMARY

On June 10, 2016, about 0900 eastern daylight time, an experimental WSK PZL MIELEC M-18A, N2283M, operated by Canam Aviators Inc., was substantially damaged when it impacted trees and the ground while maneuvering near Brunswick, North Carolina. The commercial pilot was fatally injured. Visual meteorological conditions prevailed and no flight plan was filed for the aerial application flight operated under the provisions of 14 *Code of Federal Regulations*, Part 137. The flight originated from Bear Pen Airstrip (NC43), Supply, North Carolina, around 0845.

D. DETAILS OF THE INVESTIGATION

1.0 Airplane

The Mielec M-18A Dromader is a two-seat, single engine, low wing airplane designed for agricultural spraying operations with both solid and liquid chemicals (Figure 1¹). The airplane is of all metal construction, has a conventional tail, and is equipped with fixed conventional landing gear. The original airplane was powered by a WSK radial piston engine driving a 4-blade tractor propeller and had a hopper capacity of 2,500 liters (660 gallons). The airplane has a maximum takeoff weight of 9,260 pounds. The airplane is 31 feet long, has a wingspan of 58 feet, and a tail height of 12 feet. The second seat is provided for a mechanic and is located aft of the pilot's seat.

The airplane wing is composed of three sections; the center section and right and left outboard sections. The outboard wings are connected to the center wing at three points, two on the forward spar and one on the aft spar. The center section contains clevis fittings at the forward spar upper and lower spar caps and a clevis fitting at the aft spar. Corresponding lug fittings on the outboard wings fit into the center wing clevis fittings. The forward spar connections utilize an expansion mandrel installed through the bores of the center wing clevis and wing lug fittings. The aft spar connection utilizes a bolt installed through the bores of the center wing clevis and wing lug fittings.

The accident airplane was modified by several Supplemental Type Certificates (STC), one of which replaced the radial engine with a turbine engine driving a 5-blade tractor propeller. The turbine conversion extended the nose of the airplane several feet. The airplane was painted white with black and red stripes at the time of the accident (Figure 2).

2.0 Accident Aircraft Examination

S/N: 1Z024-25

TAT: 8,567.9 hours (as of January 15, 2016)

The NTSB did not travel to the scene for this accident. All on-scene work was conducted by a Federal Aviation Administration (FAA) inspector and the data supplied to the NTSB. The NTSB Investigator-in-Charge examined the airplane wreckage at the salvage facility after recovery. Examination of the wreckage revealed that the right outboard wing separated from the airplane prior to impact with trees and the ground. The outboard half of the right aileron also separated from the right wing during the accident sequence. The right outboard wing forward spar lower

¹ All figures are presented in Appendix A to this report.

fitting was fractured outboard of the lug and the outboard portions of the fitting remained installed in the right outboard wing. The expansion mandrel remained intact and installed through the bores of the right lower center wing clevis and outboard wing lug with the inboard portion of the outboard fitting attached. The right wing forward spar upper wing connection remained intact with the expansion mandrel installed through the bores of the fittings. The right outboard wing forward spar upper fitting was intact but separated from the outboard wing and a section of right outboard wing upper spar cap remained attached to the upper fitting. The right wing aft spar fittings were intact on the center and outboard wings but were not connected together. The right wing aft spar attach bolt was not recovered. The right outboard aileron bracket was fractured with the aft portion attached to the aileron and the forward portion attached to the right wing. The left outboard wing remained attached to the center wing at its three attach points. See Figure 3 for a photo of the intact left wing forward spar upper attach point. The FAA reported there was moderate to severe corrosion noted throughout the airplane.

The fractured right outboard wing forward spar lower fitting, a fractured bolt from the lower fitting, the intact right center and outboard wing aft spar attach points, a fractured section of the right outboard wing upper spar cap, the fractured right outboard aileron bracket, and the intact right center and inboard aileron brackets were removed from the wreckage and sent to the NTSB Materials Laboratory for examination².

The Materials Laboratory examination focused on the fractured wing fitting, bolt, and right outboard aileron bracket due to the presence of fatigue cracking on these parts. The outboard lower wing fittings are manufactured from low alloy, high strength steel, and are fastened to the lower spar cap through 6 vertical bolts of differing diameters and 3 horizontal bolts. See Figure 4 for a drawing of the outboard wing lower fitting. The fracture in the fitting intersected the first vertical hole from the inboard end on the upper arm and the second vertical hole from the inboard end on the lower arm with most of the fracture faces exhibiting fatigue crack features. The fractured bolt examined was reportedly installed in the third vertical hole from the inboard end and its diameter matched this hole in the fitting. A photo of the fractured bolt is shown in Figure 5 with most of the fracture face exhibiting fatigue crack features.

The aileron brackets are manufactured from welded low alloy, high strength tubular steel and are attached to the wing aft spar. See Figure 6 for a drawing of the aileron bracket. The right outboard aileron bracket was fractured through the main tube at the weld location where the upper arms attach to the main tube. The fracture face exhibited fatigue features through about half the tube thickness on the upper third of the circumference. The mid and inboard aileron brackets exhibited visible cracks in the same location but were not opened to expose the fractures. The brackets were cut aft of the crack location to examine the interior surface of the main tube.

The FAA inspector estimated that the takeoff weight for the accident flight was about 11,787 pounds utilizing an airplane empty weight of 5,975 pounds, chemical weight of 4,940 pounds (800 gallons), a fuel weight of 692 pounds (1.5 hours), and a pilot weight of 180 pounds.

² See NTSB Materials Laboratory Factual Report No. 17-024 in the public docket for the details of the examination.

3.0 Maintenance Records³

The accident airplane was manufactured by WSK PZL Mielec in 1994 and imported into the United States through their authorized distributor Melex USA, Inc. The airplane was issued a Special Airworthiness Certificate in the Restricted Category for the purpose of agriculture and pest control on June 8, 1994. The accident operator, Canam Aviators, Inc., purchased the airplane in 2003.

The original radial piston engine was removed from the airplane in April 1996 and replaced with a Honeywell TPE 331-10UA turbine engine driving a Hartzell HC-B3TN-5C 3-blade, constant speed, reversing, and feathering propeller in accordance with STC SA09039SC. Geared servo tabs were installed on the ailerons, elevators, and rudder in accordance with STC SA09063SC as part of the engine conversion. At the time of the modification, the airplane had accrued 997.0 hours total time-in-service. The accident airplane was again modified in January 2005, in accordance with STC SA09039SC, to install a Honeywell TPE331-11UA-612G turbine engine driving a Hartzell HC-B5MP-5BL 5-blade constant speed, reversing, and feathering propeller. The records indicated that the airplane and engine mount were converted from a clockwise turning engine to a counter-clockwise turning engine. The airplane had accrued 5,153.7 hours total time-in-service at the time of this modification. The maximum weight approved as part of the STC was 9,260 pounds with the spray bar installed and 8,800 pounds with the spreader installed. A modified hopper was also installed at this time to increase the hopper capacity to 800 gallons⁴ based on data and drawings from Delta Turbines, Inc and documented on an FAA Form 337 (Major Repair or Alteration).

Airworthiness Directive (AD) 2000-18-12 was first complied with on January 9, 2001, at an airframe total time of 4,195.7 hours. The records indicated that the left and right forward spar, lower wing attach fittings on the outboard wings and the center section were replaced with new fittings as a result of the inspection along with the wing straps and the left aft center-wing-to-fuselage attach fitting. The upper fittings were found to be serviceable. The manufacturer Service Bulletin (SB) E/02.170/2000 was also complied with. Each AD 2000-18-12 inspection in the logbooks was documented in Table 1 below.

Four inspection reports from Applied Technical Services, Inc., were found in the logbook that documented magnetic particle inspections of the lower wing fittings. The reports were dated October 2012, November 2013, December 2014, and July 2015. There was no specific information on the reports to conclusively tie the results to a particular logbook entry though the first three reports were consistent by date with logbook entries. The July 2015 inspection report was the only report that was not consistent with a logbook entry.

³ See Attachment 1 to this report for the relevant maintenance records.

⁴ The logbook entry states that the hopper capacity was 785 gallons but the FAA Form 337 for the modification indicated that the capacity was 800 gallons.

Date	Hours	Time since previous	Result
1/9/01	4195.7	N/A	Replaced lower fittings
1/25/05	5153.7	958.0	No cracks
6/15/06	6389.0	1235.3	No cracks
5/7/07	7318.0	929.0	No cracks
6/1/08	7440.0	122.0	No cracks
4/27/09	7457.0	17.0	No cracks
5/20/10	6147.0	Unknown	No cracks
10/1/11	6628.0	481.0	No cracks
10/17/12	7365.8	737.8	No cracks
2/20/14	8042.0	676.2	Replaced left lower fittings
1/22/15	8395.0	353.0	No cracks
1/15/16	8567.9	172.9	No cracks

Table 1 – AD 2000-18-12 compliance

A logbook entry at an airframe time of 6,389.0 hours on June 21, 2006, indicated that the service life of the airplane was increased to 10,000 hours by incorporation of SB E/02.172/2001. A logbook entry on October 9, 2009, adjusted the total time-in-service of the airframe from 7,630 hours down to 6,147 hours. The explanation provided in the entry indicated that the hour meter installed was recording incorrectly. The entry was not signed off and the certificate number provided did not match the name according to the FAA. On February 20, 2014, at an airframe time of 8,042.0 hours, a logbook entry documented the replacement of both left lower wing attach fittings and expanding mandrel in accordance with SB E/02.170/2000. On July 2, 2015, a logbook entry documented the replacement of the wing center section with a used serviceable unit with an estimated total time of 7,460 hours at an airframe time of 8562.9 hours.

The most recent annual inspection was performed on January 15, 2016, and the entry specified that the inspection was in accordance with the M18 Service Manual. At that time, the airframe had accumulated 8,567.9 hours total time-in-service. All of the inspection and maintenance entries from October 17, 2012, and on were performed by the same company and signed off by the same mechanic. There were 4 annual inspections completed in this timeframe and all entries specified that the inspections were in accordance with the M18 Service Manual. There was no specific information to indicate which of the published inspections from the manual were performed. There were two additional logbook entries after the most recent annual inspection. On April 17, 2016, minor maintenance was performed at a tach time of 3,819.9 hours, 226 hours after the last annual. There was no airframe time annotated for this logbook entry. On May 31, 2016, minor maintenance was performed on the hydraulic pump but no time was recorded. The most recent AD compliance record in the logbook was dated 5/14/2007 and listed two applicable recurring AD's, one for the engine and AD 2000-18-12. The remaining AD's listed were identified as not applicable.

4.0 Tests and Research

FAA Information

In January 2000, the FAA issued Special Airworthiness Information Bulletin (SAIB) CE-00-13 to provide safety information regarding inspection and maintenance of the Mielec M-18, M-18A, M-

18B airplanes as a result of NTSB investigation FTW99LA170. The SAIB encouraged inspection of the wing attach fittings on all M-18 airplanes in accordance with the manufacturer SB. It was noted that the FAA was considering an AD to require inspection.

In July 2000, the FAA issued SAIB CE-00-27 to provide "high priority" safety information regarding possible cracks and corrosion in the wing attach fittings on Mielec M-18, M-18A, and M-18B airplanes as a result of NTSB investigation FTW00LA149. The SAIB recommended that operators comply with the inspection of the wing fittings outlined in the manufacturer's service information. It was noted again that the FAA was considering an AD to require inspection. The SAIB also made note of the 1.35 service life factor contained in the repair manual for overweight operation.

In September 2000, the FAA issued AD 2000-18-12 to address corrosion and cracking of the wing attach fittings on all PZL M-18, M-18A, and M-18B airplanes as a result of the two wing separation accidents. The AD required that operators repetitively inspect the center-wing-to-outboard wing attach joints for cracks in the lugs, corrosion in the main holes, and ovalization of the main holes every one year or 500 hours time-in-service (whichever occurs first), repair corrosion and apply anti-corrosion protection, replace the wing attach joints, as necessary, and eliminate any ovalization of the wing main joint holes. The AD specified that the inspection of the main holes must be done using magnetic particle methods and all other procedures were to be in accordance with Polskie Zaklady Lotnicze Co. Ltd. SB E/02.170/2000. The initial inspection compliance time for the AD was 3,000 hours time-in-service or 30 days after the effective date of the AD, whichever occurred later. The procedures published in the SB and AD were focused on the main attach lug and clevis on the forward spar wing fittings and did not specifically address the vertical bolt holes where the fittings attached to the wing or center section forward spar.

The FAA approved the type certificate for the PZL M-18A airplane in September 1987. The airplane, as approved, was equipped with a PZL-Kalisz 1 ASz-62IR-M18 nine-cylinder air cooled radial engine driving a PZL-Warszawa AW-2-30, four blade constant speed propeller. The maximum weight was 9,260 pounds with a maximum weight in the hopper of 3,300 pounds regardless of the hopper capacity. Note 3 on the type certificate data sheet specifies that the maximum service life of the M-18A airplane is 6,000 flight hours provided the relevant service bulletins are complied with. The note also states "All manufacturer's service bulletins (and other manual material) which contain a statement that the document is approved by the exporting airworthiness authority (GICA) may be interpreted as FAA Approved."

The FAA has published Advisory Circular (AC) 23-13A to provide guidance on the fatigue, fail-safe, and damage tolerance evaluation of metallic structure for normal, utility, acrobatic, and commuter category airplanes. Section 1-6 of the AC is applicable for alterations, modifications, or changes to the design and states "Changes to the operational characteristics that may be important for fatigue include higher design airspeeds or higher average speed. They also include changes to the maximum allowable weight and center of gravity envelope, changes to the average weight and center of gravity location, and engine or propeller changes." Further the section discusses a comparative fatigue analysis that should be performed when a modifier does not have access to the data from a manufacturer.

Manufacturer Information⁵

The PZL M18 Description and Service Manual provides procedures for maintaining and inspecting the airplane. Procedures are provided to the operator for corrosion prevention and control in Section 4.2 to include a description of the surface treatments applied to steel and aluminum structures and reapplication of these surface treatments. Particular emphasis is placed on the cleaning of the aircraft with the statement that “regular and thorough cleaning of both the interior and exterior of the aircraft is a major part of corrosion control.” The instructions for cleaning included the statement that “particular attention should be given to wing fittings”. Section 4.27 provides instructions for non-destructive inspection of airframe structural fittings using magnetic particle, fluorescent penetrant, and eddy current procedures with specific details for the inspection of the wing fittings in Section 4.27a and anti-corrosion protection of the wing fittings in Section 4.27b. Section 5, Maintenance Schedule, provides instructions for a pre-flight inspection, end-of-day cleaning, special inspections for hard landings and in-flight severe turbulence, verifying inspections every 3,000 flight hours, and periodic inspections at 50, 100 and 500 flight hours. Section 8, Airworthiness Limitations, refers the operator to the Repair Manual for information on the service life of the airframe. This section also calls for a mandatory annual inspection within the scope of the 500-hour inspection and special verifying inspections each 3,000 hours of operation.

The PZL M18 Aircraft Repair Manual was published in March 1998 and contains information on typical repairs, replacement parts and fasteners, and service lives. The airframe service life is set at 10,000 flight hours in Section III-Service Lives for the standard airplane. Only one airframe part has a limited service life less than 10,000 flight hours as specified in paragraph 5. The left aft center-wing-to-fuselage attach fitting (P/N D21.530.00.1L) has a service life of 3,000 flight hours. Paragraph 7 defines an “Airframe Service Life in Overload Version”. The original airplane service life was calculated for a takeoff weight of 10,340 pounds. There are procedures to increase the takeoff weight to 11,700 pounds that “causes higher fatigue wear and drop of service life by 1.35 times.” For all operations performed above the standard weight of 10,340 pounds, the operator should multiply the flight hours by 1.35 to obtain the proper flight hours for calculating the service life of the airplane.

The manufacturer issued SB E/02.159/97 in 1997 to provide instructions for corrosion protection of the outboard wing forward spar fittings as a result of findings on 4 airplanes that were operated in Greece. The bulletin provides instructions for inspection of the fitting arms where they attach to the forward spar, removal of any corrosion within limits, and protection of the fittings by application of a corrosion inhibiting compound. The bulletin also provides instructions for adding an inspection panel in the lower leading edge of the outboard wing to improve access to the outboard wing forward spar fittings. The manufacturer provided a photo (Figure 7) showing the left wing forward spar attach point on a new airplane with the fairing removed. Note the inspection panels on the lower leading edge of both the center wing and outboard wing. The center wing inspection panel was standard and the outboard wing inspection panel was added by the above referenced SB. Additionally, the leading edge nose ribs on the center and outboard wings have lightening holes through which the inboard end of the center wing fitting and the outboard end of the outboard wing fitting are visible. Fabric patches are installed over the lightening holes to prevent the entry of dirt and debris.

⁵ See Attachment 2 to this report for the relevant manufacturer information.

The manufacturer issued SB E/02.170/2000 in August 2000 to provide instructions for inspection of the wing attach joints as a result of two accidents in the United States. The accidents were caused by corrosion in the lower wing attach fittings that resulted in fatigue cracking and failure of a fitting lug. The bulletin provides instructions for inspection of the wing fittings for corrosion in the lug bore and on the exterior surface of the fittings, repair of minor corrosion, inspection for ovalization of the lug holes, and magnetic particle inspection of the fitting lugs for cracks. The procedures do not require removal of the outboard wings but do require removal of the expansion mandrels. Procedures are also provided for replacement of the wing fittings, if necessary, with the recommendation that both left and right pairs of lower wing fitting should be replaced even if only one pair has damage beyond limits. There are no specific procedures for inspection of the vertical holes where the fittings attach to the spar. The manufacturer issued Service Letter M18/034/2016 in February 2016 with instructions that only the magnetic particle inspection method is applicable for the SB and suggesting that the wings be removed from the airplane to better perform the inspection. The provisions of this SB were mandated by AD 2000-18-12.

The original service life of the airframe was 3,000 flight hours for S/N 1Z001-01 through 1Z022-26. Beginning with airplane S/N 1Z022-27, design changes to the center-wing-to-fuselage attach point were incorporated and the airframe service life was increased to 6,000 flight hours. Modification procedures were published to allow an increase in the service life of the original airplanes. The manufacturer conducted additional fatigue testing, inspected operational airplanes, and performed analyses to further increase the airframe service life to 10,000 flight hours for S/N 1Z028-02 and up. In January 2001, the manufacturer issued SB E/02.172/2001 to provide guidelines for increasing the service life of the airframe up to 10,000 flight hours for airplanes S/N 1Z001-01 through S/N 1Z028-01. The SB instructed operators to perform the 3,000 hour special inspection in the Service Manual with particular attention paid to:

- Incorporation of all applicable mandatory bulletins on the airplane subject to the verification inspection;
- Corrosion, cracks and wear in the outboard wing-to-centerwing and the centerwing-to-fuselage truss attach fittings;
- Corrosion and cracks in the steel caps of the outboard wings and centerwing main spars;
- Corrosion and cracks in the fuselage truss;
- Condition of the attach fittings at the horizontal tail and vertical tail attachment to the fuselage truss;
- Excessive free play in the airplane component assys and units attachment joints, in the flight and engine control systems;
- Condition of the skins and internal stiffening members of the centerwing, outboard wings and empennage (tail).

The SB referenced the previous SB (E/02.170/2000) for the allowable damage on the wing fittings and provided a maximum allowable corrosion pit depth of 1 mm (0.04") for the forward spar caps. In addition, the SB instructed the operator to replace the left aft center-wing-to-fuselage attach fitting regardless of its actual condition. Application of anti-corrosion protection was recommended for all attach fittings and steel spar caps at the completion of the inspection.

There are two published Airplane Flight Manuals (AFM) for the airplane, one FAA approved version for those airplanes operating in the United States and one European Aviation Safety Agency (EASA) approved version. The EASA approved AFM is also used by other Airworthiness Authorities around the world. The FAA AFM specifies that the airplane is certificated in the restricted category for agricultural operations and dispensing fire-fighting materials. The limitations specify a maximum takeoff and landing weight of 9,260 pounds, a maximum hopper load of 3,300 pounds⁶, a never exceed speed of 151 knots, a maximum cruising speed of 124 knots, maneuvering load factors of +3.4 and -1.4, and prohibits operational flights with a person in the mechanic's seat.

The EASA AFM specifies that the airplane is certificated in the normal category in accordance with FAR 23 with a maximum takeoff weight of 9,260 pounds and a maximum hopper load of 3,300 pounds. However, AFM Supplements numbers 1 and 16 to the EASA AFM provide for overweight operation of the airplane. EASA AFM Supplement No. 1 provides a maximum takeoff weight of 10,340 pounds, a maximum landing weight of 9,260 pounds, a maximum hopper load of 4,180 pounds, revises the center-of-gravity limits, limits the never exceed speed to 124 knots and the cruising speed to 108 knots, and limits the maneuvering load factors to +3.0 and -1.2. EASA AFM Supplement No. 16 is applicable for operation of the airplane in the fire-fighting overload version and provides a maximum takeoff weight of 11,700 pounds, a maximum landing weight of 9,260 pounds, a maximum hopper load of 4,850 pounds⁷, revises the center-of-gravity limits, limits the never exceed speed to 124 knots, the maximum operational and cruising speed to 108 knots, and the minimum speed to 92 knots, limits the maneuvering load factors to +2.8 and -1.1, limits the maximum bank to 15° (+5°), specifies minimum pilot qualifications, and applies a 1.35 factor to the operational flight hours above 10,340 pounds for calculation of service life. The supplement also states that the airplane shows dynamic longitudinal instability with a free control stick and that operation of the airplane at the 11,700 pounds weight is not permitted for agricultural missions.

The manufacturer was not able to supply any information on the modification of the M-18A airplane by installation of a turbine engine including any changes to the flight loads, fatigue spectrum, or reliability data. They are aware that there are STC provisions for the modification but were not consulted for the modification by the STC holders.

Other NTSB Investigations

FTW99LA170 - On June 18, 1999, a Wsk Pzl Mielec M-18A agricultural airplane, N7075D, was substantially damaged when the outboard right wing separated from the airplane during a pull up maneuver at the completion of a spray pass near Basile, Louisiana. The airplane was powered by a reciprocating radial engine and had accrued about 4,840 hours time-in-service at the time of the accident. Metallurgical examination revealed that the separation of the right center wing forward spar lower attachment fitting was the result of fatigue cracking in the fitting lugs. The fatigue cracking initiated from areas of severe corrosion damage in the lugs. Evidence of extensive corrosion pitting was found on all other examined front spar attachment fittings and cracking was found on the intact left inboard attach fitting. Although the aircraft records showed that during the last annual inspection, which was completed approximately 596.5 hours prior to the accident, all

⁶ This equates to about 400 gallons (1500 liters) of water.

⁷ This equates to about 580 gallons (2200 liters) of water.

time life items were complied with, the metallurgical examination disclosed no trace of dye penetrant residue on any of the examined components. The operator reported the maximum gross weight of the airplane was 9,260 pounds.

FTW00LA149 – On May 22, 2000, a Pzl-Mielec M-18A agricultural airplane, N2296C, was destroyed when its right wing separated in flight while maneuvering near Kilbourne, Louisiana. The airplane was powered by a reciprocating radial engine and had accrued about 5,160 hours time-in-service at the time of the accident. Metallurgical examination revealed that the right outboard wing forward spar lower attach fitting separated as a result of fatigue cracking in the fitting lug. The fatigue cracking initiated from areas of severe corrosion pitting in the bore of the lug. Evidence of severe corrosion was found on all the other forward spar attach fittings. According to the aircraft maintenance records, the attach fittings were inspected using a fluorescent penetrant method on August 1, 1999, about 1140 hours prior to the accident. The operator reported the maximum gross weight of the airplane was 10,400 pounds.

FTW00LA267 – On September 21, 2000, a Pzl-Mielec M-18A agricultural airplane, N81548, was destroyed when its right wing separated in flight while maneuvering near Jacksonville, Arkansas. The airplane was powered by a reciprocating radial engine and had accrued about 5,900 hours time-in-service at the time of the accident. The right outboard wing forward spar lower attachment fitting separated as a result of fatigue cracking in the fitting lug. The fatigue cracking initiated due to severe corrosion pitting in the bore of the lug. The right lower expansion mandrel and bolt were found void of grease or anti-corrosive material. Evidence of severe corrosion was found on all the other forward spar attach fittings. There was no indication in the aircraft maintenance records that the recommended wing attachment fitting inspection had been conducted. The operator reported the maximum gross weight of the airplane was 10,400 pounds.

ATSB Information

The Australian Transport Safety Bureau (ATSB) investigated an accident involving a PZL Mielec M-18A airplane that suffered an in-flight failure of the left wing in October 2013. The details of the investigation can be found in ATSB Report AO-2013-187. The airplane was equipped with a TPE331 turbine engine. They determined that there was fatigue cracking that initiated due to corrosion pitting in the bore of the left outboard wing forward spar lower fitting attach lug. The fatigue cracking was only present on one leg of the lug and comprised about 19% of the total cross-sectional area of the fractured lug. The ATSB utilized 25 hours of recorded data from the accident airplane to develop a maneuver load spectrum for comparison with the manufacturer's design load spectrum and the FAA load spectrum for agricultural operations published in AC 23-13A. Analysis of the load spectrums showed that "the negative acceleration fraction spectrum correlated well with the other reference spectra, falling between the FAA and aircraft manufacturer's spectra" and "other than at low acceleration fractions, the positive acceleration fraction spectrum was significantly greater than both the FAA and aircraft manufacturer's spectra." The manufacturer calculated the effect of the derived spectrum, flight time, and operating speed on the airplane's fatigue life finding that the fatigue life could be reduced by a factor of as much as 3.85.

The ATSB found that the airplane had been operated at higher speeds than assumed by the manufacturer and at weights above the certificated maximum gross weight, that the flight loads imposed on the airplane were more severe than assumed during design, and that the service life

factors were not appropriately applied for these operations. This resulted in greater fatigue damage than anticipated by the manufacturer rendering the service life limits and inspection intervals inadequate for the operation of the airplane. The ATSB identified 8 safety issues and actions in the report addressing airframe life factoring, removal of the wings during inspection, flight load spectrums, eddy current and other inspection procedures, recordkeeping, and the Australian engine conversion STC. All but one of these were addressed to the Civil Aviation Safety Authority (CASA), operators, or maintenance organizations in Australia. The identified actions were either adequately addressed or had pending action. The one issue regarding wing removal during inspection was addressed to the manufacturer. In response, the manufacturer issued Service Letter M18/034/2016 in February 2016, suggesting that the wings be removed from the airplane to better inspect the wing fittings in accordance with the SB.