

NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF AVIATION SAFETY
WASHINGTON, D.C. 20594

May 17, 2016

POWERPLANTS GROUP CHAIRMAN'S FACTUAL REPORT

NTSB ID No.: ERA15FA353

A: ACCIDENT

Location: Oneida, Tennessee
Date: September 12, 2015
Time: 1625 eastern daylight time
Aircraft: Aero Vodochody L-39C Albatross, N139RT

B: POWERPLANTS GROUP

Investigator-in-Charge: Luke Schiada
National Transportation Safety Board
Ashburn, Virginia
Group Chairman: Gordon J. Hookey
National Transportation Safety Board
Washington, D.C.
Member: Bill Anderson
Federal Aviation Administration
Nashville, Tennessee
Member: Aaron deVogel
Federal Aviation Administration
Nashville, Tennessee

C: SUMMARY

On September 12, 2015, about 1625 eastern daylight time, an Aero Vodochody L-39C Albatross, N139RT, operated by a private individual, was destroyed when it impacted terrain shortly after takeoff from Scott Municipal Airport (SCX), Oneida, Tennessee. The airline transport pilot was fatally injured. Visual meteorological conditions prevailed and no flight plan had been filed for the local airshow performance flight that was conducted under the provisions of 14 Code of Federal Regulations Part 91.

The airplane was equipped with an Ivchenko AI-25TL turbofan. The engine was partially disassembled and examined in the presence of the Powerplants Group at AMF Aviation, Springfield, Tennessee on October 6 and 7, 2015. The disassembly revealed the fan blades were bent opposite the direction of rotation. But the disassembly did not reveal any evidence of an in-flight fire, case rupture, uncontainment or case rupture.

D: DETAILS OF INVESTIGATION

1.0 Engine information

1.1 Engine description

The engine installed in N139RT¹ was an Ivchenko AI-25TL turbofan². The AI-25TL turbofan engine features a 3-stage fan, 8-stage high pressure compressor (HPC), annular combustor with 12 fuel nozzles, 1-stage high pressure turbine (HPT), and 2-stage low pressure turbine (LPT). The AI-25TL engine has a takeoff thrust rating of 3,792 pounds.

1.2 Engine operating history

According to the engine's maintenance logbook, the engine was an Ivchenko AI-25TL, serial number 7052522200176. According to the logbook, the engine had accumulated 324.9 hours time since new up to the time of the last inspection, which was a 100 hour/12 month inspection, that was accomplished on April 2, 2015. The logbook also shows that the engine was installed new into the airplane on March 27, 2001. The engine maintenance logbook shows the only maintenance actions that were accomplished to the engine were routine 50 hour/6 month and 100 hour/12 month inspections. The logbook did not list any non routine maintenance actions accomplished to the engine since it had been installed in the airplane.

¹ N139RT was an Aero Vodochody L-39C serial number 332505. According to the airplane's logbook, it was manufactured in 1983.

² The AI-25TL engine was designed by the Ivchenko Design Bureau located in Zaporozhye, Ukraine, Confederation of Independent States (CIS). The AI-25TL engine was manufactured by Motor-Sich in Zaporizhia, Ukraine, CIS.

2.0 Engine examination

2.1 Engine exterior

The engine was complete from the inlet case front flange and inlet dome to the exhaust duct. (Photos Nos. 1 and 2) The engine was crushed on the right side from the inlet case to the fan exhaust duct and rear mount that was twisted out of position.³ The fan ducts and exhaust duct were blistered. The fan duct between the intermediate case and the rear fan duct between 10 and 2 o'clock was burned away. There was no evidence of an uncontainment, case rupture, or in-flight fire.



Photo No. 1: View of bottom of engine showing no uncontainments, case ruptures, or in-flight fire damage.

³ All directions or locations on the engine as referenced to the clock, will be as viewed from the aft looking forward (ALF), unless otherwise specified.



Photo No. 2: View of top of engine showing no uncontainments, case ruptures, or in-flight fire damage.

The inlet guide vanes (IGV) and fan blades were examined with an ultraviolet light and none of the surfaces fluoresced.⁴

2.2 Inlet

The inlet dome was in place on the front of the inlet case. The inlet dome was dented radially inward between 3 and 4 o'clock. The exterior of the inlet dome was lightly sooted.

The inlet case was in place on the forward fan duct. The inlet case was partially crushed radially inward between 1 and 5 o'clock. All of the IGVs were present. All of the IGVs were separated from the inner shroud. The IGVs between 2 and 4 o'clock were buckled. (Photo No. 3) There were three IGVs that were separated completely from the inner and outer shrouds. The inlet case outer shroud inner diameter had an elliptical shaped rub mark, which was about 18.7-inches long and 1.1-inches wide at the widest point, directly in front of the fan stage 1 blade rub strip, which did not have any circumferential rub marks.

⁴ Organic proteins such as bird remains and blood will fluoresce when illuminated with an ultraviolet light.



Photo No. 3: View of inlet case showing damage to the inlet guide vanes.

2.3 Fan

The fan rotor could be moved about 1° back and forth, but the LPT rotor did not move concurrently when the fan rotor was moved.

All of the 1st, 2nd, and 3rd stage fan blades were in place in their respective disks. There were five 1st stage fan blades that were fractured transversely across the airfoil between about 0.6-inches and 2-inches above the blade root platforms and there were five 2nd stage fan blades that were fractured across the airfoils up to 1-inch below the tips. The fracture surfaces on all of the fractured fan blades were coarse and grainy. All of the remaining 1st and 2nd stage fan blades and all of the 3rd stage fan blades were full length and were bent opposite the direction of rotation. (Photo No. 4) None of the 1st stage fan blades had any soft body⁵ or hard body⁶ impact damage. Many of the 1st and 2nd stage fan blades had a purple discoloration along the full length of the airfoil.

⁵ Soft body impact damage is characterized by the large radius of curvature of the deformation to the blade, typically a fan blade. Soft body impact damage can result from impacts with pliable objects such as birds, ice slabs, wood, tire rubber, and plastic objects.

⁶ Hard body impact damage is characterized by a serrated appearance and deep cuts or tears to the airfoil's leading and trailing edges. Hard body impact damage can result from the impact with metal parts, concrete, asphalt, and rocks.



Photo No. 4: View of fan rotor showing fan blades bent opposite the direction of rotation.

Many of the full length 1st stage fan blades had a flat spot at about a 45° angle to the airfoil on the convex side tip corner between about 0.4-inches and 1-inch aft of the leading edge. (Photo No. 5) There was an approximately 30° arc of blades that had an approximately 0.4-inch wide rub mark that had heat discoloration. (Photo 6)



Photo No. 5: Close up of 1st stage fan blade tip showing flat spot on concave corner.



Photo No. 6: Close up of a 1st stage fan blade tip that had circumferential rub mark and tab of metal with heat discoloration.

Many of the 2nd and 3rd stage fan blades had the leading tip corner bent towards the direction of rotation. There was a group of five 3rd stage blades that had an imprint of parallel cuts on the tips that corresponded to the spacing of the circumferential knife edges on the 3rd stage fan shroud. (Photo No. 7) The 3rd stage fan shroud had an approximately 10-inch long sector that was missing the coating and corresponded to the cuts on the 3rd stage fan blades tips. (Photo No. 8) There were three pairs of adjacent 3rd stage fan blades that had the blade root platforms shingled.⁷

⁷ Shingled is the condition of the mid span shroud on a blade overlapping the mid span shroud of an adjacent blade in lieu of abutting at the contact surfaces.



Photo No. 7: Close up of 3rd stage fan blade tip showing marks from shroud rub strip.



Photo No. 8: Close up of 3rd stage fan rub strip showing imprints of blade tips.

The 1-2 and 2-3 fan stage spacers were intact. The fan spacers' triple knife edges were intact except each one had one section up to about 0.5-inches long on one knife edge that was bent or broken away.

The fan stators were in place. The 1st and 2nd stage vane stators had several vanes completely separated from the inner and outer shrouds, but were found in their respective stages.

The 3rd stage fan stator was intact, but there was an approximately 90° arc of vanes that were buckled.

2.4 Intermediate case

The intermediate case was intact. The left hand forward engine mount was in place on the intermediate case. The right hand forward engine mount was missing from the engine, but was recovered from the airplane debris.

2.5 High pressure compressor

The HPC variable stator vane indicator was pointing to about 17.⁸ (Photo No. 9)



Photo No. 9: Close up view of variable stator vane indicator needle pointing to 17.

The HPC IGVs were all in place in what appeared to be a partially open position. There was no apparent damage to the HPC IGVs. (Photo No. 10)

The HPC 1st stage blades that were visible did not have any apparent damage.

⁸ The scale on the variable stator vane indicator is 0 to 30.



Photo No. 10: Close up view of high pressure compressor inlet guide vanes and 1st stage blades.

A small sector of the HPC 8th stage blades were visible through a hole that was cut in the aft end of the compressor case and forward end of the diffuser case. The HPC 8th stage blades that were visible did not have any apparent damage or metal spray on the airfoils. (Photo No. 11)

A small sector of the HPC 8th stage vanes were visible through a hole that was cut in the aft end of the compressor case and forward end of the diffuser case. The HPC 8th stage vanes that were visible did not have any apparent damage.



Photo No. 11: Close up of high pressure compressor 8th stage blades showing no damage.

2.6 Diffuser

The exterior of the diffuser case did not have any apparent damage. All of the fuel nozzle mounting plates were in place. The fuel nozzle pigtail B-nuts were all in place on the manifolds.

2.7 Combustor

The exterior of the combustor case did not have any apparent damage.

The combustor was examined with a rigid borescope inserted through a small hole that was cut in the aft end of the compressor case and forward end of the diffuser case. Three combustor domes and fuel nozzles were visible. All three of the fuel nozzles were in place in their respective combustor dome swirlers. The three visible combustor domes did not have any apparent metal spray. There were no feathers on the visible combustor domes.

2.8 High pressure turbine

The exterior of the HPT case did not have any apparent damage.

2.9 Low pressure turbine

The exterior of the low pressure turbine case did not have any apparent damage.

The LPT rotor could not be moved. The LPT 2nd stage blades were all in place. There was no apparent damage to the LPT 2nd stage blade airfoils nor was there any apparent metal spray on the airfoils. (Photo No. 12)



Photo No. 12: View of low pressure turbine 2nd stage blades showing no damage to the airfoils.

2.10 Turbine exhaust case

The turbine exhaust case was in place on the LPT case. The turbine exhaust case struts were in place, but the struts at 4:30 and 6:00 o'clock were buckled. There was no apparent metal spray on the leading edges of the struts.

2.11 Exhaust

The exhaust duct was in place on the turbine fan duct. The rear of the exhaust duct was crushed radially inward from the bottom against the tail cone.

2.12 Gearbox

The gearbox was missing from the engine. A small section of the gearbox housing was recovered from amongst the airplane debris. The piece included three internal spur gears. There was no apparent damage on the spur gears' gear teeth.

The tower shaft was in place in the intermediate case. The tower shaft could not be rotated. The bevel gear teeth at the base of the tower shaft did not have any apparent damage.

2.13 Fuel system

The fuel control unit (FCU) was in place on the bottom of the engine. The FCU was intact, but it appeared to have been exposed to heat. The throttle protractor indicating pointer was pointing to about 30.⁹ (Photo No. 13) It was not possible to test the FCU. There are no facilities in the U.S. to test an AI-25TL engine's FCU. The manufacturer did not respond to several requests for information or assistance.



Photo No. 13: Close up view of fuel control throttle protractor indicator pointing to 30.

The fuel-oil heat exchanger had some residual fuel in it. The fuel-oil heat exchanger fuel filter housing was split along the back side for the full length of the filter housing. The fuel filter cover was in place and the safety wire was intact. The fuel filter housing bowl did not have any fuel in it. The fuel filter element did not have any debris.

2.14 Oil system

The oil tank was ruptured. The oil tank did not have an acrid odor. The oil filter was not recovered.

⁹ The scale on the fuel control protractor is from 0 to 110.