



Rolls-Royce

Engine Investigation

Allison
M250-C20F

Engine #1 CAE 840098
Engine #2 CAE 840350

Airbus (Aerospatiale) AS355F1
Registration: N708AC



Model 250-C20B/J

Aircam
Rifle, Colorado

David Riser

David Riser
Senior Air Safety Investigator

Accident date: July 11, 2020
Investigation date: July 30, 2020
Report date: September 22, 2020

Report Enclosures:

Report Narrative

Appendix A, Photographs at Recovery Location Engine #1

Appendix B, Photographs at Recovery Location Engine #2

Appendix C, Selected #1 Engine Records

Appendix D, Selected #2 Engine Records

Background Information:

On July 11, 2020 at approximately 07:34 am local time, an Airbus (Aerospatiale) AS355 F/2 helicopter, N708AC, was involved in an accident near Rifle, Colorado. The helicopter was operated by Aircam National Helicopter Services Inc. Visual meteorological conditions prevailed in the area at the time. The flight departed Rifle, Garfield County Airport on a power line observation flight with one pilot and one passenger on board. After an approximate 3-4 minute flight, witnesses reported the helicopter spinning and descending approximately one mile south of the departure point. The helicopter impacted the ground following which a post-crash fire occurred consuming much of the helicopter. Both the pilot and passenger were able to egress the aircraft with both sustaining serious injuries.

The helicopter was recovered to a facility in Greeley Colorado where the NTSB requested technical support from the engine manufacturer, Rolls-Royce and the airframe manufacturer, Airbus.

Engine Investigation:

On July 30, 2020 a Rolls-Royce Air Safety Investigator and an Airbus Air Safety Investigator joined an NTSB Air Safety Investigator and an FAA Inspector for a wreckage examination at the recovery location located in Greeley, Colorado. The following represents the engine facts and findings of that investigation.

Both engines were initially positioned on a trailer along with the balance of the wreckage with both exhibiting heavy post-crash fire damage and both being entangled in melted wire and sheet metal. Both engines were stripped of airframe material for further examination. The accessory gear boxes from both engines had been consumed in the post-crash fire. The compressor of the #1 engine remained attached by the left side compressor air discharge tube and the spur adapter gear shaft. The compressor from the #2 engine was separate from the engine. The balance of both engines from the exhaust collector supports aft remained in their relative positions. (Fig 1)

Engine Information:

Engine #1

An Allison M250-C20F gas turbine engine, S/N CAE 840098, was one of two engines powering the helicopter and was positioned in the #1 (left side) position. Engine records indicate the engine was last installed on the airframe November 20, 2019 following compressor and turbine replacement at 12545.9 ETT.

Manufacturer	Allison
Engine Model	250-C20F
Rating:	420 Shaft Horsepower
Serial Number	CAE 840098
Engine Total Hours	12642.2
Last 100-Hour Inspection	12584.5
Last 300-Hour inspection	12584.5

Component	Serial Number	Part Number	TSO	Total Time
Engine	CAE 840098	6887190	New	12642.2
Gearbox	CAG 40893	23001938	New	4895.7
Compressor	CAC 43178	6890550	737.3	4446.4
Turbine	CAT 40555	23069745	614.0	13977.6
Fuel Control	319524	23070606	883.0	Unknown
Governor	86090359	23065123	953.0	4363.4
Fuel Pump	T100084	6899253	756.6	Unknown
Fuel Nozzle	AG57936	23077068	883.0	Unknown
Bleed Valve	FF288695	23053176	999.39	unknown

❖ Times taken from daily status and log records and do not include accident flight

Compressor Section:

The compressor remained generally in its normal position and connected to the aft portion of the engine by the left side compressor air discharge tube and the spur adapter gear shaft and exhibited overall discoloration from fire exposure. The compressor inlet and guide vanes displayed no evidence of impact damage. The stage one and stage two compressor blades and vanes exhibited no evidence of impact or FOD type damage. The case halves displayed no external damage however the abradable material inside the case halves had burned away resultant of post-crash fire. The compressor bleed valve had been consumed by post-crash fire.

The compressor scroll was generally normal in appearance and other than post-crash fire exposure was visually normal. Both left and right compressor air discharge tubes exhibited no impact damage and other than fire exposure were visually normal. (Fig 2)

Accessory Gearbox Section:

The accessory gear box was consumed by the post-crash fire. Several internal gears normally contained within the accessory gear boxes were recovered. Other than thermal damage from fire exposure the recovered gears were visually normal. No determination could be made from which gear box the recovered gears were originally positioned.

Combustion Section:

The outer combustion case remained in position and other than discoloration from fire exposure was visually normal. Examination of both the left and right arm pit areas as well as the basket area revealed dirt and debris in all three areas. Removal of the outer combustion case revealed the combustor liner in proper position and undamaged. Removal and examination of the combustor liner revealed it to be visually normal with no evidence of streaking or unusual burn patterns. (Fig 3)

Turbine Section:

The turbine module remained properly mated to the exhaust collector support and other than discoloration from fire exposure was visually normal. Visual examination of the stage four turbine wheel and stage four turbine nozzle through the exhaust collector support revealed both to be visually normal with no evidence of vane or blade damage.

The stage one nozzle shield was in position and other than a soot coating and dirt adhesion was otherwise normal. The stage one nozzle and stage one turbine wheel were both visually normal with no evidence of blade or vane damage. Dirt ingestion throughout the gas path was noted on the first stage nozzle vanes and first stage wheel blades as well as on the fourth stage nozzle and wheel surfaces. (Fig 4)

Engine Shafting:

The power turbine to pinion gear coupling and the turbine to compressor coupling remained properly seated inside the turbine module. Other than discoloration from fire exposure and the melting away of the Teflon rings, the power turbine to pinion gear coupling was otherwise normal. The turbine to compressor coupling was visually normal with the exception of discoloration from fire exposure and the internal splines exhibited no evidence of damage. The spur adapter gear shaft remained properly seated within the compressor on the forward end. The aft end was stuck inside the #3/4 bearing housing and could not be removed however the spur adapter gear exhibited no visible damage nor did visible portions of the fore and aft end splines. (Fig 5)

Oil System and Engine Bearings:

No examination of the oil system could be conducted as the oil pump normally housed in the accessory gear box had been consumed by post-crash fire and the majority of oil lines were either consumed by fire or heavily damaged.

The #2, 3, 4 bearings were visually examined. All three exhibited heavy post-crash fire damage and as such were non rotatable however all balls and rollers displayed no other damage or evidence of spalling. (Fig 6)

Fuel System:

The fuel pump was either not recovered or consumed by the post-crash fire. The fuel nozzle remained in position and was normal in appearance with no excessive carbon on the outer air shroud. Engine fuel lines were heavily impact damaged or exhibited heavy burn damage. (Fig 7)

Engine Accessories:

Both the power turbine governor and the fuel control unit were consumed by post-crash fire and therefore not examined.

Engine #2

An Allison M250-C20F gas turbine engine, S/N CAE 840350, was one of two engines powering the helicopter and was positioned in the #2 (Right Side) position. Engine records indicate the engine was removed and reinstalled on the airframe October 9, 2019 at 9906.5 ETT following compressor, power turbine governor and fuel control unit replacement. The last recorded component maintenance action was a bleed valve replacement June 23, 2020 at 9964.6 ETT.

Manufacturer	Allison
Engine Model	250-C20F
Rating:	420 Shaft Horsepower
Serial Number	CAE 840350
Engine Total Hours	10008.1
Last 100-Hour Inspection	9950.4
Last 300-Hour inspection	9950.4

Component	Serial Number	Part Number	TSO	Total Time
Engine	CAE 840350	6887190	New	10008.1
Gearbox	CAG 40290	23001938	2864.5	Unknown
Compressor	CAC 35467	6890550	103.6	7098.4
Turbine	CAT 36498	23069745	1010.8	10615.0
Fuel Control	335940	23070606	153.1	Unknown
Governor	26331	23065123	515.0	Unknown
Fuel Pump	SERT109881	6899253	3880.1	Unknown
Fuel Nozzle	1799	23077068	1010.8	Unknown
Bleed Valve	FF14264	23053176	435.0	Unknown

❖ Times taken from daily status and log records and do not include accident flight.

❖ Eng #2 ETT taken from daily flight log hours due to ETT log book discrepancies and are assumed accurate.

Compressor Section:

The compressor was separate from the aft portion of the engine and exhibited overall discoloration from fire exposure. The compressor inlet and guide vanes exhibited no evidence of impact damage. The stage one and stage two compressor blades and vanes exhibited no evidence of impact or FOD type damage. The case halves displayed no external damage however the abradable material inside the case halves had burned away resultant of post-crash fire. The compressor bleed valve had been consumed by post-crash fire. The compressor scroll was generally normal in appearance and other than post-crash fire exposure was visually normal. Both left and right compressor air discharge tubes exhibited no impact damage and other than fire exposure were visually normal. (Fig 8)

Accessory Gearbox Section:

The accessory gear box had been consumed by the post-crash fire. Several internal gears normally contained within the accessory gear boxes were recovered. Other than thermal damage from fire exposure the recovered gears were visually normal. No determination could be made from which gear box the recovered gears were originally positioned.

Combustion Section:

The outer combustion case remained in position and other than discoloration from fire exposure was visually normal. Examination of both the left and right arm pit areas as well as the basket area revealed dirt and debris in all three areas. Removal of the outer combustion case revealed the combustor liner in proper position and undamaged. Removal and examination of the combustor liner revealed it to be visually normal with no evidence of streaking or unusual burn patterns. (Fig 9)

Turbine Section:

The turbine module remained properly mated to the exhaust collector support and other than discoloration from fire exposure was visually normal. Visual examination of the stage four turbine wheel and stage four turbine nozzle through the exhaust collector support revealed both to be visually normal with no evidence of vane or blade damage.

The stage one nozzle shield was in position and other than dirt adhesion was otherwise normal. The stage one nozzle and stage one turbine wheel were both visually normal with no evidence of blade or vane damage. Dirt ingestion throughout the gas path was noted on the first stage nozzle vanes and first stage wheel blades as well as on the fourth stage nozzle and wheel surfaces. (Fig 10)

Engine Shafting:

The power turbine to pinion gear coupling was found separate from the balance of the engine. Other than discoloration from fire exposure and the melting away of the Teflon rings, the power turbine to pinion gear coupling was otherwise normal.

The turbine to compressor coupling was not recovered. The spur adapter gear shaft remained properly seated within the compressor on the forward end. The aft end was stuck inside the #3/4 bearing housing and could not be removed however the spur adapter gear exhibited no visible damage nor did visible portions of the fore and aft end splines. (Fig 11)

Oil System and Bearings:

No examination of the oil system could be conducted as the oil pump normally housed in the accessory gear box was consumed by post-crash fire and the majority of oil lines were either consumed by fire or heavily damaged. The #2, 3, 4 bearings were visually examined. All three exhibited heavy post-crash fire damage and as such were non rotatable however all balls and rollers displayed no other damage or evidence of spalling. (Fig 12)

Fuel System:

The fuel pump was either not recovered or consumed by the post-crash fire. The fuel nozzle remained in position and was normal in appearance with no excessive carbon on the outer air shroud. Engine fuel lines were heavily impact damaged or exhibited heavy burn damage. (Fig 13)

Engine Accessories:

The fuel control unit was recovered in the wreckage and had sustained heavy post-crash fire damage with approximately 25% of the body having burned away allowing for internal fire damage. The power turbine governor was either not recovered or consumed by post-crash fire. (Fig 14)

Summary of Findings:

- Examination of the recovered engine components from both #1 and # 2 engines revealed no evidence of failures which would have precluded normal engine operation.
- Both engine #1 and # 2 engines exhibited dirt and debris present throughout the gas path consistent with engines operating after ground impact.

**Appendix A,
Photographs at Recovery Location
Engine #1**

Fig 1



Engines as Removed From Wreckage



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Fig 2



Compressor at Removal



Compressor Inlet



Compressor Air Discharge Tubes

Fig 3



Outer Combustion Case



Combustor Liner

[\(Return\)](#)

Fig 4



Turbine Module



Stage 1 Nozzle Shield



Stage Four Turbine Wheel



Stage One Nozzle



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Fig 5



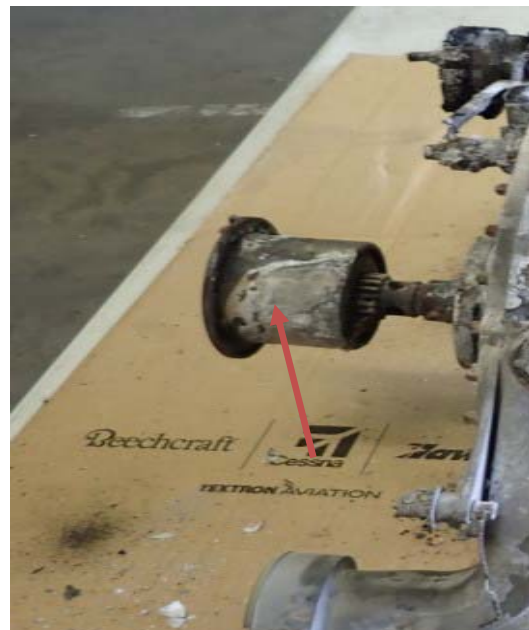
Power Turbine to Pinion Gear Coupling
with Turbine to Compressor Coupling



Power Turbine to Pinion Gear Coupling

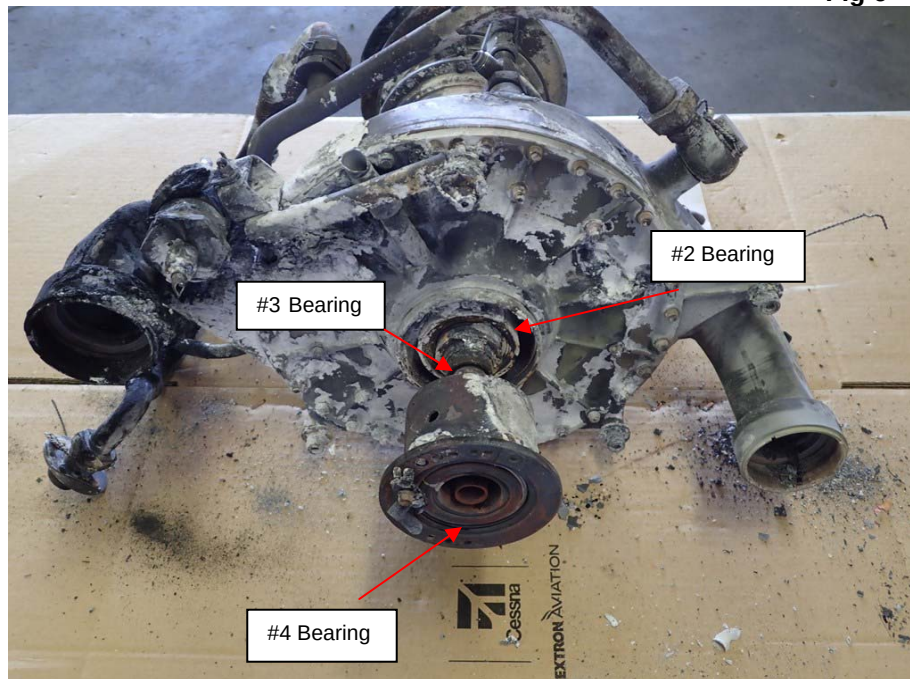


Turbine to Compressor Coupling



Spur Adapter Gear Shaft

Fig 6



3/4 Bearing Housing - #2 Bearing



#2 Bearing



#4 Bearing

Fig 7

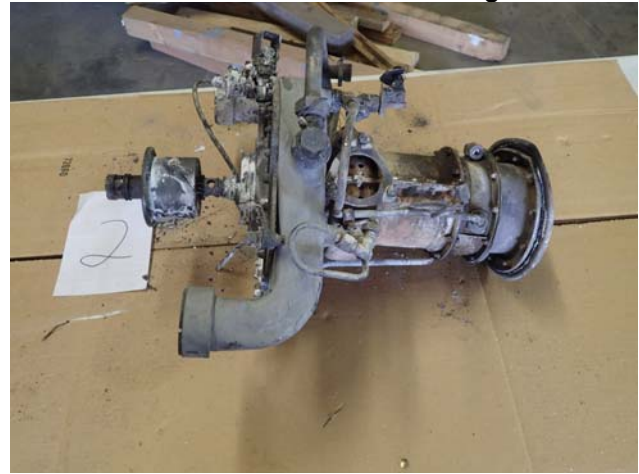


Fuel Nozzle in Position

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**Appendix B,
Photographs at Recovery Location
Engine #2**

Fig 8



Compressor as Recovered



Compressor Inlet
(Return)

Fig 9



Outer Combustion Case



Combustor Liner



Compressor Air Discharge Tubes

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Fig 10



Turbine Module



#1 Nozzle Shield



Stage Four Turbine Wheel

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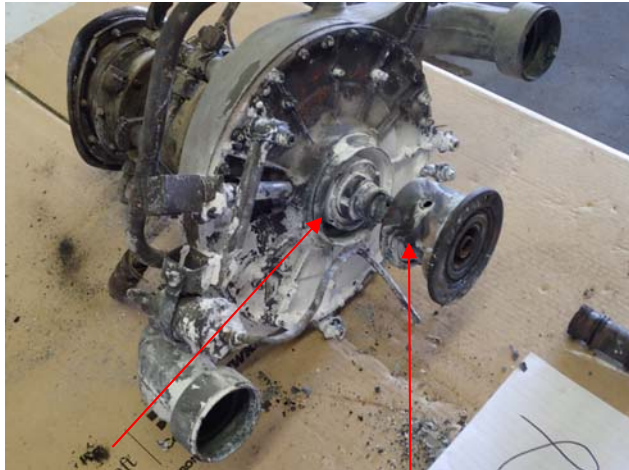


Power Turbine to Pinion Gear Coupling

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Spur Adapter Gear Shaft



#2 Bearing - #3-4 Bearing Housing



#2 Bearing



#4 Bearing

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Fig 12

Fig 13



Fuel Nozzle

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Fig 14



Fuel Control Unit

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