NTSB File No. WPR19FA079
Cessna 414A N414RS, Yorba Linda, CA 2/3/19

Hartzell Engine Technologies
Turbocharger Examination Field Notes

Turbocharger Examination

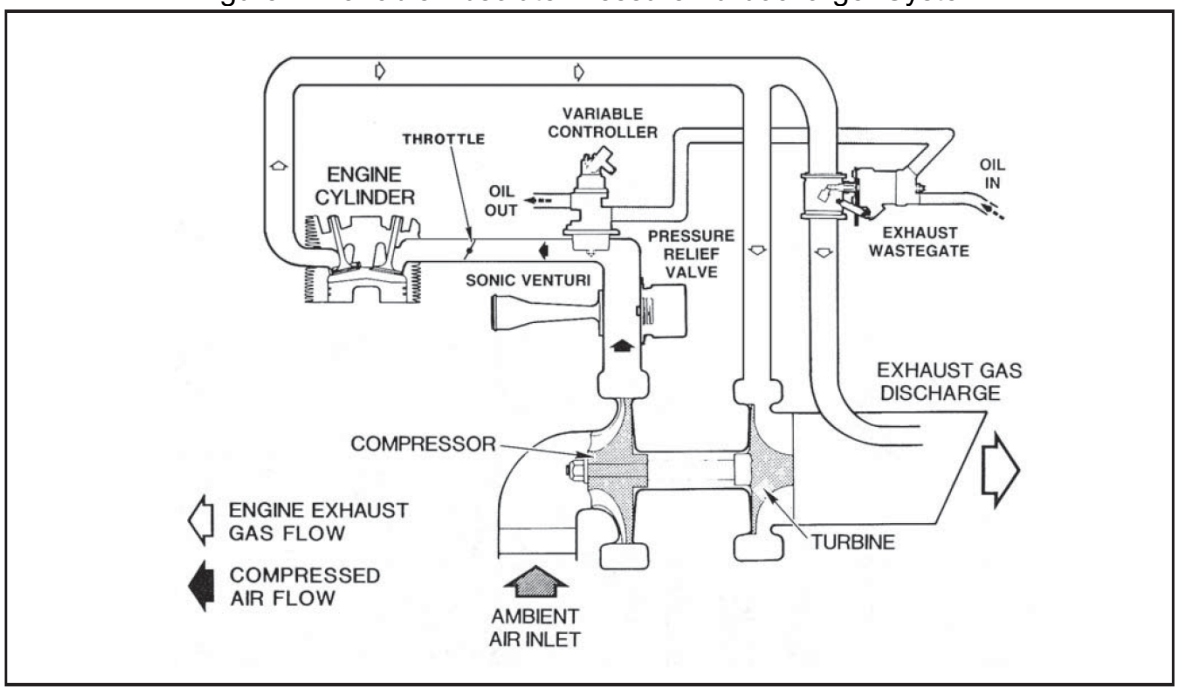
Location: Air Transport, Phoenix, AZ
Date: February 8, 2019
Participants: Les Doud – Hartzell Engine Technologies Air Safety Investigator
Maja Smith – NTSB Investigator in Charge
Eliott Simpson – NTSB Sr. Air Safety Investigator
Clint Crookshanks – NTSB Structural Engineer
Ricardo Asensio – Textron Air Safety Investigator

Turbocharger Description

Model: TH08A67
L/H RAM P/N 2060-1
L/H S/N: IGL00305
R/H Garrett/Allied Signal P/N 407810-9001
R/H S/N: AA021152

Description: The TSIO-520-NB engine on the Cessna 414A uses a "Variable Absolute Pressure" turbocharger system. A single turbocharger is controlled by a variable controller that senses deck pressure (upstream of throttle valve), compares it to a reference absolute pressure, and adjusts the wastegate butterfly (controlling turbocharger speed) to maintain sea-level horsepower at varying altitudes. It differs from the non-variable version, however, in that it is directly linked to the engine throttle, and through a system of cams and followers, adjusts itself to varying power settings, achieving the optimum deck pressure for a given throttle movement. A pressure relief valve, set slightly in excess of maximum deck pressure, is provided to prevent damaging overboost in the event of a system malfunction. A sonic venturi is incorporated to provide a constant source of compressed air to the cabin pressurization system. An intercooler is added to cool the compressor outflow and increase cylinder charge air density. A system schematic is shown in Figure 1.

Figure 1: Variable Absolute Pressure Turbocharger System



As Received Condition

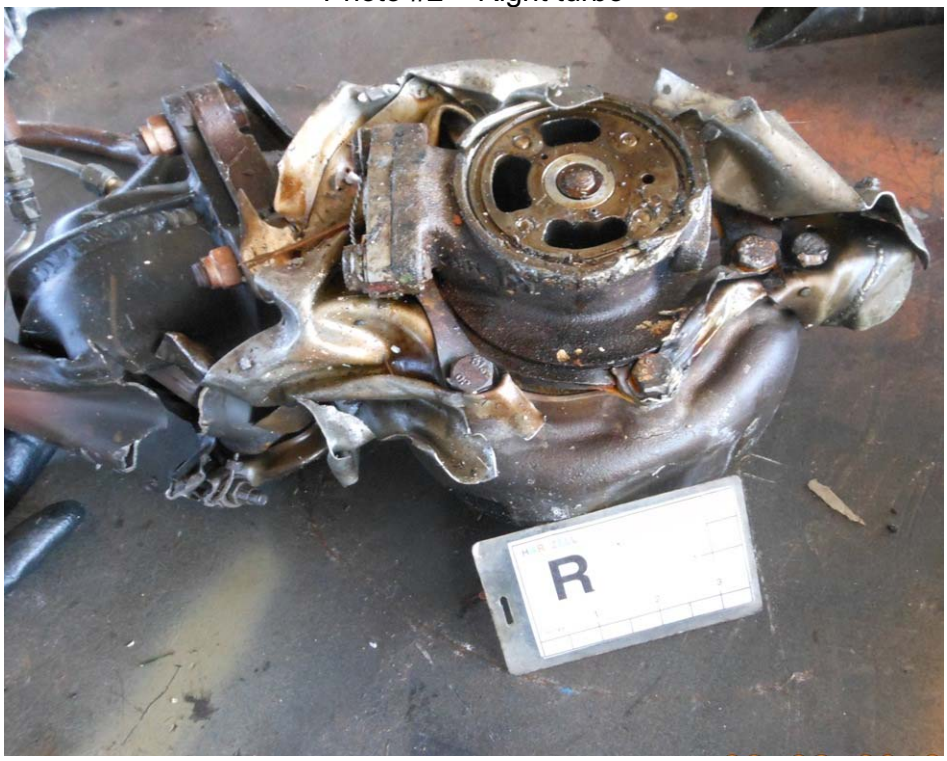
The turbocharger systems were fractured-separated from each engine during the impact sequence and recovered at the crash scene.

The left turbocharger remained mostly intact and attached to the turbine inlet exhaust duct and some aircraft structure (Photo #1).

The right turbocharger fractured into several pieces during the impact sequence (Photo #2). The main components were the turbine and center housings still connected to each other, the compressor housing that separated and the compressor wheel that fracture-separated with the forward end of the shaft still attached. The turbocharger data tag was found in the debris recovered at the crash scene.

Photo #1 – Left turbo assembly

Photo #2 – Right turbo



Turbocharger Examination Findings

A visual inspection of the turbocharges was conducted; no disassembly was completed. The oil outlet drain fitting on each turbo was fracture-separated allowing for visual access to the Center Housing. The interiors of both turbos were wet with oil. The following observations were made (see Photos #3 through #12):

1. Both turbo chargers had fractured compressor backplates (right was fracture-separated, left was cracked around the mounting circumference).

2. The left turbo rotor group was intact; turbine and compressor rotated together by light finger force. Blade clearances varied on both the compressor and turbine housings. There appeared to be light rub indications in the compressor housings and the compressor blades appeared to have a bur opposite rotation on the tips. The right rotor was not intact. The right compressor wheel fracture-separated from the assembly where the shaft exits the center housing. The turbine housing had dislodged from the center housing and was impinging on the turbine wheel; it could not be rotated. Some turbine blades contacted the turbine housing and appeared to "plow" material in the direction of rotation.

3. Balance cuts were present on the turbine wheel hub of each turbocharger.

4. There was some evidence of compressor wheel contact/rub on both turbochargers; the compressor housing had light rub marks and there was evidence of light rub on some compressor blade tips.

5. There were also what appeared to be stationary blade impact marks on the right compressor housing. Both compressor wheels had blade impact damage indicating contact with the housing.

6. Both compressor wheel nuts were present.

7. There was NO visible FOD damage on either the compressor or turbine side on both turbochargers.

8. There was NO excessive exhaust build-up on the turbine housing walls or wheel surfaces of either turbocharger.

9. There was NO evidence of oil leakage on either the compressor or turbine side; no oil residue or oily buildup on the wheels or in the compressor or turbine discharge ports.

10. When viewing the internal cavity of the Center Housings after disassembly, the following was observed:
    a. There was evidence of sufficient oil/lubrication
    b. There was NO evidence of coking
    c. There was NO evidence of excessive heat.
    d. There was NO evidence of FOD in the oil prior to impact with terrain.
    e. There was NO evidence of lubrication blockage prior to impact with terrain and all oil passages and radial holes were clear.

Turbocharger System Components

The following turbocharger system components were visually examined but not disassembled or tested.

Right Engine

Wastegate actuator (Photo #7)
RAM data tag – Red color, “OH”
P/N: 470908-9013
S/N: 811040

The right wastegate actuator was fracture-separated from the wastegate assembly and one of the fitting ports was fractured.

Pressure Relief Valve (Photo #9)
RAM data tag – Red color, “OH”
P/N: 1020-2
S/N: IL0219

Turbo Controller (Photo #8
The right controller was fractured and only some pieces were found in the recovered debris. A data plate was not found.

Left Engine

Wastegate actuator (Photo #10)
RAM data tag – Red color, “OH”
P/N: 470908-9012
S/N: IK0153

The left wastegate actuator remained attached to the valve shaft. The valve shaft could not be turned by hand force

Pressure Relief Valve (Photo #11)
RAM data tag – Red color, “OH”
P/N: 1020-2
S/N: KK0153

Turbocharger Controller (Photo #12)
RAM data tag – Red color
P/N 470836-20RAM
S/N BD047136

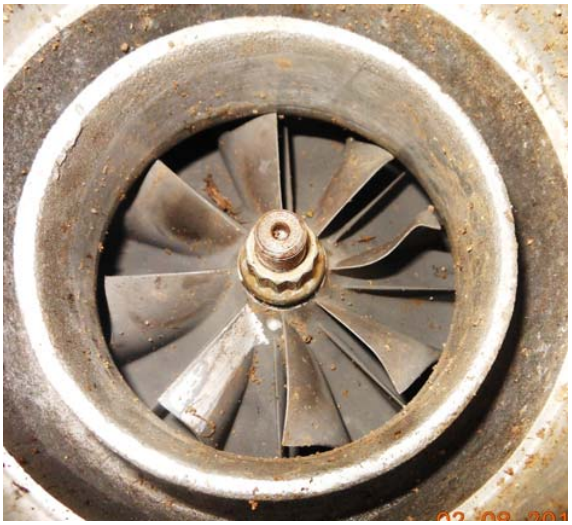
Conclusions

The turbochargers exhibited characteristics of normal operation with no evidence of distress prior to inflight breakup and impact. There were no discrepancies noted that would prevent or degrade normal turbocharger operation prior to the inflight breakup and impact.

Les Doud
Air Safety Investigator
Hartzell Engine Technologies Inc.

Photo #3 – Compressor inlet/wheels

Left



Right

Photo #4 –Turbine exit/wheels

Left

Right

Photo #5 – Compressor housing rub and wheel impact marks

Left

Right

Photo #6 – Center housing internal condition

Left

Right

Photo #7 – Right wastegate actuator

Photo #8 – Right Turbocharger Controller

Photo #9 – Right Pressure Relief Valve

Photo #10 – Left wastegate and actuator

Photo #11 – Left Pressure Relief Valve

Photo #12 – Left Turbocharger Controller