Date of Accident: April 7, 2015

Location: Bloomington, IL

NTSB File No.: CEN15FA190

Aircraft: Cessna 414A

Registration No.: N789UP

Serial No.: 414A0495

Operator: per the FAA registry:
Make It Happen Aviation LLC.
[redacted].
Towanda, IL 61776

Written by: Les Doud – Air Safety Investigator

Date: February 2, 2016

Contents:

ACCIDENT SYNOPSIS

According to the NTSB preliminary report: “On April 7, 2015, about 0006 central daylight time (all referenced times will reflect central daylight time), a Cessna model 414A twin-engine airplane, N789UP, was substantially damaged when it collided with terrain following a loss of control during an instrument approach to Central Illinois Regional Airport (BMI), Bloomington, Illinois. The airline transport pilot and six passengers were fatally injured. The airplane was owned by and registered to Make It Happen Aviation, LLC, and was operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 while on an instrument flight rules (IFR) flight plan. Night instrument meteorological conditions prevailed for the cross-country flight that departed Indianapolis International Airport (IND), Indianapolis, Indiana, at 2307 central daylight time.

According to preliminary Federal Aviation Administration (FAA) Air Traffic Control (ATC) data, after departure the flight proceeded direct to BMI and climbed to a final cruise altitude of 8,000 feet mean sea level (msl). According to radar data, at 2344:38 (hhmm:ss), about 42 nautical miles (nm) south-southeast of BMI, the flight began a cruise descent to 4,000 feet msl. At 2352:06, the pilot established contact with Peoria Terminal Radar Approach Control, reported being level at 4,000 feet mean sea level (msl), and requested the Instrument Landing System (ILS) Runway 20 instrument approach into BMI. According to radar data, the flight was located about 21 nm south-southeast of BMI and was established on a direct course to BMI at 4,000 feet msl. The approach controller told the pilot to expect radar vectors for the ILS Runway 20 approach. At 2354:18, the approach controller told the pilot to make a right turn to a 330 degree heading. The pilot acknowledged the heading change. At 2359:16, the approach controller cleared the flight to descend to maintain 2,500 feet msl. At 2359:20, the pilot acknowledged the descent clearance.

At 0000:01, the approach controller told the pilot to turn left to a 290 heading. The pilot acknowledged the heading change. At 0000:39, the approach controller told the pilot that the flight was 5 nm from EGROW intersection, cleared the flight for the ILS Runway 20 instrument approach, issued a heading change to 230 degrees to intercept the final approach course, and told the pilot to maintain 2,500 feet until established on the inbound course. The pilot correctly read-back the instrument approach clearance, the heading to intercept the localizer, and the altitude restriction.

According to radar data, at 0001:26, the flight crossed through the final approach course while on the assigned 230 degree heading before it turned to a southerly heading. The plotted radar data showed the flight made course corrections on both sides of the localizer centerline as it proceeded inbound toward EGROW. At 0001:47, the approach controller told the pilot to cancel his IFR flight plan on the

approach control radio frequency, that radar services were terminated, and authorized a change to the common traffic advisory frequency (CTAF). According to radar data, the flight was 3.4 nm outside of EGROW, established inbound on the localizer, at 2,400 feet msl. At 0002:00, the pilot transmitted over the unmonitored CTAF, "twin Cessna seven eight nine uniform pop is coming up on EGROW, ILS Runway 20, full stop." No additional transmissions from the pilot were recorded on the CTAF or by Peoria Approach Control.

According to radar data, at 0003:12, the flight crossed over the locator outer marker (EGROW) at 2,100 feet msl. The flight continued to descend while tracking the localizer toward the runway. At 0003:46, the airplane descended below available radar coverage at 1,500 feet msl. The flight was about 3.5 nm from the end of the runway when it descended below radar coverage. Subsequently, at 0004:34, radar coverage was reestablished with the flight about 1.7 nm north of the runway threshold at 1,400 feet msl. The plotted radar data showed that, between 0004:34 and 0005:08, the flight climbed from 1,400 feet msl to 2,000 feet msl while maintaining a southerly course. At 0005:08, the flight began a descending left turn to an easterly course. The airplane continued to descend on the easterly course until reaching 1,500 feet msl at 0005:27. The airplane then began a climb while maintaining an easterly course. At 0005:42, the airplane had flown 0.75 nm east of the localizer centerline and had climbed to 2,000 feet. At 0005:47, the flight descended below available radar coverage at 1,800 feet msl. Subsequently, at 0006:11, radar coverage was reestablished at 1,600 feet msl about 0.7 nm southeast of the previous radar return. The next two radar returns, recorded at 0006:16 and 0006:20, were at 1,900 feet msl and were consistent with the airplane continuing on an easterly course. The final radar return was recorded at 0006:25 at 1,600 feet msl about 2 nm east-northeast of the runway 20 threshold."

Aircraft Damage: Destroyed

Injuries: 7 on board, 7 fatal

SUMMARY

The following turbocharger system components from the subject accident aircraft were examined at Hartzell Engine Technologies in Montgomery, AL on September 3, 2015.

Component Name	Left Engine	Right Engine
Turbocharger	M/N TH08A67 P/N 2060-1 RAM P/N (STC part) S/N KJL00495 2007 October	M/N TH08A67 P/N 635630 CMI P/N P/N 407810-9001 S/N ZL018835 1996 December new (AirResearch)
Wastegate Valve	P/N 470908-12 P/N C165006-0106 Cessna P/N S/N YJ085012 1995 December new (AirResearch)	P/N 470908-9013 P/N C165006-0107 Cessna P/N S/N LE000460 2007 May new (Kelly) or 1982 May (AirResearch)
Turbo Controller	AirResearch P/N 470836-9020 S/N JLR0108 1980 Dec O/H (AirResearch) or 2006 Dec O/H (Kelly)	Garrett P/N 470836-9020 Customer P/N 642247 CMI (TCM) P/N S/N BB0(?)013(?) 1998 Feb (complete S/N not readable due to damaged data plate)

Both the L/H and R/H turbocharger systems exhibited considerable impact and post-crash fire damage that hindered disassembly and inspection. A summary of observations is provided and detailed teardown reports (including photos) of each turbocharger examination are provided in Appendices A and B.

CONCLUSIONS OF TURBOCHARGER EXAMINATIONS

Despite evidence of contact between the compressor wheel and housing during impact, there was no evidence of rotational scoring on the turbocharger housings that would normally be consistent with moderate-to-high RPM/ boost operation. The examination findings were consistent with engine power levels not requiring significant boost pressure from the turbochargers at the time of impact. All the damage was consistent with high impact forces and post-crash fire. There were no discrepancies noted that would prevent or degrade normal turbocharger operation prior to impact.

Turbocharger Teardown Report

Date of Investigation: September 3, 2015

Location: Hartzell Engine Technologies, Montgomery, AL

Representatives:	Judd Hough	Hartzell Engine Technologies
	John Mincey	Hartzell Engine Technologies
	Les Doud	Hartzell Engine Technologies
	Todd Fox	NTSB Investigator in Charge
	David Slaybaugh	FAA Springfield, IL FSDO
	Ernest Hall	Textron Air Safety Investigator
	Rick Roper	RAM Aircraft Director of Operations

General Comments:

The turbocharger system on the Cessna 414 with the TSIO-520-NB engine is called a "Variable Absolute Pressure System (Twin Engine, without Cover)." The variable absolute pressure controller senses deck pressure, compares it to a reference absolute pressure, and adjusts the wastegate butterfly (controlling turbocharger speed) to maintain the desired 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, if installed, 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.

Teardown Field Notes/Observations: (Details of each turbocharger teardown are provided in Appendices A and B)

The R/H turbocharger compressor/turbine wheel assembly could not be rotated by hand in the as-received condition. The compressor housing was deflected aft and to the left, into the compressor wheel and had impact damage to the inlet duct.

The R/H turbocharger was disassembled by first removing the compressor housing. The compressor/turbine shaft was bent and had to be pressed (with hydraulic press) through the compressor wheel and bearings for removal. The compressor wheel showed impact and thermal damage to several blades. The compressor wheel had a circumferential fracture where the compressor housing contacted outer edge. There were no visually remarkable rotational score marks on the compressor housing. The compressor backplate was partially fractured at the center body attachment screws with cracks emanating from the mounting

points. The center body oil seal o-ring was compromised by heat damage. The shaft did not appear to be fused to the shaft bearings but it and the thrust bearings had some corrosion consistent with exposure to a post-crash fire. The turbine wheel did not exhibit any obvious blade damage. There were small impact marks on the turbine housing adjacent to each blade and three larger marks in the five o'clock position (aft-looking-forward at housing), the longest being approximately the length of 0.5 blade chord.

The R/H wastegate actuator mount was fractured. The wastegate butterfly valve could be moved by finger force from full-open to full-closed. The wastegate actuator was intact but the oil fitting ports were fractured so the actuator could not be functionally tested.

The R/H wastegate controller control arm could be moved by hand and the plunger followed cam movement. The controller was mounted on a test bench and functioned normally but had been field-adjusted so it did not meet all factory settings.

The L/H turbocharger compressor/turbine wheel assembly could not be rotated by hand in the as-received condition. The L/H turbocharger compressor housing could not be removed due to impact and thermal damage. The compressor backplate was fractured behind the compressor wheel at the center body mounting surface around the entire circumference and was visually misaligned with the shaft centerline.

The compressor housing and wheel were removed by pressing (with hydraulic press) the shaft through the compressor wheel and bearings. The compressor/turbine shaft was bent consistent with the impact damage to the compressor housing and wheel. The compressor wheel blades showed impact and/or heat damage to all blades with circumferential fractures similar to the R/H compressor wheel. There were no visually remarkable rotational score marks on the compressor housing. The center body oil seal o-ring was compromised by heat damage. The shaft did not appear to be fused to the shaft bearings but it and the thrust bearings had some corrosion consistent with exposure to a post-crash fire. The turbine wheel did not exhibit any obvious blade damage and there were no rotational score marks on the turbine housing.

The L/H wastegate actuator mount was fractured. The wastegate butterfly valve could be moved by finger force and the butterfly valve looked similar to the R/H wastegate valve. The wastegate actuator housing was thermally damaged and the piston and oil fitting end of the housing was melted/missing so the actuator could not be functionally tested.

The L/H wastegate controller control arm could be moved by hand but the plunger did not consistently follow cam movement. The controller was intact but showed external thermal distress. The controller was mounted on a test bench but did not function due to internal leakage due to suspected thermal damage of the seals.

PHOTOGRAPHIC SUMMARY

NOTE: The following digital photographs are original and unedited and available on compact disc. The numbering sequence may not be chronological as some may have been deleted if out-of-focus, too dark, redundant, etc. Photos used in the text of this report are taken from photos on this list but may have been adjusted from the original. Modifications to images used in the report are limited to cropping, magnification, file compression, or enhancement of color, brightness, or contrast for the sole purpose to improve clarity of the report. No other alterations are permitted.

LEFT TURBOCHARGER PHOTOS

Picture File Name	Description
IMG_4968.JPG	turbo as-received box unopened
IMG_4969.JPG	turbo as-received box opened A
IMG_4970.JPG	turbo as-received box opened B
IMG_4971.JPG	Turbo dataplate A
IMG_4972.JPG	Turbo dataplate B
IMG_4973.JPG	Compressor inlet and wheel A
IMG_4974.JPG	Compressor inlet and wheel B
IMG_4975.JPG	Compressor housing, inlet and wheel
IMG_4976.JPG	Turbine inlet and wheel A
IMG_4977.JPG	Turbine inlet and wheel B
IMG_4978.JPG	Fractured turbine mounting flange A
IMG_4979.JPG	Fractured turbine mounting flange B
IMG_4980.JPG	Compressor exit duct A
IMG_4981.JPG	Compressor exit duct B
IMG_4982.JPG	Compressor exit duct C
IMG_4983.JPG	Compressor housing A
IMG_4984.JPG	Compressor housing B
IMG_4985.JPG	Compressor housing/backplate v-band removed A
IMG_4986.JPG	Compressor housing/backplate v-band removed B
IMG_4987.JPG	Compressor housing/backplate v-band removed C
IMG_4988.JPG	Compressor housing/backplate v-band removed D
IMG_4989.JPG	Oil line port
IMG_4990.JPG	Turbine housing A
IMG_4991.JPG	Turbine housing B
IMG_4992.JPG	Turbine housing C
IMG_4993.JPG	Turbine housing C
IMG_4994.JPG	Turbine wheel A
IMG_4995.JPG	Turbine wheel B
IMG_4996.JPG	Turbine wheel C
IMG_4997.JPG	Turbine wheel D
IMG_4998.JPG	Compressor housing backplate
IMG_4999.JPG	Compressor housing backplate mounting area A
IMG_5000.JPG	Turbine heat shield
IMG_5001.JPG	Turbine wheel and shaft assembly A
IMG_5002.JPG	Compressor backplate fracture A
IMG_5003.JPG	Compressor backplate fracture B

IMG_5004.JPG	Compressor backplate fracture C
IMG_5005.JPG	Compressor backplate fracture D
IMG_5006.JPG	Compressor backplate fracture E
IMG_5007.JPG	Turbine wheel and shaft assembly B
IMG_5008.JPG	Turbine wheel and shaft assembly C
IMG_5009.JPG	Shaft bearing surfaces A
IMG_5010.JPG	Shaft bearing surfaces B
IMG_5011.JPG	Compressor housing backplate mounting area B
IMG_5012.JPG	Center body - turbine side
IMG_5013.JPG	Center body - turbine side bearing A
IMG_5014.JPG	Center body - turbine side bearing B
IMG_5015.JPG	Center body - turbine side bearing C
IMG_5016.JPG	Compressor wheel (aft side) in housing A
IMG_5017.JPG	Compressor wheel (aft side) in housing B
IMG_5018.JPG	Compressor wheel A
IMG_5019.JPG	Compressor wheel B
IMG_5020.JPG	Compressor wheel C
IMG_5021.JPG	Compressor housing interior A
IMG_5022.JPG	Compressor housing interior B
IMG_5023.JPG	Compressor housing interior C
IMG_5024.JPG	Compressor housing interior D
IMG_5025.JPG	Compressor housing interior E
IMG_5026.JPG	Center body compressor end A
IMG_5027.JPG	Center body compressor end B
IMG_5028.JPG	Center body compressor end cap A
IMG_5029.JPG	Center body compressor end cap B
IMG_5030.JPG	Thrust collar
IMG_5031.JPG	Thrust spacer A
IMG_5032.JPG	Thrust spacer B
IMG_5033.JPG	Center body - compressor end bearing A
IMG_5034.JPG	Center body - compressor end bearing B
IMG_5035.JPG	Center body - compressor end bearing C
IMG_5036.JPG	Wastegate valve and actuator body A
IMG_5037.JPG	Wastegate valve and actuator body B
IMG_5038.JPG	Wastegate valve and actuator body C

RIGHT TURBOCHARGER PHOTOS

Picture File Name	Description
IMG_4891.JPG	turbo as-received box unopened
IMG_4892.JPG	turbo as-received box opened A
IMG_4893.JPG	turbo as-received box opened B
IMG_4894.JPG	turbo as-received box opened C
IMG_4895.JPG	Turbo dataplate A
IMG_4896.JPG	Turbo dataplate B
IMG_4897.JPG	Compressor housing, inlet and wheel A
IMG_4898.JPG	Compressor housing, inlet and wheel B
IMG_4899.JPG	Turbo side view A
IMG_4900.JPG	Turbine housing, inlet and wheel
IMG_4901.JPG	Turbo side view B
IMG_4902.JPG	Compressor wheel A
IMG_4903.JPG	Compressor wheel B
IMG_4904.JPG	Compressor housing backplate crack
IMG_4905.JPG	Compressor wheel C
IMG_4906.JPG	Compressor housing interior view A
IMG_4907.JPG	Compressor housing interior view B
IMG_4908.JPG	Compressor wheel D
IMG_4909.JPG	Compressor wheel E
IMG_4910.JPG	Turbo side view compressor housing removed A
IMG_4911.JPG	Turbo side view compressor housing removed B
IMG_4912.JPG	Turbo side view compressor housing removed C
IMG_4913.JPG	Turbo side view compressor housing removed D
IMG_4914.JPG	Turbo side view compressor housing removed E
IMG_4915.JPG	Turbo side view compressor housing removed F
IMG_4916.JPG	Turbine blade rub mark A
IMG_4917.JPG	Turbine blade rub mark B
IMG_4918.JPG	Turbine wheel A
IMG_4919.JPG	Turbine wheel B
IMG_4920.JPG	Turbine housing interior A
IMG_4921.JPG	Turbine housing interior B
IMG_4922.JPG	Turbine housing interior C
IMG_4923.JPG	Turbine wheel A
IMG_4924.JPG	Turbine wheel B
IMG_4925.JPG	Compressor wheel shaft threads A
IMG_4926.JPG	Compressor wheel shaft threads B
IMG_4927.JPG	Compressor wheel and shaft A
IMG_4928.JPG	Compressor wheel and shaft B
IMG_4929.JPG	Compressor wheel removed, top/front view A
IMG_4930.JPG	Compressor wheel removed, top/front view B
IMG_4931.JPG	Compressor wheel removed, bottom/aft view A
IMG_4932.JPG	Compressor wheel removed, bottom/aft view B
IMG_4933.JPG	Compressor housing backplate A
IMG_4934.JPG	Compressor housing backplate B
IMG_4935.JPG	Compressor housing backplate C
IMG_4936.JPG	Compressor housing backplate D

IMG_4937.JPG	Compressor housing backplate mounting area A
IMG_4938.JPG	Compressor housing backplate mounting area B
IMG_4939.JPG	Compressor backplate removed. center body side A
IMG_4940.JPG	Compressor backplate removed, center body side B
IMG_4941.JPG	Center body compressor side, thrust collar, and shaft threads A
IMG_4942.JPG	Center body compressor side, thrust collar, and shaft threads B
IMG_4943.JPG	Center body compressor side, thrust collar, and shaft threads C
IMG_4944.JPG	Compressor backplate removed, center body side C
IMG_4945.JPG	Thrust collar A
IMG_4946.JPG	Thrust collar B
IMG_4947.JPG	Thrust collar C
IMG_4948.JPG	Thrust collar D
IMG_4949.JPG	Thrust spacer A
IMG_4950.JPG	Thrust spacer B
IMG_4951.JPG	Thrust spacer C
IMG_4952.JPG	Thrust spacer C
IMG_4953.JPG	Compressor-side shaft bearing A
IMG_4954.JPG	Compressor-side shaft bearing B
IMG_4955.JPG	Compressor-side shaft bearing C
IMG_4956.JPG	Turbine wheel assembly A
IMG_4957.JPG	Turbine wheel assembly B
IMG_4958.JPG	Shaft compressor/threaded end
IMG_4959.JPG	Shaft bearing surfaces A
IMG_4960.JPG	Shaft bearing surfaces B
IMG_4961.JPG	Wastegate assembly A
IMG_4962.JPG	Wastegate assembly B
IMG_4963.JPG	Wastegate valve
IMG_4964.JPG	Wastegate actuator
IMG_4965.JPG	Controller A
IMG_4966.JPG	Controller B
IMG_4967.JPG	Controller adjustment screw

APPENDIX A

Left Turbocharger Teardown Inspection Form
S/N KJL00495

Accident / Incident Information Request / Findings

Report Date: 9/8/15	Accident Number: CEN15FA190	Occurrence Date and Time: April 7, 2015	Location: Bloomington, IL
	Aircraft Year and Model: Cessna 414A	Aircraft Registration N789UP	Aircraft Serial Number:
	Aircraft Total Time	Aircraft Engine Model:	Engine Total Time:
	Aircraft Damages:	Injuries:	Investigator In Charge: Todd Fox

Owner Information, Name and Address:

Narrative (synopsis of events leading up to accident):

See NTSB preliminary report in Appendix A

Prelim. Released?	Y	Factual Released?	Probable Released?

Parties to NTSB Investigation:	Representing:
Todd Fox	NTSB
Ernie Hall	Textron
Rick Roper	RAM Aircraft
Les Doud	HPI/HET
David Slaybaugh	FSDO, Springfield IL
Judd Hough/John Mincey	HET

Location of Teardown Inspection: HET

Turbocharger Teardown Report

Date 9/8/2015

NTSB Report # CEN15FA190
AircraftType Cessna 414A
N-Number N789UP

DATA TAG INFO:
AirResearch ___ Allied Signal ____ Garrett _____ RAJAY____ HET ____
OEM RAM ____ Model:_____ HET P/N#: _____
OEM P/N: 2060-1 S/N: KJL00495

Parties to Teardown:	Representing:
Todd Fox	**NTSB**
Ernie Hall	**Textron**
Rick Roper	**RAM Aircraft**
Les Doud	**HPI/HET**
David Slaybaugh	**FSDO, Springfield IL**
Judd Hough	**HET**
John Mincey	**HET**

General Condition:
(Before Disassembly)

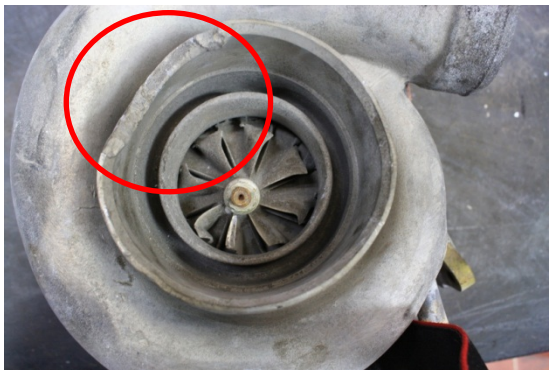
Note any Additional Parts affixed to TC as received:

Inlet Check Valve _____ Outlet Check Valve _____ Brackets X____

Air/Oil Separator _____ Turbine Blanket _____ Wastgate Assy X____

Are there any unusual discrepancies associated with any of these attaching parts? NO

Any evidence of eroding, fretting, or damage to attachment/mounting surfaces?
DAMAGED INLET ON THE COMPRESSOR HSG & TURBINE EXIT FLANGE



Note orientation of housings (sketch orientation of C,B,T hsgs. below)

Able to Turn/Spin the Turbine Wheel? NO
Measured Resistance (in Ounce/Inches): N/A; UNABLE TO TURN

Axial Play (as Observed) N/A* Allowable _____

Radial Play (as Observed) N/A* Allowable _____

* UNABLE TO ROTATE DUE TO BENT SHAFT.

Clearance Between T-Wheel blades and Housing YES

Clearance Between Impeller Blades and Housing NO; DUE TO IMPACT DAMAGE

Turbine Wheel Rub? NO Witness Marks on T Hsg? NO

Compressor Wheel Rub? NO Witness Marks on C Hsg? SLIGHT IMPACT MARKS

V-Band(s)intact? YES

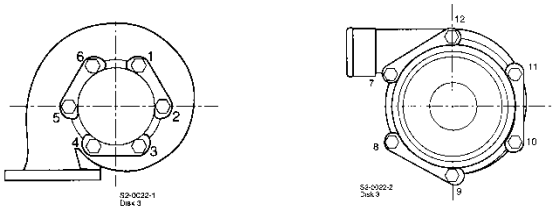
- Safety wired? NO
- # of Threads from nut to end of shaft ~4
- Release Torque of nut N/A*

* LOOSE DUE TO IMPACT DAMAGE; NOT ORIGINAL NUT ON V-BAND. THE NUT WAS CASTELLATED.

Clamps and Lockplates:
Number of **Clamps**: 1* Number of **Lockplates**: 1*

*OTHER TWO REMOVED AT ENGINE TEARDOWN.

Note Clamp Orientation:
(Indicate by numbers below the orientation of clamps as observed)



- Turbine Housing Clamp Locations SEE PHOTO BELOW

- Compressor Housing Clamp Locations N/A; V-BAND STYLE
- Are tabs on Lockplates folded over wrenching flats of bolt heads? YES
- Condition of Compressor Housing: DAMAGED INLET
    - Any Helicoil repairs? N/A

Turbine Housing Crack Locations: N/A

Weld Repairs N/A

Circle or highlight areas affected (note weld or crack)

P/Ns or Markings on Turbine Housings _____

Foreign Object Damage / Bent Blades:

Turbine Wheel: None X Light ____ Moderate ____ Heavy ____ Extreme _____

Blade tips feather edged or torn? _____ Less than 0.025? _____

Compressor Wheel: None ____ Light ____ Moderate ____ Heavy X* Extreme _____
* DUE TO IMPACT

Any Residual pieces? NO

Where Pieces located? N/A

CHRA Assembly:

Coking/Carbon: None ____ Light X Moderate ____ Heavy ____ Extreme ____

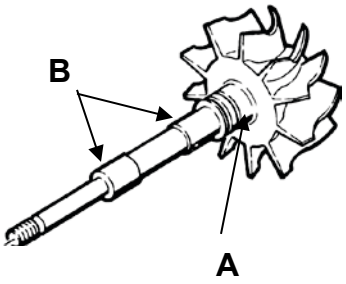
- Break-away Torque of Compressor Wheel Nut > 400 INLBS

Heat Shield Height _____

Compressor Wheel Part Number _____

- Location of balance marks
- ID of Impeller bore _____ (observed) _____ (allowable)
- Location of FOD impact marks

Turbine Wheel Part Number _____



- **A** - Seal Hub OD (min.) _____
- **B** - Journal OD (min.) T side_____ C side _____
- Piston Ring Groove OD (min.) _____
- Piston Ring Groove Width (max.) _____
- Shaft Run-out (not to exceed 0.001 relative to journal diameters) _____

Piston Rings: Placement and condition PRESENT

Journal Bearings:

- Turbine Side: OD_____ ID____ Height _____
- Comp. Side: OD_____ ID____ Height _____
- Radial Holes clear _____ Diameter_____
- Part Number Markings: _____

Thrust Collar:

- Bore ID _____ Thickness _____
- Radial Holes Clear?_____
- Any scratches, scoring, or galling of end surfaces? _____
- Evidence of rubbing on Backplate seal bore (TA04, TA36)? _____

Inboard Thrust Bearing:

- ID____ Thickness_____
- Any scoring or worn face area? _____

Thrust Spacer:

- OD____ Piston Ring Groove Width_____ _____

Back Plate: Part Number: _____

- Condition FRACTURED; SEE PHOTO
- Damage to attachment surfaces? FRACTURED
- Seal Bore ID for spacer damaged or scored? _____
- Oil Squirt Holes Clear? _____

Center Bearing Housing: Part Number: _____

- Existence of Residual Oil? DRY & CORROSION PRESENT
- Oil Squirt Holes Clear? YES
- Center Housing Bearing bore(s) ID (max) _____ _____
- Center Housing Seal bore ID (max) _____
- OutletPort restricted by Coking? NO
- Outlet / Inlet Gasket condition _____

Anti-Rotation Pins:

- Split Pins X Solid Pins _____
- Height (.075-.085) _____
- Pins Secure? YES
- Properly oriented (longitudinal groove radially outward from bearing bore)? YES
- No indentions around pin holes? NO

Were pictures taken during teardown process? Y How Many? 71

Additional Comments:

DIMENSIONAL INSPECTIONS NOT PERFORMED BY AGREEMENT OF THE INVESTIGATIVE TEAM DUE TO TIME CONSTRAINT ASSOCIATED WITH CHAIN OF CUSTODY.

THE TURBOCHARGER ASSEMBLY WAS CONSISTENT WITH THE DESIGN DATA AND THERE WAS NO EVIDENCE OF MECHANICAL MALFUNCTION. THE INTERNAL LUBRICATION PASSAGES WERE PRESENT WITH NO INDICATIONS OF CONCERN. NO LIQUID INDICATION OF LUBRICATION PRESENT PRESUMABLY DUE TO FIRE AND TIME ELAPSED FROM ACCIDENT. ADDITIONALLY ELASTOMERIC SEALS WERE "CRUMBLING" FURTHER INDICATION OF HIGH TEMPERATURE FROM FIRE.

THE DAMAGE TO THE COMPRESSOR BACKPLATE, COMPRESSOR WHEEL/HSG AND THE BENT TURBINE WHEEL SHAFT WAS CONSISTENT WITH THE ACCIDENT IMPACT (SEE FIGURE 1).

THE ACCUATOR BODY ON THE WASTEGATE ASSEMBLY (P/N 470908-0012; S/N YJ085012) WAS FRACTURE AT THE MOUNTING FLANGE AND CONSISTENT WITH THE ACCIDENT IMPACT. THE WASTEGATE VALVE WAS FREE AND HAD A FULL RANGE OF MOTION.

THE CONTROLLER (P/N 470836-9020; S/N JLR0108) WAS TESTED ON THE ATP BENCH AT HET AND WAS FUNCTIONAL, BUT THE UNIT DID NOT SEAL. THUS THE SET POINTS COULD NOT BE VERIFIED.

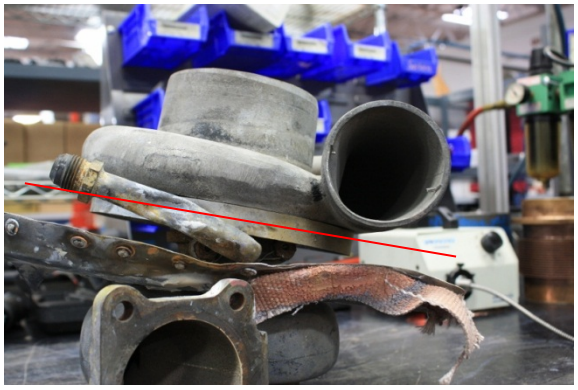


FIGURE 1: BENT COMPRESSOR

APPENDIX B

Right Turbocharger Teardown Inspection Form
S/N ZL018835

Accident / Incident Information Request / Findings

Report Date: 9/8/15	Accident Number: CEN15FA190	Occurrence Date and Time: April 7, 2015	Location: Bloomington, IL
	Aircraft Year and Model: Cessna 414A	Aircraft Registration N789UP	Aircraft Serial Number:
	Aircraft Total Time	Aircraft Engine Model:	Engine Total Time:
	Aircraft Damages:	Injuries:	Investigator In Charge: Todd Fox

Owner Information, Name and Address:

Narrative (synopsis of events leading up to accident):

See NTSB preliminary report in Appendix A

Prelim. Released?	Y	Factual Released?	Probable Released?

Parties to NTSB Investigation:	Representing:
Todd Fox	NTSB
Ernie Hall	Textron
Rick Roper	RAM Aircraft
Les Doud	HPI/HET
David Slaybaugh	FSDO, Springfield IL
Judd Hough/John Mincey	HET

Location of Teardown Inspection: HET

Turbocharger Teardown Report

Date 9/8/2015

NTSB Report # CEN15FA190
AircraftType Cessna 414A
N-Number N789UP

DATA TAG INFO:
AirResearch ___ Allied Signal ____ Garrett _____ RAJAY____ HET ____
OEM CMI Model:_____ HET P/N#: 407810-9001
OEM P/N: 635630 S/N: ZL018835

Parties to Teardown:	Representing:
Todd Fox	**NTSB**
Ernie Hall	**Textron**
Rick Roper	**RAM Aircraft**
Les Doud	**HPI/HET**
David Slaybaugh	**FSDO, Springfield IL**
Judd Hough	**HET**
John Mincey	**HET**

General Condition:
(Before Disassembly)

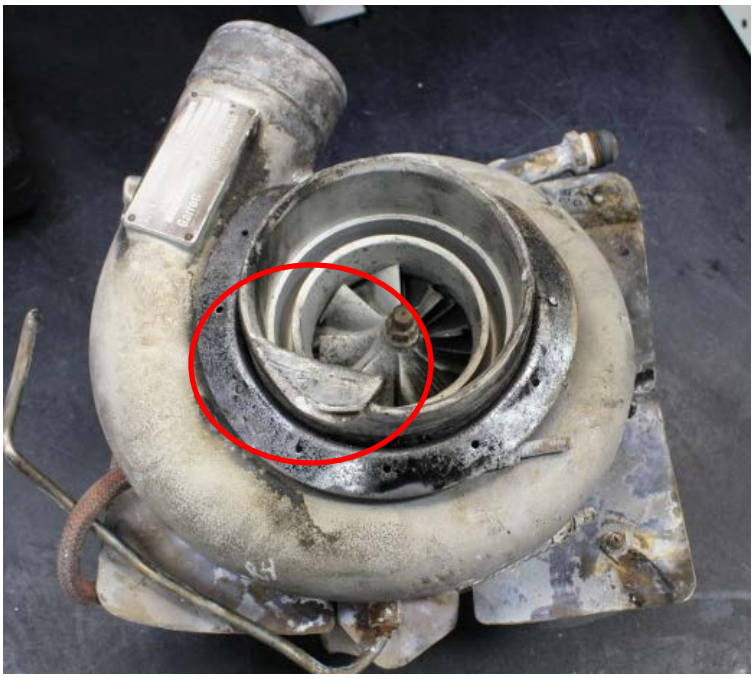
Note any Additional Parts affixed to TC as received:

Inlet Check Valve _____ Outlet Check Valve _____ Brackets _X_____

Air/Oil Separator _____ Turbine Blanket _____ Wastgate Assy _X_____

Are there any unusual discrepancies associated with any of these attaching parts? NO

Any evidence of eroding, fretting, or damage to attachment/mounting surfaces?
DAMAGED INLET ON THE COMPRESSOR HSG.



Note orientation of housings (sketch orientation of C,B,T hsgs. below)

Able to Turn/Spin the Turbine Wheel? NO
Measured Resistance (in Ounce/Inches): N/A; UNABLE TO TURN

Axial Play (as Observed) N/A* Allowable _____

Radial Play (as Observed) N/A* Allowable _____

* UNABLE TO ROTATE DUE TO BENT SHAFT.

Clearance Between T-Wheel blades and Housing YES

Clearance Between Impeller Blades and Housing YES

Turbine Wheel Rub? NO Witness Marks on T Hsg? SLIGHT IMPACT MARKS

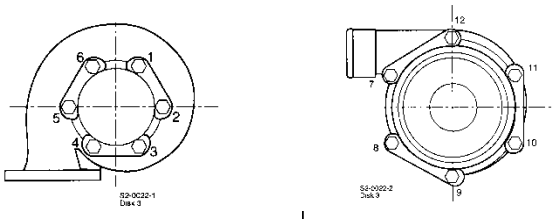
Compressor Wheel Rub? NO Witness Marks on C Hsg? SLIGHT IMPACT MARKS

V-Band(s)intact? YES

- Safety wired? YES
- # of Threads from nut to end of shaft ~13
- Release Torque of nut N/A

Clamps and Lockplates:
Number of **Clamps**: 3 Number of **Lockplates**: 3

Note Clamp Orientation:
(Indicate by numbers below the orientation of clamps as observed)



- Turbine Housing Clamp Locations SEE PHOTOS BELOW

- Compressor Housing Clamp Locations N/A; V-BAND STYLE
- Are tabs on Lockplates folded over wrenching flats of bolt heads? YES
- Condition of Compressor Housing: INTERNAL SOOTING; DAMAGED INLET
  - Any Helicoil repairs? N/A

Turbine Housing Crack Locations: N/A

Weld Repairs N/A

Circle or highlight areas affected (note weld or crack)

P/Ns or Markings on Turbine Housings _____

Foreign Object Damage / Bent Blades:

Turbine Wheel: None X Light ____ Moderate ____ Heavy ____ Extreme _____

Blade tips feather edged or torn? _____ Less than 0.025? _____

Compressor Wheel: None ____ Light ____ Moderate X Heavy ____ Extreme _____

Any Residual pieces? NO
Where Pieces located? N/A

CHRA Assembly:

Coking/Carbon: None ____ Light X Moderate ____ Heavy ____ Extreme ____

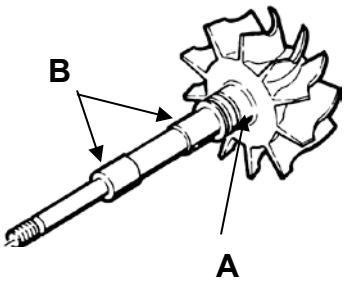
- Break-away Torque of Compressor Wheel Nut 165-170 INLBS

Heat Shield Height _____

Compressor Wheel Part Number _____

- Location of balance marks SEE PHOTOS ABOVE
- ID of Impeller bore _____ (observed) _____ (allowable)
- Location of FOD impact marks

Turbine Wheel Part Number _____



- **A** - Seal Hub OD (min.) _____
- **B** - Journal OD (min.) T side_____ C side _____
- Piston Ring Groove OD (min.) _____
- Piston Ring Groove Width (max.) _____
- Shaft Run-out (not to exceed 0.001 relative to journal diameters) _____

Piston Rings: Placement and condition PRESENT

Journal Bearings:

- Turbine Side: OD_____ ID____ Height _____
- Comp. Side: OD_____ ID____ Height _____
- Radial Holes clear _____ Diameter_____
- Part Number Markings: _____

Thrust Collar:

- Bore ID _____ Thickness _____
- Radial Holes Clear?_____
- Any scratches, scoring, or galling of end surfaces? _____
- Evidence of rubbing on Backplate seal bore (TA04, TA36)? _____

Inboard Thrust Bearing:

- ID ____ Thickness_____
- Any scoring or worn face area? _____

Thrust Spacer:

- OD____ Piston Ring Groove Width_____ _____

Back Plate: Part Number: _____

- Condition FRACTURED; SEE PHOTOS
- Damage to attachment surfaces? FRACTURED
- Seal Bore ID for spacer damaged or scored? _____
- Oil Squirt Holes Clear? _____

Center Bearing Housing: Part Number: _____

- Existence of Residual Oil? DRY & CORROSION PRESENT
- Oil Squirt Holes Clear? YES
- Center Housing Bearing bore(s) ID (max) _____ _____
- Center Housing Seal bore ID (max) _____
- OutletPort restricted by Coking? NO
- Outlet / Inlet Gasket condition_____

Anti-Rotation Pins:

- Split Pins X Solid Pins _____
- Height (.075-.085) _____
- Pins Secure? YES
- Properly oriented (longitudinal groove radially outward from bearing bore)? YES
- No indentions around pin holes? NO

Were pictures taken during teardown process? Y How Many? 77

Additional Comments:

DIMENSIONAL INSPECTIONS NOT PERFORMED BY AGREEMENT OF THE INVESTIGATIVE TEAM DUE TO TIME CONSTRAINT ASSOCIATED WITH CHAIN OF CUSTODY.

THE TURBOCHARGER ASSEMBLY WAS CONSISTENT WITH THE DESIGN DATA AND THERE WAS NO EVIDENCE OF MECHANICAL MALFUNCTION. THE INTERNAL LUBRICATION PASSAGES WERE PRESENT WITH NO INDICATIONS OF CONCERN. NO LIQUID INDICATION OF LUBRICATION PRESENT PRESUMABLY DUE TO FIRE AND TIME ELAPSED FROM ACCIDENT. ADDITIONALLY ELASTOMERIC SEALS WERE "CRUMBLING" FURTHER INDICATION OF HIGH TEMPERATURE FROM FIRE.

THE DAMAGE TO THE COMPRESSOR BACKPLATE, COMPRESSOR WHEEL/HSG AND THE BENT TURBINE WHEEL SHAFT WAS CONSISTENT WITH THE ACCIDENT IMPACT.

THE ACCUATOR BODY ON THE WASTEGATE ASSEMBLY (P/N 470908-9013; S/N LE000460) WAS FRACTURE AT THE MOUNTING FLANGE AND CONSISTENT WITH THE ACCIDENT IMPACT. THE WASTEGATE VALVE WAS FREE AND HAD A FULL RANGE OF MOTION.

THE CONTROLLER (P/N 470836-9020; S/N BB0?013?) WAS TESTED ON THE ATP BENCH AT HET AND WAS FULLY FUNCTIONAL.

FIGURE 1: BENT COMPRESSOR