

ENGINE TEARDOWN/RUN REPORT INSPECTOR STATEMENT

Engine Model: Continental TSIO-520-NB (Left Position)

Engine Serial Number: 218706-R

Aircraft Make: Cessna

Aircraft Model: CE-414A

Aircraft Serial Number: 414A0463

Registration Number: N2735A

Date of Examination: September 12-15, 2016

Requesting FAA Office:

Nina McBride; Aviation Safety Inspector, FSDO-SO-09

NTSB: Timothy Monville

Accident/Incident Number: ERA 16 FA 279

Investigation Party:

Jack E. Clark---Birmingham, Al. FSDO SO-09

Earnest C. Hall---Textron Aviation (Beechcraft, Cessna, Hawker)

Phillip Grice---Continental Motors, Mobile, Al.

Description of Engine:

520 cubic inch displacement, six cylinder air cooled, horizontally opposed, fuel injected, Turbo-charged engine, developing 310 horsepower at 2700 RPM (take-off/max continuous) and 240 horsepower at 2450 RPM recommended cruise. This engine has modified in accordance with STC 19104 SC by RAM Aircraft, increasing horsepower to 335 HP @ 2700 RPM.

Initial Inspection:

Aircraft engine was located in the Analytical Department at Continental Motors, Mobile, Alabama. The engine was removed from a shipping container and placed on an engine stand. This engine was received with the magnetos, harness, spark plugs, fuel system, exhaust system, alternator, vacuum pump, tach generator, propeller governor, turbo charger, wastegate, turbo controller, over-boost valve and engine baffling.

Initial inspection revealed impact damage to the lower portion of the engine involving the oil sump, starter adapter, starter (missing), exhaust system and salt water emersion/corrosion damage. Examination of the crankshaft flange revealed cracks in the radius area behind the flange and several through bolts nuts were found either missing or cracked, through bolts with nuts still attached were found backed away from cylinder flange and impacted into cylinder barrel fin.

Engine Disassembly:

- Engine baffle, exhaust system were removed to expedite the engine run. The oil sump, starter adapter were removed and replace with serviceable slave starter, starter adapter and oil sump.
- Magneto timing was checked: right magneto 23 degrees; left magneto 25 degrees (RAM STC requires right magneto 21 degrees and left magneto 23 degrees).
- Magneto's were removed, disassembled, dried, cleaned, reassembled and tested. Magneto's were reinstalled on engine and timed as originally found (right magneto 23 degrees; left magneto 25 degrees).
- No disassembly required for the crankcase and power section, however, through bolts nuts were found either missing or cracked, through bolts with nuts still attached were found backed away from cylinder flange and impacted into cylinder barrel fin. A sampling of through bolt nuts was sent to Continental Motors Metallurgical Department for examination.
Top#1 Cylinder-nut attached split/cracked
Bottom#1 Cylinder-nut missing
Top#2 Cylinder- nut attached; thru bolt backed out
Bottom #2 Cylinder-nut missing
Top#3 Cylinder-nut attached split/cracked
Bottom#3 Cylinder-nut attached; thru bolt backed out
Top#4 Cylinder-nut attached; thru bolt backed out
Bottom#4 Cylinder- nut attached; split/cracked
Top#5 Cylinder-nut missing
Bottom#5 Cylinder-nut attached; thru bolt backed out
Top#6 Cylinder-nut missing
Bottom#6 Cylinder-
Top Front of Cooler-nut attached; split/cracked
Bottom Front of Cooler- nut attached; thru bolt backed out
- Through bolt nuts were replaced and torqued to cylinder.

Accessory Testing:

- Magneto's were removed, disassembled, dried, cleaned, reassembled and tested to 7 MM gap.
- Fuel pump was tested on flow bench after initial engine test run; results recorded below:

Manufactures Specifications		
RPM	Fuel Flow	Pressure
600	6.5-7.0	6.5-7.0
2700	200	19-22
600	6.5-7.0	6.5-7.0
2700	200	32.5 @ 36 inches MP

Actual Test Results		
700	6.5	6.7
2700	200	17.8
2700	200	21.6 @ 36 inches MP

- Fuel pump was disassembled, revealing internal corrosion; corrosion in and around anode prevented the opening of high side fuel flow.

Installed Accessories:

Left Magneto:	p/n 6320	s/n 14040536
Right Magneto:	p/n 6320	s/n 14040537
Magneto Harness:	p/n not recorded	s/n not recorded
Starter:	p/n missing	s/n missing
Alternator:	p/n AVL9610	s/n H-0060195
Prop Governor:	p/n DCFS290 DV/T3	s/n 791874
Throttle Body:	p/n 632916-11	s/n H139305AR
Fuel Pump:	p/n 646210-11	s/n D148703BR
Fuel Manifold:	p/n 634326-4A10	s/n D218802RC
Spark Plugs:	p/n RHB-32-E	
Oil Filter:	p/n CH-48108	
Turbo-charger:	p/n 466412-0004	s/n H-RFL00170
Turbo Controller:	p/n 470008-9012	s/n A14486
Overboost Valve:	p/n 1020-1	s/n KK0102
Wastegate Actuator:	p/n 470836-8020	s/n L00187
Tach Generator:	p/n MS 25038-2	s/n 55907
Hydraulic Pump:	p/n 24194-LAA	s/n SN135
Vacuum Pump:	p/n 442CW-6	s/n 150137

Added Information/Other:

First Compression (cold) #1 06/80, #2 32/80, #3 09/80, #4 10/80, #5 08/80, #6 14/80
Final Compression (hot) #1 72/80, #2 71/80, #3 62/80, #4 64/80, #5 66/80, #6 68/80.
Run Out: .055 End Play: .009 Deflection: .080

Engine Run/ Observations:

Initial engine run: Engine ran to 2100 RPM maintaining 38 inches manifold pressure; the engine ran as if an extremely lean mixture, fuel pressure 21 lb.'s at 2100 RPM; fuel nozzles became clogged allowing CHT's to rise above normal operating temperatures. Fuel nozzles were removed and cleaned; replaced fuel pump with slave unit. Engine was run with a manifold pressure leak between the inter-cooler and throttle body, no slave unit available for replacement. Oil filter was removed and replaced with new filter due to indications of low oil pressure.

Second engine run: Engine ran to 2450 RPM maintaining 38 inches manifold pressure; engine shut down several times to clean fuel nozzles. Engine was run with a manifold pressure leak between the inter-cooler and throttle body, no slave unit available for replacement. Engine run data was recorded from this run and attached to this report. Observation of this engine run has determined that this engine was capable of making power in accordance with manufactures and STC holder's specifications at the time of the occurrence.



Aviation Safety Inspector, FSDO SO-09
September 26, 2016

Enclosures: Photographs one CD.
CMI's Engine Run Sheet, dated September 16, 2016.

Clark, Jack E (FAA)

From: Lisa Jersild [REDACTED]
Sent: Friday, September 16, 2016 1:49 PM
To: Clark, Jack E (FAA)
Subject: TSIO520NB9B S/N 218706-R N2735A ENGINE RUN

ENGINE RUN PARAMETERS

Time		RPM	MP / TDP " Hg	Oil		Fuel				Cell °F	Cylinder Head Temperature °F					
Reading	Minutes			PSI	°F	Lbs/Hr	Nozzle PSI	Pump PSI	Fuel °F		# 1	# 2	# 3	# 4	# 5	# 6
1	5	1200	N/A													
2	5	1600	244/30.7	50	187	57.0		15.20	85	85	175	284	396	304	332	281
3	5	2100	282/31.46	54	205	106	8.1	17.79	86	84	249	417	441	363	384	335
4	5	2450	32.7/35.3	40	247	135		22.43	87	84	379	523	512	420	454	372
5	5	F/T 2456	38.1/41	40	268	151		30.65	87	84	420	504	584	482	502	382
6	5	Idle 1612	26.8/	28	248	61.3		17.01	85	84	196	280	450	361	385	313
7	5		/													
Ambient Air Temperature °F		Ambient Air Pressure		Transfer Collar Δ P		Maximum Rated Power Engine Operational Parameters										
				IN	OUT	RPM	" Hg MP	Fuel Flow Lbs/Hr	Metered PSI	Unmetered PSI						
				8	22	2700	38.0	170 - 186	16.9 - 19.9	32.0 - 35.0						

Notes: Operator – Lisa Jersild. Transfer collar pressure delta measured at full throttle power setting.

Engine Performance Test				
Test RPM	Left Magneto	Left Magneto	Right Magneto	Right Magneto
	RPM	RPM Drop	RPM	RPM Drop
2100	2128	+50	2124	-28

ENGINE TEARDOWN/RUN REPORT INSPECTOR STATEMENT

Engine Model: Continental TSIO-520-NB (Right Position)
Engine Serial Number: 290669-R

Aircraft Make: Cessna
Aircraft Model: CE-414A
Aircraft Serial Number: 414A0463
Registration Number: N2735A

Date of Examination: September 15, 2016

Requesting FAA Office:
Nina McBride; Aviation Safety Inspector, FSDO-SO-09
NTSB: Timothy Monville

Accident/Incident Number: ERA 16 FA 279

Investigation Party:
Jack E. Clark---Birmingham, Al. FSDO SO-09
Earnest C. Hall---Textron Aviation (Beechcraft, Cessna, Hawker)
Phillip Grice---Continental Motors, Mobile, Al.

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Initial Inspection:
Aircraft engine was located in the Analytical Department at Continental Motors, Mobile, Alabama. The engine was removed from a shipping container and placed on an engine stand. This engine was received with the magnetos, harness, spark plugs, fuel system, exhaust system, starter, alternator, vacuum pump, propeller governor, turbo charger, wastegate, turbo controller, over-boost valve and engine baffling.

Initial inspection revealed impact damage to the lower portion of the engine involving the oil sump & exhaust system with salt water emersion/corrosion damage present. Examination of the crankshaft flange revealed possible cracks in the radius area behind the flange and several through bolts nuts were found either missing or cracked, through bolts with nuts still attached were found backed away from cylinder flange and impacted into cylinder barrel fin.

Engine Disassembly:

- Engine baffle, exhaust system and accessories were removed to expedite the disassembly of the engine.
- Spark plugs were removed—Spark plug removed from Cylinder #1- #5 electrodes impacted with salt water corrosion, both spark plugs from #6 cylinder reveal normal operating appearance.
- Inspection of crankcase and power section found through bolts nuts either missing or cracked, through bolts with nuts still attached were found backed away from cylinder flange and impacted into cylinder barrel fin. A sampling of through bolt nuts was sent to Continental Motors Metallurgical Department for examination.
Top#1 Cylinder-nut intact
Bottom#1 Cylinder-nut missing
Top#2 Cylinder- nut attached, cracked/split
Bottom #2 Cylinder-nut intact, thru bolt backed out
Top#3 Cylinder-nut attached; thru bolt backed out
Bottom#3 Cylinder-nut attached, cracked/split
Top#4 Cylinder-nut attached; thru bolt backed out
Bottom#4 Cylinder- nut attached; thru bolt back out
Top#5 Cylinder-nut missing, thru bolt flush with cylinder flange.
Bottom#5 Cylinder-nut attached, cracked/split
Top#6 Cylinder-nut attached
Bottom#6 Cylinder-nut attached, thru bolt backed out
Top Front of Cooler-nut attached.
Bottom Front of Cooler- nut attached; thru bolt backed out
- Cylinder break-away torque was checked on remaining cylinder nuts.
- Cylinders removed—#1- #5 cylinders having salt water corrosion deposits in the cylinder head and piston dome areas. #6 cylinder revealed no signs of salt water corrosion, visual inspection of all six cylinders and pistons had normal operating appearance.
- Crankcase separated---main bearings displayed a normal operating appearance, with not fretting noted on the crankcase bearing bosses.
- Camshaft/governor drive gear displayed a normal operating appearance.
- Crankshaft was removed and disassembled—main and rod journals had normal operating appearance; connecting rod bearings had normal operating appearance; Crankshaft appeared (visual) to be cracked in the radius behind the flange.
- Oil pump disassembled—no abnormalities noted.
- Fuel pump was removed---shaft would not rotate; fuel pump disassembled—internal components contaminated with salt water corrosion material.

Accessory Testing:

- Both magneto's were removed, disassembled and visually inspected noting internal corrosion material.
- Fuel pump initially would not rotate was disassembled, revealing internal corrosion, anode chamber impacted with corrosion material and bellows collapsed from corrosion pitting.

- Fuel manifold valve was disassembled disclosing corrosion material in the internally.

Installed Accessories:

Left Magneto:	p/n 6320	s/n 13110864
Right Magneto:	p/n 6320	s/n 13110865
Magneto Harness:	p/n not recorded	s/n not recorded
Starter:	p/n data tag missing	s/n data tag missing
Alternator:	p/n AVL9610	s/n H-0060193
Prop Governor:	p/n DCFS290 D9/T3	s/n 791236
Throttle Body:	p/n 632916-11	s/n C200081R
Fuel Pump:	p/n 646210-11	s/n G288804BR
Fuel Manifold:	p/n 634326-4A10	s/n C04KA197R
Spark Plugs:	p/n RHB-32-E	
Oil Filter:	p/n CH-48108	
Turbo-charger:	p/n data tag missing	s/n data tag missing
Turbo Controller:	p/n 470826-9020	s/n KFR0135
Overboost Valve:	p/n 1020-1	s/n KK0102
Wastegate Actuator:	p/n 470906-9012	s/n EK0105
Vacuum Pump:	p/n 442CW-6	s/n 148818

Added Information/Other:

Teardown / Observations:

No mechanical issues or failures were observed during the teardown of this engine. Examination revealed that this engine was operating normally and within manufactures specifications prior to occurrence.

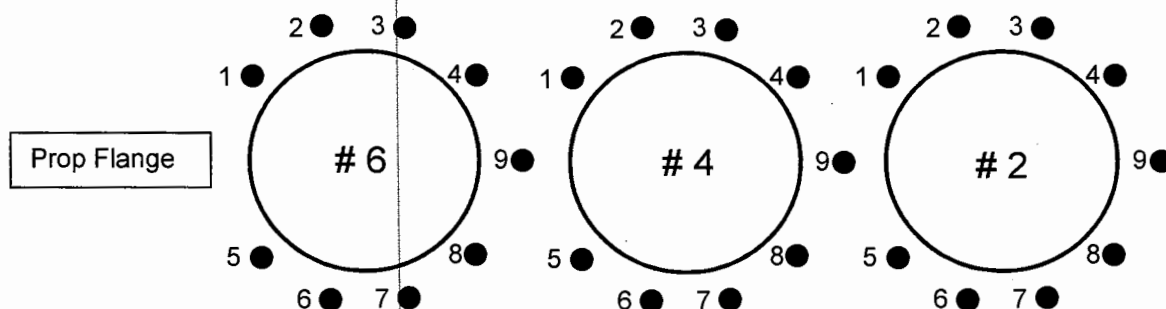
Aviation Safety Inspector, FSDO SO-09
September 26, 2016

Enclosures: Photographs one CD.
CMI Torque/Break-Away Torque Sheet dated September 12, 2016

Date	Engine Model	Engine Serial Number	Aircraft Registration	Page
09-12-2016	TSIO520NB	290669-R	N2735A	1 of 1

Cylinder Through-Bolt and Deck Stud Break-Away (Tightening / Loosening) Torque Measurements (Foot-Pounds)
(Position numbers 1 and 5 are through-bolts)

	Bolt 1	Stud 2	Stud 3	Stud 4	Bolt 5	Stud 6	Stud 7	Stud 8	Stud 9
	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose
Cylinder #2	Cracked	801 /694	870/711	802/643	Backed off	816/640	757/586	790/665	640/550
Cylinder #4	Backed off	813 /660	776/635	749/636	Cracked	874/680	841/649	787/609	562/467
Cylinder #6	708 /693	824/640	831/713	884/694	Cracked	875/680	822/637	858/678	581/493



	Bolt 1	Stud 2	Stud 3	Stud 4	Bolt 5	Stud 6	Stud 7	Stud 8	Stud 9
	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose	Tight / Loose
Cylinder # 1	964/616	851/693	823/694	860/722	Missing	919/693	828/681	816/701	520/461
Cylinder # 3	Backed off	839/704	804/614	740/612	Cracked	787/647	850/746	795/638	820/695
Cylinder # 5	Missing	879/706	786/649	869/666	Backed off	851/655	803/646	807/676	600/508

