



Continental Motors

ENGINE RUN REPORT

ENGINE MODEL	IO-550-N68B
ENGINE SERIAL NUMBER	1005587
AIRCRAFT MAKE & MODEL	Cirrus SR22
AIRCRAFT SERIAL NUMBER	3812
AIRCRAFT REGISTRATION	N217CE
FILE NUMBER	16-295

NAME	SIGNATURE	DATE
Nicole Charnon		04/05/2017

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GENERAL INFORMATION			
EXAMINATION		ACCIDENT DATA	
DATE	04/04/201	NTSB ACCIDENT #	ERA17LA063
FACILITY	Continental Motors	NTSB INVESTIGATOR	Leah Read
ADDRESS	[REDACTED] Mobile, AL 36615	FAA INVESTIGATOR	Bruce Schemmel
		ACCIDENT DATE	11/22/2016
		ACCIDENT LOCATION	Bluefield, WV

ENGINE INFORMATION	
ENGINE POSITION	Single-Engine
TOTAL TIME	1,420.1 hours
TIME SOH	N/A
TYPE & TIME SLI	5.3 hours since annual inspection 11/15/2016
BUILD DATE	10/14/2011
IN SERVICE DATE	11/07/2011

Significant logbook information:

The engine was installed in the accident airplane in 2011. On November 7, 2013, at a flight meter time of 587.8 hours, the #2 cylinder was removed, repaired and reinstalled due to low compression. On July 16, 2014 at a flight meter time of 781.3 hours, the #2 cylinder was again removed and replaced due to low compression. On May 1, 2015, at a flight time of 896.1 hours, the starter adapter was removed and replaced, the #5 cylinder was removed and replaced, and the magnetos were removed and replaced after a 500-hour inspection. On November 12, 2015, at a total time of 1,088.2 hours, the magnetos were replaced with overhauled units. On August 10, 2016 at an engine total time of 1,352.9 hours the right magneto was replaced. The last annual inspection took place on November 15, 2016, at a flight meter time of 1,416.0 hours. During the last annual inspection, the magneto-to-engine timing was checked. The flight meter indicated 1,420.1 hours at the time of the post-accident examination.

Report Summary:

Search Code(s): 15-12-68

During the pre-test run examination, it was noted that the magneto-to-engine timing was set in advance of that specified for this engine model. The timing was not adjusted and remained in the as-received condition. The engine was placed on a test cell and run for 30 minutes at various RPM settings, to include full throttle, with no pre-accident anomalies noted.

Disposition of engine following exam:

The engine was shipped to Precision Air, Inc. in Manning, SC following the examination on shipper request number AD00985. The crankshaft gear bolts were retained for further examination by Continental Motors.

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INSPECTION WITNESSES			
NAME	Nicole Charnon	NAME	Greg Eastburn
ADDRESS	Washington, DC	ADDRESS	Mobile, AL
ORGANIZATION	Continental Motors	ORGANIZATION	Continental Motors
PHONE	██████████	PHONE	██████████
NAME	Lisa Jersild	NAME	Brad Miller
ADDRESS	Mobile, AL	ADDRESS	Duluth, MN
ORGANIZATION	Continental Motors	ORGANIZATION	Cirrus Aircraft
PHONE	██████████	PHONE	██████████
NAME	Leah Read	NAME	Phillip Grice
ADDRESS	Eastern Region	ADDRESS	Mobile, AL
ORGANIZATION	NTSB	ORGANIZATION	Continental Motors
PHONE	██████████	PHONE	██████████

EXTERNAL INSPECTION OF ENGINE

The engine was in the shipping crate with the exhaust manifold removed and placed within the crate separately. There were no external anomalies noted with the engine or the engine-related systems. Movement of the throttle and mixture control levers resulted in a coinciding movement of their control shafts with no slipping or binding noted. Only residual oil remained on the oil dipstick. The engine was placed on a test stand for pre-test run examination.



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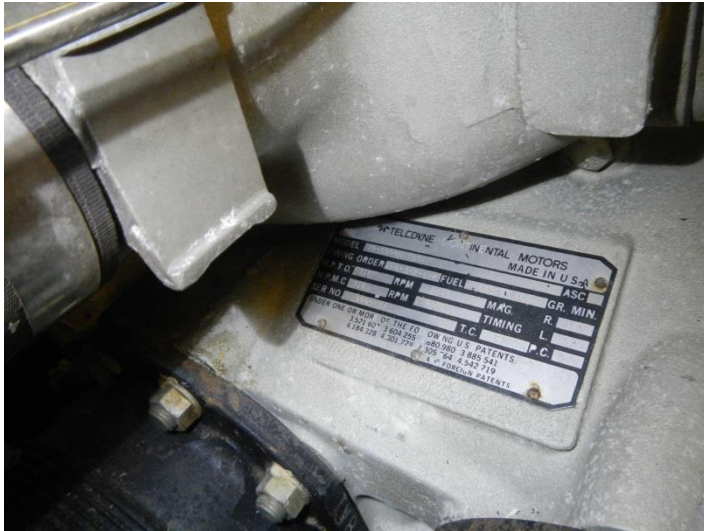
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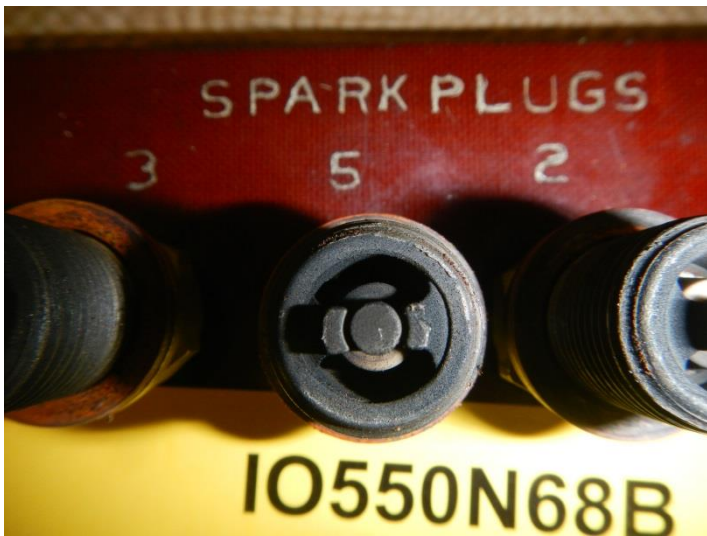
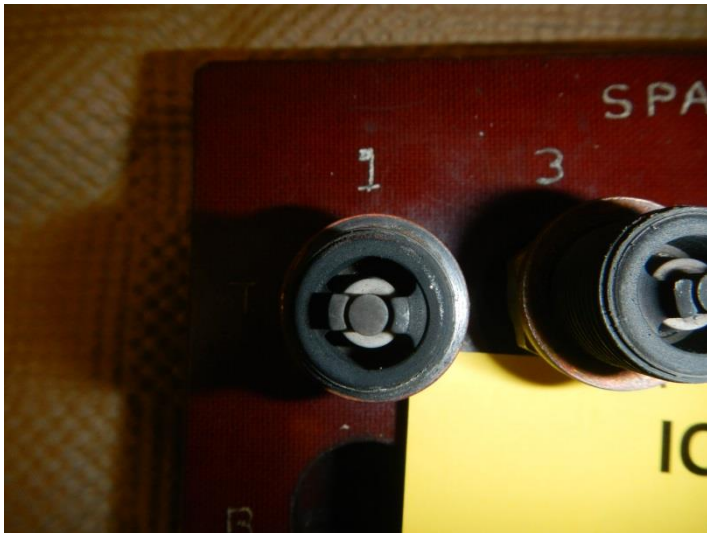
ENGINE PREPARATION PRIOR TO RUN

There were a number of airframe related items removed in preparation for operation on the CMI test bed. Items removed included the propeller governor, alternator bracket, and oil temperature probe.

The top sparkplugs were removed and examined. The top sparkplugs displayed a near-new were condition with normal combustion deposits. There was no sign of carbon or lead fouling.



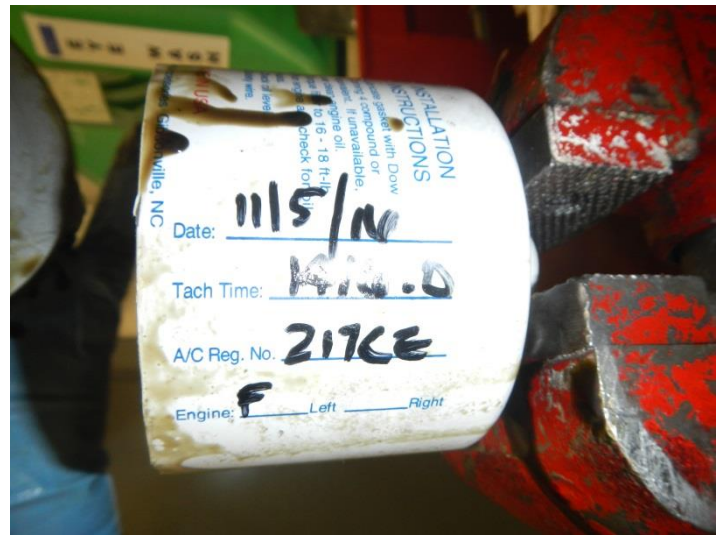
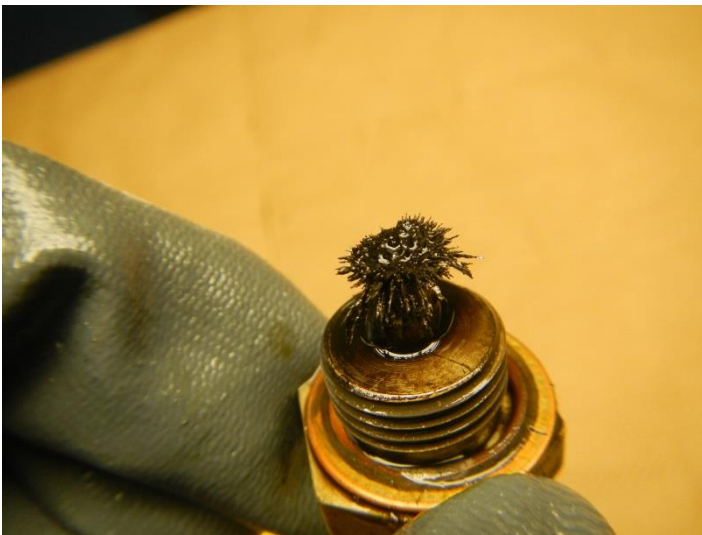
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Only residual oil registered on the oil quantity gauge (dipstick) and it was assumed that the oil was drained prior to shipping. Prior to the engine run, the oil drain plug was removed and slivers of ferrous material were adhering to the drain plug magnet. The oil filter was removed and cut open prior to the engine run and a replacement filter was used for the test. Examination of the original oil filter prior to the test run revealed small pieces of metal and carbon within the pleats of the filter.

Review of recorded engine data revealed that the engine underwent 32 start attempts prior to the accident flight. Therefore, the starter adapter was removed for examination in accordance with Service Bulletin 16-6, Engine Damage Due to Kickback. Manual rotation of the starter shaft gear resulted in a ratcheting effect. A replacement starter adapter was placed on the accident engine and the original adapter was examined further (see Appendix A of this report for more information regarding the examination).



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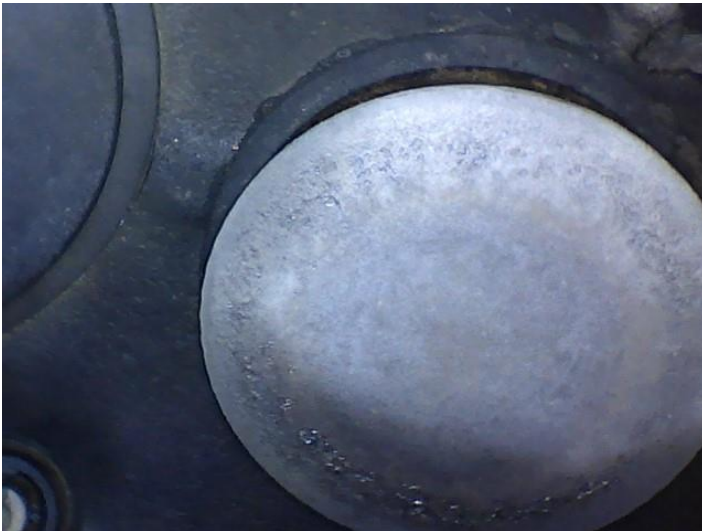
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The cylinders were examined utilizing a lighted borescope and no pre-accident anomalies were noted. The photographs that follow each cylinder number represent the cylinder's piston, intake valve, exhaust valve, and bottom sparkplug, in that order.

CYLINDER 1



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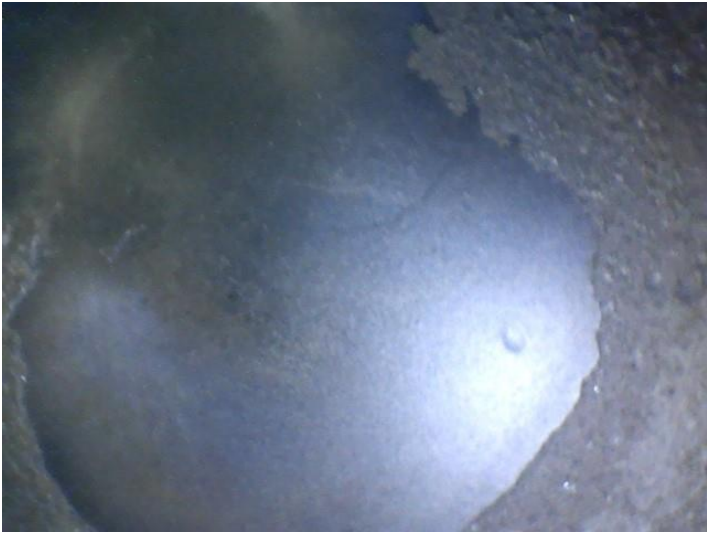
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CYLINDER 3



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CYLINDER 5



No bottom sparkplug image

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CYLINDER 2

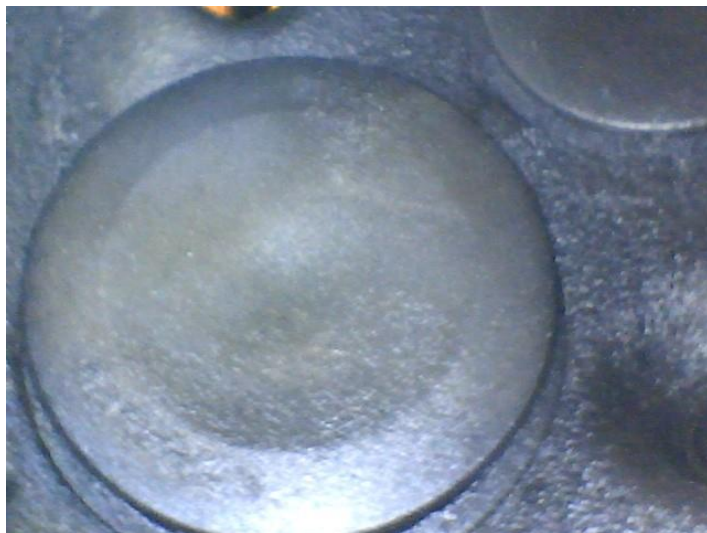


CYLINDER 4



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CYLINDER 6



The magneto-to-engine timing was checked and with the following results:

Magneto-to-Engine Timing (Specified):	Left Magneto:	Right Magneto:
22°BTDC	29°BTDC	28°BTDC

Prior to the test run, with the engine at room temperature, a cylinder leakage test was performed in accordance with the latest revision of the CM maintenance manual with the following results (master orifice reading - 43 PSI):

Cylinder #1 - 20/80 PSI (rings)

Cylinder #2 - 63/80 PSI (rings)

Cylinder #3 - 47/80 PSI (rings)

Cylinder #4 - 6/80 PSI (exhaust valve)

Cylinder #5 - 43/80 PSI (rings)

Cylinder #6 - 48/80 PSI (exhaust valve)

(*) – Leakage Source

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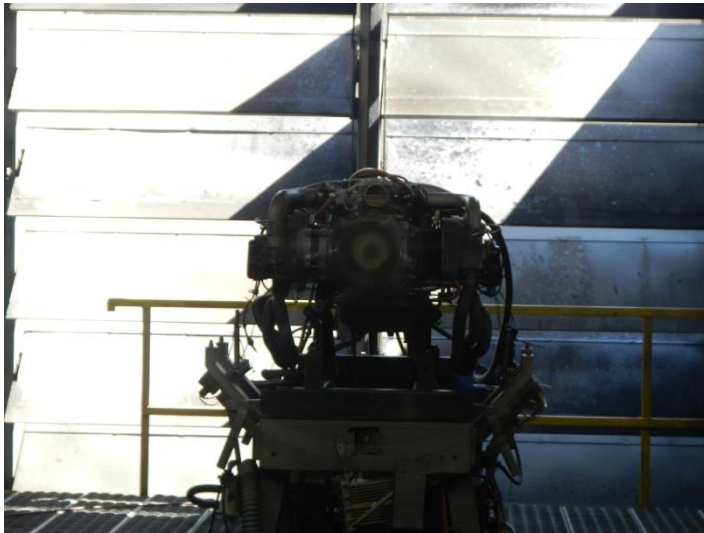
The engine was not disassembled prior to the engine run. The crankshaft end-play measured 0.011" and the run-out was 0.002".

The engine was then prepared for operation by installing the appropriate thermocouples, pressure lines and test pads for monitoring purposes. The engine was then moved to CMI test cell number 43 and mounted for operation. The engine was fitted with a test club propeller for the IO-550 engine model.

DESCRIPTION OF RUN

The engine experienced a normal start on the first attempt without hesitation or stumbling in observed RPM. The engine RPM was advanced in steps for warm-up in preparation for full power operation. The engine throttle was advanced to 1200 RPM and held for five (5) minutes to stabilize. The engine throttle was advanced to 1600 RPM and held for five (5) minutes to stabilize. The engine throttle was advanced to 2450 RPM and held for five (5) minutes to stabilize. The engine throttle was advanced to full open position and held for five (5) minutes to stabilize. The engine throttle was rapidly advanced from idle to full throttle five times where it performed normally without any hesitation, stumbling or interruption in power.

Throughout the test phase, the engine accelerated normally without any hesitation, stumbling or interruption in power and demonstrated the ability to produce rated horsepower.



Following the test run, with the engine still warm, a cylinder leakage test was performed in accordance with the latest revision of the CM maintenance manual with the following results (master orifice reading - 43 PSI):

Cylinder #1 - 67/80 PSI (rings)

Cylinder #2 - 71/80 PSI (rings)

Cylinder #3 - 58/80 PSI (rings)

Cylinder #4 - 71/80 PSI (rings)

Cylinder #5 - 65/80 PSI (rings)

Cylinder #6 - 71/80 PSI (rings)

(*) – Leakage Source

ENGINE RUN PARAMETERS

Time		RPM	MP " 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	11.6	52	143	20.7	4.04	15.69	75	79	264	236	249	225	212	197
2	5	1600	16.11	48	178	41.5	4.72	20.42	75	80	308	267	308	243	233	212
3	5	2100	20.56	45	210	82.6	8.52	26.60	75	80	363	310	353	272	272	230
4	5	2450	25.15	42	233	119.0	13.18	31.42	76	80	400	350	400	304	310	259
5	5	F/T 2764	28.5	42	245	163	20.7	35.88	80	81	390	413	356	341	338	286
6	5	Idle 836	--	18	--	14.8	4.6	13.4	82	87	310	323	288	292	258	217
Ambient Air Temperature °F		Ambient Air Pressure		Transfer Collar Δ P		Maximum Rated Power Engine Operational Parameters										
77.3		29.14		IN	OUT	RPM	" Hg MP	Fuel Flow Lbs/Hr	Metered PSI	Unmetered PSI						
				22	27	2700		150-160	19.0-21.3	28.30						

Notes: Operator – Lisa Jersild/Phillip Grice. 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	2084	16	2080	20

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APPENDIX A

STARTER ADAPTER EXAMINATION

The starter adapter underwent a teardown examination. Removal of the starter adapter housing cap revealed metal debris adhering to the sides of the housing along with gear impressions as well as circumferential scrapes and gouges in the housing walls.



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Removal of the gear shaft revealed that the drum displayed compression damage from the spring that smeared and deformed the aft ends of the splined area. The gear shaft displayed denting marks consistent with needle bearing impingement. The needle bearing rollers displayed areas of galling.



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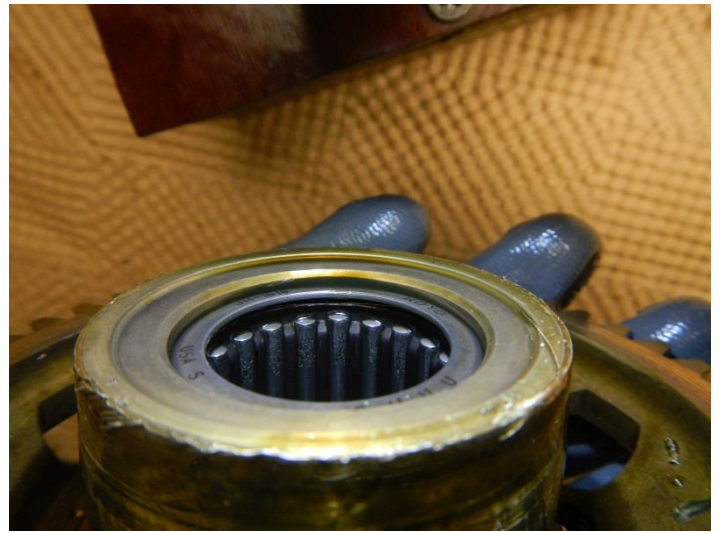
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The gear that engages with the worm gear displayed deformation damage and impression damage was noted near the teeth valleys.



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The damage noted on the starter adapter components were consistent with that noted on starter adapters that have been involved in engine kickback events. In addition, the magneto-to-engine timing was advanced of that specified for this engine model, which can contribute to a kickback event. As such, a decision was made to examine the crankshaft gear bolts as directed in Service Bulletin 16-6, Engine Damage Due to Kickback. The crankshaft gear bolts remained in place with the safety-wire intact. The bolts were removed from the crankshaft gear and there was no visible damage to the bolts noted. The NTSB investigator-in-charge authorized further examination/testing for the crankshaft gear bolts.

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