



Continental Motors

ENGINE EXAMINATION REPORT

ENGINE MODEL	TSIO-520-P
ENGINE SERIAL NUMBER	278936
AIRCRAFT MAKE & MODEL	Cessna P210N
AIRCRAFT SERIAL NUMBER	P21000576
AIRCRAFT REGISTRATION	N732FU
FILE NUMBER	15-415

NAME	SIGNATURE	DATE
Phillip Grice		06/30/2016

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GENERAL INFORMATION

EXAMINATION		ACCIDENT DATA	
DATE	05-03-2016	NTSB ACCIDENT #	CEN16LA107
FACILITY	Continental Motors Inc.	NTSB INVESTIGATOR	Pam Sullivan
ADDRESS	2039 S Broad St Mobile, AL 36615	FAA INVESTIGATOR	Carl Thomas
		ACCIDENT DATE	02/16/2016
		ACCIDENT LOCATION	Bryan, Texas

ENGINE INFORMATION

ENGINE POSITION	Single
TOTAL TIME	980.6
TIME SOH	N/A
TYPE & TIME SLI	11.1 hours since last annual inspection.
BUILD DATE	09/10/2005
IN SERVICE DATE	10/10/2005

Significant logbook information:

The last annual inspection was performed on 01/06/2016 at a tachometer time of 1391.2. A review of the provided logbooks did not reveal any cylinder work performed.

Report Summary:

Search Code(s):	13-24-03 06-01-36
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It was found that the crankshaft was fractured into two pieces; the fracture was in the crankshaft cheek between the #2 main bearing journal and the #2 connecting rod journal. The #2 bearing displayed signatures consistent with a bearing shift event and a spun bearing. Several of the bearing supports displayed fretting near the through-bolt holes.

Disposition of engine following exam:

The engine was shipped to Air Salvage of Dallas in Lancaster, Texas per the NTSB IIC request.

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NAME	Phillip Grice	NAME	Greg Eastburn
ADDRESS	Mobile, Alabama	ADDRESS	Mobile, Alabama
ORGANIZATION	Continental Motors	ORGANIZATION	Continental Motors
PHONE		PHONE	
NAME	Lisa Jersild	NAME	Kurt Gibson
ADDRESS	Mobile, Alabama	ADDRESS	Mobile, Alabama
ORGANIZATION	Continental Motors	ORGANIZATION	Continental Motors
PHONE		PHONE	
NAME	Pam Sullivan	NAME	Andrew Hall
ADDRESS	Denver, Colorado	ADDRESS	Wichita, Kansas
ORGANIZATION	NTSB	ORGANIZATION	Textron Aviation
PHONE		PHONE	

EXTERNAL INSPECTION OF ENGINE

The engine remained intact and displayed impact damage signatures to several components. All six cylinders remained attached to their cylinder bays and displayed varying degrees of impact damage signatures. It was noted that one of the deck stud nuts on the #1 cylinder was loose. The external portions of the crankshaft remained intact. The crankcase displayed damage at one of the rear backbone bolts; the damage consisted of a crack and a small portion of the crankcase was pushed outward.

The fuel pump remained attached to its installation location and was undamaged. The throttle and fuel metering assembly remained attached to its installation location and displayed minor impact damage. The fuel manifold valve remained attached to its installation point and was undamaged. The fuel nozzles remained intact and installed in their cylinders.

Both of the magnetos remained attached to their installation points and were undamaged. The ignition harness remained attached to both of the magnetos and to each of the spark plugs. All of the spark plugs remained installed in their cylinders and they were undamaged.

The induction system displayed impact damage signatures to several different intake components. The exhaust system had been partially removed by the salvage yard personnel. The exhaust system displayed some impact damage signatures to some of the components. The turbocharger remained intact and was undamaged.

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ENGINE TEARDOWN AND COMPONENT EXAMINATION

EXHAUST SYSTEM

Condition: The exhaust system displayed impact damage signatures and normal operating signatures. There were no anomalies noted with the exhaust system.



INDUCTION SYSTEM

Condition: The induction system displayed impact damage signatures and normal operating signatures. There were no signatures of induction leaks noted.



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IGNITION SYSTEM

MAGNETO-TO-ENGINE TIMING

Specification: 22° BTDC

L/H Magneto:
Unable to
determine

R/H Magneto:
Unable to
determine

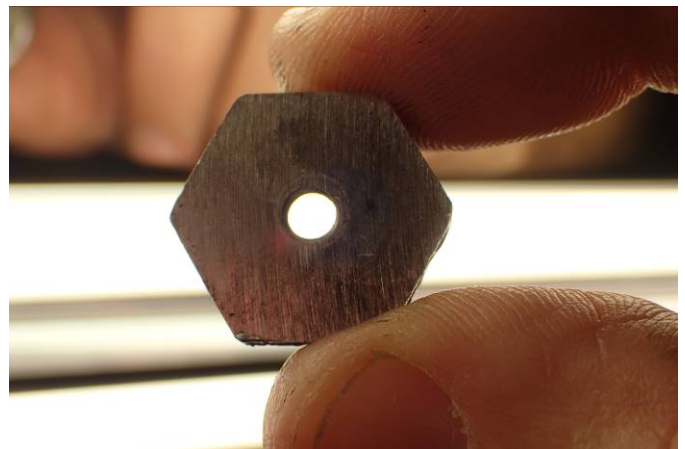
LEFT MAGNETO

Manufacturer: Slick

P/N: 6320

S/N: 05081968

Condition: The magneto remained attached to its installation point and was undamaged. The magneto was removed from the engine and installed on a magneto test bench. It was noted that the magneto was not capable of producing a spark on any of the posts. The magneto was disassembled and it was noted that the internal components displayed a significant amount of corrosion. The magneto was further inspected and it was found that the magneto pressurization vent was completely blocked.



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RIGHT MAGNETO

Manufacturer: Slick

P/N: 6320

S/N: 12091498

Condition: The magneto remained attached to its installation point and was undamaged. The magneto was removed from the engine and installed on a magneto test bench. It was noted that the magneto was able to produce a spark on all six posts. The magneto was disassembled and the internal components displayed normal operating signatures; it was noted that the magneto pressurization vent was clear.



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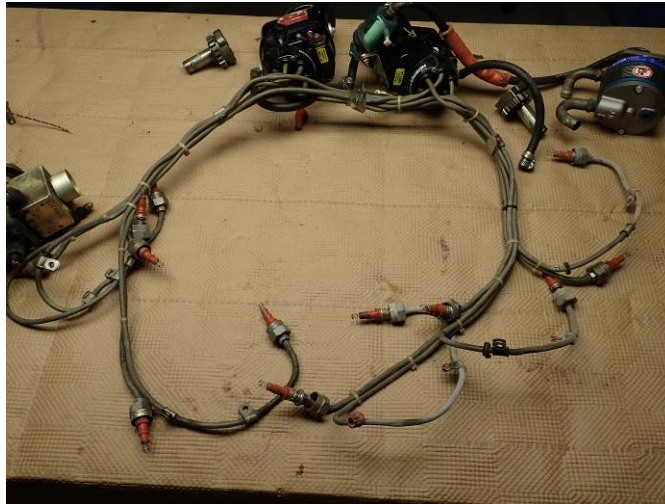
IGNITION HARNESS

Manufacturer: Slick

P/N: LH: M-2783
RH: M-2784

S/N: N/A

Condition: The ignition harness remained attached to the magnetos and to each of the spark plugs. The bottom odd cylinder ignition leads displayed a white discoloration. The remaining ignition leads displayed normal operating signatures.



SPARK PLUGS

Manufacture: Tempest

P/N: URHB32E

Condition: All of the spark plugs remained installed in their cylinders and were undamaged. The spark plugs were removed and visually inspected. The bottom #5 and #6 spark plugs were oil soaked which was consistent with post-accident accumulation. The remaining spark plugs displayed normal operating and wear signatures.



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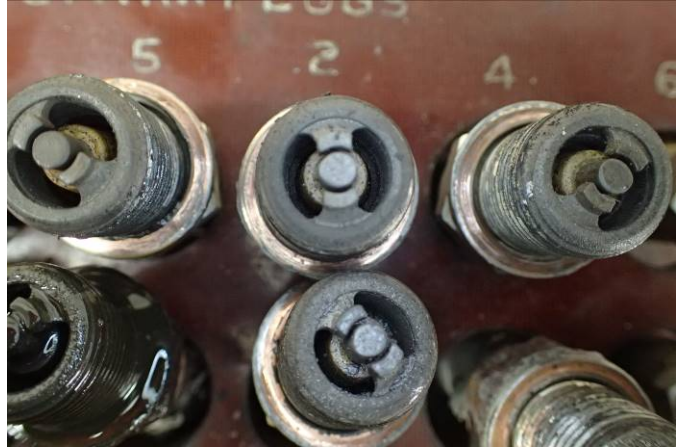
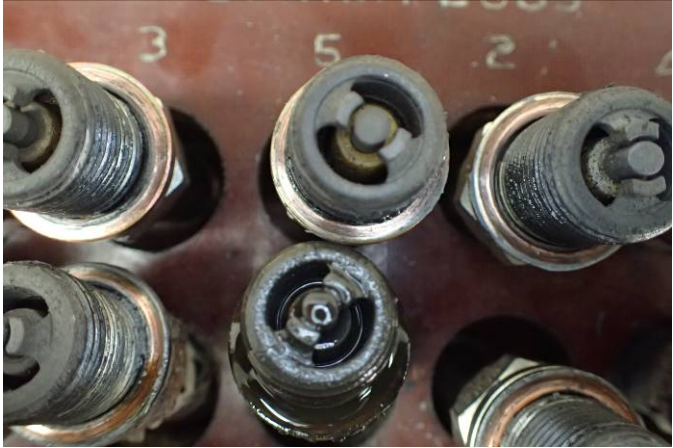
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FUEL SYSTEM

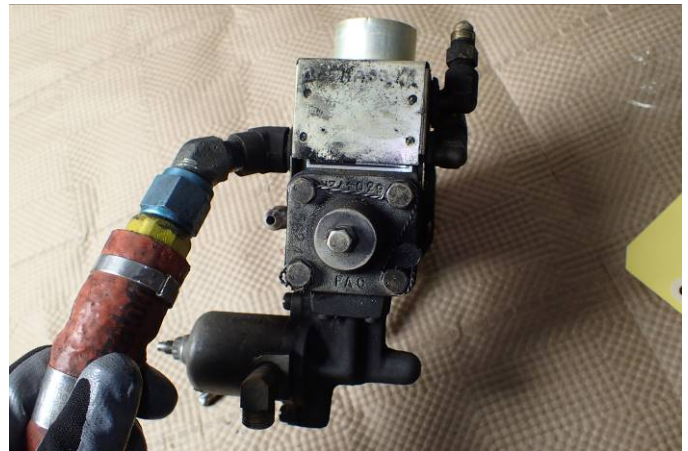
FUEL PUMP

Manufacturer: CMI

P/N: Inaccessible

S/N: B05HA334R

Condition: The fuel pump remained attached to its installation point and was undamaged. The fuel pump was removed and it was noted that the fuel pump drive coupling remained intact; it was also noted there several flakes of metal were found between several of the fuel pump drive gear teeth. The fuel pump drive shaft was capable of rotation and there were no anomalies noted with the fuel pump.



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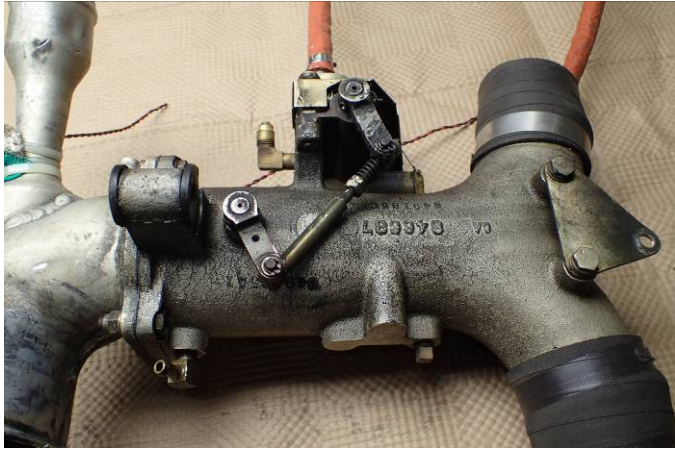
THROTTLE BODY METERING UNIT

Manufacturer: CMI

P/N: Inaccessible

S/N: A05HA291R

Condition: The throttle and fuel metering unit displayed some impact damage signatures. The throttle and mixture arms were capable of normal movement. There were no anomalies noted with the throttle and fuel metering assembly.



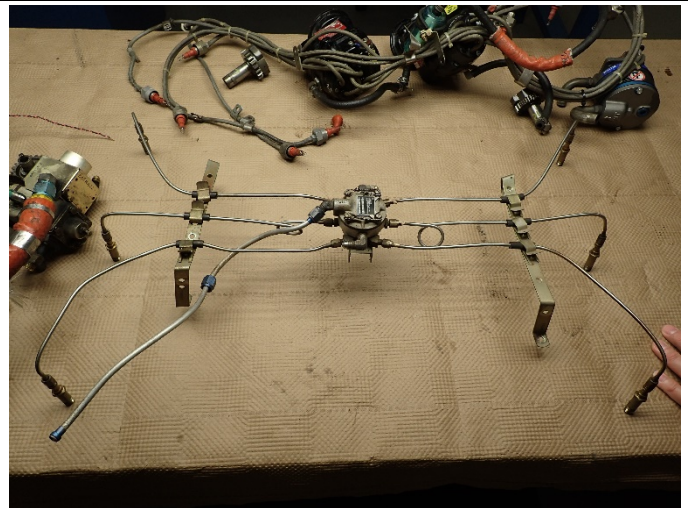
FUEL MANIFOLD VALVE

Manufacturer: CMI

P/N: 634326-12A2

S/N: C05HA284R

Condition: The fuel manifold valve remained attached to its installation point and was undamaged. There were no signs of fuel leaks or any other anomalies noted with the manifold valve.



FUEL NOZZLES AND LINES

Manufacturer: CMI

Position	#1	#3	#5	#2	#4	#6
Size	128 (O62)	328 (O62)	528 (O62)	228 (O62)	428 (O62)	628 (O62)

Condition: All of the fuel nozzles remained installed in their cylinders and remained attached to their fuel lines. There were no anomalies noted with the fuel nozzles.

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#1 Injector



#3 Injector



#5 Injector



#2 Injector



#4 Injector



#6 Injector

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LUBRICATION SYSTEM

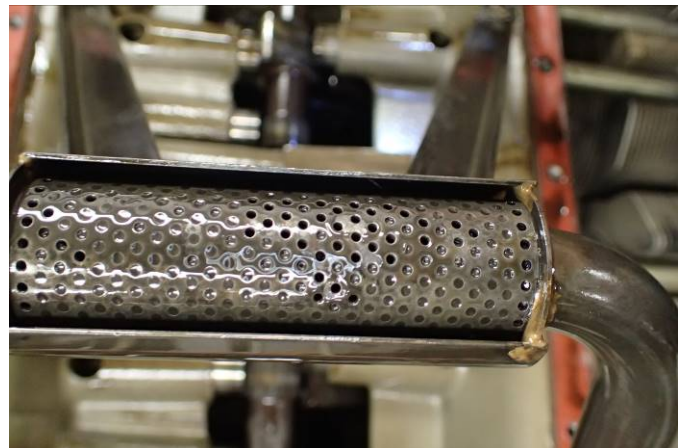
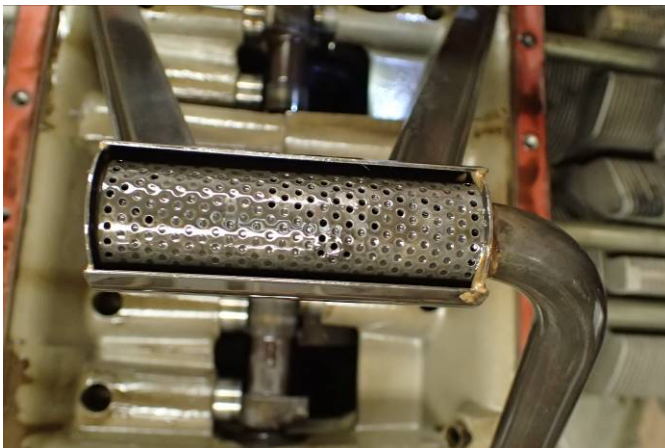
OIL SUMP

Condition: The oil sump remained intact and displayed impact damage signatures. The oil sump was removed and it was noted that there were several pieces of material consistent with bearing and piston material found in the oil sump.



OIL PICK-UP TUBE & SCREEN

Condition: The oil pick-up tube and screen was undamaged and the screen was clear of any contaminants.



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OIL PUMP

Condition: The oil pump remained intact and undamaged. The oil pump and the scavenge pump were disassembled and the internal components were visually inspected. The oil pump housing displayed scoring consistent with hard particle passage. The oil pump and scavenge pump gears displayed normal operating and lubrication signatures. The oil pressure relief valve had several flakes of metal on the surface.



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OIL FILTER

Manufacturer: Not recorded

P/N: Not recorded

Condition:

The oil filter remained attached to the oil filter adapter and remained intact. The oil filter housing was cut open and the filter pleats were inspected. The filter plates contained a significant amount of metallic particles within the pleats.



OIL COOLER

Manufacturer: Illegible

P/N: 10634D

S/N: 1496

Condition:

The remote oil cooler displayed normal operating signatures. There were no anomalies noted with the oil cooler.



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CYLINDERS

CYLINDER #1

P/N: 655470A3

S/N: AC05HA729

Head Date: 08/17/05

Condition: The cylinder remained attached to its cylinder bay and there was no external damage. One of the top cylinder hold down nuts was noted to be loose and was capable of being moved by hand. The remaining nuts were noted to have white torque putty. The cylinder was removed and it was noted that the cylinder skirt displayed mechanical damage. The cylinder bore, combustion chamber, and the overhead components (valves, rocker arms, push rods) displayed normal operating and lubrication signatures.



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CYLINDER #3	P/N: 655470A3	S/N: AC05HA728	Head Date: 08/17/05
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Condition:	The cylinder remained attached to its cylinder bay and was undamaged. It was noted that there was white torque putty on all of the cylinder hold down nuts for the studs and through bolts. The cylinder was removed and it was noted that the cylinder skirt was undamaged. The cylinder bore, combustion chamber, and the overhead components (valves, rocker arms, push rods) displayed normal operating and lubrication signatures.
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CYLINDER #5	P/N: 655470A3	S/N: AC05HA773	Head Date: 08/17/05
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Condition:	The cylinder remained attached to its cylinder bay and was undamaged. It was noted that there was white torque putty on all of the cylinder hold down nuts for the studs and through bolts. The cylinder was removed and it was noted that the cylinder skirt was undamaged. The cylinder bore, combustion chamber, and the overhead components (valves, rocker arms, push rods) displayed normal operating and lubrication signatures.
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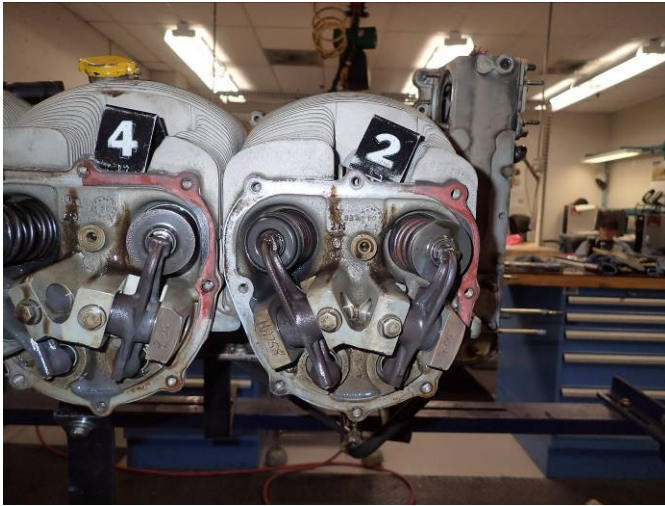


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CYLINDER #2	P/N: 655470A3	S/N: AC05HA758	Head Date: 08/17/05
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Condition: The cylinder remained attached to its cylinder bay and there was no external damage noted. It was noted that there was white torque putty on all of the cylinder hold down nuts for the studs and through bolts. The cylinder was removed and it was noted that the cylinder skirt displayed mechanical damage. The cylinder bore, combustion chamber, and the overhead components (valves, rocker arms, push rods) displayed normal operating and lubrication signatures.



CYLINDER #4	P/N: 655470A3	S/N: AC05HA775	Head Date: 8-05
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Condition: The cylinder remained attached to its cylinder bay and was undamaged. It was noted that there was white torque putty on all of the cylinder hold down nuts for the studs and through bolts. The cylinder was removed and it was noted that the cylinder skirt was undamaged. The cylinder bore, combustion chamber, and the overhead components (valves, rocker arms, push rods) displayed normal operating and lubrication signatures.



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CYLINDER #6

P/N: 655470A3

S/N: AC05HA743

Head Date: 08/17/05

Condition:

The cylinder remained attached to its cylinder bay and was undamaged. It was noted that there was white torque putty on all of the cylinder hold down nuts for the studs and through bolts. The cylinder was removed and it was noted that the cylinder skirt was undamaged. The cylinder bore, combustion chamber, and the overhead components (valves, rocker arms, push rods) displayed normal operating and lubrication signatures.



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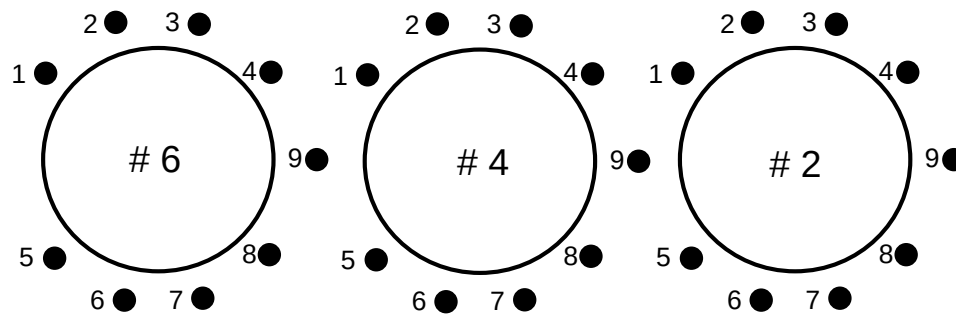
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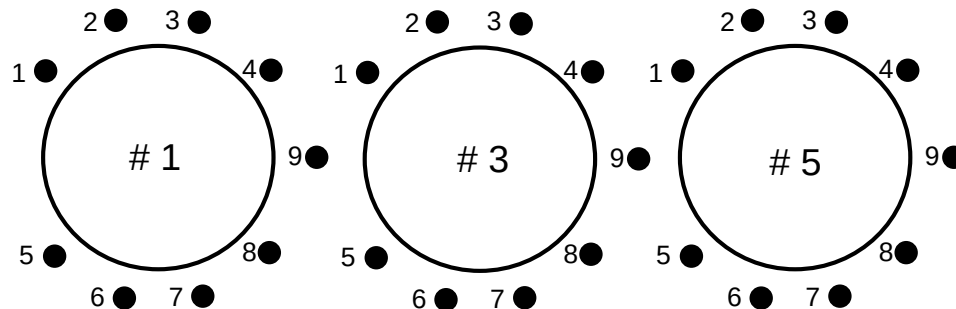
Cylinder Through-Bolt and Deck Stud Break-Away (Tightening/Loosening) Torque Measurements (in-lbs)

(NOTE: 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	647/ 884	597/ 727	760/ 610	815/ 685	715/ 1087	866/ 668	801/ 698	850/ 656	846/ 663
Cylinder #4	626/ 874	941/ 718	877/ 699	779/ 600	709/ 831	828/ 637	814/ 638	827/ 687	706/ 620
Cylinder #6	1013/ 985	938/ 729	823/ 642	653/ 533	898/ 697	814/ 666	885/ 692	804/ 613	753/ 663



	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	920/ 924	885/ 711	818/ 689	Loose	1122/ 874	859/ 724	845/ 732	753/ 626	566/ 500
Cylinder # 3	1038/ 1020	782/ 669	837/ 685	749/ 610	1075/ 869	905/ 687	876/ 697	729/ 560	851/ 619
Cylinder # 5	1024/ 940	780/ 596	841/ 683	768/ 622	1137/ 1075	871/ 639	765/ 598	834/ 606	520/ 446



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VALVES AND GUIDES

Condition: All of the valves displayed normal operating and combustion signatures. There were no anomalies noted with any of the valves.

ROCKER ARMS AND SHAFTS

Condition: All of the rocker arms displayed normal operating and lubrication signatures. There were no anomalies noted with any of the rocker arms.



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#1 PISTON, RINGS AND PIN

Piston P/N: 654840C

Condition:

The piston remained attached to its connecting rod and displayed mechanical damage to the piston skirt. The piston face displayed normal combustion signatures. The rear piston ring was broken; the forward 3 piston rings were intact, and free to move in their grooves. There were no anomalies noted with the piston.



#3 PISTON, RINGS AND PIN

Piston P/N: 654840C

Condition:

The piston remained attached to its connecting rod and was undamaged. The piston face displayed normal combustion signatures. The pistons rings remained intact and were capable of normal movement in their grooves. There were no anomalies noted with the piston.



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#5 PISTON, RINGS AND PIN

Piston P/N: 654840C

Condition:

The piston remained attached to its connecting rod and was undamaged. The piston face displayed normal combustion signatures. The pistons rings remained intact and were capable of normal movement in their grooves. There were no anomalies noted with the piston.



#2 PISTON, RINGS AND PIN

Piston P/N: 654840C

Condition:

The piston remained attached to its connecting rod and displayed mechanical damage to the piston skirt. The piston face displayed normal combustion signatures and some corrosion. The rear piston ring displayed mechanical damage and remained within its groove; the forward 3 piston rings were intact, and free to move in their grooves. There were no anomalies noted with the piston.



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#4 PISTON, RINGS AND PIN

Piston P/N: 654840C

Condition: The piston remained attached to its connecting rod and was undamaged. The piston face displayed normal combustion signatures. The pistons rings remained intact and were capable of normal movement in their grooves. There were no anomalies noted with the piston.



#6 PISTON, RINGS AND PIN

Piston P/N: 654840C

Condition: The piston remained attached to its connecting rod and was undamaged. The piston face displayed normal combustion signatures. The pistons rings remained intact and were capable of normal movement in their grooves. There were no anomalies noted with the piston.



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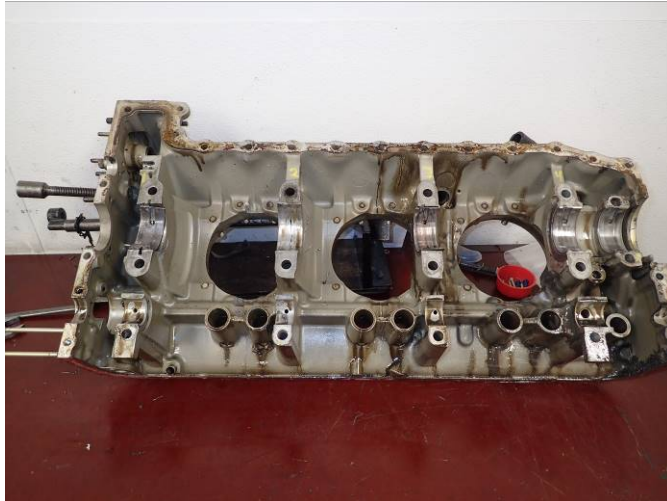
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CRANKCASE ASSEMBLY

CRANKCASE	Casting Number:	1-3-5: 653961	2-4-6: 653960	S/N: E209903R
Condition:	The external portion of the crankcase displayed damage in the area near one of the rear backbone bolts; the damage consisted of a crack and a small portion of the crankcase was pushed outward. The crankcase halves were split from one another and the internal portion of the crankcase was inspected. It was noted that there was mechanical damage to the #1 and the #2 cylinder bays. The #2 main bearing support displayed damage consistent with a bearing shift and a spun bearing. The #1 bearing support displayed minor bearing movement signatures. The #1 and the #2 main bearing supports displayed fretting near the through bolt holes.			



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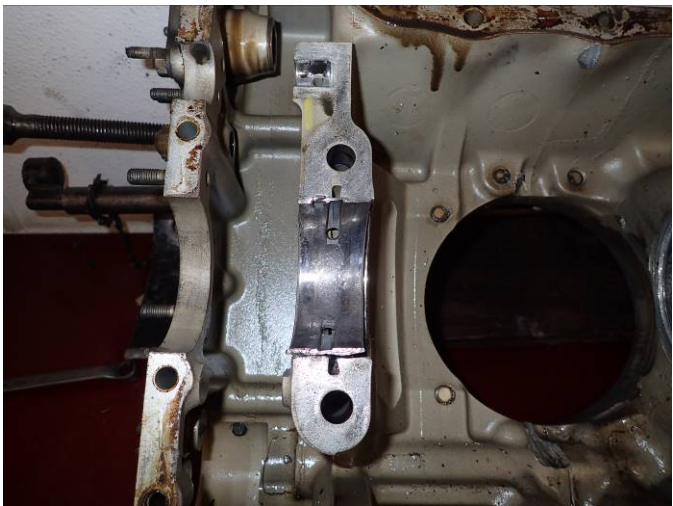
#2 Bearing Supports

#1 MAIN BEARINGS

P/N: 653547 M010

Date Code: 7-05

Condition: The bearings displayed normal lubrication signatures. The bearings displayed deformity consistent with minor bearing movement. It was noted that there was fretting on the bearing supports near the through bolt holes.



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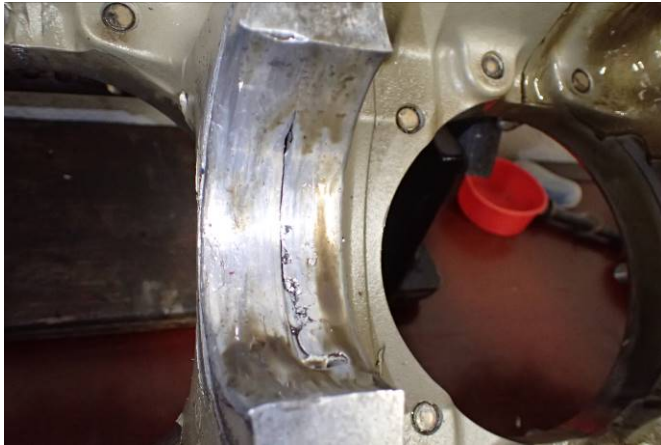
#2 MAIN BEARINGS

P/N: Illegible

Date Code: Illegible

Condition:

The bearings displayed damage consistent with a bearing movement event. Several portions of the bearing were located in the oil sump. One portion of the right side bearing remained within the bearing saddle; the bearing had extruded out of the bearing support.



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#3 MAIN BEARINGS

P/N: 653547 M010

Date Code: 7-05

Condition: The bearings remained in their bearing supports and there were no signatures of bearing shift. It was noted that the #3 bearings displayed signs of lubrication distress and the copper layer was exposed.

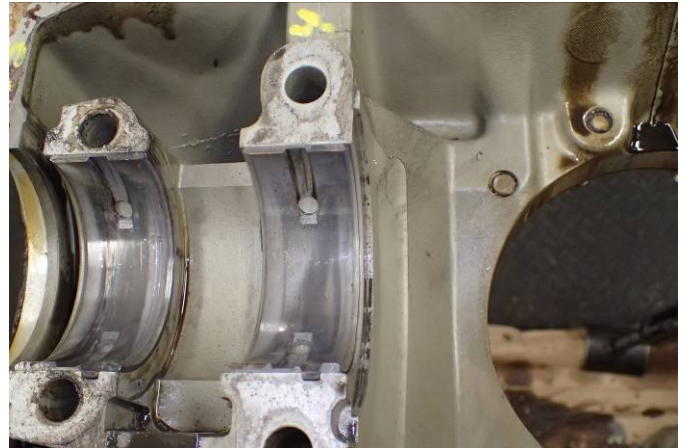


#4 MAIN BEARINGS

P/N: 653547 M010

Date Code: 7-05

Condition: The bearings remained in their bearing supports and there were no signatures of bearing shift. The bearing displayed normal wear, operating, and lubrication signatures.



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#5 MAIN BEARINGS

P/N: 653547 M010

Date Code: 7-05

Condition:

The bearings remained in their bearing supports and there were no signatures of bearing shift. The bearing displayed normal wear, operating, and lubrication signatures.



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CRANKSHAFT ASSEMBLY

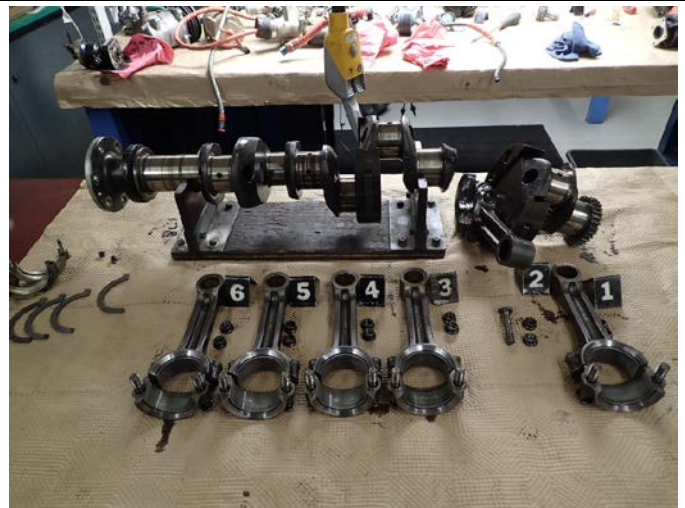
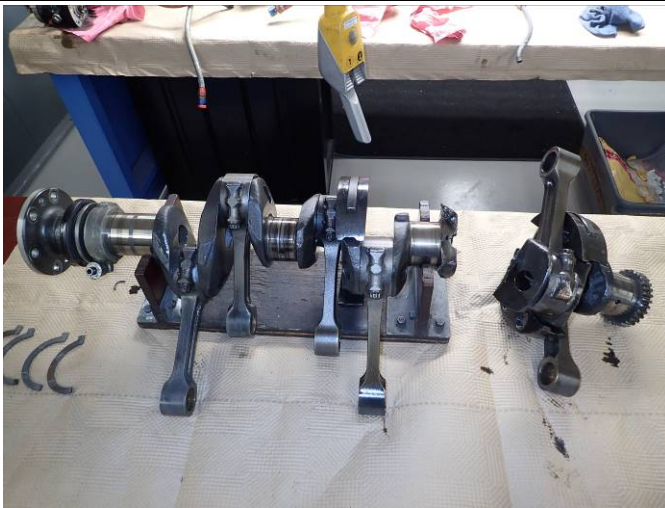
CRANKSHAFT

Forging Number: 649130

S/N: N00JA074

Heat code: KUA3

Condition: The crankshaft was fractured into two pieces; the fracture was located at the crankshaft cheek between the #2 main bearing journal and the #2 connecting rod journal. The #3 main journal displayed heat discoloration consistent with heat and scratches consistent with hard particle passage. The remaining main journals displayed normal operating and lubrication signatures. The #2 connecting rod journal was unable to be observed due to the #2 connecting rod being impinged in place on the journal. The connecting rod journals capable of inspection displayed normal operating and lubrication signatures.



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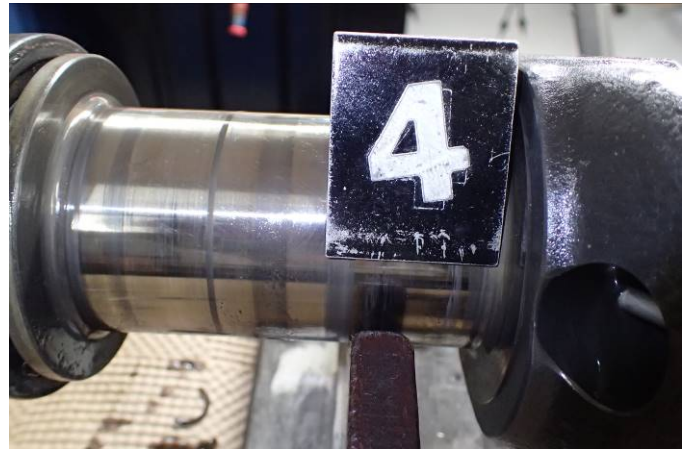
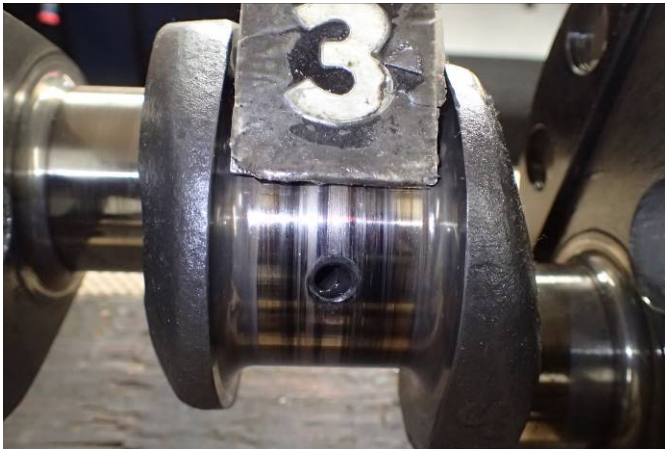
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ENGINE EXAMINATION REPORT**FILE NUMBER:**

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COLLAR**

Condition: The transfer collar displayed normal operating signatures. There were no anomalies noted with the transfer collar.

**COUNTER
WEIGHTS**

Condition: All of the counterweights remained secure to their hangers and displayed normal operating signatures. All of the counterweights were capable of normal movement.

**INTERNAL
TIMING**

Condition: Due to the damage to the crankshaft the internal timing could not be verified.

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#1 CONNECTING ROD

P/N: 655910

S/N: AE05GA891

Condition: The connecting rod remained attached to its connecting rod journal and displayed normal operating signatures.

#1 CONNECTING ROD BEARING

P/N: 630826 M010

Date Code: 3-04

Condition: The connecting rod bearing displayed normal operating and lubrication signatures.



#3 CONNECTING ROD

P/N: 655910

S/N: AE05GA731

Condition: The connecting rod remained attached to its connecting rod journal and displayed normal operating signatures.

#3 CONNECTING ROD BEARING

P/N: 630826 M010

Date Code: 3-04

Condition: The connecting rod bearing displayed the incipient signs of lubrication distress. It was noted that the #3 connecting rod journal and bearing receive oil from the #2 main bearing journal.



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#5 CONNECTING ROD

P/N: 655910

S/N: AE05GA714

Condition: The connecting rod remained attached to its connecting rod journal and displayed normal operating signatures.

#5 CONNECTING ROD BEARING

P/N: 630826 M010

Date Code: 3-04

Condition: The connecting rod bearing displayed normal operating and lubrication signatures.



#2 CONNECTING ROD

P/N: 655910

S/N: AE05GA895

Condition: The connecting rod remained secured to its connecting rod journal and displayed some mechanical damage. The connecting rod was impinged onto its journal by displaced crankshaft material at fractured area of the crankshaft. There were no anomalies noted with the connecting rod.

#2 CONNECTING ROD BEARING

P/N: 630826 M010

Date Code: 3-04

Condition: Due to the connecting rod being impinged in place the bearing was not capable of being observed.



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#4 CONNECTING ROD

P/N: 655910

S/N: AE05GA751

Condition: The connecting rod remained attached to its connecting rod journal and displayed normal operating signatures.

#4 CONNECTING ROD BEARING

P/N: 630826 M010

Date Code: 3-04

Condition: The connecting rod bearing displayed normal operating and lubrication signatures.



#6 CONNECTING ROD

P/N: 655910

S/N: AE05GA739

Condition: The connecting rod remained attached to its connecting rod journal and displayed normal operating signatures.

#6 CONNECTING ROD BEARING

P/N: 630826 M010

Date Code: 3-04

Condition: The connecting rod bearing displayed normal operating and lubrication signatures.



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CAMSHAFT

CAMSHAFT	P/N: 655384	S/N: Z05HA109
Condition:	The camshaft was intact and displayed mechanical damage towards the rear of the camshaft. The camshaft gear remained intact and was secured. The camshaft lobes displayed normal operating signatures.	



LIFTERS	#1	#3	#5	#2	#4	#6
INTAKE	653888	653888	653888	653888	653888	653888
EXHAUST	653877	653877	653877	653877	653877	653877
Condition:	The #1 intake lifter was impinged in its installation area and was unable to be removed. The visible portions of the #1 intake lifter displayed normal operating and lubrication signatures. The remaining lifters all displayed normal operating and lubrication signatures.					



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ACCESSORY GEARS

Condition:

The accessory gears displayed normal operating signatures. There were no anomalies noted.



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ACCESSORIES

STARTER

Manufacturer: Hartzell

P/N: ES646275-1

S/N: H-M071044

Condition:

The starter remained attached to the starter adapter and was undamaged. There were no anomalies noted with the starter.

**STARTER ADAPTER**

P/N: Illegible

Condition:

The starter adapter remained attached to its installation point and was undamaged. There were no anomalies noted with the starter adapter.



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ALT/GEN #1	Manufacturer: Aerotech	P/N: E3FF10300AA	S/N: A702151
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Condition:	The alternator remained attached to its installation point and was undamaged. The alternator drive belt was noted to be no longer attached to the alternator drive pulley or to the starter adapter pulley.
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ALT/GEN #2	Manufacturer: Cessna	P/N: C611507-0101	S/N: 435A
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Condition:	The secondary alternator remained attached to its mounting location and was undamaged. The generator was removed and it was noted that the drive shaft was not secured to the internal portion of the generator.
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VACUUM PUMP

Manufacturer: Tempest

P/N: AA216CW

S/N: I4259-15

Condition: The vacuum pump remained attached to its mounting location and was undamaged. The vacuum pump sheer coupling was noted to be intact. There were no anomalies noted with the vacuum pump



PROPELLER GOVERNOR

Manufacturer: McCauley

P/N: C290D4K/T2

S/N: 801907

Condition: The propeller governor remained attached to its installation point and displayed only minor impact damage. The propeller governor was removed and it was noted that the gasket screen was clear of any contaminants.



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TURBO

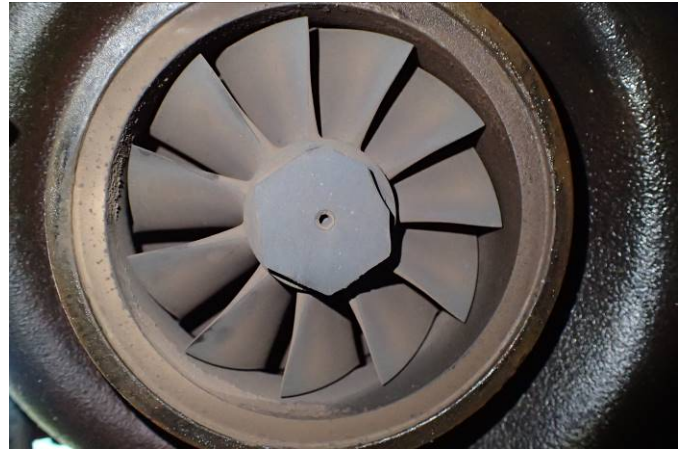
Manufacturer: Garrett

P/N: C295001-0202

S/N: KF0103

Condition:

The turbocharger remained attached to the exhaust system and had been removed from the engine with the right side exhaust. The turbine and the compressor were capable of rotating freely and both sections displayed normal operating signatures.



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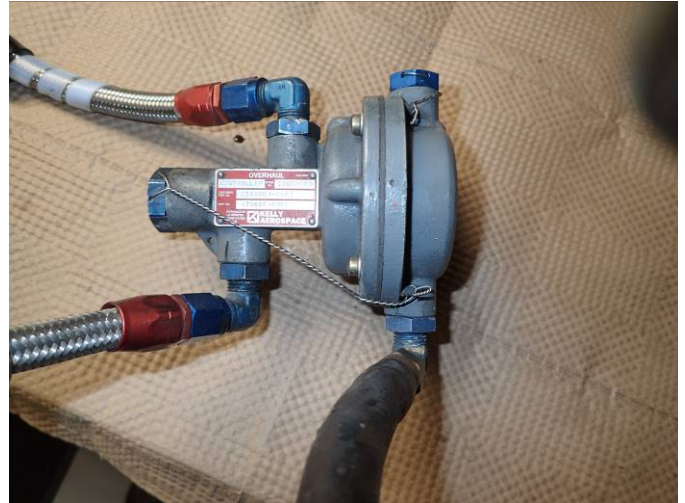
TURBO CONTROLLER

Manufacturer: Kelley Aerospace

P/N: 470688-9008

S/N: IC0000873

Condition: The turbocharger controller displayed normal operating signatures. There were no anomalies noted.



WASTEGATE

Manufacturer: Kelly Aerospace

P/N: 470908-9020

S/N: ID000762

Condition: The wastegate remained attached to its installation point and was undamaged. There were no anomalies noted with the wastegate.

