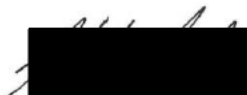




ENGINE EXAMINATION REPORT

ENGINE MODEL	IO-550-B
ENGINE SERIAL NUMBER	281784-R
AIRCRAFT MAKE & MODEL	Beechcraft F33A
AIRCRAFT SERIAL NUMBER	CE-504
AIRCRAFT REGISTRATION	N80WH
FILE NUMBER	19-072

NAME	SIGNATURE	DATE
Kurt Gibson		12/18/2019

ENGINE EXAMINATION REPORT**FILE NUMBER:**

19-072

ENGINE S/N:

281784-R

PAGE 2 of 36**GENERAL INFORMATION**

EXAMINATION		ACCIDENT DATA	
DATE	12/11/2019	NTSB ACCIDENT #	ERA19LA258
FACILITY	Continental Aerospace Technologies	NTSB INVESTIGATOR	Peter Wentz
ADDRESS	2039 S Broad St Mobile, AL 36615	FAA INVESTIGATOR	Carlos Enriquez
		ACCIDENT DATE	08/23/2019
		ACCIDENT LOCATION	Hobe Sound, Florida

ENGINE INFORMATION

ENGINE POSITION	Front (single engine)
TOTAL TIME	2835.9 (time was taken from the last maintenance entry)
TIME SOH	1,135.9 (time was taken from the last maintenance entry)
TYPE & TIME SLI	Unknown
BUILD DATE	03/29/1993
IN SERVICE DATE	Unknown

Significant logbook information:

The engine was overhauled by Powermaster Aircraft Engines (FAA CRS #P46R287Y) on 09/01/2004; the logbook entry for installing the engine after overhaul was dated at 08/01/2019 which is inconsistent with the overhaul entry date of 09/01/2004. On 04/09/2014 the annual inspection stated that AD2014-05-29 was complied with and that the installed cylinders must be replaced by 08/2016; the cylinders that were installed on the engine at the time of the accident were the original cylinders that were installed at the last overhaul in 2004. The 100-hour inspection performed on 04/05/2017 the entry states that AD2014-05-29 was complied with an alternative method of compliance (AMOC) by performing a leak check and borescope. AD2014-05-29 states that the cylinders must always be borescoped and leak checked and that any AMOC must be approved by the Manager of the Special Certification Office; it is unknown at the time of this report's writing if the owner received approval for the AMOC for a leak and borescope check. It was also observed that several of the airframe logbook entries were placed in the engine logbook and several of the engine logbook entries were placed in the airframe logbook.

Report Summary:

Search Code(s):

06-01-36

13-24-03

The crankshaft was found to be broken into two pieces and the engine displayed a bearing shift event at the #2 main bearing. The bearing support mating surfaces displayed fretting. It was also observed that the crankcase backbone mating surfaces displayed unapproved sealant material and there was no sign of a silk thread.

Disposition of engine following exam:

The engine was shipped to Florida Air Recovery in Jacksonville, Florida.

ENGINE EXAMINATION REPORT**FILE NUMBER:**

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PAGE 3 of 36**INSPECTION WITNESSES**

NAME	Kurt Gibson	NAME	Phillip Grice
ADDRESS	Mobile, Alabama	ADDRESS	Mobile, Alabama
ORGANIZATION	Continental Aerospace	ORGANIZATION	Continental Aerospace
PHONE	██████████	PHONE	██████████
NAME	Lisa Jersild	NAME	Randy Bryant
ADDRESS	Mobile, Alabama	ADDRESS	Mobile, Alabama
ORGANIZATION	Continental Aerospace	ORGANIZATION	Continental Aerospace
PHONE	N/A	PHONE	N/A
NAME	Peter Wentz	NAME	
ADDRESS	Eastern Region	ADDRESS	
ORGANIZATION	NTSB	ORGANIZATION	
PHONE	██████████	PHONE	

ENGINE EXAMINATION REPORT**FILE NUMBER:**

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PAGE 4 of 36**EXTERNAL INSPECTION OF ENGINE**

The engine remained intact and there was minimal impact damage to the engine. The crankcase displayed a crack near the back of the upper crankcase. The propeller flange remained attached to the rest of the crankshaft and there were no cracks noted in the external portion of the crankshaft. All six cylinders remained attached to their cylinder bays and the cylinders were undamaged.

Both magnetos remained attached to their installation points and were undamaged; however, the magnetos did display some corrosion. The ignition harness remained intact and there were no torn leads observed. All the spark plugs remained installed in their cylinders and were undamaged.

The fuel pump, throttle and metering assembly, fuel manifold valve, and fuel nozzles remained installed in their installation points and were undamaged. There were no signs of fuel leaks observed around any of the fuel components or fuel lines.

The exhaust system remained attached to its installation point and the returned portions of the exhaust system were undamaged; the tailpipes were not shipped with the engine. The induction system remained intact and displayed minimal impact damage to the Y-pipe. There were no signs of exhaust or induction leaks observed.

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ENGINE TEARDOWN AND COMPONENT EXAMINATION

EXHAUST SYSTEM

Condition: The exhaust system remained attached to the engine and the returned portions of the exhaust were undamaged. There were no exhaust leaks or blockages observed with the returned exhaust system components.



INDUCTION SYSTEM

Condition: The induction system remained attached to the engine and displayed minor impact damage to the Y-pipe. There were no signs of induction leaks or blockages observed.



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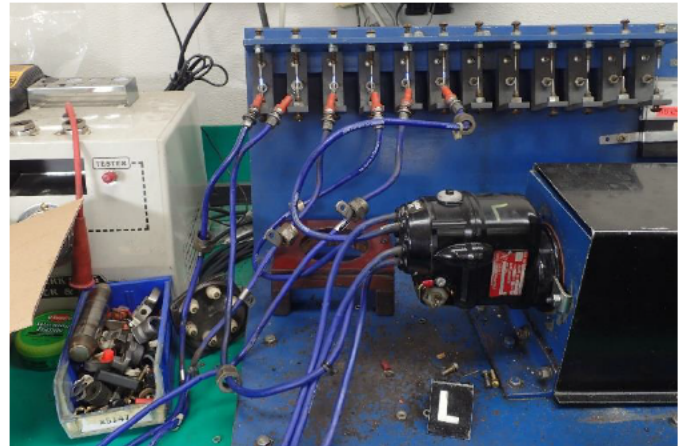
PAGE 7 of 36**IGNITION SYSTEM****LEFT
MAGNETO**

Manufacturer: Slick

P/N: 6310

S/N: 08050591

Condition: The magneto remained attached to its installation point and was undamaged. The magneto was removed and placed on a test bench. The magneto was capable of producing a spark to the end of each ignition lead in the correct firing order and at various RPM settings.

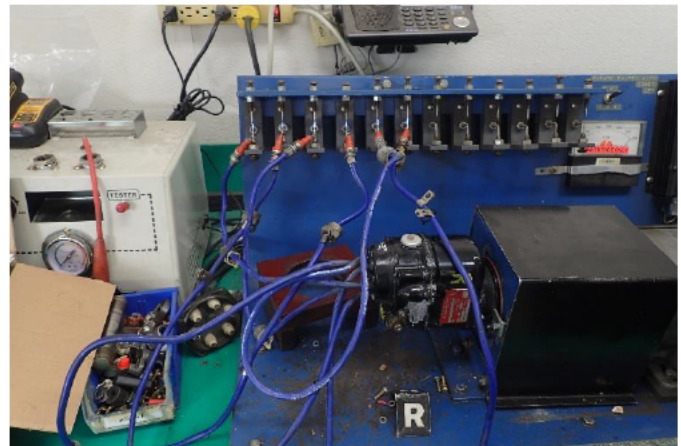
**RIGHT
MAGNETO**

Manufacturer: Slick

P/N: 6310

S/N: 04021480

Condition: The magneto remained attached to its installation point and was undamaged; however, the magneto was corroded. The magneto was removed and placed on a test bench. The magneto was capable of producing a spark to the end of each ignition lead in the correct firing order and at various RPM settings.



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IGNITION HARNESS

Manufacturer: Unisom

P/N: LH: M-2380
RH: M-2379

S/N: Not observed

Condition: The top ignition leads had been removed from their spark plugs during the initial examination; the bottom spark plug ignition leads remained secured to their spark plugs. The ignition harness was used during the magneto testing and each ignition lead was capable of conducting a spark from the magneto to the ignition lead end.



SPARK PLUGS

Manufacturer: Champion

P/N: RHB32E

Condition: The spark plugs remained installed in their cylinders and were undamaged. The spark plugs were removed, and the electrodes were visually inspected. All of the electrodes were in a worn-out condition and several of the electrodes were extremely worn out.



#1 Spark Plugs



#3 Spark Plugs

ENGINE EXAMINATION REPORT

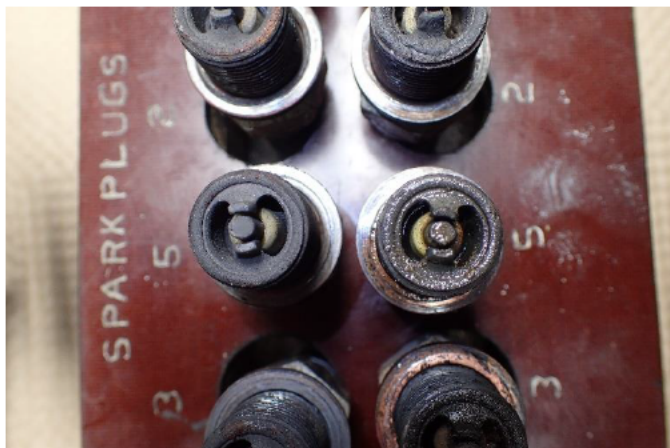
FILE NUMBER:

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ENGINE S/N:

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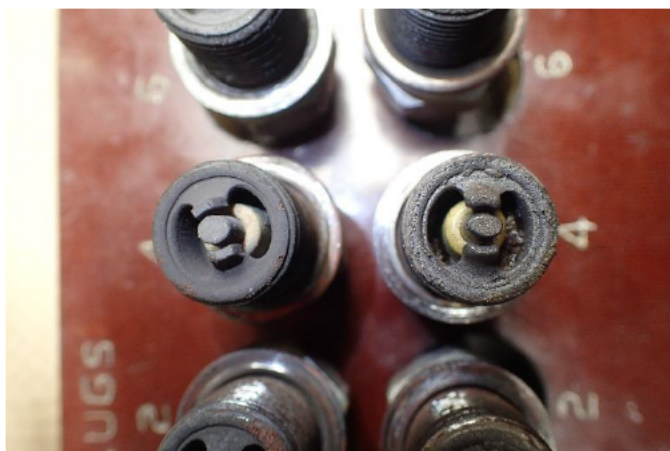
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#5 Spark Plugs



#2 Spark Plugs



#4 Spark Plugs



#6 Spark Plugs

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FUEL SYSTEM

FUEL PUMP

Manufacturer: TCM

P/N: 646766-4A1

S/N: B03GA150R

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 was broken; it was noted that the drive coupling is installed in the back of the crankshaft and the rear portion of the crankshaft had shifted from its normal position. The fuel pump drive was capable of normal rotation and there were no signs of fuel leaks around the fuel pump.



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THROTTLE BODY METERING UNIT

Manufacturer: TCM

P/N: 646628A7

S/N: A04EA055R

Condition:

The throttle and metering assembly remained attached to its installation point and was undamaged. The assembly was removed and it was observed that the throttle and mixture control arms remained secured to their shafts. The fuel inlet screen was removed and it was noted to be clear of contaminants.



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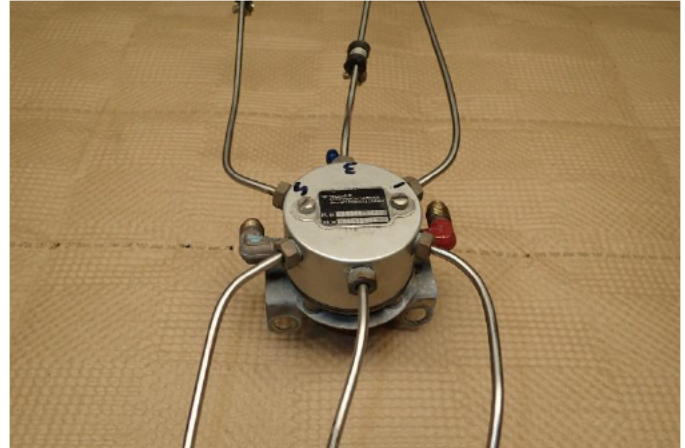
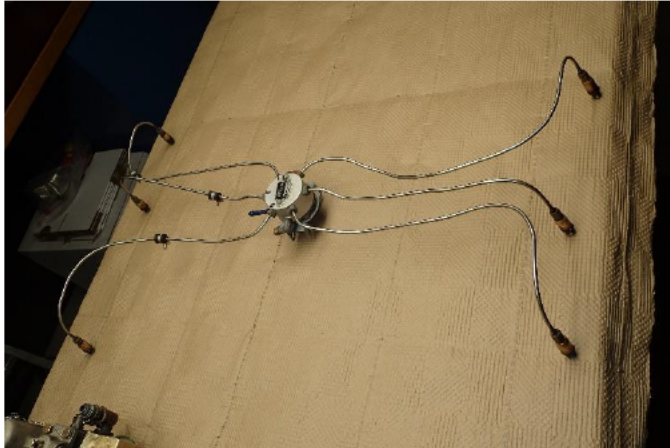
FUEL MANIFOLD VALVE

Manufacturer: TCM

P/N: 646508-14A6

S/N: C04EA060R

Condition: The fuel manifold valve remained attached to its installation point and was undamaged. There were no signs of fuel leaks observed and all of the fuel lines were secure.



FUEL NOZZLES AND LINES

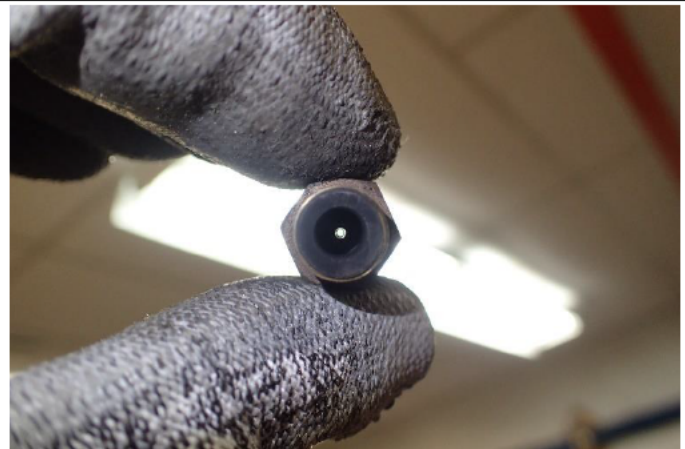
Manufacturer: GAMI

Position	#1	#3	#5	#2	#4	#6
Size	GA168	GM151	GF143	GA168	GM151	GF143

Condition: The nozzles remained installed in their cylinders and were undamaged. The nozzles were removed and checked for obstructions. All of the nozzles were noted to be clear of any obstructions.



#1 Nozzle



#3 Nozzle

ENGINE EXAMINATION REPORT

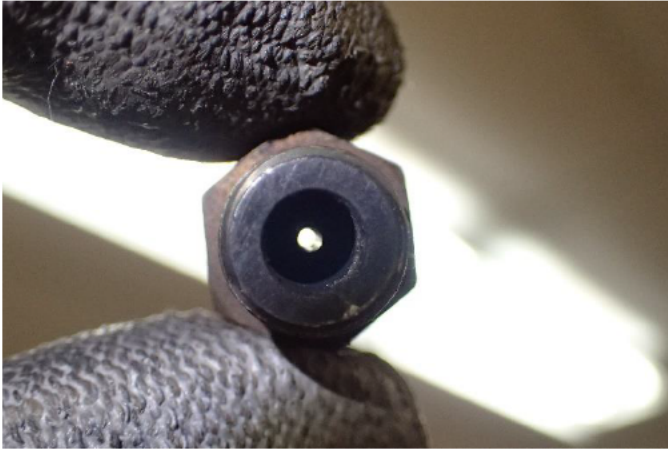
FILE NUMBER:

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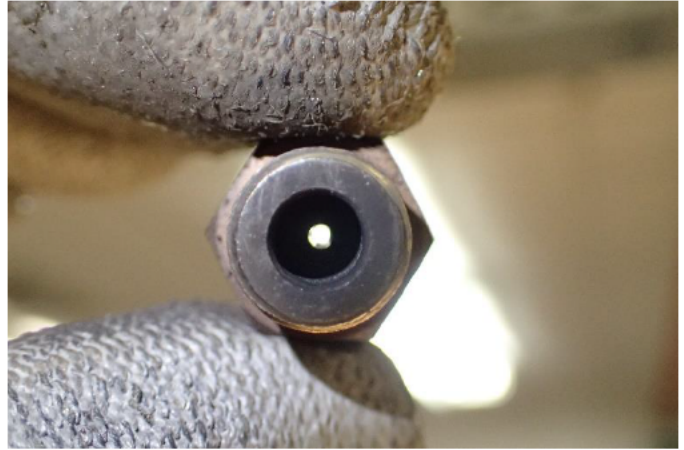
ENGINE S/N:

281784-R

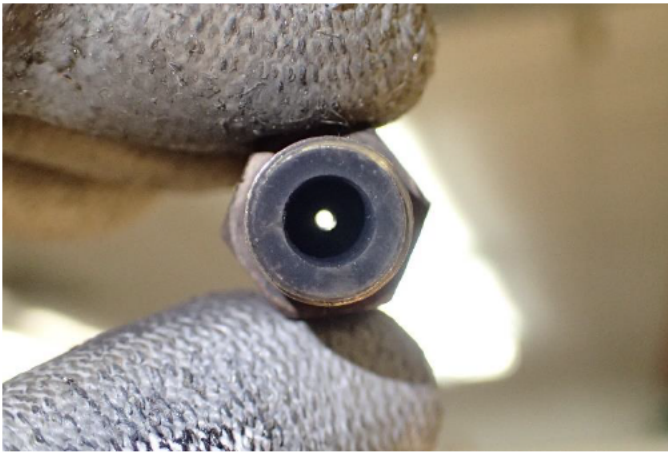
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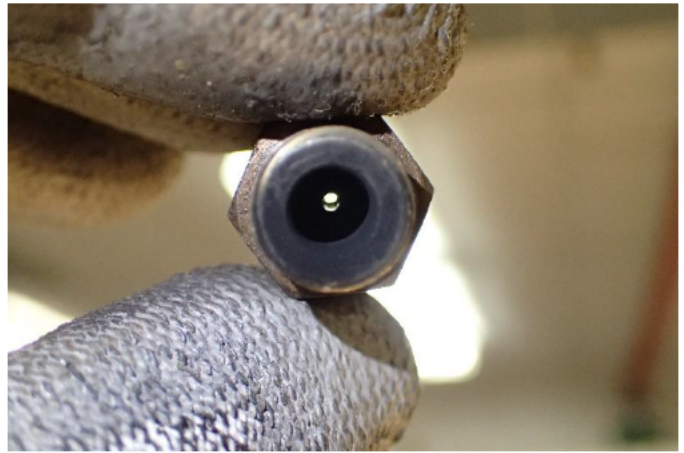
#5 Nozzle



#2 Nozzle



#4 Nozzle



#6 Nozzle

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LUBRICATION SYSTEM

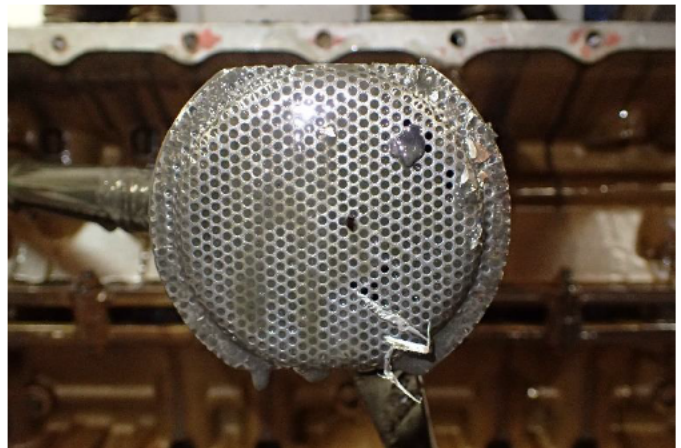
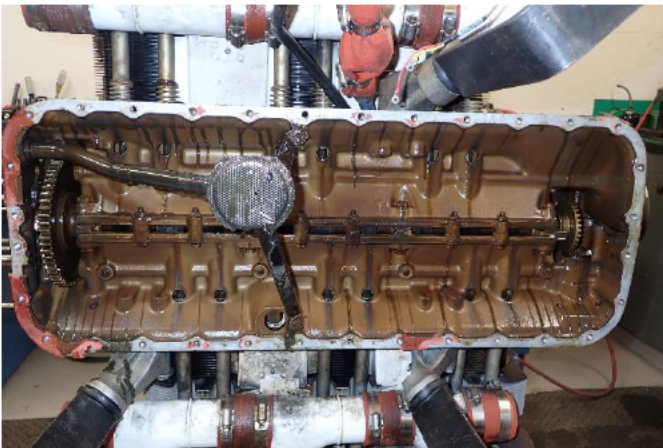
OIL SUMP

Condition: The oil sump remained intact and was undamaged. The oil sump was removed and it was noted there were several large pieces of loose metal in the oil sump; some of the material was consistent with bearing material.



OIL PICK-UP TUBE & SCREEN

Condition: The oil pick-up tube and screen remained attached to its installation point and was undamaged. The oil pick up screen had several pieces of metallic material within the screen.



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OIL PUMP

Condition:

The oil pump remained attached to its installation point and was undamaged. The oil pump was removed and disassembled. The oil pump housing displayed scoring consistent with hard particle passage. The oil pump gears and pressure relief valve displayed normal operating signatures.



OIL FILTER

Manufacturer:

P/N:

Condition:

The oil filter was removed and the filter housing was cut open. The filter pleats were visually inspected and it was observed that there was a significant amount of metallic material within the filter pleats.



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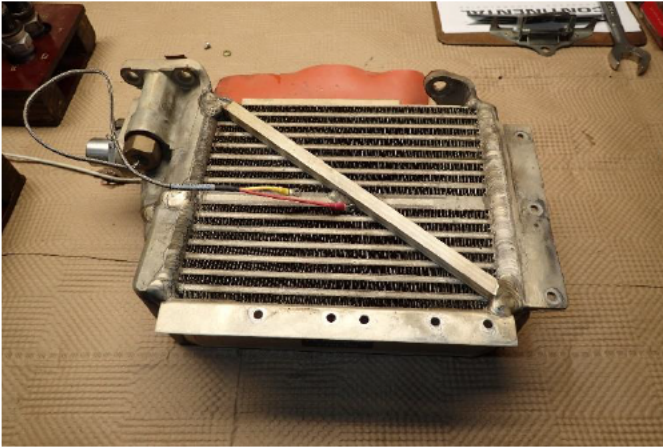
OIL COOLER

Manufacturer: Not observed

P/N: 635996

S/N: B04-50774-3

Condition: The oil cooler remained attached to its installation point and was undamaged. There were no signs of oil leaks observed around the oil cooler.



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CYLINDERS

CYLINDERS

P/N: SA52000-A1

S/N: See Photos

Condition:

The cylinders remained attached to their cylinder bays and there were no signs of impact damage. The cylinders were removed and visually inspected. The #1, #2, and the #4 displayed mechanical damage to the cylinder skirts. The cylinder bores and valve heads displayed normal operating and combustion signatures. The cylinder overhead components (valves, springs, and rocker arms) displayed normal operating and lubrication signatures.



#1 Cylinder (S/N: 29524)



#3 Cylinder (S/N 29528)

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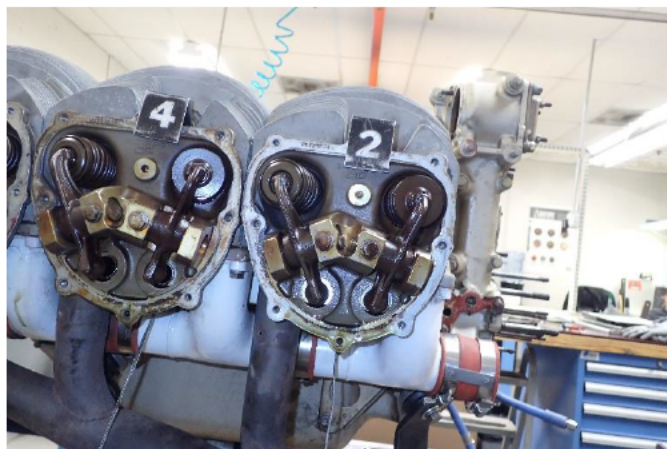
ENGINE S/N:

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#5 Cylinder (S/N: 29527)



#2 Cylinder (S/N: 29525)



#4 Cylinder (S/N: 29523)

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#6 Cylinder (S/N: 29542)

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ENGINE S/N:

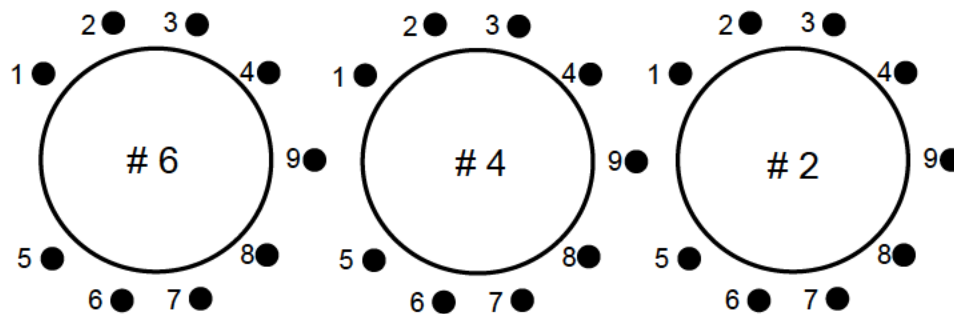
281784-R

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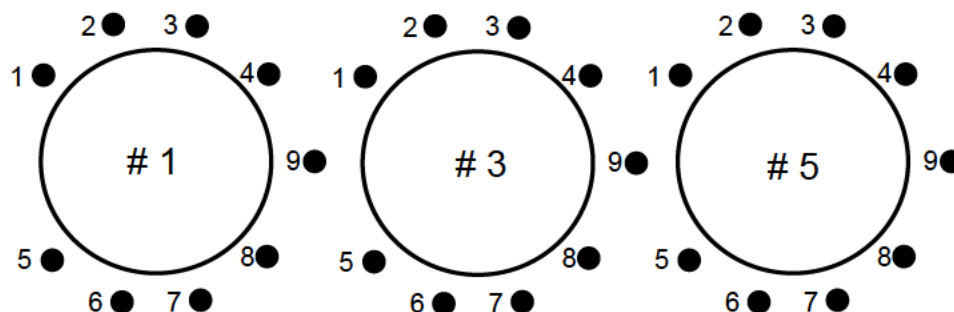
Cylinder Through-Bolt and Deck Stud Break-Away (Tightening/Loosening) Torque Measurements (in-lbs)

(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	870/694	673/593	686/624	597/545	807/728	651/581	667/ error	814/719	814/710
Cylinder #4	1050/892	766/713	692/651	667/605	907/766	734/649	708/676	635/562	640/457
Cylinder #6	1095/850	807/755	759/706	682/624	821/611	796/728	831/806	799/726	725/676



	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	1069/888	778/688	860/744	202/0	996/846	752/713	952/831	670/645	778/642
Cylinder # 3	688/587	682/589	922/816	691/634	849/754	769/710	794/726	781/701	974/677
Cylinder # 5	857/855	735/659	785/705	673/638	1154/1044	815/753	820/763	797/742	825/730



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VALVES AND GUIDES

Condition: The valve heads displayed normal operating and combustion signatures. The valve stems, guides, and springs displayed normal operating and lubrication signatures.

ROCKER ARMS AND SHAFTS

Condition: The rocker arms remained intact and were undamaged. The rocker arms displayed normal operating and lubrication signatures.



PISTONS

Piston P/N: 654857

Condition: All six pistons remained attached to their connecting rods. The #1 and the #2 pistons displayed mechanical damage and had broken piston rings. The #4 piston face displayed a semicircular impression consistent with a valve strike. The rest of the pistons displayed normal operating and combustion signatures. There were no signs of detonation or preignition observed.



#1 Piston

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#3 Piston



#5 Piston



#2 Piston

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#4 Piston



#6 Piston

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CRANKCASE ASSEMBLY

CRANKCASE

Casting
Number:

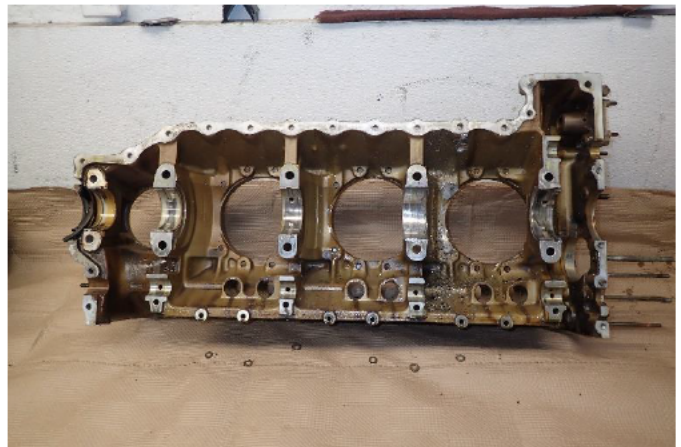
1-3-5: 646201

2-4-6: 646200

S/N: 4A460PL

Condition:

The crankcase remained mostly intact; there was a large crack observed on both crankcase halves on the top rear portion of the crankcase. The crankcase halves were split and the internal portions of the crankcase were examined. The #1 and the #2 bearings displayed bearing shift signatures with the #2 bearing displaying the most movement; the #2 bearing had been extruded from the bearing support. The bearing support mating surfaces for the #1, #2, #3, and the #4 displayed varying amounts of fretting with the #1 and the #2 mating surfaces displaying the most fretting. It was also observed that along the outer mating surfaces of the crankcase was material that was not consistent with approved sealant and there were no signs of a silk thread along the outer mating surfaces.



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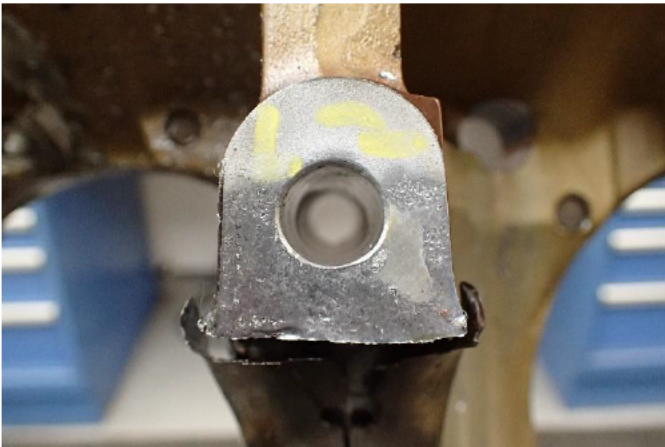
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Right Side #2 Bearing Support Mating Surfaces



Left Side #2 Bearing Support Mating Surfaces



Sealant found on crankcase mating surfaces

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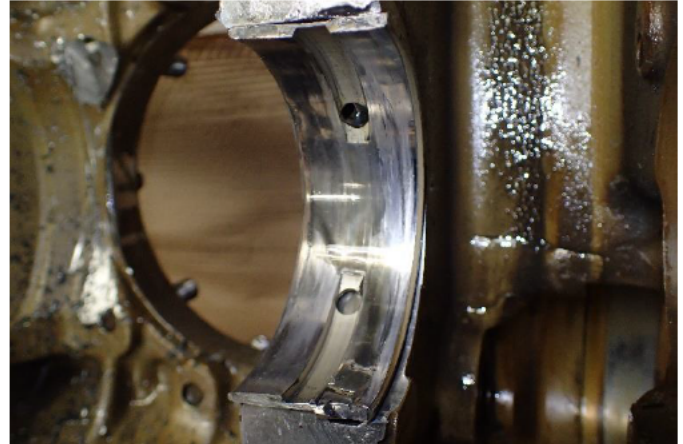
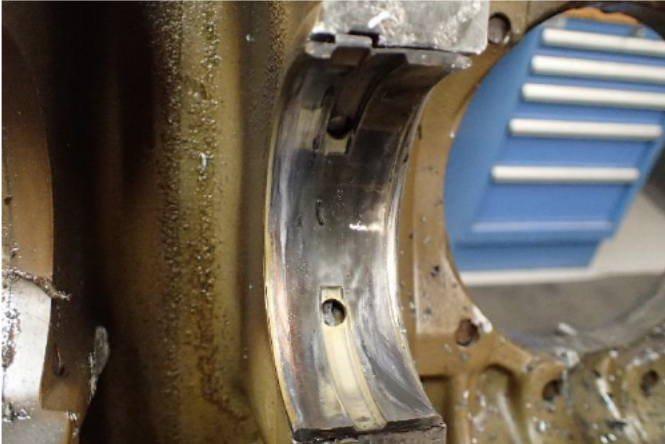
#1 MAIN BEARINGS

P/N: SA634503

Date Code: 10-03

Condition:

The bearing support mating surfaces displayed significant fretting. The bearing support displayed minor lock tab elongation and the bearing had slightly shifted. There were no signs of lubrication distress.



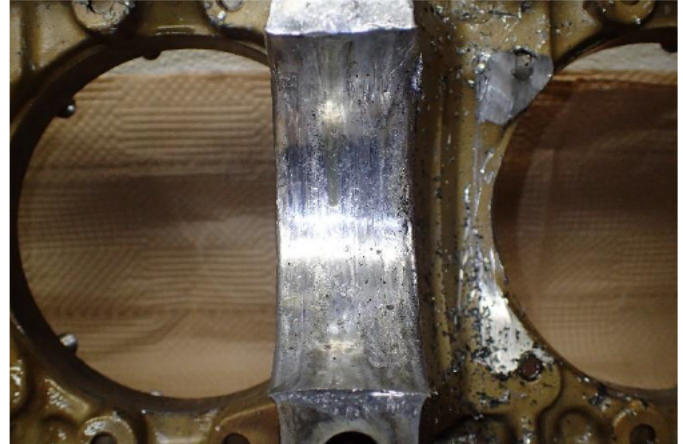
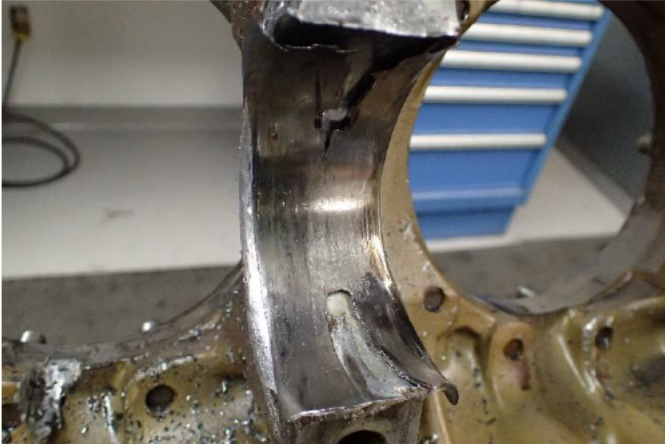
#2 MAIN BEARINGS

P/N: SA634503

Date Code: 10-03

Condition:

The bearing displayed significant bearing shift signatures and a large portion of the bearing had extruded from the bearing support. The bearing support mating surfaces displayed fretting and the lock tab had completely worn away.



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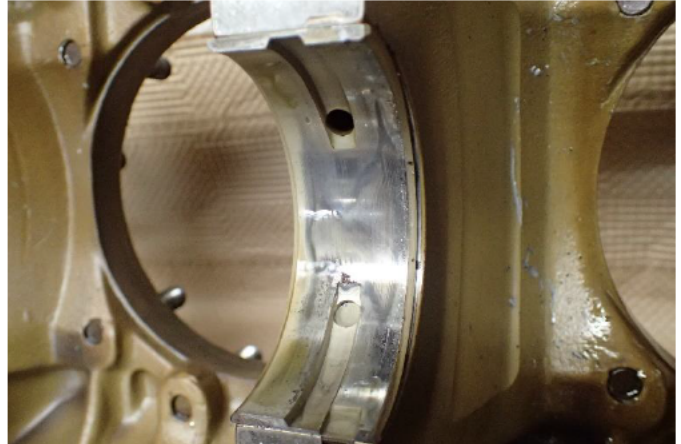
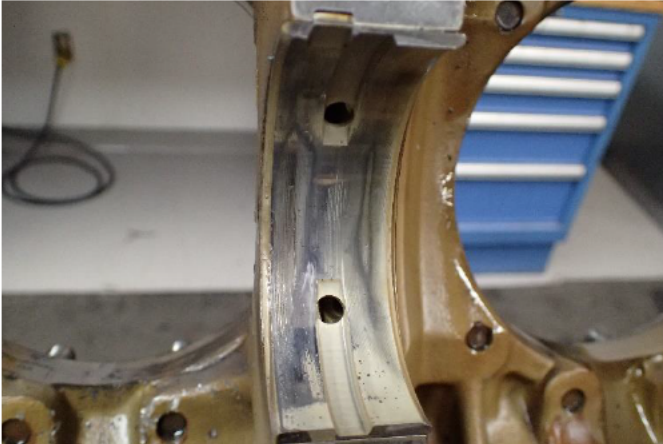
#3 MAIN BEARINGS

P/N: SA634503

Date Code: 10-03

Condition:

The bearing remained within the bearing support and displayed normal operating and lubrication signatures. The bearing support mating surfaces displayed minor fretting at the bottom mating surfaces.



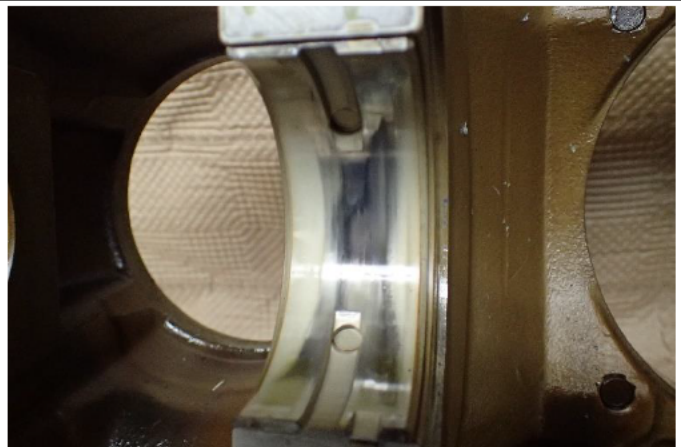
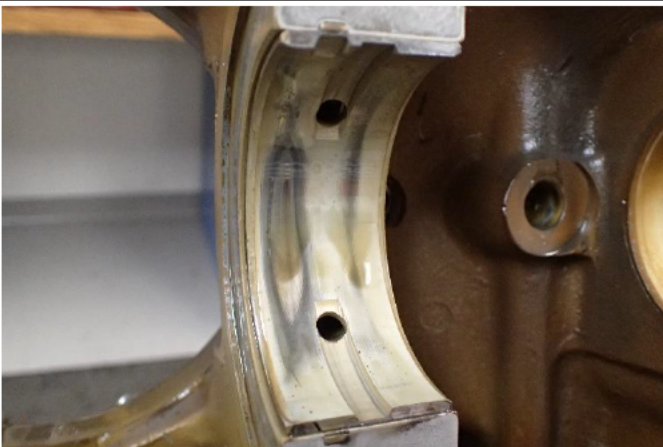
#4 MAIN BEARINGS

P/N: SA642720

Date Code: 9-03

Condition:

The bearing remained within the bearing support and displayed normal operating and lubrication signatures. The bearing support mating surfaces displayed minor fretting at the bottom mating surfaces.



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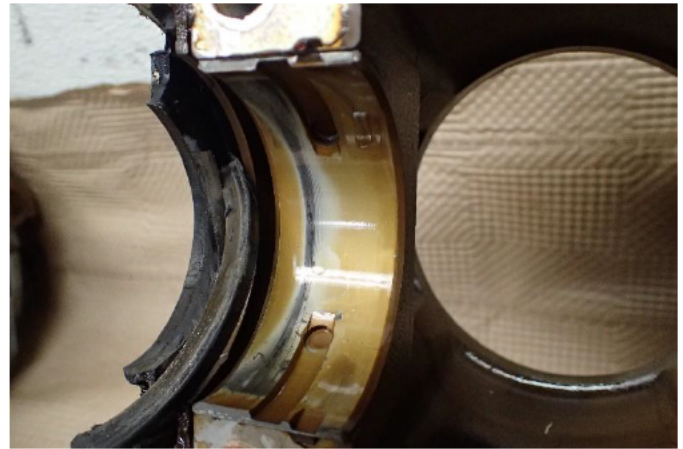
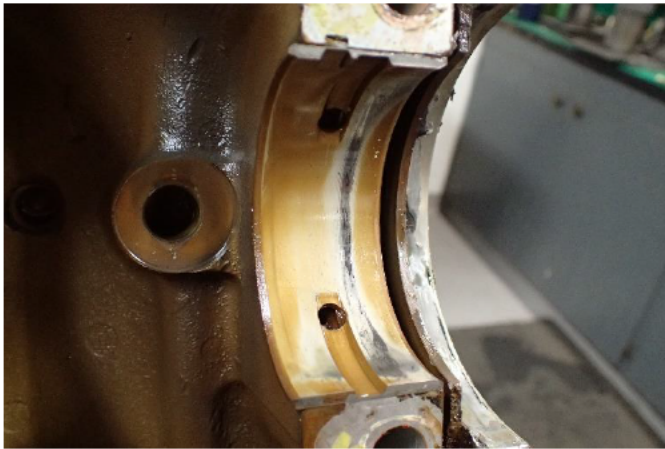
#5 MAIN BEARINGS

P/N: SA642720

Date Code: 9-03

Condition:

The bearing remained within the bearing support and displayed normal operating and lubrication signatures. There was no fretting observed at the bearing support mating surfaces.



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CRANKSHAFT ASSEMBLY

CRANKSHAFT

Forging Number: 649878

S/N: N02JA264

Heat code: Not
observed

Condition:

The crankshaft was found to be broken into two pieces; the fracture area occurred at the crankshaft cheek between the #2 main bearing journal and the #2 connecting rod journal. It was noted that the fracture location coincided with the location of the extruded #2 main bearing. The fracture surface displayed several fracture beach marks. The bearing #2 connecting rod bearing journal displayed lubrication distress signatures; the rest of the journals displayed normal operating and lubrication signatures. The crankshaft gear remained secured and one gear tooth had broken free.



ENGINE EXAMINATION REPORT

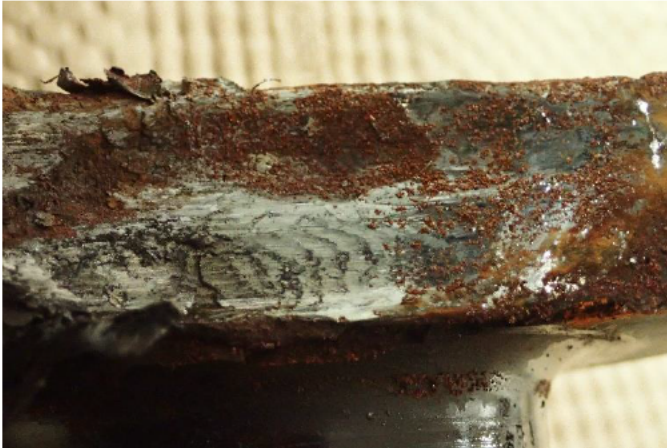
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Fracture Surface on Forward Portion of the Crankshaft

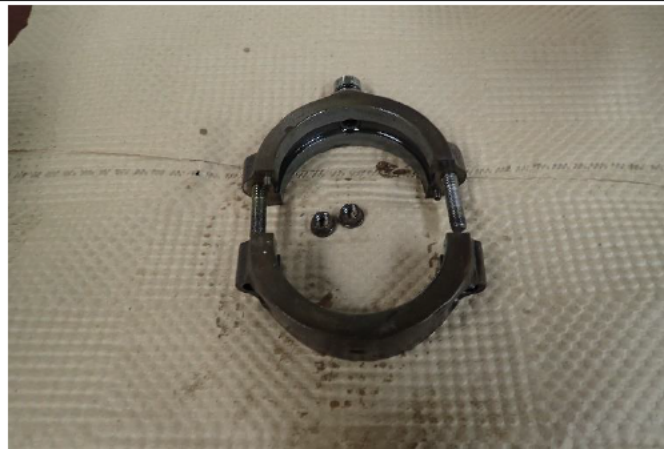


Fracture Surface on Aft Portion of the Crankshaft

TRANSFER COLLAR

Condition:

The transfer collar remained intact and was undamaged. The transfer collar displayed normal operating signatures.



COUNTER WEIGHTS

Condition:

The counterweights remained attached to their hangers, were undamaged, and were capable of normal movement on their hangers.



ENGINE EXAMINATION REPORT

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INTERNAL TIMING

Condition: Due to the damage to the crankshaft, the crankshaft to camshaft timing was unable to be verified.

CONNECTING RODS

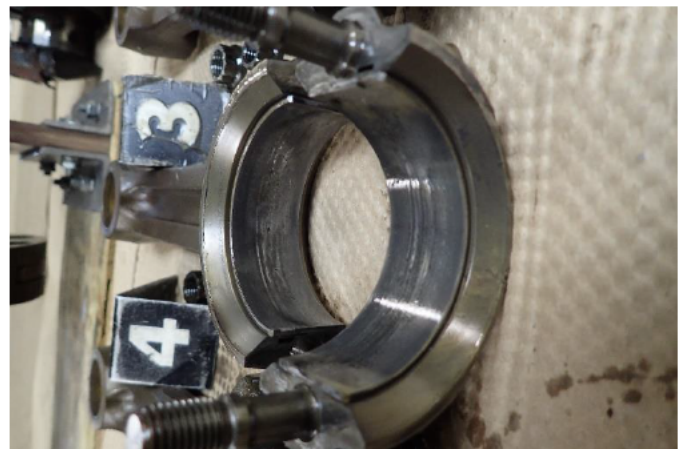
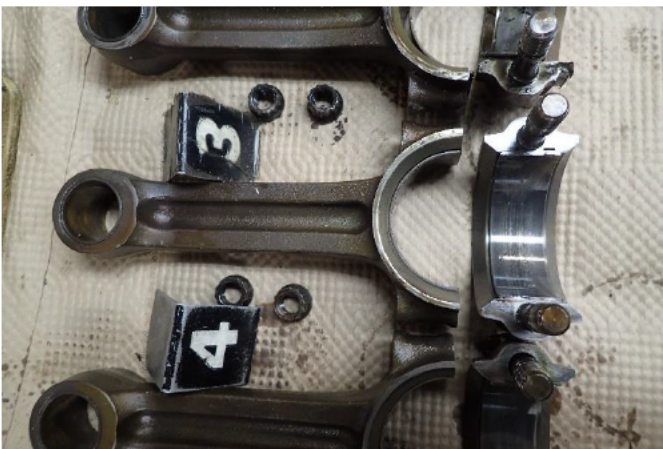
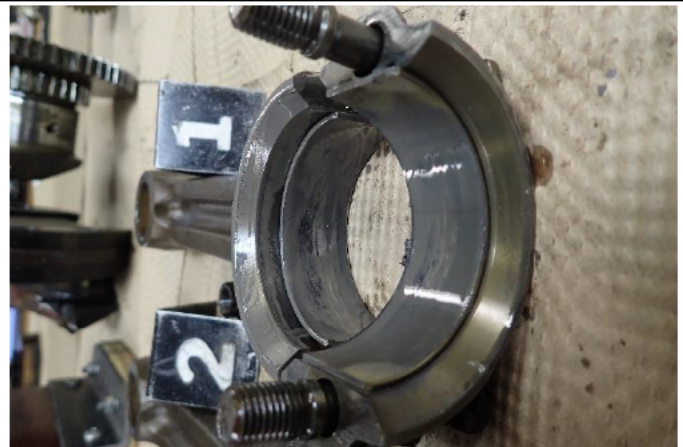
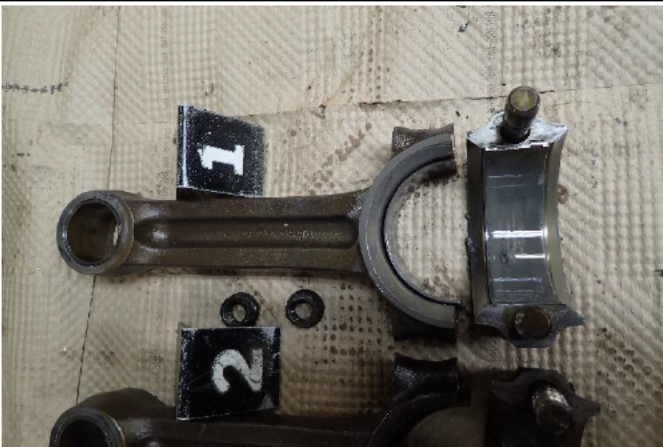
Forging Number: 646126-B Serial Number: N/A

Condition: All of the connecting rods remained attached to their journals and remained intact. The #2 connecting rod journal displayed thermal discoloration consistent with lubrication distress of the bearing. The rest of the connecting rods were undamaged.

CONNECTING ROD BEARINGS

P/N: SA642398 Date Code: 9-03

Condition: The #2 connecting rod bearing displayed smearing and damage consistent with lubrication distress and the #3 connecting rod bearing displayed minor lubrication distress signatures. The rest of the connecting rod bearing displayed normal operating and lubrication signatures.



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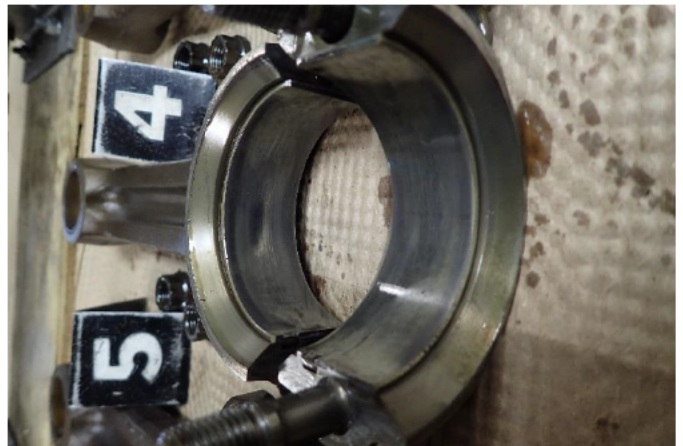
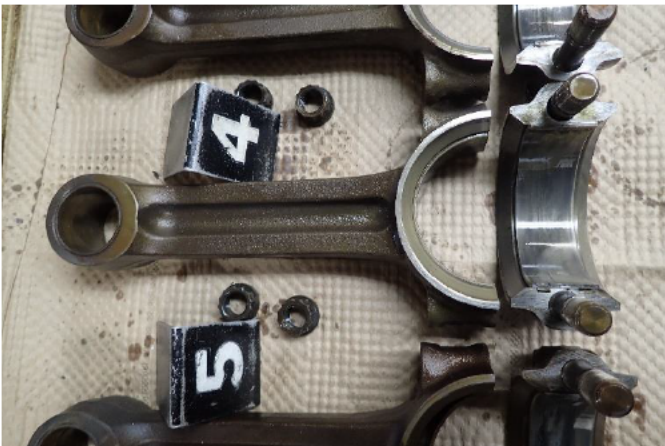
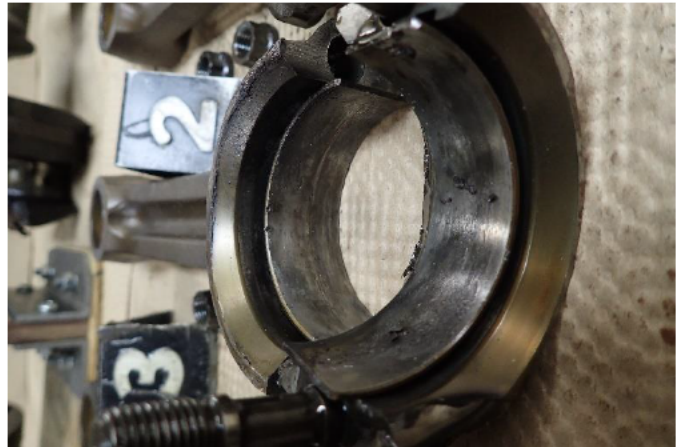
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CAMSHAFT

CAMSHAFT

P/N: 629726

S/N: Not observed

Condition:

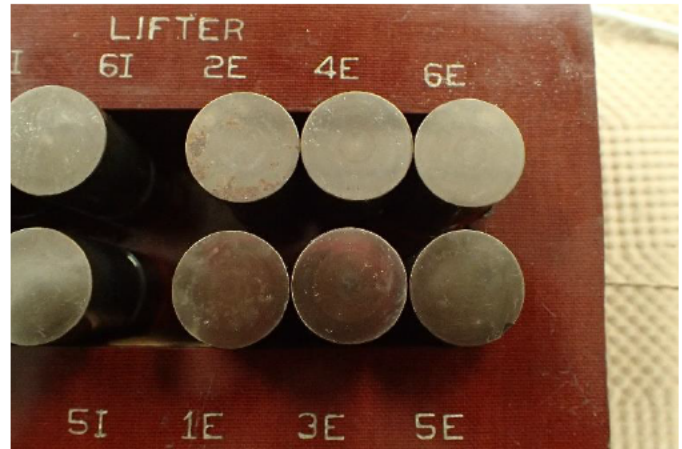
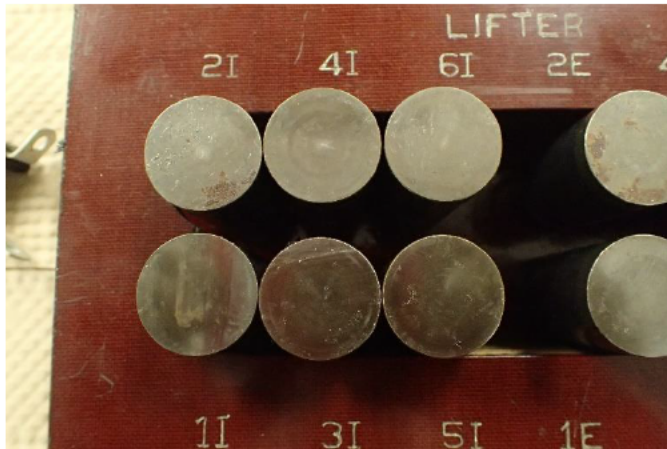
The camshaft remained intact and displayed mechanical damage; the camshaft was bent and there was a crack noted at one of the journals. The camshaft gear remained intact and was undamaged and the camshaft lobes displayed normal operating signatures.



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LIFTERS	#1	#3	#5	#2	#4	#6
INTAKE	SA-628488	SA-628488	SA-628488	SA-628488	SA-628488	SA-628488
EXHAUST	646277	646277	646277	646277	646277	646277
Condition:	The lifters remained intact and were undamaged. Some of the lifters displayed minor corrosion and spalling as well as normal operating and lubrication signatures.					



ACCESSORY GEARS

Condition: The magneto drive gears, governor drive gear, and the idler gear displayed normal operating signatures.



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Manufacturer: CMI

P/N: 646238-2

S/N: H-Q060105

Condition:

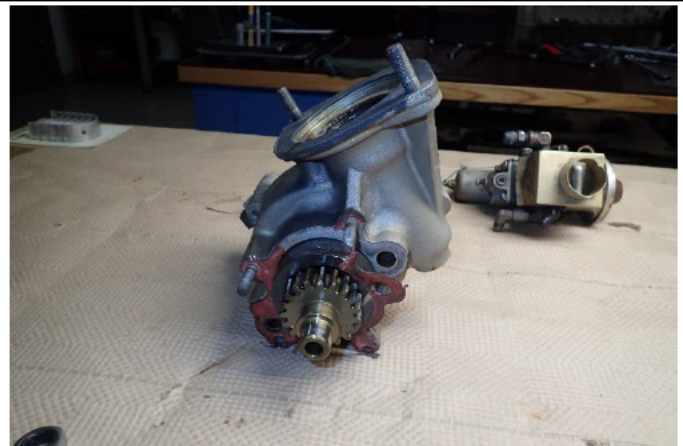
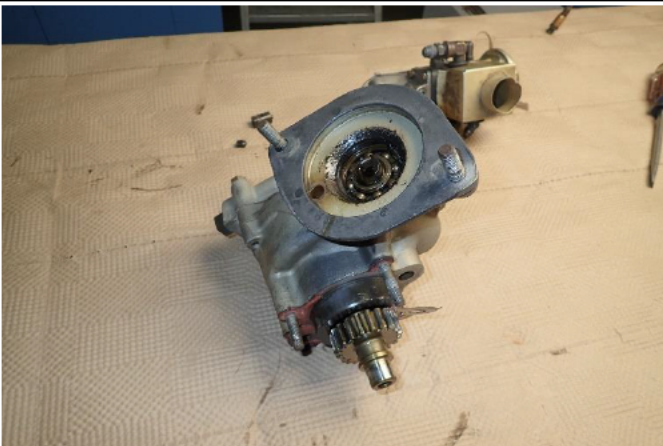
The starter remained intact and was undamaged. The starter was removed, and the driveshaft was noted to be capable of rotation.

**STARTER ADAPTER**

P/N: Not observed

Condition:

The starter adapter remained attached to its installation point and was undamaged. The adapter was removed and the adapter driveshafts were capable of normal movement.



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Manufacturer: Hartzell

P/N: ALX-9524

S/N: H-00710

Condition:

The alternator remained attached to its installation point and was undamaged. The alternator was removed, and the drive coupling was observed to remain intact and was capable of normal movement.

**PROPELLER GOVERNOR**

Manufacturer: Woodward

P/N: D210680

S/N: 1112306 AF

Condition:

The governor remained attached to its installation point and was undamaged. The governor was removed, and the driveshaft was noted to have remained intact and was capable of normal rotation. During rotation, it was observed that the governor was capable of pumping residual oil. The oil screen gasket was intact and there were no contaminants noted within the screen.

