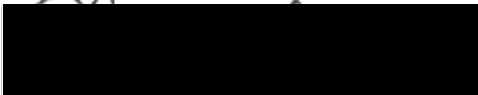




Continental Motors

ENGINE EXAMINATION REPORT

ENGINE MODEL	IO520BB10B
ENGINE SERIAL NUMBER	249335-R
AIRCRAFT MAKE & MODEL	F33A
AIRCRAFT SERIAL NUMBER	CE-1593
AIRCRAFT REGISTRATION	N3291X
FILE NUMBER	17-603

NAME	SIGNATURE	DATE
Phillip Grice		09/23/2019

ENGINE EXAMINATION REPORT**FILE NUMBER:**

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EXAMINATION		ACCIDENT DATA	
DATE	11/08/2018	NTSB ACCIDENT #	CEN118LA213
FACILITY	Mobile	NTSB INVESTIGATOR	Josh Lindberg
ADDRESS	[REDACTED] Mobile Alabama 36615	FAA INVESTIGATOR	Not Reported
		ACCIDENT DATE	06/07/2018
		ACCIDENT LOCATION	Uvalde Tx.

ENGINE INFORMATION

ENGINE POSITION	Single
TOTAL TIME	3215.8
TIME SOH	1031.6 STOH 111.9
TYPE & TIME SLI	Annual Unknown Tach was destroyed by Fire.
BUILD DATE	10/09/1985
IN SERVICE DATE	Not reported

Significant logbook information:

According to the aircraft's airworthiness the engine was originally an IO-520-BA (S/N: 249335-R) that was converted to an Ultimate Engines IO-550-B/UE (S/N: 24125) on 09/21/2004. The conversion was completed per STC SE9979SC and was installed in accordance with STC SA5223NM. On 11/07/2004 the engine was modified with an Engine Technologies, Inc. turbo normalizing system in accordance with STC SE5222NM.

The last annual was performed on 06/05/2018 at a tachometer time of 2126.3. At that time the engine had a total time of 3215.8, TSMOH was 1031.6, and time since a top was 111.9. The top was performed on 06/09/2014 at a tachometer time of 2014.3 and all six cylinders were replaced with 6 new continental cylinder assemblies. It was noted that all the rocker box covers were Millennium box covers; however, there were no logbook entries for replacing the rocker box covers.

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PAGE 3 of 40**Report Summary:**

Search Code(s):

15-12-40

The engine was received and placed on a teardown stand for disassembly. The engine was thermally damaged from the post-crash fire. The left magneto was broken from its mounting on the engine. There was a hole in the crankcase above the number two cylinder. The number two connecting rod was separated from the crankshaft. the remainder of the number two connecting rod was still attached to the piston pin and found in the number two cylinder. Disassembly of the engine revealed the number two connecting rod suffered an oil starvation event and became detached from the crankshaft. Number three and four connecting rods suffered heat damage from loss of lubrication. All the oil passages in the crankshaft and the crankcase were checked and found to be clear of any blockage. The number two rod journal was heat damaged and the oil passage was melted/ smeared closed from the excessive heat. The remainder of the engine excluding the mechanical damage from the internal engine components and the post-crash fire exhibited normal operating signatures. Numerus oil lines connected to the turbo normalizing system were either not returned or return disconnected. No source could be determined for the loss of oil that contributed to the oil starvation event.

Disposition of engine following exam:

Engine was returned to Air Salvage of Dallas 1361 Ferris Road Lancaster, Tx. 75146. On CMI Shipper AD01104 11/12/2018.

INSPECTION WITNESSES

NAME	Phillip Grice	NAME	Randy Bryant
ADDRESS	Mobile, Alabama	ADDRESS	Mobile, Alabama
ORGANIZATION	Continental Motors	ORGANIZATION	Continental Motors
PHONE	██████████	PHONE	██████████
NAME	Lisa Jersild	NAME	Pam Sullivan
ADDRESS	Mobile, Alabama	ADDRESS	Chicago
ORGANIZATION	Continental Motors	ORGANIZATION	NTSB
PHONE	██████████	PHONE	██████████

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EXTERNAL INSPECTION OF ENGINE



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AIRFRAME COMPONENTS RETURNED WITH ENGINE

Cooling baffles, exhaust system, Vacuum pump, Propeller governor.

ENGINE TEARDOWN AND COMPONENT EXAMINATION

IGNITION SYSTEM

**MAGNETO-TO-ENGINE
TIMING**

Specification: 22° BTDC

L/H Magneto: °

R/H Magneto: °

Engine would not rotate unable to check magneto timing.

**LEFT
MAGNETO**

Manufacturer: CMI

P/N: 10-349350-4

S/N: A221376

Condition:

The left Magneto was thermally damaged and detached from its mounting pad.



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RIGHT MAGNETO

Manufacturer: Not legible

P/N: N/L

S/N: N/L

Condition:

The right magneto was thermally damaged.



IGNITION HARNESS

Manufacturer: Not legible

P/N: N/L

S/N: N/L

Condition:

Exhibited thermal damage from the post-crash fire.



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PAGE 8 of 40**SPARK PLUGS**

Manufacturer: Champion

P/N: RHB32E

Condition:

The spark plugs exhibited normal operating signatures.



FUEL SYSTEM

Thermal damage from the post-crash fire prevented testing of the fuel system components

FUEL PUMP

Manufacturer: Not Legible

P/N: 632818-271

S/N: 190

Condition:

The fuel pump was thermally damaged and would not rotate. The drive coupling was intact.



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THROTTLE BODY METERING UNIT

Manufacturer: Not legible

P/N: FT-B85/1442

S/N: H199206A

Condition:

The throttle body had mechanical and thermal damage.



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FUEL MANIFOLD VALVE

Manufacturer: TCM

P/N: 646508-14A1P

S/N: C03KA263R

Condition: Exhibited thermal damage to the body lines and nozzles.



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LUBRICATION SYSTEM

OIL SUMP

Condition:

Exhibited thermal damage and contained fragments of the internal engine components



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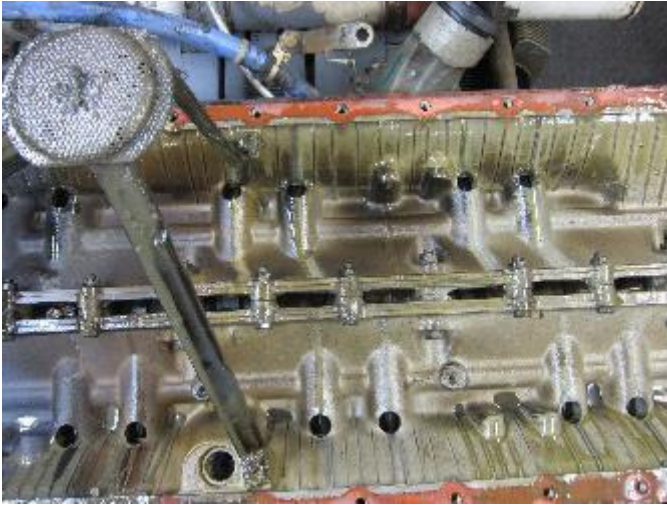
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OIL PICK-UP TUBE & SCREEN

Condition:

The oil pick-up tube was undamaged and contained small fragments of the internal engine components.



OIL PUMP

Condition:

Was intact and exhibited thermal damage. The oil pump drive was intact.



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OIL FILTER

Manufacturer: N/A

P/N: N/A

Condition:

Was not returned with this exhibit.

OIL COOLER

Manufacturer: Drake Air

P/N: 635996

S/N: 16002
W.O. 410625

Condition:

Exhibited thermal damage.



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CYLINDERS

CYLINDER #1	P/N: 658175A1	S/N: AC14DA612	Head Date: 4-14
Work Orders:	N/A		
Condition	The cylinder exhibited normal operating signatures. Externally thermal damage was present.		



CYLINDER #3	P/N: 658175A1	S/N: AC14DA614	Head Date: 4-14
Work Orders:	N/A		
Condition:	The cylinder exhibited normal operating signatures. Externally thermal damage was present.		



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CYLINDER #5	P/N: 658175A1	S/N: AC14DA618	Head Date: 4-14
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Work Orders:	N/A
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Condition:	The cylinder exhibited normal operating signatures. Externally thermal damage was present.
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CYLINDER #2	P/N: 658175A1	S/N: AC14DA935	Head Date: 4-14
--------------------	---------------	----------------	-----------------

Work Orders:	N/A
--------------	-----

Condition:	The cylinder had impact damage from the connecting rod that released from the crankshaft. Externally thermal damage was present.
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CYLINDER #4	P/N: 658175A1	S/N: AC14DA539	Head Date: 4-14
--------------------	---------------	----------------	-----------------

Work Orders:	N/A
--------------	-----

Condition:	The cylinder exhibited normal operating signatures. Externally thermal damage was present.
------------	--



CYLINDER #6	P/N: 658175A1	S/N: AC14DA637	Head Date: 4-14
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Work Orders:	N/A
--------------	-----

Condition:	The cylinder exhibited normal operating signatures. Externally thermal damage was present.
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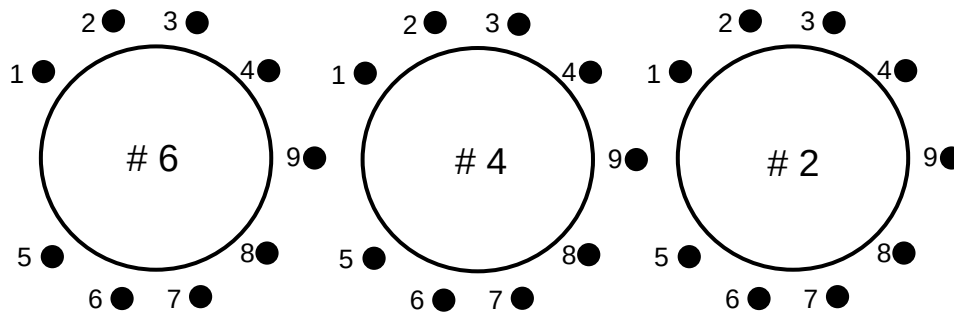
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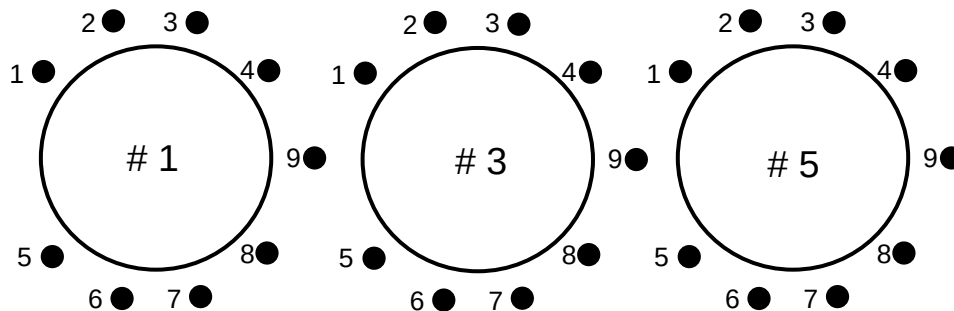
Cylinder Through-Bolt and Deck Stud Break-Away (Tightening/Loosening) Torque Measurements (in-lbs.)

(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	878/665	Crankcase fractured	Crankcase fractured	163/0	588/725	612/514	493/372	348/296	388/392
Cylinder #4	998/787	697/566	686/581	648/573	965/839	626/547	673/586	659/580	757/654
Cylinder #6	1174/904	757/616	795/638	802/692	1118/907	820/661	693/624	750/586	575/506



	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	Loose	361/302	525/454	Loose	Nut Cracked backed off	393/314	459/388	560/483	756/669
Cylinder #3	962/784	619/526	599/449	598/510	975/894	613/519	658/547	593/525	673/586
Cylinder #5	935/770	632/531	728/605	676/581	1067/867	744/529	705/531	547/461	714/613



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#1 PISTON, RINGS AND PIN

Piston P/N: 654857

Condition:

Piston exhibited normal operating signatures. The piston had some mechanical damage.



#3 PISTON, RINGS AND PIN

Piston P/N: 654857

Condition:

Piston exhibited normal operating signatures. The piston had some mechanical damage.



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#5 PISTON, RINGS AND PIN

Piston P/N: 654857

Condition:

Piston exhibited normal operating signatures. The piston had some mechanical damage.



#2 PISTON, RINGS AND PIN

Piston P/N: 654857

Condition:

The piston remained in the cylinder with the connecting rod attached. The piston exhibited mechanical damage.



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#4 PISTON, RINGS AND PIN

Piston P/N: 654857

Condition:

Piston exhibited normal operating signatures. The piston had some mechanical damage.

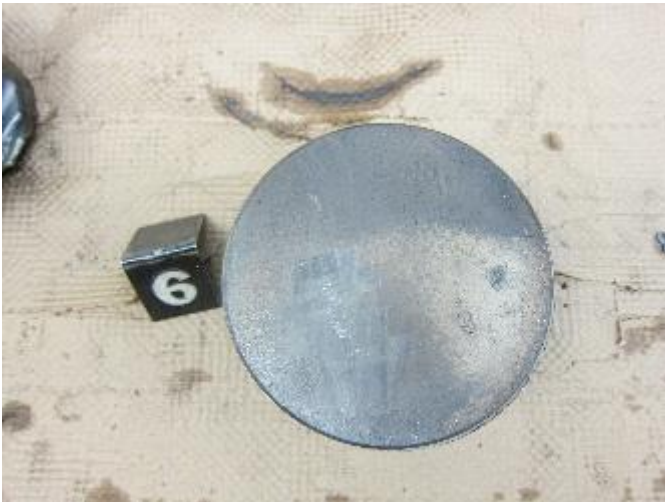


#6 PISTON, RINGS AND PIN

Piston P/N: 654857

Condition:

Piston exhibited normal operating signatures. The piston had some mechanical damage.



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CRANKCASE ASSEMBLY

CRANKCASE

Casting
Number:

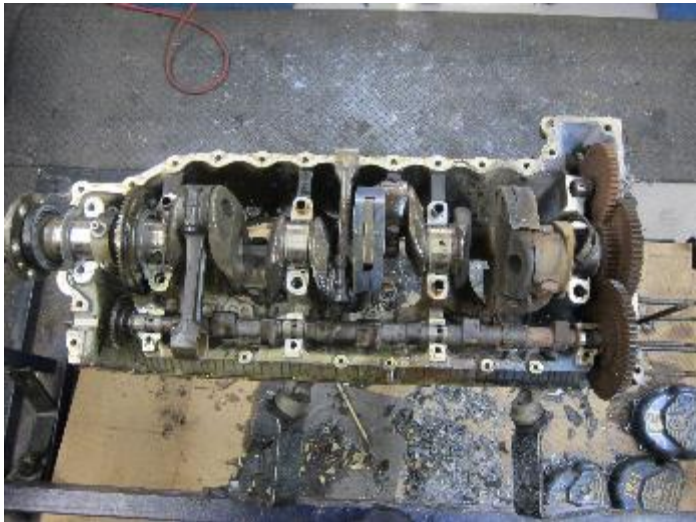
1-3-5: 646201

2-4-6: 646200

S/N: C049103RPL

Condition:

The crank case had thermal damage from the post-crash fire. There was a hole above the number two cylinder from the released connecting rod. The bearing lock slots exhibited normal operating signatures. Other parts of the crankcase exhibited mechanical damage from the internal engine components.



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#1 MAIN BEARINGS

P/N: SA634503

Date Code: 10-03

Condition: The bearings exhibited thermal damage from the post-crash fire. The lock slots were intact and undamaged.



#2 MAIN BEARINGS

P/N: SA634503

Date Code: 10-03

Condition: The bearings exhibited thermal damage from the post-crash fire. The lock slots were intact and undamaged.



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#3 MAIN BEARINGS

P/N: SA634503

Date Code: 10-03

Condition:

The bearings exhibited normal operating. The lock slots were intact and undamaged.



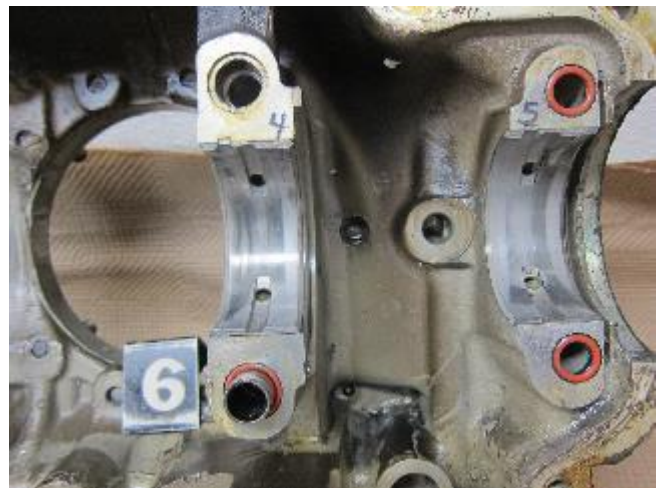
#4 & 5 MAIN BEARINGS

P/N: SA642720

Date Code: 6-04

Condition:

The bearings exhibited normal operating. The lock slots were intact and undamaged.



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CRANKSHAFT ASSEMBLY

CRANKSHAFT

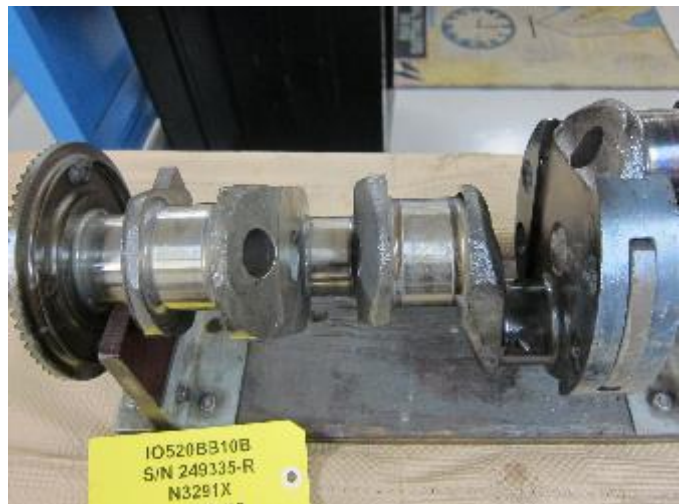
Forging Number: 649878

S/N: N02IA179

Heat code:

Condition:

The crankshaft exhibited thermal damage to the rear of the shaft and the gears. The number two rod journal was thermally damaged, and the oil passage melted and smeared over. The number three and four journal exhibited heat signatures consistent with lubrication distress. Except for the number two journal being melted closed, all oil passages in the crankshaft were open to allow oil flow.



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TRANSFER COLLAR

Condition: Exhibited normal operating signatures



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#1 CONNECTING ROD

P/N: N/A

Forging or Serial Number: 646126F A17

Condition: Exhibited thermal and mechanical damage

#1 CONNECTING ROD BEARING

P/N: P/N: SA642398

Condition: The bearing exhibited lubrication distress.



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#3 CONNECTING ROD

P/N: N/A

Forging or Serial Number: 646126F A17

Condition:

Exhibited thermal damage and mechanical damage to the cap.

#3 CONNECTING ROD BEARING

P/N: SA642398

Condition:

The bearing exhibited lubrication distress and wear down to the copper layer.



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#5 CONNECTING ROD

P/N: N/A

Forging or Serial Number: 646126F A17

Condition: Exhibited normal operating signatures. Slight mechanical damage was noted on the cap.

#5 CONNECTING ROD BEARING

P/N: SA642398

Condition: Exhibited normal operating signatures.



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#2 CONNECTING ROD

P/N: N/A

Forging or Serial Number: 646126F A17

Condition:

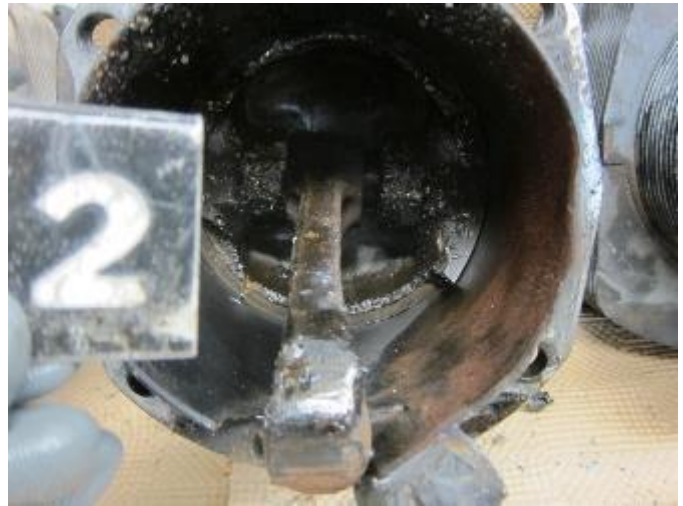
The large end of the rod was fragmented and melted away. Portions of the bearing were found in the oil sump.

#2 CONNECTING ROD BEARING

P/N: SA642398

Condition:

The number two rod bearing was fragmented and melted away from oil starvation.



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#4 CONNECTING ROD

P/N: N/A

Forging or Serial Number: 646126F A17

Condition: Exhibited normal operating signatures. The connecting rod had mechanical damage to the cap.

#4 CONNECTING ROD BEARING

P/N: SA642398

Condition: The connecting rod bearing exhibited thermal damage, wear thru the Babbitt layer.



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#6 CONNECTING ROD

P/N: N/A

Forging or Serial Number: 646126F A17

Condition: Exhibited normal operating signatures. The connecting rod had mechanical damage to the cap.

#6 CONNECTING ROD BEARING

P/N: SA642398

Condition: Exhibited normal operating signatures.



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CAMSHAFT

CAMSHAFT

P/N: RAM

S/N: 0583, 0310311C, 1058-1A

Condition:

The camshaft exhibited thermal and mechanical damage and was intact.



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LIFTERS	#1	#3	#5	#2	#4	#6
INTAKE	N/L	SA628488	SA628488	N/L	SA628488	SA628488
EXHAUST	N/L	N/L	SA628488	N/L	SA628488	SA628488
Condition:	The lifters exhibited thermal damage, some were stuck in the crankcase. All lifters were narrow band lifters normally only used on the intake side of the engine.					



ACCESSORY GEARS

Condition: The gears exhibited thermal damage and other wise intact and undamaged.



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ACCESSORIES

STARTER

Manufacturer: TCM

P/N: 646275

S/N: W-079024

Condition:

The starter exhibited thermal damage.



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STARTER ADAPTER

P/N: Not legible

Condition:

The starter adapter was thermally damaged, with impact signatures but otherwise intact.



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ALT.

Manufacturer: TCM

P/N: 649304R

S/N: L09905. OR

Condition:

The alternator was undamaged and had slight thermal signatures. The drive was intact, and rotation was possible.



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VACUUM PUMP

Manufacturer: Not legible

P/N: Not legible

S/N: Not legible

Condition:

The vacuum pump was thermally damaged, and the drive coupling melted from the post-crash fire.



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PROPELLER GOVERNOR

Manufacturer: McCauley

P/N: C290D3J/T23

S/N: NO. 802424

Condition:

Exhibited normal operating signatures.



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TURBO

Manufacturer: TCM

P/N: 632729-13

S/N: HG0193

Condition:

The turbo charger exhibited thermal damaged from the post-crash fire.



TURBO CONTROLLER

Manufacturer:

P/N:

S/N:

Condition:

Not returned

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WASTEGATE

Manufacturer: Kelly

P/N: C165006-0105

S/N: 470908-9011

Condition:

The waste gate exhibited thermal damage from the post-crash fire.



OVERBOOST VALVE

Manufacturer: Kelly

P/N: C482002-0101

S/N: VHR0814

Condition:

The over boost valve exhibited thermal damage from the post-crash fire.

