

Continental TSIO-520-M(7)
ENGINE EXAM: WPR21LA059 (N878AH)
DATE: 03MAR2021

LOCATION: SouthWest Aircraft Recovery & Transport

AFFILIATION/ATTENDEES:

Corona Engines: Ben O'con

FAA: Ricardo Hernandez, Jared Tapsfield

SouthWest Aircraft Recovery & Transport: Jack Vanderman

A/C MK/MDL	Cessna TU206G
Accident Location	Twentynine Palms Airport (KTNP)
Accident Date	21NOV2020

ENGINE Make	Continental
Model	TSIO-520-M(7)
Serial No.	291532-R
Engine Time	At time of Accident HOBBS: <u>4,558.8</u> TACH: <u>2,408.4</u> Last Inspection ☒ Ann ☐ 100-hr ☐ Other Date: 01NOV2020 TSMOH: 1,274.1 ESTIMATED TT: 2,180.1

AIFRAME EXAM

Position of fuel selector valve/firewall shutoff: **OFF**

Are fuel caps in place? L ☒ YES ☐ NO R ☒ YES ☐ NO

Vented Caps: L ☒ YES ☐ NO R ☒ YES ☐ N Vents Clear ☒ YES ☐ NO

Are tanks ruptured? L ☒ NO ☐ YES

R ☒ NO ☐ YES

Any fuel in the wing/main tanks L/R? ☒ NO ☐ YES

Smell Like ☒ Avgas ☐ Auto

If none, determine when last refueling occurred.

How much at departure? 47g

FUEL DRAINS

L-Wing ☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS

Smell Like ☒ Avgas ☐ Auto

R-Wing ☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS
Smell Like ☒ Avgas ☐ Auto
Belly ☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS
Smell Like ☒ Avgas ☐ Auto

FUEL SCREENS/Gascolator

Color: Blue Quantity: <1oz Smell Like ☒ Avgas ☐ Auto
☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS
Right Fuel Reservoir: ☒ Clear ☐ Blocked
Left Fuel Reservoir: ☒ Clear ☐ Blocked

Throttle ☐ Stuck ☒ Moves Freely S2S ☐ Binds ☐ FR ☐ SEPARATED
POSITION ☒ OPEN ☐ FULL ☐ $\frac{3}{4}$ ☐ $\frac{1}{2}$ ☐ $\frac{1}{4}$ ☐ < $\frac{1}{4}$ ☐ CLOSED

MIXTURE ☐ Stuck ☒ Moves Freely S2S ☐ Binds ☐ FR ☐ SEPARATED
POSITION ☐ OPEN ☐ FULL ☐ $\frac{3}{4}$ ☐ $\frac{1}{2}$ ☐ $\frac{1}{4}$ ☐ < $\frac{1}{4}$ ☒ CLOSED/OFF

RUNNABLE? ☐ YES ☒ NO

-Prop damage prevented engine test running. Borescope of cylinders indicated #2 exhaust valve head failure. #5 piston, cylinder head, top and bottom spark plug damage.



Figure 1: View of propeller damage which occurred upon impact with terrain

ENGINE EXAM

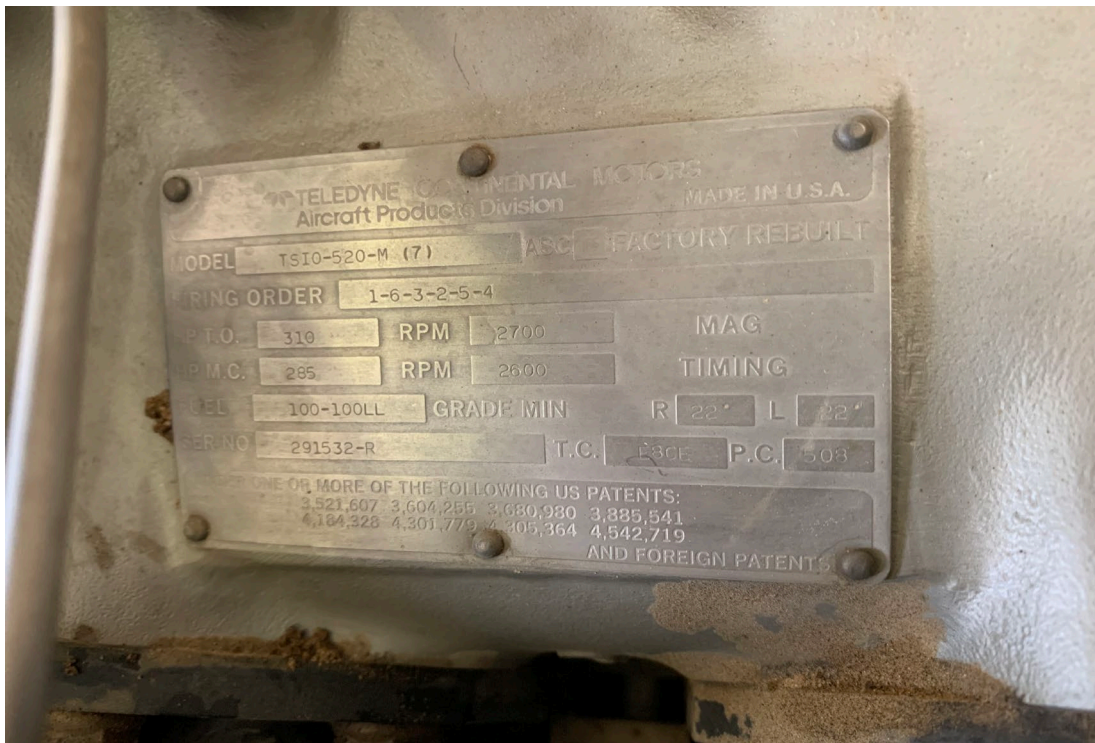


Figure 2: View of N878AH Engine Data Plate

- All push rods & rocker arms were unremarkable.
- All valve guides were worn.
- All exhaust valves exhibited tulip-ing and/or extreme heat signatures about the valve head.
- Timing was within 2° at TOC

SPARK PLUGS

- No. 1 and No. 5 bottom spark plugs were torqued in excess of 25-inch-lbs.
- No. 6 spark plug (top) ignition cable wires exposed at ferrule.

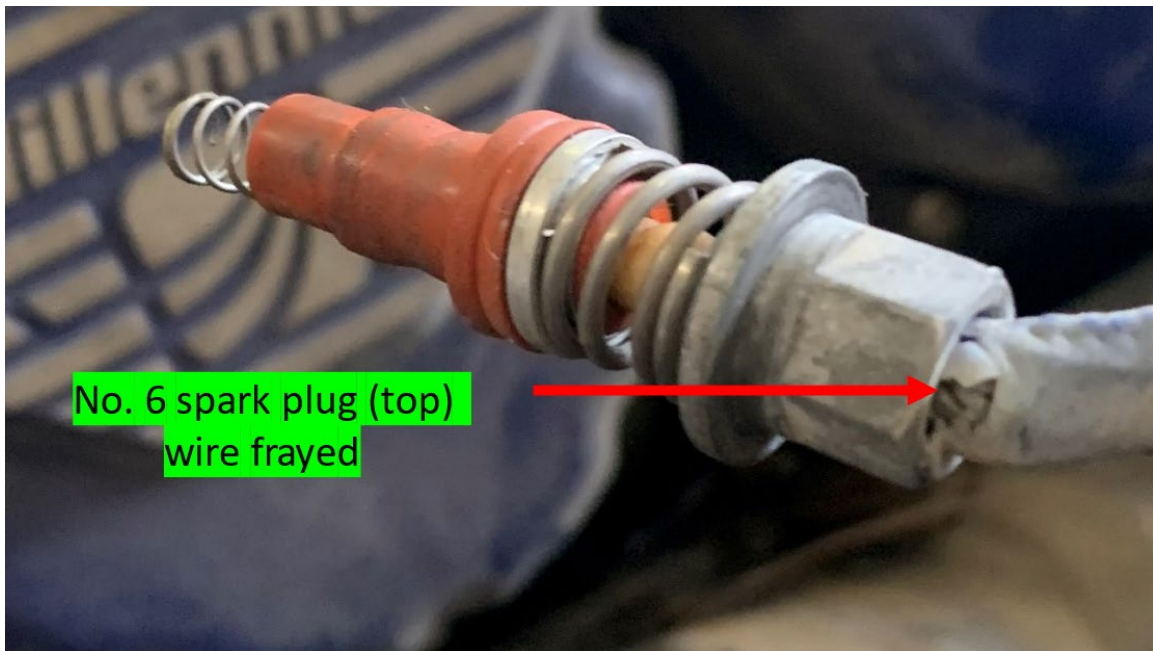


Figure 3: View of frayed spark plug wire (No. 6 top plug)

GAPS SIMILAR ☐ All yes ☒ NO __ No. 1 gap is wide, No. 2 is wide, No. 5 top and bottom missing electrodes and points, No. 6 wide

MECHANICALLY DAMAGED ☐ None ☒ 1 ☒ 2 ☐ 3 ☐ 4 ☒ 5 ☒ 6

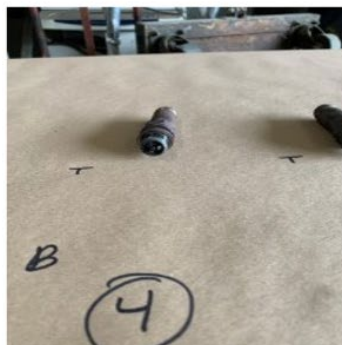
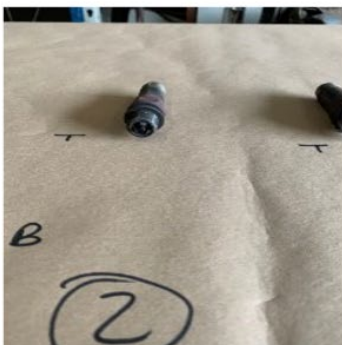
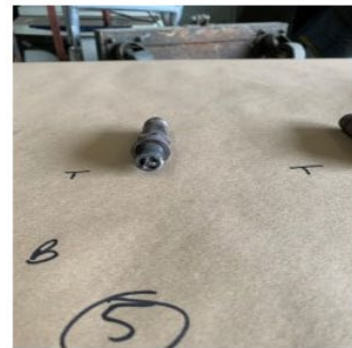
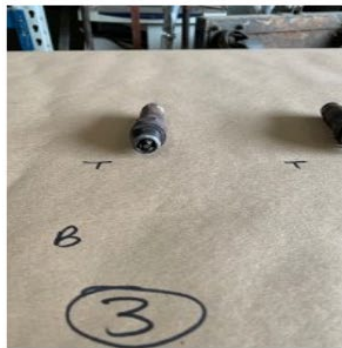
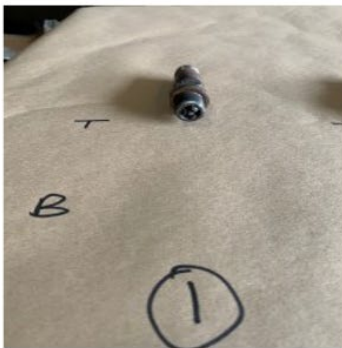


Figure 4: View of top spark plugs from cylinders 1-6

- Valve Covers Removed: Unremarkable, no discoloration
- Is rocker discolored from heat ☒ NO ☐ YES
- Visually inspected inside of cylinders using borescope
- Evidence of stuck valve ☒ None ☐ YES

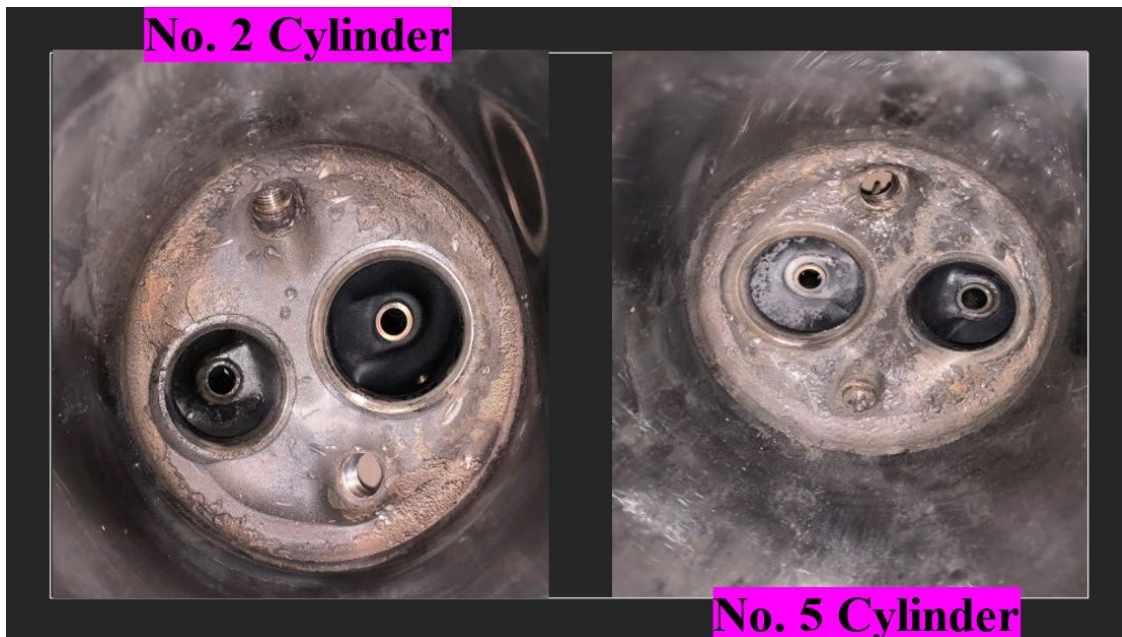


Figure 5: View of damage to No. 2 and No. 5 Cylinders

☐ NONE ☒ YES _Damage to No. 2 and 5. piston heads from foreign object contact. No. 2 and No. 5 cylinders were unremarkable



Figure 6: View of damage to No. 2 and No. 5 Pistons

OIL FILTERS AND OIL SCREENS

☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS

FUEL FOUND ☐ UNK ☒ YES ☐ NO

Color: Blue Quantity: >2 oz. Smell Like ☒ Avgas ☐ Auto

Fuel found in fuel valve.

Auxiliary Fuel Pump

Function Check -No anomalies

ELECTRIC FUEL PUMP

Function check -Vaness are intact -No anomalies

INDUCTION SYSTEM / AIR FILTER / COWL FLAPS

Air filter clean.

Cowl flaps damaged.

Induction system clear yet oily.

EXHAUST SYSTEM/MUFFLER

Exhaust system crack turbo side below no. 5 cylinder.

Heat shroud normal.

Rotate engine 360 degrees ☒ Yes ☐ No ☐ Unable

Listen for metallic sounds? ☒ YES ☒ NONE

THE ENGINE WAS: ☐ REMOVED, ☐ ON A STAND ☒ REMAINED ON A/C

☒ MANUALLY ROTATED ☒ With Prop ☐ Tool in accessory ☐ Wrench on crank

☒ ALL VALVES MOVED IN SEQUENCE AND APPROXIMATELY ☒ SAME AMOUNT OF LIFT

☒ THE VACUUM PUMP ☒ ACCESSORY GEARS TURNED

☒ THUMB COMPRESSION OBTAINED ON CYLINDERS 1, 3, 4, 6 IN FIRING ORDER

☒ THUMB COMPRESSION NOT OBTAINED ON CYL No. 2 and 5

☒ BORESCOPE INSPECTION REVEALED ☒ MECHANICAL DEFORMATION ON THE

☒ VALVES, ☐ CYLINDER WALLS, OR ☒ INTERNAL CYLINDER HEAD OF THE No. 2 AND No. 5.

IGNITION HARNESS

Shower of Sparks ☒ Yes ☐ No

LEFT MAG

☒ SECURE ☐ SEPARATED

Impulse Coupling ☒ Yes ☐ No PRODUCED SPARK AT ☒ ALL POSTS WHEN TURNED BY HAND

Correct firing order. ☒ YES ☐ NO

RIGHT MAG

☒ SECURE ☐ SEPARATED

Impulse Coupling ☒ Yes ☐ No PRODUCED SPARK AT ☒ ALL POSTS WHEN TURNED BY HAND.

Correct firing order. ☒ YES ☐ NO

MAG TIMING: LEFT= 21° MAG TIMING: RIGHT= 21°



Figure 7: The No. 2 injector nozzle contained a greenish-yellowish foreign substance

Fuel Found ☒ Yes ☐ No
Color-Blue Smell Like ☒ Avgas ☐ Auto
☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS

LINES ☒ CLEAR ☐ BLOCKED

FUEL MANIFOLD VALVE DIAPHRAM ☒ INTACT ☐ RUPTURED ☒
CONTAINS FUEL

Color: Blue Quantity: Smell Like ☐ Avgas ☐ Auto

SCREEN ☐ NI ☒ Intact ☐ Damaged
☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS

LINES ☒ INTACT ☐ RUPTURED

NOZZLES ☒ OPEN ☐ PLUGGED ☐ PARTIALLY OPEN

PN: 1,2,3,4,5,6= 14C

LUBRICATION

OIL SUMP -Didn't open

☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS

OIL PUMP ☒ INTACT ☐ DAMAGED ☐ SCORED ☐ Not scored ☐ OP ☐ INOP
Continental -Crankshaft engages oil pump drive ☐ NA ☒ YES ☐ NO

OIL FILTER

☒ CLEAN ☐ CONTAMINATED WITH ☐ WATER ☐ DIRT ☐ DEBRIS

OIL COOLER & LINES

Intact no damage

VACCUM PUMP

☐ WET ☒ DRY MAKE -Rapco

DRIVE COUPLER ☒ Intact ☐ FR _____ ☐ Melted ☐ Stuck ☒ Turns
Freely ☐ Binds

TURBOCHARGER ☐ NI

MAKE -Rajay

COMPRESSOR:

☐ STUCK ☒ ROTATES FREELY ☐ Partial _____° ☐ BINDS

TURBINE:

☐ STUCK ☒ ROTATES FREELY ☐ Partial ☐ BINDS

WASTEGATE:

-Intact, rotates freely

CONTROLLER:

-Intact, good condition, pressure relief valve in good condition

REMOVE CYLINDERS

-Post borescope insight warranted the removal of the No. 2 and No. 5 cylinders

Check torque. ☒ OK ☐ Loose

Check cylinder walls. ☒ OK ☐ Damaged (Scored, etc)

Check rings. ☒ OK ☐ Broken

Push rods bent:

☒ NO ☐ YES

Valves Sticking:

☒ NO ☐ YES

Valve Irregularities: ☐ NONE ☒ YES -No. 2 and No. 5 exhaust valves significantly stretched

Guide wear. ☐ NONE ☒ YES -Significantly worn

Discoloration. ☒ NONE ☐ YES

Metal transfer on valve stem (brass guide). ☒ NONE ☐ YES

Valve faces worn/damaged. ☐ NONE ☒ YES

All intake valves were dished, and all exhaust valves exhibited extreme heat signatures.

Valve seats have wear pattern. ☒ NONE ☐ YES

PUSH RODS & HOUSINGS



Figure 8: View of No. 2 push rods and housings

SPRINGS/ VALVES

- Exhaust valve keepers normal. Exhaust valve missing about 45% of the head. Exhaust valve head exhibited extreme dishing and stretched.
- Intake valve: Exhibited extreme dishing & about .014 stretched.
- Intake/exhaust springs normal. Spring retainer for intake and exhaust normal. No. 2 valve guide severely worn.



Figure 9: View of No. 2 intake & exhaust springs with seats



Figure 10: Top/Down view of No. 2 exhaust valve



Figure 11: Profile view of No. 2 exhaust valve

ROCKER ARMS/SHAFTS

-No. 2 rocker arm severely worn, and rocker arm shaft severely worn.



Figure 12: View of No. 2 cylinder exhaust rocker arm & shaft

CYLINDER 5

PUSH RODS

-Normal.

VALVES/SPRINGS

-Exhaust valves exhibited dishing & compression damage about the head.

-Intake Valve exhibited dishing about the head. Intake valve also shows compression damage to the head. Exhaust valve stretched .007.

-Springs looked normal. Exhaust rotor coil normal. Air reference line is normal. Keepers on No. 5 exhaust normal.



Figure 13: View of Cylinder #5 Intake Valve damage

ROCKER ARMS/SHAFTS

- Intake and exhaust rocker arms severely worn. Both intake rocker arm shafts severely worn.
- Exhaust rocker arm shaft worn .005



Figure 14: No. 5 exhaust rocker arm & shaft

CYLINDER BARREL

-Normal wear on No.5 barrel for its age. Foreign object damage to cylinder barrel head.
Injectors clear

PISTON PINS

-Pin to connecting rod exceed limitations by .004 to .005

CRANKCASE

PN: 642360 & 642361

CRACKS ☒ NONE ☐ YES

COUNTERWEIGHTS ☒ All Free on Shafts

DAMAGE ☒ NONE ☐ YES

DISCOLORED ☒ NO ☐ YES

CAMSHAFT ☒ WEAR -Good condition

Cam lobes. ☒ OK ☐ UNSAT

LIFTERS

Intake -Good condition

Exhaust -Good condition

Lifter faces. ☒ OK ☐ UNSAT

STARTER

Make: Kelly Aerospace

P/N: 646275

S/N: E041815

ALTERNATOR

Make: Hartzell

P/N: DOFF103BR

S/N: H-R0022637

PROP:

Make: Hartzell
Model: D3A34C402
SN: 785174
TT: 4,558.1
TSPOH: 1,270.3

GOVERNOR

Make: McCauley
Model: C2990D4J/T2 SN-810013

CS – CHORDWISE STRIATIONS ACS – ANGLED CHORDWISE STRIATIONS

SB – S-Bends F – FACE B - BACK (Cambered) T – TIP SH - SHANK

BLADE 1
CS, ACS, SB, F, B, T, SH

BLADE 2
CS, ACS, SB, F, B, T, SH

BLADE 3
CS, ACS, SB, F, B, T, SH

SPINNER

Exhibited compression signatures as a result of impact damage