

INVESTIGATION SUPPORT SUMMARY

HISTORY OF FLIGHT

On June 10, 2019, about 1245 Pacific daylight time, a Cessna 210D, N3997Y, experienced a total loss of power and collided with terrain short of the runway during an emergency landing to Ramona Airport, Ramona, California. The certified flight instructor (CFI), the registered owner, was operating the airplane under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91. The CFI and pilot-rated passenger were not injured; the airplane sustained substantial damage to the right wing. The personal local flight departed from Gillespie Field, San Diego, California, about 1200 and was diverting to Ramona, California. Visual meteorological conditions prevailed and no flight plan had been filed.

The pilot stated that he was planning on practicing a series of instrument approaches. While inbound to the Julian VOR, with the airplane about 6,000 feet mean sea level (msl), the engine rpm increased to above 3,000 and in response, he retarded the propeller control to 2,400 rpm. He thought that erratic engine rpm was a due to a propeller governor anomaly and communicated with the air traffic controller that he was terminating the practice approach. He stated his intention to return back to Gillespie Field and began the flight back. When about five miles south of Ramona, he felt the airplane shake and declared an emergency to the Ramona Air Traffic Control Tower. The airplane was unable to maintain altitude and touched down in a field about 1/8 mile short of runway 27.



Picture 01: Flight Path According to Flight Aware

PILOT INFORMATION

Pilot: Scott Patterman

Airplane Rating(s) (Check all that apply)	Other Aircraft Rating(s) (Check all that apply)	Instrument Rating(s) (Check all that apply)	Instructor Rating(s) (Check all that apply)
☐ None ☒ Single-Engine Land ☐ Single-Engine Sea ☒ Multiengine Land ☐ Multiengine Sea	☐ None ☐ Airship ☐ Balloon ☐ Glider ☐ Gyroplane ☐ Helicopter	☐ None ☒ Airplane ☐ Helicopter ☐ Powered Lift	☐ None ☒ Airplane Single-Engine ☒ Airplane Multi-Engine ☐ Gyroplane ☐ Powered Lift ☒ Instrument Airplane ☐ Instrument Helicopter ☐ Helicopter ☐ Glider ☐ Sport

Flight Time <i>(Enter appropriate number of hours in each box)</i>	All Aircraft	This Make & Model	Airplane Single Engine	Airplane Multiengine	Night	Instrument	
						Actual	Simulated
Total Time	>4000	>250	>3000	>500			
Pilot in Command (PIC)	>4000	>250	>3000	>500			
Time as Instructor	>3000	>30	>2500	>400			
This Make/Model							
Last 90 Days	46	22	68	1		0	1
Last 30 Days	21	17	21	0		0	1
Last 24 Hours	1	1	1	0		0	0

ENGINE

The Continental Motors IO-520-FcA, serial number 240902-R, was a Millennium overhauled engine installed in June 2003 at an airplane total time of 1,119 hours and engine total time of 1,767.7. Continuity was established from the throttle, mixture, and propeller controls in the cockpit to their respective arms in the engine compartment.



Picture 02: Data Plate from Engine

An external examination revealed there was a hole in the upper right crankcase a few inches wide in diameter. There was a larger hole in the upper left crankcase and the top of a separated connecting rod was lodged in this hole. Turning the propeller resulted in the engine being able to turn about 270 degrees before binding internally. Removal of the upper spark plugs revealed that the faces were slightly dark, but according to the Continental representative, were in normal condition. An electronic borescope inspection disclosed that all intake and exhaust valves were intact and exhibited normal combustion signatures.

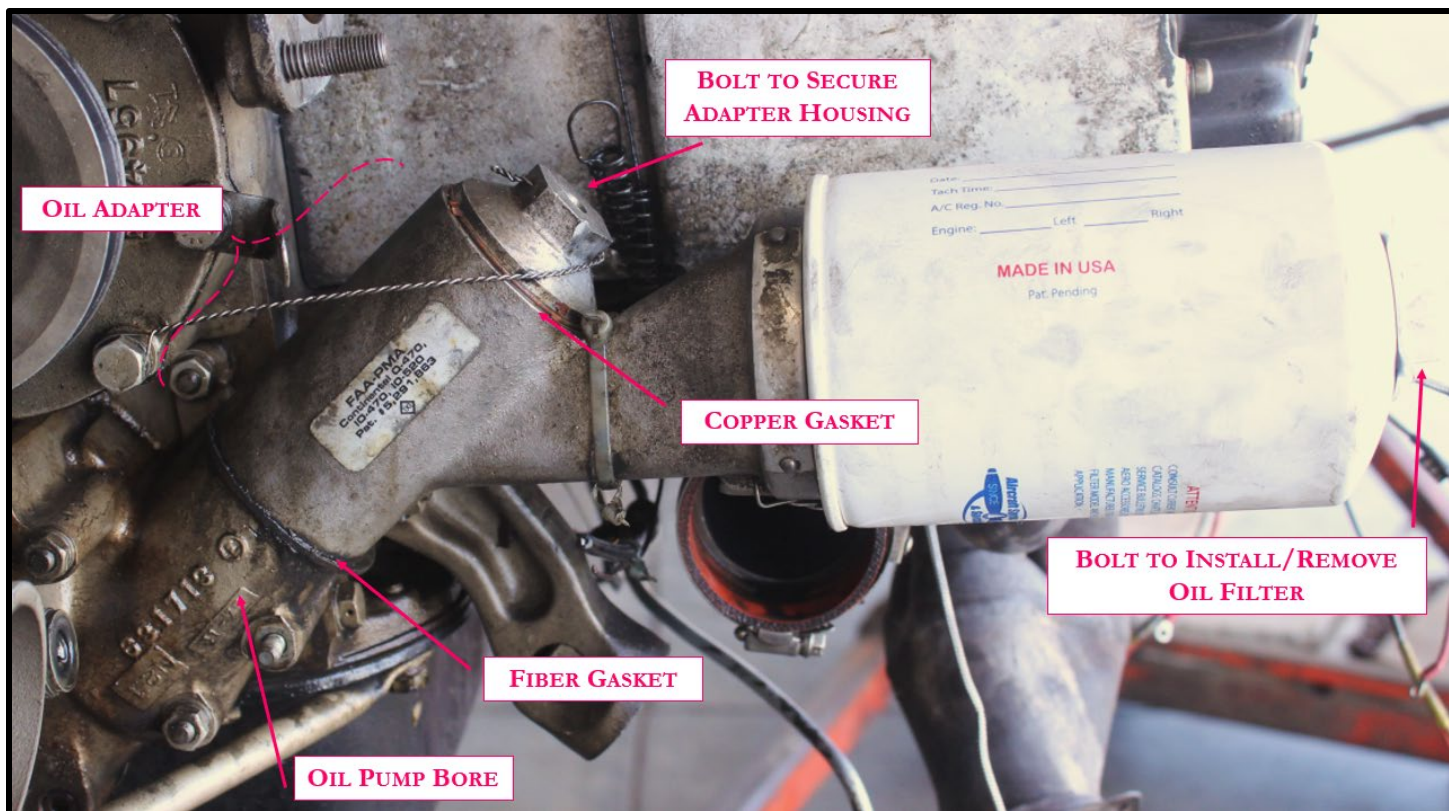
OIL ADAPTER

The engine was equipped with an F&M Enterprises Inc. engine oil filter adapter, model C6LC-L (s/n 10706L).

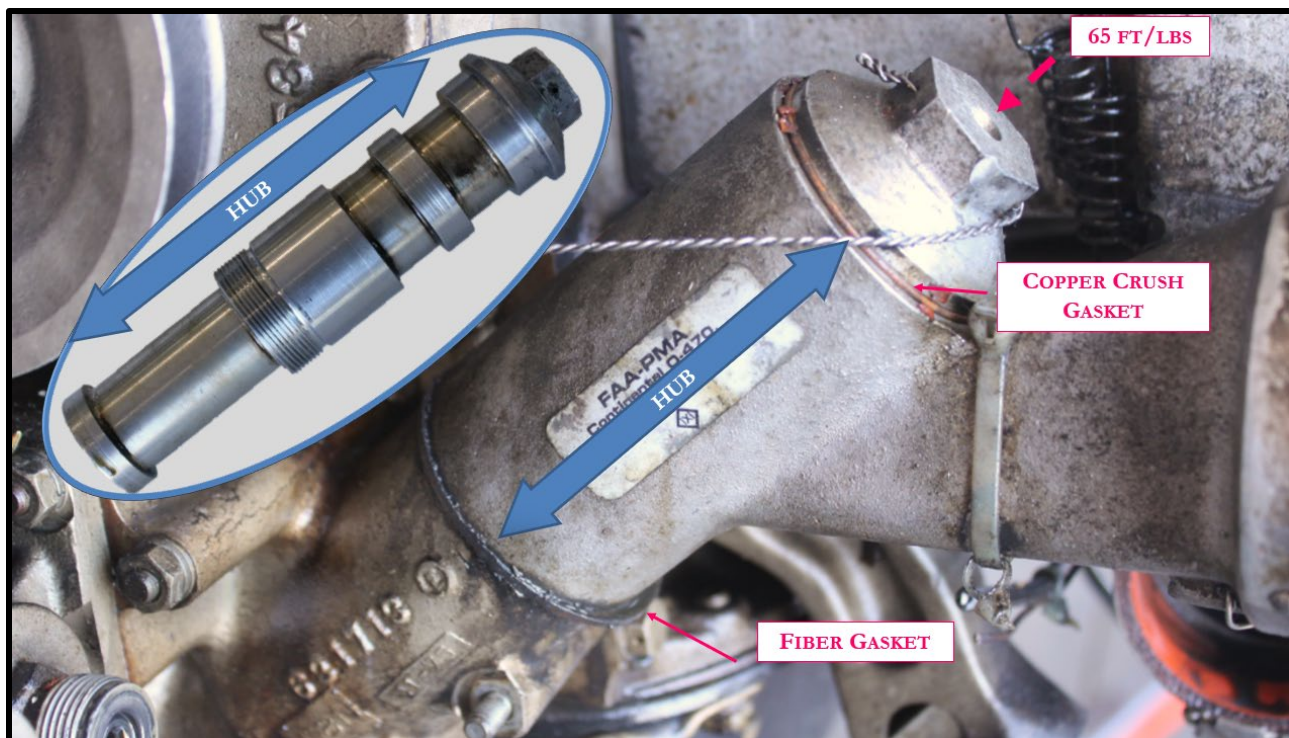
ADAPTER FUNCTION

The purpose of the adapter was to enable the engine to use a conventional spin-on oil filter. As manufactured, the oil pump has a brass oil screen mounted to the casing and the filter adapter uses the oil screen bore to attach to the engine.

According to the patent, the adapter included a tee casting (housing) and a hub (shaft) which was threaded to screw into the oil screen hole on the oil pump casting. The tee casting had a sleeve with a through bore and a mounting base with an end for receiving a spin-on oil filter. When installed, the hub was journaled into the bore of the sleeve and screwed into the oil screen hole, which had two oil passage openings. A crown (1-inch bolt head) at the outer end of hub secures the tee casting against the oil pump casing. Oil inlet and oil outlet passages are provided through the hub and the tee casting to circulate oil from the oil screen hole into the spin-on filter, and back into the oil screen hole from the spin-on filter.



Picture 03: Oil Filter Adapter Assembly



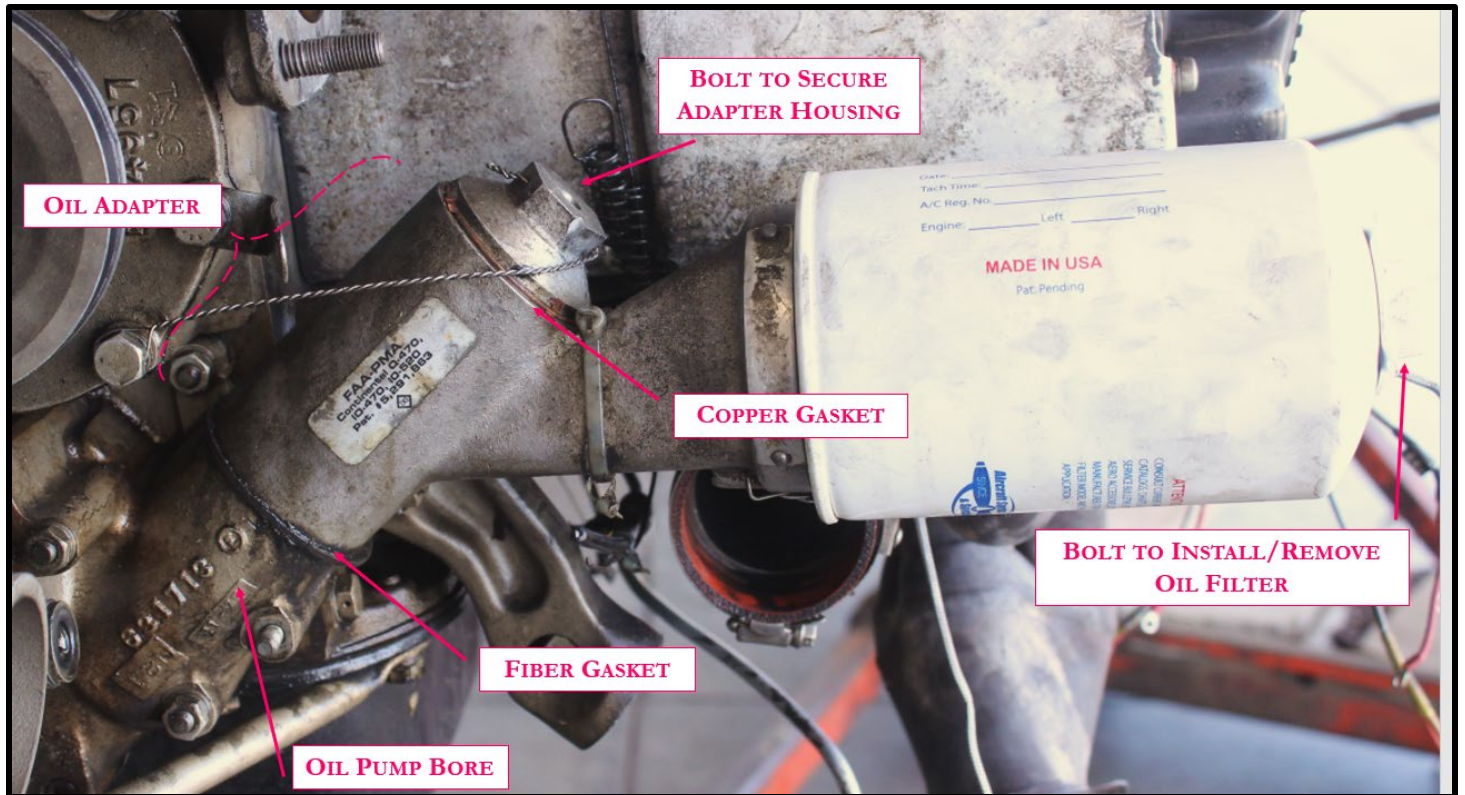
Picture 04: Oil Filter Adapter Showing Hub and Gasket

OIL ADAPTER EXAMINATION

An external examination revealed that the filter adapter was loose, and the adapter housing could be rotated about the shaft.¹ The crown head of the shaft and the oil filter screen bolt head both remained saftied. There was a

¹ See <https://www.flickr.com/photos/136005688@N02/28283176785/in/set-72157668173219294/> for example

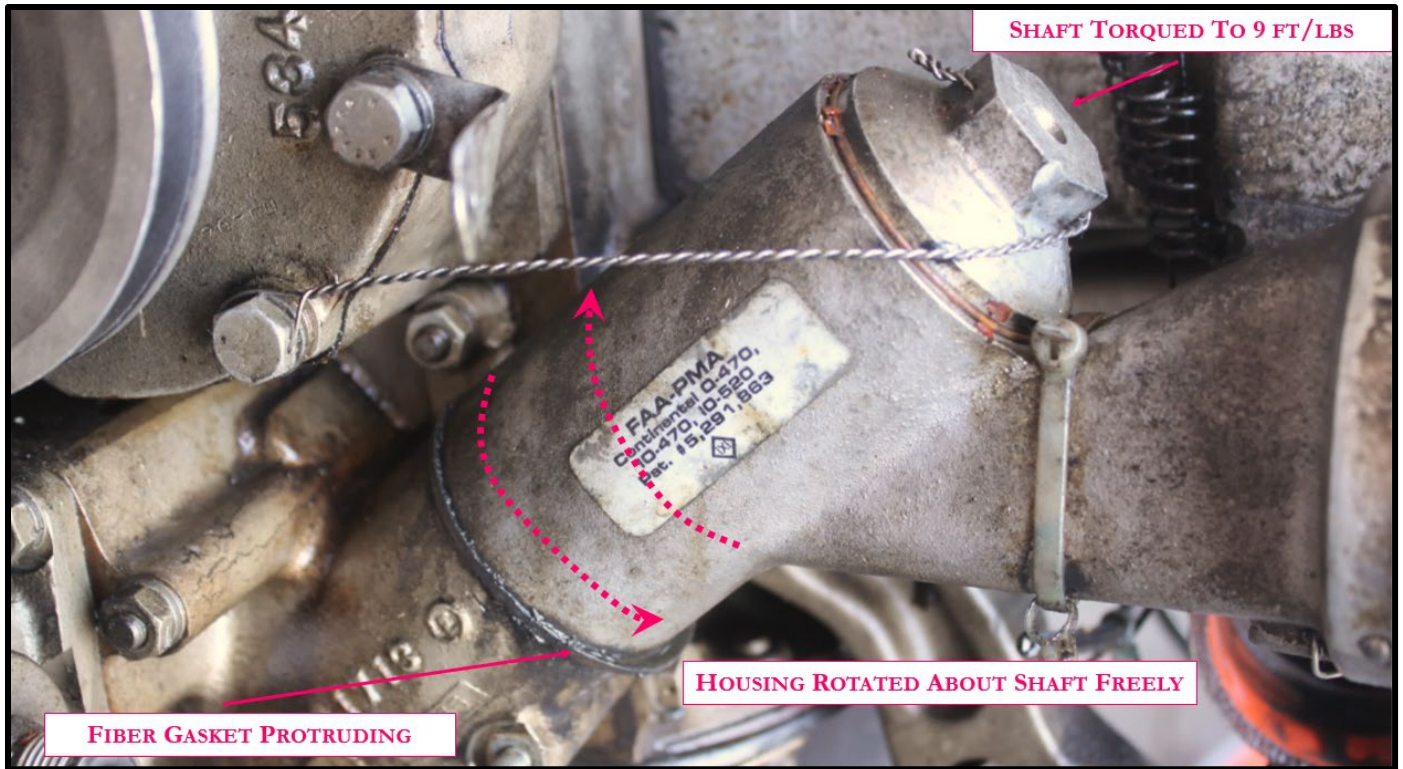
concentration of oil in the area of the adapter and adjacent firewall. The nut on the hub had several wear marks, consistent with a tool slipping on the nut. There was an older zip tie around the adapter arm that held two wires. The plastic and wear was consistent with the tie wrap being installed several years prior, and the location of the wrap end was in position near the nut, where the installation/removal of the nut was prohibited by its position.²



Picture 05: Oil Filter Adapter as Installed on Oil Pump Bore

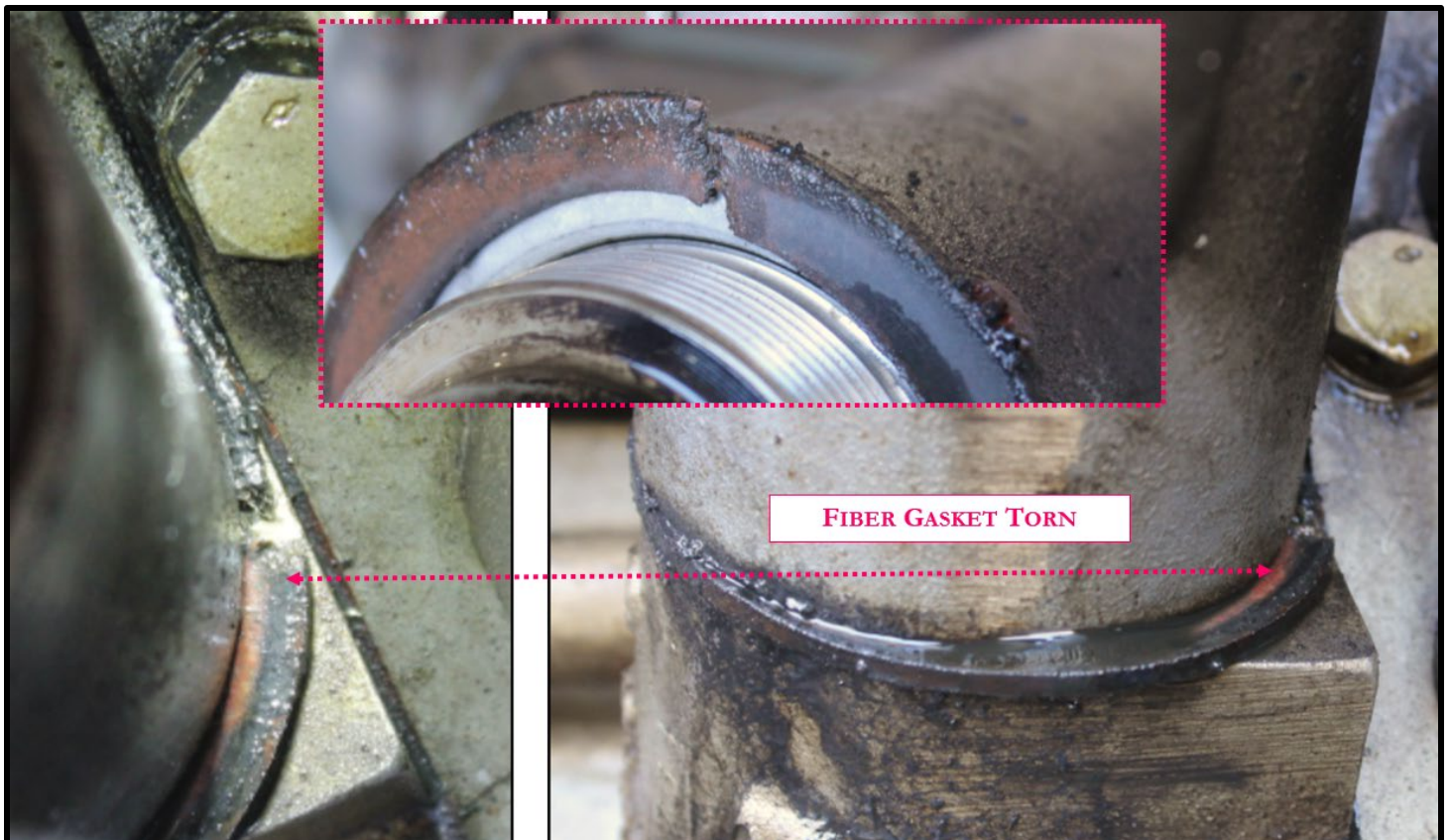
A closer examination revealed that the fiber gasket, located between the oil pump casting and the adapter was protruding with the outside edge extending beyond the castings. Additionally, a tear could be seen in the gasket where the adapter housing abutted the engine case. Investigators removed the safety wire and attempted to assess the breakaway torque of the adapter. A torque wrench was used to determine that the breakaway torque was 9 foot-pounds

² This conflicts with the mechanic's statement that performed the last annual inspection that he recently re-torqued the adapter.

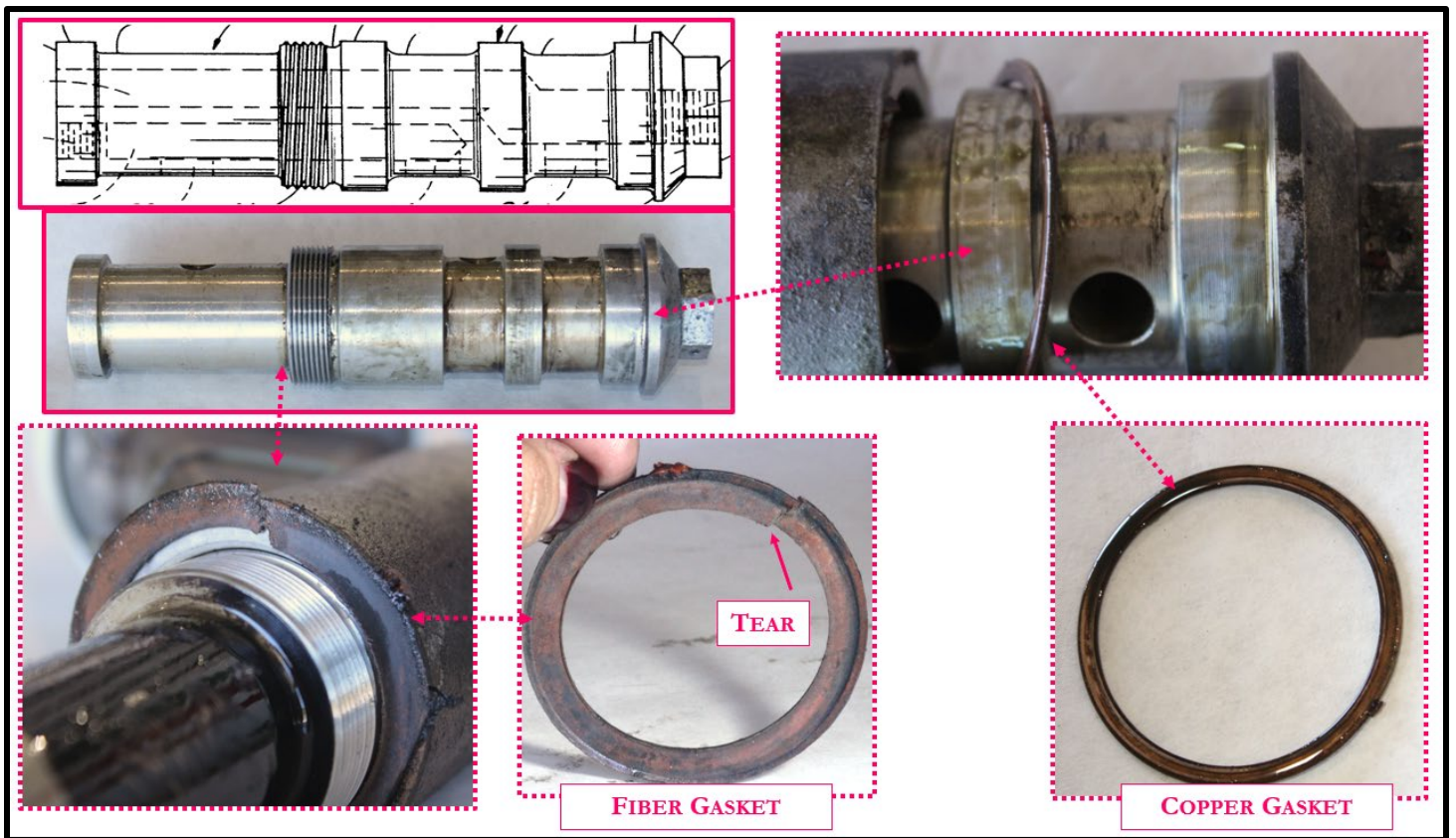


Picture 06: Oil Filter Adapter Could be Rotated Freely

Removal of the adapter revealed that the fiber gasket was completely split and contained several lips where it appeared the gasket had been pinched between the engine case and the adapter housing. The copper crush gasket was intact.

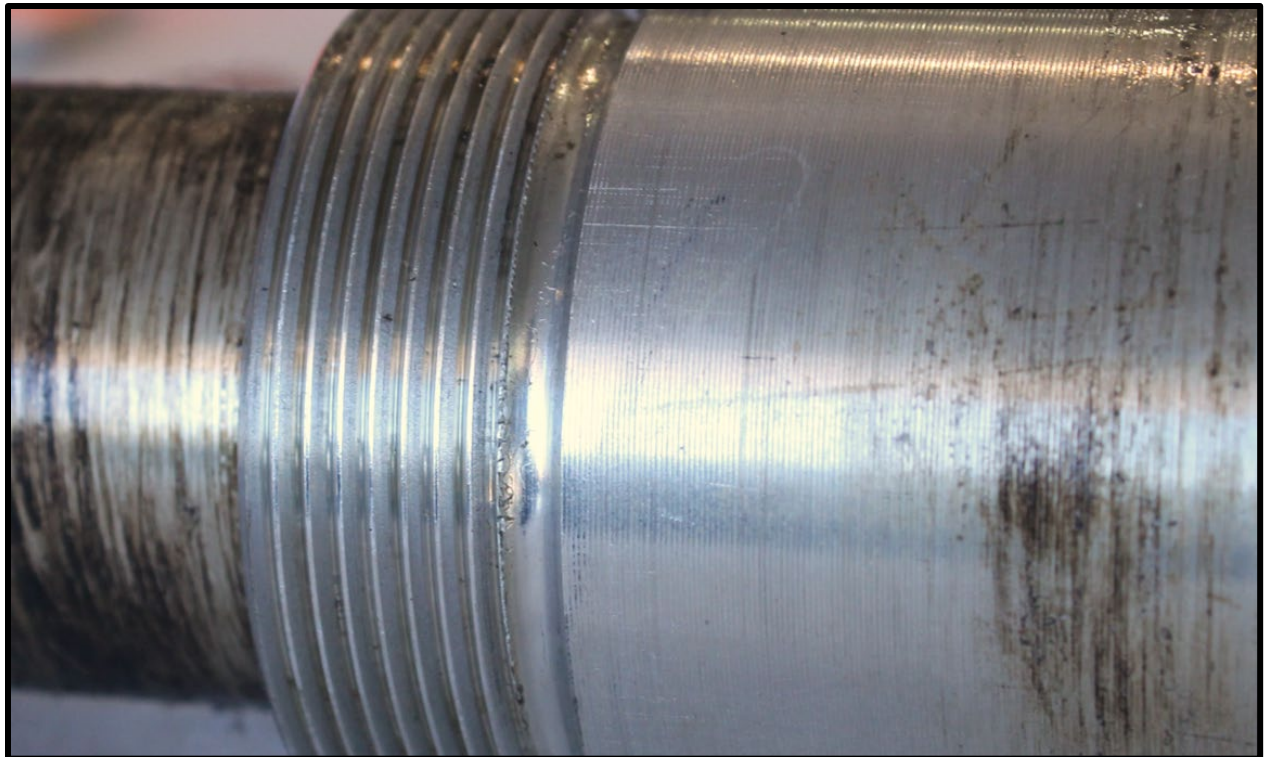


Picture 07: Fiber Gasket

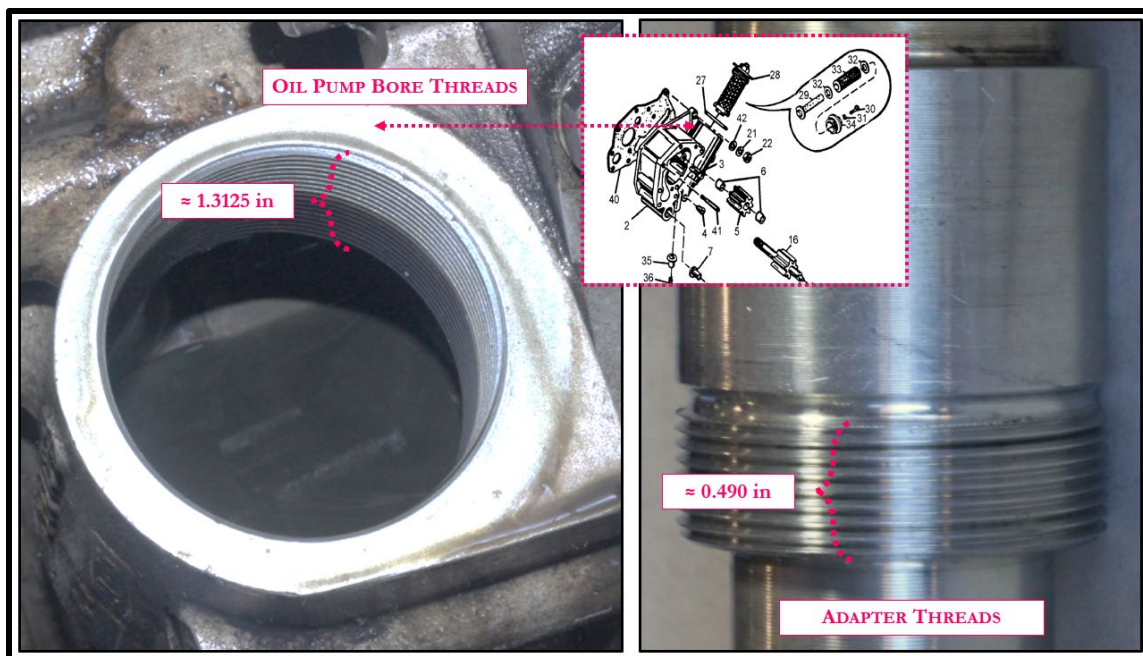


Picture 08: Shaft Showing Gaskets

The threads on the upper area of the hub, adjacent to the annular groove were rough.



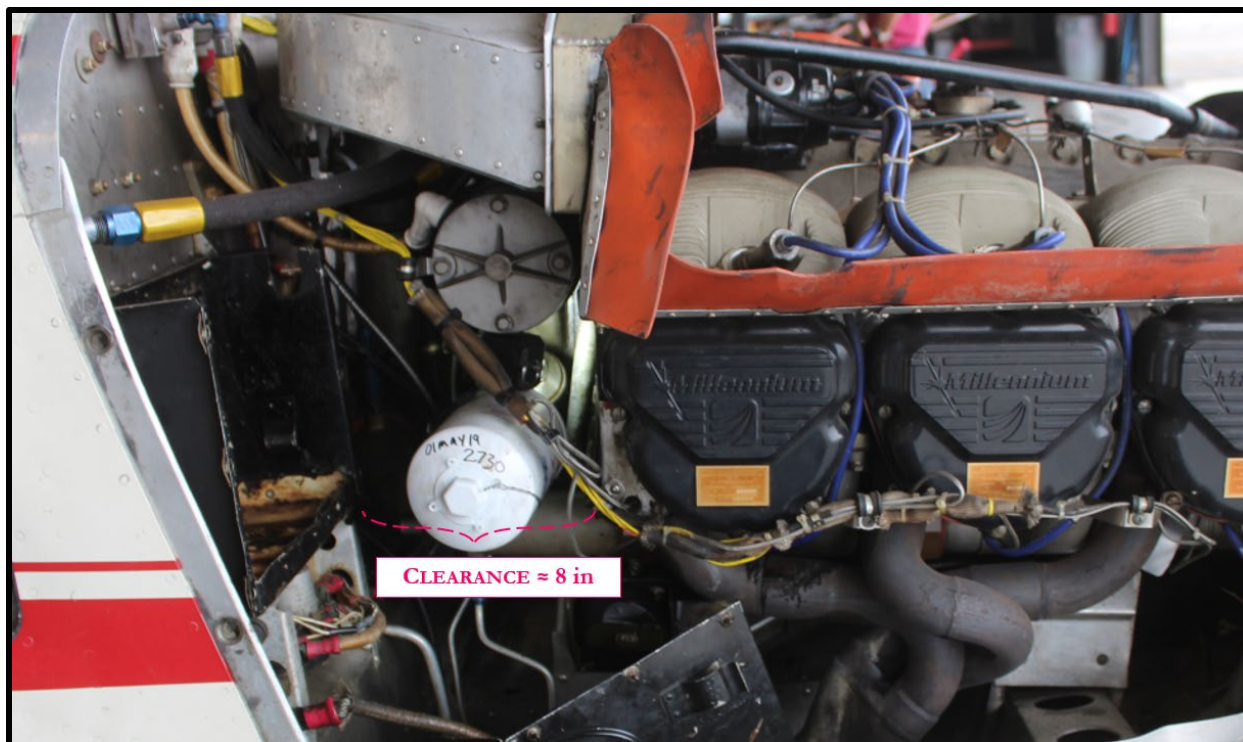
Picture 09: Threads on Hub



Picture 10: Threads of Oil Pump and Adapter

FUNCTIONAL TESTING

After measuring and photo documenting the oil filter adapter assembly, a new fiber and copper gasket were used to install the oil filter adapter on the engine, using a calibrated torque wrench. A mechanic installed the adapter while investigators captured the installation on video.³ When sliding the fiber gasket over the hub threads, there was light scraping due to the tight fit of about 0.022 inches as measured with a feeler gauge. Despite numerous components being removed (e.g., the starter), the mechanic had only about 8 inches of space to torque the adapter. The limited space prohibited the mechanic from being able to visually discern the alignment of the fiber gasket.⁴



Picture 11: Area to Install Adapter with All Components Installed

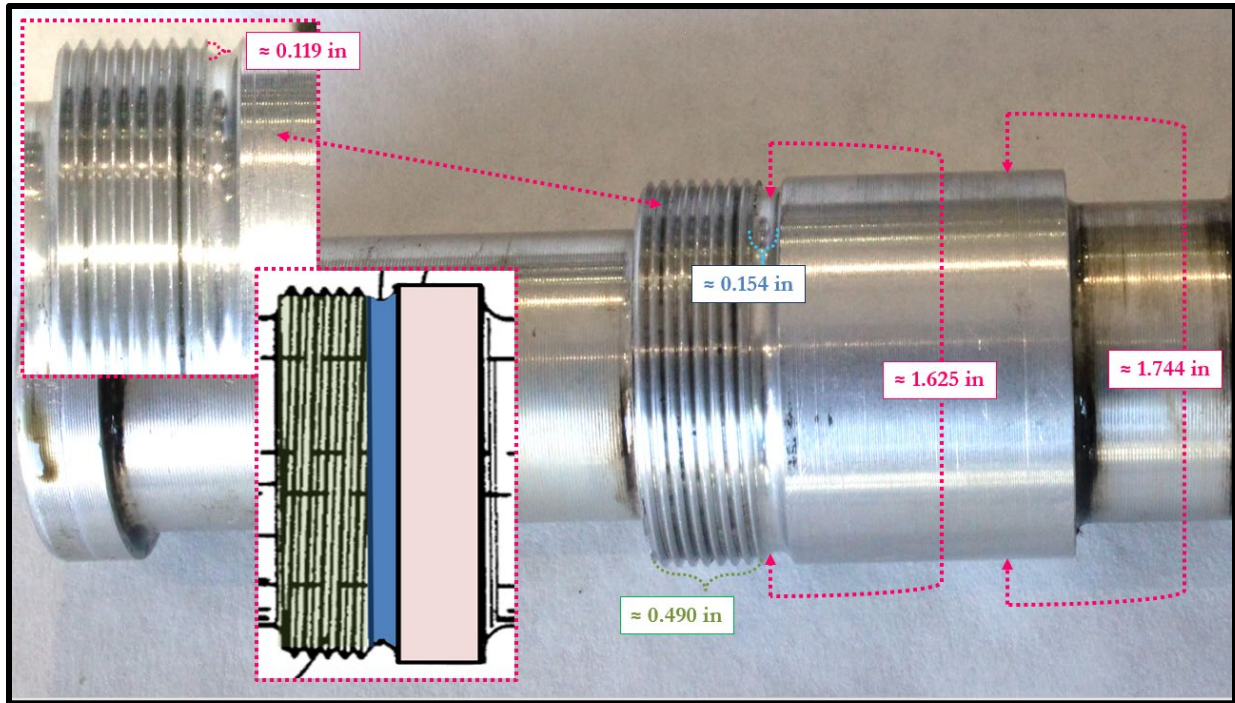
³ See Videos 1a, 1b, 2a, 2b showing two installations from 2 different angles.

⁴ The clearance between the hub and the fiber gasket was about 0.031 inch clearance.

The mechanic had great difficulty torquing the adapter where the entire adapter body would rotate prior to reaching 65 ft/lbs. After great effort, the mechanic was able to torque the adapter to 65 ft/lbs, with the body having shifted. Even with that amount of torque, the adapter could still be moved by applying force to the oil filter or adapter body.⁵ It was not possible to torque it tight enough to prohibit movement.

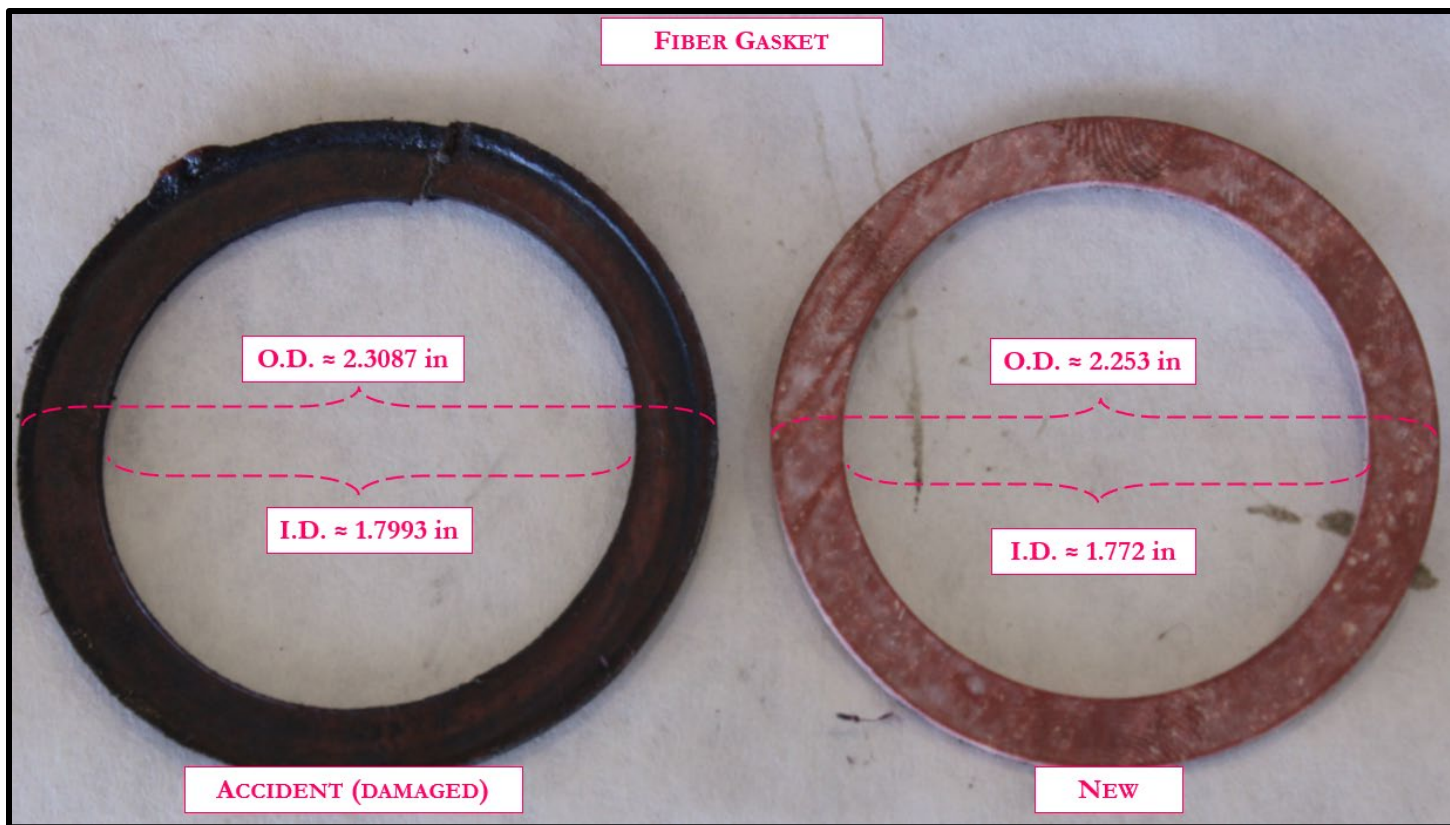
MEASUREMENTS

Measurements taken during examination.

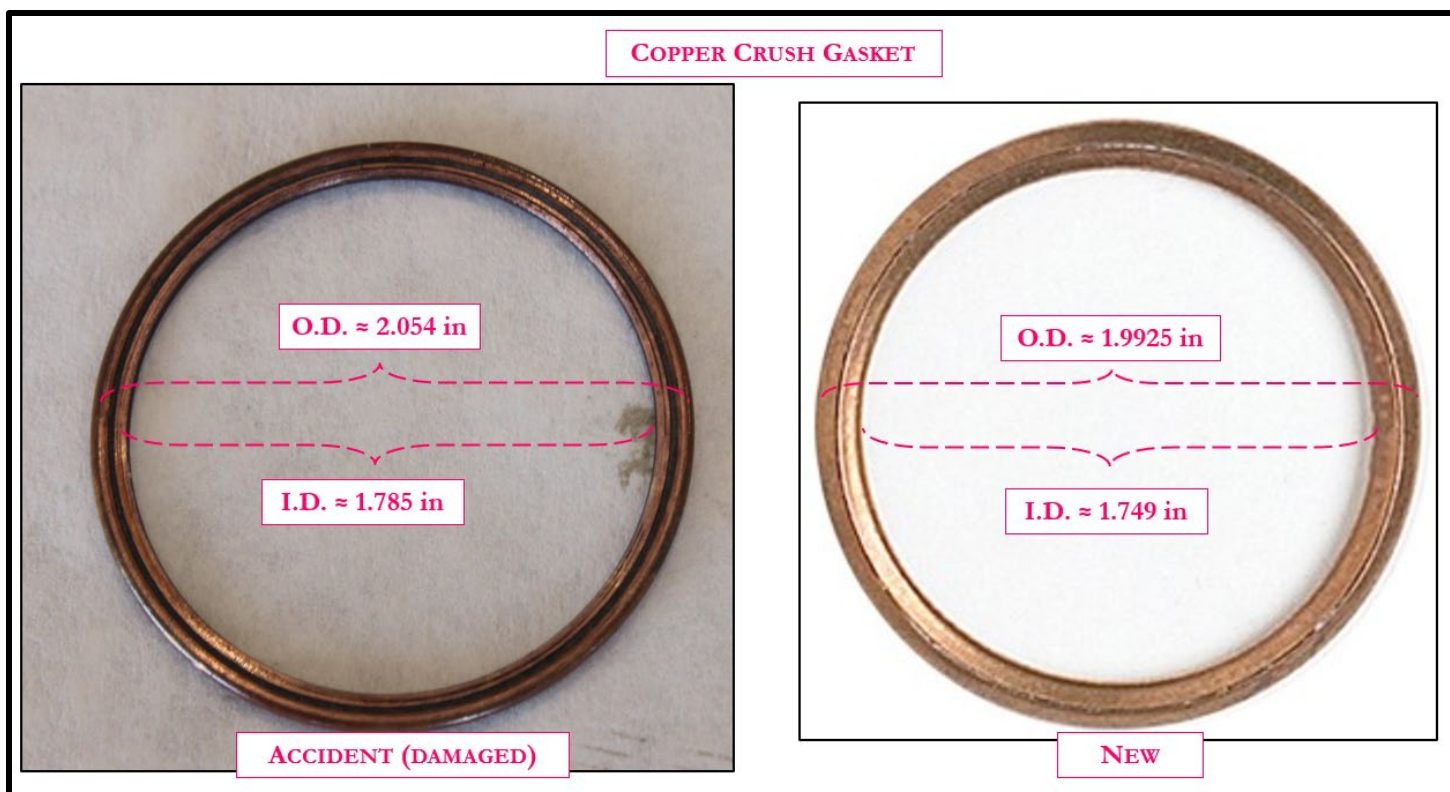


Picture 12: Hub Measurements

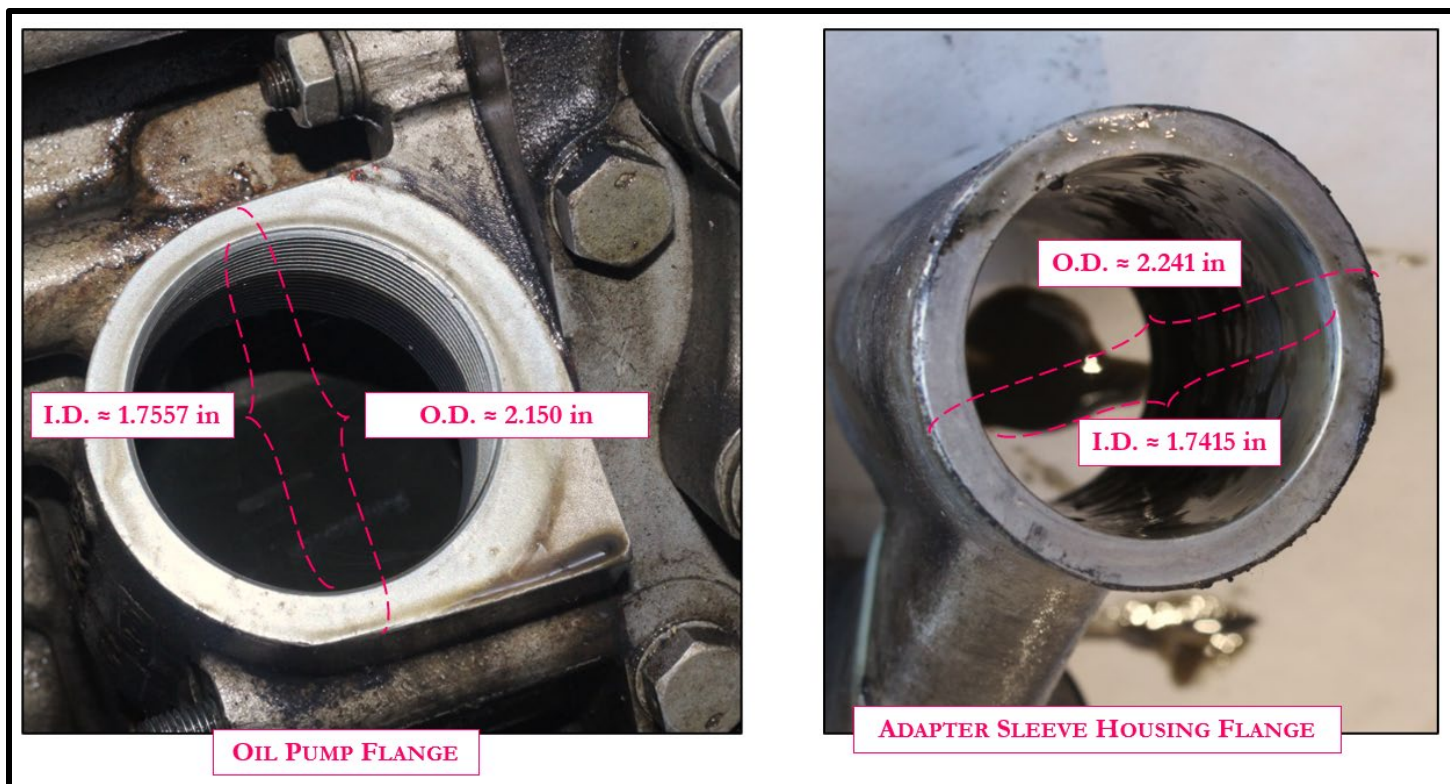
⁵ See Video 3 showing movement of the filter after adapter is torqued to 65 ft/lbs.



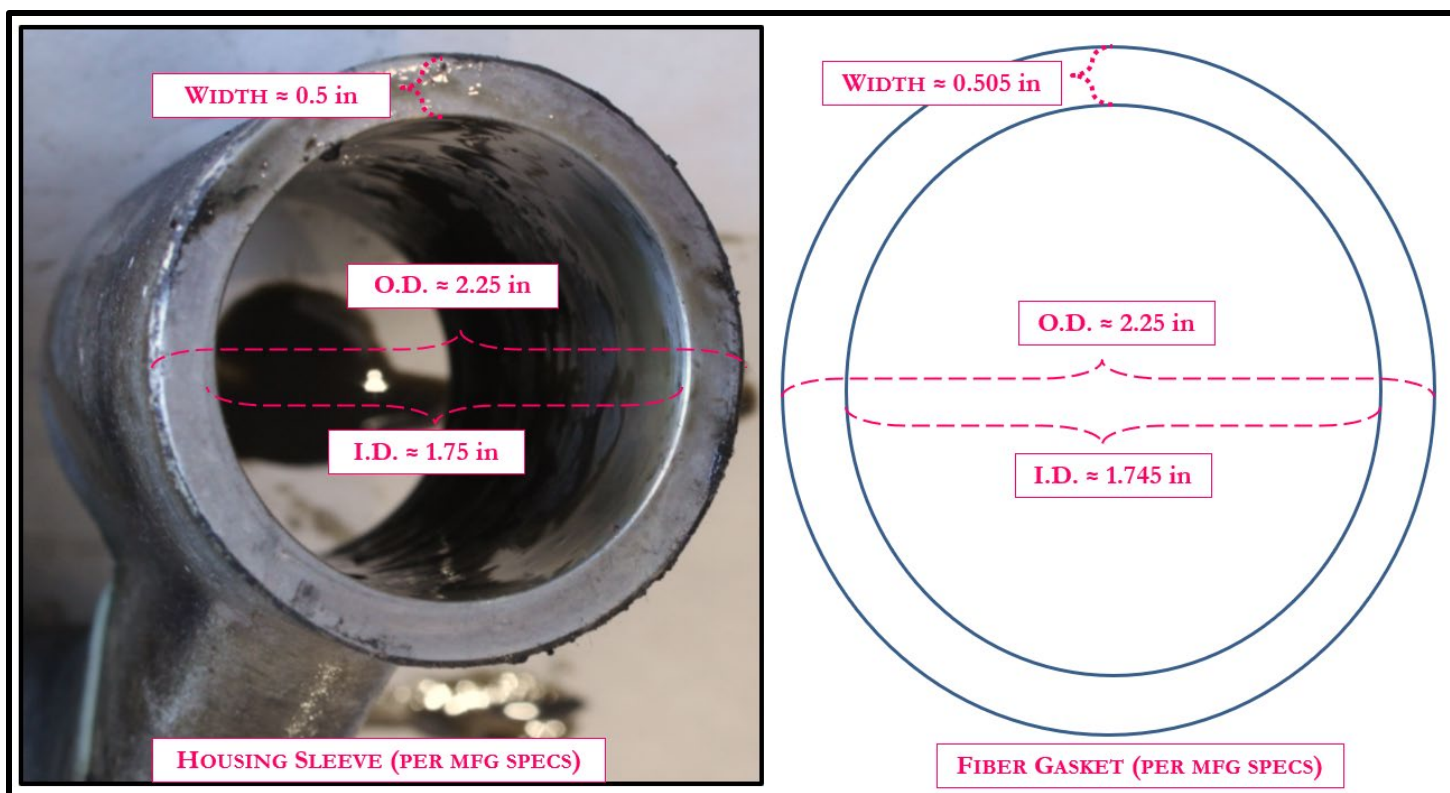
Picture 13: Fiber Gasket Measurement Comparison



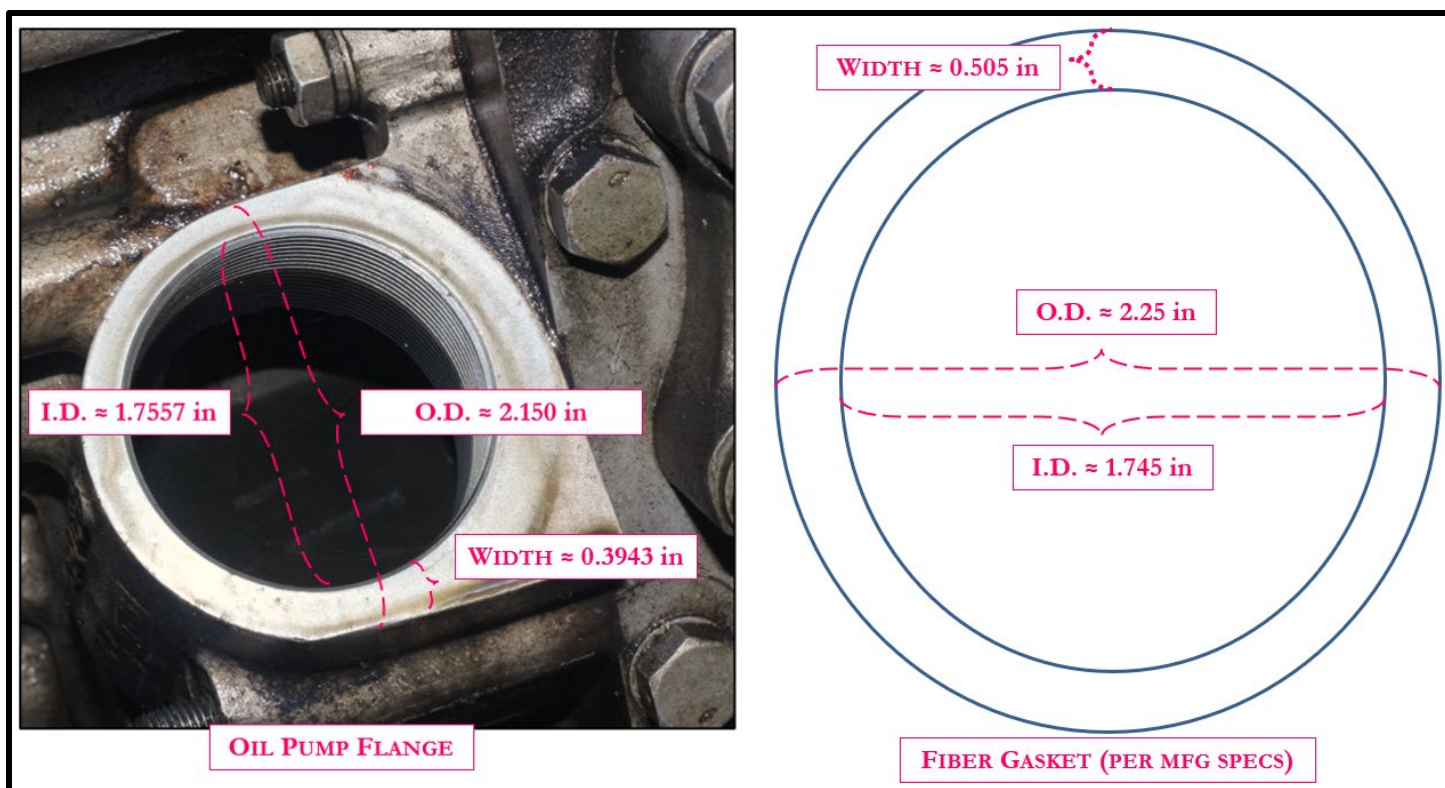
Picture 14: Copper Gasket Measurement Comparison



Picture 15: Oil Pump Flange and Adapter Housing Measurement Comparison



Picture 16: Adapter Housing Measurement Comparison to Fiber Gasket



Picture 17: Oil Bore Measurement Comparison to Fiber Gasket

ACCIDENT ADAPTER HISTORY

The Continental Motors IO-520-FCA, serial number 240902-R, was a Millennium overhauled engine installed in June 2003 at an airplane total time of 1,119 hours and engine total time of 1,767.7. At the examination the tachometer read 2,747.88 (17.2 hours since last maintenance) and an engine time of 1,435.9.

The engine was equipped with an F&M Enterprises Inc. engine oil filter adapter, model C6LC-L (s/n 10706L) under FAA Supplemental Type Certificate (STC) SE09356SC. According to the owner, the installed oil filter adapter was likely originally installed on of the then newly-overhauled engine in June 2003. There were no documents regarding the installation of the adapter, but there were mentions of the adapter throughout the partial logbook entries.⁶ The mechanic that performed the last maintenance stated that when he performed the annual inspection on May 03, 2019 he replaced the copper crush gasket and retorqued the filter adapter; he did not replace the fiber gasket.

Pro Air Aviation		
Registration : N 3997Y	9221 Dulene Dr.	Date: 05/03/2019
Manufacture: Cessna		
Model : C 210 D	Lakeside, CA 92420	Tach/Hobbs: 2730.66
	(619) 208-3887 ph	TTSN: 1611.66
Engine: IO 520-FcA		Work Order #: 7629
		S/N: 240902-R
All routine maintenance and service completed per an ANNUAL inspection.		
Drained oil, replaced oil filter, Sreviced engine with 11 QTS. Of Phillips 50w OIL.		
Cleaned and inspected all spark plugs, Cleaned and inspected All fuel injectors.		
Inspected magneto to engine timing, inspected and pressure tested exhaust system for leaks, none found. Compression check as follows: #1.67 /80, #2.70 /80, #3.70 /80, #4. 68 /80. #5.66 /80. #6.68 /80. Replaced air induction elements with new. Washed		
Engine and cowl, test run normal. I certify that this ENGINE has been inspected I.A.W.		
AN ANNUAL Inspection and was determined to be in airworthy condition. AD's Current through bi-weekly issue: 2019-09.		

Picture 18: Last Maintenance

⁶ The FAA inspector collected the recent logbooks from the pilot, preventing the investigation team from being able to review them prior to and during the examination.

RECORDS

The engine logbooks indicated that the engine was installed on the airframe in June 2003. The engine was subjected to a propeller strike in October 2001 and January 2005.

A logbook entry on March 04, 2004 states that the mechanic retorqued a non-Cessna oil filter adapter at a tach time of 1239.39 hours.

& visually inspected removed oil filter. Very clean. (7925) Torqued oil filter adapter (not Cessna) to 500 in/lbs & safety wired with .040. (9010) Completed post inspection leak checks. (9030) Completed local flight check 03/27/04 for oil filter adapter leak check. Little Flyers WO# 3712 Roger A. Stern A&P [REDACTED]

Picture 19: Logbook Entry for Oil Filter Adapter

A logbook entry in January 2007 states that the mechanic retorqued an oil filter adapter at a tach time of 1554.77 hours.

1/13/07 Engine log entry:
Cessna 210D Sn: 21058497 N3997Y Tach: 1554.77
TCM IO-520-FcA Sn: 240902-R
(1220) Serviced with additional 2 qts of Aeroshell W100 (to 11qts.) Recommend changing oil in 10-15 hrs, inspecting oil filter for contaminants & re-torquing oil filter adapter. (6110) Reinstalled propeller with new A1633-3 seal, torqued to wet torque 45-50 ft / lbs. (6146) Reinstalled [REDACTED]

Repositioned oil filter adapter & torqued to 65 ft/lbs, safety wired. Oil filter adapter due re-torque (65 ft / lbs) in 10 operating hours. (9010) Completed repair / post inspection leak checks. (9020) Completed post repair / inspection function & [REDACTED]

✓ 7925 OIL FILTER
1. Repositioned oil filter adapter and torqued to 65 ft/lbs, safety wired. RS
2. Re-torque oil filter adapter after 10 hrs.

Picture 20: Logbook Entire for Oil Filter Adapter