



MEMORANDUM

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According to Lycoming, the engine was newly built on February 2, 2005, and then sold to Cessna. The no. 1 cylinder, its intake and exhaust valve train components (springs, pushrod, rocker arms etc.), piston and all 12 hydraulic lifters were sent to Lycoming for investigation. The engine was field overhauled at Fort Worth, TX between November 4, 2013, and March 17, 2014. Total time since new (TTSN) was 1983.9 hours. The overhaul record indicated 12 hydraulic lifters got replaced, while the original intake and exhaust rocker arms were reworked and reused.

It was found that the intake valve failed by fatigue initiated from the key recess fillet radius surface, and the fatigue crack grew across approximately 2/5 of the cross section. The intake valve had conforming hardness, chemistry, microstructure and key dimensions. The dimensional check indicated that both intake and exhaust rocker arms had nonconforming gauge shoe height after about 0.01" material was ground away on the shoe pad in the rework. Except for the #2 intake, #5 intake and #1 exhaust, all other 9 hydraulic lifters failed the leak down test with higher rate, including the #1 intake. All other intake valve train components including valve springs, valve keys, spring seats and rotator cap were sound. The root cause of the #1 intake valve tip failure was not determined for certain; however, the nonconforming rocker arm and lifter may have contributed to a malfunction in the #1 intake valve train. Then the dropped valve caused more secondary impact damages on piston crown and cylinder combustion chamber. The intake valve itself had conforming hardness, chemistry, microstructure and key dimensions.

Severe damage was noted on the surface of the no. 1 cylinder, including intake and exhaust valve seat surfaces, as well as intake valve guide, by impact with fractured intake valve pieces. The no. 1 piston was severely damaged on the crown by impact with fractured intake valve pieces. One fractured intake valve piece was still stuck in the crown. There were signs of blowby on the piston skirts. Inside surfaces had dark discoloration. Three piston rings were all unbroken, free to move, and the ring grooves did not have excessive coke buildup.

All 12 hydraulic lifters were in good condition without any visible damage. Except for the no. 2 and no. 5 intakes and the no. 1 exhaust, all the other 9 lifters failed the leak down test with

higher rate, including the no. 1 intake. The no. 1 intake and exhaust rocker arms were in good condition without any damage. Off-center wear patterns were indicative of side loads on the valve tip in both intake and exhaust sides. The no. 1 intake valve tip was separated from stem at the keeper fillet radius. The stem was bent, and head was fractured into several pieces by post-fracture contacts with piston and combustion chamber dome after the tip separated.