TELEDYNE CONTINENTAL® AIRCRAFT ENGINE

service bulletin

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Supersedes M76-18 Rev. 1
Technical Portions Are
FAA Approved

Compliments of

21 December 1984

TO: Aircraft Manufacturers, Distributors, Dealers, Engine Overhaul Facilities, Owners and Operators of Teledyne Continental Motors' Aircraft Engines.

SUBJECT: CYLINDER LEAKAGE CHECK (Compression)

MODELS AFFECTED: All

The differential pressure test is an accepted method of determining cylinder condition by measuring air pressure loss past the pistons, rings and valves. The operation of the equipment is based on the principle that, for any given airflow through a fixed orifice, a constant pressure drop across that orifice will result. On many engines it is now a regular part of the 100 hour or annual inspection.

We have received reports of incorrect cylinder leakage check results caused by improper use of test equipment and/or by the use of faulty test equipment.

To help you accurately accomplish a leakage check, we submit the following information on leakage and use of the Master Orifice Tool (Ref. Figure 1) to calibrate the leakage checking equipment used on Teledyne Continental engines.

A. LEAKAGE CHECKS

Cylinder leakage is broken down into two areas of concern, the "Static Seal" and the "Dynamic Seal".

Static Seal

The static seal consists of the valve to valve seat seals, spark plug to spark plug port seals and cylinder head to barrel seal (Ref. Figure 2). No leakage of the static seal is permissable.

Dynamic Seal

The dynamic seal consists of the piston rings to the cylinder wall seal (Ref. Figure 2). This seal leakage can vary from engine to engine by the cylinder displacement, cylinder choke, ring end gap and piston design.

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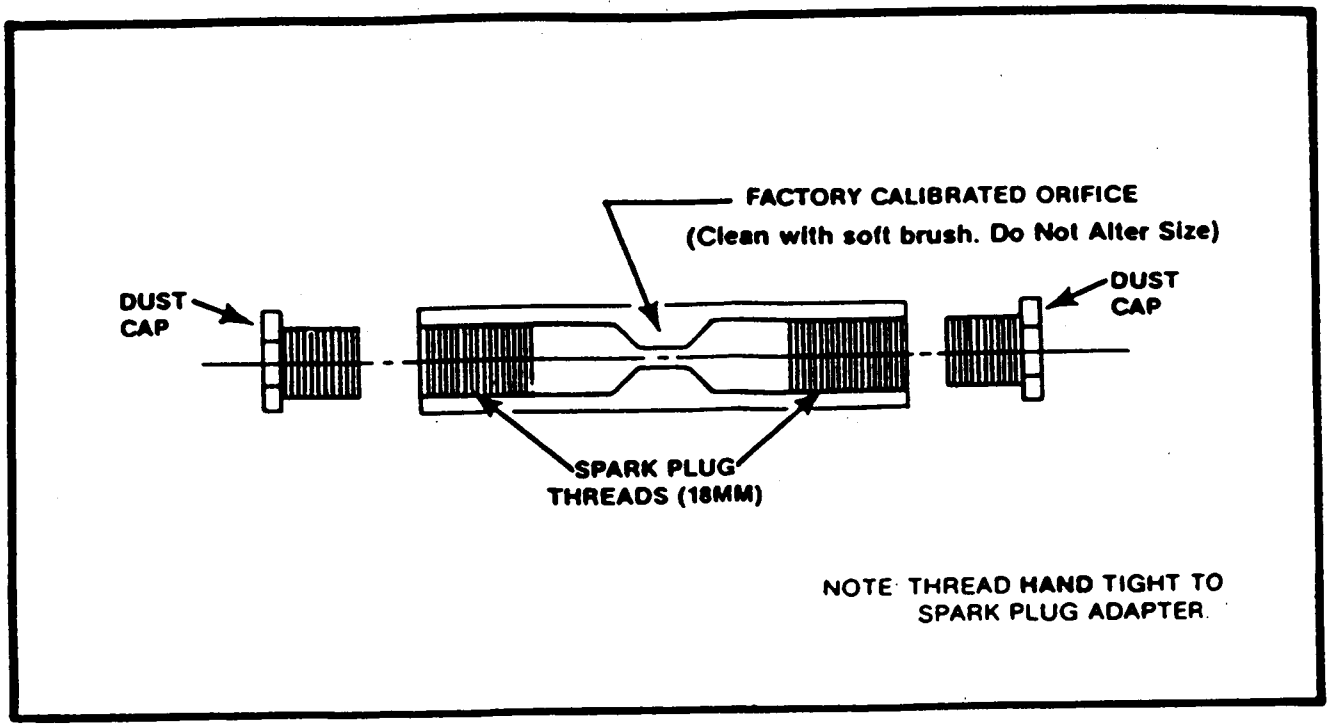
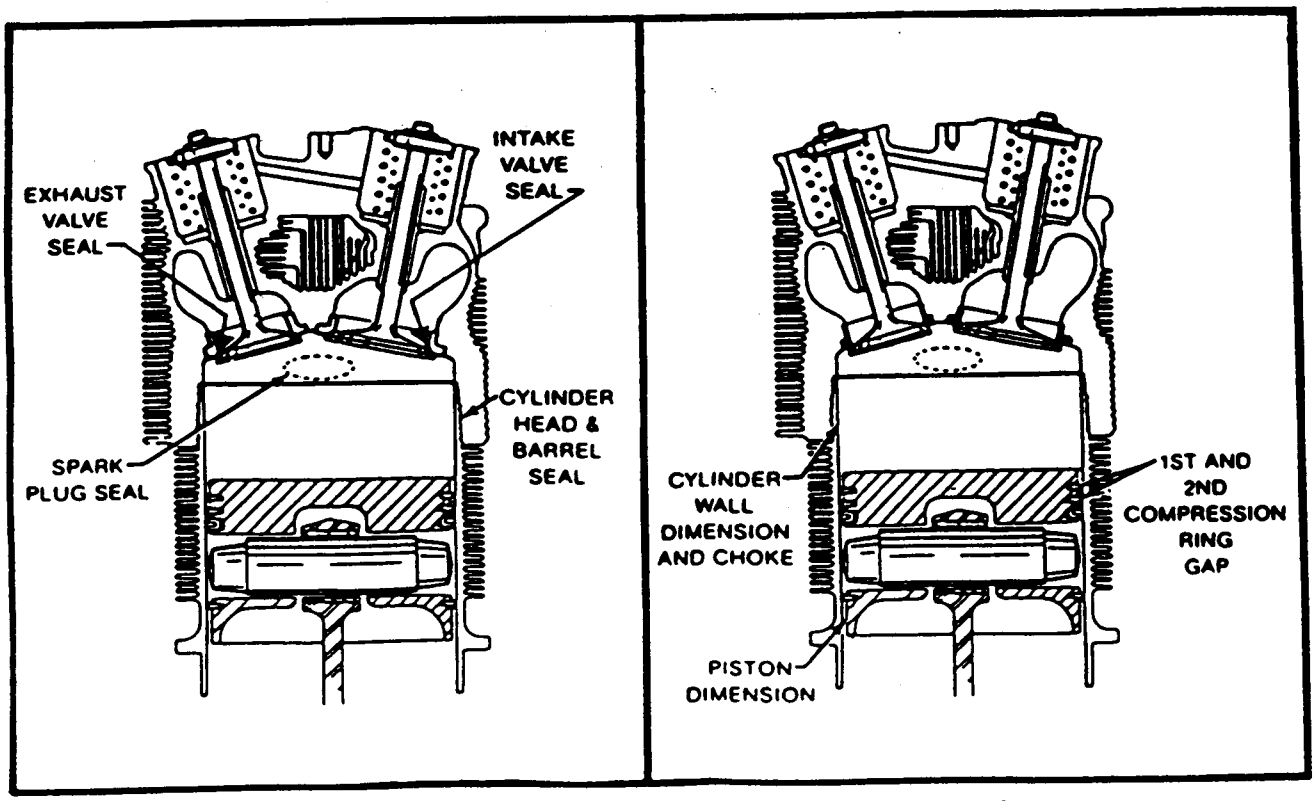


FIGURE 1. MASTER ORIFICE ASSEMBLY TOOL BORROUGHS P/N 646953.

Borroughs Tool & Equipment Corp.
2429 N. Burdick St.
Kalamazoo, MI 49007
Tel. 616/345-2700



STATIC SEAL DYNAMIC SEAL

FIGURE 2.

B. EQUIPMENT

Testing equipment must be kept clean and checked periodically for accuracy as follows: Using a line pressure of 100 to 120 p.s.i., close the cylinder pressure valve, then set the regulator pressure valve to 80 p.s.i. The pressure in both gages should stabilize with no leakage.

The restrictor orifice dimension in the differential pressure tester (Fig. 3) for Teledyne Continental aircraft engines must be 0.040 inch orifice diameter, 0.250 inch long with 60° approach angle, and must flow 120 ±5 cubic feet per hour at 30 p.s.i. differential pressure.

Master Orifice Tool

For conformity in tester equipment, a Master Orifice Tool has been developed to calibrate equipment and determine the low indicated leakage limit prior to the engine leakage check. Connect compressed air at 100-120 p.s.i. to the tester with cylinder pressure valve closed. Turn the regulator pressure valve on, adjusting pressure to indicate 80 p.s.i. Remove the dust caps from both ends of the Master Orifice Tool and install onto your cylinder spark plug adapter. Turn the cylinder pressure valve on and readjust regulator pressure gage to read 80 p.s.i. At this time the cylinder pressure gage indication will be the low allowable limit for cylinder leak checks. The low allowable limit is referred to as the master orifice calibrated pressure reading. After the master orifice calibrated pressure reading has been recorded, close regulator pressure valve and remove Master Orifice Tool from your cylinder adapter.

A schematic diagram of a typical differential pressure tester is shown in Figure 3.

C. PERFORMING THE CHECK

The following procedures are listed to outline the principles involved, and are intended to supplement the manufacturer's instructions for the particular tester being utilized.

CAUTION . . . Magnetos and fuel must be shut off prior to test to make certain that the engine cannot accidently fire.

(a) Perform the test as soon as possible after the engine is shut down to ensure that the piston rings, cylinder walls, and other engine parts are well lubricated and at running tolerance.

(b) Remove the most accessible spark plug from each cylinder.

(c) Turn the crankshaft by hand in the direction of rotation until the piston (in the cylinder being checked) is coming up on its compression stroke.

(d) Install an adapter in the spark plug hole and connect the differential pressure tester to the adapter. (NOTE: Cylinder pressure valve is in the Closed position). Slowly open the cylinder pressure valve and pressurize the cylinder not to exceed 20 p.s.i.

Continue rotating the engine against this pressure until the piston reaches top dead center (TDC). Reaching TDC is indicated by a flat spot or sudden decrease in force required to turn the crankshaft. If the crankshaft is rotated too far, back up at least one-half revolution and start over again to eliminate the effect of backlash in the valve operating mechanism and to keep the piston rings seated on the lower ring lands. This is critical because the slightest movement breaks this piston ring sealing and allows the pressure to drop.

CAUTION . . . Care must be exercised in opening the cylinder pressure valve, since sufficient air pressure will be built up in the cylinder to cause it to rotate the crankshaft if the piston is not at TDC. It is recommended that someone hold the propeller during check to prevent possible rotation.

(e) Open the cylinder pressure valve completely. Check the regulator pressure gauge and adjust, if necessary, to 80 p.s.i.

(f) Observe the pressure indication on the cylinder pressure gage. The difference between this pressure and the pressure shown by the regulator pressure gage is the amount of leakage through the cylinder. If the cylinder pressure gage reading is **higher** than the previously determined master orifice calibrated pressure reading, proceed to the next cylinder leak check. If the cylinder pressure gage reading is **lower**, proceed with the following.

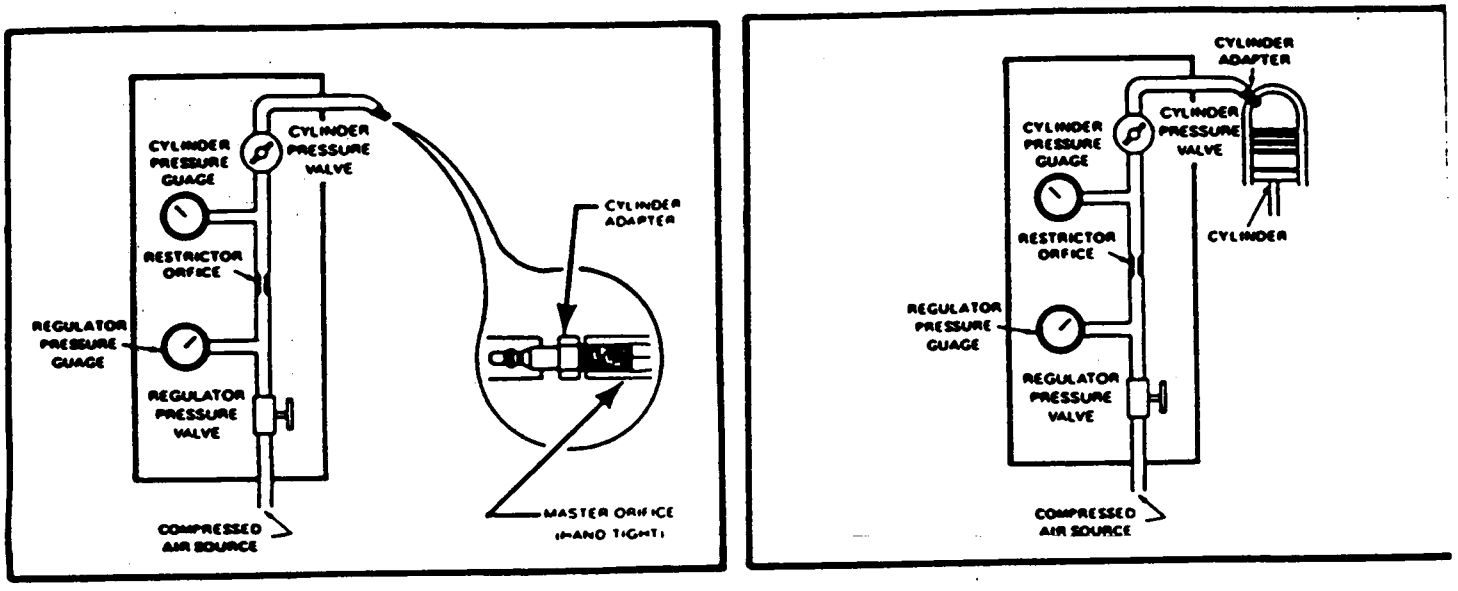


FIGURE 3 - DIFFERENTIAL PRESSURE TESTER

Static Seal Check (Table I)

(g) The source of air leakage should first be checked for the static seal. Positive identification of static seal leakage is possible by listening for air flow sound at the exhaust or induction system cylinder port. When checking for cylinder head to barrel leakage, use a soapy solution between the fins and watch for bubbles. Use a soapy solution also around both spark plug seals for leakage. NO LEAKAGE IS ALLOWED IN STATIC SEALS.

(h) If leakage is occurring in the intake or exhaust valve areas, it may be possible to correct a low reading by staking the valves. This is accomplished by placing a fiber drift on the rocker arm directly over the valve stem and tapping the drift several times with a hammer to dislodge any foreign material that may be between the valve face and seat.

CAUTION . . . When correcting a low reading in this manner, rotate the propeller so the piston will not be at TDC. This is necessary to prevent the valve from striking the top of the piston in some engines. Rotate the propeller again before rechecking leakage to reset the valves in the normal manner.

NOTE . . . When the rocker cover is removed, inspect valve springs, valve retainers, and valve stem for wear. This may have contributed to the valve leakage.

(i) If leakage is noted between the cylinder head and barrel, REPLACE THE CYLINDER. If leakage cannot be corrected at the valves by "staking", the cylinder must be removed and repaired before a Dynamic Seal Check

NOTE . . . When the cylinder is removed, with the spark plugs installed, inspection can be accomplished by filling the inverted cylinder bore with nonflammable solvent and then inspected for leaks at the static seal areas.

(j) If the cylinder was removed for static leakage, replacement or repair, inspect piston ring gap and cylinder wall for tolerance (Ref. Dynamic Seal, Figure 2). Once the piston and the cylinder have been cleaned, inspected, and ring gap tolerances have been met, reassemble to the engine.

Dynamic Seal Check

(k) To check the dynamic seal of a cylinder, proceed with the leakage test and observe the pressure indication of the cylinder pressure gage. The difference between this pressure and the pressure shown by the regulator gage is the amount of leakage at the dynamic seal.

(l) If the leakage is below the previously determined low cylinder gage reading, loss past the dynamic seal may be due to piston ring end gap alignment or by the piston and piston rings angular direction in the cylinder bore (Figure 4). First assure that the piston and piston rings are centered. This may be accomplished by reducing regulator pressure to 20 p.s.i. and working piston through TDC several times, bringing the piston to TDC in the normal direction of engine rotation. Adjust regulated pressure to 80 p.s.i. and determine amount of loss. If the gage reading is higher than the previously determined master orifice calibrated reading, proceed to next cylinder to be tested.

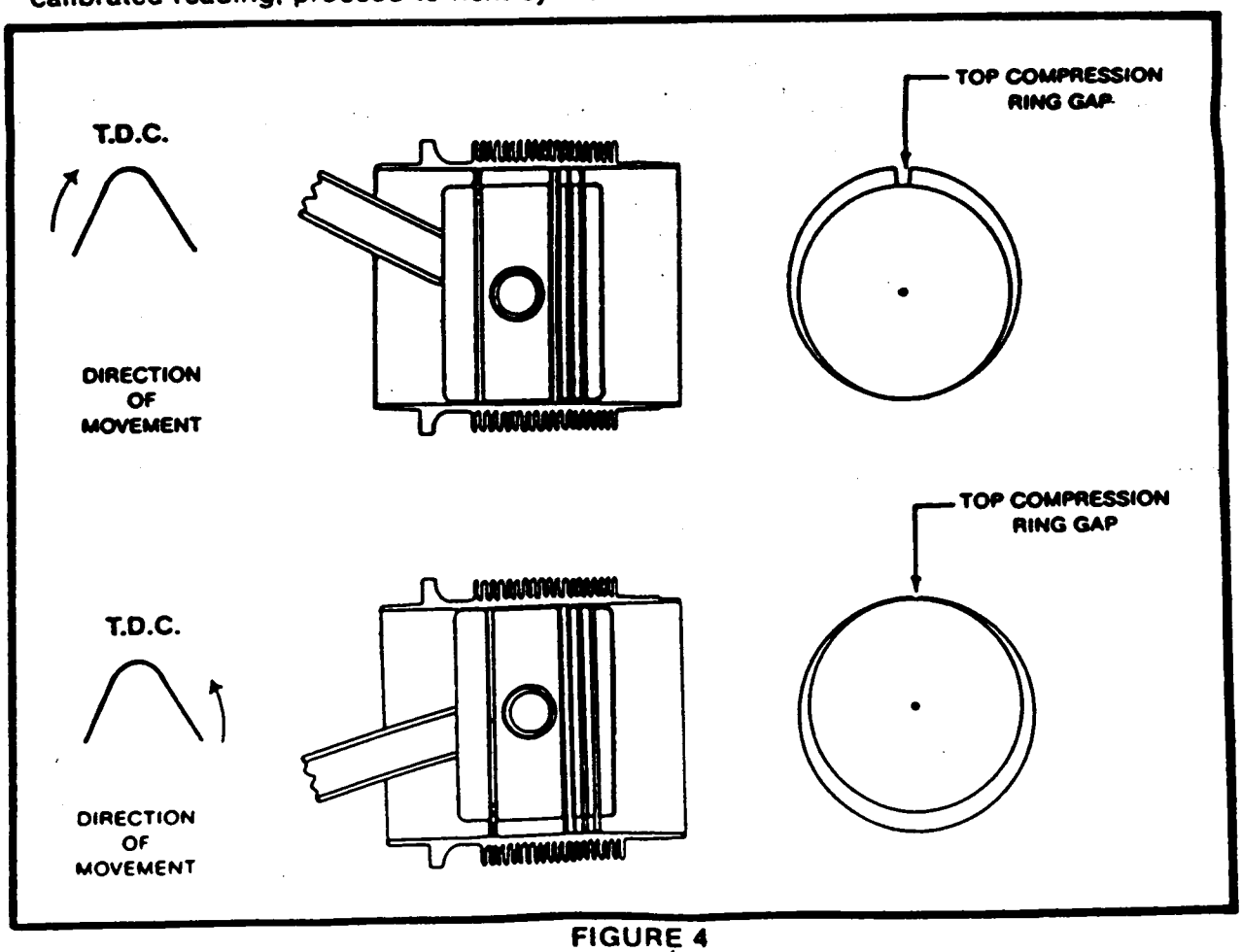


FIGURE 4

NOTE . . . Piston ring rotation within the ring land is a normal design characteristic. As illustrated in Fig. 4, the compression ring location may have a direct bearing on the dynamic seal pressure check. Therefore, we suggest you complete the test in the opposite direction if readings are below prescribed limits.

(m) If recheck of cylinder pressure gage reading indication remains below allowable loss, engine may be run-up to operating temperature and rechecked prior to cylinder being removed and repaired. Rework of cylinders should be accomplished as outlined in the engine overhaul manual and service bulletins.

FIRST CHECK	CHECK FOR	METHOD	1. DISCREPANCY	2. CORRECTIVE ACTION	2. CORRECTIVE ACTION
STATIC SEAL (NO LEAKAGE PERMISSIBLE)	Intake Valve to Seat Seal	Listen for Air Flow in Intake Port	Carbon	Stake Valve	
			(Cracked Cylinder)	Replace Cylinder	
			Seat Worn or Burned	Grind or Replace	Reinspect
			Valve Worn or Burned	Grind or Replace	
	Exhaust Valve to Seat Seal	Listen for Air Flow in Exhaust Port	Carbon	Stake Valve	
			(Cracked Cylinder)	Replace Cylinder	
			Seat Worn or Burned	Grind or Replace	Reinspect
			Valve Worn or Burned	Replace	
	Spark Plug (2) to Port Seal	Apply Soapy Solution Around Spark Plug	Loose Heli-coil	Replace Heli-coil	Reinspect
			Cracked Cylinder	Replace Cylinder	
	Cylinder Head to Barrel Seal	Apply Soapy Solution Between Head and Barrel	Bubbles	Replace Cylinder	
	Cylinder Head Cracks	Apply Soapy Solution Around Fins	Bubbles	Replace Cylinder	
SECOND CHECK	CHECK FOR	METHOD	1. DISCREPANCY	2. CORRECTIVE ACTION	2. CORRECTIVE ACTION
DYNAMIC SEAL	Leakage by Piston Rings	Test Gauge below Tolerance	Piston cracked or out of limits	Replace Piston	
			Worn Rings	Replace Rings	
			Cylinder wall dimentions out of limits	Replace Cylinder	
		Test Gauge above Tolerance	None	None	

Table 1

IMPORTANT

Checking the Differential Pressure Tester with Master Orifice Tool (646953)

With the Master Orifice Tool connected in place per Service Bulletin M84-15 and the Regulator Pressure Gauge is reading exactly 80 psi, the Cylinder Pressure Gauge must read 40-50 psi. *When connecting Master Orifice Tool-Be sure there are no leaks in connections.

If the Cylinder Pressure Gauge reading is not 40-50 psi, the Differential Pressure Tester is out of calibration and should not be used.

* Master Orifice Tools (646953) are accurately factory inspected prior to shipping.*CAUTION: Remove Master Orifice Tool (646953) before connecting Compression Tester to aircraft cylinder.