Service Instruction ENGINE COMPONENTS, INC.	S.I. No.: **93-6-7** Page: **1 of 1**
Title: RAPID ENGINE LEANING *Technical Portions are FAA DER Approved.*	Issued: **06/25/93** Revision: **0**

1.0 **PURPOSE**: Rapid engine leaning

2.0 **SCOPE**: All (applies to all controllable mixture aircraft piston engines).

3.0 **COMPLIANCE**: During engine operation.

Proper leaning is essential to efficient operation of aircraft piston engines. Much has been written about the technique for establishing the optimum lean operating conditions, but not much has been written about the effects of *rapid leaning*. A recent occurrence in an engine test being performed by Engine Components, Inc. (ECi) to show the compliance with the regulations regarding detonation has caused us to reconsider the danger of rapid leaning. During the test, an engine was rapidly leaned from a rich cruise power setting in an attempt to create conditions for detonation. The engine Coughed, and a brief flame was observed coming from the exhaust. However, an engine analyzer was being used, and no detonation was observed on the scope. An immediate tear down revealed that the pistons overheated and were scuffed around the skirt. There was no evidence of detonation. Additionally, the cylinder bores appeared glazed, and two cylinders had ripple (washboard) patterns in the bore corresponding to the location of the cooling fins around the barrel.

Evaluation of the test and results has convinced ECi that the cause for the scuffing and washboard effect is the rapid heat influx due to leaning could not be dissipated by the piston, but the barrel remained relatively cool due to airflow. The piston expanded due to heat, and the loss of side clearance caused further heating. In two cylinders, the piston expanded so fast that the pressures on the bore deformed the barrel between cooling fins.

Glazed and washboard cylinder barrel bores have been observed over the years by personnel at ECi, but the cause was usually attributed to break-in problems or shock cooling. It is now confirmed that shock heating can also create the anomaly. The cylinders in the engine test described above were confirmed to have been broken-in properly, and had even been checked with a bore scope just prior to the rapid leaning incident. ECi personnel are convinced that this phenomena can be produced in any engine that is leaned too rapidly.

The use of a fuel flow meter to rapidly establish preliminary mixture settings can lead to the anomaly described. In fact, many of the cylinders found with the characteristics described above are from the type of airplanes that often have fuel flow meters. ECi recommends that the following note be added to operating instructions:

CAUTION

LEANING OF THE MIXTURE SHOULD ALWAYS BE ACCOMPLISHED SLOWLY TO ALLOW CYLINDER TEMPERATURES TO STABILIZE. RAPID LEANING CAN CAUSE LOSS OF PISTON TO BORE CLEARANCE THAT CAN CAUSE PISTON SCUFFING AND BARREL DAMAGE.