BELIZE DEPARTMENT OF CIVIL AVIATION
AIWORTHINESS ADVISORY CIRCULARS

LIGHT AIRCRAFT PISTON ENGINE OVERHAUL PERIOD

Table of Contents **Page**

Light Aircraft Piston Engine Overhaul Periods

1. Normally, for a light aircraft piston engine, the BDCA will accept the engine manufacturer's overhaul period recommendations which have been promulgated under a system approved by the responsible airworthiness authority. Light aircraft engine in this context means either:

1.1 An engine installed in an aircraft, the Maximum Weight of which does not exceed 2730 kg, or

1.2 An engine of 400 hp or less.

NOTE: For the purpose of this Circular, engine includes those components and equipment necessary for satisfactory functioning and control. The propeller and its associated equipment are excluded.

2. Some manufacturers' publications permit operation beyond the overhaul periods recommended, at the discretion of the owner/operator, if the condition of the engine shows it to be justified. In certain instances the recommended overhaul periods are associated with particular rates of engine utilization, service bulletin/modification configuration and types of operation. The BDCA policy in respect of engines used in light aircraft is set out in paragraphs 3 to 6 and in the Appendices to this Airworthiness Advisory Circular.

3. Continuation in service shall be in accordance with paragraph 3.1, as qualified by paragraphs 3.1.1 to 3.1.2, as appropriate.

3.1 Engines may be operated to the periods between overhauls which have been recommended by the manufacturer and promulgated under a system approved by the responsible airworthiness authority, provided they conform to the appropriate service bulletin/modification configurations and types of operation. All such overhaul period recommendations by the manufacturer constitute a recommended overhaul period for the purposes of this Airworthiness Advisory Circular, including recommendations by the manufacturer for reduced overhaul periods with particular types of operation or, particular service bulletin/ modification configurations.

3.1.1 Where any overhaul period recommendation is stated in terms of both operating time and calendar time limitations, the BDCA will not permit the engine to operate beyond the calendar time limitation. Calendar time periods run from the date on which the appropriate release document was signed, by the manufacturer in the case of a new engine, or by the over-hauler in the case of an over-hauled engine, unless it can be established that the engine was adequately inhibited/stored up to the time of installation.

3.1.2 Engines which have reached the operating time limitation of a recommended overhaul period may continue in service for a further period of operation not

exceeding 20% of the recommended operating time, subject to (a), (b), (c), (d), and (e)

a) Compliance being shown with the appropriate limitations specified in Appendix No.1 to this Circular.

b) Compliance being shown with any Airworthiness or Additional Directive or Service Bulletin recommended as mandatory by the engine manufacturers that requires compliance at engine overhaul.

c) The engine must have been operated in an aircraft registered in Belize for a period of at least 200 hours immediately prior to completion of the engine manufacturer's overhaul period recommendation.

d) The engine being inspected in accordance with paragraph 4, in order to assess its condition immediately prior to the increase, and subsequently at 100 hour intervals. For engines operated in crop spraying aircraft the inspection must be repeated at 50 hour intervals.

e) The engine is within its calendar time limitation.

3.2 In the event that the inspection referred to in paragraphs 3.1.1 and 3.1.2 results in rejection, the affected assembly, e.g. cylinder, must be completely overhauled.

4 The inspections referred to in paragraphs 3.1.1 and 3.1.2 to assess the condition of engines, shall be in accordance with appendix 2 of this circular and shall be carried out by persons or organizations as follows:

4.1 Engines installed in aircraft operated for Commercial Air Transport shall be inspected by an Approved Maintenance Organization approved in accordance with the BCARs.

4.2 Engines installed in aircraft not operated for Commercial Air transport may be inspected and certified by an appropriately licensed aircraft maintenance engineer or an Approved Maintenance Organization specifically approved for the purpose. In the case where the inspection and certification have been made by appropriately licensed aircraft maintenance engineer the aircraft cannot then be subsequently used for commercial Air Transport without it being inspected and certified by an Approved maintenance organization.

5 In no case shall any mandatory restrictions be exceeded, and the compliance with mandatory bulletins/modifications/inspections shall be completed at the specified times.

6 In the case of engines not incorporating all the service bulletins/modifications or parts which would enable it to qualify currently for any recommended overhaul period as defined in paragraph 3.1 of this Circular, or of engine types not included in the

manufacturers' bulletins, a specific recommendation in writing must be sought from the manufacturer, and if this is not obtainable, Operators should be aware when seeking extensions that some manufacturers documents restrict recommendations of TBOs or TBO extensions to engines embodying only parts specified by the engine manufacturer.

Appendix No 1

1. The concept of allowing engines to run beyond the manufacturer's recommended overhaul period depends upon the presumption that it is possible to check the condition of the engine by prescribed inspections carried out at defined intervals. It is not intended to provide a freedom to run until the engine fails. The validity of the concept depends on the ability of the inspections to give warning of impending failure and in many areas of the engine this ability exists. There are, however some types of failure (e.g. crankshaft cracking, counter weight wear) for which predictive checks are not possible other than by stripping

2. In assessing the suitability of any engine to continue in operation beyond the manufacturer's recommended overhaul period, the Approved Maintenance Organization or engineer concerned must not go beyond any life limits and conditions specified in this Appendix.

3. LIMITATIONS

3.1 Thielert engines – All types

3.2 Under no circumstances will an aircraft be allowed to operate with more than one engine on a TBO extension programme, which has been approved by the BDCA in accordance with this Airworthiness Advisory Circular.

APPENDIX No 2

PISTON ENGINES - OPERATION BEYOND RECOMMENDED OVERHAUL PERIODS

1. INTRODUCTION

This Appendix gives guidance on the procedures which are necessary for a small piston engine to be accepted as being in a condition which will allow completion of, or operation beyond, the recommended overhaul period under the terms of this AAC

2. GENERAL

A piston engine which has reached the end of its normal overhaul period may be expected to have suffered some wear to cylinders, pistons, valves, bearings and other moving parts, but an engine which has been carefully operated and maintained may still be in a condition suitable for a further period of service.

2.1 Many factors affect the wear which takes place in an engine, the most important including the efficiency of the air intake filter, the techniques used in engine handling, particularly during starting, the quality of the fuel and oil used in the engine and the conditions under which the aircraft is housed when not in use. Conditions of operation are also relevant; the length of flights, the atmospheric conditions during flight and on the ground, and the type of flying undertaken. Many of these factors are outside the province of the maintenance engineer, but meticulous compliance with the approved Maintenance Programme, and any instructions provided in the form of service bulletins or constructor's recommendations will undoubtedly help to prolong the life of an engine.

2.2 This Airworthiness Advisory Circular lays down certain conditions which must be fulfilled in order that an engine may be considered for:

a. Operation for the manufacturer's recommended overhaul period,

b. operation for up to 120% of the recommended overhaul period, or

2.2.1 The inspections and tests which may be necessary to assess the condition of an engine in compliance with this Airworthiness Advisory Circular are detailed in paragraphs 3 to 6.

3 EXAMINATION AND CHECKING OF ENGINE:

A number of items included in the normal scheduled maintenance of an engine may be repeated to determine the condition of an engine at the end of its normal overhaul period, and additional inspections may also be specified.

3.1 External Condition.

The engine should be examined externally for obvious faults such as a cracked crankcase, excessive play in the propeller shaft, overheating and corrosion, which would make it unacceptable for further use.

3.2 Internal Condition.

Significant information concerning the internal condition of an engine may be obtained from an examination of the oil filters and magnetic plugs, for metal particle contamination. These checks may be sufficient to show that serious wear or breakdown has taken place and that the engine is unacceptable for further service.

3.3 Oil Consumption.

Since the oil consumption of an engine may have increased towards the end of its normal overhaul period, an accurate check of the consumption over the last 10 flying hours would show whether it is likely to exceed the maximum recommended by the constructor, should the overhaul period be extended.

3.4 Compression Check.

Piston ring and cylinder wear, and poor valve sealing could, in addition to increasing oil consumption, result in a significant loss of power. A cylinder compression check is a method of determining, without major disassembly, the standard of sealing provided by the valves and piston rings.

3.4.1 On engines with a small number of cylinders, a simple compression check may be carried out by rotating the engine by hand and noting the resistance to rotation as each cylinder passes through its compression stroke. The check should normally be made shortly after running the engine while a film of oil remains on the rubbing surfaces, to assist sealing and prevent scoring the working parts. If this is not possible, the constructor may recommend that oil is introduced into each cylinder and the engine turned through a number of revolutions before making the test.

a. This method may be used to determine serious loss of compression on a single cylinder or the difference between the compressions of individual cylinders, but may not accurately show a similar partial loss of compression on all the cylinders of an engine.

b. An alternative method, which will give a more accurate result, is to fit a pressure gauge (reading up to 1400 kPa (200 lbf/in^2))in place of one sparking plug in each cylinder in turn and note the reading as the piston passes through top dead centre (TDC) on the compression stroke.

3.4.2 Another method of carrying out a direct compression test is by use of proprietary type of compression tester equipped with a means of recording cylinder pressures on a graph card. One set of plugs should be removed immediately after an engine run, and the compression tester fitted to each cylinder in turn while rotating the engine by means of the starter motor. The effectiveness of combustion chamber sealing can be judged by assessment of the graph records obtained.

3.4.3 A further method of checking engine compression is the differential pressure test. In this test a regulated air supply (normally 560 kPa (80 lbft/in²) is applied to each cylinder in turn and a pressure gauge used to record the actual air pressure in the cylinder. Since some leakage will normally occur, cylinder pressure will usually be less than supply pressure and the difference will be an indication of the condition of the piston rings and valves. By listening for escaping air at the carburetor intake, exhaust and crankcase breather, a defective component may be located. As with the previous tests, it is usually recommended that the differential pressure test is carried out as soon as possible after running the engine.

NOTE: The crankshaft should be restrained during this test as, if the piston is not exactly at the end of its stroke, the test air pressure may be sufficient to cause rotation.

4. POWER OUTPUT OF AEROPLANE ENGINES

The power developed by an aeroplane engine after initial installation is established in the form of a reference engine speed, which is recorded in the appropriate log book so that comparisons can be made during subsequent power checks. The reference engine speed is the observed engine speed obtained using specified power settings and operating conditions, corrected by means of graphs supplied by the engine constructor, to the figure which would be obtained at standard sea-level atmospheric temperature and pressure; changes in humidity do not produce large changes of power and are ignored for the purpose of establishing a reference engine speed or subsequently checking engine power. Power checks should be carried out using the same power settings and operating conditions as when the reference engine speed was established, and should be corrected in the same way.

4.1 Power Checks.

The majorities of light aeroplane piston engines are air-cooled and rely on an adequate flow of air for proper cooling of the cylinders. This condition can only be obtained during flight, and ground runs should, therefore, be as brief as possible. Cooling can be assisted by facing the aircraft into wind, but high wind conditions must be avoided when making power checks, as they will seriously affect the results obtained. Before running the engine at high power the normal operating temperatures should be obtained (not the minimum temperatures specified for

operation) and during the test careful watch should be kept on oil and cylinder temperatures to prevent the appropriate limitations being exceeded.

4.1.1 Normally-aspirated engines are tested at full throttle and, where a controllable pitch propeller is fitted, with maximum fine pitch selected. The changes in barometric pressure affecting engine power are considered to be balanced by changes in propeller load, so that only a temperature correction is necessary. This correction factor may be obtained from a graph supplied by the engine constructor. The observed full throttle speed multiplied by the correction factor will give the corrected speed.

4.1.2 Although normally-aspirated engines are often fitted with variable-pitch propellers, the engine speed obtained at full throttle is usually less than the governed speed and the propeller remains in fully fine pitch. With supercharged engines, however, the propeller is usually constant speeding at high power settings and small changes in power will not affect engine speed. The power of a supercharged engine is, therefore, checked by establishing a reference speed at prescribed power settings

a. Since a supercharged engine is run at a specified manifold pressure regardless of the atmospheric pressure, corrections must be made for both temperature and pressure variations from the standard atmosphere.
b. The procedure is to run the engine until normal operating temperatures are obtained, open up to maximum take-off manifold pressure, decrease power until a fall in engine speed occurs (denoting that the propeller blades are on their fine pitch stops), then throttle back to the manifold pressure prescribed by the constructor and observe the engine speed obtained.
c. The correction factor to be applied to the observed engine speed of a supercharged engine may be obtained from graphs supplied by the engine constructor.

4.1.3 Although the engine speed obtained during a check of engine power is corrected as necessary for atmospheric temperature and pressure, no correction is made for humidity, ambient wind conditions or instrument errors and, consequently, the corrected engine speed is seldom exactly equal to the reference speed even if engine condition is unchanged. However, engine power may usually be considered satisfactory if the corrected speed obtained during a power check is within 3% of the reference speed.

4.1.4 If it is not possible to assess power deterioration by means of a power check (e.g. due to fitting a different propeller), a rate-of-climb flight test should be carried out.

5. POWER LOSS.

If the power check (paragraph 4) or normal engine operation reveal an unacceptable loss of power or rough running, it may be possible to rectify this by carrying out certain of the normal servicing operations or by replacement of components or equipment. The replacement of sparking plugs, resetting of tappets or magneto contact breaker points, or other adjustments to the ignition or carburetion systems, are all operations which may result in smoother running and improve engine power.

6. SERVICING.

If the engine proves to be suitable for further service, then a number of servicing operations will normally be due, in accordance with the approved Maintenance Schedule. Unless carried out previously (paragraph 6) these operations should be completed before the engine is returned to service.

7 LOG BOOK ENTRIES.

A record of the checks made, and any rectification or servicing work, must be entered and certified in the engine log book before the engine is cleared to service for its recommended or extended life under the provisions of this Airworthiness Advisory Circular.

8. CHECK LIST.

The check list on pages 11 to 12 of this AAC must be completed and entered in aircraft logbook. Prior to the implementation of the extension provided by this AAC, the operator should submit a letter of notification to the BDCA making reference to the aircraft registration, engine part number and serial number.

PISTON ENGINE OVERHAUL EXTENSION CHECKLIST

Operator: _____ Maint Organization: _____

A/C Registration: _____ A.C. Type: _____ Engine Type: _____

Engine S/N: _____ Date of Construction: _____ T.T:_____

Position: _____ Manufacturer's TBO:_____

Date overhauled: _____ Over hauler:_____

Inspection Frequency: (Initial) - (1st 100 hr) - (2nd 100 hr) - (3rd 100 hr) (Delete as appropriate).

Item	Details of Inspection	Mechanic	Inspected By
1	Check engine externally for cracks, leaks, corrosion and signs of overheating		
2	Check prop shaft for excessive play		
3	Check engine internally for unusual wear scoring of cylinder walls, signs of overheating and general condition		
4	Examine any magnetic plugs for metal particles contamination		
5	Drain oil filter cloth and check for metal particles		
6	Replace oil filters(full flow) and check for metal particle contamination		
7	Examine oil filters and magnetic plugs for metal particles		
8	Record oil consumption over the last 100 hours to ensure it does not exceed the maximum recommended quarts per hour		
9	Carry out engine compression check and record results No. 1 Cyl: _____ No. 2 Cyl: _____ No. 3 Cyl: _____ No 4 Cyl: _____ No. 5 Cyl: _____ No. 6 Cyl: _____		

Item	Details of Inspection	Mechanic	Inspected By
10a	Carry out engine power check and record <u>Original:</u> RPM: _____ Man pressure: _____ Oil Press: _____ LH mag drop: _____ RH mag drop: _____		
10b	Carry out engine power check and record <u>Present:</u> RPM: _____ Man Pressure: _____ Oil Press: _____ LH mag drop: _____ RH mag drop: _____ Bar press: _____ Oil Temp: _____ Fuel Press: _____		
11	The engine is in compliance with all applicable Airworthiness Directives for type		
12	The engine is in compliance with all applicable BDCA Airworthiness for type		
13	The engine is in compliance with all applicable manufacturer's requirements regarding engine life extensions		
14	Carry out 100 hours inspection to the approved maintenance schedule		
15	Complete engine log book entries and signed by Belizean licensed engineer		

Certifies that the work specified above was carried out in accordance with the current Belize Civil Aviation Regulations and in respect to that work, the aircraft/component is considered ready for release to service.

Name: _____ Date: _____

Signature: _____ License No.: _____

Approved Maintenance Organization: _____