

European Aviation Safety Agency

Acceptable Means of Compliance (AMC)

to

Part-M

I. Draft Decision Part-M - Annex to Decision 2013/005/R

Annex I to ED Decision 2003/19/RM of the Executive Director of the Agency of 28 November 2003, on 'Acceptable means of compliance and guidance material to Commission Regulation (EC) No 2042/2003 of 20 November 2003 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks', is hereby amended as follows:

The text of the amendment is arranged to show deleted text, new text or new paragraph as shown below:

1. deleted text is marked with ~~strike-through~~.
2. new or amended text is highlighted in **grey**.
3. an ellipsis (...) indicates that the remaining text is unchanged in front of or following the reflected amendment.

1) A new AMC, AMC2 M.A.302 (d) is added:

AMC2 M.A.302 (d) – Aircraft Maintenance programme

TIME BETWEEN OVERHAULS

1. Introduction

When the instructions for continuing airworthiness referred to in M.A.302 (d) (ii) contain overhaul intervals for components, typically referred to as Time Between Overhauls (TBO), they should be taken into account when developing the aircraft maintenance programme. Unless paragraph 2 or 3 below is followed, TBO values established by the design approval holder¹ (DAH) should apply. TBOs included in the Airworthiness Limitations Section or otherwise mandated by the Agency cannot be deviated from. TBOs are normally defined in terms of calendar time and/or operating or flying hours/cycles/landings, whichever occurs first.

Intervals proposed by the DAH as TBOs may be different for different variants of the component and for components with design changes or service bulletins embodied.

2. Eligibility and process for TBO extension

Except for the cases mentioned in paragraph (1) below, for non-powered and piston engine aircraft other than complex motor-powered aircraft (CMPA), the owner or the CAMO managing the aircraft maintenance programme may propose, in accordance with M.A.302(d)(iii), extended intervals for overhauling the components (TBO^E from now on) compared to those TBOs recommended by the DAH (hereinafter referred to as TBO^R).

In order to obtain the approval of a different overhaul interval compared to the one established by the DAH, the following should be observed:

- a) Inspection standards and tests conditions as well as pass-fail criteria should be stated before the component is inspected and be based on the components' typical parameters provided by the DAH in the form of manuals. In addition to the provisions of Appendix I to the AMC M.A.302 and AMC M.B.301(b) 'Content of maintenance programme', these standards, conditions and criteria should be considered part of the aircraft maintenance programme.

¹ Type certificate, Supplemental Type Certificate or repair design approval holder as applicable

- b) At the TBO^R the component should be inspected (and possibly tested, depending on the type of component) by an appropriately B or C rated maintenance organisation in accordance with the maintenance data for obvious defect or abnormal functioning.
- c) For ELA1 aircraft not used in commercial air transport these inspections may also be performed by M.A.801 (b) 2 certifying staff in accordance with M.A.502(d). For piston engines, these inspections should satisfy Appendix XIV to this AMC2.
- d) All component's parts identified by the DAH for replacement at TBO^R which are accessible during the inspection should be individually inspected and replaced if necessary.
- e) The results of the inspection should be considered as maintenance records by the maintenance organisation and should be conclusive. A copy of the inspection results should be provided to the aircraft owner.
- f) Airworthiness Directives affecting the component and required to be completed at the time of the overhaul should be completed not later than TBO^R.
- g) If the inspection is satisfactory and there is no reason to believe that the component will not function as intended (e.g. consideration of past occurrences affecting the individual aircraft), the TBO^E will be reflected in the aircraft maintenance programme (refer to paragraph j)) together with any additional maintenance action identified as necessary so that the component functions as intended until that time. As a minimum, another conclusive inspection should be programmed when 50 % of the extended interval $((TBO^E - TBO^R)/2)$ is reached. TBO^E should not exceed 20 % of TBO^R in calendar time or operating hours, whichever comes first.
- h) At TBO^E, a second extension (TBO^{E2} from now on) of a maximum of 20 % of TBO^R may be granted when conditions a) to g) are similarly met.
- i) No further TBO extension should be allowed except for components fitted on privately operated aircraft with a MTOM of 2 730 kg or below, for which there is no limit on the number of extensions (20 % of TBO^R each) when conditions a) to g) are similarly met. In this case, at the time of the third TBO extension, the fact that the aircraft is privately operated should be stated in the aircraft's continuing airworthiness records (e.g. aircraft logbook). The components affected should also be identified.
- j) Based on the results of the inspection mentioned in paragraphs g), the aircraft maintenance programme amendment containing the extended TBO should be approved by the competent authority. Alternatively, and notwithstanding the provisions of paragraph 7 of AMC M.A.302(d), for privately operated aircraft with a MTOM of 2 730 kg or below the maintenance programme may be approved in accordance with the M.A.302 (c) indirect approval procedure.
- k) A component with an extended TBO should not be installed on a different aircraft unless agreed by the competent authority of the Member State of registry.
- l) TBO extensions in accordance with this AMC2 should not be considered for components:
 - i. installed in aircraft used in commercial air transport
 - ii. installed in aircraft used for 'ab initio' training activities,
 - iii. linked to IFR operations, and
 - iv. for which their normal serviceable condition could be affected because of the aircraft's utilisation (e.g. engine on an aircraft used for aerobatic flights).
- m) Despite (l)(iv) above, the TBO extensions in accordance with this AMC2 can be considered for the components affected by the operation of the aircraft in highly

corrosive environment or installed on aircraft used for towing provided that the inspections/checks of the components are performed at intervals of 25 % of the extended interval $((TBO^E - TBO^R)/4)$. In these cases, for the extension of the engine's TBO in addition to the measures defined by the paragraph 3 of Appendix XIV to AMC2 M.A.302 (d), a boroscoping inspection and/or an oil spectrographic analysis should be part of the inspection.

3. Components' Trend Monitoring

Alternatively to the maintenance programme containing scheduled overhaul intervals of the components, the owner or the CAMO managing the aircraft maintenance programme may propose a maintenance programme based on trend monitoring and analysis of these trends, together with component rejection criteria. This maintenance programme should start at the beginning of the component's life or include a minimum of 6 scheduled condition checks performed before the TBO is reached.

2) AMC M.B.301(b) is modified with M.B.301(b)(9):

AMC M.B.301 (b) – Maintenance programme

In respect of the extension of the TBOs mentioned in AMC2 M.A.302 (d):

1. the competent authority may elect not to extend the component's TBO when the individual aircraft has been under its Member State register for less than 12 months or has been operated under that registration for less than 100 flying hours. If necessary, CAMO procedures allowing maintenance programme indirect approval should be limited accordingly.
2. for aircraft types/components for which the competent authority considers not having enough experience, it may elect not to extend the TBO of components until the sufficient service experience is gained.
3. in the case described in paragraph 3 of AMC2 M.A.302(d), the competent authorities may accept the trend monitoring approach based on a positive opinion of the DAH or, when having enough knowledge and history record of the subject component, considering also the particular circumstances (e.g. intended utilisation) of the individual aircraft.
4. In respect to the paragraph 2.2 of the Appendix XIV to AMC2 M.A.302 (d), competent authorities may accept alternative inspections/test that would provide equivalent information or findings.

3) A new appendix, Appendix XIV to AMC2 M.A.302 (d) is added:

Appendix XIV to AMC2 M.A.302 (d) – Aircraft Maintenance programme

PISTON ENGINE CRITERIA FOR OPERATION BEYOND DESIGN APPROVAL HOLDERS' RECOMMENDED OVERHAUL PERIODS

1 Subject

This appendix provides criteria on the procedures needed for the extension of TBO^R of a piston engine. Refer to AMC2 M.A.302 (d).

2 Introduction

A piston engine that has reached the end of its DAH recommended overhaul interval may be expected to have suffered some wear to cylinders, pistons, valves, bearings and other moving

parts, but an engine that 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 that takes place in an engine. The most important of these include: 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 duties of the maintenance personnel, but meticulous compliance with the approved maintenance programme and any instructions provided in the form of service bulletins or DAH's recommendations will undoubtedly help to prolong the life of an engine.

2.2 The inspections and tests that may be necessary to assess the condition of an engine in compliance with AMC2 M.A.302 (d) are detailed in the following paragraphs. Alternative inspections/tests that would provide equivalent information or findings may be proposed.

3 Inspection and maintenance

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 defects such as a cracked crankcase, excessive play in the propeller shaft, overheating and corrosion, which would make it unacceptable for further use.

Special attention should be drawn to the cables, plugs, connectors and sensors of engines equipped with electronic control systems regarding improper mounting, shaving, worn contacts, and other kind of damage. Worn or damaged parts have to be repaired/replaced according to the Design Approval Holder's (DAH) instructions.

External tubes and houses should be checked and if necessary replaced in accordance with the DAH's instructions.

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 consumption defined by the DAH, if the overhaul period were to be extended.

3.4 Compression check

Piston ring or cylinder wear, or poor valve sealing could, in addition to increasing oil consumption, result in a significant loss of power. A cylinder compression check should be carried out in accordance with the DAH's instructions.

The usual method of checking engine compression is the differential pressure test. In this test a regulated air supply (normally 560 kPa (80 lbf/in²)) is applied to each cylinder in turn and a pressure gauge is used to record the actual air pressure in the cylinder. Since some leakage will normally occur, cylinder pressure will usually be less than the 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 carburettor intake, exhaust and crankcase breather, a defective component may be located. It is usually recommended that the differential pressure test is carried out as soon as possible after running the engine.

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 logbook so that a comparison can be made during subsequent power checks. The reference engine speed is the observed engine speed obtained using specified power settings and conditions corrected, by means of graphs supplied by the engine DAH, 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 corrected in the same way.

4.1 Power checks

The majority 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 significantly 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 fully fine pitch selected. The changes in barometric pressure affecting engine power are considered to be balanced by changes in propeller load, so that only temperature correction is necessary. This correction factor may be obtained from a graph supplied by the engine DAH (if not provided by the DAH, Leaflet 70-70 Piston Engine Overhaul – Correcting Engine Test Results of CAA UK CAP 562 could be used). 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 governed to a constant speed 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 DAH 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 DAH.

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 the 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 output of helicopter engines

The power developed by the engine of a single-engine helicopter is considered to be adequately checked during normal operations; any loss of power should be readily apparent. It is thus not considered necessary to check the power output of a helicopter engine separately specifically for the purpose of complying with this annex.

6 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 normal servicing operations or by replacement of components or equipment. The replacement of spark plugs, resetting of tappets or magneto contact breaker points, or other adjustments to the ignition or carburation systems, are all operations that may result in smoother running and improve engine power.

7 Servicing

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

8 Logbook entries

A record of the checks made, and any rectification or servicing work, must be entered and certified in the engine logbook before the engine is released to service for its recommended or extended service life under the provision of AMC2 M.A.302 (d). The logbook entry made should also specify any restriction on further use (refer to AMC2 M.A.302 (d)).

9 Maintenance programme amendments

The aircraft maintenance programme should reflect the provisions for TBO extension and the additional maintenance tasks required with their periodicity to operate the aircraft engine beyond its recommended overhaul period as detailed in AMC2 M.A.302 (d).