

OPERATING INSTRUCTIONS

STARTING AND GROUND RUNNING INSTRUCTIONS

(This EO replaces EO 10A-1-1J dated 20 Oct 58)

1 Starting, running-up and shutting down of an aero-engine in a landplane or seaplane (when on shore) is to be done only by personnel as authorized in EO 00-50-16.

STARTING INSTRUCTIONS

2 In addition to the procedure outlined in the relevant Engineering Order on pre-starting precautions, starting, running-up and stopping each type of aero-engine, the following rules and precautions are to be adhered to:-

(a) If an engine fails to start, despite a correct drill, further efforts are NOT to be made, or additional measures taken to start the engine without the advice of an Engineer Officer or a qualified NCO aero-engine technician.

(b) Starting and stopping procedure for engines equipped with an oil dilution system is outlined in applicable AOIs.

(c) At times when there is a shortage of qualified ground personnel for engine starting, such as just prior to commencement of the day's flying at Service Flying Training Schools, arrangements are to be made to have qualified student pilots available for the starting and running-up of aero-engines.

(d) At no time is any person to start an aero-engine or operate the ancillary controls of an aircraft without first carrying out a complete cockpit check.

(e) When starting an engine by means of an external power source, this unit if possible is to be positioned behind the line of the propeller(s). During the operation of removing the external power source connection from the aircraft, the airman is to FACE the propeller(s).

(f) On all occasions when starting up engines, an airman, equipped with a hand fire extinguisher and trained in its use, must be standing by each aircraft. It will be this airman's responsibility to ensure the propeller and engine area of operation are clear of obstruction.

(g) When an aero-engine is hot from recent running, it is to be regarded as on "contact" and handled accordingly. No attempt is to be made to rotate a very hot engine by hand.

(h) If for any reason the ground crew should require the engine(s) to be shut down after it is started, they shall attract the attention of the person at the controls by shaking the aileron, or by some other pre-determined means, and give the "CUT MOTORS" signal.

PROCEDURE IN THE EVENT
OF ENGINE FIRE

3 The procedure is as follows:-

(a) Should a fire occur, ground crew must immediately warn the pilot by giving the "CUT MOTORS" signal and at the same time alternately point to the fire extinguisher and the engine in question. If the appropriate action to be taken in event of fire is not contained in the relevant

aircraft EO, the following procedure will be adhered to. No attempt is to be made to deal with fire by merely opening the throttle as this may increase the severity of the blaze rather than check it. On receipt of warning from the ground crew, the pilot or technician is to:-

- (1) Close the throttle.
- (2) Stop the engine, using the idle cut-off or slow running cut-off, or if neither is fitted, by turning off the ignition.
- (3) Turn off fuel and switch off booster pump.
- (4) Switch off ignition (if this has not already been done to stop the engine).

(b) An intake fire may be dealt with by the ground crew by blanketing the intake as soon as the propeller has stopped. In the case of any other type of fire, or of a serious intake fire, the ground crew should use fire extinguishing equipment and/or call for the pilot to operate the cockpit fire extinguisher as soon as the propeller has stopped. The pilot should operate the cockpit fire extinguisher on his own initiative if he considers it necessary, but not before the engine has stopped, as the fire is liable to recur as soon as the brief action of the extinguisher is finished.

(c) No attempt is to be made to restart an engine that has been on fire until it has been examined. An exception may be made if an intake fire has been successfully dealt with by blanketing the intake and without the use of the cockpit fire extinguisher or hand fire extinguisher.

4 The pilot or technician is to ensure that:

(a) They are familiar with and thoroughly understand all verbal and visual signals used when starting aero-engines.

(b) They are familiar with and thoroughly understand the cockpit check as detailed in the relevant Pilot's Notes for the aircraft of which they are about to start the engines.

(c) The aircraft is securely chocked on suitable ground.

(d) There is no possibility of the slipstream causing any damage.

(e) Personnel are present with adequate fire extinguisher equipment and that the procedure to be carried out, as detailed in para. 3, in the case of the engine fires is understood.

(f) All doors are securely closed.

(g) The coupe top or sliding windows in the pilot's position are open to exchange signals clearly.

5 Chief Technical Engineer Officers are to ensure that adequate instructions are issued for each type of aircraft in use at the Unit as to the nature of a cockpit check to be carried out by ground crew personnel when starting engines. Wherever possible, starting and stopping instructions are to be displayed inside each aircraft.

DAMAGE FROM "HYDRAULIC ACTION"

6 When radial engines or engines with inverted cylinders are left idle for even short periods, oil may drain down past the piston rings of the inverted cylinders and collect in the combustion chambers. If this accumulation exceeds the minimum cubic capacity of the chamber, the pistons cannot pass top dead centre. This condition is termed "Hydraulic Lock". If a start is attempted when a Hydraulic lock exists, serious damage will occur. To determine if this condition is present all engines are to be turned over through at least one complete firing cycle immediately prior to each engine start.

7 To meet this requirement all engines equipped with direct drive electric starters are to be motored by continuous engagement of the starter. Inching the engine through is not permitted under any circumstances. Engines with inertia starters are to be turned slowly by hand. When using the starter the presence of liquid lock is indicated by the engine kicking back or by the starter clutch slipping and preventing further turning of the engine. Undue resistance when hand turning is a similar indication.

8 When hydraulic lock is indicated, remove one spark plug from each cylinder below the centre line of the engine and rotate the propeller shaft in the direction of normal rotation until all liquid accumulated in the cylinders is expelled through the spark plug holes or exhaust ports. In certain installations where the engine is not mounted with the crankshaft horizontal, liquid may accumulate in the lowest points of the intake pipes and be drawn into the combustion chamber when the engines start. In this type of installation when hydraulic lock is determined and drain pipes are not fitted to the induction pipes all pipes below the centre line of the engine are to be removed and drained.

DAMAGE FROM OVER PRIMING

9 If fuel priming is done to excess:

- (a) The engine will not start.
- (b) The lubricant is washed from the cylinder walls, causing dry friction, loss of compression and damage to the cylinders sleeve valves, pistons and rings, with subsequent loss of performance and possible engine failure.
- (c) Sufficient fuel/oil mixture may accumulate in one or more cylinders, to cause "Hydraulic Action".
- (d) Unburnt fuel mixture may accumulate in the exhaust manifold or drain to the air intake, and the ground, constituting a serious fire hazard.

Prepared by:
AMC/SAMO/PA1

ISSUED ON AUTHORITY OF THE CHIEF OF THE AIR STAFF

CAUTION

Under no conditions are aero-engines to be primed inside the Hangar.

- (e) If fuel drains to the ground, the aircraft is to be moved to a new position before attempting a new start.

RUNNING AND TESTING ON THE GROUND

10 Starting up and ground running of aero-engines are not to be considered a necessary adjunct to the Daily Inspection and may be omitted at the discretion of the Commands concerned. Boost and rpm are to be kept to the minimum required for functional testing of ancillary equipment.

11 When it becomes necessary to run up and ground test aero-engines installed in aircraft warm up procedure and testing of magnetos, propellers, and superchargers is to be carried out in accordance with the relevant EO's. The period of running for each test is to be restricted to the minimum necessary to ensure steady running and consistent readings of instruments.

12 Idling of engines is to be carried out between 800 and 1200 rpm and vibration ranges are to be avoided. If the throttle has been completely closed, spark plugs may be cleared by increasing the rpm.

13 Engines are not to be opened up beyond observed field barometric pressure except under the following circumstances:

- (a) To enable adjustment of a boost control or propeller governor.
- (b) To test a propeller installation.

14 Air cooled engines are not to be run up on the ground for any purpose without the complete engine cowling fitted, as the cowling is an essential part of the cooling system.

15 Engines are not to be stopped by turning off the fuel supply and running the carburettor dry, if any other means is available. If a slow running cut-out is fitted, it is always to be used.

