NOTES for PILOTS and FLIGHT ENGINEERS

"Bristol"

HERCULES VI & XVI ENGINES

IN

STIRLING III, IV & V AIRCRAFT

These Notes are applicable only to fully-rated engines running on 100-octane fuel and are complementary to information given in official publications

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FLYING CONDITIONS.

	FOR	R.P.M.	BOOST lb./sq. in.	MIX-TURE.	GEAR RATIO (See "Running Notes")	COWL GILLS	CYL. TEMP.	OIL TEMP.
1	TAKE-OFF AND INITIAL CLIMB (5-minute limit)	2,800	+8¼	NORMAL	'M'	⅓ OPEN	Not more than 230°C. at start	Over 15°C. (+5°C. Min. in emergency)
2	MAXIMUM CLIMB	2,400 (2,500 in 'S' gear)	+6	NORMAL	'M' below approx. 9,000 ft.	ADJUST to keep cylinder temperatures within limits quoted	270°C. Max. 160°C. Min.	90°C. Max.
3	MAX. ECONOMICAL CRUISE	2,400	+2	WEAK	'M' below approx. 14,000 ft.		Emergency concession 290°C. Max. (See "Key to Flying Conditions" No. 7)	80°C. Max. (55/65° desirable)
4	MAX. CONTINUOUS CRUISE	2,400	+6	NORMAL	'M' below approx. 9,000 ft.			80°C. Max. (55/65° desirable)
5	ALL-OUT (5-minute limit)	2,800	+8¼	NORMAL	'M' below approx. 10,000 ft.		280°C. Max.	100°C. Max.
6	DIVE (Max.)	3,120	+8¼	NORMAL	Preferably 'M'	CLOSED	Emergency concession 300°C. Max. (See "Key to Flying Conditions" No. 7)	100°C. Max.
7	MAXIMUM FOR STATIC GROUND-RUNNING OR ANY CONDITIONS IN FLIGHT							100°C.

Always set air intake controls to COLD except when cruising or gliding in damp atmosphere, clouds, rain or snow

Use only 100-octane fuel.

RUNNING NOTES.

STARTING.

1. Turn on fuel cocks. Ensure all balance cocks off.
2. If carburettor empty, adjust priming cock to feed appropriate engine. Then half-fill float-chambers by giving 10 double strokes of small-capacity (20 c.c.) pump ; if larger pump fitted, give proportionally less strokes. Avoid over-priming since full carburettor unnecessary for starting. Cease pumping immediately if fuel runs from volute-casing drain.
3. Set throttle just off closed position.
4. With Hercules VI engines, check that mixture control is at NORMAL.
5. Set propeller speed control lever fully up.
6. Ensure supercharger control set to 'M' gear.
7. Ensure air-intake heat control at COLD.
8. Set cowl gills fully open, unless air temp. below 0°C. when control should not be moved until engine has run for about 2 min.
9. With ignition off, hand-turn propeller 2 complete revs., then press starter button for another 2 revs. If free rotation impeded in either case, stop turning and suspect hydraulic locking.
10. Adjust doping cocks to appropriate position (high-volatility fuel should be used when air temp. below 0°C.). Then operate doping pump until increase in resistance to movement indicates pipe lines full.
11. Press starter button. While engine is turning, operate doping pump vigorously at rate according to air temp., increasing rate the lower the temp. Switch on ignition and booster coil after engine has turned through 2 revs. If engine does not start within 20 sec., release starter button and wait 30 sec. before further turning.

Never pump-handle throttle lever or lower cylinders may become filled with fuel and damage to engine will result.

Turn off doping cock and screw home doping-pump plunger after use.

In cold weather do not shut down until engine thoroughly warm ; otherwise, after a stand-by, ice might form in cylinders or across sparking-plug points.

WARMING UP AND GROUND-RUNNING.

If oil pressure does not rise immediately after starting, shut down for investigation. If satisfactory, open up to 1,200/1,500 r.p.m. and run at this speed until oil pressure settles. But, in cold weather, restrict first minute's running to 800 r.p.m. to avoid damage to oil coolers and pipe joints.

When engine warmed up, momentarily close throttle and then open up to +6 lb./sq. in. boost in one smooth decisive movement ; run at this boost for a few seconds only, to clear sparking-plugs. Closing throttle momentarily allows full advantage to be taken of accelerator pump, and this procedure should always be adopted if difficulty experienced in opening up ; it is also recommended before opening up to full power for take-off.

Before take-off, perform checks as follows :—

1. With speed control lever fully up, set throttle to give zero lb./sq. in. boost. Ensure all cylinders are firing by verifying that r.p.m. within 50 of figure normally recorded on particular engine at these control settings.
2. Adjust throttle to give 1,200/1,500 r.p.m. Check and exercise supercharger by changing to 'S' gear and back six times, observing momentary drop in oil pressure at each change ; pause for one minute after each change back to 'M' gear, to allow clutches to cool. Finally, with 'S' gear engaged, set speed control to allow 2,400 r.p.m. and open throttle to max. climbing position ; then, to ensure clutches are engaging properly, verify that +6 lb./sq. in. boost obtained without fluctuation. Return to 'M' gear.

RUNNING NOTES—continued.

3. Set speed control lever fully up and throttle to give 2,400 r.p.m. Check and exercise propeller by depressing speed control lever to give drop of 500/600 r.p.m. and returning it fully up ; ensure response to movements satisfactory and original r.p.m. restored.
4. Hercules VI engines only. Move mixture control to ECONOMICAL and check drop in r.p.m., then return to NORMAL.
5. Open throttle fully. Check boost, r.p.m., fuel pressure.
6. Immediately retract throttle to max. climbing position ; if this does not cause decrease in r.p.m., throttle back further until there is a drop. Switch off each magneto in turn ; faulty ignition is indicated by rough running or if drop in r.p.m. exceeds 50. Perform check as quickly as possible, but pause for 5 sec. between operation of switches.

Watch cylinder temp. carefully at all times and if rising unduly, run engine at 800/900 r.p.m. until cooled down. Never allow engine to idle at less than 800 r.p.m. a moment longer than necessary.

TWO-SPEED SUPERCHARGER SETTINGS.

Always use 'M' gear for ground-running, taxying, and take-off. For maximum power at particular condition, use 'S' gear above altitude quoted in "Flying Conditions." Also, to conserve engine and save fuel, use 'S' gear for *all* economical cruising above approx. 14,000 ft.

FEATHERING PROPELLER.

1. Press feathering button and immediately close throttle.
2. Turn off engine fuel cock and switch off ignition when propeller has ceased to rotate.
3. Close gills on stationary engine.

UNFEATHERING PROPELLER.

1. Set speed control lever fully down and ensure throttle closed.
2. Switch on ignition and turn on fuel.
3. Press feathering button and hold it in until not more than 1,000 r.p.m. is reached.
4. Open throttle, and warm up slowly if engine cold.
5. Set speed control to give desired r.p.m.

LANDING.

Before landing, set propeller speed controls to permit 2,400 r.p.m., and ensure superchargers in 'M' gear and mixture controls of Hercules VI engines at NORMAL.

Immediately aircraft comes to rest, and before taxying to dispersal point, open cowl gills fully.

SHUTTING DOWN.

1. Exercise superchargers by running for short period in 'S' gear at r.p.m. not exceeding 1,500. Then return to 'M' gear.
2. Run at –2 lb./sq. in. boost for 5 sec.
3. Slowly retract throttle until 800 r.p.m. is reached. then run at this speed for 2 min.
4. Close throttle, then operate cut-out and hold up until engine has stopped.
5. Switch off ignition and turn off fuel.

To avoid overheating ignition leads, allow engines to cool off as much as possible before stopping ; also shut down head-to-wind whenever practicable and leave gills fully open for about 10 min. after switching off.

OIL DILUTION.

1. Shut down as above, then top-up oil tanks.
2. Restart when oil inlet temp. fallen to 20/40°C.
3. Open up to –2 lb./sq. in. boost for 5 sec.
4. Slowly retract throttle to 800 r.p.m., then run for four min. with dilution button depressed.
5. Close throttle, then operate cut-out.
6. When engine has stopped, release dilution button and cut-out. Switch off ignition and turn off fuel.

KEY TO FLYING CONDITIONS.

Unless otherwise stated, data apply to both 'M' and 'S' supercharger gear ratios.
Throttles should never be set *between* max. economical cruising, max. climbing and take-off positions.

1 Boost and r.p.m. quoted should be used only for shortest period consistent with safe take-off, and must not be employed for longer than time taken to climb 1,000 ft. If full power not required, use lower r.p.m. with throttles fully open. Always reduce r.p.m. to 2,400 before retracting throttles to max. climbing position.

2 When boost has fallen to +3½ lb./sq. in. (approx. 9,000 ft.), change to 'S' gear. When boost in 'S' gear fallen to +3 lb. retract throttles to max. economical cruising position ; if cylinder temp. rise excessively, return mixture levers of Hercules VI engines to NORMAL or throttles of Hercules XVI to max. climbing position.

3 Throttles must not be moved beyond max. economical cruising position. Always use 'S' gear above approx. 14,000 ft. To obtain greatest range, set throttles at max. economical cruising position and maintain required I.A.S. by adjusting r.p.m. between 2,400 and lowest speed consistent with smooth running ; retract throttles to lower boost only when further reduction in r.p.m. impracticable. For maximum duration of flight, reduce r.p.m. to lowest figure consistent with smooth running and set boost to lowest figure at which aircraft will fly comfortably.

4 Throttles must not be moved beyond max. climbing position. If altitude has caused boost in 'S' gear to fall to approx. +3 lb./sq. in. or below, retracting throttles to max. economical cruising position will increase performance and economy by preventing over-richness. When throttles of Hercules VI engines have been so retracted, movement of mixture controls to ECONOMICAL will give considerable further economy for only slight loss of power.

5 Always report excessive periods of running at these conditions to your Engineer Officer. If altitude has caused boost to fall to +6 lb./sq. in. or below, throttles should be returned to max. climbing position to prevent loss in I.A.S. and excessive fuel consumption. Throttles should not be returned to max. economical cruising position when r.p.m. above 2,400, especially with Hercules XVI engines.

6 During dive, throttles must be at least one-third open.

7 Provided thermocouple fitted on No. 14 cylinder, concession permits cylinder temp. of 290°C. for cruising and climbing, and 300°C. (5-min. limit) in emergency. These temp. must be avoided whenever possible.

OIL PRESSURES

Ground setting : 90 lb./sq. in. at 70°C. and 2,400 r.p.m.
Normal in flight : 75/80 lb./sq. in. at over 2,000 r.p.m.
Minimum : 60 lb./sq. in. at over 2,000 r.p.m.
Emergency (5-min. limit) : 50 lb./sq. in. at over 80°C.

Pressure below 60 lb./sq. in. is not permitted unless oil temp. has risen rapidly above 80°C.
Oil pressure reading is subject to tolerance of ±5 lb./sq. in. to compensate for inaccuracies of gauge and slight variations in pressure. Pressures will be higher when oil is cold.

NEVER

. . . exceed 230°C. cylinder temperature when taxying, or begin take-off when temperature above this figure.

. . . run engine on ground at maximum boost except to perform specific checks, which must be of shortest duration to prevent burning of ignition leads.

. . . allow fuel to be obtained by pump-handling of throttle lever or misuse of priming or doping pumps.

. . . run starter motor for longer than 20 seconds at a time.

. . . change supercharger gear from 'M' to 'S' ratio at r.p.m. higher than 1,500, either on ground or in flight below 5,000 ft.

ALWAYS

. . . reduce r.p.m. rather than boost for economical cruising.

. . . allow engine to cool by running at 800 to 900 r.p.m. after periods of high-power running on ground.

. . . set gills fully open after landing, for taxying, during all ground-running, and after shutting down.

. . . endeavour to have aircraft head-to-wind during ground-running and shutting down.

. . . inform Engineer Officer of excessive periods of running at maximum conditions.