FIJI ISLANDS AERONAUTICAL INFORMATION CIRCULAR

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TAKE-OFF, CLIMB AND LANDING PERFORMANCE OF LIGHT AEROPLANES

1. INTRODUCTION

1.1 Accidents, such as failure to get airborne in the distance available, collision with obstacles owing to inadequate climb and over-run on landing, continue to occur fairly frequently to light aeroplanes. Many such accidents have occurred when operating from short strips, often taking-off or landing out of wind, or with sloping ground. Poor surfaces such as wet grass are also frequent contributory factors. What is not generally realised by many pilots is that these are PERFORMANCE accidents and many, if not all, of these accidents could have been avoided if the pilots had been fully aware of the PERFORMANCE LIMITATIONS of their aeroplanes.

1.2 Pilots-in-command of ANY FIJI REGISTERED aeroplane have a legal obligation placed on them by Regulation 31 of the Air Navigation Regulations which requires them to check that the aeroplane will have adequate performance for the proposed flight. The purpose of this Circular is to remind pilots of the actions needed to ensure that the take-off, climb and landing performance will be adequate.

1.3 Aeroplane performance is subject to many variables including:

Aeroplane weight
Aerodrome altitude
Temperature
Wind
Runway length
Slope
Surface
Flap setting
Humidity

1.3.1 The performance data will usually allow adjustment to be made for these variables. On certification, allowances are made to cater for slight variations in individual pilot's handling of a specific technique.

2. WHERE TO FIND INFORMATION

2.1 Performance figures may be given in a variety of publications and it is important for pilots to know where to find the data needed to predict the performance in the expected flight conditions. The appropriate document is specified in the Certificate of Airworthiness and may be any one of the following:

a) CAAFI approved Flight Manual
b) Owners Manual or Pilot's Operating Handbook. These documents, which sometimes contain CAAFI supplements giving additional performance data which may either supplement or override data in the main document, are the ones applicable to many light aeroplanes.
c) Performance Schedule (as applicable to a few of the older aeroplanes)
d) For some imported aeroplanes, the English language flight manual approved by the Airworthiness Authority in the country of origin, but with a Supplement containing the performance data approved by the CAAFI.

3. USE OF PERFORMANCE DATA

3.1 The majority of modern, light aeroplanes are certified in Performance Group E for the purposes of public transport. The performance information in manuals and handbooks for Group E aeroplanes is UNFACTORED; this means the data represents the performance achieved by the manufacturer using a new aeroplane in ideal conditions. This level of performance will not be achieved if the flying techniques used by the manufacturer are not followed closely or if the meteorological conditions are not as favourable as those encountered during the testing. It is therefore PRUDENT TO ADD SAFETY FACTORS to the data in order to take account of less favourable conditions.

3.2 To ensure a high level of safety on public transport flights, there is a legal requirement to add specified safety factors to the data. It is RECOMMENDED that those same factors be used for private flights. When a pilot planning a private flight chooses to accept aerodrome distances or climb performance less than that required for a public transport flight he should recognise that the level of safety is lowered accordingly.

3.3 Performance data in manuals for aeroplanes certified in performance Groups B, C, D or F for the purposes of public transport normally include the public

transport factors. These manuals usually make it clear if factors are included, but if in any doubt the user should consult the CAAFI.

3.4 It should be remembered that any “limitations” given in the Certificate of Airworthiness, the Flight Manual, the Performance Schedule, or the Owner’s Manual/Pilots Operating Handbook, are MANDATORY ON ALL FLIGHTS.

4. PERFORMANCE PLANNING

4.1 A list of variables affecting performance together with guideline factors is shown in tabular form at the end of this Circular. These represent the increase in take-off distance to a height of 50ft or the increase in landing distance from 50ft. It is intended that the tabular form will be suitable for attaching to a pilot’s clipboard for easy reference. WHEN SPECIFIC CORRECTIONS ARE GIVEN IN THE AEROPLANE MANUAL, HANDBOOK OR SUPPLEMENT, THESE MUST BE CONSIDERED THE MINIMUM ACCEPTABLE.

5. TAKE-OFF

5.1 Aeroplane Weight: it is important that the actual weight stated on the weight and balance sheet for the individual aeroplane is used as the basis for calculations. The weight of individual aeroplanes of a given type can vary considerably dependent on the level of equipment. Using the example weight shown in the weight and balance section of the handbook is not satisfactory.

5.1.1. Guideline factor: take-off distance will be increased by 20% for each 10% increase in aeroplane weight (a factor of x 1.2).

5.2 Aerodrome Altitude: aeroplane performance deteriorates with an increase in altitude and the pressure altitude at the aerodrome of departure should be used for calculations. This equates to the height shown on the altimeter on the ground at the aerodrome with the sub-scale set at 1013 hectopascals (hPa).

5.2.1 Guideline factor: take-off distance will be increased by 10% for each 1000ft increase in aerodrome altitude (a factor of x 1.1).

5.3 Temperature: aeroplane performance deteriorates with an increase in ambient temperature.

5.3.1 Guideline factor: take-off distance will be increased by 10% for a 10 degree C increase in ambient temperature (a factor of x 1.1)

5.4 Wind: a tailwind increases the take-off distance.

5.4.1 Guideline factor: the take-off distance will be increased by 20% for a tailwind component of 10% of the lift-off speed (a factor of x 1.2).

Note: Where the data allows adjustment for wind, it is required that not more than 50% of the headwind component and not less than 150% of the tailwind component of the reported wind be assumed. In some manuals this factoring is already included and it is necessary to check the relevant section.

5.5 Slope: an uphill slope increases the ground run.

5.5.1 Guideline factor: the take-off distance will be increased by 10% for each 2% of uphill slope (a factor of x 1.1) (See also paragraph 8.3).

5.6 Surface: grass, soft ground or gravel/crushed coral increase rolling resistance and therefore the ground run.

5.6.1 Guideline factors: (a) for dry grass (less than 8 inches) the take-off distance will be increased by 20% (a factor of x 1.2).

6. CLIMB

6.1 So that the aeroplane climb performance does not fall below the prescribed minimum, some manuals give take-off and landing weights that should not be exceeded at specific combinations of altitude ad temperature (WAT limits). Unless included in the limitations section, these weight restrictions are mandatory only for public transport flights. THEY ARE HOWEVER, RECOMMENDED FOR PRIVATE FLIGHTS and are calculated using the altitude and temperature at the relevant aerodrome. Where WAT limits are not given the following procedures are recommended:

a) At the expected take-off and landing weights the aeroplane should be capable of a rate of climb of 700ft/min if it has a retractable undercarriage; or 500ft/min if it has a fixed undercarriage. The rates of climb should be assessed at the relevant aerodrome altitude and temperature in the en-route configuration at the en-route climb speed and using maximum continuous power.

b) For an aeroplane with more than one engine, if conditions are such that during climb to, or descent from, the cruising altitude, obstacles cannot be avoided visually, the aeroplane should be able to climb at 150ft/min with one engine inoperative, at the aerodrome altitude and temperature.

7. LANDING

7.1 Aeroplane Weight: See paragraph 5.1

7.1.1 Guideline factor: landing distance will be increased by 10% for each 10% increase in aeroplane weight (a factor of x 1.1).

7.2 Aerodrome Altitude: aeroplane performance deteriorates with an increase in pressure altitude.

7.2.1 Guideline factor: landing distance will be increased by 5% for each 1000ft increase in aerodrome pressure altitude (a factor of x 1.05).

7.3 Temperature: aeroplane performance deteriorates with an increase in ambient temperature.

7.3.1 Guideline factor: landing distance will be increased by 5% for a 10 degree C increase in ambient temperature (a factor of x 1.05).

7.4 Wind: a tailwind increases the landing distance.

7.4.1 Guideline factor: landing distance will be increased by 20% for a tailwind component of 10% of the landing speed (a factor of x 1.2).

Note: Where the data allows adjustment for wind, it is recommended that not more than 50% of the headwind component and not less than 150% of the tailwind component of the reported wind be assumed. In some manuals this factoring is already included and it is necessary to check the relevant section.

7.5 Slope: A downhill slope increases the landing distance.

7.5.1 Guideline factor: landing distance will be increased by 10% for each 2% of downhill slope (a factor of x 1.1)

7.6 Surface: grass increases the ground roll; despite increased rolling resistance because brake effectiveness is reduced.

7.6.1 Guideline factors: for dry grass (less than 8 inches) the landing distance will be increased by 20% (a factor of x 1.2).

Note: When the grass is very short, the surface may be slippery and distances may increase by up to 60% (a factor of x 1.6).

Note: For surface and slope factors, remember the increases shown are to the landing distance from a height of 50ft. The correction to the ground roll will be greater.

7.7 Safety factors: it is required that the public transport factor should be applied for all flights. For landing, this factor is x 1.67 for Group B aeroplanes and x 1.43 for Groups C, D, E and F aeroplanes.

7.8 The above factors are cumulative and when several factors are relevant they must be multiplied. As in the take-off case, the total distance required may seem surprisingly high.

For example: In still air on a level, dry runway with an ambient temperature of 10 degree C, an aeroplane requires a landing distance from a height of 50ft (LDR) of 350m. This should be multiplied by the safety factor of 1.43 giving a LDR of 501m. The same aeroplane landing in still air at a wet grass strip (factor x 1.3) 500ft above sea-level (factor x 1.025) at 20 degree C (factor x 1.05) including the safety factor (factor x 1.43) will require a landing distance of:

350 x 1.3 x 1.025 x 1.05 x 1.43 = 700m

7.9 The pilot should always ensure that after applying all the relevant factors including the safety factor the landing distance required from a height of 50ft (LDR) does not exceed landing distance available.

8. ADDITIONAL INFORMATION

8.1 Engine failure: the possibility of an engine failing during any phase of the flight should also be considered. Consideration should include the one engine inoperative performance of multi-enginned types and the glide performance of single-enginned types. In the latter case, the ability to make a safe forced landing should be borne in mind throughout the flight.

8.2 Obstacles: it is essential to be aware of any obstacles likely to impede either the take-off or landing flight path and to ensure there is adequate performance available to clear them by a safe margin.

8.3 Aerodrome distances: for many aerodromes, information on available distances is published in some form of aerodrome guide such as commercially available flight guides. At aerodromes where no published information exists, distances should be paced out. The pace length should be established accurately or assumed to be no more than 2.5ft. Slope can be calculated if surface elevation information is available, if not they should be estimated. Prior to take-off it might be helpful to taxi the aeroplane from one end of the strip to the other and take an altimeter reading at each end. Most altimeters will show differences down to 20ft and to find the slope simply divide altitude difference by strip length and give the result as a percentage. For example, an altitude difference of 50ft on a 2500ft strip indicates a 2% slope. Be sure not to mix metres and feet in your calculations.

8.4 Operations from strips covered in extensive standing water should not be attempted.

8.5 Where doubt exists on the source of data to be used or its application in given circumstances, advice should be sought from the Flight Safety Oversight Unit of the Civil Aviation Authority of the Fiji Islands

TAKE-OFF

CONDITION	INCREASE IN TAKE-OFF DISTANCE TO HEIGHT 50FT	FACTOR
A 10% increase in aeroplane weight	20%	1.2
An increase of 1000ft in airfield altitude	10%	1.1
An increase of 10 degree C in ambient temperature	10%	1.1
Dry grass* - up to 20cm (8in) (on firm soil)	20%	1.2
Wet grass* - up to 20cm (8in) (on firm soil)	30%	1.3
A 2% uphill slope	10%	1.1
A tailwind component of 10% of lift-off speed	20%	1.2
Soft ground	25% or more	1.25+

- Effect on Ground Run/Roll will be greater

LANDING

CONDITION	INCREASE IN LANDING DISTANCE FROM 50FT	FACTOR
A 10% increase in aeroplane weight	10%	1.1
An increase of 1000ft in airfield altitude	5%	1.05
An increase of 10 degree C in ambient temperature	5%	1.05
Dry grass* - up to 20cm (8in) (on firm soil)	20% +	1.2
Wet grass* - up to 20cm (8in) (on firm soil)	30% +	1.3
A 2% uphill slope*	10%	1.1
A tailwind component of 10% of lift-off speed	20%	1.2
Soft ground	25% or more	1.25+

- Effect on ground Run/Roll will be greater

Note 1: After taking account of the above variables it is required that the relevant safety factor (1.15 for Group B, 1.25 for Group F, 1.33 for Groups C, D and E for take-off; 1.67 for Group B and 1.43 for Groups C, D, E and F for landings) is applied.

Note 2: Any deviation from normal operating techniques is likely to result in an increase in the distance required.

Note 3: When the grass is very short, the surface may be slippery and distances may increase by up to 60% (a factor of x 1.6).