Australian Performance Testing of Self Launching Gliders

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1. Introduction

The Australian Department of Transport is presently evaluating self launching gliders with the eventual object of establishing Australian airworthiness standards for this class of aircraft. To provide background experience regarding performance and flight characteristics, the Airworthiness Branch of the Department has conducted flight tests of three first-of-type in Australia self launching gliders. The types tested were the Schleicher ASK-14, Slingsby T61A (Scheibe SF-25B), and the Sportavia RF-5B. These tests were carried out over the period July 1969 to December 1972. This report presents a summary of the results of the performance tests conducted on these aircraft. The flight tests results for the ASK-14 are reported in full in reference 1.

2. Test Methods

Full throttle climbs and glide performance tests were conducted using the partial climb and descent method, measuring the pressure height gain or loss at half minute intervals for a nominal period of five minutes. Where a large height loss was involved, for example, partial glide tests with airbrakes extended, the time for a 1000 ft. height loss was recorded. Test runs were conducted consecutively in reciprocal directions and across wind, to minimise the influence of wind shear, and took place in smooth atmospheric conditions. Test points were taken at indicated air speed intervals of 10 knots or less. Although it is recognised that more test points would be required to positively establish the climb rate curves and glide polars the testing carried out was sufficiently extensive for our purposes and the test results are considered to be generally representative of the aircraft types examined. The test results were reduced to standard conditions using conventional methods. No special attention was paid to the stationary propeller positions during glide tests except that on the ASK-14 the propeller was feathered and horizontal.

Take-off distance tests were conducted on short dry grass runway surfaces and distances were measured from rest to a height of 50 ft. above the runway surface. An automatic wind-on camera was used to take sequential photographs of the aircraft flight path to accurately establish the 50 ft. height point. At least six take-offs were measured for each aircraft, under calm conditions, and the results reduced to nil-wind Sea Level ISA conditions and for a level, short dry grass surface runway. Except in the case of the ASK-14, for which landing tests were not conducted, the landing distance tests were carried out by a similar method to the above. The aircraft were flown in a glide at the nominated approach speed and photographed passing through the 50 ft. screen height. During the ground run maximum safe braking was applied.

3. Test Results

(a) Glide Performance

The glide performance of these three aircraft was established for the normal «enroute» configuration of airbrakes retracted and landing gear retracted where applicable. The maximum lift/drag ratios established for the ASK-14, the T61A, and the RF-5B respectively, were 25.6, 18.3 and 20.5. Individual glide polars are plotted at figures 1, 2 and 3, and for comparison purposes graphs of lift/drag ratio vs forward speed are plotted at figure 4. The results were further reduced to non dimensional form and are plotted as a graph of CL^2 vs CD at figure 5. It is of interest to note that the linearised drag polar for the Slingsby T61A agrees closely with that published by Whitfield (Reference 4) for the Scheibe SF-25B with propeller stationary in the vertical position. The glide test results are summarised in Table 1.

(b) Climb Performance

The full throttle climb performance for the three aircraft has been plotted vs forward speed at figures 1, 2 and 3 for the enroute configuration (landing gear retracted where applicable), and as best climb rate vs standard altitude in figure 6.

One of the Department's particular interests in this program has been the climb gradients achieved by the aircraft in the take-off configuration, since

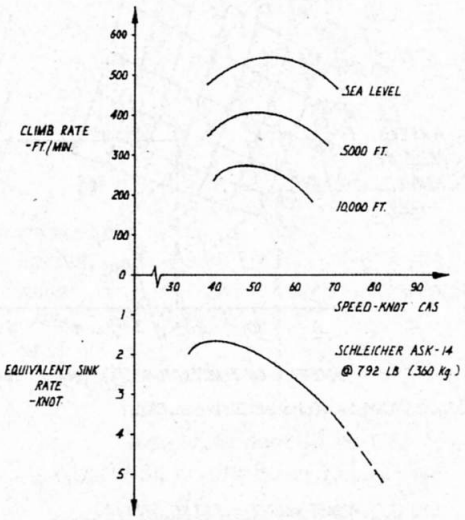

Fig. 1. Climb and Glide Performance. Schleicher ASK-14

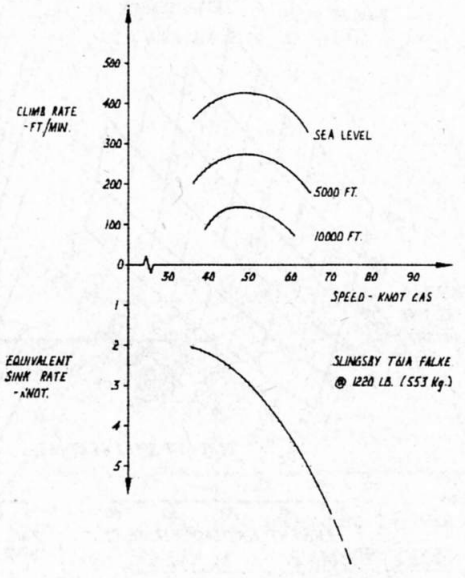

Fig. 2. Climb and Glide Performance. Slingsby T61A

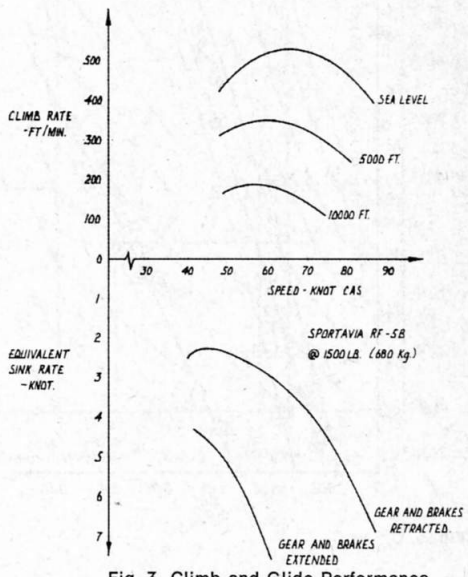

Fig. 3. Climb and Glide Performance. Sportiva RF-5B

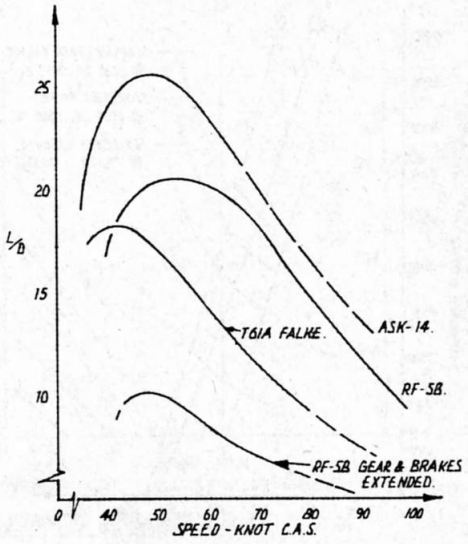

Fig. 4. Lift Drag Ratios vs Speed

this aspect is important in relation to obstacle clearance after take-off. The take-off climb gradient performance of these self launching gliders can be compared wiht that of the aerotow launching of unpowered gliders for which a take-off climb gradient of not less than six percent under ambient pressure and temperature conditions is required in Australia. For sea level standard conditions the ASK-14, T61A, and RF-5B can achieve climb gradients of 11.2, 8.6, and 8.3 percent respectively. The standard heights at which a six percent take-off climb gradient can just be maintained are, 7700 ft., 3500 ft., and 4300 ft. respectively. The take-off climb gradient performance of these aircraft is generally similar to those achieved in aerotow launching operations of normal gliders.

(c) Take-off Performance

After reduction to ISA Sea Level conditions, the take-off distances to 50 ft., measured for a short dry grass runway surface at maximum take-off weight,

Table 1 – Summary of Aircraft Particulars and Results

Type	Schleicher ASK-14	Slingsby T61A (Scheibe SF-25B)	Sportavia RF-5B
Serial Number	14020	1742	51019
Registration	VH-GXU	VH-GZO	VH-GCA
Span, metre (ft)	14.3 (46.9)	15.3 (502)	17.02 (55.8)
Wing area, metre² (ft²)	13.2 (142.3)	17.5 (188.0)	19.0 (204.4)
Aspect Ratio	15.4	13.4	15.2
Maximum Take-off Weight, kg (lb)	360 (792)	553 (1220)	680 (1500)
Wing loading Kgm^{-2} ($lb\ ft^{-2}$)	27.3 (5.56)	31.6 (6.5)	35.8 (7.3)
Engine Type	Hirth F 10K-A1	Stamo MS 1500	Limbach SL1700E
Rated Power, BHP *a* RPM	26 *a* 5000	45 *a* 3200	68 *a* 3600
Propeller	feathering	fixed pitch	fixed pitch
Minimum Sink Rate, Knot	1.65	2.05	2.20
a Speed, Knot CAS	40	35	44
Maximum L/D	25.6	18.3	20.5
a Speed, Knot CAS	48	42	55
Linearised Drag Equation $C_D=C_{DO}+KC_L^2$	$C_D=0.0145+0.027C_L^2$	$C_D=0.030+0.026C_L^2$	$C_D=\ 020+0.030C_L^2$
Max. Climb Rate ISA Sea Level FPM	550	420	525
Max. Climb Rate ISA 5000ft. FPM	405	270	350
Take-off Distance to 50 ft. metre (ft)	285 (935)	479 (1570)	427 (1400)
a Take-off speed, knot CAS	40	49	51
Landing Distance from 50 ft. metre (ft)	not tested	414 (1360)	546 (1791)
a Approach speed, knot CAS	not tested	50	56

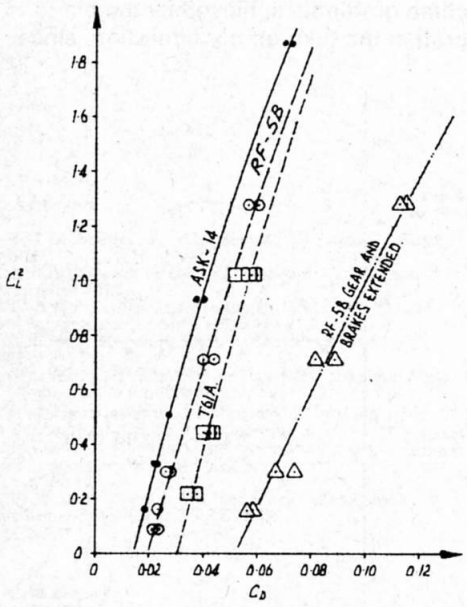

Fig. 5. C_L^2 vs C_D

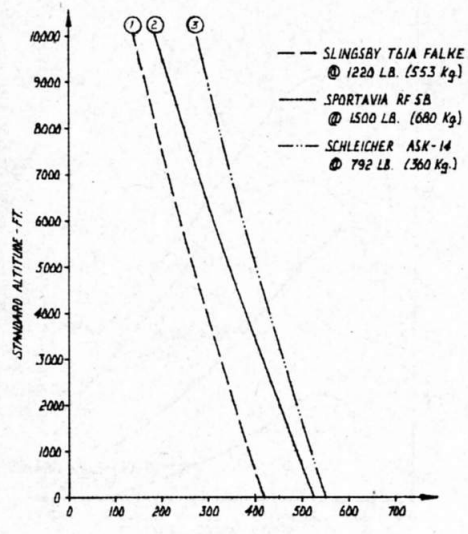

Fig. 6. Best Rate of Climb Vs Standard Altitude

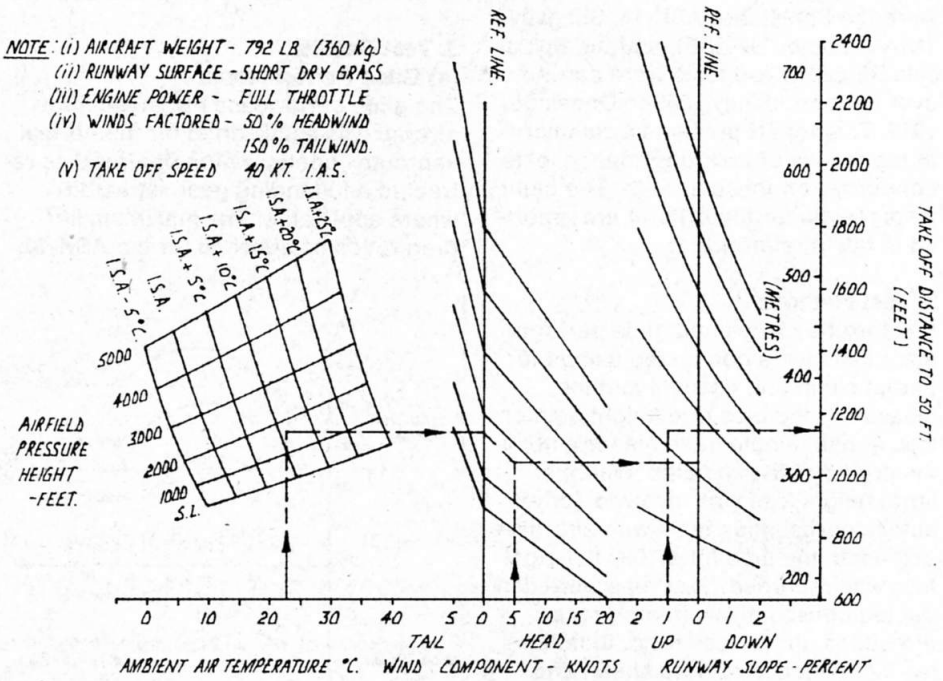

Fig. 7. ASK 14. Take-off Distance Chart

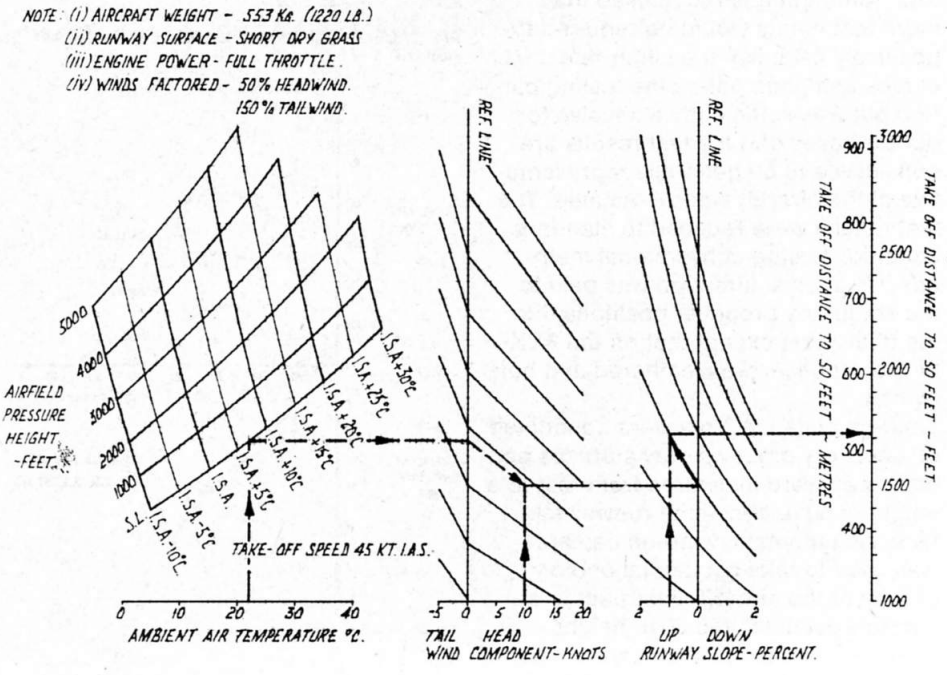

Fig. 8. Slingsby T61A. Take-off Distance Chart

were determined to be 285 metre, 479 metre, and 427 metre for the ASK-14, T61A and RF-5B respectively. These basic data have been expanded to form the take-off distance charts at figures 7, 8 and 10. These take-off distances are roughly comparable with those of «typical» light aeroplanes. However, because lift-off speeds and take-off safety speeds are somewhat less than those of most light aeroplanes, accelerations, during both the ground roll and the airborne phase from lift-off to the attainment of the take-off safety speed, are relatively low. Consequently the self launching glider can be expected to be more sensitive to such parameters as adverse runway slopes and variations in surface friction coefficients than the typical light aeroplane. The low acceleration of the T61A Falke is particularly noticeable during the take off ground roll and airborne acceleration phase.

(d) Landing Performance

Landing distance tests were carried out for the Slingsby T61A and the Sportavia RF-5B. The landing distances determined, after reduction to sea level ISA conditions, were 414 metre, and 546 metre for the T61A and RF-5B respectively. The comparatively long landing distance determined for the RF-5B can be basically attributed to relatively low drag in the approach configuration. Referring to figure 5 it can be seen that the lift/drag ratio of the RF-5B for the landing gear and airbrakes extended configuration at the test approach speed of 56 Knot CAS is 9.3. By way of contrast, the approach configuration lift/drag ratio of the T61A was determined to be 7.0 at the test approach speed of 48 Knot CAS. It was also thought that the nominated approach speed for the RF-5B, of 56 Knot CAS, led to longer than necessary float distances, so the landing distance was recalculated for an approach speed of 1.3 Vso (52 Knot CAS; at which speed controlability was acceptable) and estimated to be 456 metre at this speed. This data was expanded to form the landing distance chart at figure 9. The landing distance chart for the T61A appears at figure 11.

4. Concluding Remarks

The Department of Transport realises that the three self launching glider types it has tested this far do not necessarily cover the full range of configurations and performance capabilities of this class of aircraft and intends to improve its knowledge of the various types as they become available in Australia.

References

1. «Schleicher ASK-14 Flight Testing» by J. C. Fincher. Department of Transport, Aeronautical Engineering Report AF-31, June 1970.
2. «Performance Testing the Scheibe SF-25B Falke» by G. R. Whitfield, Department of Applied Physical Sciences, University of Reading, England. OSTIV Publication XII.

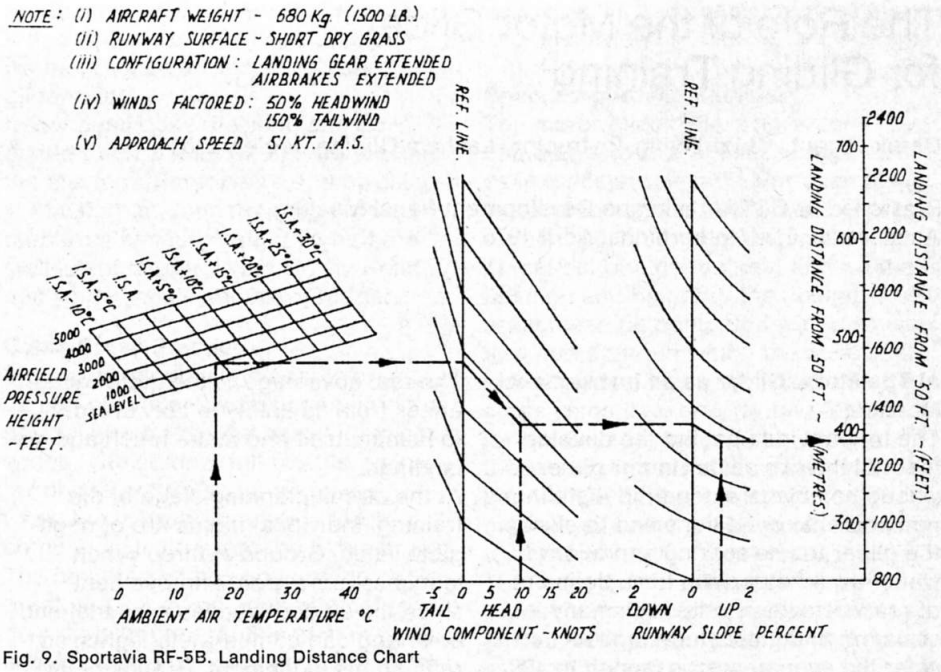

Fig. 9. Sportavia RF-5B. Landing Distance Chart

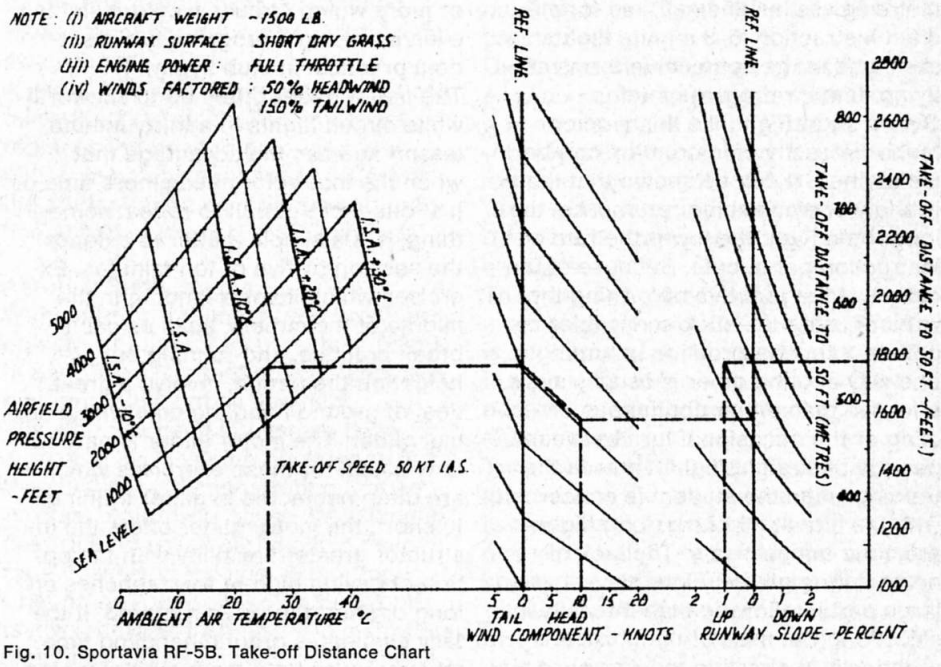

Fig. 10. Sportavia RF-5B. Take-off Distance Chart

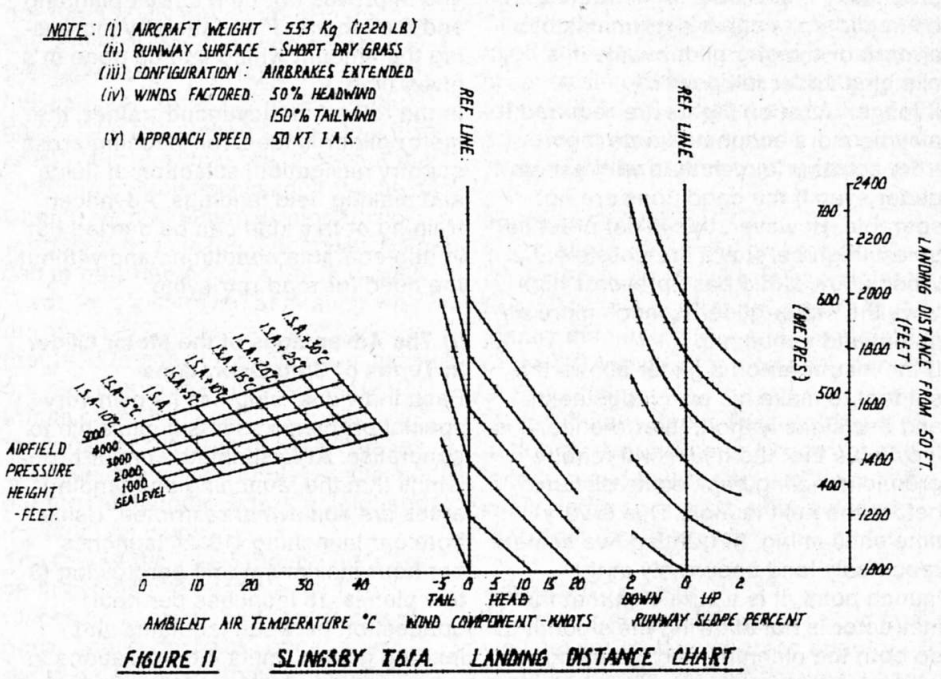

Fig. 11. Slingsby T61A. Landing Distance Chart