APPENDIX III

FLAP - AILERON DROOP OPTIMIZATION TESTS

LP-15, N-1, N6LS

W/S + 6.6 lbs./sq. ft., 32.5% m.a.c.

Tests to determine the flap and aileron droop settings which give the best performance were made at speeds of 44, 65, and 95 knots calibrated airspeed. All tests were made from tows to 14,000 ft. in early morning still air with another sailplane used as a reference to measure incremental sink rates or speed as the Nugget was flown with various combinations of flap and aileron droop. A test system was installed in the Nugget to enable the pilot to change the aileron droop in flight. Flap and aileron droop angles listed are those measured (with surface position transducers) in flight for the detent position and speeds at which the tests were made. Results are as follows:

FLAP POSITION degrees	AILERON DROOP degrees	MEASURED SINK Min. Measured Sink
	AT 44 KNOTS IAS	
3 Down	1.4 Down	1.0
3 Down	5.5 Down	.995
3 Down	1.4 Up	.995
4.8 Down	1.4 Up	.995
4.8 Down	1.4 Down	.995
4.8 Down	5.5 Down	.995
0	1.4 Up	.990
0	1.4 Down	.990
0	5.5 Down	.990
16 Down	6.0 Down	.955
	AT 65 KNOTS IAS	
0	1.6 Up	1.0
0	1.4 Down	.99
4.7 Up	1.6 Up	.99
3 Down	1.4 Down	.98
3 Down	4.8 Down	.97
4.7 Down	1.4 Down	.96
4.7 Up	1.4 Down	.95
4.7 Down	4.8 Down	.94
6.7 Up	1.4 Down	.92
6.7 Up	1.6 Up	.91
6.7 Up	3.2 Up	.89

FLAP POSITION degrees	AILERON DROOP degrees	MEASURED SINK Min. Measured Sink
	AT 95 KNOTS IAS	
6.5 Up	2.0 Up	1.0
6.5 Up	3.7 Up	.99
4.5 Up	2.0 Up	.99
6.5 Up	0.3 Down	.98
4.5 Up	0.3 Down	.97
0	2.0 Up	.95
0	0.3 Down	.95

Flap and aileron control linkages in the sailplane at the time of the tests did not permit the range of up travel required to obtain the 8° up flap and 6° up aileron droop that estimated performance data indicates would be the best settings at speeds over 80 or 90 knots. A planned test at 120 knots was delayed until the flap and aileron droop systems could be modified so that the desired settings could be obtained in flight. Unfortunately, time was not available for this and further tests need to be conducted when this is done.

Shortly after these tests, the flap system was modified to reduce deflection in the system and to give better flap handle motion in the cockpit. This change was a major improvement but further modifications are still required before the system will be fully satisfactory. The new system still limits up flap, under load to six degrees. It is a much stiffer system but some change in flap angle under load still occurs as indicated by the following measured flap angles with and without load (60 - 80 knots) at each handle position. 7° up on the ground is 6° up in the air, 3.8° up drops to 3.7° up in the air, there is no change at 0 flap or at down settings up to 37 degrees; the 77° down flap, full down setting on the ground is reduced to 75° under load in flight at 50 knots.

Analysis of the results of these tests along with theoretical analysis of the airfoil wind tunnel data indicate that the recommended settings given in the following table should provide the best combinations for, (1) the sailplane with the existing flap system and a fixed (standard class) compromise aileron droop of 2° up and, (2) the sailplane with a modified flap system and aileron interconnect (open class option) giving the optimum combination at all speeds. The difference in performance is given in the right hand column.

IAS	STD. CLASS		OPEN CLASS		Δ SINK
	FLAP	AILERON	FLAP	AILERON	
knots	deg	deg	deg	deg	per cent
40	6 Dn	1.3 Up	5 Dn	4 Dn	3
45	0	1.4 Up	3 Dn	2 Dn	1
50	0	1.5 Up	0	0	0
60	0	1.6 Up	0	1 Up	0
70	4 Up	1.7 Up	4 Up	2 Up	0
80	4 Up	1.8 Up	6 Up	4 Up	0
90	6 Up	1.9 Up	8 Up	6 Up	2
100	6 Up	2.0 Up	8 Up	6 Up	6
110	6 Up	2.1 Up	8 Up	6 Up	13
120	6 Up	2.2 Up	8 Up	6 Up	15

Some of the difference in performance at high speed could be available for standard class flying if the flap system can be modified to make 8° of up flap available in flight. Note that the air loads change the aileron droop in a favorable manner as the speed changes. Aileron droop angles listed for standard class are those actually obtained in flight when the droop is set 1.5° up on the ground. Flight at heavier weight or in turns will change the speed for these relationships since they are basically a function of angle of attack or lift coefficient. The speeds will change by the square root of the ratio of the new flight weight (or weight times "g" in turns) to the 725 pound test weight.

Further tests should be made at high speeds to determine if these values are correct.