

APPENDIX II
AIRSPEED SYSTEM TESTS
LP-15, N-1, N6LS
725 Pounds at 34% m.a.c.

Figure 1 of this Appendix shows the location of a series of paired static orifices which were installed in the nose and one pair in the tail cone during construction of the sailplane so they could be used during initial flight tests to determine the best static source for later production sailplanes. The total pressure source used for most of the tests was a stub tube projecting from the front of the fuselage nose as shown in Figure 1. Also shown is the location of the T.E. Venturi on top of the fuselage, 51 inches aft of the wing trailing edge. The basic system used for early testing was with the airspeed indicator connected to the nose total pressure and the paired statics on the tail cone.

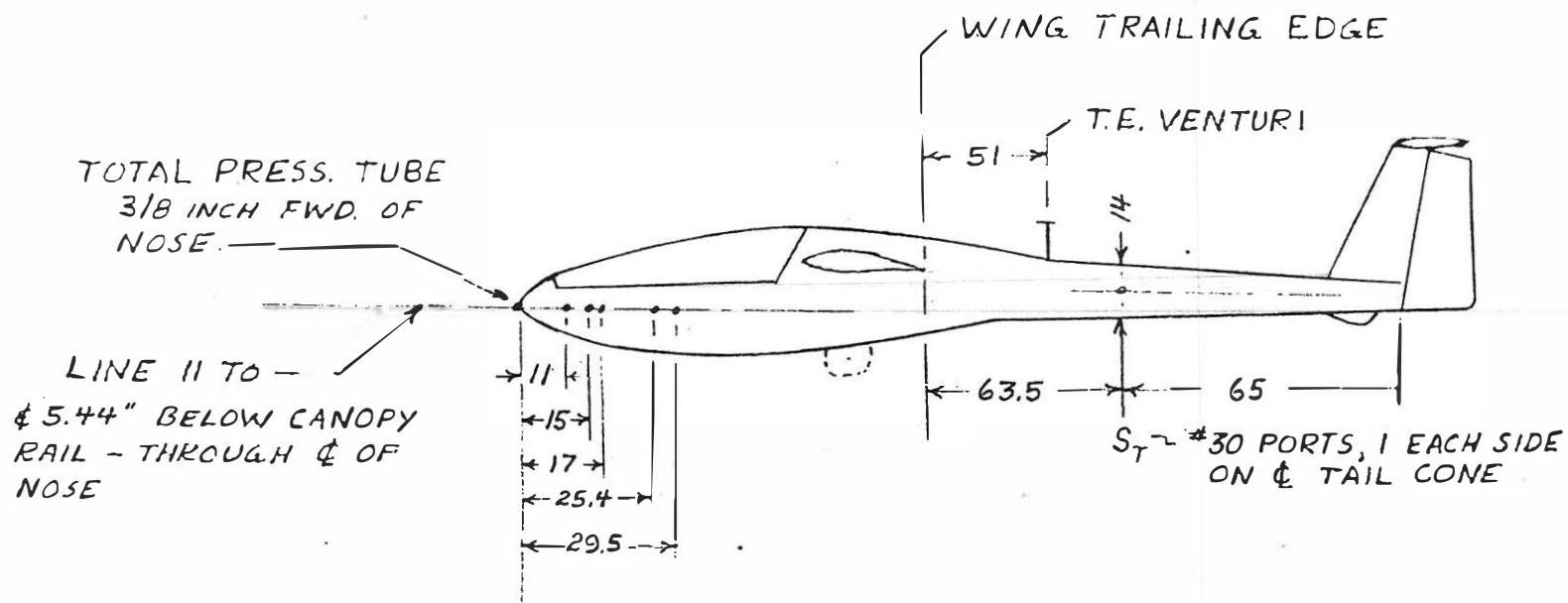
This tail cone static airspeed system was carefully calibrated in flight by comparison with a test swivel head system mounted on the left wing as shown in Figure 2. The zero error of the test boom system had been verified (Figure 3) with the test boom system mounted on another sailplane which had an extensively calibrated system from other tests. The airspeed position error for the tail cone statics on the Nugget as determined from comparisons with the test boom system mounted on the left wing is shown in Figure 4. This was later cross checked in side-by-side pacer runs with the calibrated T-6; these points are also shown in Figure 4 and are in good agreement with the test boom points. The system error for the tail cone statics is acceptable for a production system but does show a 1 knot error at speeds up to 70-80 knots with the error increasing to 2 knots at 100 knots. This system was used as a reference to calibrate the nose static systems in a search for a system with even less error and one which would not require running static lines back to the tail cone.

Calibrations to determine the position errors for each of the five paired static orifices in the nose were made in this manner using the position error in Figure 4 as a reference system and, of course, correcting all readings for instrument errors. The instrument calibration for one of the test airspeed indicators is plotted in Figure 5 to illustrate the careful calibrations and consistent readings obtainable with these test instruments. All pressure lines were leak-tight and dynamically balanced for lag and leak checks were made before each flight. Airspeed system position errors determined for each of the nose static systems are plotted in Figures 6 and 7 and summarized in Figure 3. The position error curves shift in a logical fashion with change in nose static location and the holes 15" and 17"

aft of the nose showing less than 1 knot error at all speeds except right at the stall where the system makes the airspeed readings about 1 knot low. The holes 15" aft of the nose were selected as the test system for the remainder of the N-1 test program.

Calibrations of all systems showed a greater sensitivity to yaw than was considered normal for systems of this type. Tests using a shielded total pressure head (good for + 30°) as a reference showed that the problem was caused by the stub total pressure pick up on the nose which showed 100% total pressure recovery at low side slip angles but dropped in pressure sooner than normal as side slip was increased. At the same time it was necessary to find a good source of air for cockpit ventilation. The nose was modified by installing a 1.9 inch inside diameter duct and the total pressure pick up was submerged in this duct as shown in the sketch on Figure 9. Tests with the shielded total pressure pick as a reference for the new installation showed that the yaw sensitivity was greatly reduced. The final airspeed system selected for the N-1 Nugget tests was with the airspeed indicator connected to the new nose total pressure pick up and to the S-15 nose static sources. This system was recalibrated using the tail cone system as a reference and also flight checked later in the program with flights over a ground speed course. The final position error curve is plotted in Figure 9 and again the error is less than 1 knot at all speeds; the slight difference in values from those shown for the earlier S-15 system are less than 1/2 knot and within the test accuracy. It appears that later production systems might be even better if located at S-17.

There is little change in position error with different flap settings, 75° down flap only shifted the curve by about 1/2 knot.



ANGLE OF TANGENT AT ORIFICE
TO FUSELAGE ϕ ~ (#40 HOLES)

S-11	16.4°
S-15	14.4°
S-17	13.2°
S-25.4	10.1°
S-29.4	9.0°

FIG. 1

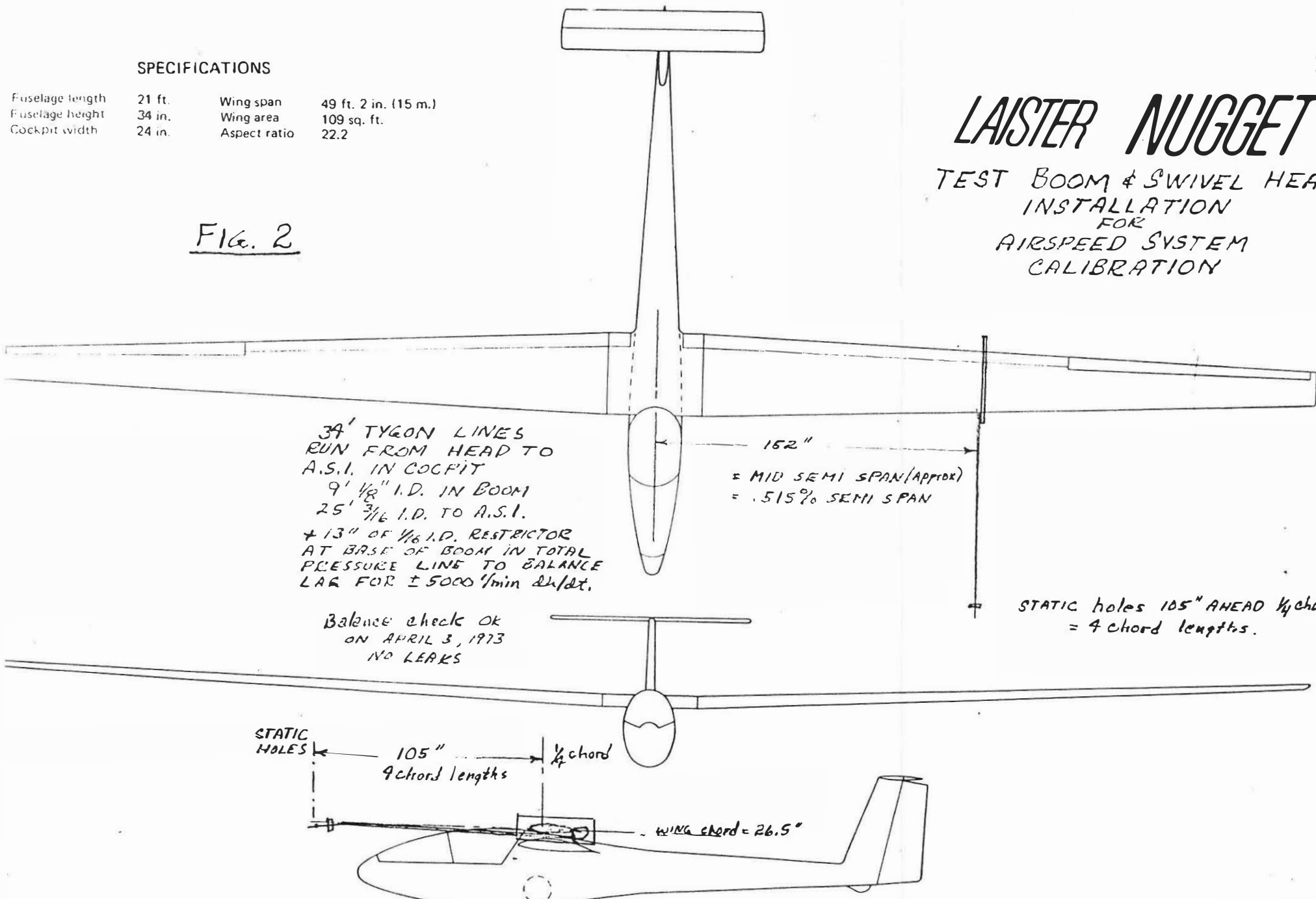
SPECIFICATIONS

Fuselage length	21 ft.	Wing span	49 ft. 2 in. (15 m.)
Fuselage height	34 in.	Wing area	109 sq. ft.
Cockpit width	24 in.	Aspect ratio	22.2

LAISTER NUGGET

TEST BOOM & SWIVEL HEAD
INSTALLATION
FOR
AIRSPEED SYSTEM
CALIBRATION

FIG. 2



34' TYGON LINES
RUN FROM HEAD TO
A.S.I. IN COCKPIT
9' 1/2" I.D. IN BOOM
25' 3/4" I.D. TO A.S.I.
+ 13" OF 1/8" I.D. RESTRICTOR
AT BASE OF BOOM IN TOTAL
PRESSURE LINE TO BALANCE
LAW FOR ± 5000'/min & 1/2".

162"
= MID SEMI SPAN (APPROX)
= .515% SEMI SPAN

Balance check OK
ON APRIL 3, 1973
NO LEAKS

STATIC holes 105" AHEAD 1/4 chord
= 4 chord lengths.

STATIC HOLES ← 105"
4 chord lengths → 1/4 chord

WING CHORD = 26.5"

SWIVEL HEAD ON CHORD LINE & INCLINED
DOWN 4° TO WING CHORD

- NOTE: BOOM MOUNTED 3.25° UP FROM
WING CHORD; FWD. SECTION DOWN 7.25° TO BOOM
& HEAD 4° DOWN TO WING CHORD LINE

FIG. 3

FLIGHT CHECK OF
SWIVEL HEAD AIRSPEED WING FOAM
VS.
CALCULATED T-6 AIRSPEED SYSTEM
A.F.M. - 3, 1975

SW STAYLES 103" FULL WAVE
1/4 CHORD NEAR LEAD = 3.5 chord length
@ MID SPAN OF WING

6 ON TOW
10 OFF TOW

NOTE: BOTH ERRORS ARE ESSENTIALLY
ZERO & WELL WITHIN ± 0.5 KT.
T-6 CALIBRATION ACCURACY

TO BE ADDED

+1
0
-1

IAS CORRECTION FOR INSTR. ERROR - KTS.

20 30 40 50 60 70 80 90 100 110 120 130 140

POINTS FROM SWIVEL HEAD ON WING GEAR - FLT #7

- A FLAP 45° FULL UP, GEAR UP
- O " " " ZERO, GEAR UP
- ▽ FLAP 5° DN, ALL FULL DN, GEAR UP
- X FLAP 45° ZERO, ON TAIL - GEAR UP & DOWN
- FLAP 45°, ALL DOWN, GEAR DN
- ⊕ FULL FLAP " "

FIG. 4

AIR SPEED
 POSITION ERROR
 CALIBRATION

MUGGET TAIL STATICS

MAY 2, 1973

740 KTS + 30% MAC

NOTE: - SIDE VIEW SPANWISE
 BEYOND 34" YARD STRING
 OR 1/2 BALL

* FROM T-6 PAPER - FLT #6

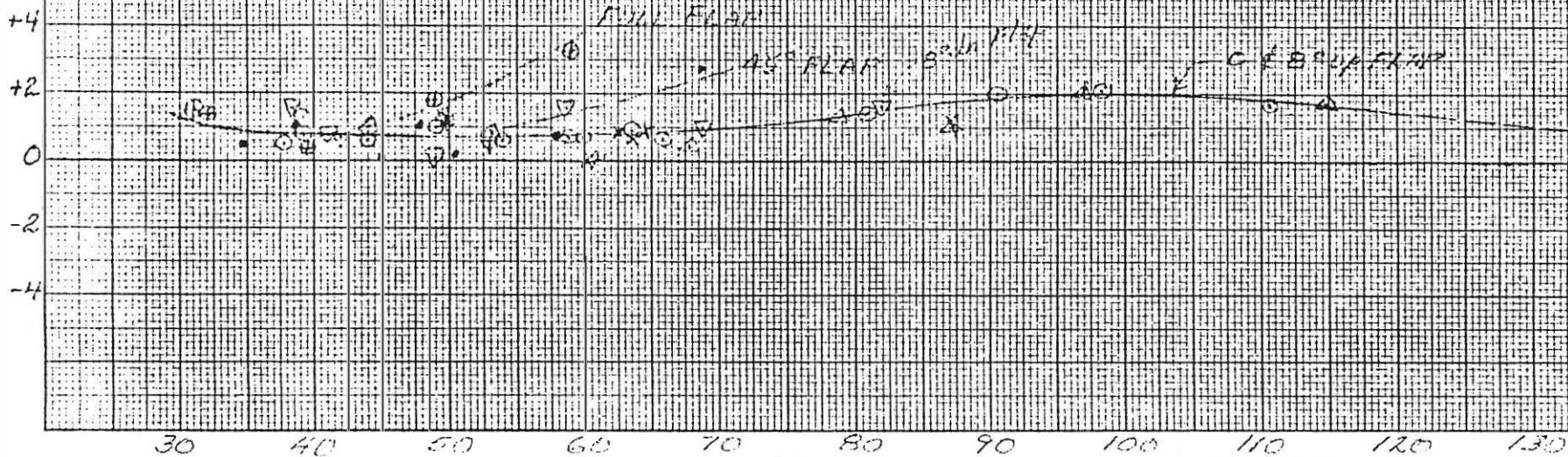


FIG 5

#2

KOLLSMAN (0-200 KTS.) (A=1.0)
 S/N 12153

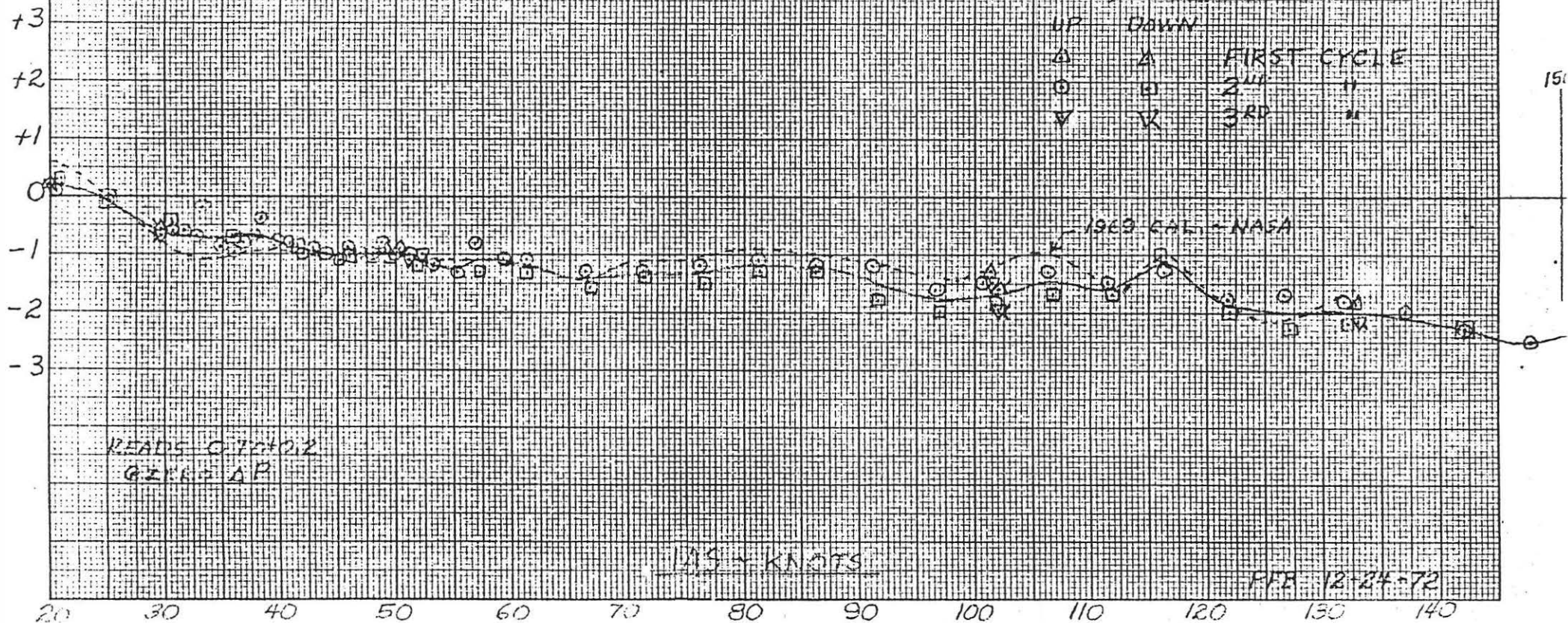
Δ VIAS ~ KNOTS
 CORR. TO BE ADDED

AIR SPEED INDICATOR CALIBRATION

11-21-73 CHECK CAL. vs. #1 GK, L. 1 KTS., BFB

FABR INSTR. LAB.
 DEC. 13, 1972 RAY JACKSON

UP	DOWN		
Δ	∇	FIRST CYCLE	
\circ	\square	2ND "	
∇	∇	3RD "	



LP-15 NO. 1
 GROSS WT. = 724 lbs
 C.G. @ 30.5 to 34% MAC

FIG 6
 AIRSPEED SYSTEM
 STATIC ORIFICE SURVEY

- ~ 0° FLAP, 2° UP AILERON
- △ ~ 6.1 UP FLAP, 2° UP AILERON
- ▽ ~ 35° DN. FLAP, 2° UP AILERON
- ◇ ~ 60° DN. FLAP, 0° AILERON

NOTE: - POSITION ERROR CORRECTION, ΔV_{PE} , FROM REF. TO CALIBRATED TAIL CONE SYSTEM & (*) POINTS FROM T-6 PACER.

(*) (*) ~ CALIBRATED ON TOW

(S-11)

P_T , 3/8" TUBE ON NOSE
 P_S , STATIC HOLES 11" AFT NOSE

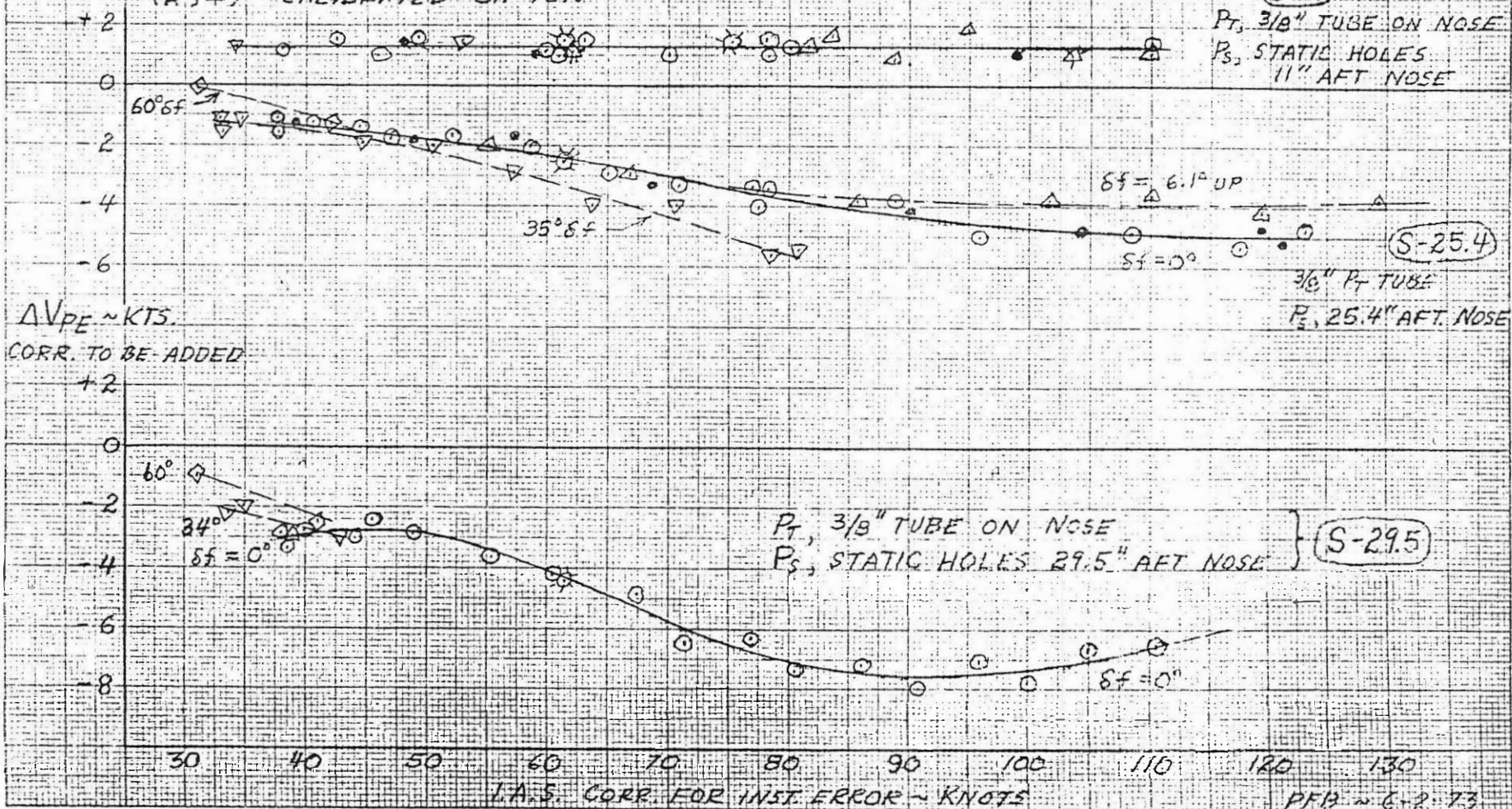


FIG. 7
AIR SPEED SYSTEM
STATIC ORIFICE SURVEY

$P_T \sim \frac{3}{8}$ " TUBE ON NOSE

LP-15 NO. 1

GROSS WEIGHT = 121 lbs.

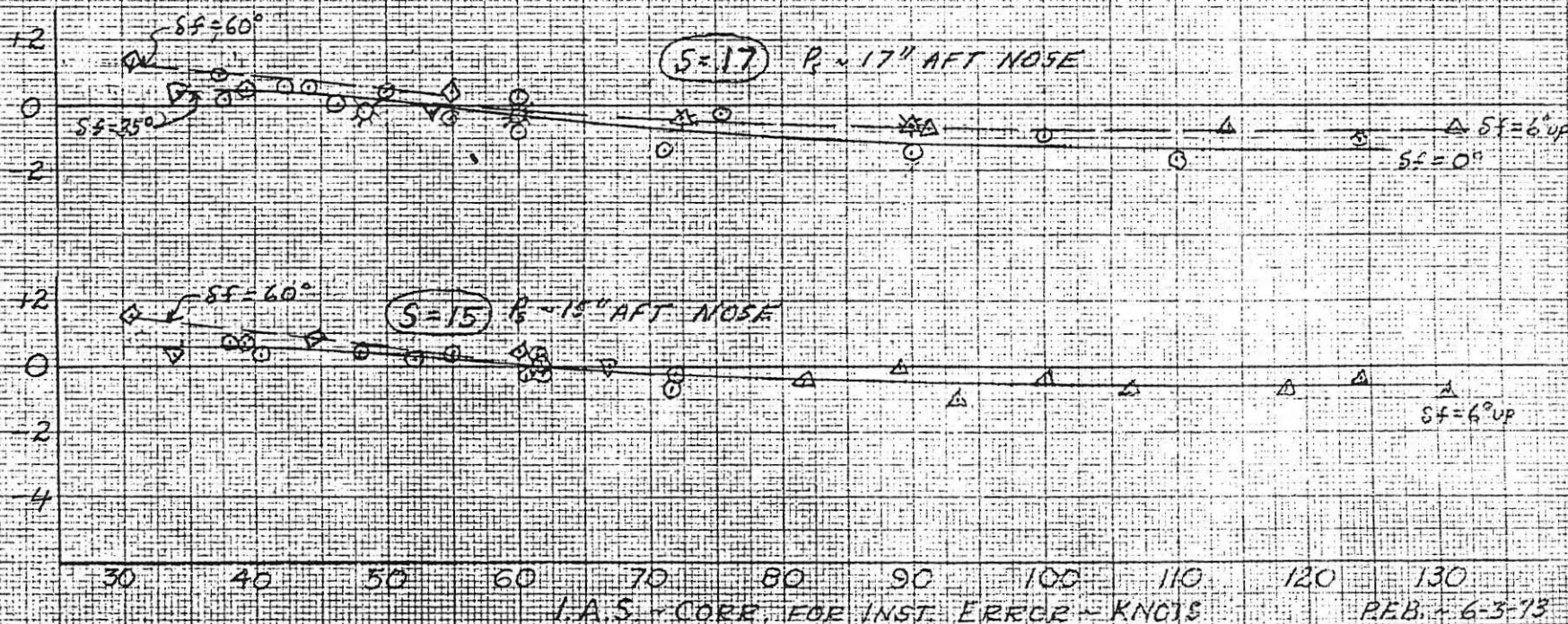
C.G. = 34% m.a.b.

- ~ 0° FLAP, 2° up aileron
- △ ~ 6.1° UP FLAP, 2° UP aileron
- ▽ ~ 35° dn Flap, 2° up aileron
- ◇ ~ 60° dn Flap, 0° aileron

(X, Y) ~ POINTS ON TOW

NOTE: - CALIBRATION VS REF. TO
 TAIL CONE STATIC SYSTEM

$\Delta V_{PE} \sim$ KNOTS
 CORR. TO BE ADDED



P.E.B. - 6-3-73

FIG. 8
 LP-15 NO. 1

SUMMARY OF AIRSPEED SYSTEM
 STATIC DRIFICE SURVEY

GROSS WEIGHT = 724.16s
 C.G. = 30.5 TO 34% MAC

TOTAL PRESSURE FROM
 TUBE EXTENDING $\frac{3}{8}$ " FWD.
 OF NOSE.

LINE 11 TO 5.44"
 BELOW CANOPY RAIL
 THROUGH NOSE



- 29.5" AFT NOSE, S-29.5, \angle OF NOSE SURFACE TO FUS. \angle = 9.0°
- 25.4" AFT NOSE, S-25.4, \angle " " " " " " = 10.1°
- 17" AFT NOSE, S-17, \angle = 13.2°
- 15" AFT NOSE, S-15, \angle = 14.4°
- 11" AFT NOSE, S-11, \angle = 16.4°

NOTE: 2 STATIC DRIFICES, ONE EACH SIDE, AT EACH STATION

ΔV_{PE} - KNOTS

CORR TO BE ADDED

+2
0
-2
-4
-6
-8
-10

8f = 60 37 0

30 40 50 60 70 80 90 100 110 120 130

I.A.S. CORR FOR INSTR. ERROR - KNOTS

S-11

S-15

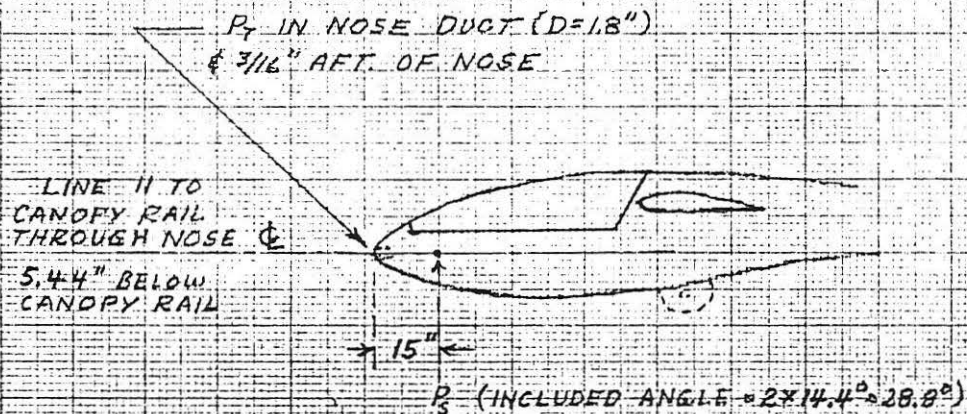
S-17

S-25.4

S-29.5

FIG. 9
LP-15 NO. 1

AIRSPPEED SYSTEM CALIBRATION



MODIFIED NOSE

P_1 - IN NOSE DUCT INLET
 P_2 - ORIFICES 15" AFT. NOSE

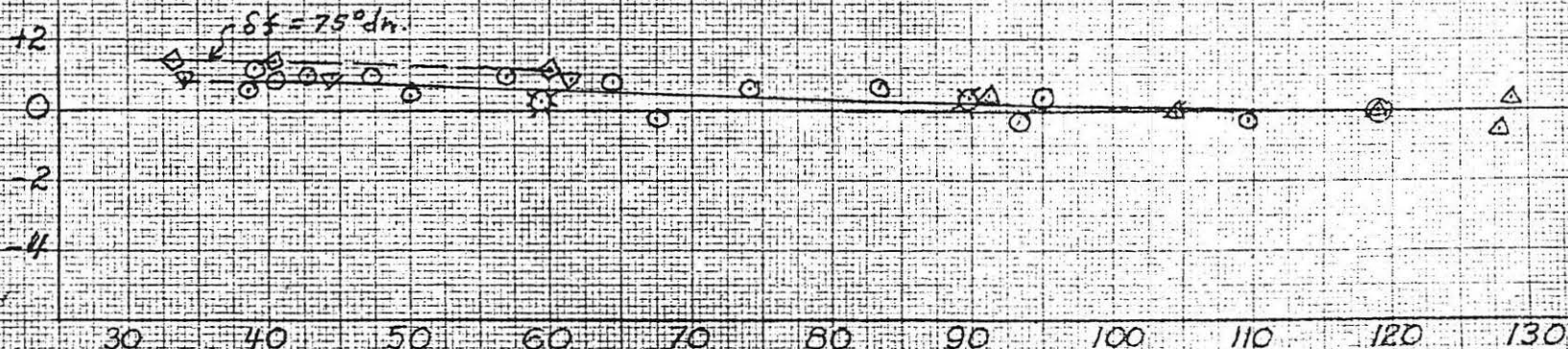
GROSS WEIGHT ~ 728 lbs.
 C.G. @ 34% m.a.c.

- \circ 0° FLAP, 2° UP AILERON
- \triangle 6.0° UP FLAP, 2° UP AILERON
- ∇ 37° DN FLAP, 0° AILERON
- \diamond 75° DN FLAP, 0° AILERON

NOTE: - CALIBRATED VS. TAIL CONE SYSTEM -
 MAY 1973

\otimes - CALIBRATION ON TDW OVER
 2 MILE SPEED COURSE - AUG. 1973

AVPE. ~ KNOTS
CORR TO BE ADDED



IAS. CORR. FOR INST. ERROR - KNOTS