THE EVOLUTION OF 2 METER DESIGN & CONSTRUCTION

Larry Dunn & Bill Kuhlman

What is 2 Meter?

- 2 Meter (2M) is a contest format where the wing span is limited to two meters (78.74”)
- Additional restraints like launch method, number of servos and/or control surfaces, and construction materials may be further defined by a local club, a national organization like the AMA (Academy of Model Aeronautics) here in the U.S., or the FAI (Fédération Aéronautique Internationale)

Why is 2 Meter popular?

- With 2 Meter (2M) maximum span, aircraft are of a reasonable size for transportation
- Contests are held internationally: U.S, Australia, all of Europe & Eastern Europe, and Japan
- Three major launch methods: hi-start, winch, and e-power
- 2 Meter contests are run under either local rules, rules defined by national organizations like the AMA, or rules promulgated by FAI (F3L).

The 2 Meter design challenge(s)

- Wing
  - Lift distribution
  - Wing chord
  - Weight
  - Aspect ratio
  - Airfoil(s)

The 2 Meter design challenge(s)

- Tail shape
  - T-tail
  - Cruciform tail
  - V-tail
  - Horizontal stabilizer separate from fin/rudder

The 2 Meter design challenge(s)

- Tail surface areas
  - Tail volume coefficient (mathematical)
  - Use 10% for stab, 6% for fin/rudder
  - Copy successful designs

- Tail surface shapes
  - Stabilizer and fin/rudder should be elliptical so far as possible
  - T-tail caps fin/rudder but fuselage must be strengthened to withstand torsional loads

Controls

- Rudder only (not really viable)
- Rudder & elevator *
- Rudder, elevator & spoiler (FAI F3L)
- Rudder, elevator & aileron (spoiler optional)
- Rudder, elevator, aileron & flaps

* Australia 2 Meter rules limit the number of servos to two.

Wing structure depends on…

- Launch method
  - Hi-start (pull force at launch ~8 lbs for FAI F3L, but higher for early 2 meter contests)
  - Winch (line breaking strength; can be up to 170 for #18 line to 250 lbs for #24)
- Aerodynamic loads during flight: resistance to bending and torsional loads, includes g-forces during pull-up from high speed dive and resistance to flutter.

Wing structures

For Hi-start

- Completely open bay with ribs and spar(s)
- Leading edge sheeting (D-tube) and spar(s)

For Winch

- D-tube, and fully sheeted
- Foam core with spar(s) and balsa or obechi sheeting
- Hollow core with spar(s)

Spar structure

- **Cross-section**
  - I-beam
  - Box beam
  - Tubular
- **Materials**
  - Balsa
  - Spruce
  - Plywood
  - Carbon fiber
  - Kevlar

Boron filaments:

Boron filaments consist of a tungsten core and amorphous boron sheath. Filaments are 4 - 5.6 thousands of an inch thick.

No kits or ARFs have utilized boron filaments, but they have been used in a couple of DIY aircraft by Model Research Labs.

Designing "the best" 2 Meter

Aspect ratio…

Sailplane Designer's Handbook - Eric Lister (1974)
Aspect ratio: 10-14:1 for 8 oz/ft^2 wing loading

Tech Topics – Dave Register (2004)
Aspect ratio: 8 – 10:1 for 9.7 oz/ft^2 - 10.8 oz/ft^2

Note: As aspect ratio increases, area decreases and wing loading goes up. Lighter models can therefore have higher aspect ratios.

Designing "the Best" 2 Meter

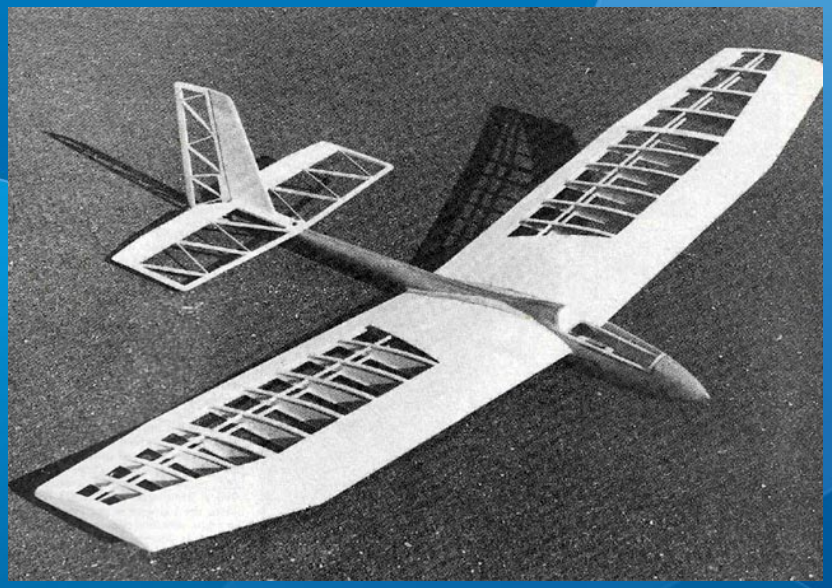
Airfoil…

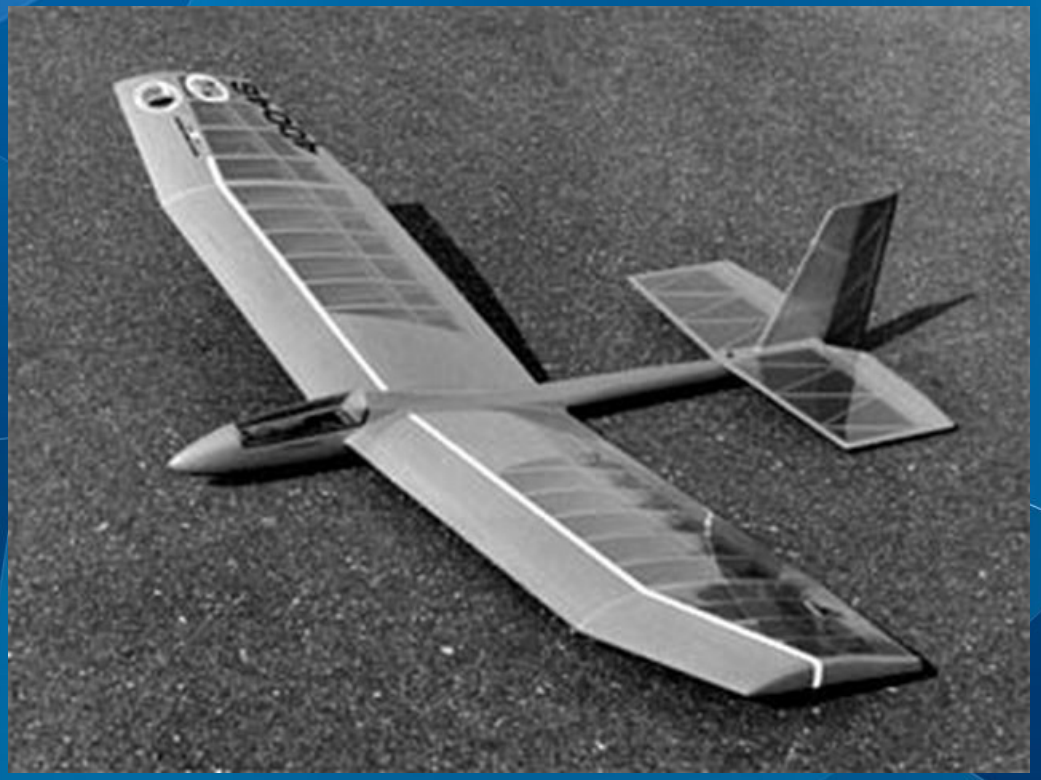
Sailplane Designer's Handbook - Eric Lister (1974)
Clark Y, sections 10% thick with 5-7% camber

AG series (AG35, AG36, AG37) - Mark Drela (1992)

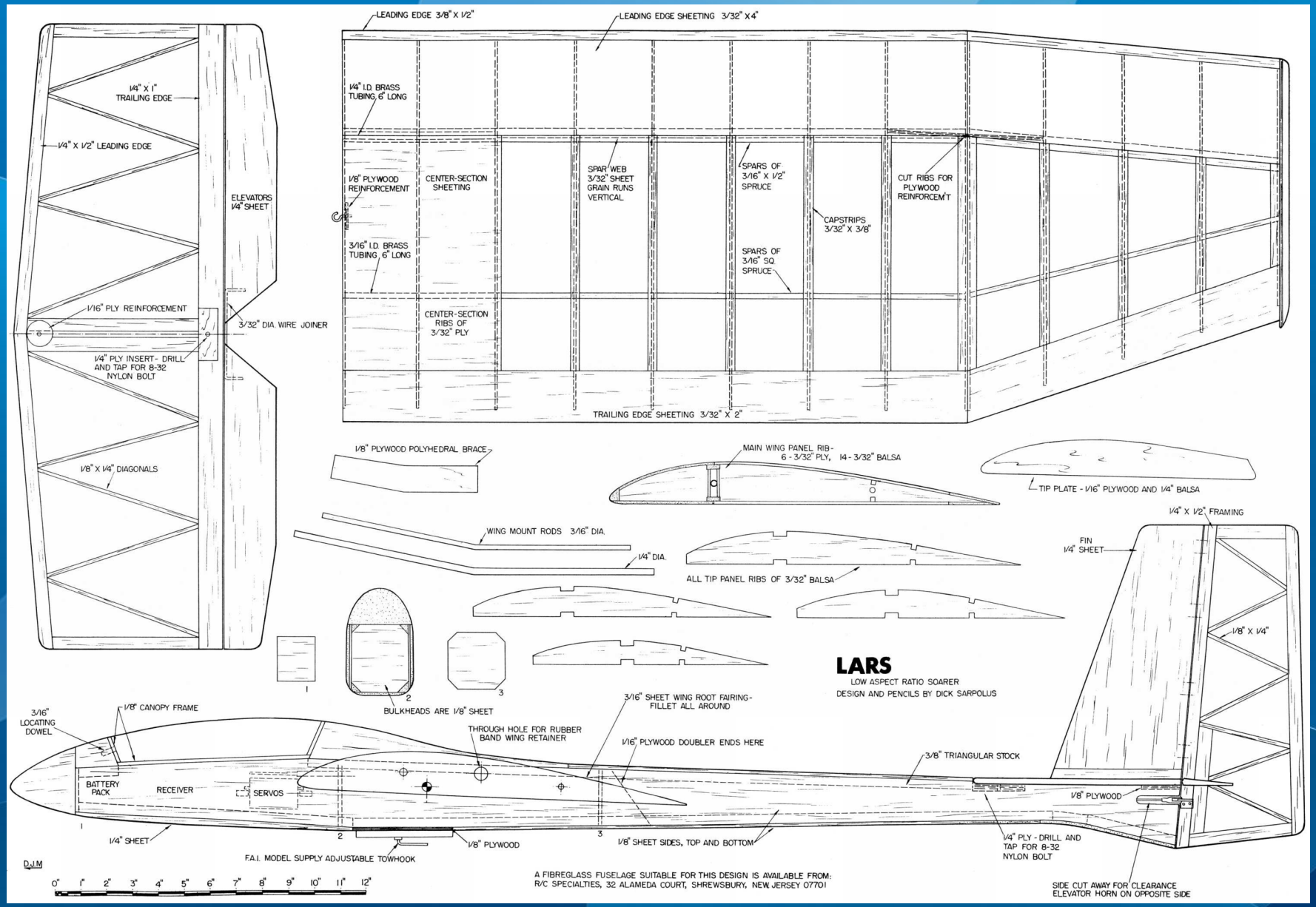
Tech Topics – Dave Register (2004)
Selig *et al* sections: SA7035 and SA7038

Representative 2 Meter Models 1976 to Present





1976 LARS
Dick Sarpolus

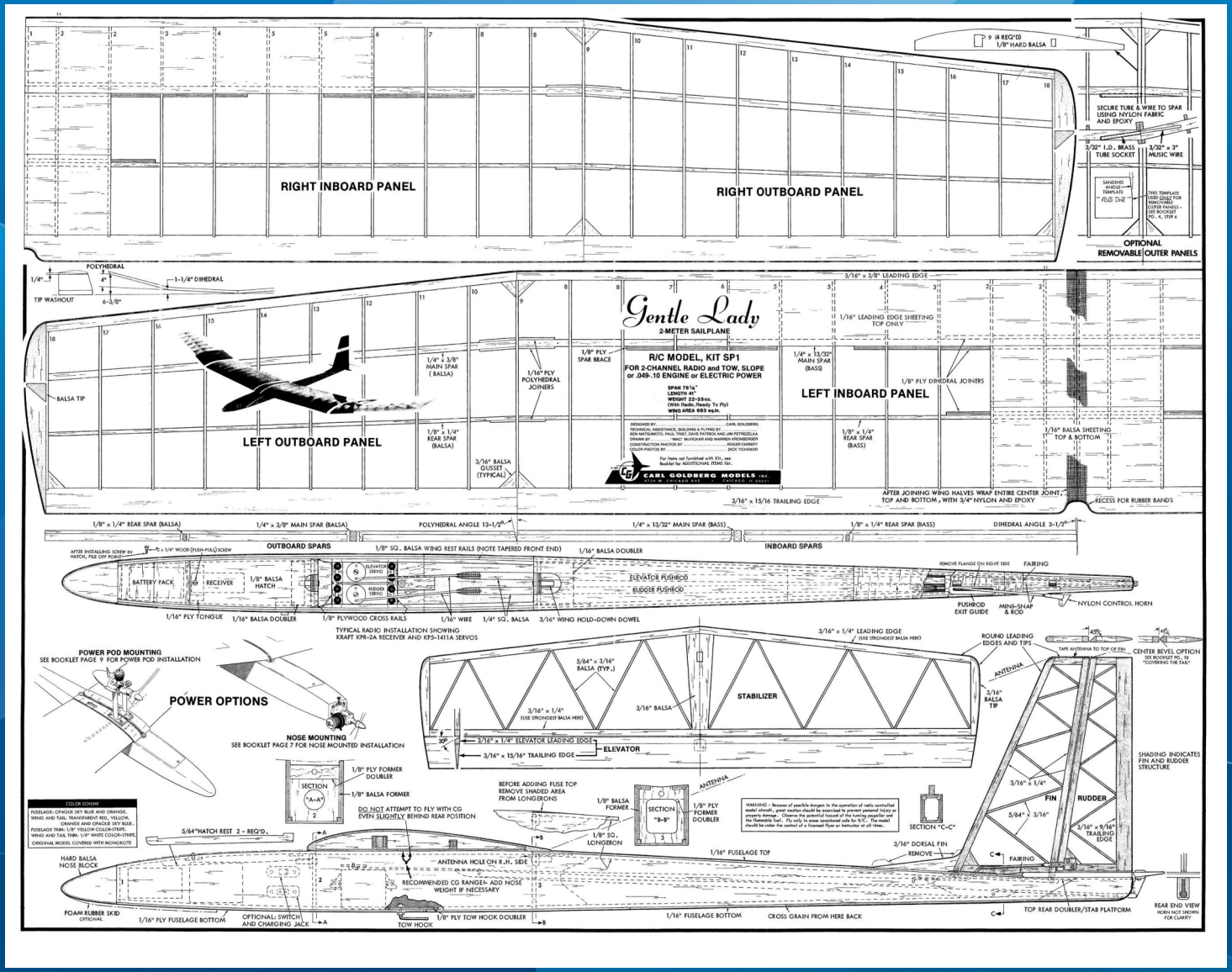


1976 LARS Dick Sarpolus





1980 Gentle Lady
Carl Goldberg

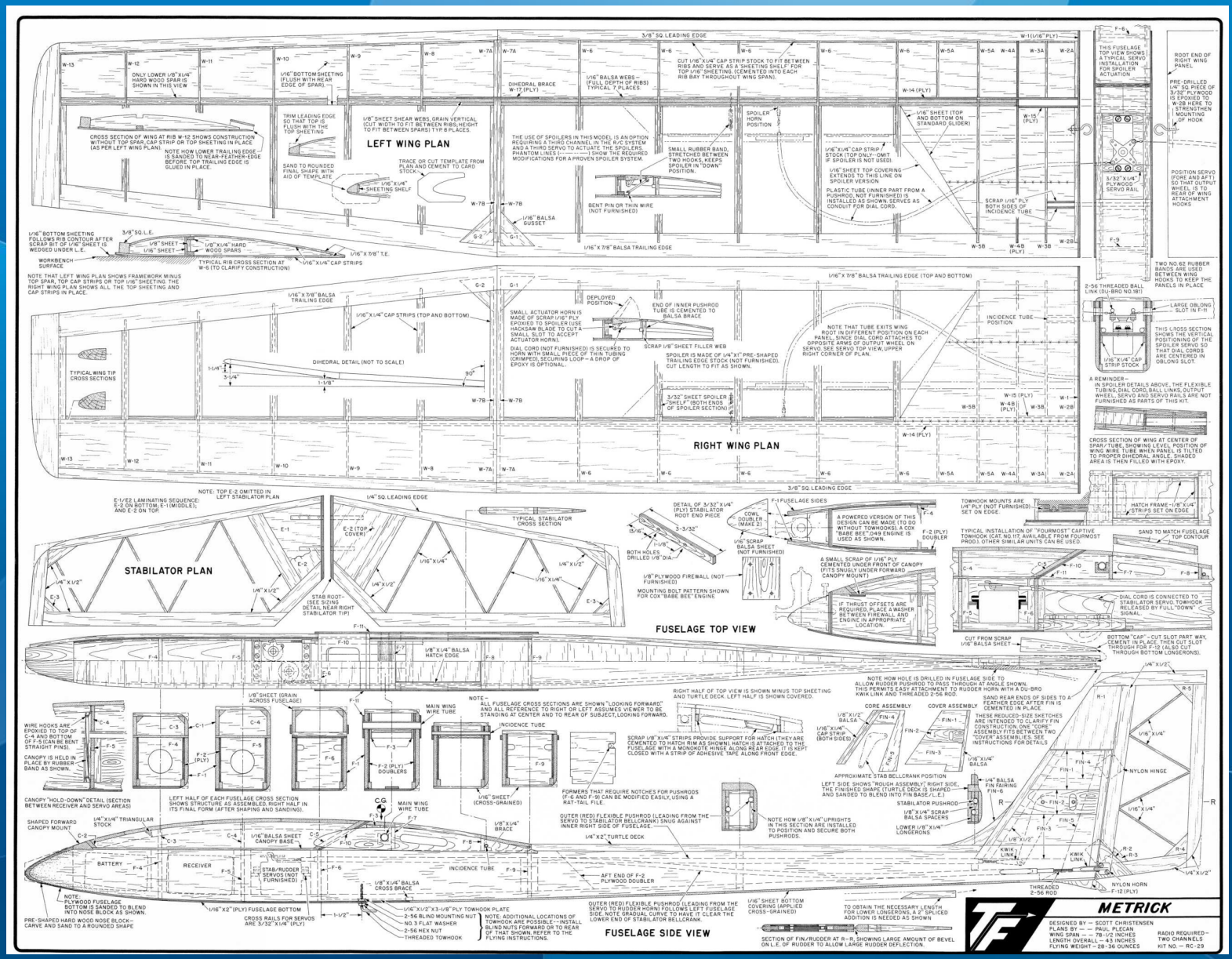


1980 Gentle Lady Carl Goldberg

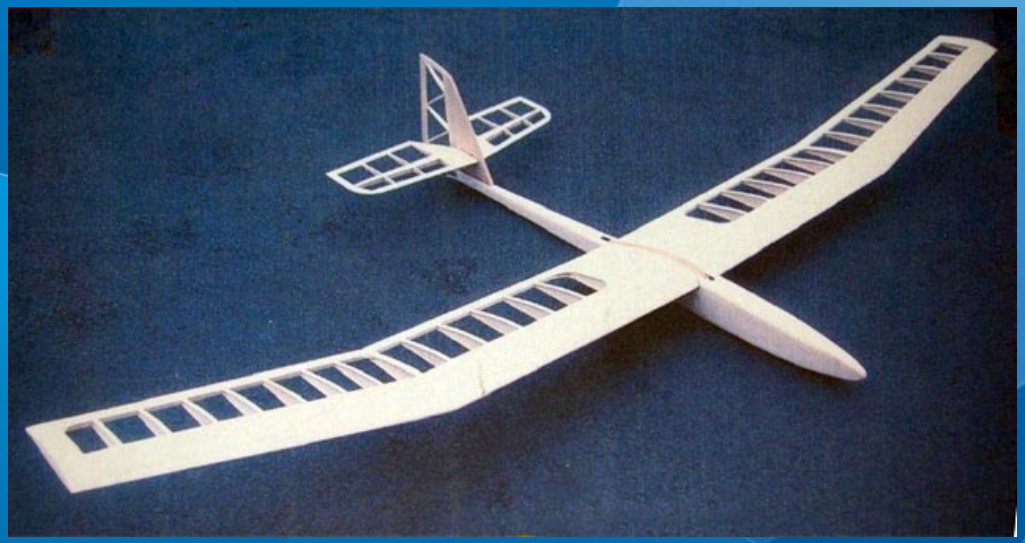


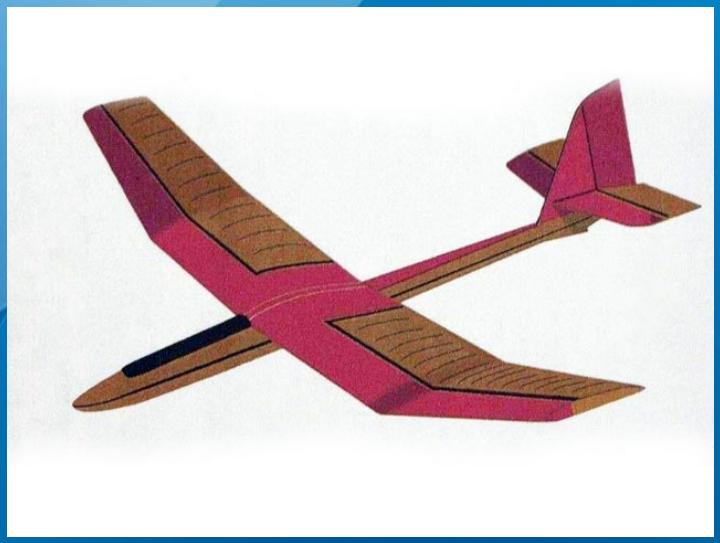


(1982) Metrick
Scott Christensen



(1982) Metrick - Scott Christensen

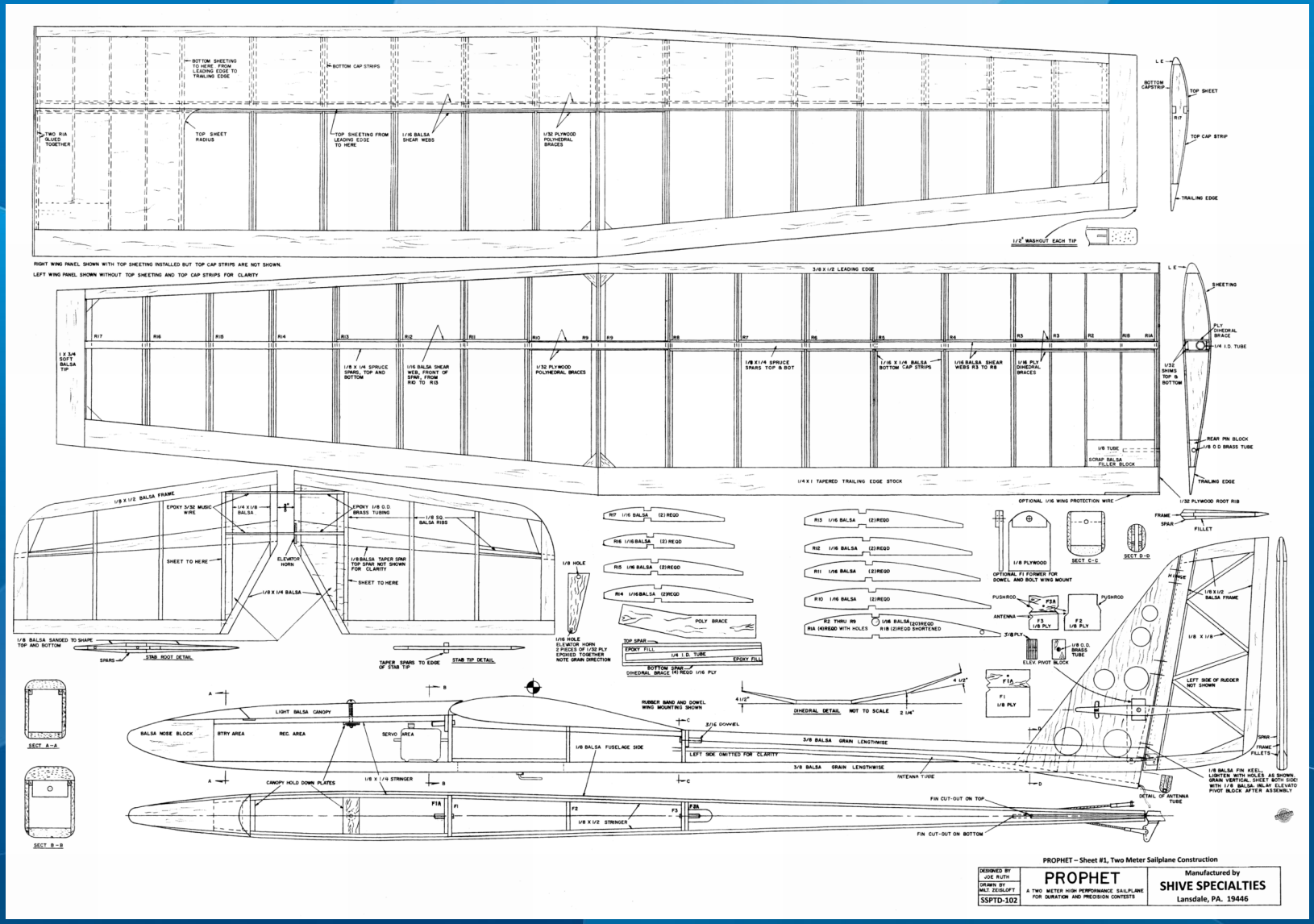




1982 Prophet
Joe Ruth

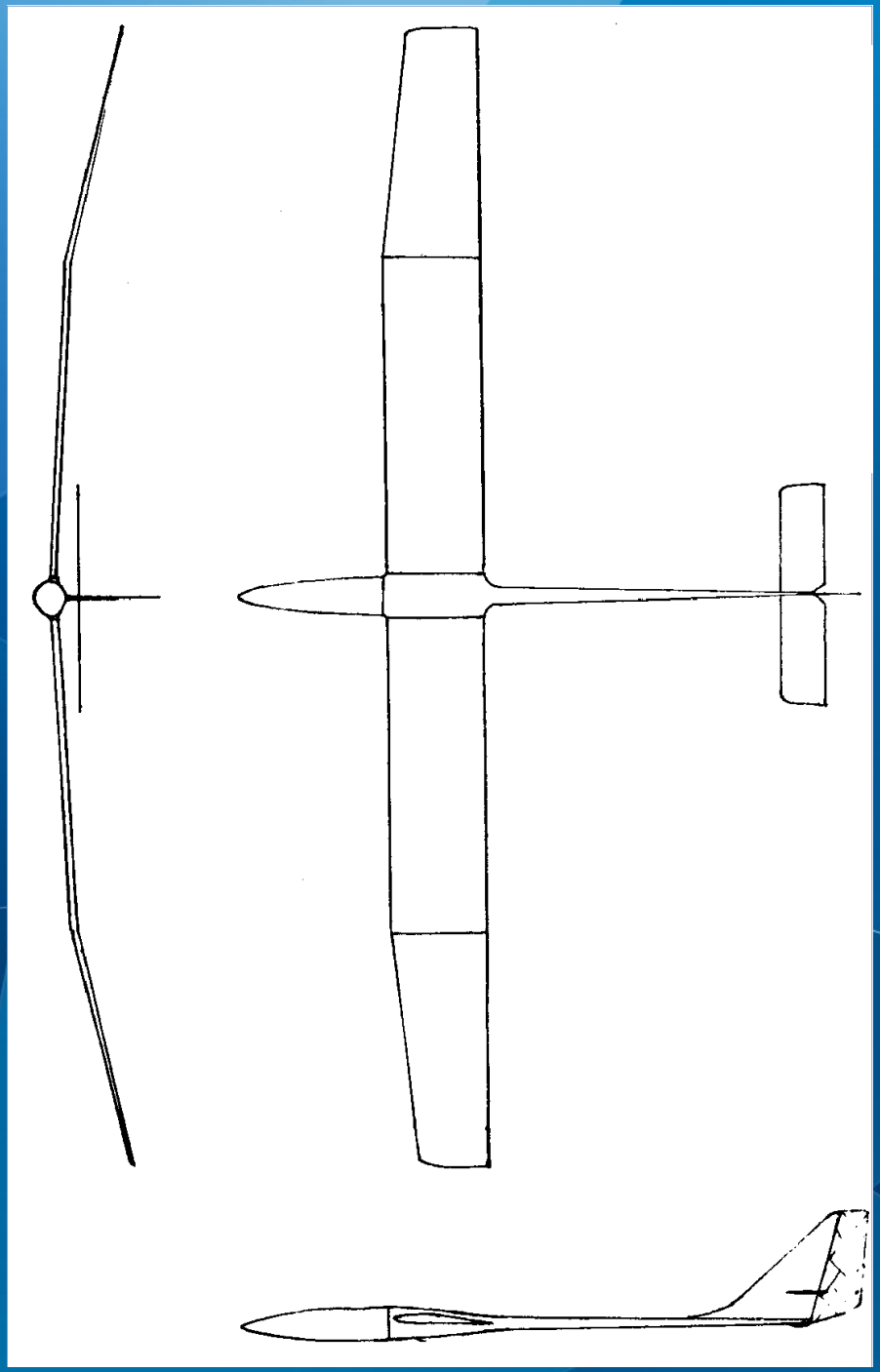


Ted Davey of Pennsylvania and winch-retriever fame flew a Two-Meter Prophet.

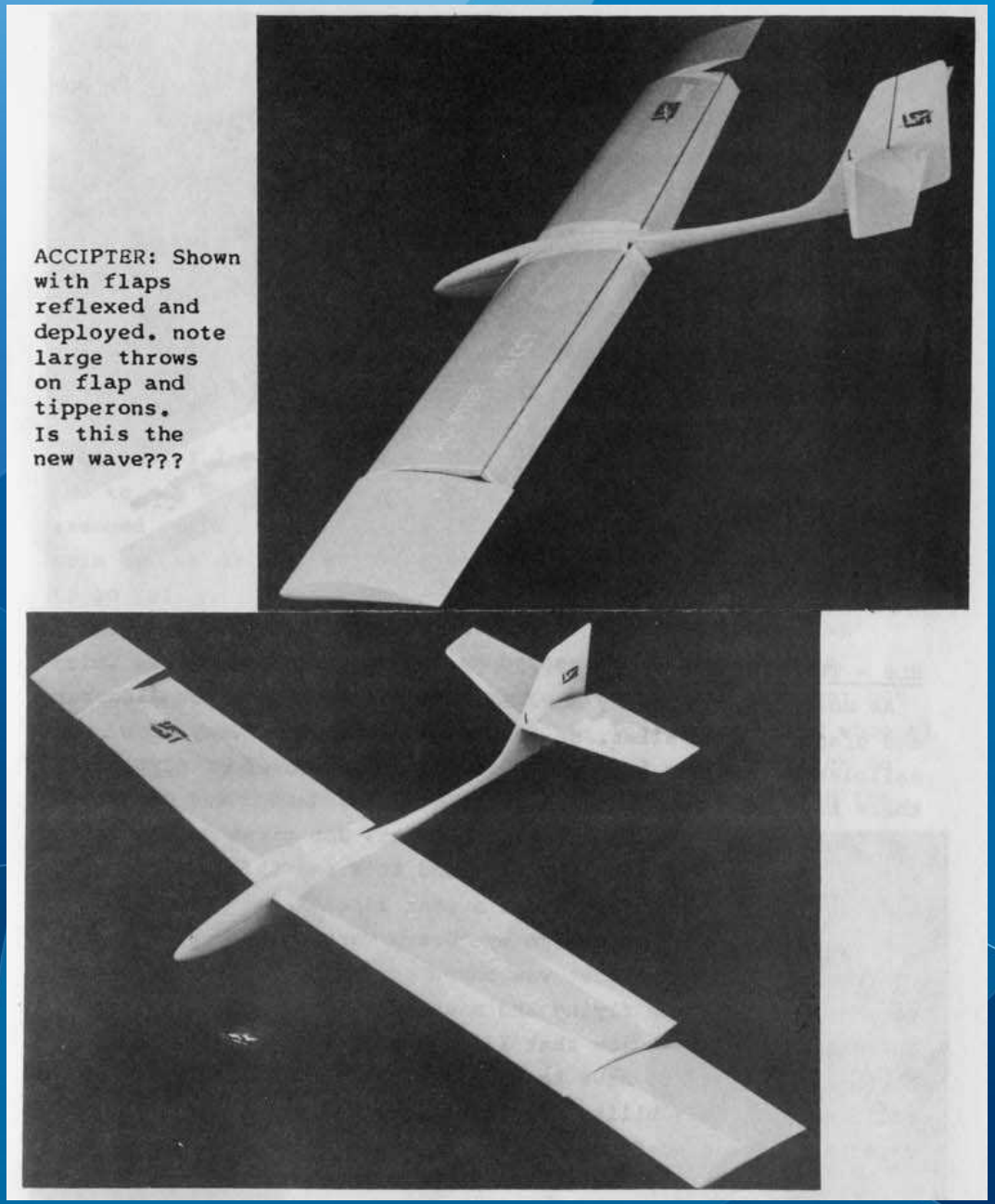


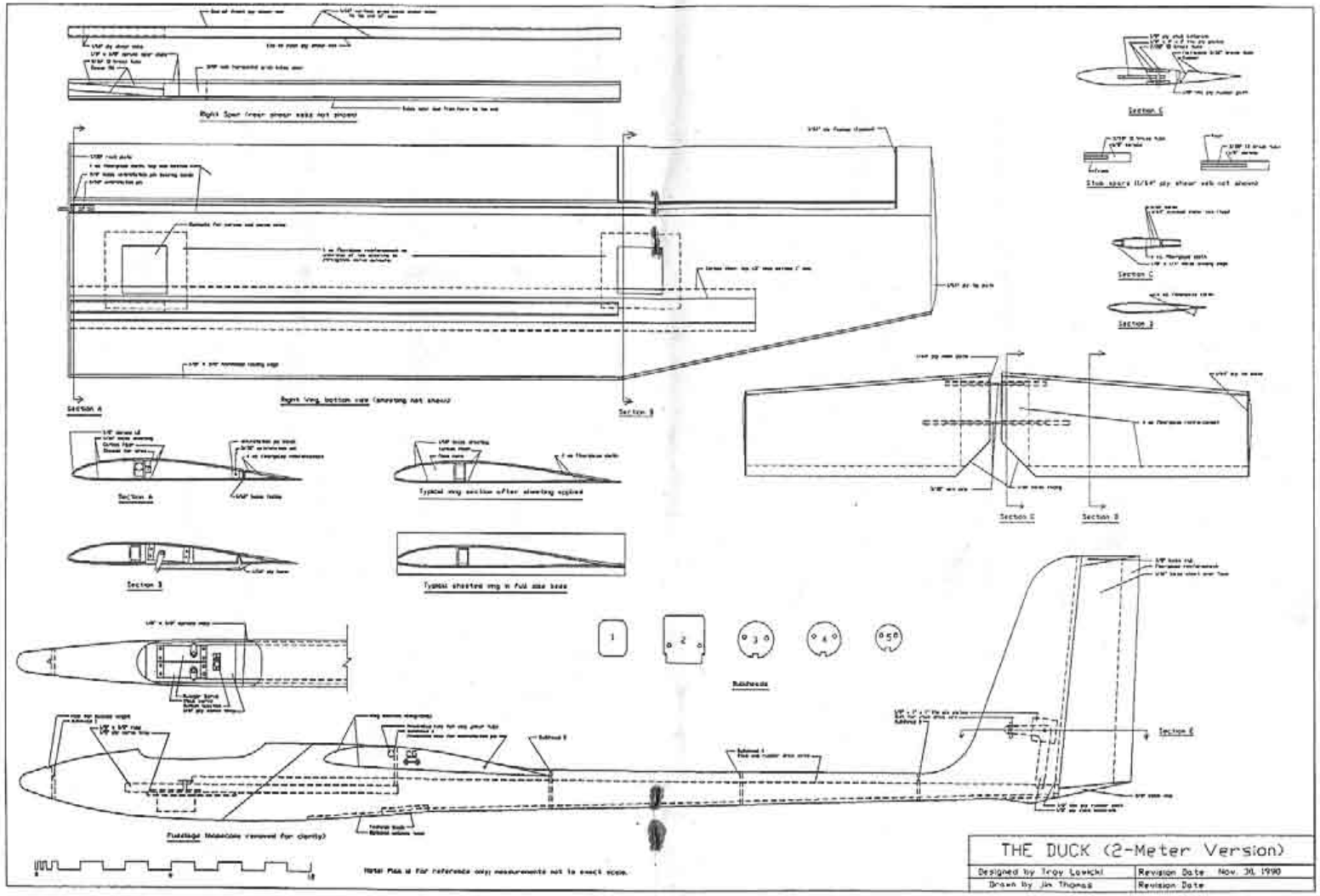
1982 Prophet Joe Ruth

(1982) Petre III
Peter Abell

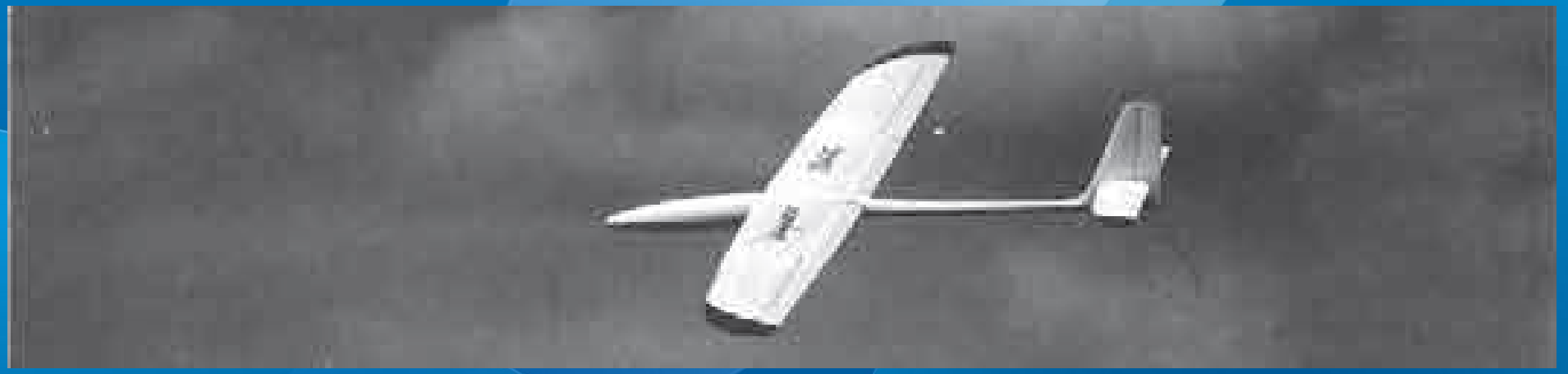


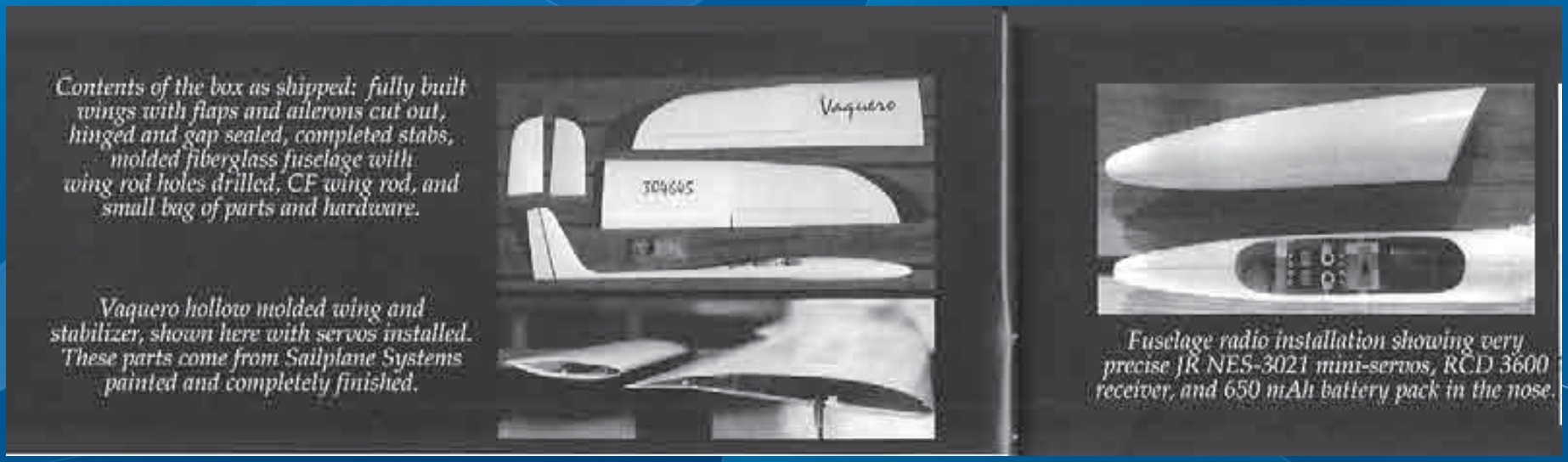
(1986) Accipiter
CALSOAR/Jeff Morton





(1990) Duck Troy Lowichi





(1996) Vaquero Tom Finch



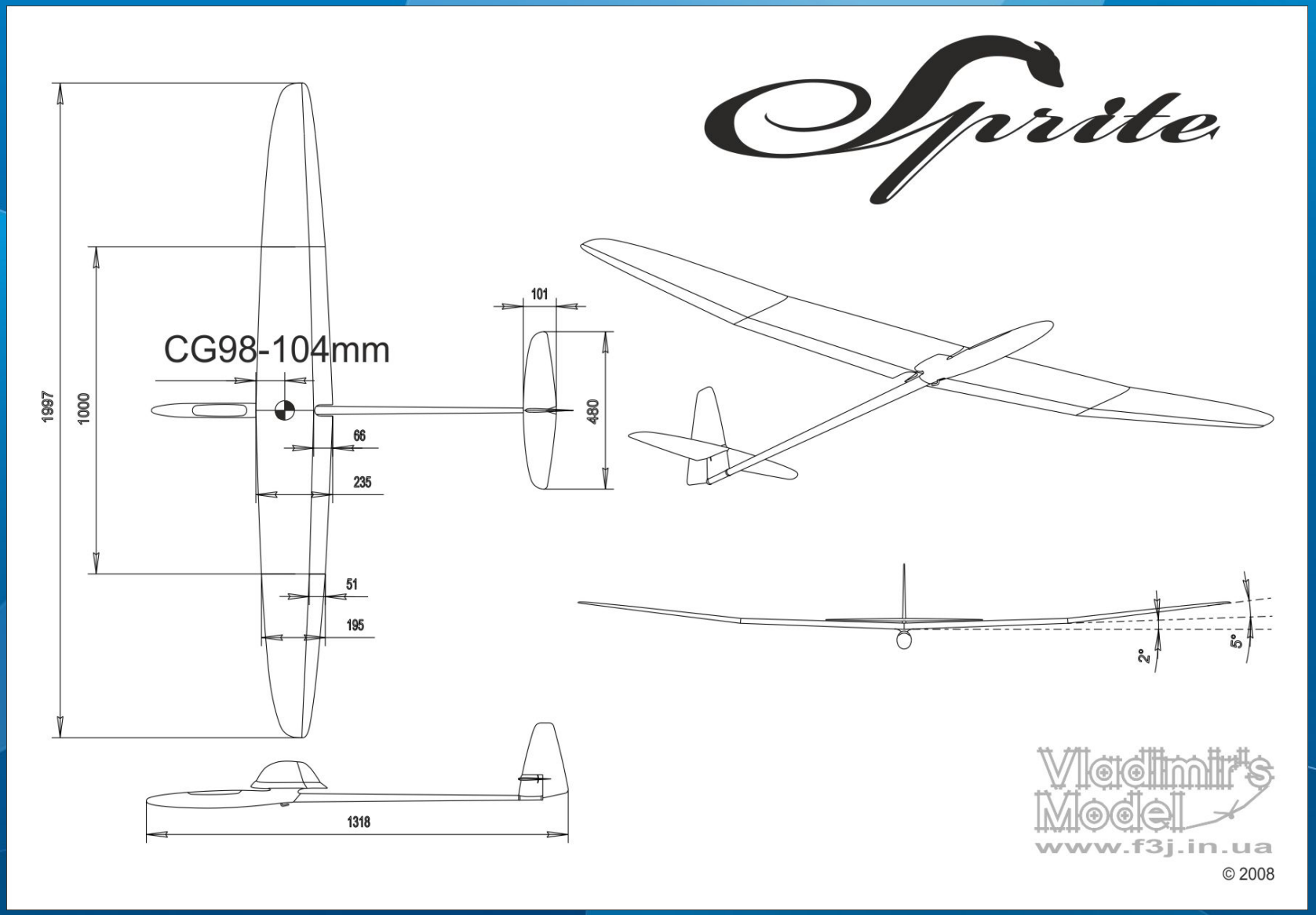


(1998) Monarch 2M
DJ Aerotec





~2009 Sprite
Mark Drela

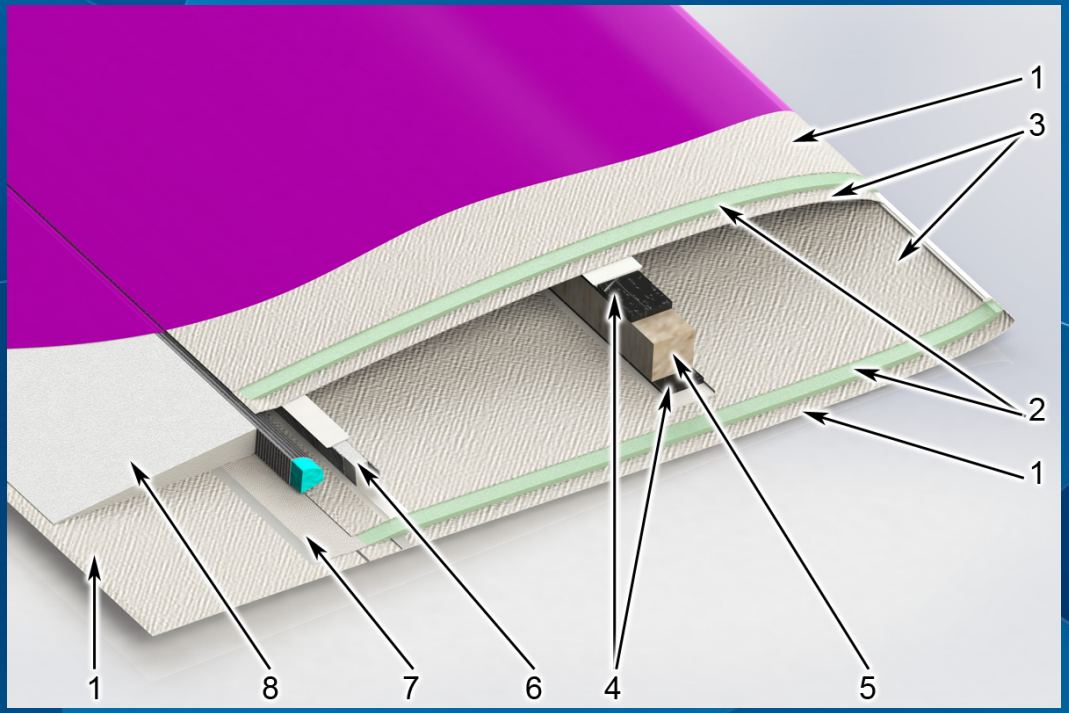


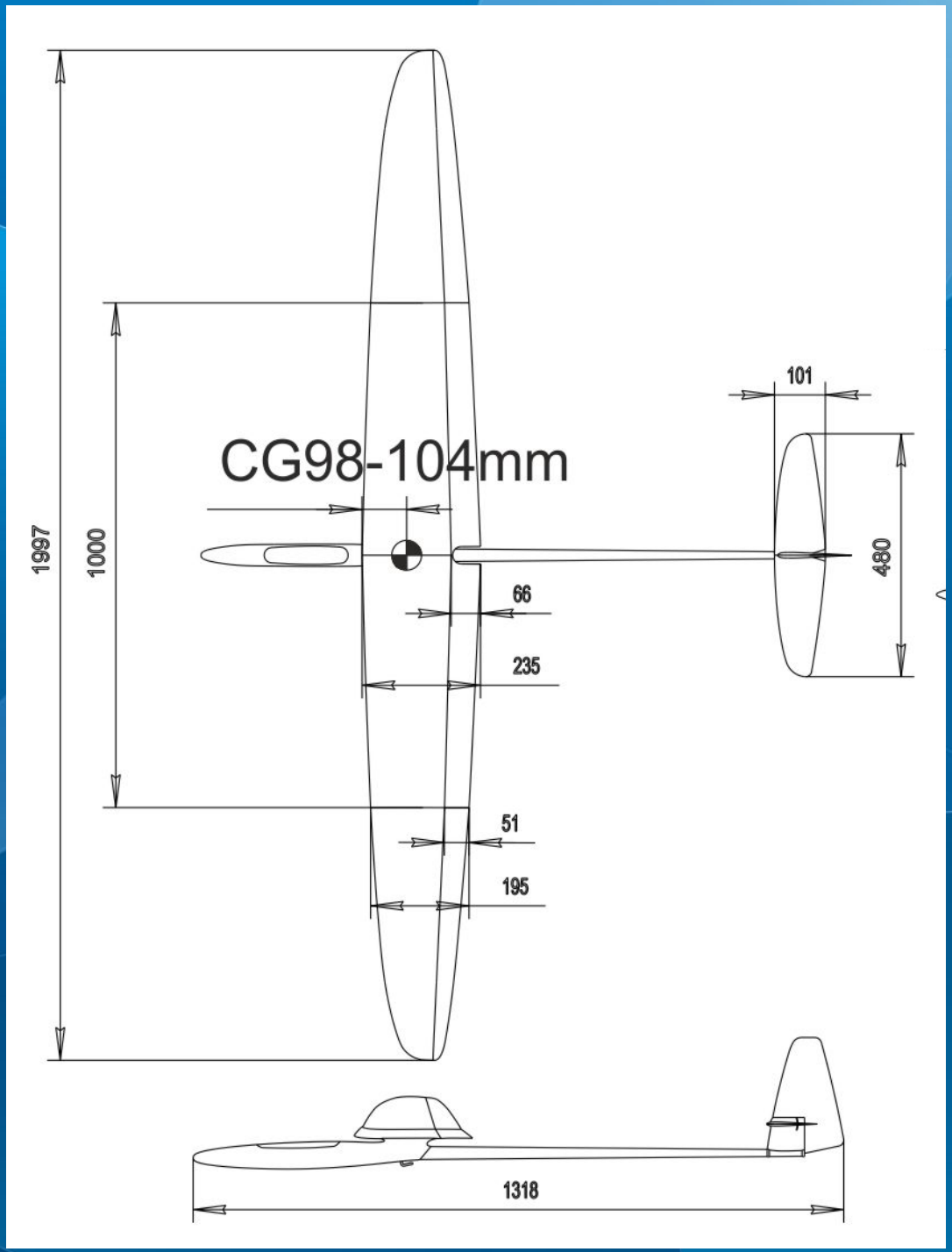
~2009 Sprite Mark Drela

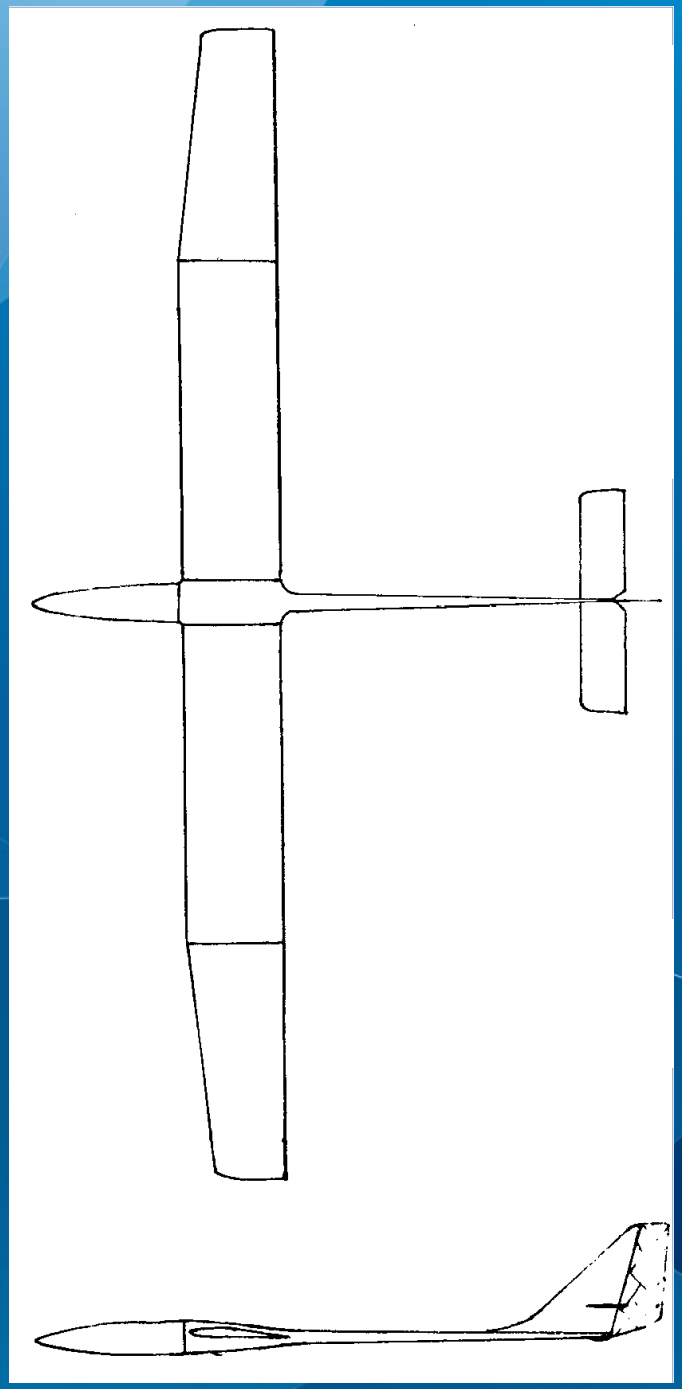




~2009 Sprite
Mark Drela




CG98-104mm
1997
1000
101
480
66
235
51
195
1318





Czech F3L Champs September 2024

Finis