Competition Boost-Gliders

Trip Barber
NAR 4322
What it Takes to Win

• Reliability
• Good Boost
• Clean Transition to Glide
• Good Glide
• Returned Model
Glider Reliability

• Proper structural strength for boost
  – Balsa thickness & grain, gluing technique
  – Lower-thrust motors preferred
  – Tissue covering for B and higher power classes

• Good release from launcher
  – Restrain ignition clips from catching the tail,
    provide wind bracing so glider stays on pod

• Clean pod separation
  – Proper friction fit, small chute for recovery

• Practice makes perfect!
Good Boost

- Provide enough launch rod travel length
  - Use “power tower”, extended rod lengths and larger diameters if necessary
- Get the force balance and stability right
  - Thrust vs aerodynamic balance, CG vs CP
- Align wings correctly on pad
  - Wing span parallel to wind direction
- Use a smaller glider unless it’s windy
  - High altitude = long duration
Boost Stability

Boost CG must be well ahead of CP

Boosts nose-down, pod height governs how much

Coasts with nose-up loop, stab incidence governs how much
Clean Transition

- Put some (~2%) incidence on stabilizer
  - Pulls out of “death dives”
  - Too much incidence will cause boost loops & glide balance issues
- Trim for wide-diameter right turn
  - Start with horizontal toss at normal glide speed
  - Check with hand launches nearly straight up
- Choose proper motor delay time
  - Eject pod on the way up, not down
Good Glide

- Minimize glider drag and weight
  - Smooth wing surface, without paint
- Select and shape an appropriate airfoil
  - High point at 30% chord, taper wing thickness
- Minimize wing loading (weight / wing area)
- Trim to glide at a small angle of attack
  - Maximize $C_L^{1.5}/C_D$ for max duration
- Get the CG vs neutral point balance right
  - Glide CG at $\frac{3}{4}$-chord point is ideal
Boost Glider Design

From Tim VanMilligan's "Model Rocket Design"
## Glider Sizes

<table>
<thead>
<tr>
<th>Engine Power</th>
<th>Wing Area (Sq. inches)</th>
<th>Wing &amp; Boom Thickness</th>
<th>Stab/Rudder Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ A</td>
<td>15 – 25</td>
<td>3/32</td>
<td>1/32</td>
</tr>
<tr>
<td>A</td>
<td>20 – 35</td>
<td>1/8</td>
<td>1/16</td>
</tr>
<tr>
<td>B</td>
<td>30 – 45</td>
<td>1/8 – 3/16</td>
<td>1/16</td>
</tr>
<tr>
<td>C</td>
<td>40 – 60</td>
<td>3/16</td>
<td>3/32</td>
</tr>
</tbody>
</table>

Wings & stabilizers from 6 lb/ft\(^3\) density C-grain balsa
Fuselage booms from 12-16 lb density
Glider Airfoil

\[ \alpha = \text{angle of attack} \]

\[ \text{Reference line} \]

\[ \text{Zero-lift line} \]

\[ \text{Camber} \]

\[ \text{Point of max camber} \]

\[ \text{Zero-lift line goes through camber line approx 40\% c_w forward of T.E.} \]

\[ \text{Camber line high point (max thickness)} \]

\[ \text{Airflow at velocity v} \]
GRAPH OF THEORETICAL LIFT COEFFICIENT AND DRAG COEFFICIENT VS ANGLE OF ATTACK FOR NACA 1305 AND 2305 AIRFOILS (data from Bob Parks)
Picking Air

- Good durations require flying in air that is warmer than the surrounding air and is rising – a “thermal”
- Most likely to occur on sunny afternoons, downwind of areas (plowed dirt, asphalt) that absorb sun heat
- Generally occur in “waves” – a bubble of warmth for a minute or two followed by cool downdraft for a longer period – on a regular cycle
- Detected by thermal streamers, sudden calm and warming, recording thermometers, or circling birds
- Aim slightly downwind to boost into the thermal
Returning Models

• Enhance glider visibility
  – Dark magic marker on underside of wings, aluminized mylar on tops of wingtips
  – Use larger gliders in windy weather

• Use radio control

• Use a dethermalizer
  – Wing flap, “beer can” or drop weight