Mechanical Prototype Review

Strengths, Improvements, Insights
Prototype Timeline

- Date – SolidWorks Models Finished
- Date – Teflon Stock Cut
- Date – MasterCam Nose Cone CNC Mill Code
- Date – Teflon Nose Cone Milling Completed
- Date – Teflon Nose Cone Lathe Completed
- Date – Aluminum Stock Cut
- Date – MasterCam Back Cap CNC Lathe Code
- Date – MasterCam Back Cap CNC Mill Code 1/2
- Date – MasterCam Nose Cap CNC Mill Code
- Date – Back Cap Lathe Completed
- Date – Back Cap Milling 1/2 Completed
- Date – Nose Cap Lathe Completed
- Date – Back Cap Axial Completed
- Date – Nose Cap Axial Completed
- Date – Body Tube Completed
- Date – Nose Cap Completed
- Date – MasterCam Back Cap CNC Mill Code 2/2
- Date – Back Cap Milling 2/2 Completed
- Date – Back Cap Completed
Machining Highlights

• Nothing was broken!
• Prototype is a good packaging model
  – External dimensions correct to +/- 0.1 in
  – Actual weight close to expectations
    • 843 grams (measured) vs. 852 grams (predicted)
    • Measured w/o screws & o-rings, which add 39 grams
• The model is strong and rigid
Areas of Improvement

• We should machine all of the pieces to be flush to improve aerodynamics.
• We should use finishes that produce smooth surfaces without deep machining marks.
• We should make the hook thicker to ensure it won’t fail with a parachute.
• We should remove sharp edges and do rounding to prevent catching and crack initiation.
• We should make the first radial holes on 1 piece at a time to ensure correct distances are maintained.
• We should see where we can remove material without compromising strength.
Insights

• Radial holes are difficult because we are on a 3-axis vertical mill.
• Our parts are complicated and must be chucked and zeroed at least 2 to 5 times on two machines (mill, lathe) to manufacture. This is time consuming and opens us up to mistakes.
• We should find a way to work with 3 radial holes to eliminate a technical re-chucking due to interference from the rotary indexer.
• Some of our geometry is complicated, and as a result the g-code for CNC operations takes up a lot of memory. If we could simplify the machining paths or part geometry we could avoid program memory errors as well as improving the machining speed.
• We remove a lot of material, so we should do tool changes more often to speed up milling and get better finishes.
• We should add features to allow probe contents to be oriented and held in the body tube or nose cone.
Prototype Probe
Parachute Hook

- Tool pass error, excess material removed
- Check code for this pass information
- "Bumps" from cutter, rough finish
- Slow down tool feed for this cut
- Drill bit scratches visible
- Not a significant problem here
- Screws are flush to surface, good
- Good contact, no gaps visible
- Change end cap outer dimensions to match body tube
Screws are flush to surface, good

Check connections for gaps
Re-orient to minimize
Nose Cone Pocket View

Finish pass work, geometry.
End Can Pocket Views

Small tool used

Larger tool used
End Cap Radial Hole Views

- Good

- Wrong spot for o-ring
- Bit chatter
- Extends into o-ring space
Tool Sizes For Screws (Reference)

- **Nose Cone Screws:** Torx T15 Tool
- **End Cap Screws:** Hex 5/32in Tool