



GUIDELINES AND SUGGESTIONS FOR BALLOON GONDOLA DESIGN

**MAY 16-18 2017
HUGO FRANCO**



DESIGN REQUIREMENTS

- **STRUCTURAL INTEGRITY**

- Primarily to survive termination event
 - Safety
 - Mission assurance
- Has been sufficient for landing – Although not a CSBF requirement

- **LAUNCHABILITY**

- Important to prevent damage
- Allows for less than ideal launch conditions

- **STAGING/PICKUP**

- Must be able to fit inside existing high bays
- Allows for hoist pickup and roll out to launch vehicle

- **RECOVERY**

- Some existing recovery limitations – Particularly Antarctica
- Crucial to stay within limitations for critical components



- **10G VERTICAL – 5 G SIDE LOAD**
 - Based on ultimate load of the material (not yield)
 - Intended to prevent freefall of components

- **ROTATOR**
 - Critical Component
 - Single point failure
 - Watch for concentration factors

- **SUSPENSION LINES (WHERE APPLICABLE)**
 - Great historical data for steel cables
 - Have used synthetic systems before to save weight – Kevlar, Spectra
 - UV a concern, one time use perhaps

- **STRUCTURAL MEMBERS**
 - Mostly made of Aluminum or other lite tough metals
 - Have flown Carbon Fiber/metal hybrids
 - Still learning to test and approve for certification



- **PAYLOAD MUST BE ABLE TO SURVIVE LAUNCH**

- These are dynamic launches
 - Damage to antennae, solar panels or other protruding objects
 - Sensitive equipment can be damaged
 - Latching mechanisms

- **MINIMUM DESIRED DISTANCES FROM LAUNCH VEHICLE**

- “20 degree rule” – Assures minimum desired clearance Launch Vehicle
- 6 ft. of ground clearance – Avoids contact with ground
- 5 ft. of clearance from front end of vehicle – Avoids contact with front end of vehicle during launch

- **OTHER OBSERVATIONS**

- Width/Length of payload – High MOI
- Wide sections near the boom (higher)
 - Risk of contact with boom and damage



- **FACILITIES LIMITATIONS**

- Height/Width of payload
 - Allow for weighing the payload inside the building (Antarctica)
 - Allow for ease of roll in/and out of building

- **CART/WHEELS**

- Allows people to work underneath
- Ideally allows for ballast hoppers and solar panels to stay attached for roll out.
 - Huge time saver
- Must be big enough for easy rollout
- Must allow rotation of payload for vehicle pickup



● GONDOLA DISASSEMBLY

- Critical components to stay within a certain allowable size and weight
 - Limited by recovery vehicle
 - Helo
 - Twin Otter and Bassler (Antarctica)
 - Land Vehicles

- Easy/Quick Disassembly
 - Allows for quicker recovery - Antarctica
 - Data vaults and other critical components accessible
 - Trade off between access and protection



- **WAITING TOO LONG TO CONTACT CSBF**
 - The sooner the better on gondola design
 - Pointing systems are critical and expensive components
 - The sooner we see the design the better
 - Placing CSBF equipment in appropriate location
 - Thermal considerations
 - Antenna placement

- **PROVIDING ANALYSIS FOR MAXIMUM WEIGHT**
 - Final weights are usually higher than predicted
 - Avoids rerunning the analysis if overweight

- **PROTECTIVE CAGE FOR SIP**

- **NO APPROPRIATE CASTERS/TIRES**
 - Hard to maneuver

