

Outline for NAR Level 3 Certification Package

- I) Introduction
 - A) General narrative description of model including:
 - 1) Describe dimensions (length, diameter) and launch weight
 - 2) Planned motor
 - B) Narrative description of flight operation including:
 - 1) Expected altitude
 - 2) Recovery system operation(e.g. drogue-main, main only)
 - C) Any novel or unique design features
 - D) Any major risks and mitigation of those concerns
- II) Scale drawing showing:
 - A) May be a hand drawn or computer graphic
 - B) Major dimensions (dimensions used in CP calculations should be shown)
 - C) Calculated center of pressure
 - D) Aft CG limit
- III) Description of construction materials and techniques (Construction Package)
 - A) May be narrative, tabular, or graphic or a combination of all
 - B) Airframe materials including
 - 1) Body tubes or fuselage
 - 2) Fins
 - 3) Centering rings
 - 4) Launch pad interface (e.g. launch lugs)
 - 5) Reinforcement materials
 - 6) Adhesives
 - 7) Nosecone
 - C) Construction techniques including
 - 1) Fin mounting method
 - 2) Reinforcement areas
 - 3) Frangible or breakaway components
 - D) Drawing showing interior layout of components/airframe assembly
 - E) Photographs
 - 1) Show construction of areas hidden after assembly
 - 2) Show details of construction
 - 3) Include a size reference, e.g. coin or ruler
- IV) Description of recovery system components and operation (Recovery Systems Package)
 - A) May be narrative, tabular, graphic, photographic or a combination of all
 - B) Description of operation
 - 1) Describe deployment sequence
 - 2) Describe mounting locations, riser connection scheme
 - 3) Describe parachute compartments and closures
 - a) Describe shear pins or other closure retention methods (e.g. friction fits)
 - b) Describe protection from hot ejection charge gasses
 - 4) Describe compartment venting
 - 5) Show estimates for descent rates for all parts
 - a) Use manufacturers recommendations or
 - b) Show calculations for descent rate

- C) Description of components
 - 1) Control devices
 - a) Manufacturer and model
 - b) Sensing method/control logic (e.g. acceleration, barometric pressure, timer)
 - c) Power sources
 - d) Safe and arm controls
 - e) Mounting method
 - f) Wiring schematic showing connections of the control devices to power sources, safe and arm controls, and output (e.g. pyrotechnic) devices
 - g) Schematics may show purchased devices as "black boxes" without internal wiring detail
 - 2) Parachutes
 - a) Drogue parachute manufacturer, size, and description
 - b) Main parachute manufacturer, size, and description
 - c) Parachute bags
 - 3) Risers
 - a) Material length, width, breaking strength
 - b) Attachment methods, e.g. knots or sewn
 - 4) Mounting hardware
 - a) Mounting points
 - b) Quick disconnect links
 - c) Release mechanisms
 - 5) Pyrotechnic devices
 - a) Quantity
 - b) Bridgewire description (e.g. flashbulb, electric match)
 - c) Volume/weight of pyrotechnic materials
 - d) How was pyrotechnic material volume/weight determined?
- D) Recovery sequence initiation device testing and operation verification
 - 1) Tests the control and pyrotechnic devices
 - 2) Verify via flight tests on smaller and/or lower powered models
 - 3) Verify by ground tests
 - 4) Recovery system initiation devices must be previously tested prior to the Level 3 flight attempt
- V) Stability evaluation
 - A) Launch pad description/ rail or rod size and length/tower length
 - B) Center of pressure calculations
 - 1) Show calculations if performed manually
 - 2) Show computer printout if done by software; identify the software
 - C) Aft CG limit or actual CG
 - 1) If measured during assembly and checkout indicate the actual CG
 - 2) Verify that the pre-launch checklist verifies the CG location is not aft of the aft CG limit if the actual CG has not been previously verified
 - D) CG is a minimum of one body tube diameter ahead of the CP
 - E) Stability for complex shapes may be verified by sub-scale models
 - 1) Sub-scale model should be a minimum of 50% scale
 - 2) CG locations should be scaled identically
 - 3) Flight tests should have approximately the same dynamics, e.g. launch g's

- VI) Expected performance/flight profile
 - A) Provide the following estimated flight parameters:
 - 1) Launch weight
 - 2) Motor type
 - a) Motor designation must be an "M", "N", or "O"
 - b) Motor must have a total impulse of 5120.01 Newton-seconds or more
 - c) Motor must be currently certified by the NAR or Tripoli
 - 3) Estimated drag coefficient
 - 4) Velocity as the rocket leaves the launch system
 - 5) Maximum expected velocity
 - 6) Maximum expected altitude
 - 7) Maximum expected acceleration
 - B) Multiple profiles over a range of conditions are recommended when conditions are either estimated, unknown or variable, e.g. launch site altitude, launch day temperature, drag coefficient
 - C) Identify the method (and program if applicable) used to determine the flight performance parameters
- VII) Pre-launch checklist; typical checklist items include:
 - A) Equipment list including
 - 1) Motor preparation materials, e.g. lubricants
 - 2) Tools for airframe assembly and inspection
 - 3) Electrical test items for voltage and resistance tests
 - 4) Loose hardware (e.g. for motor retention, shear pins)
 - 5) Safety equipment (e.g. face shield)
 - 6) Comfort items (e.g. chair, table, shade)
 - B) Safety practices
 - 1) Identify items where pyrotechnics or hazardous items are being prepared, installed or tested
 - 2) Identify precautions, e.g.
 - a) Safety equipment to be used
 - b) Safety procedures to follow
 - 3) Require coordination of radio frequencies with other modelers to prevent interference
 - C) Motor preparation per manufacturer's instructions
 - 1) Igniter installation is deferred until the model is on the launch pad
 - 2) This item might be left until after the airframe is prepared in case of an airframe problem
 - 3) Install and secure the motor in the airframe
 - D) Electronics preparations
 - 1) Verify safe status prior to commencing activity
 - 2) Verify battery capacity or replace
 - 3) Inspect electronics for damage, mounting integrity
 - 4) Test to verify built in test indicators
 - 5) Verify safe status when checks are complete
 - 6) Prepare any non-flight critical electronics, e.g. location transmitters

- E) Pyrotechnics
 - 1) Observe safety practices prior to handling pyrotechnics
 - 2) Test and/or inspect bridgewire (e.g. flash bulb, electric matches) items
 - 3) Verify electronics are safed prior to connections
 - 4) Verify electronics are safed after connections
- F) Recovery system
 - 1) Inspect all components for damage (e.g. tears, burns, cuts)
 - 2) Inspect for tangles
 - 3) Verify all hardware is properly secured and risers are connected
 - 4) Pack all parachutes/risers
 - 5) Verify heat protection (e.g. wadding, shields) is in place
 - 6) Verify closures are properly secured
 - a) Install shear pins as required
 - b) Verify friction fits
- G) Final assembly
 - 1) Verify electronics remain in a safed condition
 - 2) Verify igniter is available for installation (not installed)
 - 3) Verify CG location; is it forward of the aft allowable limit?
 - 4) Verify alignment of launch pad interfaces (if applicable)
- IX) Launch checklist
 - A) Equipment list including
 - 1) Ladders, step stools for loading and access
 - 2) Standoffs
 - 3) Special launch rails, rods
 - 4) Launch pad tools (e.g. wrenches, allen wrenches)
 - 5) Recovery support items, e.g. radios
 - B) Place model on launcher
 - C) Verify launch angle/trajectory
 - D) Install igniter
 - E) Arm recovery systems
 - 1) Verify all removable items are removed
 - 2) Verify switch locking devices or connector bayonets are engaged
 - 3) Verify any built in test or power indications are normal for flight
 - 4) Verify that permission exists for radio frequency usage
 - F) Turn on non-flight critical electronics/payloads
 - G) Connect igniter to launch system
 - H) Verify Flight Witnesses are ready
 - I) Indicate flight readiness to LCO/RSO
- X) Post flight checklist
 - A) Verify all pyrotechnics are discharged
 - 1) Safe the pyrotechnic systems if live devices are present
 - 2) Attempt to identify the reason for the unfired pyrotechnic
 - B) Record or save any flight data indicates that will be lost after power removal
 - C) Remove power from electronic systems

- XI) Contingency checklist
 - A) For misfires, launch aborts, or crashes
 - B) Safe pyrotechnic systems to allow safe handling and/or disassembly
 - C) Disconnect and remove motor igniter(s)
 - D) Note operating time to determine if flight batteries need charging or replacement
 - 1) Include re-inspection requirements
 - 2) Consider any other time critical items, e.g. memory storage capacity