

TO: Dr. Sarah Oman
FROM: Matt Johns, Northrop Grumman
DATE: Aug 26, 2019
SUBJECT: Request for Proposal for Northern Arizona University Capstone Project

Universal Dome Standoff Bonding Tool

Problem Statement and Requirements:

During rocket motor integration activities at Northrop Grumman field sites, many standoffs (threaded mounting devices for avionics) are bonded to motor domes using adhesives. The current method of operations uses a bracket or template, to which the standoffs are mounted. The adhesive is applied, then the bracket is taped to the motor dome to hold the bracket in place for the 24 hour or longer cure period. The tape method is unreliable and occasionally allows the brackets to slip or fall off of the domes. A waste of time and labor hours is incurred when the taping method fails.

NGC is requesting that NAU select one team to design, analyze and build a prototype articulating arm that can be mounted to the attach rings of several different motor types that will firmly hold the standoff template brackets in place during adhesive cure.

Requirements:

1. The mounting arm shall be able to support brackets bonded at a range of four inches to 36 inches inboard from the motor circumferential ring.
2. The mounting arm, shall have six degrees of freedom to allow the standoff templates to be held in place at the proper location and angle on the motor domes.
3. The handling arm shall be mountable to the forward and aft attach rings of several rocket motors (details to be supplied by NGC).
4. The handling arm must be ESD (electro static discharge) compliant.
5. The handling arm shall be adaptable to several different mounting bracket templates via adapters or another method of re-configuration.
6. The handling arm shall be able to hold an adapter and standoffs of total mass up to 10 lbs
7. The handling arm shall have the ability to be locked into place and apply a force of at least 20 lbs on the adapter pushing it onto the motor dome.
8. Safety factors for all components must be 3.0 based upon the maximum expected loads. The arm is to be load tested to 125% to demonstrate structural integrity.
9. The handling arm must be easily manipulated by hand.

Stretch Goals:

1. The solution will be able to measure its extension distance in inches and its rotation from its mounting point in degrees.
2. The design will be mounted to the motor attach rings in "quick-release" fashion, eliminating the need for bolt removal/replace when it is moved.

Additional Information

For design purposes, the following assumptions may be made:

1. The standoff templates are flat aluminum plates of sizes 6.0" x 6.0" up to 10.0" x 16.0"
2. The arm will be attached to the standoff templates by clamping, not by bolting, bonding, or any other method.
3. The height of the standoffs (distance between motor dome and bottom of template) will be at least 0.5 inches.

Specific interface requirements will be provided upon selection. Other considerations students should take into account are: Life cycle evaluation for service life prediction, service and periodic maintenance, ease of handling and transportation.

Meetings:

- Kickoff Meeting and System Requirements Review (SRR) – The team must be available to attend a Kickoff Meeting and SRR to be held on TBD Date. At this meeting additional information will be presented to the students to get them started and allow them to ask any questions.
- Preliminary Design Review (PDR) – **To Be Determined** – Team presentation of proposed solution with rough analyses and schedule, risks going forward. Northrop Grumman may assign action items to be resolved prior to Critical Design Review.
- Critical Design Review (CDR) – **To Be Determined** – Team presentation of refined solution, addressing action items from PDR, final estimates on schedule.
- Northrop Grumman University Symposium Day – **To Be Determined** – Final presentation of the solution, the design process and the product to Northrop Grumman Corporation personnel, to be held before graduation. Expect this to be a 4 hour event; approximately 2 hours of presentation time (inclusive of all universities) and 2 hours of an open forum where all NGC employees can see the project and ask questions. Friendly and constructive university rivalry is encouraged as each university has a separate project. Lunch will be provided for the team.
- Northrop Grumman Mentor Meetings – **To Be Determined** – It is expected that the selected team will meet regularly with the sponsor from Northrop Grumman to discuss progress, deadlines and various aspects of the project. These meetings will be for a duration and frequency as mutually agreed upon by the sponsor and the team.

Deliverables (in addition to NAU course deliverables):

For this proposal it is expected that the students produce a functional standoff mounting arm along with all supporting documentation created throughout the course. Examples of hardware may include, but are not limited to: Special tooling, adapter hardware for various module sizes, maintenance tools and hardware etc. Additionally, the student team must fully demonstrate the product and provide a set of instructions for its safe and proper operation in addition to a detailed assembly guide for quick replacement and/or swap-out of components.

Student Teams & Proposals:

Design teams must be comprised of US persons (citizens or permanent legal residents).

Like all other student teams, the section team of the Northrop Grumman project should follow the Capstone Design Projects process and deliverable schedules.

Confidentiality and Intellectual Property:

Each team member working on any Northrop Grumman project(s) may be required to sign a Non-Disclosure Agreement (NDA) with Northrop Grumman. Before the projects are awarded to the student team, NAU and Northrop Grumman will work together to determine the policies that govern the ownership of the intellectual property if the design is determined to be patentable.

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