



NASA STTR 2014 Phase I Solicitation

T1 Launch Propulsion Systems

Includes all propulsion technologies required to deliver space missions from the surface of the Earth to Earth orbit or Earth escape, including solid rocket propulsion systems, liquid rocket propulsion systems, air breathing propulsion systems, ancillary propulsion systems, and unconventional/other propulsion systems. The Earth to orbit launch industry is currently reliant on very mature technologies, to which only small incremental improvements are possible. Breakthrough technologies are not on the near horizon, therefore research and development efforts will require both significant time and financial investments.

Subtopics

T1.01 Affordable Nano-Launcher Upper Stage Propulsion

Lead Center: MSFC

Participating Center(s): GRC, KSC, LaRC

Small satellites are becoming ever more capable of performing valuable missions for both government and commercial customers. However, currently these satellites can only be launched affordably as secondary payloads. This makes it difficult for the sll satellite mission to launch when needed, to the desired orbit, and with acceptable risk. A dedicated launch vehicle is needed that will affordably meet the small sat launch needs. This subtopic solicits technology proposals for the upper stage propulsion system of such a launcher. Specifically, the subtopic requests proposals for propulsion design tools, systems, and stages for application as upper stages or orbit insertion stages with the following goals and constraints:

- A recurring stage cost not to exceed \$100K (for 8/year).
- The stage shall be capable of providing at least 13,000 fps delta-v to a 150 lbm mass from in vacuum conditions.
- The stage shall be designed to a diameter of 3.0 ft or less.
- The stage shall be capable of compressively supporting 700 lbf on its forward end (in addition to its own loaded mass).
- Total stage wet mass shall not exceed 1800 lbm.
- Other desired functionality include TVC, basic health and status monitoring, and throttling.
- Design analysis techniques that provide rapid, high fidelity insight into the operation of these systems are also needed.

Technologies meeting these goals will support development of an affordable launcher capable of delivering 55 lbm to 100 lbm to low-earth orbit. Phase I activities will develop the data necessary to assert with confidence that the proposed technology solution will meet the goals of the subtopic. Phase II activities will provide functionality

verification and substantiation of recurring cost.

Mission Traceability - STMD, HEOMD, and SMD all have missions that would benefit from this technology. In particular, STMD's SST and GCD Programs have expressed a strong need.

T1.02 Small Launch Vehicle Propulsion Technology

Lead Center: MSFC

Participating Center(s): GRC, KSC

Small satellites are becoming ever more capable of performing valuable missions for both government and commercial customers. However, currently these satellites can only be launched affordably as secondary payloads on large launch vehicles. This makes it difficult for the small satellite mission to launch when needed, to the optimal orbit, and with acceptable risk to the mission. There is no affordable, dedicated launcher available that will meet the small satellite launch needs. This subtopic solicits technology proposals for the boost propulsion system(s) of such a launcher. Specifically, the subtopic requests proposals for propulsion systems for application as first stages or strap-on boosters with the following functional and cost goals and within the following geometric constraints:

- Cost goal - Assuming a production rate of 8 boost systems per year, a recurring stage cost of \$400K
- Total Impulse goal - The stage shall be capable of providing 2.5M lbf-sec total impulse
- Delta-V goal - The stage shall be capable of providing 6800 fps delta-v to a 8,000 lbm mass from ground launch.
- Size goal - The stage shall be designed to fit within the size envelope of height of 25 ft and a diameter of 3.5 ft for individual elements. If a cluster of elements is proposed, the central element should stay within this envelope.
- Strength goal - It shall be capable of structurally supporting (compressively) 8,000 lbf/lbm for use as a core booster stage.

Though not explicit goals, other desired functionality in the first stage include thrust vector control (TVC), basic health and status monitoring, and throttling.

Technologies meeting these goals will support development of a 25 kg to 50 kg payload launcher to low-earth orbit. Phase I activities will be used to develop the data necessary to assert with confidence that the proposed technology solution will meet the goals of the subtopic. Phase II activities will include verification of functionality, as much as possible through testing, and substantiation of recurring cost projections. At the end of Phase II there will be sufficient validation of the technology to warrant purchase of one or more stages for initial flight testing under potential follow-on activities.