National Aeronautics and Space Administration

NASA**facts**

Green Propellant Infusion Mission Project

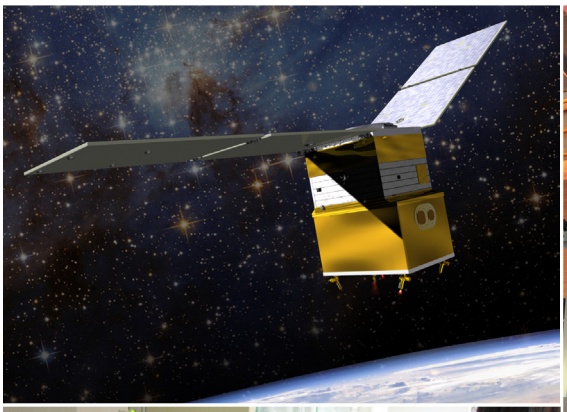
New green fuel technology will enable safer, faster and less costly space missions

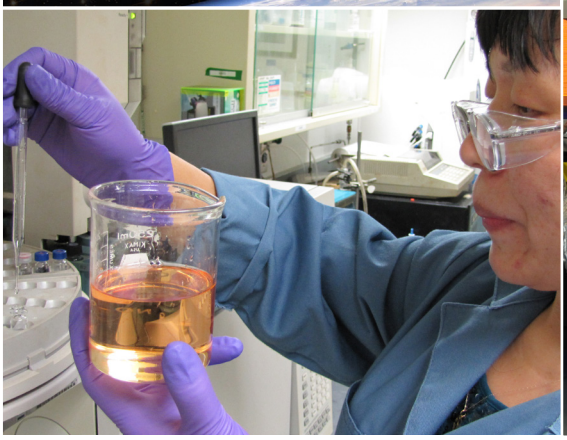
Through the Green Propellant Infusion Mission, or "GPIM" project, NASA is developing a "green" alternative to conventional chemical propulsion systems for next-generation launch vehicles and spacecraft. The new green propellant will be an enabling technology for commercial spaceports operating across the U.S. – whether in Florida, California, New Mexico or Virginia. With the green propellant, launch vehicle and spacecraft fuel loading will be safer, greener, faster and much less costly. The "short sleeve" operational environment GPIM offers will change ground processing time from weeks to days.

NASA and Ball Aerospace & Technologies Corp. of Boulder, Colo., are collaborating on the Green Propellant Infusion Mission, which seeks to improve overall propellant efficiency while reducing the toxic handling concerns associated with the highly toxic fuel, hydrazine. The space technology infusion mission also strives to optimize performance in new hardware, system and power solutions while ensuring the best value for investment and the safest space missions possible.

The Green Propellant Infusion Mission is scheduled to launch aboard a SpaceX Falcon Heavy rocket in 2019.

The GPIM project will demonstrate the practical capabilities of a Hydroxyl Ammonium Nitrate fuel/oxidizer blend, known as "AF-M315E." This innovative, low-toxicity propellant, developed by the





Images (upper left) **Ball flight vehicle artist rendering:** Carried to orbit on a Ball Aerospace smallsat, the Green Propellant Infusion Mission project will test an innovative, efficient alternative to toxic conventional chemical propellants. *(bottom left)* **Aerojet Researcher:** An Aerojet Rocketdyne researcher examines a container of AF-M315E during preparation for flight testing. *(right)* **Researchers in Bunny-suits:** The Ball smallsat, seen here in clean-room testing at Ball Aerospace facilities, is set to carry the Green Propellant Infusion Mission to space in 2018. (photo credit: Ball Aerospace)

U.S. Air Force Research Laboratory at Edwards Air Force Base, Calif., is a high-performance, green alternative to hydrazine.

NASA and its partners always strive to maintain the strictest safety standards for storage, transport and use of rocket propellants. While all rocket fuels can be dangerous to handle without the proper safety precautions, AF-M315E has significantly reduced toxicity levels compared to hydrazine, making it easier and safer to store and handle. It also requires fewer handling restrictions and potentially shorter launch processing times, resulting in lowered costs.

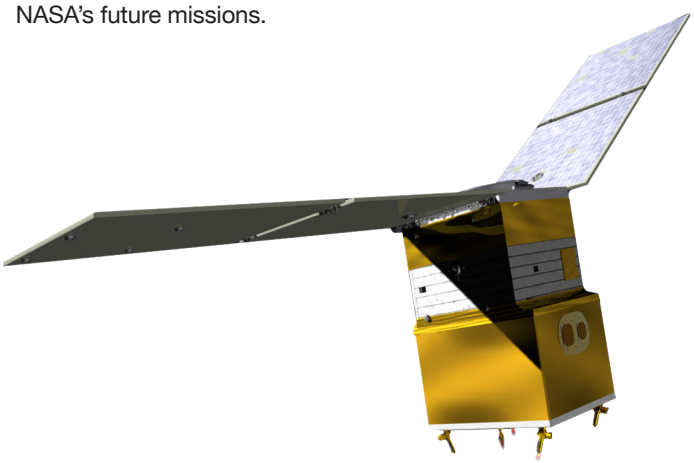
AF-M315E also is expected to improve overall vehicle performance. It boasts a higher density than hydrazine, meaning more of it can be stored in containers of the same volume. In addition, it delivers a higher specific impulse, or thrust delivered per given quantity of fuel, and has a lower freezing point, requiring less spacecraft power to maintain a higher temperature range required for storing hydrazine.

The GPIM payload will fly to space aboard a Ball compact small satellite or "smallsat." During the test flight, researchers will conduct orbital maneuvers to demonstrate the performance of the propellant during attitude control shifts, changes in orbital inclination and orbit lowering.

Once proven in flight, AF-M315E -- and compatible tanks, valves and thrusters -- will become a viable, effective solution for future green propellant-based mission applications for NASA and the commercial spaceflight industry.

The project is spearheaded by Ball Aerospace, home to the program's principal investigator, and includes co-investigators at Aerojet Corp. in Redmond, Washington; NASA's Glenn Research Center in Cleveland, Ohio; NASA's Goddard Space Flight Center in Greenbelt, Maryland; NASA's Kennedy Space Center, Florida; NASA's Glenn Research Center in Cleveland, Ohio and the Air Force Research Laboratory at Edwards Air Force Base, California. Additional support is provided by the U.S. Air Force Space and Missile Systems Center at Kirtland Air Force Base, N.M.

The GPIM, managed by NASA's Marshall Space Flight Center in Huntsville, Ala., is part of NASA's Technology Demonstration Mission Program within the Space Technology Mission Directorate. NASA's Space Technology Mission Directorate is innovating, developing, testing and flying hardware for use in NASA's future missions.



Demonstration Details

The demonstration mission will last approximately two months.

Planned on-obit maneuvers include attitude control demonstrations; spacecraft pointing and hold; thruster performance characterization and mapping; inclination change; and orbit lowering.

The project is intended to bring AF-M315E and compatible tanks, valves and thrusters to an operational level for future NASA and commercial spaceflight missions.

For more information about NASA's investments in space technology to enable future science and exploration, visit: **http://www.nasa.gov/spacetech**

Ball Aerospace & Technologies Corp.

AEROJET ROCKETDYNE

National Aeronautics and Space Administration

Headquarters
300 E Street, SW
Washington, DC 20546

www.nasa.gov

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