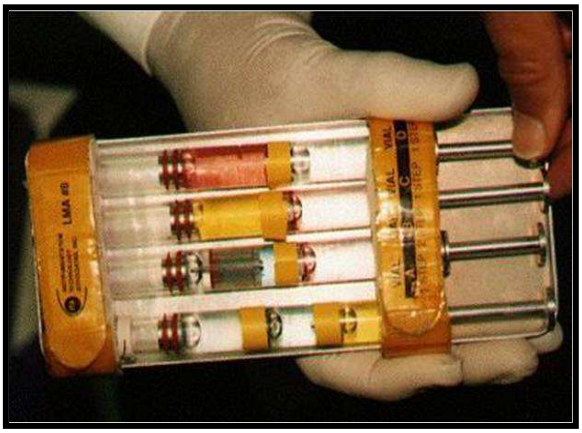
Liquids Mixing Apparatus (LMA)



BioSpace Experiments, Inc.™ (BSE) is offering a unique opportunity to fly microgravity experiments on the SpaceX Dragon spacecraft scheduled for launch the 3rd Qtr 2013. Aboard the Dragon will be BSE's flight-proven Liquids Mixing Apparatus (LMA) space experimentation hardware. Earth orbit offers a unique environment for investigating the physical effects of the absence of gravity on fluids, as well as the solidification and processing of organic and inorganic materials, among other applications. Although the fundamental effects of gravity are well known (bouyancy, sedimentation, convection, etc.), its impacts on materials and processes are subtle and intriguing. The promise of routine access to the microgravity space environment to produce unique experimental results and useful new materials aboard the NextGen launch suppliers can finally unlock the value of this unique experimentation and manufacturing environment.

The LMA hardware will be a part of BSE's commerical experiments package flown in association with NanoRacks, Inc. The mission will be the next of several that are planned to give routine access to the space environment for academic researchers, industry and the student STEM education space experiments community. The LMA can accommodate up to 16 different liquid mixing experiments in its 4-tube configuration, enabling a wide variety of research areas. This mission will offer multiple slots on an LMA unit to reduce cost to prospective participants. This means that scientists and engineers from academia, government and industry, as well as student investigators, can acquire access to space, in a proven laboratory environment, at very accessible prices. Opportunities are also available for research on the International Space Station (ISS) should extended microgravity stay times be required.

Research Areas Supported by the LMA

Experiment	Application
Protein Crystal Growth	Biomedical Research
Protein Diffusion	Biomedical Research
Cell Biology	Biomedical Research
Microencapsulation of Drugs	Biomedical Research
Electrokinetic Transport	Fluid Physics
Fluid Mixing	Fluid Physics
Immiscible Phases	Fluid Physics
Miscible-Immiscible Liquid Behavior Studies	Fluid Physics
Wetting Studies	Fluid Physics
Plant Stem Studies	Agricultural Research
Electro Optic Polymer Crystallization	Manufacturing Process Research
Precipitation Morphology	Manufacturing Process Research
Zeolite Crystallization	Manufacturing Process Research

This is not an exhaustive list. Please contact Instrumentation Technology Associates, Inc. to discuss your specific research requirements.

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LMA Capabilities

The LMA is a manually-operated system that can mix two or three sample fluids in microgravity at pre-determined times during the mission timeline. Each vial in a typical 4-vial LMA configuration can contain two to three milliliters (ml) of experiment fluid samples, dependent upon the researcher's experiment requirements. These experiment sample fluids/materials can be combined in various volumetric proportions. The standard flight configuration consists of four vials mounted within a lightweight aluminum tray.

Another vial configuration is available to provide for the growth of protein crystals. This configuration consists of four glass capillary tubes occupying one vial. In this configuration, each LMA vial produces four different experiments/sample data points, or four total data points of the same experiment, as illustrated in the graphic below.

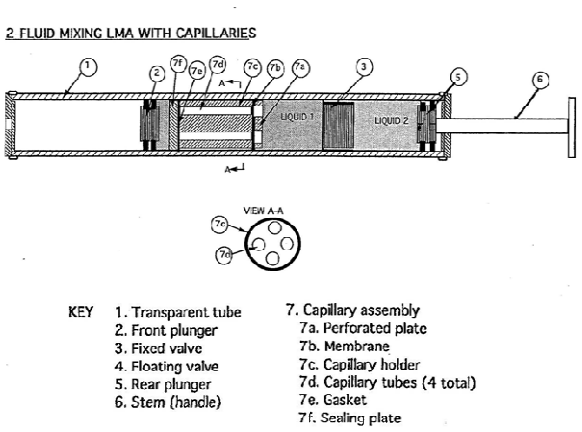
In orbit, at a specified point in the mission timeline, an astronaut depresses the push-rod in each vial to permit the liquid to pass from one chamber to the next chamber by means of an internal valve. If 3-fluid vials are used, this procedure is repeated at a later point in the mission timeline to mix the remaining fluid in that particular vial.

The LMA is flight-qualified and has been used successfully on ISS and seven missions on the Space Shuttle. The LMA provides three levels of containment for experimenters that require isolation of hazardous fluids in their experiments. There will be no temperature control available during this Space Shuttle mission.

LMA Mission Specifications

- **Data Yield**
  - Standard LMA vial configuration: 4 samples per tray
  - Vials with capillaries: 4 per vial, 16 samples per tray
- **Volumetric Capacity of Each Vial**
  - ~ Three (3) milliliters for a two fluid sample mix
  - ~ Two (2) milliliters for a three fluid sample mix
    - Capillary option:
      Four 1.0-inch capillary tubes per vial:
      Dimensions: OD = 0.084", ID = 0.064"
- **Fluid Levels of Containment**
  - Two or three, dependent upon experimental requirement to contain hazardous material
- **Power Requirements**
  - None (crewmember-activated)
- **Experiment Loading/Unloading Features**
  - Late installation of experiment into LMA vial
  - Late loading of LMAs onto launch vehicle
  - Retrieval of samples ASAP upon capsule return
- **Flight History**
  - STS-67, STS-69, STS-80, STS-95, STS-107, STS-134, STS-135
  - ISS Summer 2011

Typical LMA Vial Configuration with Capillary Tube Insert



Packaged LMA Tray Ready for Flight on STS-135

For more information and flight bookings, call Ron Jones at 703-447-1188 or email ron.jones310@gmail.com

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